State of Idaho Department of Environmental Quality

Regional Haze Plan

10/8/10

Idaho Regional Haze State Implementation Plan

Addressing Regional Haze Requirements for Idaho Mandatory Federal Class I Areas

October 8, 2010

Idaho Department of Environmental Quality

1410 North Hilton

Boise, Idaho 83706

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Photos taken by Dan Meeker and Mike Edwards

Cover: Thompson Peak in the Idaho Sawtooth Wilderness Area

Title page: Thompson Peak early in the morning as the crew heads out to ski Resurrection Chute.

Previous page: Four unknown skiers from Ketchum following Dan Meeker's boot pack trail up un-named chute just left of Resurrection Chute on Thompson Peak. Who would have guest a Wednesday in the middle of February, 5-miles from any road, the Sawtooth Wilderness Area would be crowded.

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Idaho Regional Haze Reference Materials -

Applicable Western Regional Air Partnership (WRAP) Reports and Documents and Related Websites

WRAP Website:

http://www.wrapair.org/index.html

WRAP Technical Support System

http://vista.cira.colostate.edu/tss/

WRAP Fire Emissions Tracking System

http://wrapfets.org/

Causes of Haze Assessment

http://www.coha.dri.edu/

Interagency Monitoring of Protected Visual Environments

http://vista.cira.colostate.edu/improve/

Available on CD-ROM, or at the WRAP website:

Other Reference

1. Grand Canyon Visibility Transport Commission Final Report - *Recommendations for Improving Western Vistas*, June *1996.*
2. EPA's Regional Haze Rule and Preamble - *Regional Haze Regulations* (64 Federal Register 35714), July 1, 1999.
3. Introduction to Visibility, William C. Malm, Colorado State University, May 1999

Acknowledgements

Major assistance in preparing this implementation plan was provided by the Western Regional Air Partnership (WRAP) and its forums and committees, who provided Oregon and other western states with much of the policy and technical support information needed to meet the requirements of Section 308 of the Regional Haze Rule. Special thanks to the following staff:

- Pat Cummins, WRAP Co-Director
- Tom Moore, TOC Staff Support/Technical Coordinator
- Lee Alter, IOC Staff Support
- Don Arkell, State Caucus Coordinator/Visibility Program Coordinator with WESTAR
- Bob Lebens, WESTAR

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Lisa Hansen, DEQ Tech Editor

And a special thanks to Brian Finneran with the Oregon Department of Environmental Quality who graciously allowed Idaho to follow the Oregon Regional Haze SIP layout and structure.

Executive Summary

In 1977, Congress designated all wilderness areas with more than 5,000 acres and all national parks with more than 6,000 acres, subject to the visibility protection requirements in the Clean Air Act. These national parks and wilderness areas receive special visibility protection as "mandatory federal Class I areas." A national regional haze rule has been adopted that requires states to improve visibility over the next 60 years in 156 national parks and wilderness areas across the country.

Idaho has five mandatory Class I federal areas (Class I areas): Craters of the Moon National Monument, Hells Canyon Wilderness Area, Sawtooth Wilderness Area, Selway-Bitterroot Wilderness Area, and Yellowstone National Park. Idaho shares Hells Canyon Wilderness Area, Selway-Bitterroot Wilderness Area, and Yellowstone National Park with neighboring states. It has been determined that for any shared Class I areas, the state with the largest percent of acreage is responsible for setting the required reasonable progress goals while the other states will address their portion of the visibility impairment through the required long term strategies and the consultation process. Idaho will be responsible for setting the reasonable progress goals for Craters of the Moon National Monument, Sawtooth Wilderness and Selway-Bitterroot Wilderness.

Each state is responsible for developing a Regional Haze State Implementation Plan (SIP) that will provide a comprehensive analysis of natural and man-made sources of haze impacting each Class I area. The SIP will contain strategies to control sources and reduce emissions that contribute to haze. Each SIP must also address the transport of haze across state boundaries in coordination with other states. Two of the primary SIP requirements are to address industrial source BART (Best Available Retrofit Technology) requirements and demonstrate "reasonable progress" in improving visibility by 2018 for each Class I area in the state.

The BART requirements address certain larger industrial sources that began operation before the 1977 Prevention of Significant Deterioration Rules was adopted. Through the BART process two facilities (Amalgamated Sugar Company in Nampa and Monsanto/P4) were identified as subject to BART and will be required to install control technologies within the next 5-years.

The demonstration of "reasonable progress" requires setting goals for the 20% worst visibility days and 20% best visibility days in each Class I area, based on an evaluation of how BART and other regional haze strategies will reduce emissions and improve or protect visibility. The following table lists Idaho's Reasonable Progress Goals.

Idaho Class I Area	20% Worst Days		20% Best Days	
	Baseline Condition [deciviews]	2018 Reasonable Progress Goal [deciviews]	Baseline Condition [deciviews]	2018 Reasonable Progress Goal [deciviews]
Craters of the Moon National Monument	14	13.06	4.31	3.886
Sawtooth Wilderness	13.78	13.22	3.99	3.78
Selway-Bitterroot Wilderness Area	13.41	12.94	2.58	2.48

The document is divided into the following sections:

- Chapters 1-5 provide a basic overview of the regional haze basic planning elements, consultation through the Western Regional Air Partnership, monitoring and other technical tools relied upon to develop the plan, and an introduction to Idaho's Class I areas.
- Chapters 6 through 9 provide information on Idaho's emissions inventory, the pollutants causing visibility impairment in Idaho and surrounding states, and establishes baseline, natural conditions and uniform rate of progress for each of Idaho's Class I areas.
- Chapter 10 covers Idaho's Best Available Retrofit Technology (BART) process and the determinations on the two BART subject facilities.
- Chapters 11 and 12 establish reasonable progress goals and long term strategies for Idaho.
- Chapter 13 covers the formal consultation process and future Regional Haze Plan requirements.

Chapter 1. Introduction

1.1 Purpose of this Document

This Regional Haze State Implementation Plan (SIP) has been prepared to meet the requirements of the federal Regional Haze Rule, (40 CFR, Part 51, Section 308). It contains strategies and elements related to each requirement of this rule. The appendices at the end of this to this plan provide additional information related to the strategies, including citations of new Idaho Administrative Rules associated with this plan, reference material prepared by the Western Regional Air Partnership (WRAP), and other pertinent information.

1.2 Mandatory Federal Class I Areas Addressed in this Plan

The Regional Haze Rule (40 CFR 51.308) requires the responsible states to address visibility protection for regional haze in Idaho's mandatory federal Class I Areas. These areas are listed in Section 1.2.

1.3 Definitions and Abbreviations Contained for this Plan

This plan contains terms, phrases, and abbreviations or acronyms that have formal definitions under 40 CFR 51.301 and 40 CFR 51.308, and other terms specific to the programs set forth in this plan. The definitions, which prevail over other interpretations as to the meaning and intent of this implementation plan, are contained in Appendix A.

1.4 Overview of Visibility and Regional Haze

Good visibility is essential to the enjoyment of everyday life and the viewing national parks and scenic areas. Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. This affects the clarity and color of what we see. Without the effects of air pollution, natural visual range is approximately 140 miles in the West and 90 miles in the East. However, over the years, air pollution in many parts of the United States has significantly reduced the range of distances that people can see. In the West the current range is 35-90 miles, and in the East only 15-25 miles.

Regional haze is air pollution that is transported long distances that reduces visibility in national parks and wilderness areas. The pollutants that create this haze are sulfates, nitrates, organic carbon, elemental carbon, and soil dust. Human-caused haze sources include industry, motor vehicles, agricultural and forestry burning, and windblown dust from farming practices and from roads.

A national regional haze rule has been adopted that requires states to improve visibility over the next 60 years in 156 national parks and wilderness areas in the country. These national parks and wilderness areas receive special visibility protection as "mandatory federal Class I areas." In 1977, Congress designated all wilderness areas with more than 5,000 acres and all national parks with more than 6,000 acres as mandatory Class I federal areas, subject to the visibility protection requirements in the Clean Air Act. As can be seen on the following map of all Class I areas in the United States (Figure 1-1), most of them are in the West.

Figure 1-1 Map of Class I Areas. NPS – National Park Service; FWS – Fish and Wildlife Service; FS – Forest Service

1.5 Idaho's Mandatory Federal Class I Areas

Idaho has five mandatory Class I federal areas (Class I areas): Craters of the Moon National Monument, Hells Canyon Wilderness Area, Sawtooth Wilderness Area, Selway-Bitterroot Wilderness Area, and Yellowstone National Park. Idaho shares Hells Canyon Wilderness Area, Selway-Bitterroot Wilderness Area, and Yellowstone National Park with neighboring states. It has been determined that for any of these Class I areas, the state with the largest percent of acreage is responsible for setting the required reasonable progress goals (see Chapter 11) while the other states will address their apportionment of the visibility impairment through the required long term strategies (Chapter 12) and the consultation process. Idaho will be responsible for setting the reasonable progress goals for Selway-Bitterroot. Oregon will be responsible for Hells Canyon and Wyoming will set the goals for Yellowstone National Park. For each of these five Class I areas, its total acreage, Idaho acreage, and managing agency are listed in Table 1-1. A full description of each Class I area in Idaho is provided in Chapter 3 of this report.

Table 1-1 Idaho Class I Areas

Class I Area	Acreage	Acreage in Idaho	Managing Agency
Craters of the Moon National Monument	43,243	43,243	USDI-NPS*
Hells Canyon Wilderness Area	192,700	83,800	USDA-FS*
Sawtooth Wilderness Area	216,383	216,383	USDA-FS
Selway-Bitterroot Wilderness Area	1,240,700	988,770	USDA-FS
Yellowstone National Park	2,219,737	31,488	USDI-NPS

* USDI-NPS – U.S. Department of the Interior, National Park Service; USDA-FS – U.S. Department of Agriculture, Forest Service

1.6 History of the Regional Haze Rule

In 1977, Congress amended the Clean Air Act to include provisions to protect the scenic vistas of the nation's national parks and wilderness areas. In these amendments, in Section 169A, Congress declared as a national visibility 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.*

To meet this goal, in 1980 EPA adopted regulations to address "reasonably attributable visibility impairment," or visibility impairment caused by one or a small group of man-made sources generally located in close proximity to a specific Class I area. These became known as EPA's "Phase I" visibility rules. At that time, EPA deferred writing rules to address regional haze, because they lacked the monitoring, modeling, and scientific information needed to understand the nature of long-range transport and formation of regional haze.

In 1990 amendments to the Clean Air Act, Congress established the requirements to address regional haze. They gave EPA the authority to establish visibility transport commissions and to promulgate regulations to address regional haze. The 1990 amendments also established a visibility transport commission to investigate and report on regional haze visibility impairment in Grand Canyon National Park and nearby Class I areas. A summary of the Grand Canyon Visibility Transport Commission's work is provided in Chapter 1.7.

1.7 Summary of the Regional Haze Rule

To address the problem of regional haze and to meet the national goal of reducing man-made visibility impairment in all Class I areas, EPA adopted "Phase II" visibility rules in 1999 – also known as the Regional Haze Rule. The primary purpose of the rule is to improve visibility over the next 60 years in all 156 Class I areas across the country through the development of a regional haze state implementation plan (SIP), that focus on improving the haziest days (the worst 20%) and protecting the clearest days (the best 20%), through the year 2064. Each SIP will provide a comprehensive analysis of natural and man-made sources of haze in each Class I area and will contain strategies to control sources and reduce emissions that contribute to haze. Each SIP must also address the transport of haze across state boundaries in coordination with other states.

Two of the primary SIP requirements are to address BART (Best Available Retrofit Technology) and demonstrate "reasonable progress" in improving visibility by 2018 for each Class I area in the state. The BART requirements address certain larger industrial sources that began operation before the 1977 Prevention of Significant Deterioration Rules were adopted (see section 1.8 below). Chapter 10 of this Plan describes the BART review and evaluation in detail. The demonstration of "reasonable progress" requires setting goals for the 20% worst and best days in each Class I area, based on an evaluation of how BART and other regional haze strategies will reduce emissions and improve or protect visibility. Chapter 11 of this Plan describes the Reasonable Progress Demonstration in detail.

Additional information on the Regional Haze Rule can be found on the Department's website, at http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_overview.cfm

1.8 Other Programs that Address Visibility Impairment

The 1977 Clean Air Act Amendments established Prevention of Significant Deterioration (PSD) requirements, which included protecting visibility in national parks, national wilderness areas, national monuments, and national seashores. The PSD program includes -specific (Class I, II, and III) increments or limits on the maximum allowable increase in air pollutants (particulate matter or sulfur dioxide). PSD also includes preconstruction permit review for new or modifying major sources that allows for careful consideration of control technology, consultation with federal land managers (FLMs) on visibility impacts, and public participation in permitting decisions.

1.9 Best Available Retrofit Technology

Under Section 169A(b), Congress established new requirements on major stationary sources that were in operation within a 15-year period prior to enactment of the 1977 amendments to which visibility impairment in a mandatory Class I federal area can be reasonably attributed. These sources may be required to install "best available retrofit technology" (BART) as determined by the State. In determining BART, the State must take into consideration the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use 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 installation of BART technology.

1.10 The Grand Canyon Visibility Transport Commission

The 1990 Clean Air Act Amendments created the Grand Canyon Visibility Transport Commission (GCVTC). The GCVTC was given the charge to assess the currently available scientific information pertaining to adverse impacts on visibility from potential growth in the region, identify clean air corridors, and recommend long-range strategies for addressing regional haze for Class I areas on the Colorado Plateau. The GCVTC completed significant technical analyses and developed recommendations to improve visibility in the 16 mandatory federal Class I areas on the Colorado Plateau. These 16 Class I areas are as follows: Arches National Park, Black Canyon of the Gunnison Wilderness, Bryce Canyon National Park, Canyonlands National Park, Capital Reef National Park, Flat Tops Wilderness, Grand Canyon National Park, Maroon Bells Wilderness, Mesa Verde National Park, Mt. Baldy Wilderness, Petrified Forest National Park, San Pedro Parks Wilderness, Sycamore Canyon Wilderness, Weminuche Wilderness, West Elk Wilderness, and Zion National Park.

The GCVTC found that visibility impairment on the Colorado Plateau was caused by a wide variety of sources and pollutants. A comprehensive strategy was needed to address all of the causes of regional haze. The GCVTC submitted a set of recommendations to EPA in a report dated June 1996 for consideration in rule development. These recommendations were grouped into the following nine categories:

Air Pollution Prevention Air pollution prevention and reduction of per capita pollution was a high priority for the GCVTC. The GCVTC recommended policies based on energy conservation, increased energy efficiency, and promotion of the use of renewable resources for energy production.

Clean Air Corridors Clean air corridors are geographic areas that act as a source of clean air to the 16 Class I areas of the Colorado Plateau. For these areas, the GCVTC primarily recommended careful tracking of emissions increases that may affect air quality in these corridors and ultimately in the 16 Class I areas.

Stationary Sources For stationary sources, the GCVTC recommended closely monitoring the impacts of current requirements under the Clean Air Act and ongoing studies. It also recommended regional targets for sulfur dioxide emissions from stationary sources, starting in 2000. If these targets are exceeded, the GCVTC recommends that a regional cap and market-based emission trading program be implemented.

Areas In And Near Parks The GCVTC's research and modeling showed that a host of sources adjacent to parks and wilderness areas, including large urban areas, have significant visibility impacts. However, the GCVTC lacked sufficient data regarding the visibility impacts of emissions from some areas in and near parks and wilderness areas. In general, the models used by the GCVTC were not readily applicable to such areas. Pending further studies of these areas, the GCVTC recommended that local, state, tribal, federal, and private parties cooperatively develop strategies, expand data collection, and improve modeling for reducing or preventing visibility impairment in areas within and adjacent to parks and wilderness areas.

Mobile Sources The GCVTC recognized, in 1996, that mobile source emissions were projected to decrease through about 2005 due to improved control technologies. The GCVTC recommended capping emissions at the lowest level achieved and establishing a regional emissions budget., The commission also endorsed national strategies aimed at further reducing tailpipe emissions.,

Road Dust The GCVTC's technical assessment indicated that road dust is a large contributor to visibility impairment on the Colorado Plateau and that it therefore requires urgent attention. However, due to considerable skepticism regarding the modeled contribution of road dust to visibility impairment, the GCVTC recommended further study in order to resolve the uncertainties regarding both near-field and distant effects of road dust, prior to taking remedial action. Since this emissions source is potentially such a significant contributor, the GCVTC felt that it deserved high priority attention and, if warranted, additional emissions management actions.

Emissions from Mexico Mexican sources are also shown to be significant contributors, particularly of sulfur dioxide emissions. However, data gaps and jurisdictional issues made this a difficult issue for the GCVTC to address directly. The GCVTC recommendations called for continued bi-national collaboration to work on this problem, as well as additional efforts to complete emissions inventories and increase monitoring capacities. The GCVTC recommended that these matters should receive high priority for regional and national action.

Fire The GCVTC recognized that fire plays a significant role in visibility on the Plateau. In fact, land managers propose aggressive prescribed fire programs aimed at correcting the buildup of biomass due to decades of fire suppression. Therefore, prescribed fire and wildfire levels are projected to increase significantly during the studied period.

The GCVTC recommended the implementation of programs to minimize emissions and visibility impacts from prescribed fire, as well as to educate the public.

Future Regional Coordinating Entity Finally, the GCVTC believed there was a need for an entity like the GCVTC to oversee, promote, and support many of the recommendations in their report. To support that entity, the GCVTC developed a set of recommendations addressing the future administrative, technical and funding needs of the GCVTC or a new regional entity. The GCVTC strongly urged the EPA and Congress to provide funding for these vital functions and give them a priority reflective of the national importance of the Class I areas on the Colorado Plateau.

1.11 The Western Regional Air Partnership

The GCVTC recognized the need for a long-term organization to address the policy and perform technical studies needed to address regional haze. The Western Regional Air Partnership (WRAP) was formed in September 1997 as the successor organization to the GCVTC. The WRAP is made up of western states, tribes, and federal agencies. The 13 states are Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. The WRAP's charter allows it to address any air quality issue of interest to WRAP members, though most current work is focused on developing the policy and technical work products needed by states and tribes to develop their regional haze SIPs.

The WRAP established stakeholder-based technical and policy oversight committees to assist in managing the development of regional haze work products. Stakeholder-based working groups and forums were established to focus attention on the policy and technical work products that the states and tribes need to assist them with developing their implementation plans. Additional information about the WRAP can be found on the WRAP web site at http://www.wrapair.org.

The WRAP's Technical Support System (TSS) was the source for the majority of key technical information and data used in the this plan. WRAP staff and contractors, through consultation with the states and tribes, have developed informational tools based upon IMPROVE (Interagency Monitoring of Protected Visual Environments) monitoring data (see Chapter 4), individual state emission inventories, and source-specific inventories (see Chapter 8). This information was used to develop future projected emission inventories for the year 2018 upon which modeling was developed to demonstrate the control strategies implemented through the Regional Haze SIPs. The WRAP TSS can be found at http://vista.cira.colostate.edu/tss/.

Chapter 2. Idaho Regional Haze SIP Development and Consultation Process

The Idaho Regional Haze State Implementation Plan (SIP) was developed through a process of consultation with other States, tribes, major stakeholders, and advisory committees, and through input from public outreach. The following is a brief summary of this process. Chapter 13 contains additional information and details, including comments and responses referenced in Appendix B to this plan.

2.1 Consultation with Federal Land Managers

The Regional Haze Rule 40 CFR Section 51.308(i) requires coordination between states and federal land managers (FLMs). (The FLMs involved in this SIP process are identified in this chapter.) Idaho has provided agency contacts to the FLMs as required under 51.308(i)(1), and the FLMs were consulted in accordance with the provisions of 51.308(i)(2) during the development of this plan,.

Numerous opportunities were provided by the Western Regional Air Partnership (WRAP) for FLMs to participate fully in the development of technical documents produced by the WRAP and participating States and Tribes and included in this plan. A summary of WRAP-sponsored meetings and conference calls is provided in Appendix B to this plan. In addition, through the Idaho negotiated rule making process, Idaho provided additional opportunities for coordination and consultation with FLMs as the plan was developed. Appendix B includes details of this state-specific process.

The State of Idaho has provided opportunity for in-person consultation at least 60 days prior to holding any public hearing on the SIP. This SIP was submitted to the FLMs on June 3, 2010 for review and comment. Comments were received from the FLMs on July 23, 2010. As required by 40 CFR Section 51.308(i)(3), the FLM comments and state responses are included in Appendix I to this plan.

Under 40 CFR Sections 51.308(f-h), states are required to submit , within certain timeframes, SIP revisions and progress reports that evaluate progress toward the reasonable progress goal for each Class I area. As required by 40 CFR Section 51.308(i)(4), Idaho will continue to coordinate and consult with the FLMs during the development of these plan revisions and future progress reports, as well as during the development and implementation of programs involved in controlling light impairing pollutants in mandatory Class I areas; a full discussion of this process is contained in Chapter 13.

The consultation will be coordinated with the designated visibility protection program coordinators for the National Park Service, U.S. Fish and Wildlife Service, and the U.S. Forest Service. At a minimum, the state will meet with the FLMs on an annual basis through the Western Regional Air Partnership.

2.2 Consultation with States and Tribes

As recommended by the Grand Canyon Visibility Transport Commission the states have been working through regional planning organizations.

The successor to the GCVTC, the WRAP, is the regional planning organization in the West and is composed of 13 western states, along with tribes and federal agencies. The states are Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. The member tribal organizations are the Campo Band of Kumeyaay Indians, Confederated Salish and Kootenai Tribes, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Native Village of Shungnak, Nez Perce Tribe, Northern Cheyenne Tribe, Pueblo of Acoma, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Representatives of other tribes participate on WRAP forums and committees. Participation is encouraged throughout the Western states and tribes. Federal participants are the Department of the Interior (National Park Service and Fish & Wildlife Service,) the Department of Agriculture (Forest Service), and the Environmental Protection Agency.

The primary state and federal consultation has occurred through the Western Regional Air Partnership conference calls and meetings. Idaho has participated in all of the WRAP subcommittees and co-chaired the Dust Emissions Forum and the Implementation Work Group. Following is a breakdown of the various subcommittees with a brief description of the subcommittees focus.

WRAP Committees and Workgroups

Initiatives Oversight Committee

The WRAP Initiatives Oversight Committee (IOC) is responsible for establishing and overseeing the work of forums that develop policies and programs to improve and protect air quality. Following is the list of the Initiatives Oversight Committee forums.

2.2.1..1 The Air Pollution Prevention Forum

The Air Pollution Prevention Forum is tasked with developing energy conservation initiatives and programs to expand the use of renewable energy sources. They are working to find, and encourage use of, energy sources that minimize air pollution.

2.2.1..2 The Economic Analysis Forum

This forum assists with studies to evaluate the economic effects of air quality programs being developed by the WRAP to diminish haze throughout the West.

2.2.1..3 The Forum on Emissions In/Near Class 1 Areas

This forum looks at pollution sources in and near mandatory federal Class 1 areas to determine their impact on visibility in those areas. The group also will address mitigation and outreach options.

2.2.1..4 The Mobile Sources Forum

This forum addresses the impact of motor vehicles and other mobile sources of pollution. For example, the forum developed and presented a plan to the WRAP, that suggests a revision of U.S. Environmental Protection Agency rules regarding the production of low-sulfur fuel by small refineries. The forum also recommended reforms for off-road emissions and for diesel fuel engine retrofit programs.

Technical Oversight Committee

The tasks of the Technical Oversight Committee (TOC) are to identify and manage technical issues and to establish and oversee the work of forums and work groups that are developing and analyzing scientific information related to air quality planning in the West. Following is a list of the TOC forums and work groups.

2.2.1..5 The Air Quality Modeling Forum

This forum identifies, evaluates the performance of, and applies mathematical air quality models, which can be used to quantify the benefits of various air quality programs for reducing haze in the western United States.

2.2.1..6 The Ambient Monitoring and Reporting Forum

This forum oversees the collection, use, and reporting of ambient air quality and meteorological monitoring data as needed to further the WRAP's overall goals.

2.2.1..7 The Emissions Forum

This Forum is developing the first comprehensive inventory of haze-causing air emissions in the West, including a comprehensive emissions tracking and forecasting system. The forum also monitors trends in actual emissions and forecasts emissions reductions anticipated from current regulations and alternative control strategies.

2.2.1..8 Attribution of Haze Work Group

This work group is preparing guidance for states and tribes regarding both the types of pollution emitters and the regions in which pollutants contribute to visibility impairment in national parks and other Class I wilderness areas. The work group is made up of three state and three tribal representatives, along with all members of the Technical Oversight Committee and one representative each from the Initiatives Oversight Committee, the Tribal Data Development Work Group and the technical and joint forums.

2.2.1..9 The Tribal Data Development Work Group

This work group is identifying gaps in air quality data for tribal lands and working with tribes to collect that data. While some tribes have adequate staff and equipment for such an undertaking, many lack the human and technical resources to accomplish such work. This work group is providing help both by enhancing the tribes' ability to collect the necessary data and by establishing a method for standardizing and cataloging the data so it can be used for subsequent analysis.

2.2.1..10 The Implementation Work Group

The purpose of the Implementation Work Group (IWG) is to assist states and tribes in the development of their regional haze implementation plans that are required under 40 CFR 51.308 and 40 CFR 51.309(g). The work group will be comprised of state and tribal representatives so that their needs are accommodated by recognizing the variety of regulatory and statutory authorities and range of technical and policy expertise among them.

Joint Technical and Policy Forums

The Initiative Oversight Committee and the Technical Oversight Committee have joint oversight of the following forums:

The Dust Emissions Joint Forum

This forum primarily seeks to improve the methods for estimating dust emissions and how these estimates are used as inputs in air quality models. This forum examines the extent of dust impacts and strategies to reduce dust emissions. This forum has been co-chaired by an Idaho representative.

The Fire Emissions Joint Forum

The GCVTC confirmed that forest fires contribute significantly to visibility problems and that the use of prescribed fire is expected to increase as a forest management tool. The Fire Emissions Joint Forum is developing measures to reduce the effects of prescribed fires and is examining emissions from all fires, whether ignited naturally or by humans. Both public health and nuisance effects as well as visibility impacts are considered. This forum is working in coordination with federal, tribal, state, and local agencies as well as private landowners, forest managers, and the agriculture community to develop a tracking system for fire emissions and management techniques to minimize emissions. This forum has been co-chaired by an Idaho representative.

The Stationary Sources Joint Forum

The Stationary Sources Joint Forum, formerly the Market Trading Forum, developed the details of an emissions trading program to achieve cost-effective reductions in industrial sources of sulfur dioxide. This forum first set emissions milestones for sulfur-dioxide between now and 2018 and then designed a trading program to be triggered if these emissions targets are exceeded. The forum is now examining other types of industrial source emissions, such as oxides of nitrogen and particulate matter, and is assisting WRAP members in complying with the stationary source provisions of the regional haze rule.

Chapter 3. Introduction to Idaho Class I Areas

This chapter provides a description of Class I areas in Idaho. Although Idaho has numerous Wilderness Areas and Monuments, not all of them are mandatory Class I areas as designated by Congress. Only those wilderness areas and national memorial parks exceeding 5,000 acres and national parks exceeding 6,000 acres and in existence prior to August 7, 1977, are considered mandatory federal Class I areas and must be considered under the Regional Haze rule. The mandatory Class I areas in Idaho are Craters of the Moon National Monument, Hells Canyon Wilderness, Sawtooth Wilderness, Selway-Bitterroot Wilderness, and Yellowstone National Park (Figure 3-1)

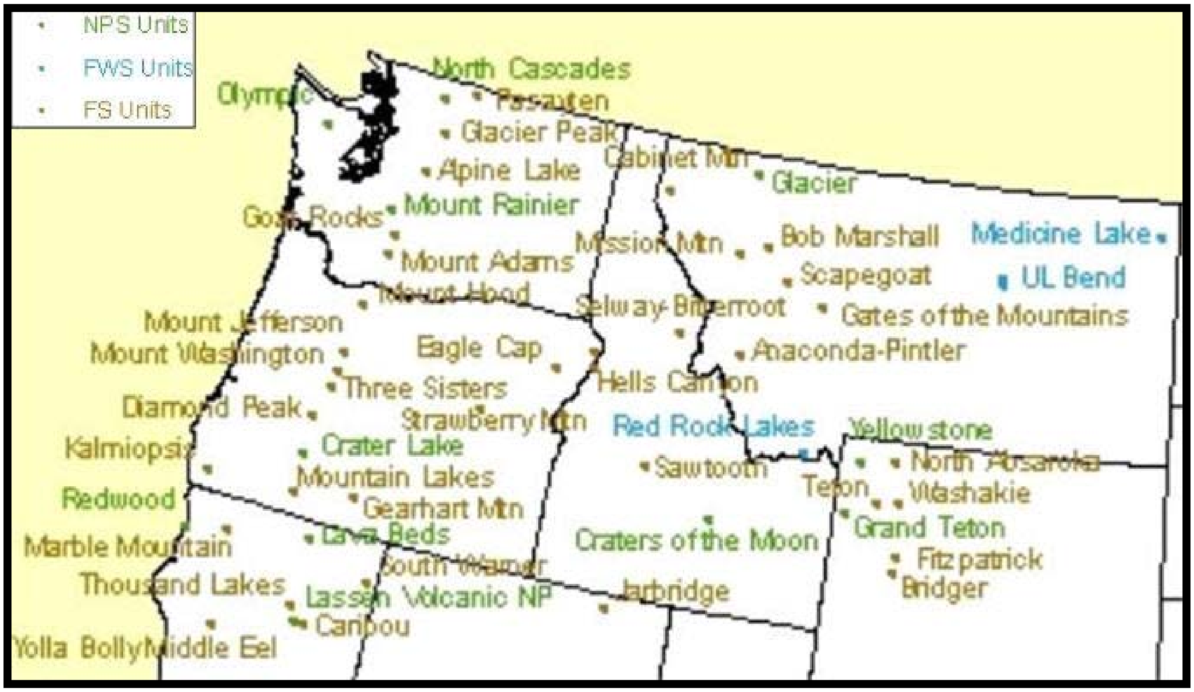

Figure 3-1. Map of Idaho's mandatory Class I areas

3.1 Craters of the Moon National Monument

Craters of the Moon National Monument is comprised of 43,243 acres on the Snake River Plain in South Central Idaho (Figure 3-2). The monument and preserve contain more than 25 volcanic cones and 60 distinct lava flows from the Craters of the Moon Lava Field ranging in age from 15,000 to 2, 000 years old.

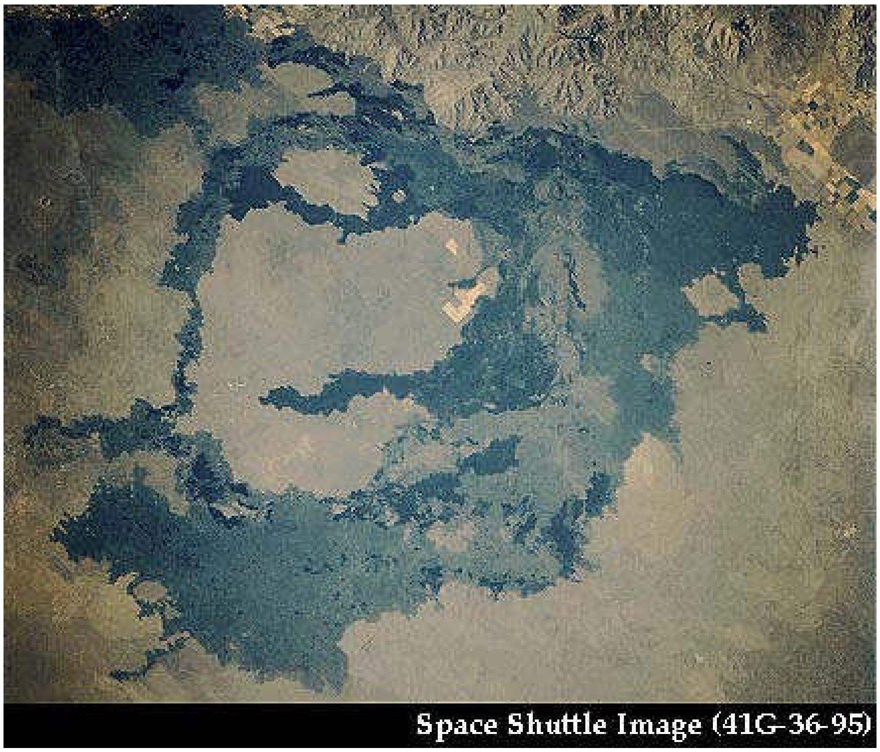

Figure 3-2. Craters of the Moon space shuttle image

The Craters of the Moon lava field reaches southwestward from the Pioneer Mountains and is part of the Great Rift volcanic zone that continues along the Snake River Plan. The average precipitation is between 15 to 20 inches per year, which is quickly lost in the basaltic rock and re-emerges in the springs along the walls of the Snake River Canyon.

The Monument was originally designated by President Calvin Coolidge in 1924 to "preserve the unusual and weird volcanic formations." The monument was expanded on October 23, 1970. Figure 3-3 shows the location of the Craters of the Moon totally within the boundaries of the State of Idaho.

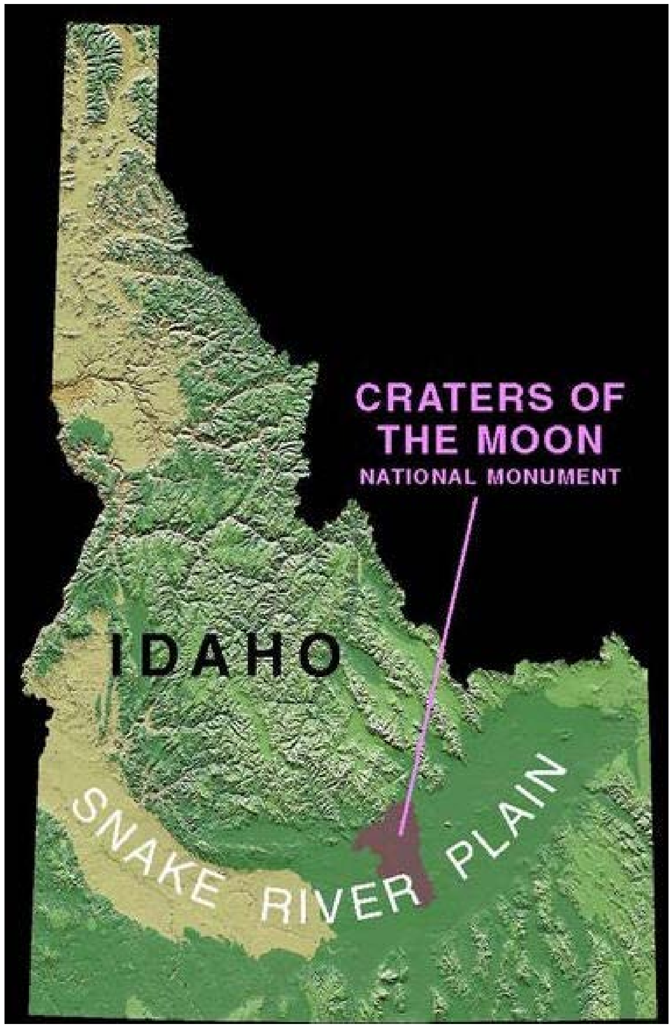

Figure 3-3. Map of Craters of the Moon National Monument

3.2 Hells Canyon Wilderness Area

Hells Canyon was designated a national wilderness in 1975 with more land added in 1984 for a total of 192,700 acres, of which 83,800 acres are in Idaho. The wilderness is divided by the Snake River as it flows between Idaho and Oregon. It contains three Wild and Scenic rivers: the Snake River in Idaho, the Rapid River in Idaho and Oregon, and the Imnaha River in Oregon. The Idaho portion of the wilderness area is characterized by sagebrush and bunch grasses at the lower elevations and deciduous bushes and Douglas fir at the higher elevations. One of the most distinguishing features is the topographic relief ranging from the top of the Peaks at 9,300' and descending 7,000' to the rivers below as shown in figure 3-4.

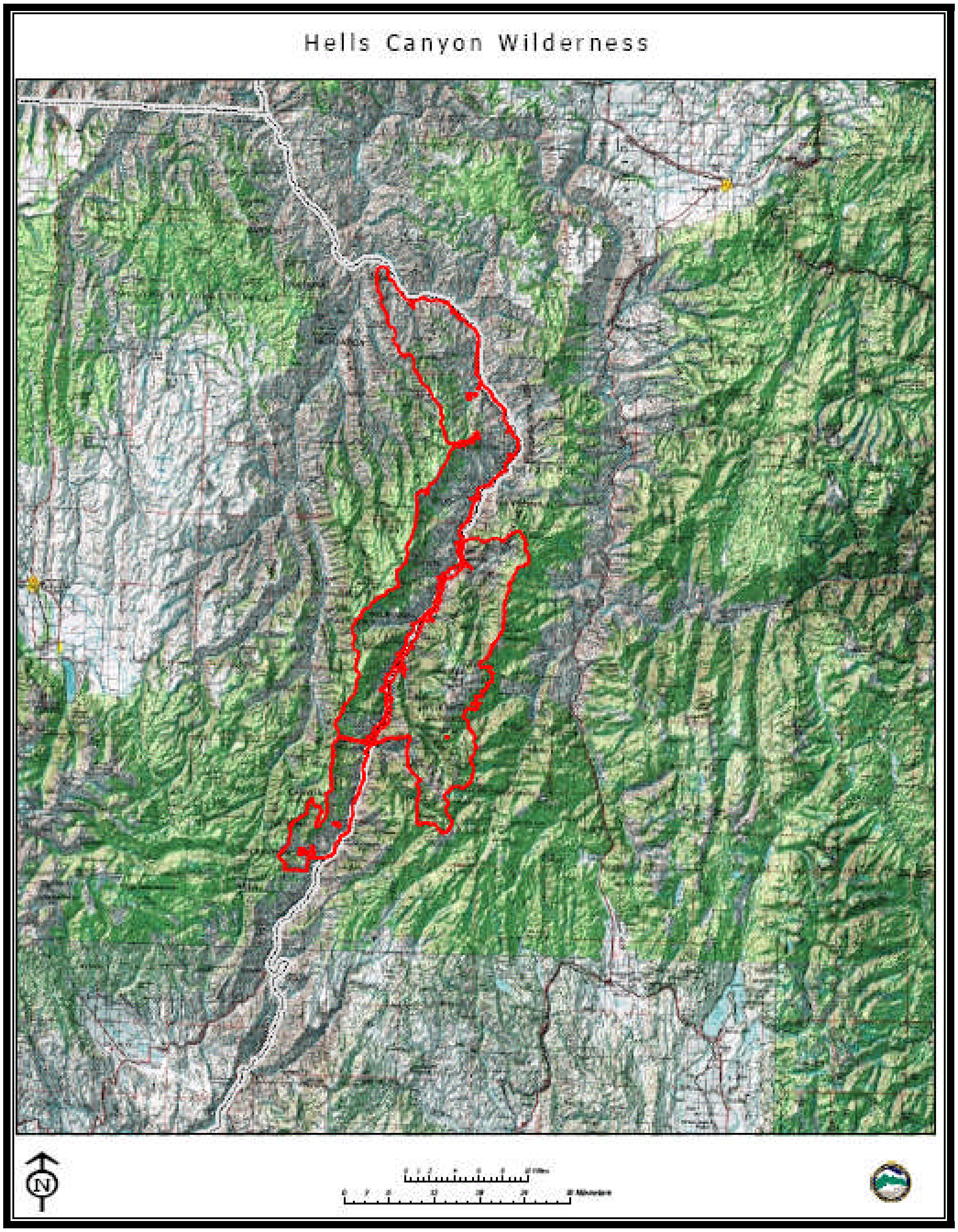

Figure 3-4. Map of Hells Canyon Wilderness

3.3 Sawtooth Wilderness Area

The Sawtooth Wilderness Area occupies 217,088 acres in the western portion of the Sawtooth National Recreation Area in central Idaho. The wilderness area consists primarily of the Sawtooth Mountains, a central headwaters source that includes headwaters of the North and Middle Forks of the Boise River, the South Fork of the Payette River, and the Salmon River. The terrain consists of steep craggy peaks and deep valleys. Elevations range from ~6,000 feet where

the Payette South Fork and Boise Middle Fork exit the wilderness on the west side, to 10,776 feet at the summit of Thompson Peak. It includes approximately 40 peaks with elevations of 10,000 feet or higher. The Sawtooth Wilderness Area, also entirely contained within Idaho, is shown in Figure 3-5.

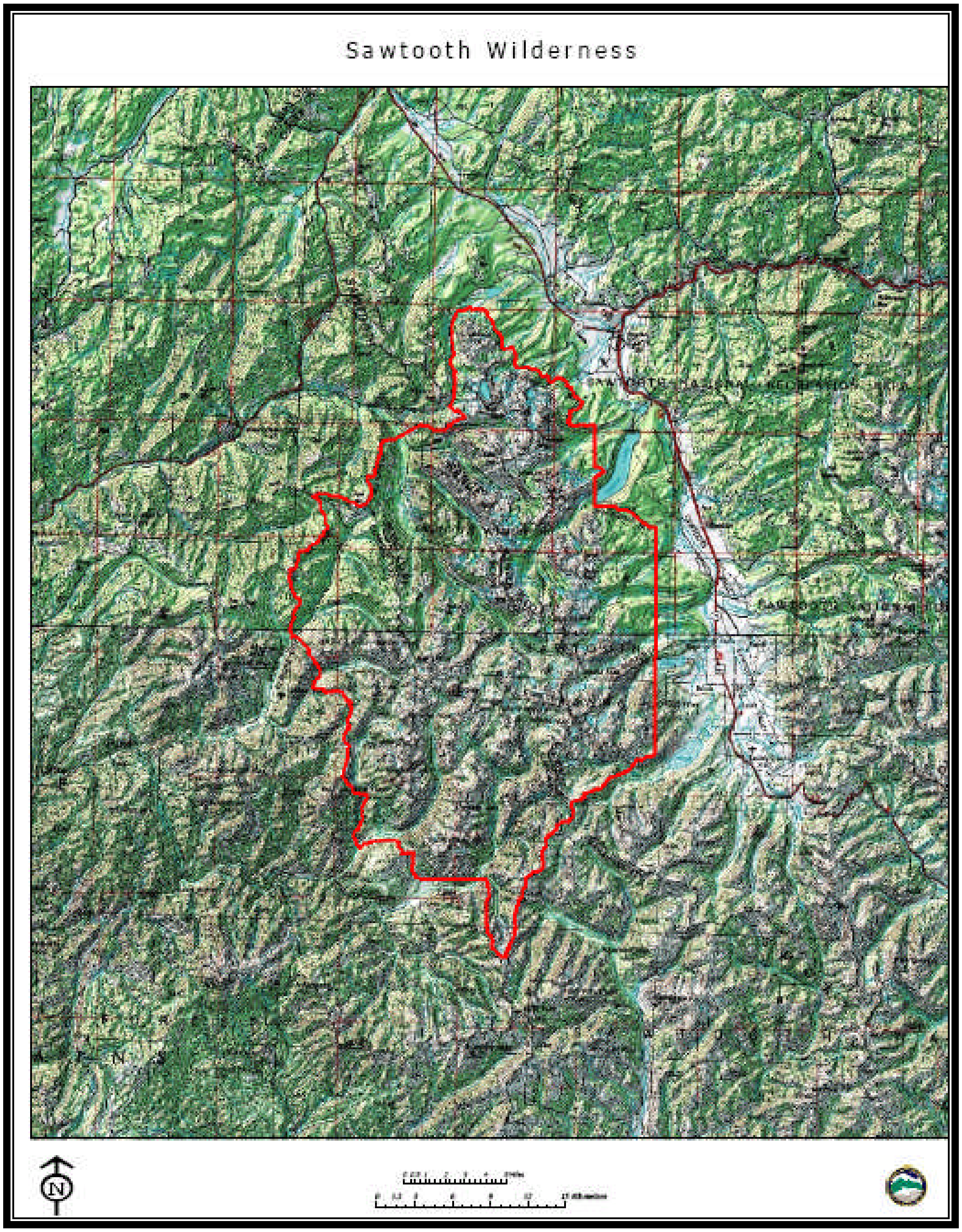

Figure 3-5. Map of Sawtooth Wilderness

3.4 Selway-Bitterroot Wilderness Area

Established in 1964, the Selway-Bitterroot Wilderness Area spans four national forests and covers 1,240,700 acres. Idaho contains the largest portion of this wilderness at 988, 700 acres with the remaining portion in Montana. It is the third-largest wilderness in the lower 48 states and supports large populations of bear, bighorn sheep, and elk.

It is characterized by rough mountainous areas with dense forests below the peaks. This wilderness also contains more than 100 mountain lakes and is home of the Wild and Scenic Selway River. The Selway-Bitterroot Wilderness is shown in Figure 3-6, with the Idaho-Montana border shown as a dashed white line.

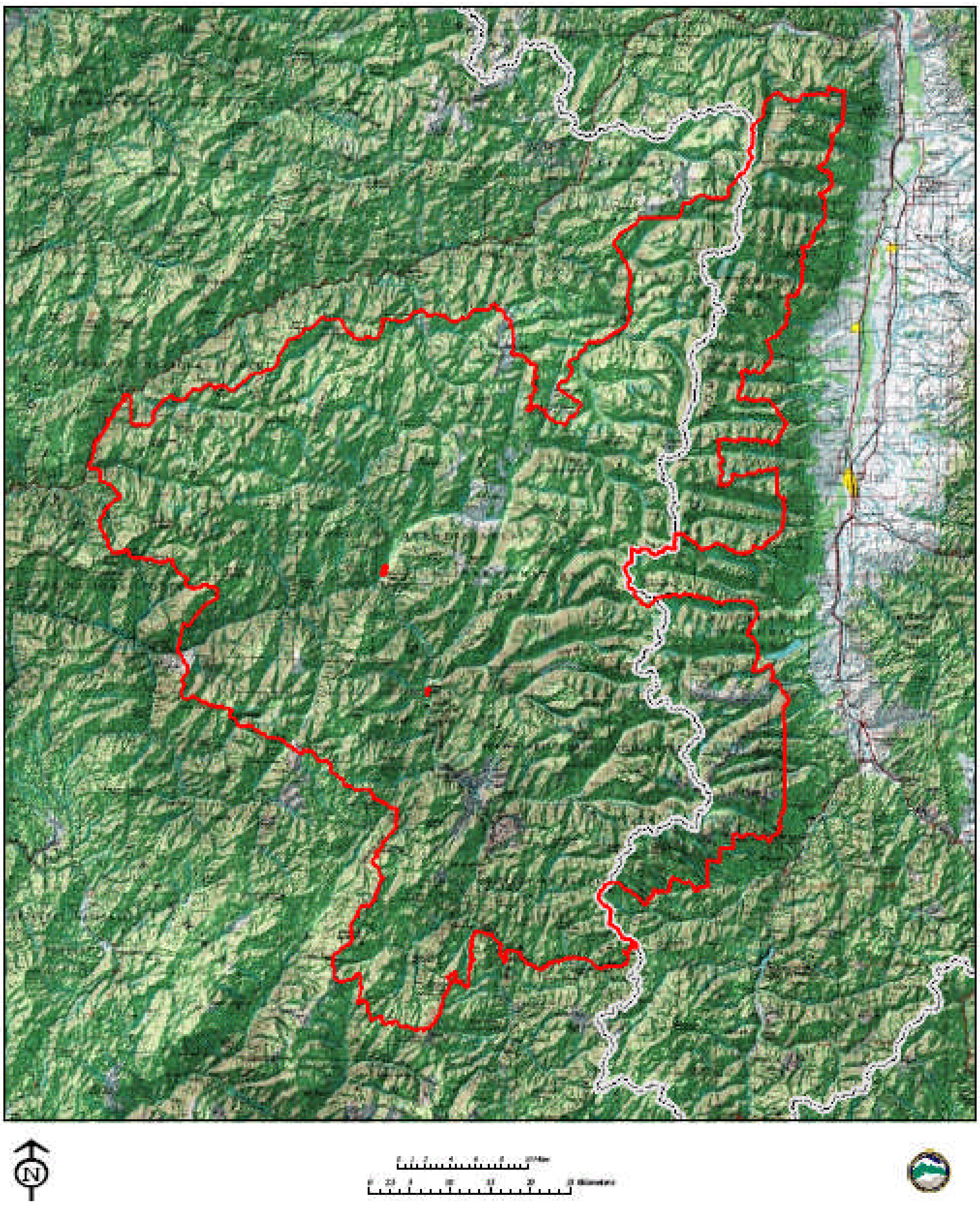

Figure 3-6. Map of Selway-Bitterroot Wilderness

3.5 Yellowstone National Park

In 1872, Congress established Yellowstone as the first national park in the world. A new concept was born and with it a new way to preserve and protect the most unique environments for the benefit and enjoyment of future generations.

Yellowstone contains half of the earth's geothermal features and the most diverse and intact collection of geysers, hot springs, mud pots, and fumaroles in the world. Its more than 300 geysers make up two thirds of all those found on earth.

Yellowstone is home to the largest concentration of mammals in the lower 48 states. Sixty-seven different types of mammals live there, including grizzly bear, black bear, gray wolf, wolverine, lynx, elk, bison, moose, and numerous types of small mammals. Bison are the largest mammals in Yellowstone National Park. Yellowstone is the only place in the lower 48 states where a population of wild bison has persisted since prehistoric times, although fewer than 50 native bison remained in 1902. Bears may be seen in Yellowstone from March through November. Yellowstone is one of the only areas south of Canada that still has a large grizzly bear (Ursus arctos) population.

Yellowstone National Park occupies 2,221,766 acres, mostly in northwestern Wyoming, overlapping into Montana and Idaho. Its terrain has been characterized as broad dissected plateau interrupted by several mountain ranges. The greatest relief is along the northern and eastern borders. Elevations range from 5,314 feet where the Yellowstone River exits the park on the north boundary, to 9,840 feet and higher at mountain summits on the eastern and northern boundary. The highest elevation is 11,358 feet at the summit of Eagle Peak on the southeastern Park boundary. Yellowstone National Park is shown in Figure 3-7.

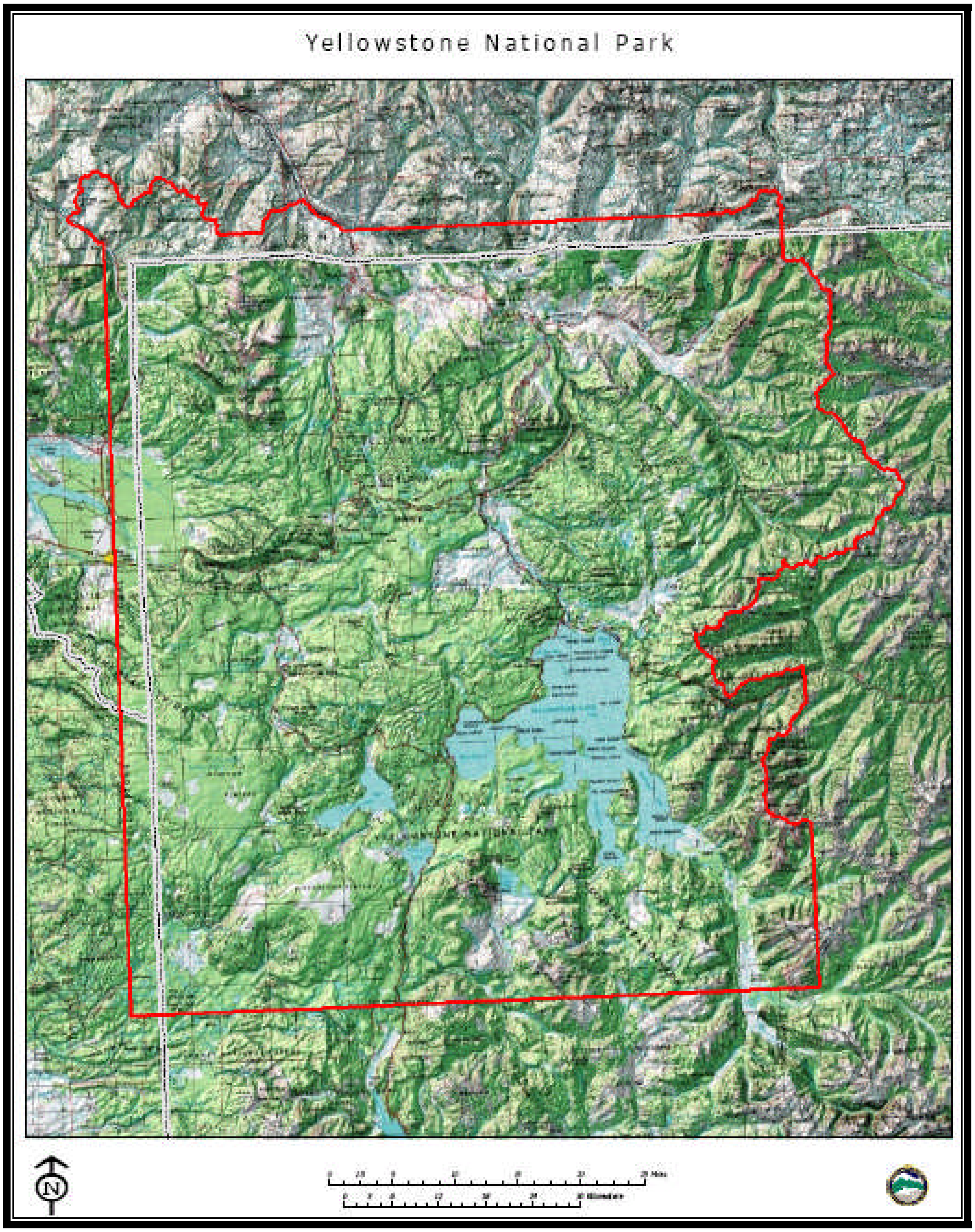

Figure 3-7. Map of Yellowstone National Park

Chapter 4. Technical Information and Data Relied Upon in This Plan

This chapter describes the information relied upon by the Idaho Department of Environmental Quality (DEQ) in developing this regional haze plan. The first part of this chapter describes the Western Regional Air Partnership (WRAP) organization and its work products relied upon by DEQ. The second part describes the IMPROVE monitoring network (see section 4.2 for information about the IMPROVE network) and data it collects that are used by states throughout the country to measure visibility in Class I areas.

4.1 The WRAP and Technical Support

As described in Section 1.7 of this plan, the WRAP is a voluntary organization of federal agencies and western states and tribes. It was formed in 1997 as the successor to the Grand Canyon Visibility Transport Commission.

The WRAP has a technical support system (TSS) with the primary purpose of providing key summary analytical results and methods documentation for the technical elements required under the Regional Haze Rule. The required technical elements support the preparation, completion, evaluation, and implementation of the regional haze implementation plans to improve visibility in Class I areas. The TSS provides technical results prepared using a regional approach, including summaries and analysis of the comprehensive datasets used to identify the sources and regions contributing to regional haze in the WRAP region.

The secondary purpose of the TSS is to be the one-stop-shop for access, visualization, analysis, and retrieval of the technical data and regional analytical results prepared by WRAP forums and work groups to support regional haze planning in the West. The TSS specifically summarizes results and consolidates information about air quality monitoring, meteorological and receptor modeling data analyses, emissions inventories and models, and gridded air quality/visibility regional modeling simulations. These copious and diverse data are integrated for application to air quality planning purposes by prioritizing and refining key information and results into explanatory tools.

4.2 IMPROVE Monitoring

4.2.1 Background on IMPROVE monitoring

In the mid-1980s, a program known as Interagency Monitoring of Protected Visual Environments (IMPROVE) was established to measure visibility impairment in mandatory federal Class I areas throughout the United States. IMPROVE monitoring sites are operated and maintained through a formal cooperative relationship between EPA, the National Park Service, the U.S. Fish and Wildlife Service, the Bureau of Land Management, and the U.S. Forest Service. In 1991, several additional organizations joined the effort: State and Territorial Air Pollution Program Administrators, the Association of Local Air Pollution Control Officials, the Western States Air Resources Council, the Mid-Atlantic Regional Air Management Association, and Northeast States for Coordinated Air Use Management.

The objectives of the IMPROVE program include establishing the current visibility and aerosol conditions in mandatory federal Class I areas; identifying the chemical species and emissions sources responsible for existing human-made visibility impairment; and documenting long-term trends for assessing progress towards the national visibility goals in supporting the requirements of the Regional Haze Rule by providing regional haze monitoring, where practical, for all visibility-protected federal Class I areas.

The sampling equipment at IMPROVE monitoring sites consists of four separate modules for measuring regional haze..

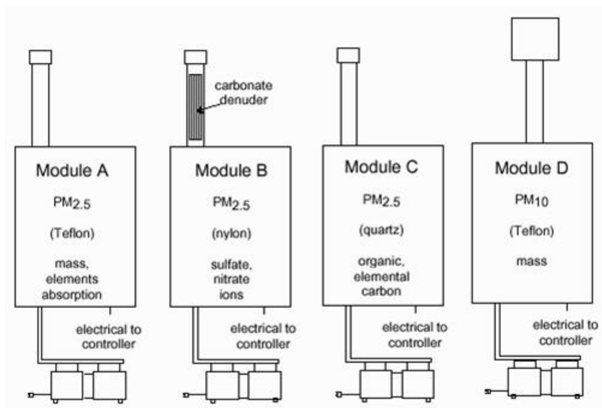

Figure 4-1 IMPROVE Sampler Modules

The data collected at the IMPROVE monitoring sites are used by land managers, industry planners, scientists, public interest groups, and air quality regulators to better understand and protect the visual air quality resource in Class I areas. Most importantly, the IMPROVE program scientifically documents the visual air quality of mandatory Class I federal areas as required by the Regional Haze Rule.

4.2.2 Measures of Visibility Impairment

The states can use IMPROVE monitoring data to calculate visibility impairment in terms of either reconstructed light extinction or haze index, both of which are described in the following paragraphs.

Visibility-impairing pollutants both reflect and absorb light in the atmosphere, thereby affecting the clarity of objects viewed at a distance by the human eye. Each haze pollutant has a different light extinction capability. In addition, relative humidity changes the effective light extinction of both nitrates and sulfates. Since haze pollutants can be present in varying amounts at different locations throughout the year, aerosol measurements of each visibility-impairing pollutant are made every three days at the IMPROVE monitors located in or near each Class I area.

There are five primary pollutants involved in visibility impairment: nitrates, sulfates, organic mass carbon, elemental carbon (also known as light-absorbing carbon), and soil. (See Figure 4-2.) These pollutants have different effects on light, depending on the size of the pollutant particle. Smaller particles of 2.5 microns or less in size impair light more efficiently than pollutants 1.0 microns or greater in size.

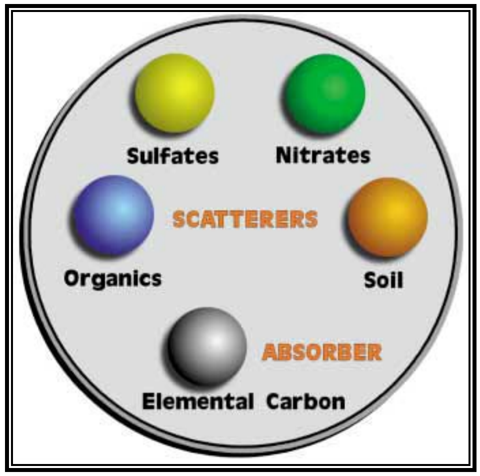

Figure 4-2. Five primary pollutants that impair visibility (Malm 1999)

To understand how these pollutants affect light, it is important to first understand light waves that are visible to the human eye. Light can be thought of as waves very similar to waves in water or sound waves. Light waves are made up of electromagnetic waves containing energy known as photons. The wavelengths are measured in microns. The human eye is capable of seeing photons in the range of 0.4 to 0.7 microns. Other light waves such as x-rays and ultraviolet light are too small for the eye to see, while infrared light, radio waves, and microwaves are too large for the eye to see. Within the size range of light wavelengths that the human eye can see, there are three primary colors: blue, green, and red light. What we see as colors are actually the photons reflected off an object. For example, if the only photons being reflected off an object are those that we see as blue, then the object appears blue to us. Figure 4-3 shows the relationship between wavelengths and colors.

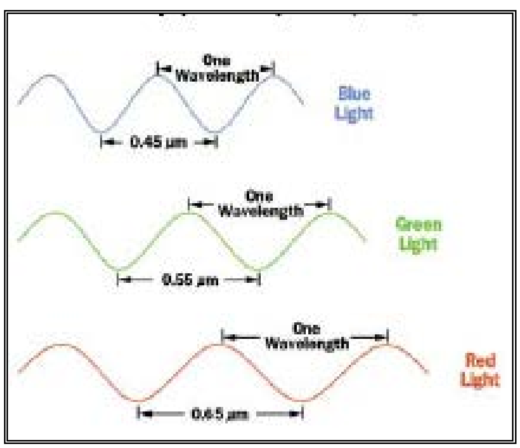

Figure 4-3 Wavelengths of light visible to humans (Malm 1999)

In the fall, we see leaves change color because the chlorophyll that was absorbing the blue and red wavelengths fades away and allows the other colors' wavelengths to show more clearly. In a similar fashion, nitrogen dioxide in the air captures the blue wavelengths, so the air appears reddish brown, which is most noticeable near the skyline. This happens due to the particle sizes of nitrogen dioxide being very close to the size of the blue wavelengths. The closer a visibility impairing pollutant particle is in relationship to the size of light wavelength, the greater the efficiency of the particle to interfere with visibility of the light.

Light scattering can occur in four ways: 1) light can be refracted and bent inward as it passes through particles in the air; 2) light can be refracted and turned away from particles in the air; 3) light waves can undergo a wave shift, during which one light wave is disrupted and gets out of sync with the surrounding waves, causing the disrupted light wave to change the direction of the other surrounding light waves; or 4) particles in the air can capture the energy contained in light waves and absorb the light waves. Particles that are greater than 10 microns in size have a tendency to scatter light forward. Molecules in gaseous form (the smallest size fraction) in the atmosphere have a tendency to bounce equal amounts of light forward and backward, with smaller amounts emanating vertically from the light source. This type of light scattering is known as Rayleigh scattering1.

As air pollutants begin to combine into compounds such as ammonium nitrate, they are known as aerosols. As mentioned above, each pollutant—whether in gaseous or aerosol form—has a different efficiency at impairing light, and this is partially based on the size of the pollutant particle. Aerosols are more efficient at scattering light than visibility impairing pollutants in the gaseous state since aerosols are larger in particle size. (Malm 1999, p. 8-10).

Aerosol measurements are weighted by their atmospheric light extinction coefficients, and their contribution to light extinction (i.e., their ability to impair visibility) is summed in the following equation2:

$b_{ext} = (3)f(RH)[sulfate] + (3)f(RH)[nitrate] + (4)[OMC] + (10)[LAC] + (1)[fine\ soil] + (0.6)[CM] + 10$

Where:

B_{ext} is the light-extinction coefficient or reconstructed light extinction;

f(RH) is the relative humidity at the particular Class I area at the time of year the measurement is made;

Sulfate is the mass of ammonium sulfate collected from the IMPROVE sampler;

Nitrate is the mass of ammonium nitrate collected from the IMPROVE sampler;

OMC is the mass of organic carbon collected from the IMPROVE sampler;

LAC is the mass of elemental carbon collected from the IMPROVE sampler;

Fine soil is the corrected mass of aluminum, silicon, calcium, iron, and titanium collected from the IMPROVE sampler;

CM is the mass of coarse particulates, which is the difference between particles 10 microns (PM_{10}) and particles 2.5 microns ($PM_{2.5}$).

The constant for Rayleigh scattering is 10.

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1 The information and figures in Section 4.2.2 were taken from “Introduction to Visibility” (May 1999) by William Malm of the Air Resources Division of the National Park Service, available at the Web site of the Cooperative Institute for Research in the Atmosphere at Colorado State University.. For a full understanding of light impairment, see this document athttp://vista.cira.colostate.edu/improve/Education/IntroToVisinstr.htm.

2 The light extinction equation above is the old IMPROVE equation which does not account for changes in light impairment do to different concentrations of some visibility impairing pollutants. For more information on the new IMPROVE equation visit the IMPROVE website listed above and search for “revised IMROVE equation.”

Reconstructed light extinction (b_{ext}) is the sum of the six particle components (sulfate, nitrate, organic carbon, elemental carbon, fine soil, and coarse mass) and Rayleigh scattering. The unit of measurement for b_{ext} is inverse megameters (1/Mm or Mm^{-1}).

4.3 Idaho IMPROVE Monitoring Network

Idaho is fortunate to have an IMPROVE monitoring site located in or very near each of Idaho's Class I areas. There are five IMPROVE monitoring sites relied upon for tracking visibility impacts and trends in Idaho (see Table 4-1 for details).

Table 4-1 The Idaho IMPROVE Monitoring Network

Class I Area	Site Code	Sponsor	Elevation MSL[a]	Start Date
Craters of the Moon National Monument	CRMO1	NPS[b]	1,817 m (5,961 ft)	5/13/1992
Hells Canyon Wilderness	HECA1	USFS[c]	655 m (2,148 ft)	8/1/2000
Sawtooth Wilderness	SAW1	USFS	1,990 m (6,529 ft)	1/26/1994
Selway-Bitterroot Wilderness	SULA1	USFS	1,895 m (6,217 ft)	8/10/1994
Yellowstone National Park	Yell2	NPS	2,425 m (4130 ft)	7/10/1996

[a] Elevation above mean sea level
[b] National Park Service
[c] U.S. Forest Service

4.3.1 Craters of the Moon National Monument IMPROVE site

The Craters of the Moon IMPROVE site shown in Figure 4-4, is located near the Craters of the Moon National Monument Visitor Center. Site elevation is 1,817 m (5,960 ft).

Figure 4-4 Craters of the Moon IMPROVE monitoring site

4.3.2 Hells Canyon Wilderness Area IMPROVE site

The IMPROVE site shown in figure 4-5, which collects data from the Hells Canyon Wilderness, is 15 km (10 mi) south of the southernmost wilderness boundary. Site elevation is 625 m (2,050 ft). It is near a hilltop west of Oxbow Dam on the Snake River, about 350 ft above river level, downstream from the dam.

Figure 4-5 Hells Canyon Wilderness IMPROVE monitoring site

4.3.3 Sawtooth Wilderness Area IMPROVE site

The IMPROVE site shown in figure 4-6, which collects data from the Sawtooth Wilderness, is located in the Stanley Basin 4 km outside of the northeastern wilderness boundary, at the U.S. Forest Service Stanley Warehouse, elevation 1,980 m (6,494 ft). It is 60 to 80 m (approximately 200 ft) lower in elevation than the wilderness boundary.

Figure 4-6 Sawtooth Wilderness Area IMPROVE monitoring site

4.3.4 Selway-Bitterroot Wilderness Areas IMPROVE site

The IMPROVE site shown in Figure 4-7, which collects data from the Selway-Bitterroot Wilderness Area (and also the Anaconda-Pintler Wilderness Area), is located near the town of Sula, Montana in the valley of the East Fork of the Bitterroot River. The site is 20 km east of the eastern Selway-Bitterroot Wilderness boundary and 17 km west of the western Anaconda-Pintler Wilderness boundary. The IMPROVE site is near the top of Sula Peak at an elevation of 1,903 m (6,242 ft).

Figure 4-7 Selway-Bitterroot Monitoring Site

4.3.5 Yellowstone National Park IMPROVE site

The IMPROVE site shown in Figure 4-8, which collects data from Yellowstone National Park (and also Grand Teton National Park, Teton Wilderness Area, and Red Rocks Lake Wilderness Area). It is located close to the north shore of Yellowstone Lake in the center of Yellowstone National Park. The site elevation is 2,425 m (7,954 ft), 67 m (220 ft) above the lake elevation of 2,358 m (7,733 ft).

Figure 4-8 Yellowstone National Park Monitoring Site

4.4 Idaho's Commitments for Supporting the IMPROVE Monitoring Network for Regional Haze Monitoring

Idaho commits to continue utilizing the IMPROVE monitoring data to track any visibility improvements over time in order to determine if reasonable progress is being made. Idaho commits to continue developing updated emission inventories sufficient to allow for the tracking of any changes in emissions level that are attributable to adopted haze reduction strategies. These monitoring and emissions data will be available for electronic processing in future modeling or other emission tracking processes. Information collected from the monitoring system and emission inventory work will be made available to the public on a periodic basis.

Idaho will depend on the IMPROVE monitoring program to collect and report aerosol monitoring data for reasonable progress tracking as specified in the Regional Haze Rule (RHR). The RHR requires a long-term tracking program with an implementation period nominally set for 60 years.

The state expects the configuration of the monitors, sampling site locations, laboratory analysis methods, and data quality assurance to remain unchanged. Network operation protocols will likely not change, but if they must, they will remain directly comparable to those operated by the IMPROVE program during the 2000-04 RHR baseline period. Technical analyses and reasonable progress goals in RHR plans are based on data from these sites. The state must be notified of and agree to any changes in the IMPROVE program affecting the RHR monitoring sites, before changes are made. Further, the state understands that the resources to operate a complete and representative monitoring network to track the long-term reasonable progress goals is the responsibility of EPA; therefore, has no plans to provide resources for these sites.

Idaho depends on six IMPROVE program-operated monitoring sites, which are shown on the WRAP's TSS Web site (http://vista.cira.colostate.edu/TSS/Tools/AOI.aspx) as of October 25, 2007 to track changes in visibility and determine whether it constitutes "reasonable progress" as required by the Regional Haze Rule. Idaho will depend on the routine timely reporting of monitoring data by the IMPROVE program, for the sites needed for tracking reasonable progress, to the Visibility Information Exchange Web System (VIEWS) and TSS. The state notes that the resources to ensure data reporting from these long-term tracking monitoring sites is the responsibility of EPA, and the state of Idaho has no plans to provide resources for this effort.

Idaho has prepared and commits to updating statewide emissions inventories periodically. The updates will be used for state tracking of emission changes, trends, and input into WRAP's evaluation of whether reasonable progress goals are being achieved and other regional analyses. The inventories will be updated every three years on the same schedule as the triennial reporting required by EPA's Consolidated Emissions Reporting Rule. Chapter 8 of this plan summarizes the emissions by pollutant and source category.

Idaho will continue to use the WRAP-sponsored Emissions Data Management System and Fire Emissions Tracking System to store and access emissions data. The state will also depend upon and participate in additional periodic collective emissions inventory efforts by the WRAP. Further, the state will continue to depend on and use the capabilities of the WRAP-sponsored Regional Modeling Center (RMC) 5 to simulate the air quality impacts of emissions for haze planning purposes. The state notes that the means to ensure data preparation, storage, and analysis by the state and WRAP require adequate ongoing resources, which are the responsibility of EPA.

Idaho will track data related to haze plan implementation, as required by the Regional Haze Rule, for sources for which the state has regulatory authority. Idaho will also depend on the IMPROVE program for monitoring data and on WRAP-sponsored collection and analysis efforts and data support systems for emissions inventory data.

Chapter 5. Basic Plan Elements

In order to better understand the information presented in the document, this chapter describes the basic plan elements and key concepts contained in the Idaho Regional Haze Plan.

5.1 Natural Sources of Visibility Impairment

Natural sources of visibility impairment include anything not directly attributed to human-caused emissions of visibility-impairing pollutants. Natural events (e.g., windblown dust, wildfire, volcanic activity, biogenic emissions) also introduce pollutants that contribute to haze in the atmosphere. Natural visibility conditions are not constant; they vary with changing natural processes throughout the year. Specific natural events can lead to high short-term concentrations of visibility-impairing particulate matter and its precursors. Therefore, natural visibility conditions, for the purpose of the Idaho regional haze program, are represented by a long-term average of conditions expected to occur in the absence of emissions normally attributed to human activities. Natural visibility conditions reflect contemporary vegetated landscape, land-use patterns, and meteorological/climatic conditions. Natural visibility is expressed as an average deciview level for the 20% of days with the best visibility and 20% of days with the worst visibility at each Class I area for the baseline period of 2000-2004.

Natural sources contribute to visibility impairment but natural emissions cannot be realistically controlled or prevented by the states and therefore are beyond the scope of this planning document. Current methods of analysis of monitoring data from the IMPROVE program (see Chapter 4) do not provide a distinction between natural and anthropogenic emissions.

5.2 Human-Caused Sources of Visibility Impairment

Human-caused (anthropogenic) sources of visibility impairment include anything directly attributable to human-caused activities that produce emissions of visibility-impairing pollutants. Some examples include transportation, agriculture activities, mining operations, and fuel combustion. Anthropogenic visibility conditions are not constant; they vary with changing human activities throughout the year. Following are the two categories of anthropogenic emissions:

> 1) "State Origin Anthropogenic" (SOA) emissions are anthropogenic emissions that are generated or originate within the boundaries of a State.
>
> 2) International Origin Anthropogenic (IOA) emissions include those that are generated outside of the United States of America but are transported into a State.

Although anthropogenic sources contribute to visibility impairment, IOA emissions cannot be regulated, controlled, or prevented by the states and therefore are beyond the scope of this planning document. Any reductions in IOA emissions would likely fall under the purview of the U.S. EPA through international diplomatic activities.

5.3 Deciview and Other Measures of Visibility

Each IMPROVE monitor collects particulate concentration data that are converted into reconstructed light extinction through a complex calculation using the IMPROVE equation (see Technical Support Documents for any Class I area). Reconstructed light extinction (denoted as b_{ext}) is expressed in units of inverse megameters (1/Mm or Mm^{-1}); However, the Regional Haze Rule requires the tracking of visibility conditions in terms of the haze index (HI) metric expressed in deciview (dv) units [40 CFR 51.308(d)(2)]. Generally, a one-deciview change in the haze index is likely humanly perceptible under ideal conditions regardless of background visibility conditions. The relationships among extinction (Mm-1), haze index (dv) and visual range (mi) are indicated by Figure 5-1.

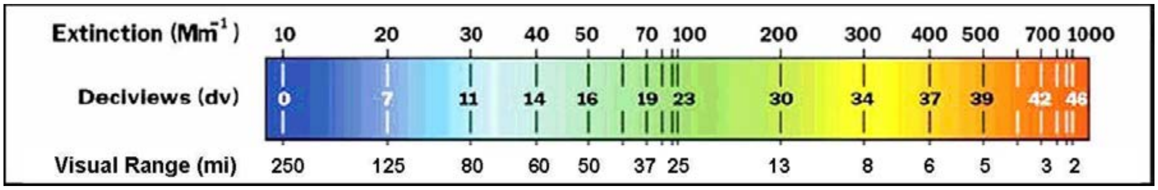

Figure 5-1. Relationships Among Various Measures of Visibility

The deciview measurement is important since it provides visibility impairment in context of a human's ability to see and is used in establishing Reasonable Progress Goals.

5.4 Baseline and Current Conditions

The Regional Haze Rule requires the calculation of baseline conditions for each Class I area. For each area, te baseline conditions is defined as the five-year average, using annual values for 2000 - 2004, based on IMPROVE monitoring data (expressed in deciviews) for the most-impaired (20% worst) days and the least-impaired (20% best) days. For this first regional haze SIP, the baseline conditions are the reference point against which visibility improvement is tracked. For subsequent regional haze (RH) SIP updates (in the year 2018 and every 10 years thereafter), baseline conditions will be used to calculate progress from the beginning of the regional haze program. Current conditions for the best and worst days can be calculated from a multiyear average, based on the most recent five years of monitored data available. This value will be revised at the time of each periodic SIP revision, and will be used to illustrate:

(1) The amount of progress made since the last SIP revision.

(2) The amount of progress made from the baseline period.

5.5 Natural Conditions

The natural condition for each Class I area is defined as the level of visibility (in deciviews) for the most-impaired (20% worst) days and the least-impaired (20 % best) days that would exist if there were no manmade impairment. Since no visibility monitoring data exists from the pre-manmade impairment period, the EPA developed guidance on how to estimate natural conditions (the EPA document *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*). Generally, for each Class I area in the western United States, the natural condition for the worst days is determined by adding two

standard deviations to the annual average of IMPROVE monitoring data. Similarly, the natural condition for the best days is determined by subtracting two standard deviations from the annual average of the IMPROVE monitoring data.

5.6 Reasonable Progress Goals

For each Class I area, the State must establish goals (measured in deciviews) that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals (RPGs) are interim goals that represent incremental visibility improvement over time for the most-impaired (20% worst) days and no degradation in visibility for the least-impaired (20% best) days. The State has flexibility in establishing different RPGs for each Class I area.

In establishing the RPG, the State must consider four factors:

1 the costs of compliance,

2 the time necessary for compliance,

3 the energy and non-air quality environmental impacts of compliance, and

4 the remaining useful life of any potentially affected sources.

States must demonstrate how these factors were taken into consideration in selecting the goal for each Class I area.

5.7 Uniform Rate of Progress

The uniform rate of progress (URP) is the calculation of the slope of the line between baseline visibility conditions and natural visibility conditions over the 60-year period. In this initial SIP submittal, the first benchmark is the deciview level that should be achieved in 2018, at the end of the first planning period, indicated in blue below (Figure 5-2).

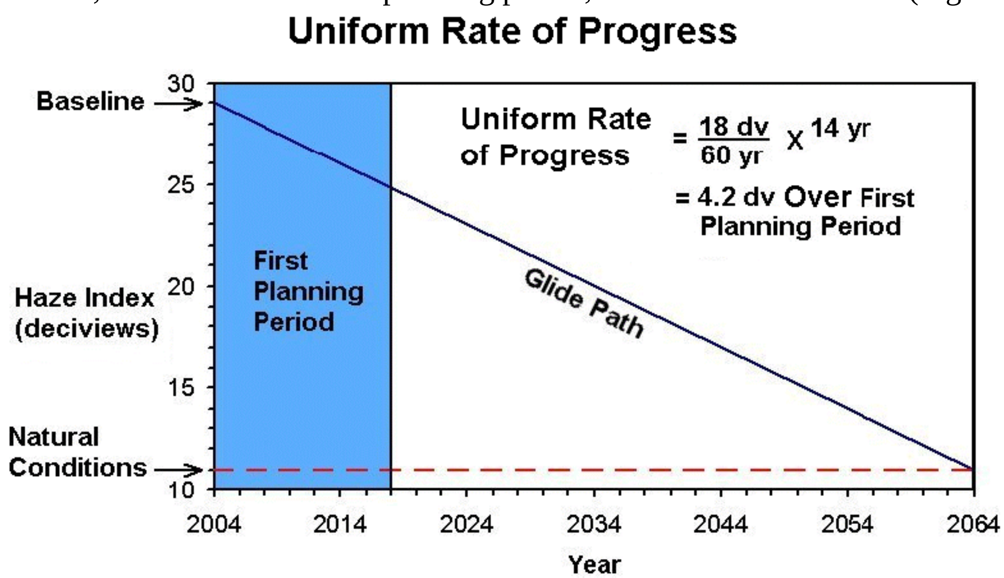

Figure 5-2. Example of How Uniform Rate of Progress is Determined

To calculate the uniform rate of progress:

- Compare baseline conditions to natural conditions. The difference between these two represents the amount of progress needed to reach natural visibility conditions. In this example, the State has determined that the baseline for the 20% worst days for the Class I area is 29 dv and estimated that natural background is 11 dv, a difference of 18 dv.
- Calculate the annual average visibility improvement needed to reach natural conditions by 2064 by dividing the total amount of improvement needed by 60 years (the period between 2004 and 2064). In this example, this value is 0.3 dv/yr.
- Multiply the annual average visibility improvement needed by the number of years in the first planning period (the period from 2004 until 2018). In this example, this value is 4.2 dv. This is the uniform rate of progress that would be needed during the first planning period to attain natural visibility conditions by 2064.

The URP is not a presumptive target. When establishing RPGs, the State may determine RPGs at greater, lesser, or equivalent visibility improvement than the URP would dictate. In cases where the RPG results in less improvement in 2018 than the URP, the State must use the statutorily mandated four factors listed above to demonstrate why the URP is not achievable.

For the 20% worst days, the URP is expressed in deciviews per year (i.e., slope of the glide path) as determined by the following equation:

URP = [Baseline Condition - Natural Condition] / 60 years

The 2018 Progress Goal (i.e., the amount of reduction necessary for the first planning period) is determined by multiplying the URP by the number of years in the first planning period.

2018 Progress Goal = [Uniform ROP] x [14 years]

The 14 years comprising the first planning period includes the four years between the baseline and the SIP submittal date plus the standard 10-year planning period.

5.8 Long-Term Strategy

The Regional Haze Rule also requires States to submit a long-term strategy that includes enforceable measures to achieve reasonable progress goals. The long-term strategy must identify all anthropogenic sources inside the State that are affecting Class I areas both inside and outside the State. The first long-term strategy will cover 10 to 15 years, with reassessment and revision of those goals and strategies in 2018 and every 10 years thereafter. In developing the long term strategy, the State can take into account emission reductions due to ongoing air pollution control programs (such as implementation of programs to meet the national ambient air quality standards for particulate matter). It may be possible to demonstrate reasonable progress based on these emission reductions alone, particularly for the first period of the long-term strategy. The following additional factors must be considered in developing the long-term strategy:

- Measures to mitigate the impact of construction activities;
- Emission limitations and schedules for compliance to achieve the RPG;
- Source retirement and replacement schedules;
- Smoke management techniques for agricultural and forestry burning, including plans to reduce smoke impacts;
- Enforceability of emission limitations and control measures; and

- The anticipated net affect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed of the long term strategy.

5.9 BART

The RPGs, the long-term strategy, and BART are the three main elements of a Regional Haze Plan. Best Available Retrofit Technology (BART) requirements apply to certain older industrial facilities that began operating before national rules were adopted in 1977 to prevent new facilities from causing visibility impairment. BART applies to facilities built between 1962 and 1977, having potential emissions greater than 250 tons per year, and which fall into one of 26 specific source categories. These facilities must be evaluated to see how much they contribute to regional haze and if retrofitting with controls are feasible.

In determining BART controls, the State can take into account several factors, including the existing control technology in place at the source, the costs of compliance, energy and nonair environmental impacts of compliance, remaining useful life of the source, and the degree of visibility improvement that is reasonably anticipated from the use of such technology.

Chapter 6. Baseline and Natural Visibility Conditions and Uniform Rate of Progress

6.1 Baseline and Natural Condition background

This chapter describes the Baseline and Natural Conditions as required by 40 CFR 51.308(d)(2)(i) and 40 CFR 51 308(d)(2)(iii). When analyzing present and future visibility conditions, there are three key concepts to take into consideration. These concepts include the baseline conditions, the natural conditions, and the reasonable progress goal (RPG) and uniform rate of progress (URP).

In determining the baseline conditions, IMPROVE monitoring data is used to determine the 20% least impaired days (20% best) and the 20% most impaired days (20% worst). Baseline conditions are established for both the best and worst days. IMPROVE monitoring data segregated into the 20% best and worst days for the years 2000 through 2004 are averaged to establish the baseline or starting point for regional haze improvement. Baseline conditions are presented in the metric of deciviews. These requirements are laid out in 40 CFR 51.308(d)(2) under baseline conditions.

In defining natural visibility for each of the Class I areas, Idaho is using the default conditions as described in natural visibility background as defined in *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program,* EPA-45/B-03-0005, September 2003. The report draws on information from numerous sources and identifies estimates for the natural levels of sulfates, organic carbon, elemental carbon, nitrate, fine particles, and coarse particles for the eastern and western regions of the United States.

The same average annual natural background conditions based upon concentration levels are assumed for all western Class I areas. Although each Class I area in the West is considered to have the same natural concentrations of visibility-impairing constituents, the natural conditions vary slightly due to different humidity levels and altitudes of the Class I areas. The frequency distributions of daily calculated deciviews for western Class I areas has been shown to follow a normal distribution curve. Natural background for the 20% worst days is estimated by assuming that fine particle concentrations for natural background are normally distributed and the 90^{th} percentile of the annual distribution represents natural background visibility on the 20% worst days.

The line between the baseline conditions and the project natural conditions represents the glide slope for analyzing progress on visibility improvements for a given Regional Haze SIP planning period. To calculate the total improvement needed by the end date of 2064, the natural conditions are subtracted from the baseline. To identify the annual improvement that follows the glide slope, the total needed improvement is divided by the 60-year life span of Regional Haze Rule which will end in 2064. The uniform rate of progress (URP) is the annual improvement rate times the number of years in the period

under each Regional Haze SIP. Most SIPs will cover a 10-year planning period with the exception of the first SIP which covers a 14-year span (2004-2018) (See Chapter 5 Figure 5-2). The URP is used as an indicator to determine whether the rate of improvement, if maintained steadily, will reach the end goal in 2064. The Regional Haze Rule, 40 CFR 51.308(d)(1)(ii), requires the state to provide an assessment of the number of years it will take to reach natural conditions if the rate of is slower than the URP.

To illustrate this concept, Table 6-1 takes a closer look at the Craters of the Moon Class I area. The IMROVE data showing the average 20% best and 20% worst days, with the exception of 2000 since monitoring data wasn't available for that year.

Table 6-1. Base Year 20% Best and Worst Days for Craters of the Moon National Monument

Year	Most Impaired Days	Least Impaired Days
2000	na	na
2001	14.3	4.8
2002	14.9	4.9
2003	14.0	3.3
2004	12.8	4.3
Baseline Average Deciview	**14.00**	**4.31**

Table 6-2 is a summary of baseline visibility, natural conditions, and the URP glide path covering the first planning period ending in 2018.

Table 6-2. 20% Best and Worst Days Baseline, Natural Conditions, and Uniform Progress Goal for Idaho Class I Areas

Idaho Class I Area	20% Worst Days				20% Best Days
	2000-04 Baseline [deciview]	2018 URP Goal [deciview]	2018 Reduction Needed [deciview]	2064 Natural Conditions [deciview]	2000-04 Baseline [deciview]
Caters of the Moon National Monument	14.00	12.49	1.51	7.53	4.31
Hells Canyon Wilderness Area	18.55	16.17	2.38	8.32	5.5
Sawtooth Wilderness Area	13.78	12.06	1.72	6.42	4.0
Selway-Bitterroot Wilderness Area	13.4	12.02	1.39	7.4	2.6
Yellowstone National Park	11.76	10.52	1.24	6.4	2.6

The following sections in this chapter show the URP for each Class I Area, grouped by the IMPROVE monitoring site that represents each area. Idaho is fortunate in having an IMPROVE monitoring site for each Class I area.

Although the Regional Haze rule only requires states to identify the baseline and natural conditions in deciviews, it is helpful to understand the individual contributors to visibility impairment and the difference between their contributions on the 20% best and 20% worst days. This will assist in understanding the contributions and begin to link to sources which will be investigated and analyzed in determining long term strategies and assist in setting reasonable progress goals.

6.2 Baseline, Natural Conditions for Craters of the Moon

Craters of the Moon National Monument has its own IMPROVE monitoring site located within the Monument. Figure 6-1 shows the URP for the Craters of the Moon National Monument on the 20% worst days and the baseline for the 20% best days. Based on IMPROVE monitoring data, the baseline is 14dv for the 20% worst days with a natural condition of 7.53dv. The baseline for the 20% best days is 4.31dv. The first planning period would need a 1.51dv improvement in order to reach 12.49dv by the year 2018. Overall, a reduction of 6.47dv will be needed to reach natural conditions in the year 2064.

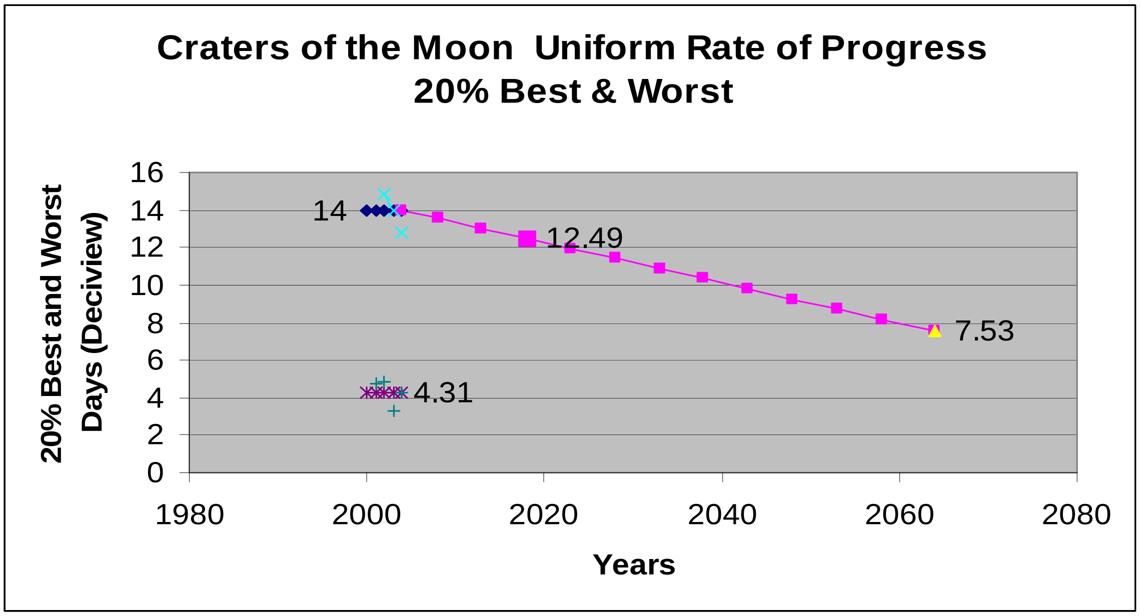

Figure 6-1. Craters of the Moon National Monument, Uniform Rate of Progress

6.3 Hells Canyon Wilderness Area

Hells Canyon Wilderness Area has an IMPROVE monitoring site located within the wilderness area near Oxbow Dam. Figure 6-2 shows the URP for the Hells Canyon Wilderness for the 20% days and the baseline for the 20% best days. Based on IMPROVE monitoring data, baseline is 18.55dv with a natural condition of 8.32dv. The baseline for the 20% best days is 5.52dv. The first planning period would need a 2.38dv improvement in order reach the uniform rate of progress of 16.17dv by the year 2018. Overall, a reduction of 10.23dv will be needed to reach natural conditions by 2064. Figure 6-3

digitally adjusted to shows the difference in visibility at Hells Canyon Wilderness between baseline and natural conditions.

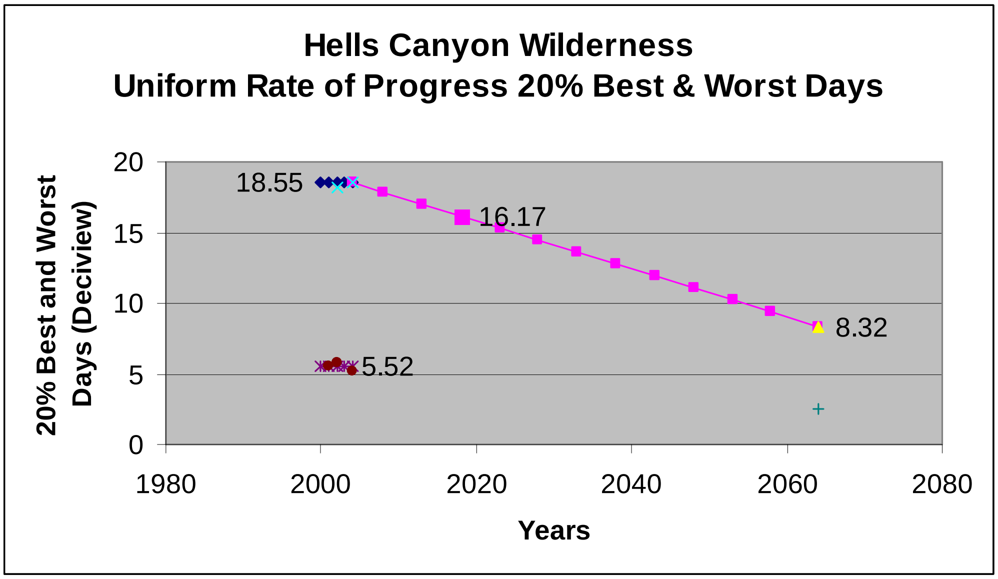

Figure 6-2 Hells Canyon Wilderness Uniform Rate of Progress

Figure 6-3 Hells Canyon Wilderness Photo of Baseline vs. Natural Condition

6.4 Sawtooth Wilderness

The Sawtooth Wilderness shown in Figure 6-5 has its own IMPROVE monitoring site located within the wilderness. Figure 6-4 shows the uniform rate of progress for the Sawtooth Wilderness on the 20% worst days and the baseline for the 20% best days. Based

on IMPROVE monitoring data, the baseline is 13.78 dv for the 20% worst days with a natural condition of 6.42dv. The baseline for the 20% best days is 3.99 dv. The first planning period would need a 1.72dv improvement in order to reach the 12.06 dv improvement by the year 2018. Overall, a reduction of 7.36dv will be needed to reach natural conditions in the year 2064. Figure 6-5 shows the difference in visibility at Sawtooth Wilderness between baseline and natural conditions.

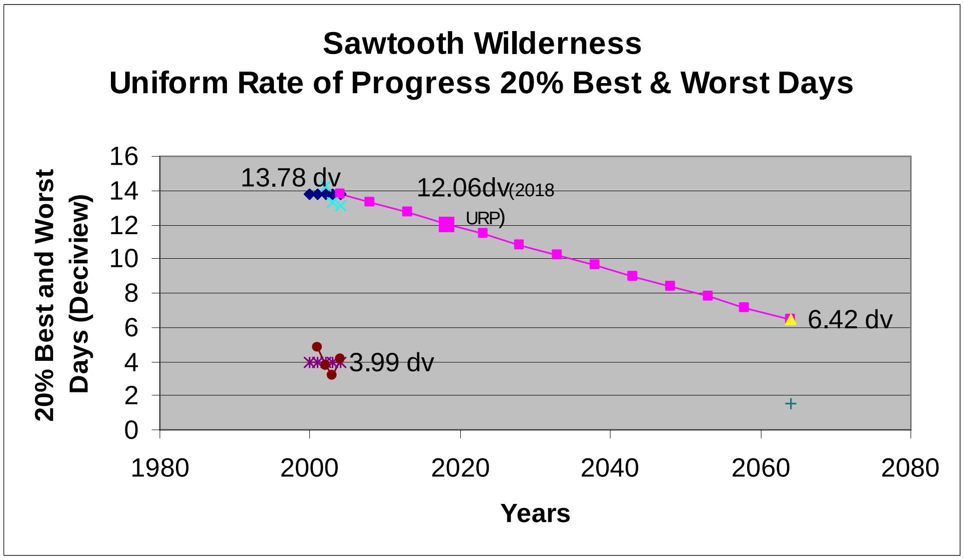

Figure 6-4 Sawtooth Wilderness Uniform Rate of Progress

Figure 6-5 Sawtooth Wilderness Photo– Baseline vs. Natural

6.5 Selway-Bitterroot Wilderness Area

The IMPROVE site representing the Selway Bitterroot and Anaconda-Pintler Wilderness Areas is located 20km east of the Wilderness near the town of Sula Montana in the valley of the East Fork of the Bitterroot River. Figure 6-6 shows the uniform rate of progress for the Sawtooth Wilderness on the 20% worst days and the baseline for the 20% best days. Based on IMPROVE monitoring data, the baseline is 13.41dv for the 20% worst days with a natural condition of 7.43dv. The baseline for the 20% best days is 2.58 dv. The first planning period would need a 1.39dv improvement in order to reach the 12.02dv improvement by the year 2018. Overall, a reduction of 7.36dv will be needed to reach natural conditions in the year 2064. Figure 6-7 shows the difference in visibility at Selway Wilderness between baseline and natural conditions.

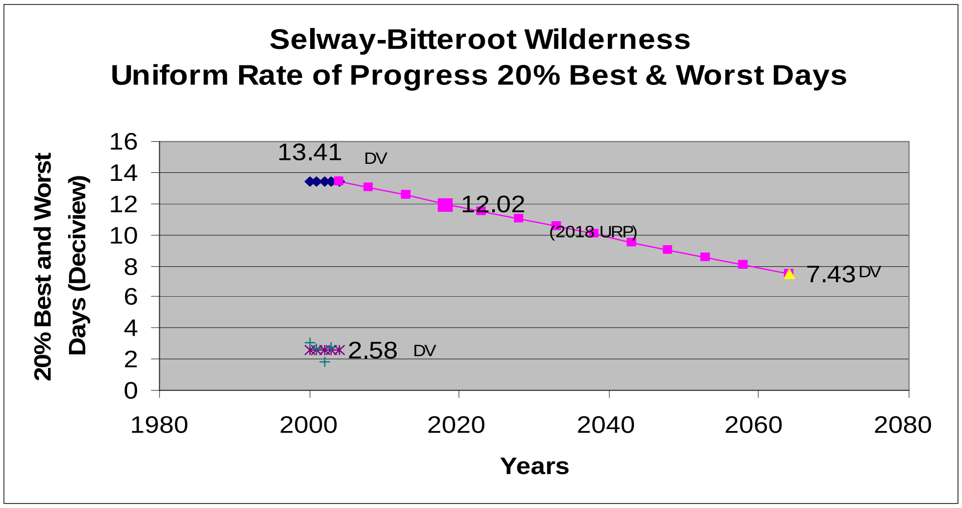

Figure 6-6 Selway-Bitterroot Wilderness Uniform Rate of Progress

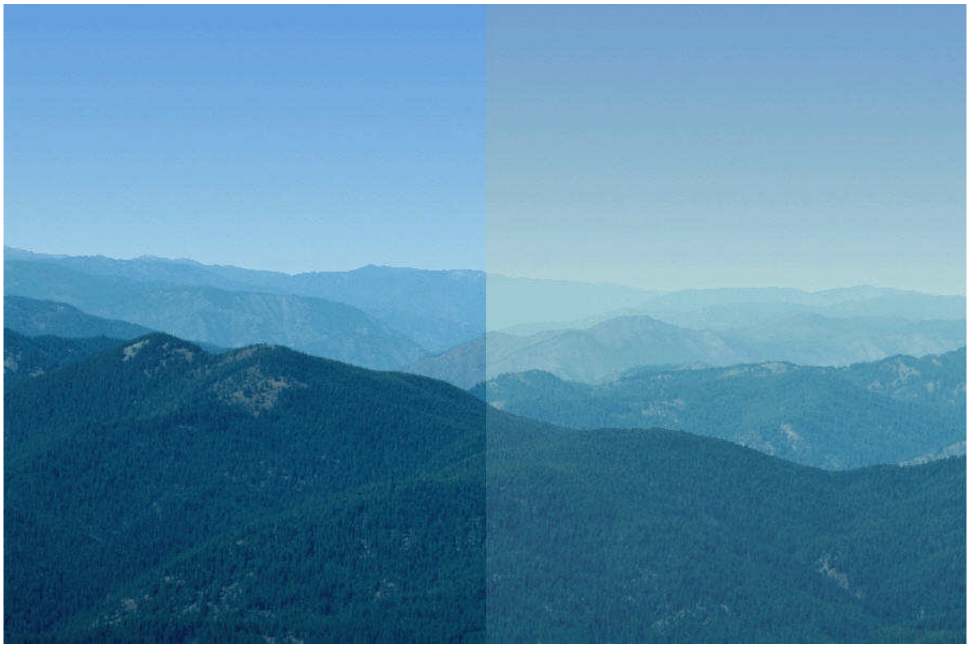

Figure 6-7 Selway Wilderness Photo of Natural Conditions vs. baseline

6.6 Yellowstone National Park

The IMPROVE monitoring site representing Yellowstone National Park is located close to the north shore of Yellowstone Lake in the center of the National Park. Figure 6-8 shows the uniform rate of progress for Yellowstone National Park on the 20% worst days and the baseline for the 20% best days. Based on IMPROVE monitoring data, the baseline is 11.76dv for the 20% worst days with a natural condition of 6.4dv. The baseline for the 20% best days is 2.58 dv. The first planning period would need a 1.24dv improvement in order to reach the 10.52dv improvement by the year 2018. Overall, a reduction of 5.32dv will be needed to reach natural conditions in the year 2064.

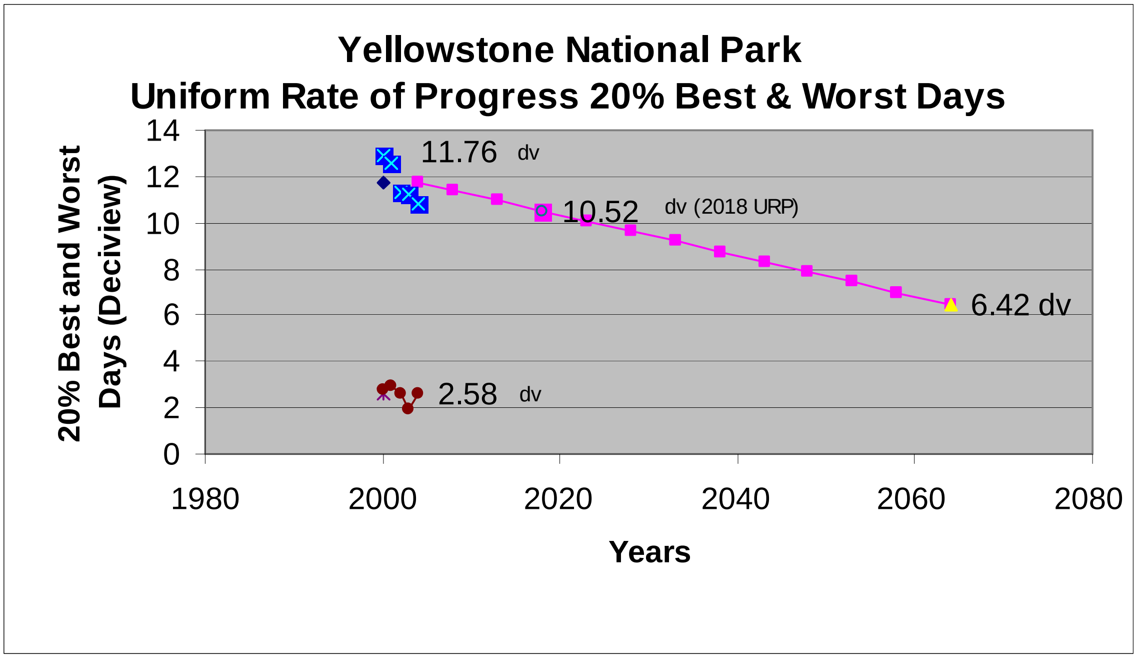

Figure 6-8 Yellowstone National Park Uniform Rate of Progress

Chapter 7. Pollutants Causing Visibility Impairment in Idaho Class I areas

7.1 Overview

This Chapter will look at the pollutants causing visibility impairment in each of the Class I areas in Idaho. As mentioned in Chapter 4, there are several light-impairing pollutants, each with a different impact on visibility. Some pollutants such as elemental carbon absorb light while other pollutants cause light to bounce or refract. Light that the human eye can see is composed of red, green, and blue, with each color having a different wave length. The size of the pollution particle can have a dramatic effect on length of the light waves. For a full discussion on how different pollutants cause visibility impairment please refer back to Chapter 5.

The primary focus of this chapter is to identify what pollutants are causing visibility impairment and the seasonal variance in pollutant concentrations. It is important to look at both the concentration levels (expressed in micrograms per meter [ug/m$^{3]}$) and the visibility impairment (expressed in inverse megameters [Mm^{-1}] or deciview [dv]). The distinction between concentrations and visibility impairment is important for each pollutant because reducing concentration levels of the various pollutants can result in very different effects on visibility improvement. Reductions in the concentrations of ammonium nitrate and ammonium sulfate will have greater impact on visibility than equal reductions in the concentration of coarse matter. As described in chapter 5, this is the result of different pollutants and different particle sizes having different effects on light impairment.

It is important to look at the seasonal nature of pollutant levels because it can help trace pollutants back to source activities that may be causing the pollution. As an example, organic mass carbon is typically higher in the summer months due to wildfire. If organic carbon is relatively high outside the summer months, there may be sources other than wildfire contributing to visibility impairment from organic carbon.

The Regional Haze Rule requires that reasonable progress goals be established for each Class I area (see Chapter 3 and 6 for a full description of each Class I area). The reasonable progress goals "must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period." This chapter will look at both the 20% best (least impaired) and 20% worst (most impaired) visibility days for each Class I area. As part of establishing reasonable progress goals, states are to take into consideration the uniform rate of progress (URP) from the baseline to the natural conditions based on a 60-year period starting in 2004 and ending in 2064. Graphs depicting the uniform rate of progress are included in this section but will be further discussed in chapter 11 as part of establishing reasonable progress goals. Although the reasonable progress goals are to be established in deciviews (dv), for simplicity this chapter will primarily use inverse megameters and not provide the mathematical conversion to deciviews.

This chapter begins with a look at all of Idaho's Class I areas collectively and then each Class I area separately. The IMPROVE monitoring sites discussed in chapter 4 are the

sources of the data used. Throughout this chapter and the remainder of the document, the colors identified in Table 7-1 will be used to represent the corresponding pollutants in graphs and tables. Throughout the remainder of this document the particulate aerosols of ammonium sulfate and ammonium nitrate will be referred to as sulfate and nitrate.

Table 7-1 Color Key for Visibility Impairing Pollutants

	Pollutant	Abbreviation	IMPROVE Abbreviation
(yellow)	Ammonium Sulfate	SO4	ammSO3f_bext
(red)	Ammonium Nitrate	NO3	ammNO4f_bext
(green)	Organic Mass Carbon	OMC	omcf_btext
(dark gray)	Elemental Carbon	EC	ecf_btext
(brown)	Fine Soil	Soil	soilf_bext
(light gray)	Coarse Matter	CM	cm_btext
(light blue)	Sea Salt	Sea Salt	Seasalt_btext

Figure 7-1 summarizes the baseline distribution of pollutants at each Class I area in Idaho. The aerosol distribution for each Class I area was averaged over the five-year base period of 2000-2004 to identify the baseline level of pollutants for the 20% worst days as monitored at IMPROVE monitoring sites.

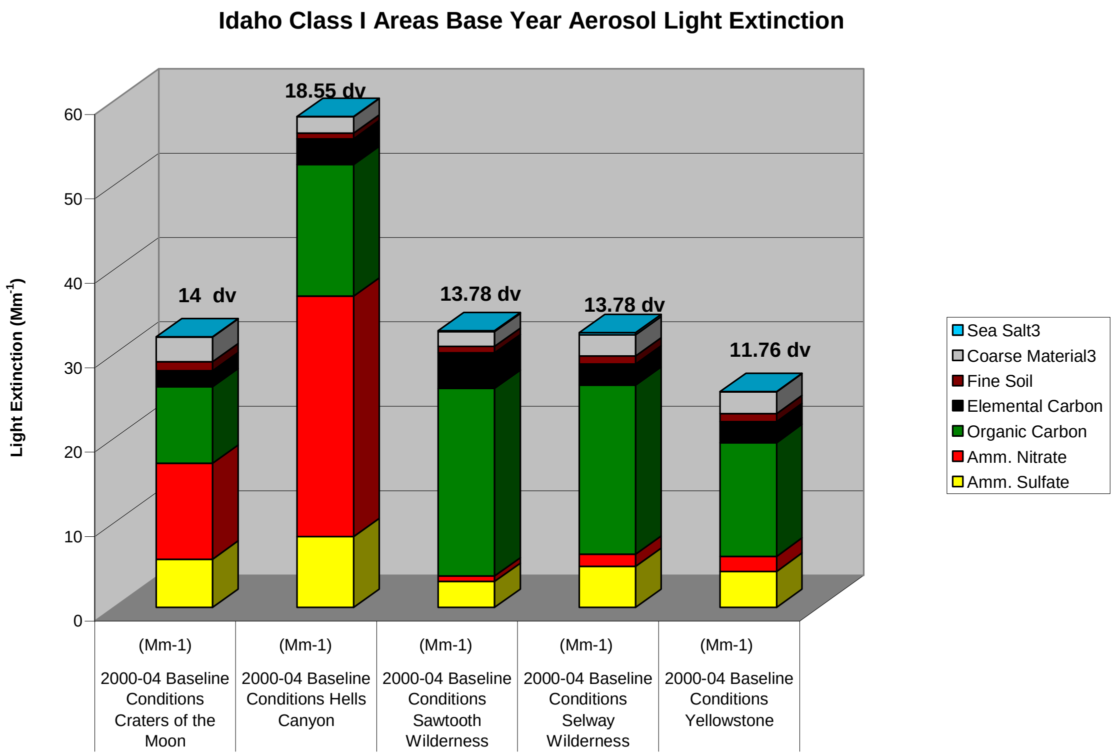

Figure 7-1. Idaho Class I Areas Baseline Aerosol Light Extinction

7.2 Craters of the Moon National Monument

The baseline for Craters of the Moon National Monument is 32.04Mm-1 (Figure 7-1). Along with determining the baseline, it is important to determine whether the aerosol distribution for the year 2002 is representative of the aerosol distribution for the five-year baseline period of 2000-2004. This is important because the emission inventory used to develop the modeling was based on 2002 data. Figure 7-2 shows the greatest contributor to visibility impairment on the 20% worst days at Craters of the Moon in 2002 was NOx at 39% followed by organic mass carbon at 31% and sulfate at 13%.

7.2.1 Craters of the Moon Visibility Impairment 20% Worst Days

Figure 7-2 shows the relative amounts of individual components of the aerosol distribution for the 20% worst days at Craters of the Moon in 2002, based on IMPROVE data.

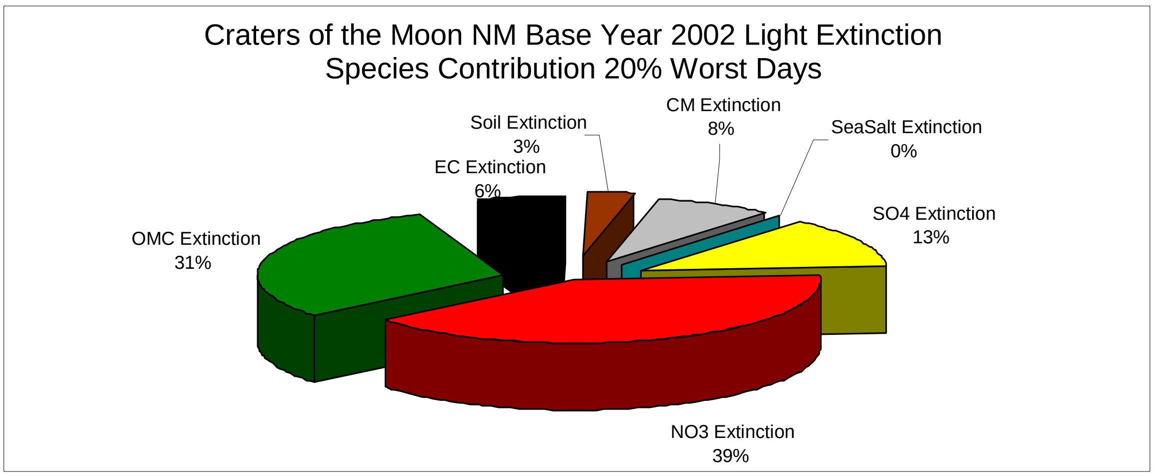

Figure 7-2. Craters of the Moon 2002 Light Extinction on the 20% Worst Days, Individual Components

Figure 7-3 shows that the annual concentrations of the light-impairing pollutants for 2002 don't appear to be out of proportion with their concentrations in other base years. It's also important to look at the actual visibility impairment and not just pollution concentrations because each pollutant has a different light-impairing ability.

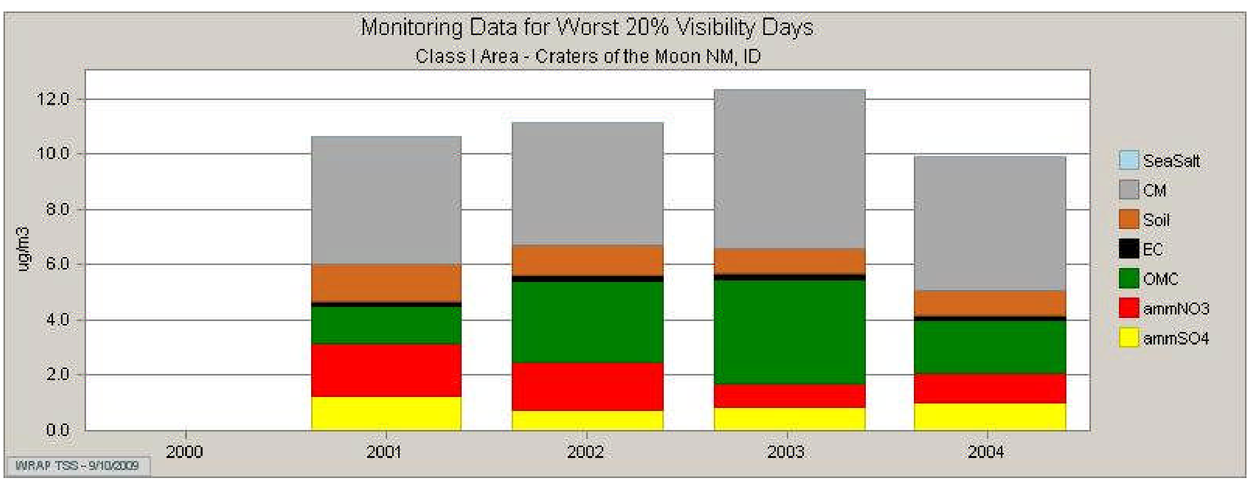

Figure 7-3. Craters of the Moon NM, Annual 2000-2004 Pollutant Species Concentrations 20% Worst Days

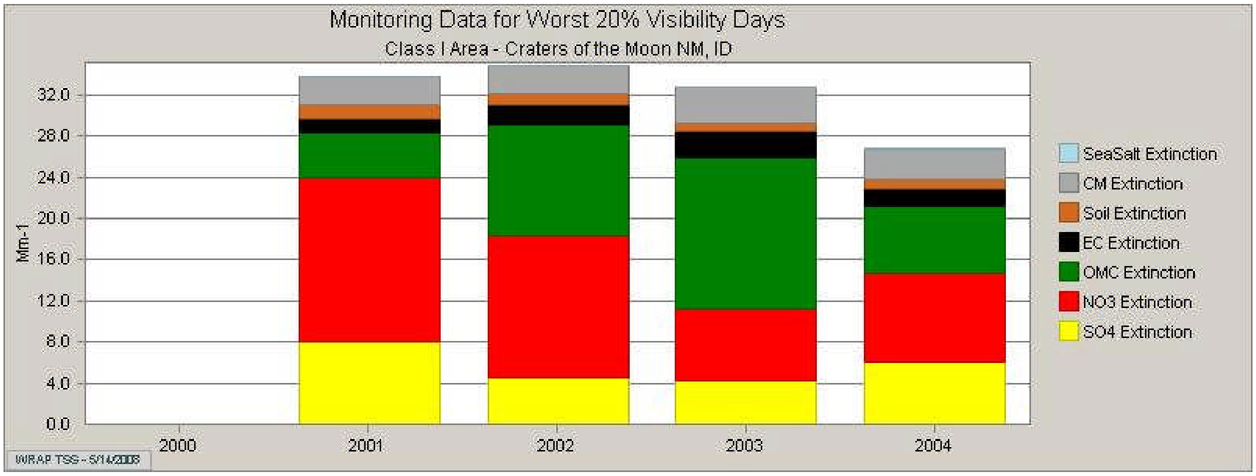

Figure 7-4. Craters of the Moon NM, Annual 2000-2004 Pollutant Species Visibility Impairment 20% Worst Days

Looking at Figures 7-3 and 7-4, it becomes obvious that both nitrate and sulfate had a greater impact on visibility impairment than coarse matter even though coarse matter concentration levels were higher. Small reductions in sulfate and nitrate will have a greater impact on visibility improvement than similar reductions in coarse matter.

Figure 7-5 separates the light-impairing constituents so that variations and trends over the five-year base period can be observed. The organic mass carbon spike in 2003 is probably attributable to wildfire activity. It also appears that sulfate and nitrate had similar trends with larger changes in nitrate. The trend lines for soil, elemental carbon, and coarse matter were rather flat and didn't seem to change much over time. Sea salt is almost negligible and the trend is relatively flat as will be seen in Idaho's other Class I areas.

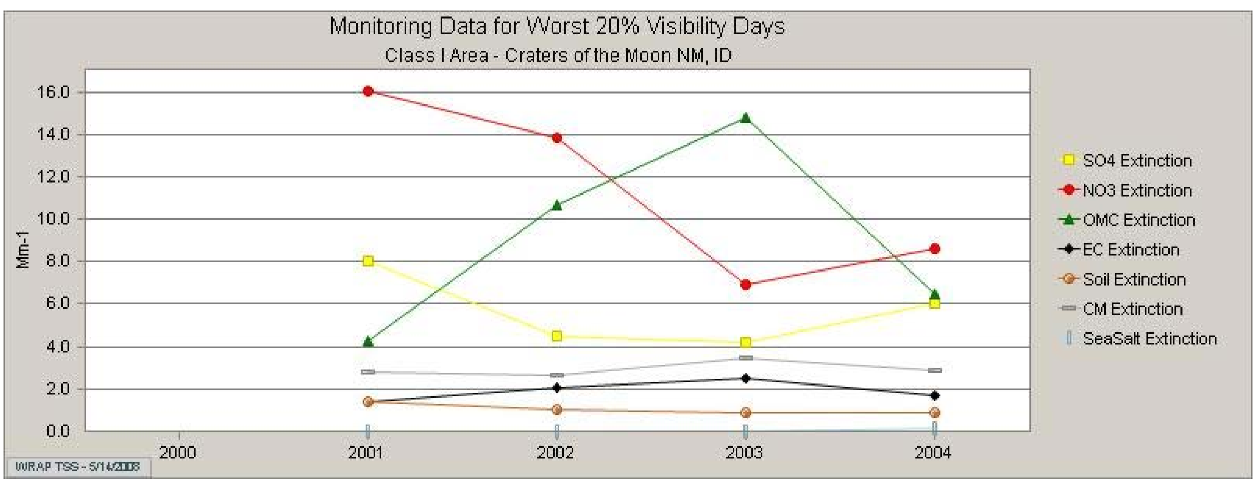

Figure 7-5. Craters of the Moon NM, Annual 2000-2004 Visibility Impairment by Pollutant Species 20% Worst days

Looking at all the IMPROVE monitored days in Figure 7-6, it appears there was a rise in visibility impairment from organic mass carbon during the summer months and from nitrate and sulfate during winter time periods.

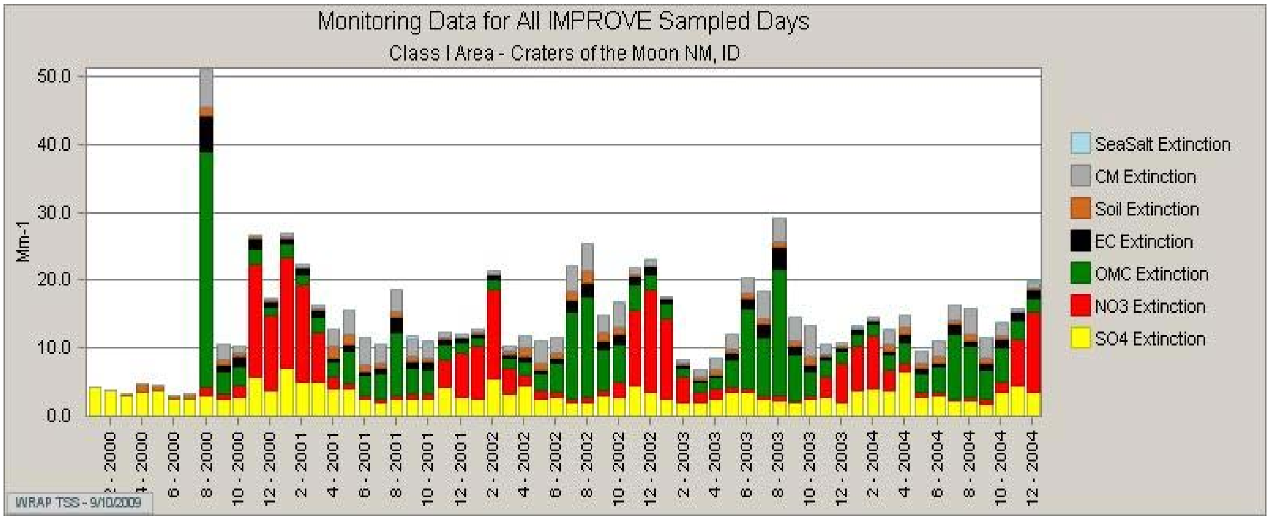

Figure 7-6. Craters of the Moon NM, 2000-2004 Pollutant Species Visibility Impairment, All IMPROVE Monitoring Days

Looking closer at the monthly impacts for just nitrate and sulfate in Figure 7-7, a distinctive pattern of increasing visibility impairment during the winter time period stands out. This observation may lead to identifying sources operating during this time period that may be contributing these two pollutants to the visibility impairment.

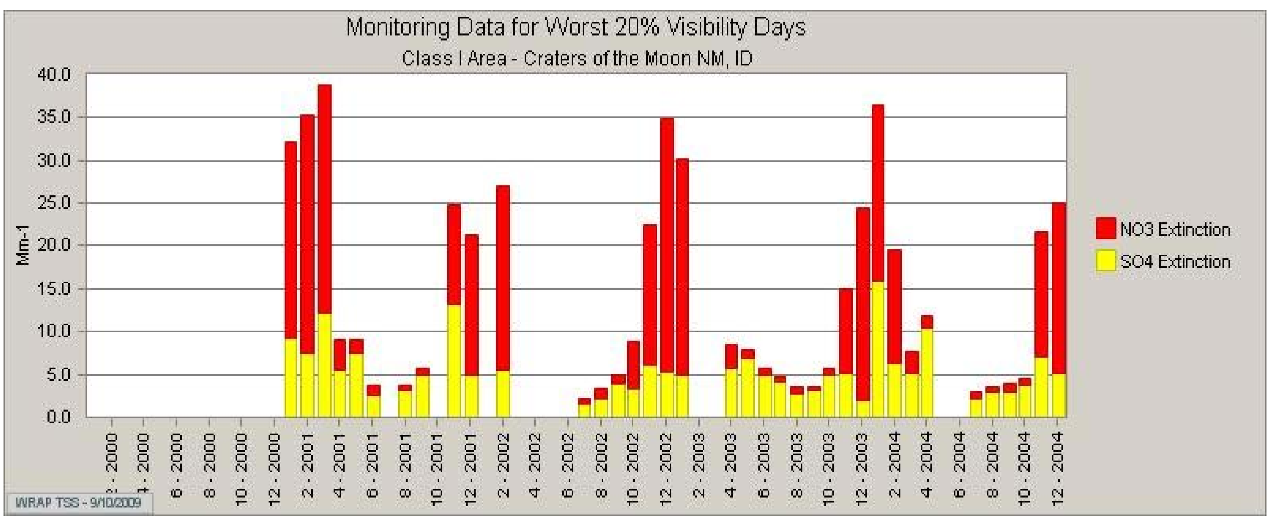

Figure 7-7. Craters of the Moon NM, Monthly 2000-2004 NO3 and SO4 Visibility Impairment 20% Worst Days

7.2.2 Craters of the Moon National Monument Visibility Impairment 20% Best Days

The Regional Haze rule requires states to improve the 20% worst days and not allow additional visibility degradation on the 20% best visibility days. With the exception of 2003, it appears the best and worst 20% days are tracking very similar as shown in Figures 7-7 and 7-8. There was a drop in organic coarse matter in 2003 for the 20% best days, as shown in Figure 7-9. Overall, it appears reductions in sulfate and nitrate would improve both the 20% worst and 20% best days.

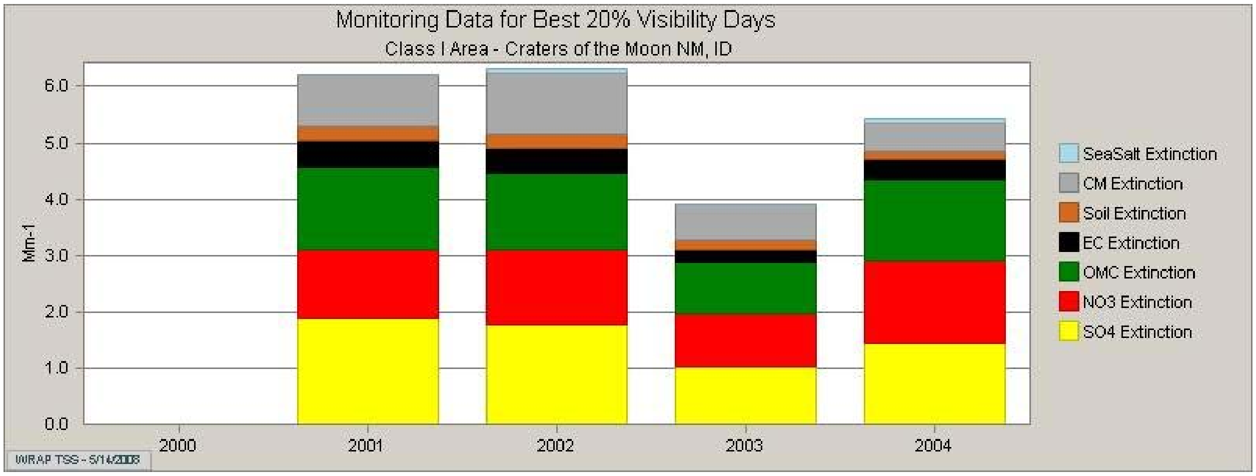

Figure 7-8. Craters of the Moon NM, Annual 2000-2004 Pollutant Species Visibility Impairment 20% Best Days

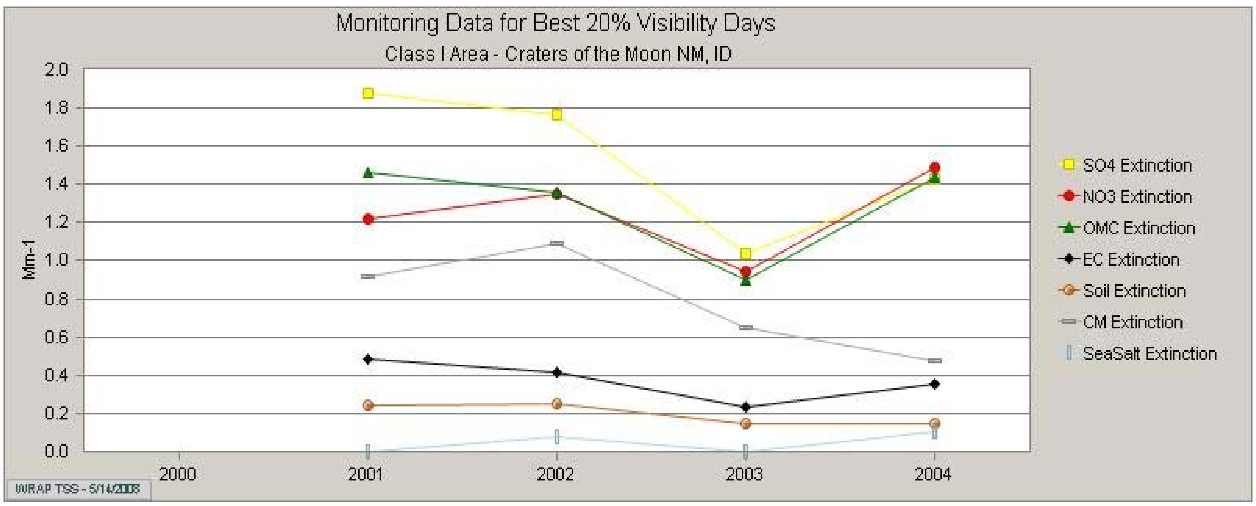

Figure 7-9. Craters of the Moon NM, Annual 2000-2004 Visibility Impairment by Pollutant Species 20% Best days

The left stack bar in figure 7-10 shows the Craters of the Moon National Monument was 32.04Mm-1 for the five-year baseline period. The lavender segment on the top of the center stack bar represents the 1.5-deciview improvement needed to meet the uniform rate of progress. The lavender section on top of the right-hand stack bar represents the 6.5-deciview improvement needed to meet the 2064 goal of natural conditions.

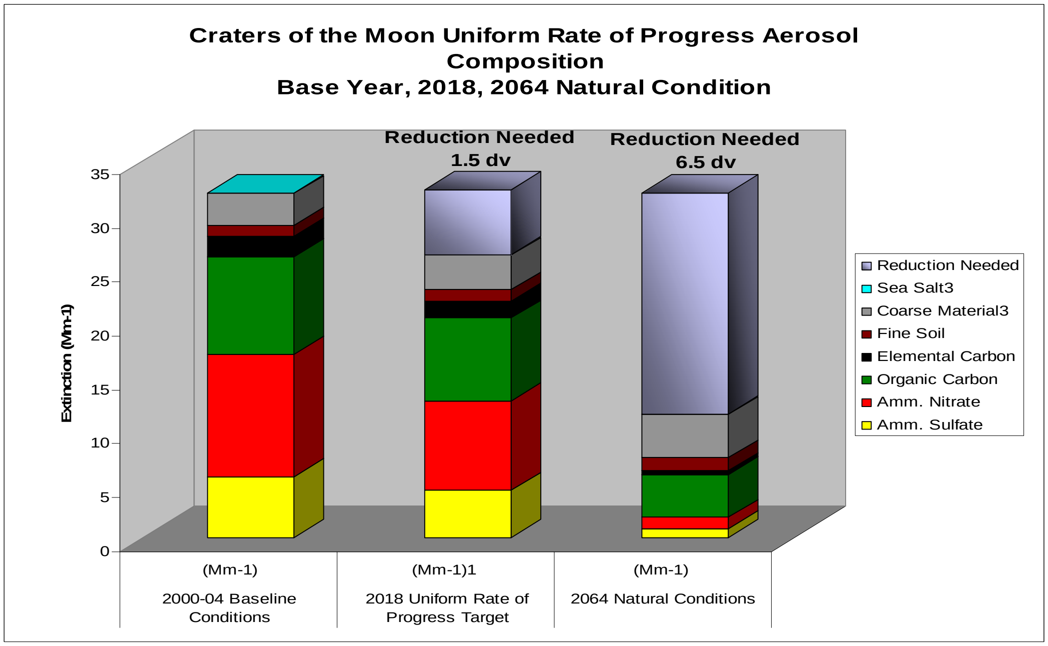

Figure 7-10. Craters of the Moon NM Aerosol Light Extinction, Baseline (2000-2004), 2018 Target, 2064 Goal

7.3 Hells Canyon Wilderness

7.3.1 Hells Canyon 20 Wilderness 20% Worst Days

Based on the 2002 20% worst days from IMPROVE monitoring data, the largest contribution of visibility impairment was from nitrate at 50% followed by organic mass carbon at 27% and sulfate at 14%, as shown in Figure 7-11. Nitrate and sulfate accounted for roughly 64% of light impairment.

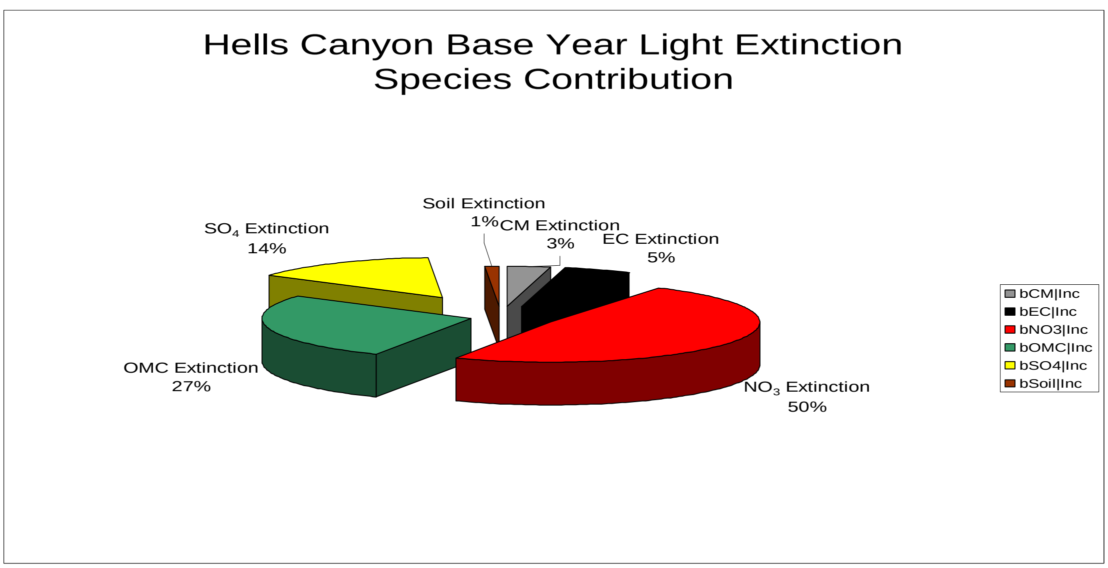

Figure 7-11. Hells Canyon Wilderness, 2002 Light Extinction 20% Worst Days

A review of Figures 7-12 and 7-13 provides additional evidence that sulfate and nitrate when combined were the largest contributors during the base years. It also appears 2002 is generally representative of the base years although nitrate was a little lower in 2002 than other base years.

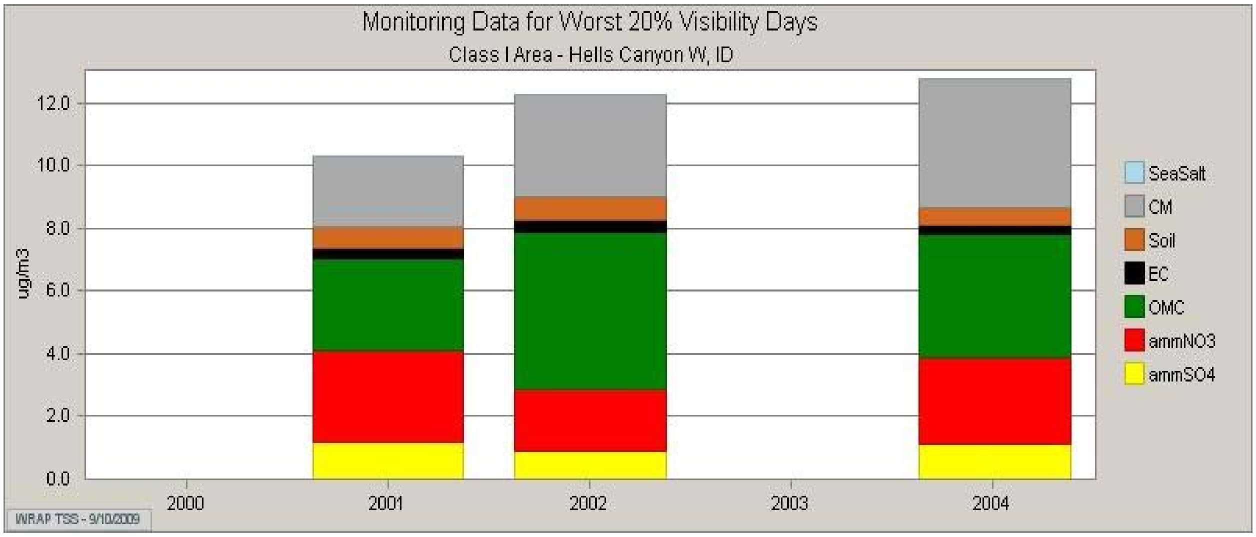

Figure 7-12. Hells Canyon Wilderness, Annual 2000-2004 Pollutant Species Concentrations 20% Worst Days

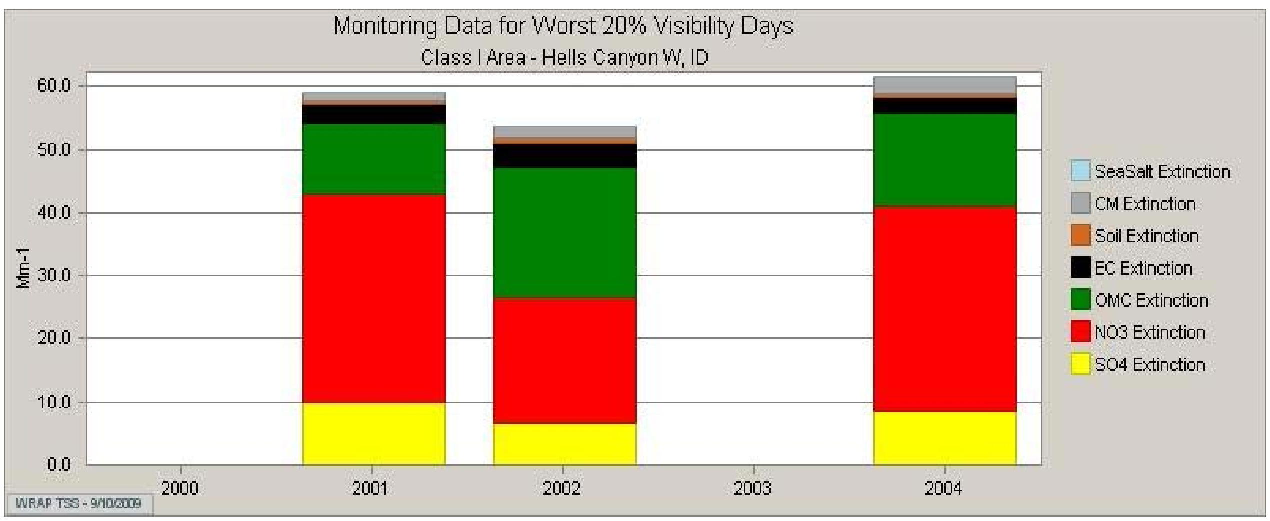

Figure 7-13. Hells Canyon NM, Annual 2000-2004 Pollutant Species Light Impairment 20% Worst Days

Looking at all of the IMPROVE sampled days as shown in Figure 7-14 it appears that nitrate and sulfate were highest in Hells Canyon during the months from November through February.

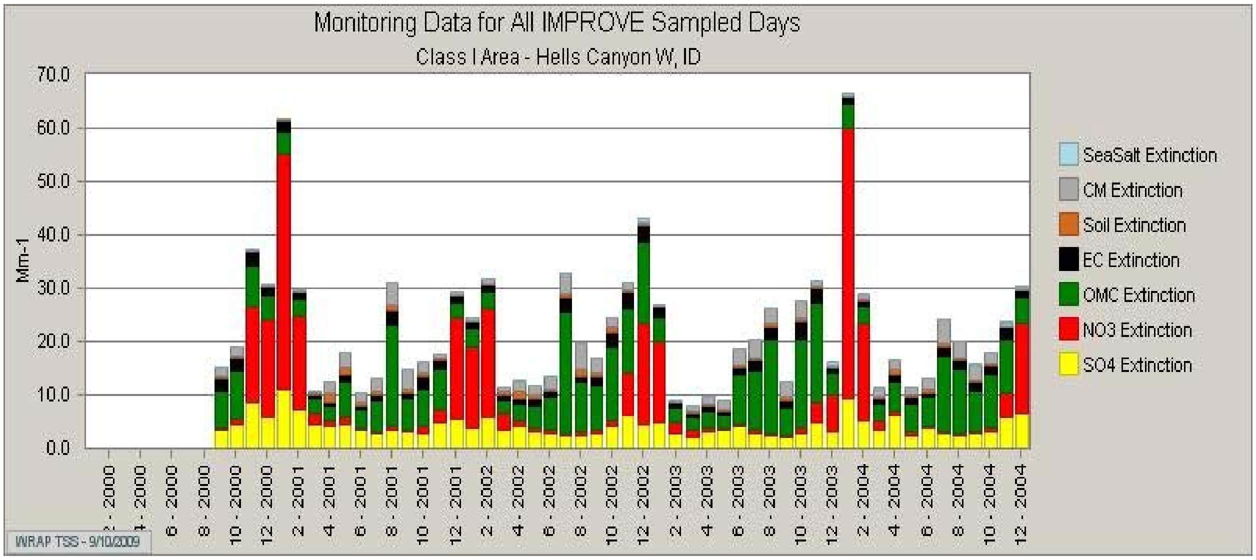

Figure 7-14. Hells Canyon Wilderness, Monthly 2000-2004 Pollutant Species Concentrations IMPROVE Sampled Days

Separating the IMPROVE monitoring days and looking only at the monthly 20% worst days as shown in Figure 7-15, the peak season for nitrate appears to have been December through January. It also appears that sulfate spikes in the winter and organic mass carbon spikes occurred during the summer months.

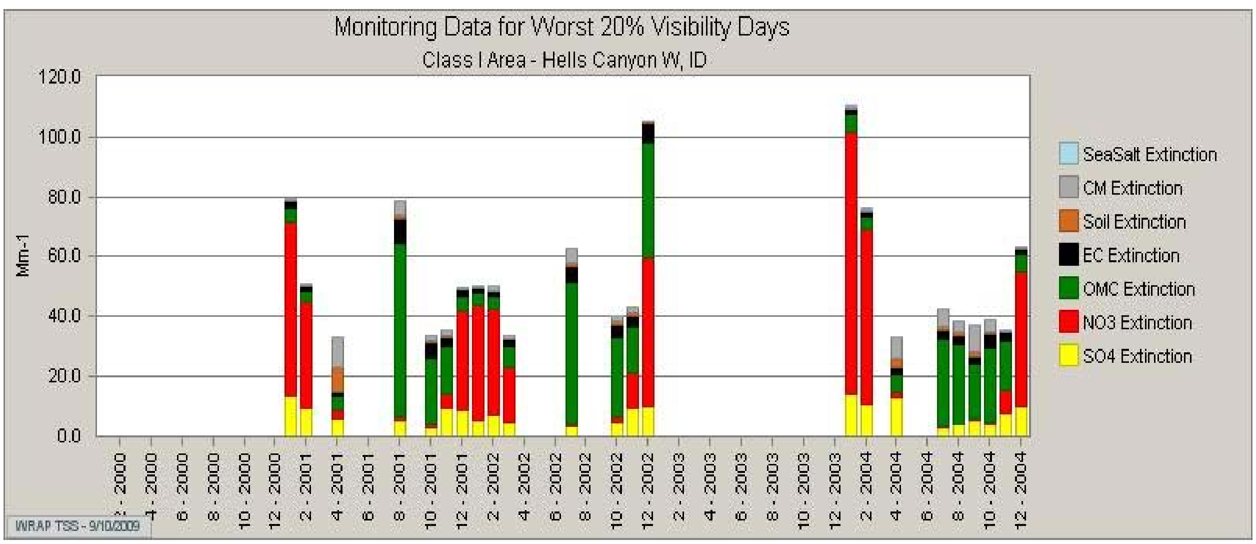

Figure 7-15. Hells Canyon Wilderness, Monthly 2000-2004 Pollutant Species Concentrations 20% Worst Days

When the 20% worst days are separated out to look at nitrate and sulfate, the pattern becomes even more apparent as shown in Figure 7-16.

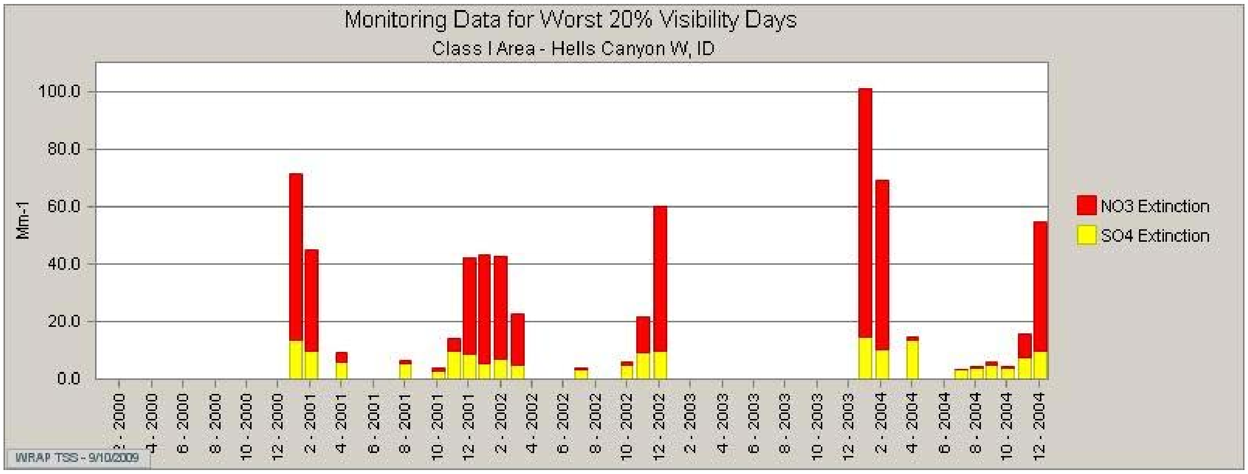

Figure 7-16. Hells Canyon Wilderness, Monthly 2000-2004 NO3 and SO4 Visibility Impairment 20% Worst Days

7.3.2 Hells Canyon Wilderness 20% Best Days

The breakout of the 2002 20% best days by pollutant species shows that compared with the 20% worst days there was a decrease in the contribution coming from nitrate and an increase coming from organic mass carbon. Both figure 7-17 and 7-18 portray this change in contributions.

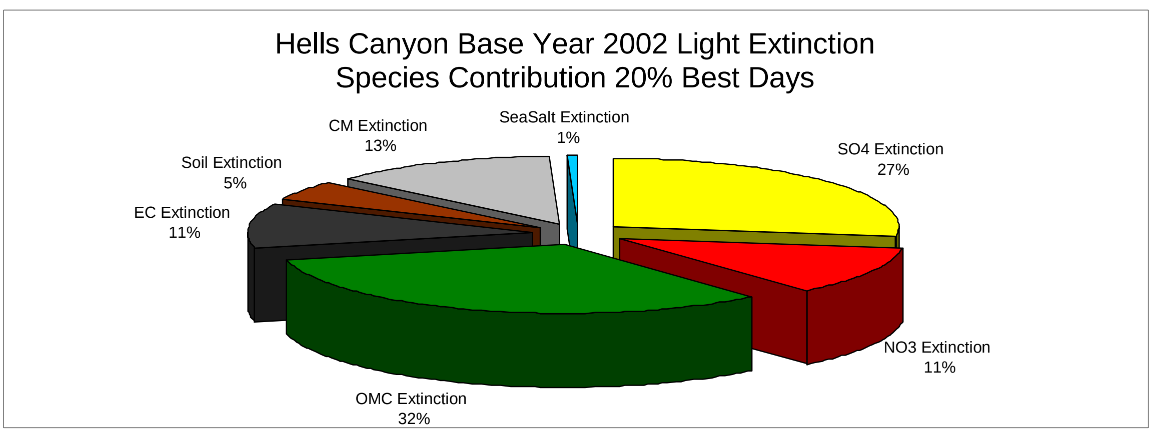

Figure 7-17. Hells Canyon Wilderness 2002 Light Extinction 20% Worst Days

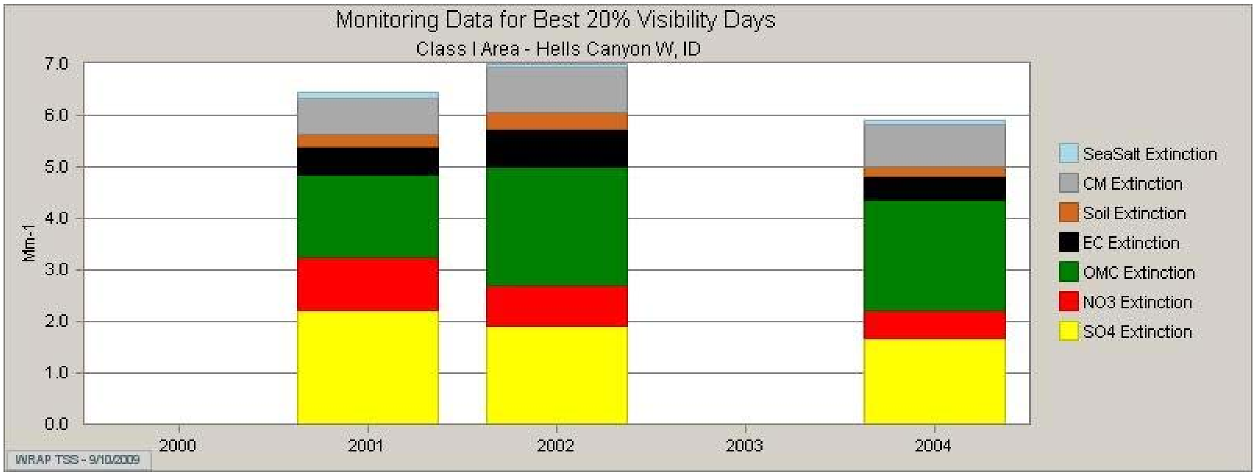

Figure 7-18. Hells Canyon Wilderness Annual 2000-2004 Pollutant Species Visibility Impairment 20% Best Days

Figure 7-19 shows Hells Canyon Wilderness had a baseline year visibility impairment of 58.14Mm-1. In order to follow the uniform rate of progress, a 2.4-deciview improvement in visibility impairing pollutants will be needed by 2018 and a 10.3 deciview improvement will be needed to reach the natural conditions goal by 2064.

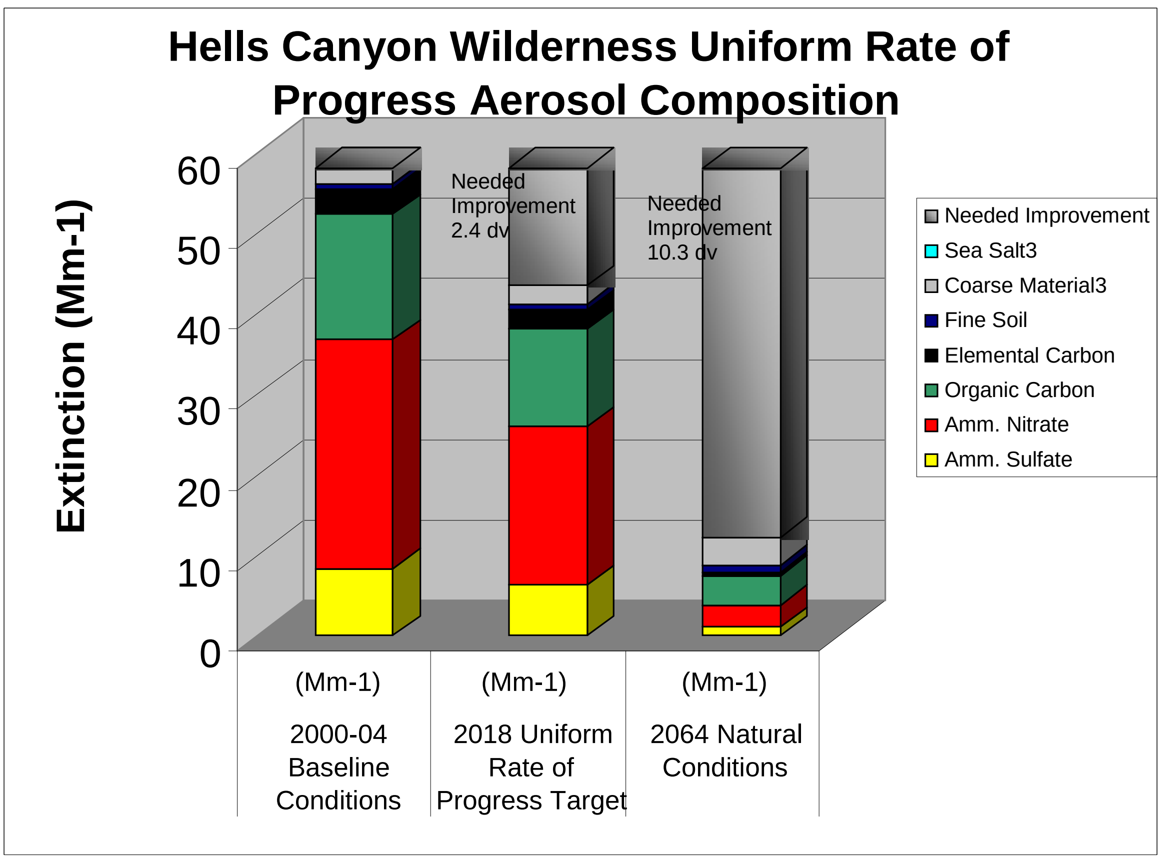

Figure 7-19. Hells Canyon Wilderness Aerosol Light Extinction Baseline (2000-2004), 2018 Target, 2064 Goal

7.4 Sawtooth Wilderness Area

7.4.1 Sawtooth Wilderness 20% Worst Days

As figure 7-20 depicts, in 2002 the largest contribution to visibility impairment to the 20% worst days in the Sawtooth Wilderness was organic mass carbon at 69%. Typically, organic mass carbon is attributed to fire activity. The two pollutants with the greatest influence from man-made pollutants was sulfate and nitrate which only accounted for 9% of the visibility impairment on the 20% worst days in the Sawtooth Wilderness.

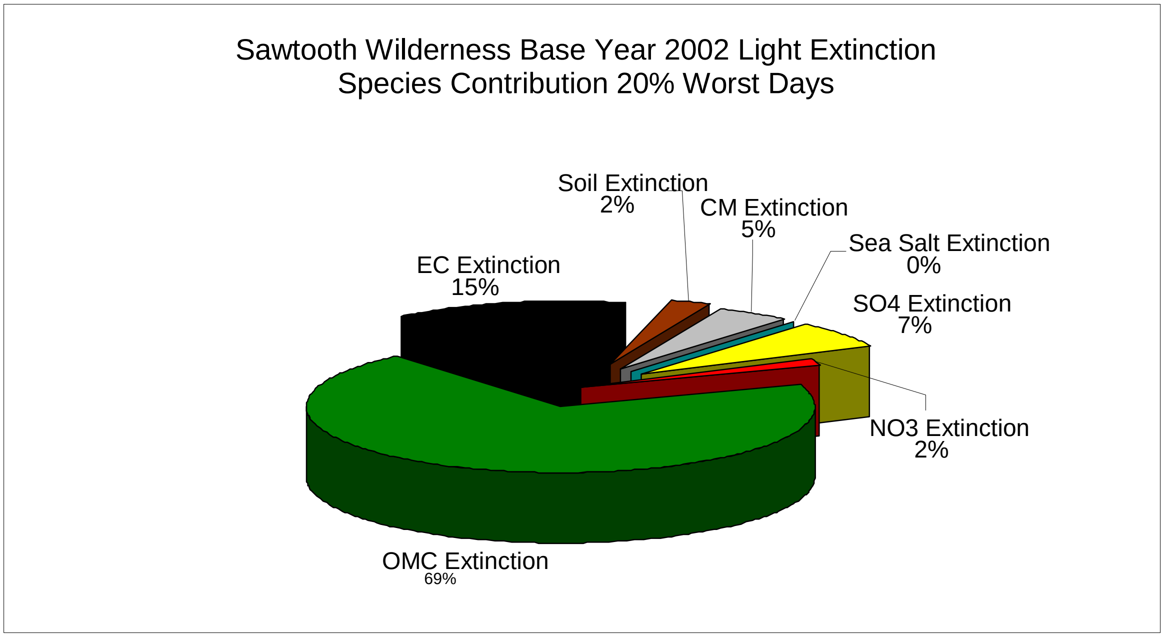

Figure 7-20 Sawtooth Wilderness 2002 Light Extinction 20% Worst Days

Organic mass carbon, nitrate, and sulfate concentrations were fairly consistent in the years 2001 through 2004. There was a slight variation in concentrations of elemental carbon, fine soil, and coarse mass as shown in Figure 7-21. The greatest concentrations are attributed to organic mass carbon for all five-years.

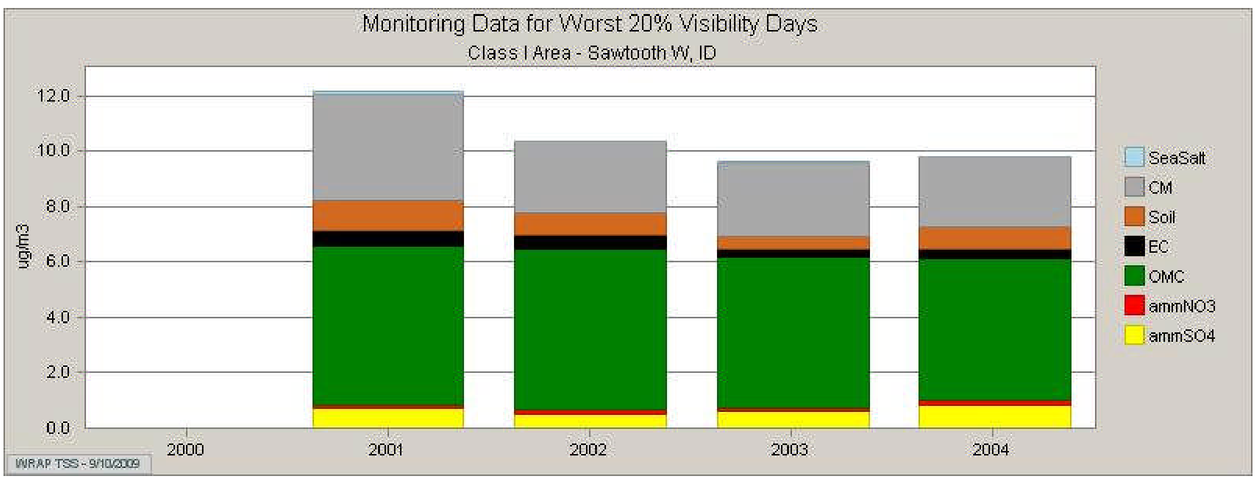

Figure 7-21 Sawtooth Wilderness Annual 2000-2004 Pollutant Species Concentrations 20% Worst Days

Figure 7-22 shows a greater variation in light-absorbing visibility impacts from elemental carbon than organic carbon. Elemental carbon is usually associated with the burning of fossil fuels and other organic materials.

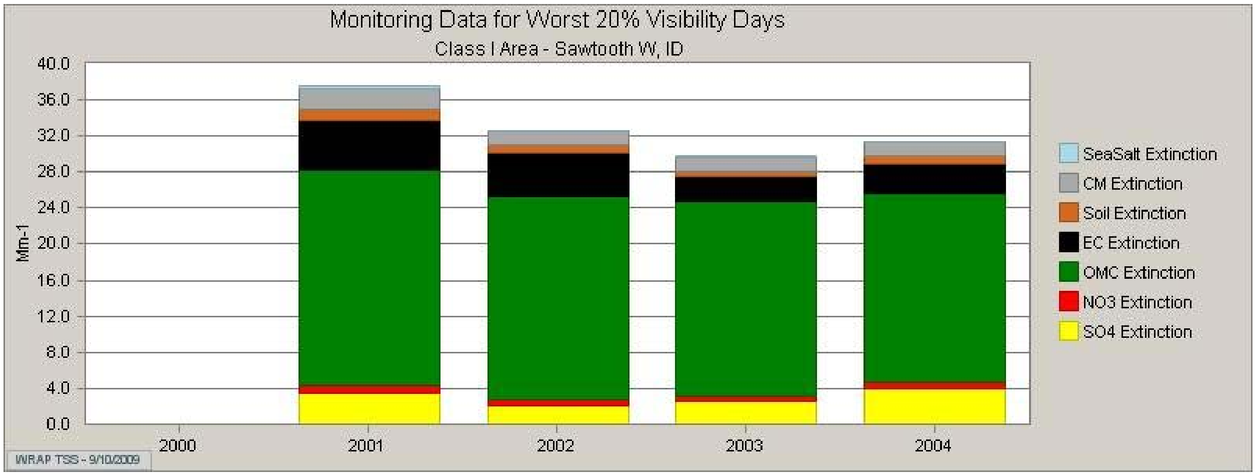

Figure 7-22. Sawtooth Wilderness Annual 2000-2004 Pollutant Species Light Impairment 20% Worst Days

The visibility impact of the various pollutants is highlighted in Figure 7-23. Organic mass carbon stands out distinctively as the largest contributor to visibility impairment and seems to have been in a slight downward trend. This downward trend may be due to a decline in local fires compared with the base year period but caution should be used when looking at this trend because of the cyclic nature of wild fire. Because organic mass carbon is such a large contributor in the Sawtooth Wilderness, it is important to identify whether the source is strictly wild fire or whether there are sources outside the normal fire season contributing to the problem.

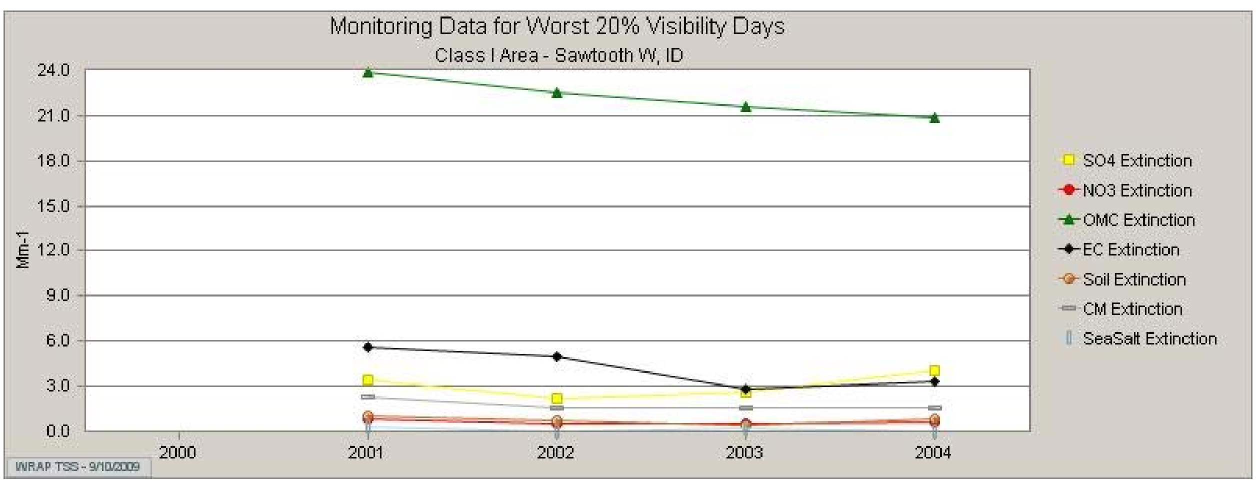

Figure 7-23. Sawtooth Wilderness Annual 2000-2004 Visibility Impairment by Pollutant Species 20% Worst days

The other pollutants all seem to be trending fairly flat. Nitrate and sulfate had both slight increases and slight decreases during the time period and they seem to be trending together. Overall elemental carbon was trending downward.

When looking at all the IMPROVE sampled days in Figure 7-24, the large spikes in organic coarse mass are typical of wildfire activity.

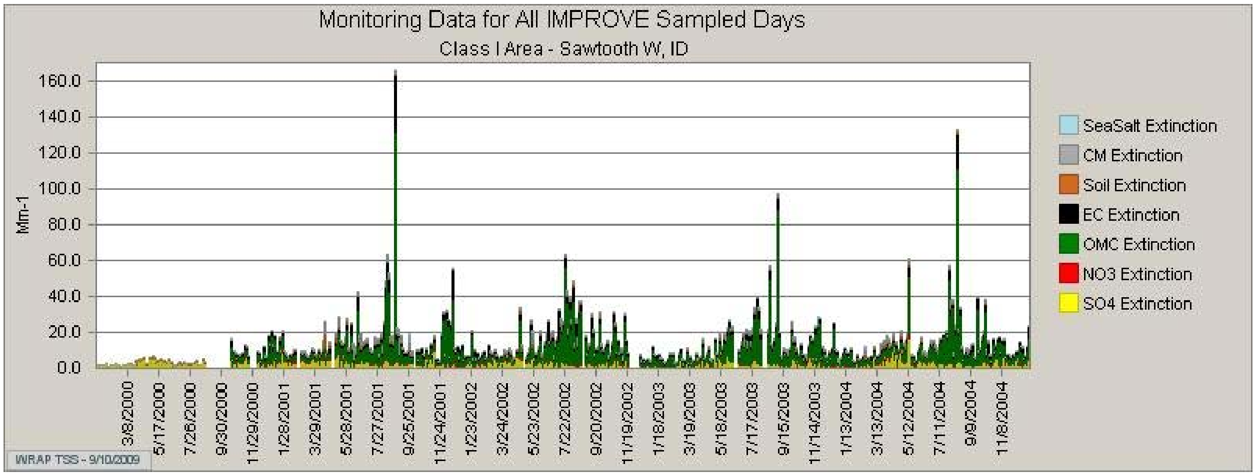

Figure 7-24. Sawtooth Wilderness, 2000-2004 Pollutant Species Visibility Impairment, All IMPROVE Monitoring Days

Looking at all the IMPROVE sampled days it is hard to determine whether fire activity is happening outside what would be considered fire season. By looking at the monthly 20% worst days, a different scenario begins to appear. Figure 7-25 shows significant organic mass carbon during the winter months of November and December and a sharp decline in January and February. While the fire season may last into the late fall it is typically gone during the first snows and late fall rain season. Because organic mass carbon appears to remain steady into the early winter, there may be localized slash burning or wood stoves. This is something that will require further investigation during this Regional Haze SIP planning period.

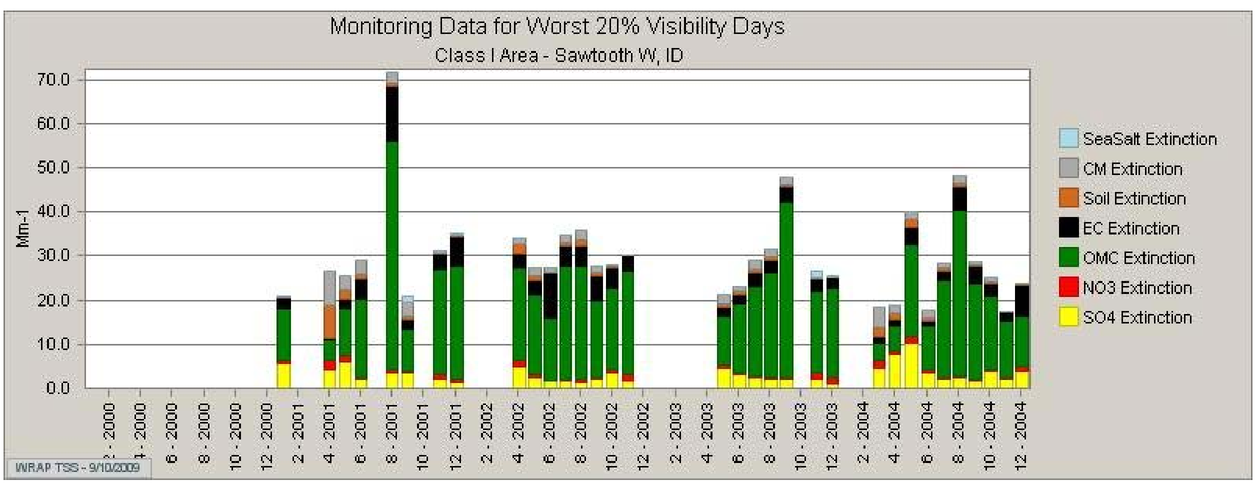

Figure 7-25. Sawtooth Wilderness Monthly 2000-2004 Pollutant Species Visibility Impairment 20% Worst Days

By separating out the organic mass carbon from the other pollutants in Figure7-26, a cyclic picture becomes clearer. The spikes occur during the summer months and decline into the fall but stay steady until January and then drop off dramatically.

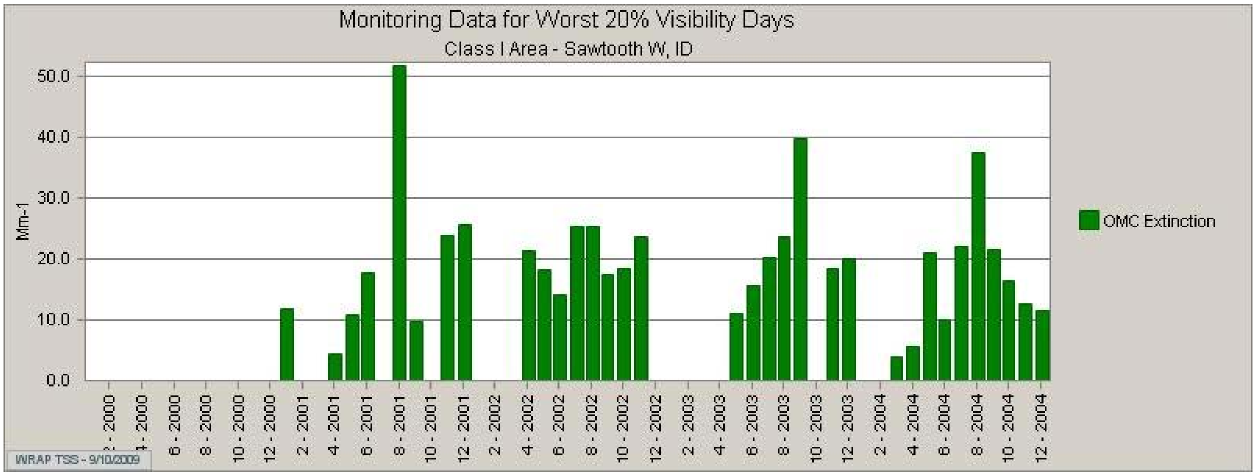

Figure 7-26 Sawtooth Wilderness Monthly 2000-2004 Organic Mass Carbon Visibility Impairment 20% Worst Days

The picture is different for nitrate and sulfate than for organic carbon. These two pollutants seem to rise rapidly in April and May and then decline into the fall. This may be due to weather patterns or mobile and sources within a relative close distance to the airshed. Figure 7-27 shows this trend and also shows that nitrate doesn't always track directly with sulfate which was the larger contributor to visibility impairment.

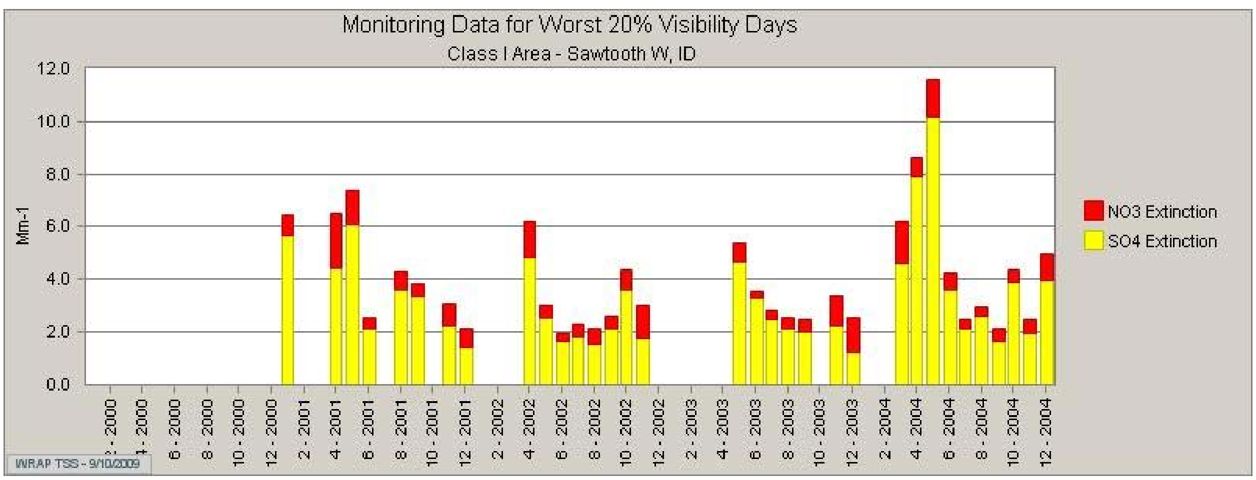

Figure 7-27 Sawtooth Wilderness Monthly 2000-2004 NO3 and SO4 Visibility Impairment 20% Worst Days

7.4.2 Sawtooth Wilderness 20% Best Days

When looking at the 20% best days, it appears that organic mass carbon was less of an influence but it still accounts for 46% of the total visibility impairment in 2002. Because sulfate and nitrate account for over 30% of the visibility impairment in 2002, improvement in the levels of these typically man-made pollutants for the 20% worst days will also improve and maintain visibility during the 20% best days. It will also be important to see whether there are man-made contributions to the organic mass carbon levels that can be reduced. Figure 7-28 depicts the contribution from each species in 2002.

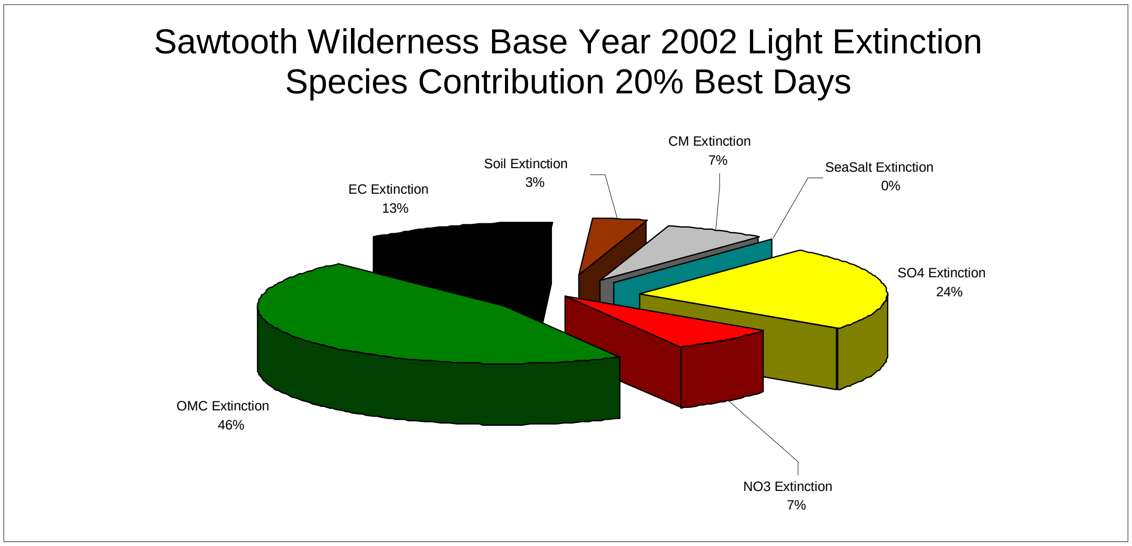

Figure 7-28. Sawtooth Wilderness 2002 Light Extinction 20% Best Days

Figure 7-29 shows the annual variation of visibility-impairing pollutant species over the base time period of 2001 through 2004. There is a variation in organic mass carbon and sulfate.

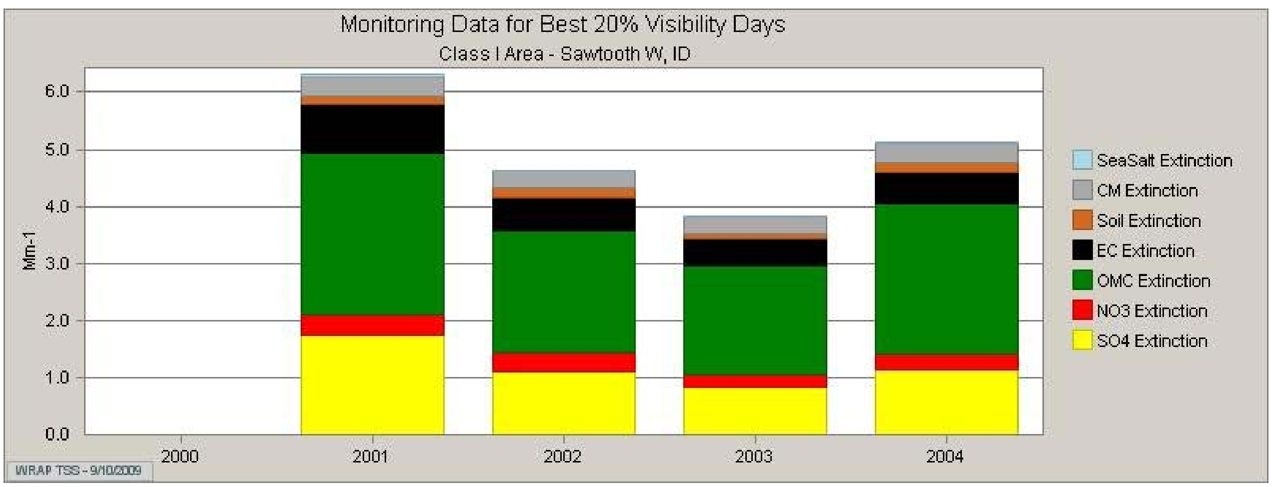

Figure 7-29. Sawtooth Wilderness Annual 2000-2004 Pollutant Species Light Impairment 20% Best Days

Figure 7-30 shows the base period average pollutant impact of 34Mm-1 with a needed improvement in visibility of 1.72dv by 2018 in accordance with the uniform rate of progress and a total improvement of 7.32dv needed by 2064 to meet the natural conditions goal.

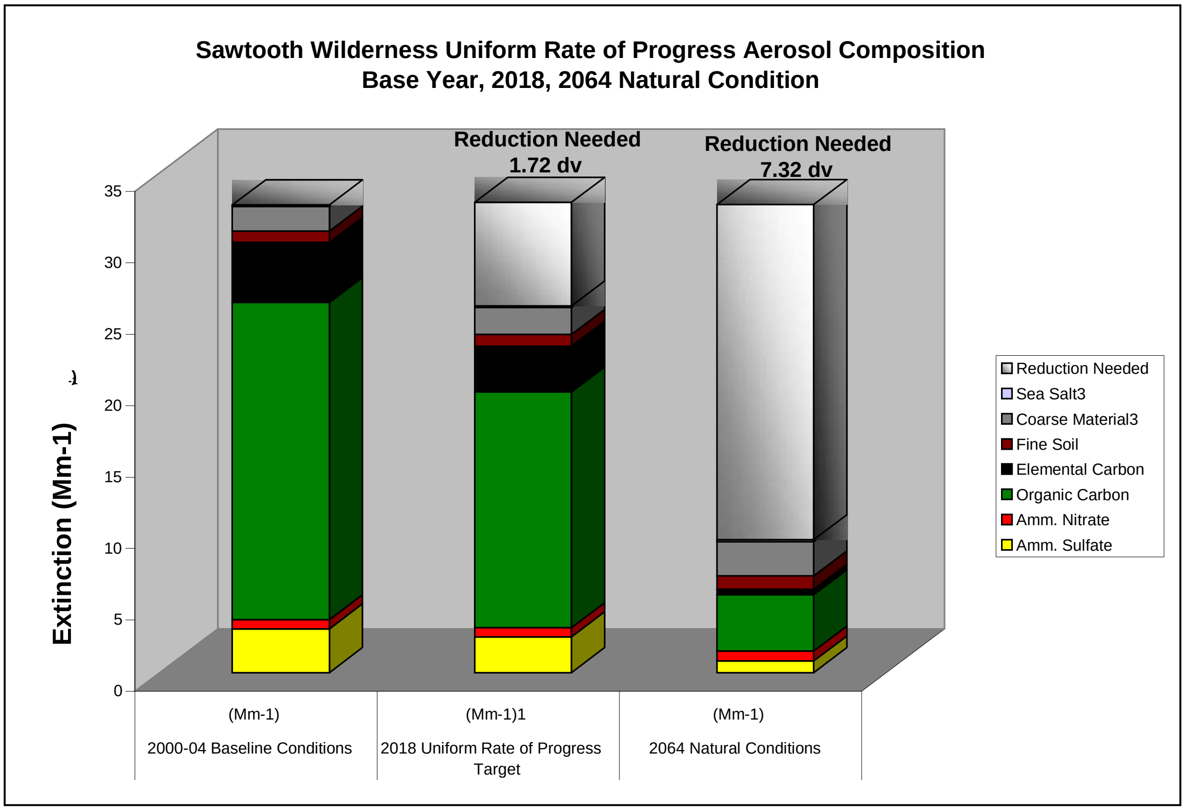

Figure 7-30. Sawtooth Wilderness Aerosol Light Extinction Baseline (2000-2004), 2018 Target, 2064 Goal

7.5 Selway-Bitterroot Wilderness Area

7.5.1 Selway-Bitterroot Wilderness 20% Worst Days

Much like the Sawtooth Wilderness, visibility in the Selway-Bitterroot Wilderness is predominantly impacted by organic mass carbon. Figure 7-31 shows 52% of the visibility impairment in 2002 was attributable to organic mass carbon. Twenty-six percent of the visibility impairment can be attributed to the combination of sulfate (19%) and nitrate (7%).

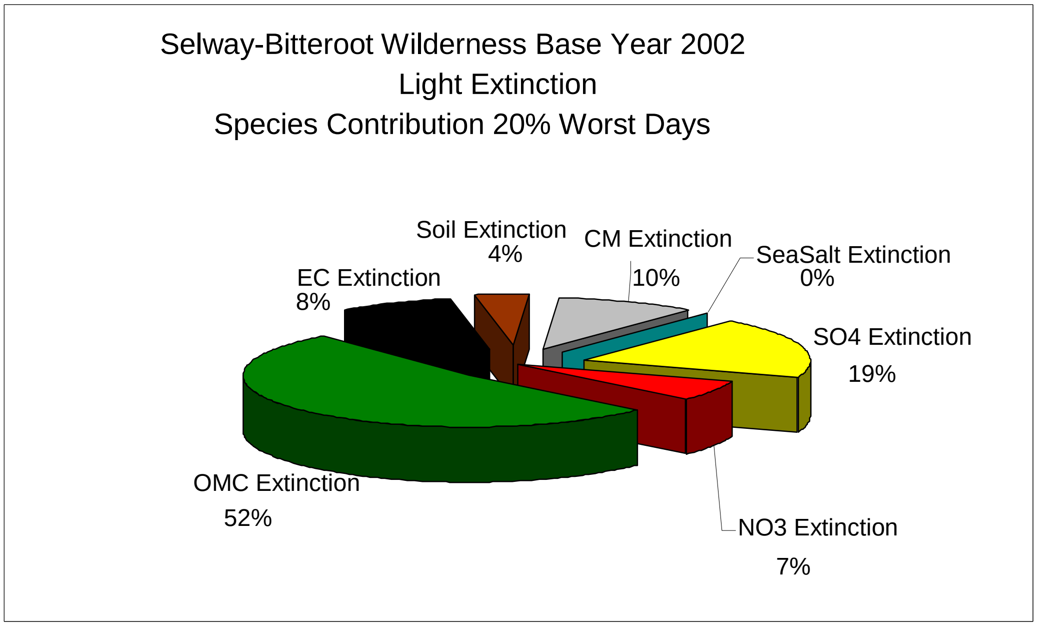

Figure 7-31. Selway-Bitterroot Wilderness, 2002 Light Extinction 20% Worst Days

Coarse mass and organic mass carbon show the greatest variation over the five-year baseline time period of 2001 through 2004. As Figure 7-32 displays, nitrate and sulfate concentrations remain relatively constant. Although the contribution of fine soil is relatively small, it does vary over the time period.

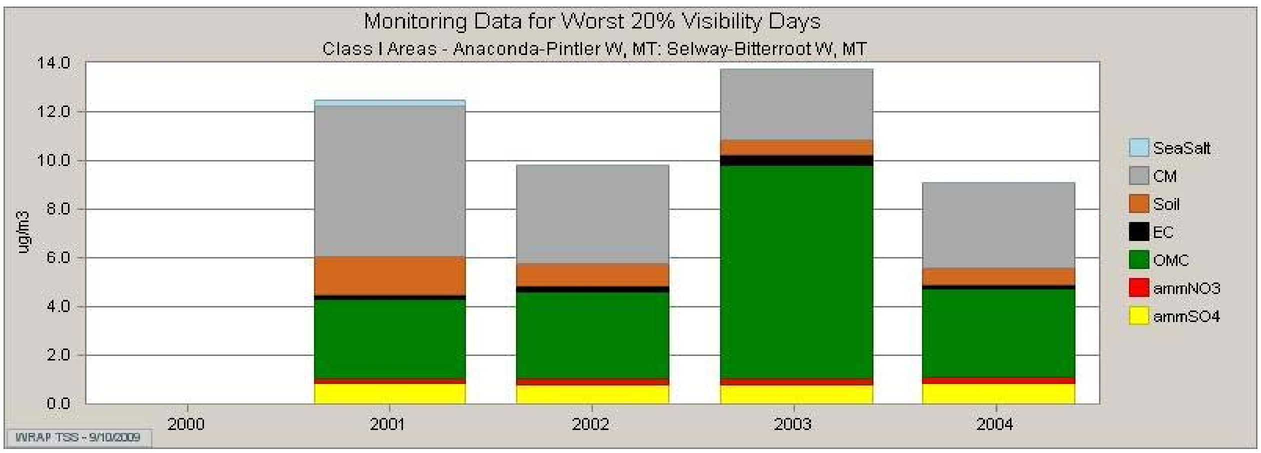

Figure 7-32. Selway-Bitterroot Wilderness Annual 2000-2004 Pollutant Species Concentrations 20% Worst Days

Moving from concentration levels to visibility impacts, the variation in organic mass carbon becomes more dramatic while the impacts from coarse mass become less dramatic. The visibility impact from fine soil is almost non-existent. And as Figure 7-33 shows, the visibility impacts from nitrate and sulfate remained fairly constant but did contribute a minimal combined amount of roughly 5Mm-1.

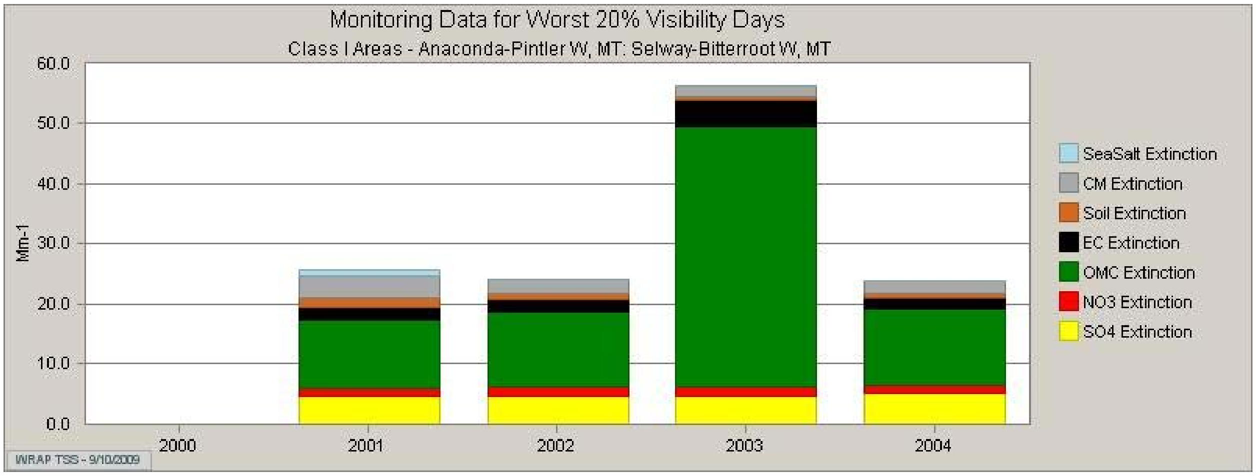

Figure 7-33. Selway-Bitterroot Wilderness Annual 2000-2004 Pollutant Species Light Impairment 20% Worst Days

By separating out the visibility-impairing pollutant species, the variation and impacts of each species can be seen to be more pronounced. The visibility impact from organic mass carbon was fairly flat with an impact of roughly 12Mm-1 in 2001, 2002, and 2004 but spiked to over 40Mm-1 in 2003. Sulfate, nitrate, elemental carbon, coarse matter, and soil were relatively flat and all contributed less than 5Mm-1. Figure 7-34 shows these changes over time.

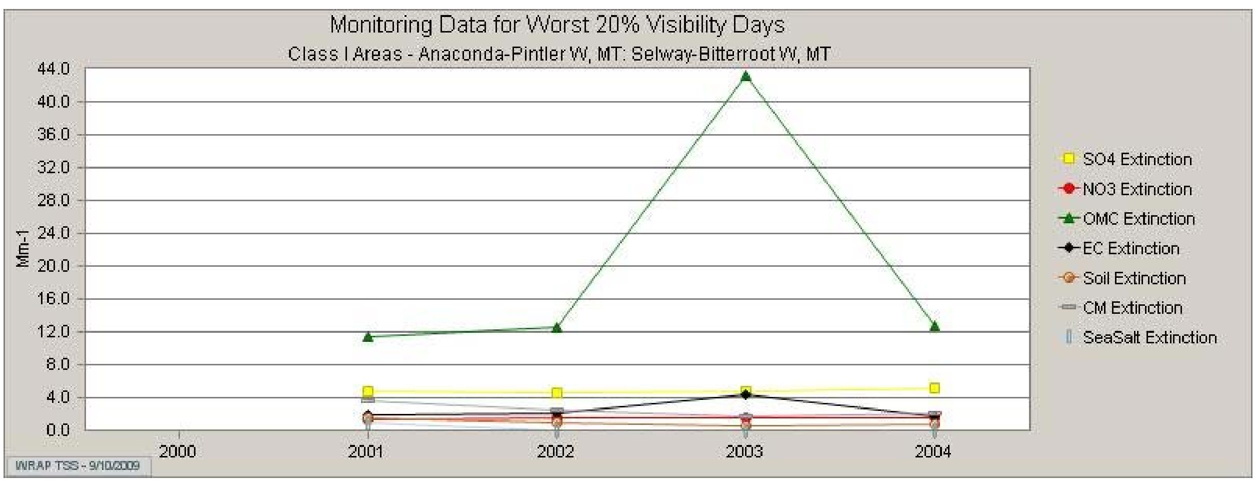

Figure 7-34. Selway-Bitterroot Wilderness Annual 2000-2004 Visibility Impairment by Pollutant Species 20% Worst days

Figure 7-35 displays the visibility impacts of all the IMPROVE sample days over the base period of 2000 through 2004. The huge spikes in 2000 and 2003 show a strong organic mass carbon signature attributed to fire events. This would explain the spike in organics in 2003. Everything else is dwarfed by the fire signature which spiked to over 400Mm-1 in 2000 although typically the highest impacts are below 50Mm-1. This scale makes it virtually impossible to see any trends in other visibility-impairing constituents.

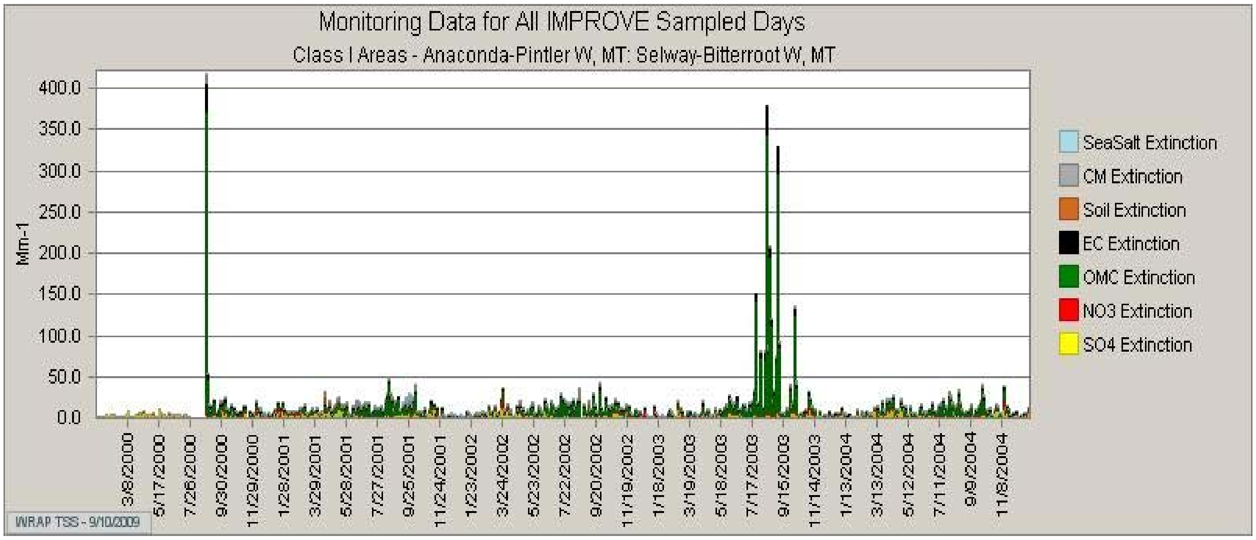

Figure 7-35. Selway-Bitterroot Wilderness, 2000-2004 Pollutant Species Visibility Impairment All IMPROVE Monitoring Days

Looking at the monthly trends over the base time period begins to show some trends with spikes in organic mass carbon over the summer time which coincides with the wild fire season. As Figure 7-36 displays, the scale due to organic carbon makes other trends difficult to see.

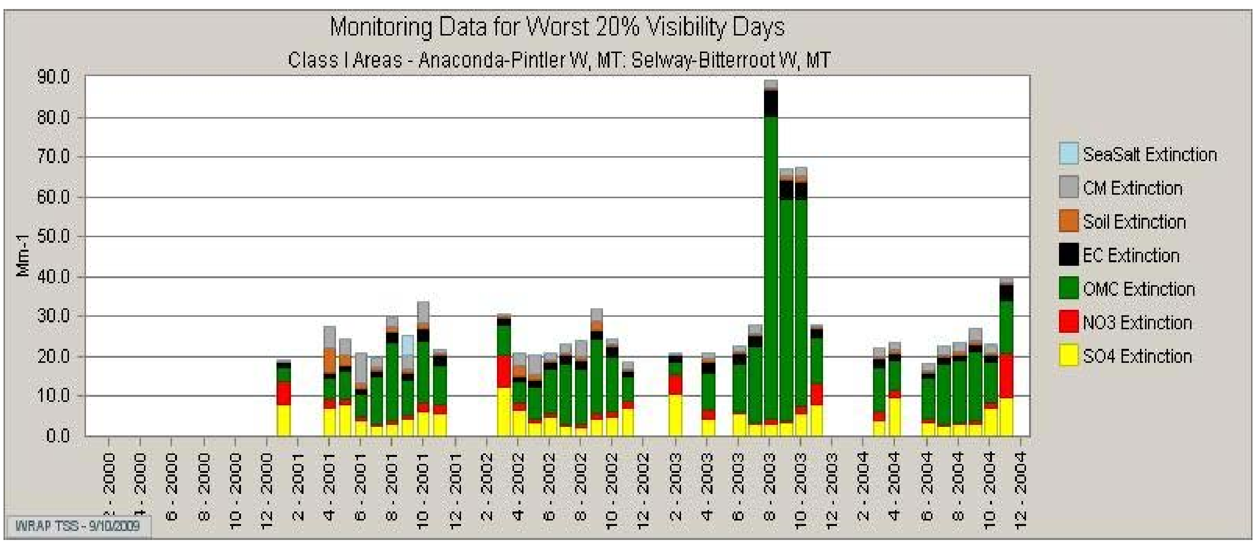

Figure 7-36. Selway Bitterroot Wilderness Monthly 2000-2004 Pollutant Species Visibility Impairment 20% Worst Days

By focusing on organic mass carbon as shown in Figure 7-37, it appears the raise and fall of visibility impairment over the summer months coincided with fire season and it doesn't appear there were activities other than wild fire and slash burning season contributing to the impacts from organic mass carbon.

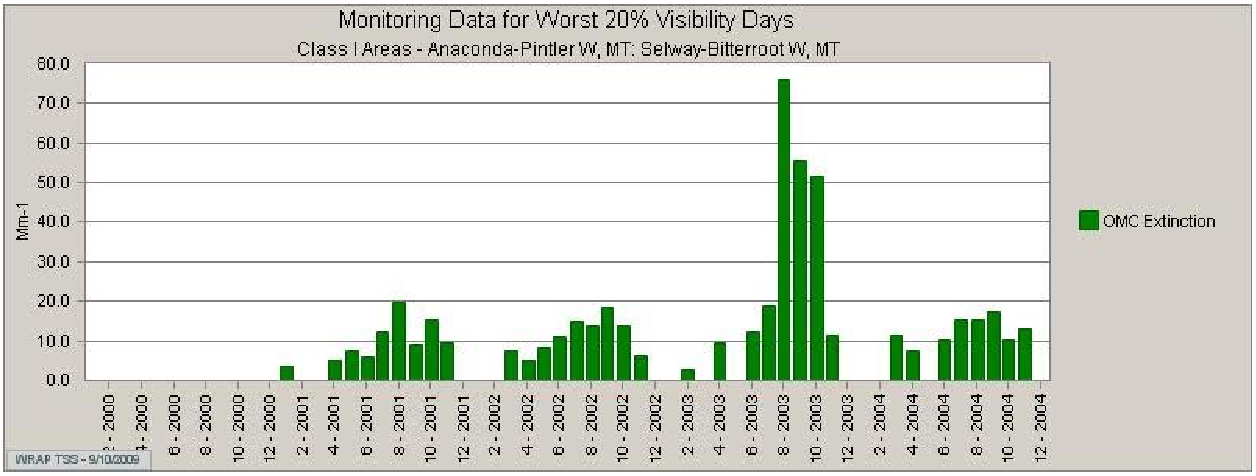

Figure 7-37. Selway Bitterroot Wilderness Monthly 2000-2004 Organic Mass Carbon Visibility Impairment 20% Worst Days

Nitrate and sulfate as shown in Figure 7-38 showed a u-shaped annual trend with the highs occurring during mid-winter and early spring and tapering off in the middle of the summer. This may be due to weather patterns or source activity in or near the airshed.

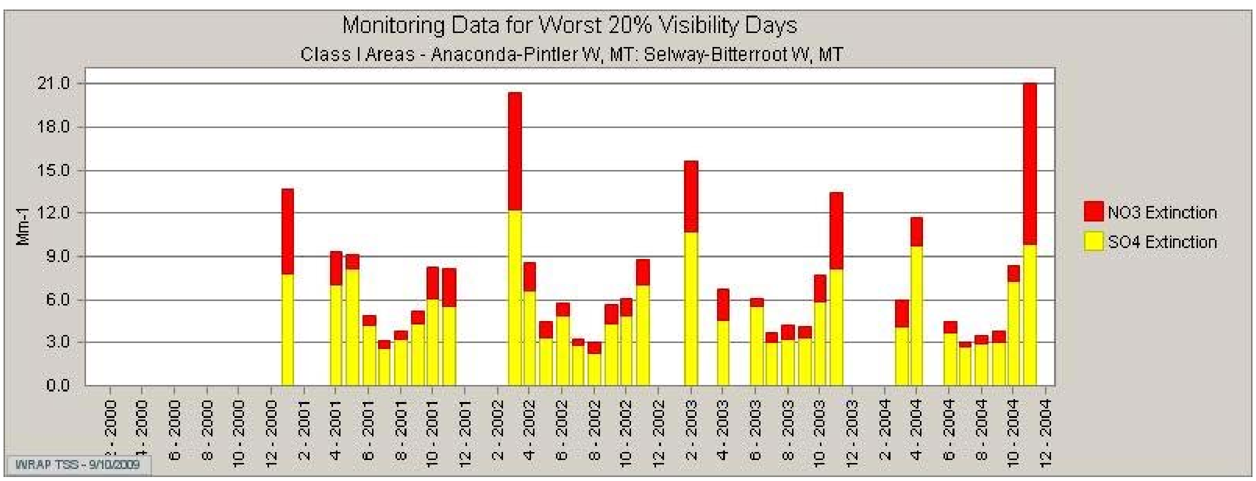

Figure 7-38. Selway-Bitterroot Wilderness Monthly 2000-2004 NO3 and SO4 Visibility Impairment 20% Worst Days

7.5.2 Selway Bitterroot Wilderness 20% Best Days

As displayed in Figure 7-39, the visibility impacts during the 20% best days in the Selway-Bitterroot showed a greater impact from sulfate and nitrate and less but still substantial impact from organic coarse mass in 2002. Reductions in nitrate and sulfate should improve both the best and worst days.

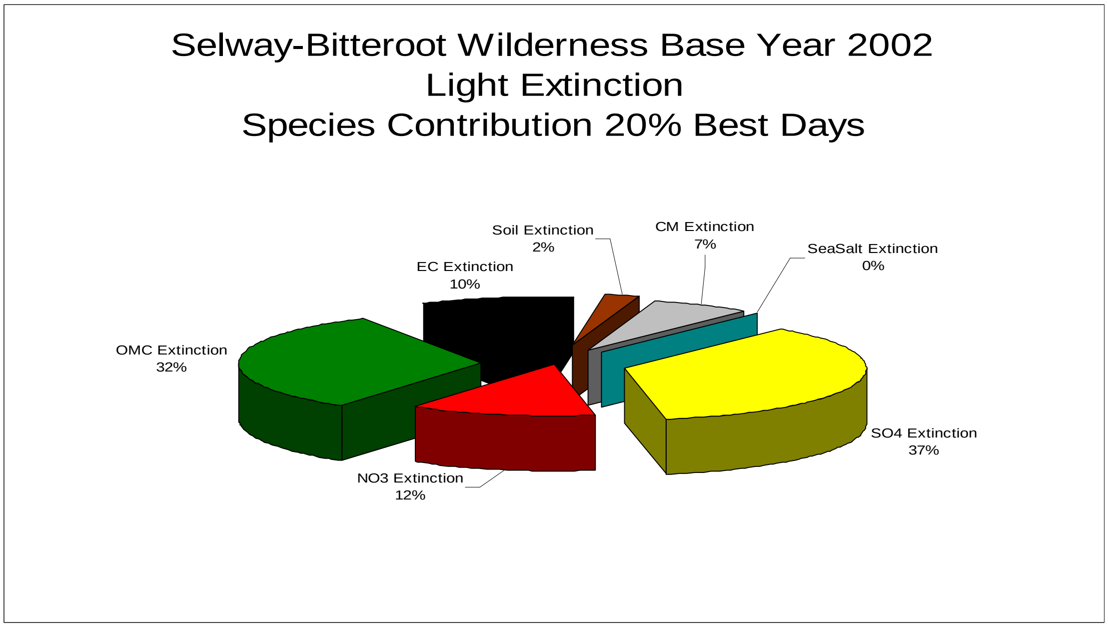

Figure 7-39. Selway-Bitterroot Wilderness 2002 Light Extinction 20% Best Days

Reductions in nitrate and sulfate should improve both the best and worst days. Figure 7-40 shows that 2002 appears to be representative of most other base years with the exception of 2003 which shows less impact from all visibility-impairing pollutants.

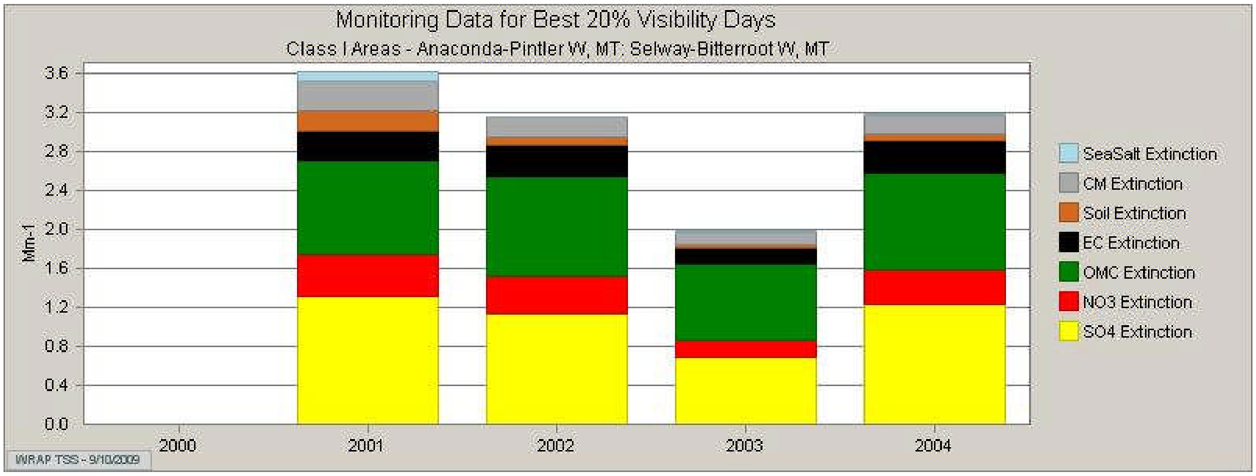

Figure 7-40 Selway-Bitterroot Wilderness Annual 2000-2004 Pollutant Species Light Impairment 20% Best Days

Figure 7-41 shows the base period average pollutant impact of 32.5Mm-1 with a needed improvement in visibility of 1.39dv by 2018 to stay in accord with the uniform rate of progress and a total improvement of 5.98dv needed by 2064 to meet natural conditions.

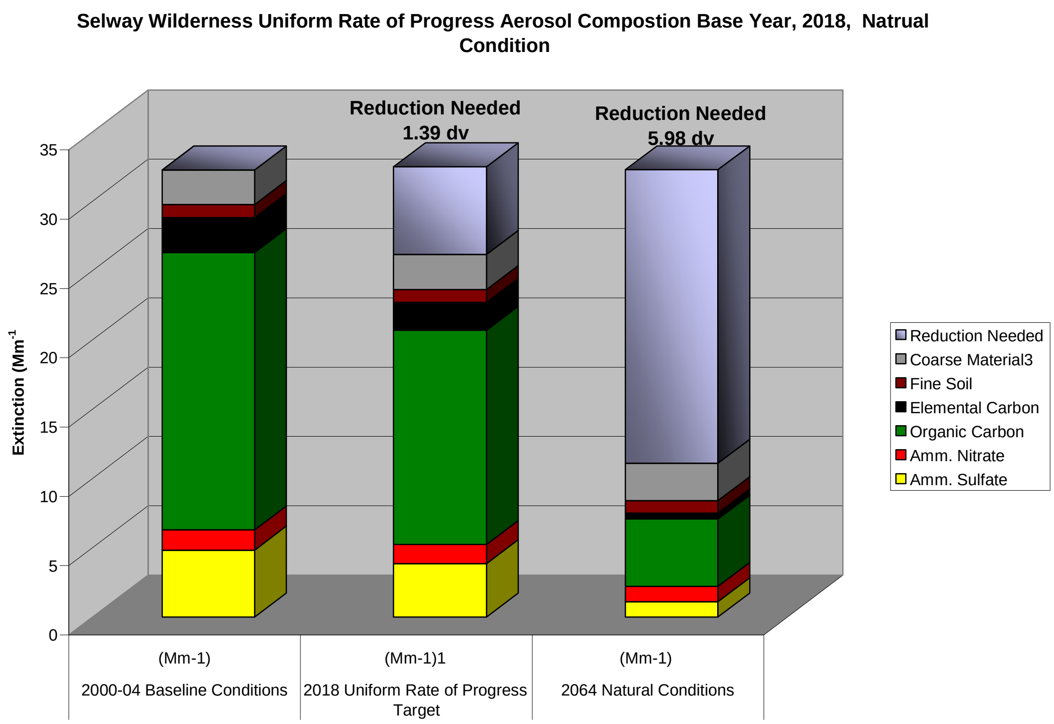

Figure 7-41 Selway-Bitterroot Wilderness Aerosol Light Extinction, Baseline (2000-2004), 2018 Target, 2064 Goal

7.6 Yellowstone National Park

7.6.1 Yellowstone National Park Worst 20% Days

Yellowstone National Park had a visibility impact of 49% from organic mass carbon in 2002, as shown in Figure 7-42. Sulfate (17%) and nitrate (7%) were 24% of the impact on visibility in 2002. This is very similar to conditions in the Sawtooth and Selway-Bitterroot Wildernesses but with slightly less nitrate. Coarse matter was slightly higher in Yellowstone than in these other two Class I areas.

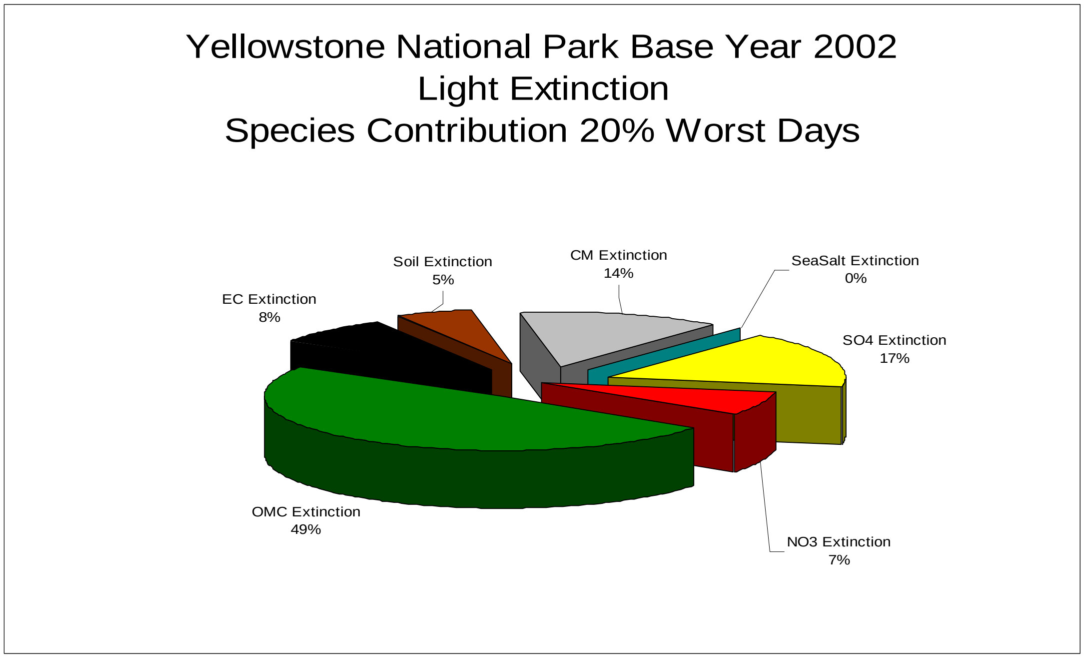

Figure 7-42. Yellowstone National Park 2002 Light Extinction 20% Worst Days

Figure 7-43 shows fairly consistent nitrate and sulfate over the base year period of 2000 through 2004. The greatest variability appears to have been in the concentrations of coarse matter.

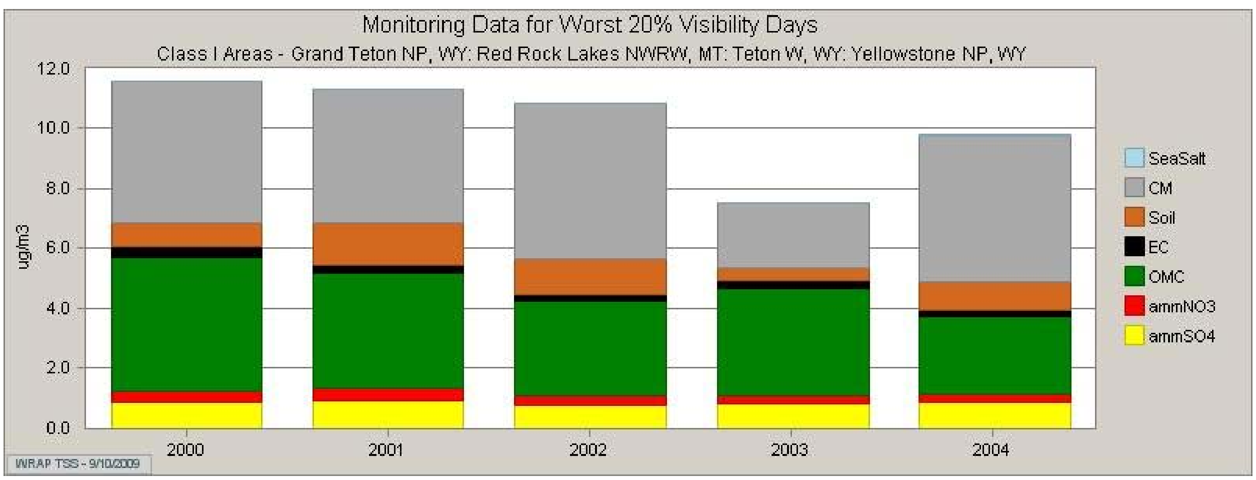

Figure 7-43. Yellowstone National Park Annual 2000-2004 Pollutant Species Concentrations 20% Worst Days

As seen in Figure 7-44, the impacts from the concentrations of coarse matter are less apparent when looking at the visibility impacts. The smaller variations in concentrations of elemental carbon and organic matter carbon become more apparent when looking at the visibility impairment associated with those pollutants. Nitrate and sulfate seem to have been trending a little above or below 6Mm-1 over the time period. Overall, visibility impairment seemed to be getting better over time and 2002 seems to have been about average of the years represented.

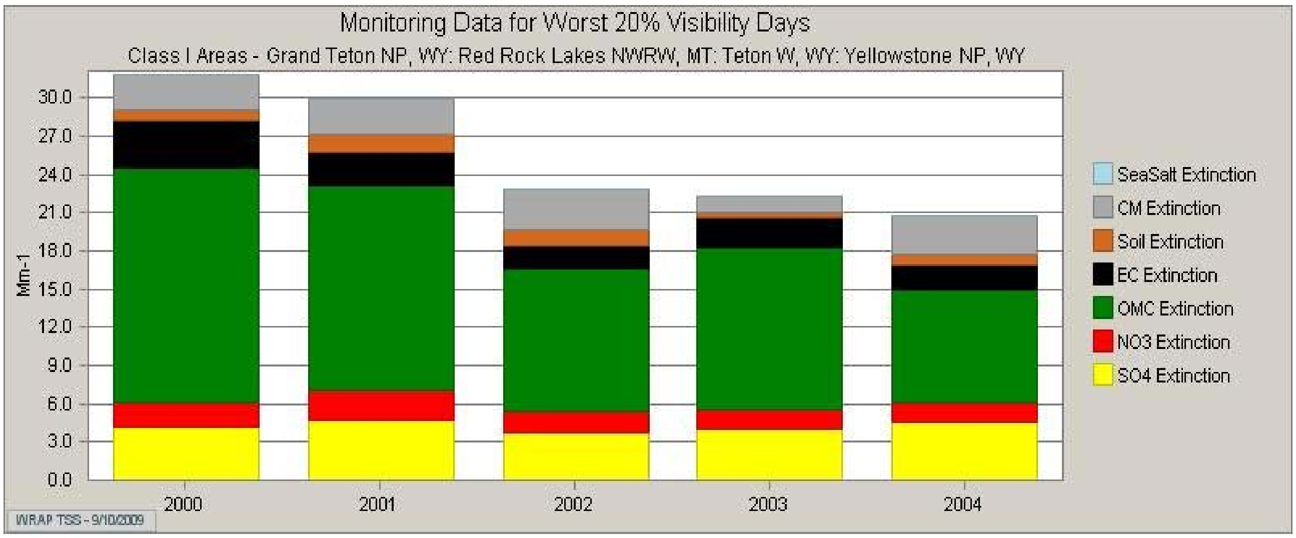

Figure 7-44. Yellowstone National Park Annual 2000-2004 Pollutant Species Light Impairment 20% Worst Days

Figure 7-45 shows the greatest reduction over the time period was from organic mass carbon. This may be misleading because organic mass carbon is usually associated with fire and the cyclic nature of fire is hard to predict. All of the other visibility-impairing pollutants appear to have been relatively flat with a change of only 1 or 2Mm-1 over the time period.

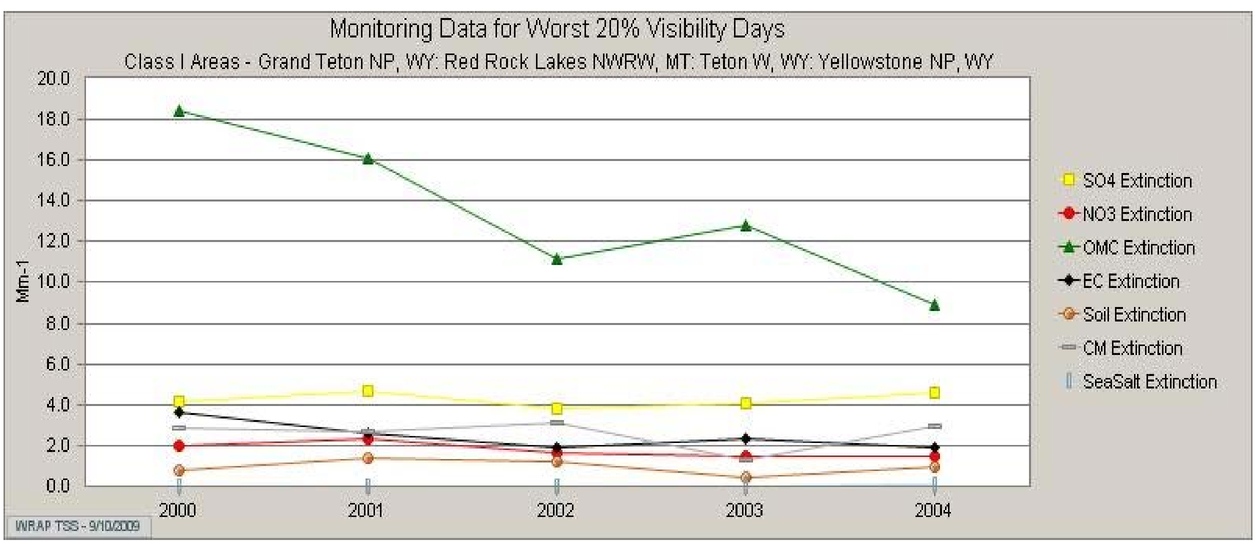

Figure 7-45. Annual 2000-2004 Yellowstone National Park Visibility Impairment by Pollutant Species 20% Worst Days

The greatest variability in the 20% worst days can be seen when looking at all the IMPROVE modeling days that show strong spikes in organic mass carbon during the summer months. All other visibility-impairing pollutants are dwarfed.

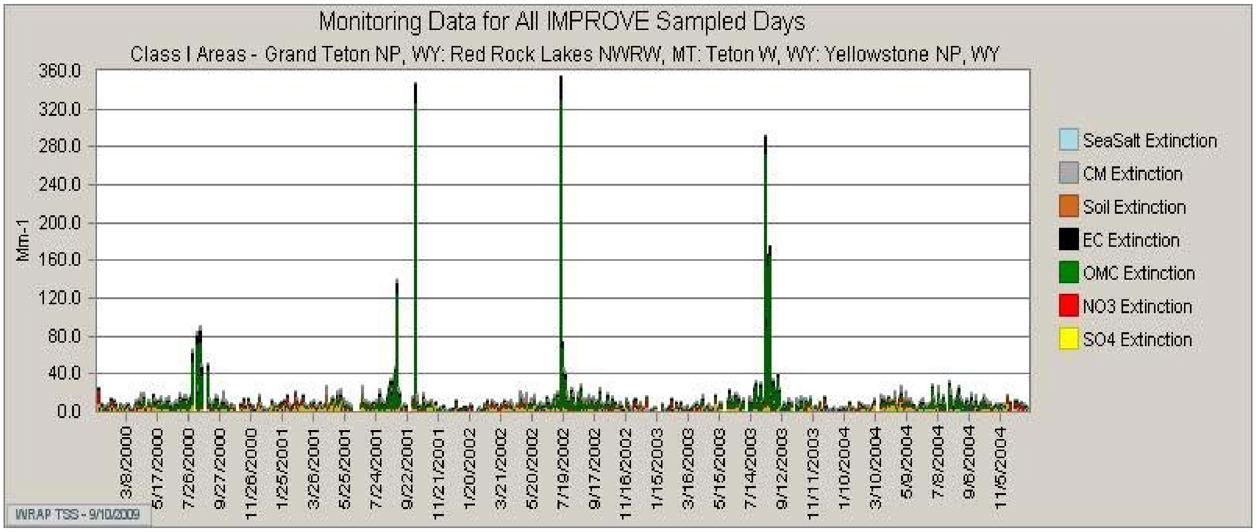

Figure 7-46. Yellowstone National Park 2000-2004 Pollutant Species Visibility Impairment All IMPROVE Monitoring Days

Looking closer at Figure 7-47, the monthly 20% worst days show trends similar to those in the Sawtooth and Selway-Bitterroot Wildernesses with summertime spikes of organic mass carbon. The scale makes it difficult to see whether there are other trends associated with other pollutants.

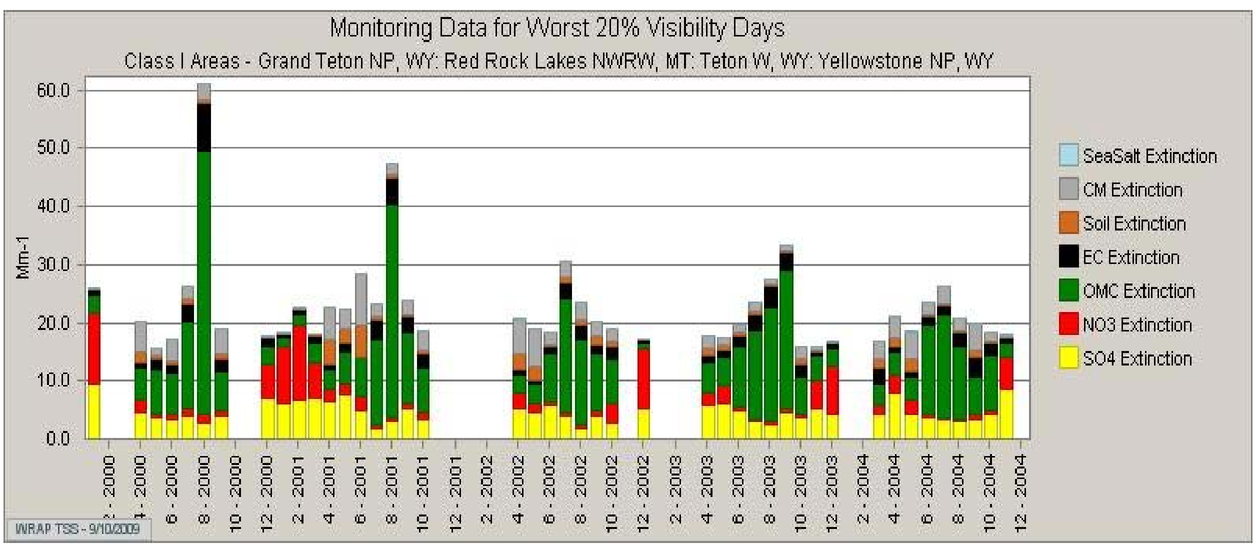

Figure 7-47 Yellowstone National Park Monthly 2000-2004 Visibility Impairment 20% Worst Days

Looking specifically at organic mass carbon in Figure 7-48, a strong fire season signature can be seen. The fire season hits the peak in late July and August and tapers off into the fall.

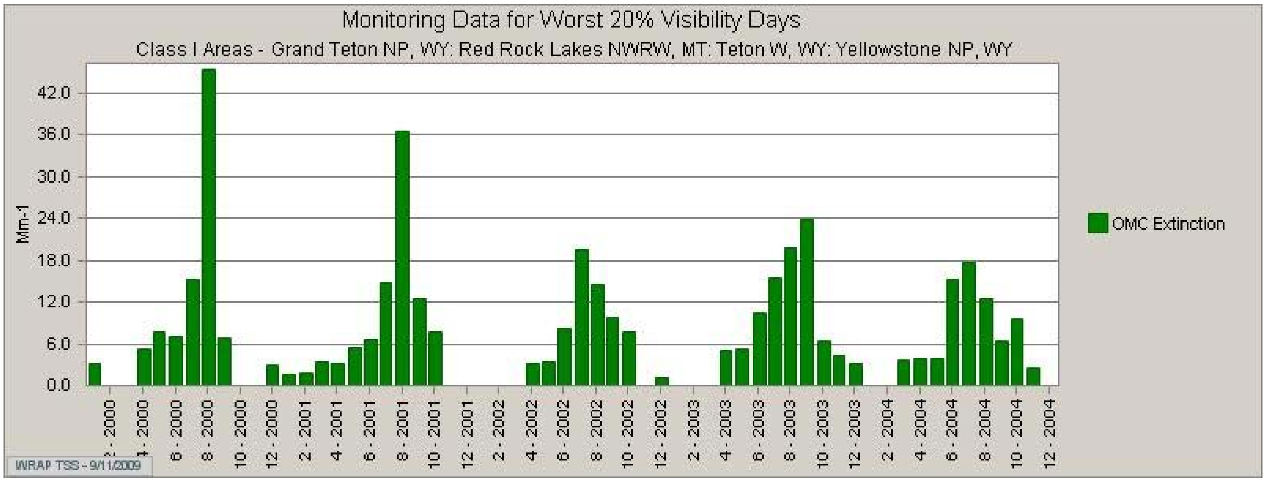

Figure 7-48 Yellowstone National Park Monthly 2000-Organic Mass Carbon Visibility Impairment 20% Worst Days

Similar to Craters of the Moon National Monument and Hells Canyon Wilderness, Figure 7-49 shows the biggest impact in Yellowstone National Park was from nitrate and sulfate starting in November and into early winter and tapering off into the falling fall season. This differs from the Sawtooth Wilderness area where the largest contributions were during May and June.

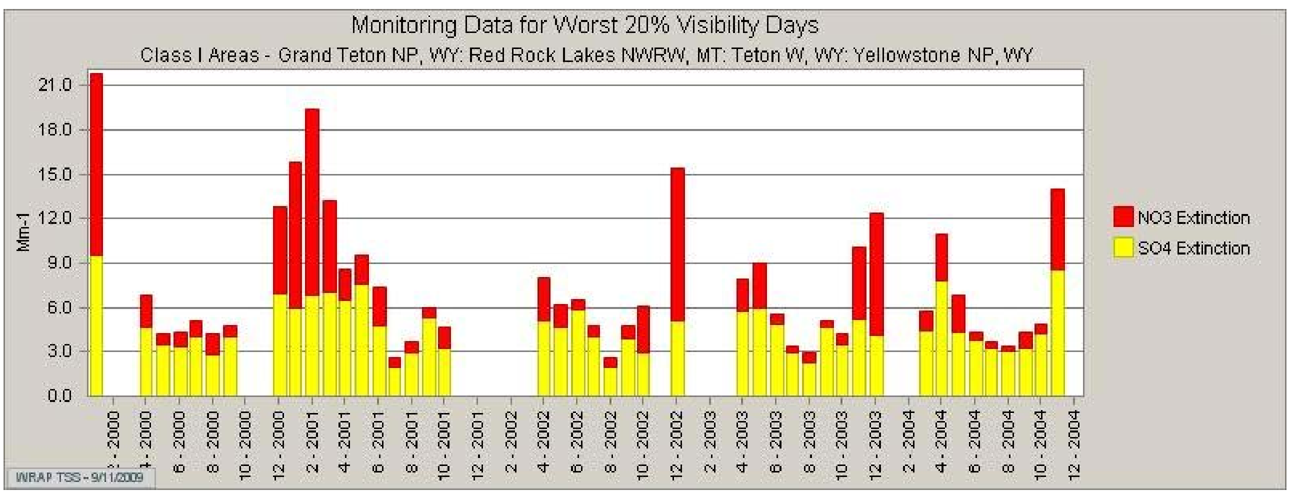

Figure 7-49 Yellowstone National park Monthly 2000-2004 NO3 and SO4 Visibility Impairment 20% Worst Days

7.6.2 Yellowstone National Park 20% Best Days

As shown in Figure 7-50, the visibility impacts during the 20% best days in the Selway-Bitterroot Wilderness show a greater impact from sulfate and nitrate and less but still substantial impact from organic coarse mass than the 20% worst days in 2002. Reductions in nitrate and sulfate should improve both the best and worst days.

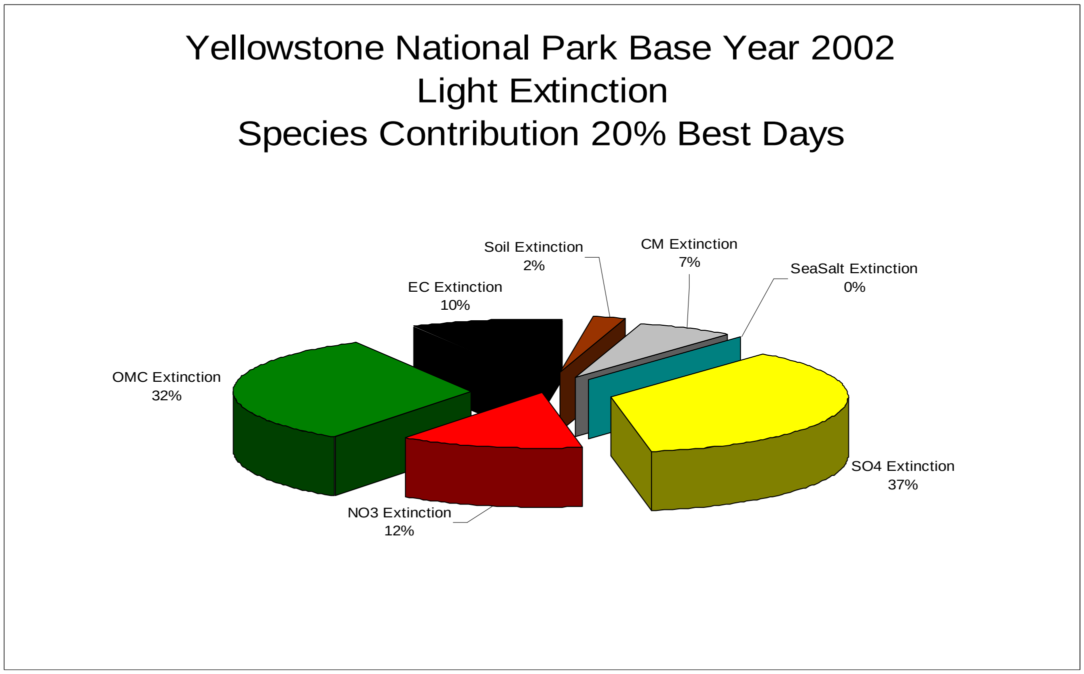

Figure 7-50 Yellowstone National Park 2002 Light Extinction 20% Best Days

Figure 7-51 shows annual 20% best days during the base time period in Yellowstone National Park are all with 1.5Mm-1 of each other and 2002 is representative of the other base years.

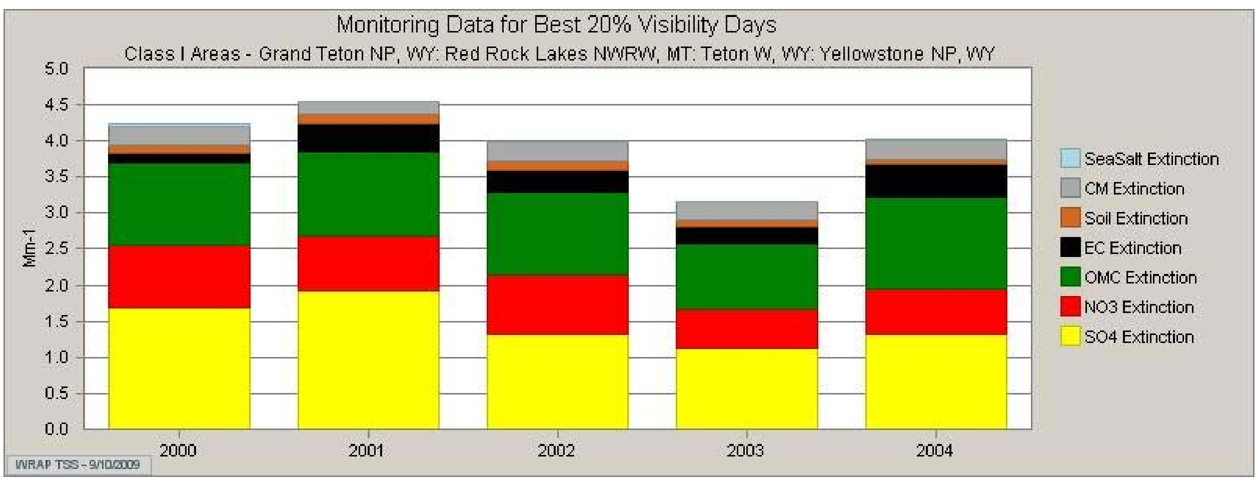

Figure 7-51. Yellowstone National Park Annual 2000-2004 Pollutant Species Light Impairment 20% Best Days

Figure 7-52 shows the base period average pollutant impact of 25.4Mm-1 with a needed improvement in visibility of 1.24dv by 2018 to stay in accord with the uniform rate of progress and a total improvement of 5.98dv needed by 2064 to meet natural conditions.

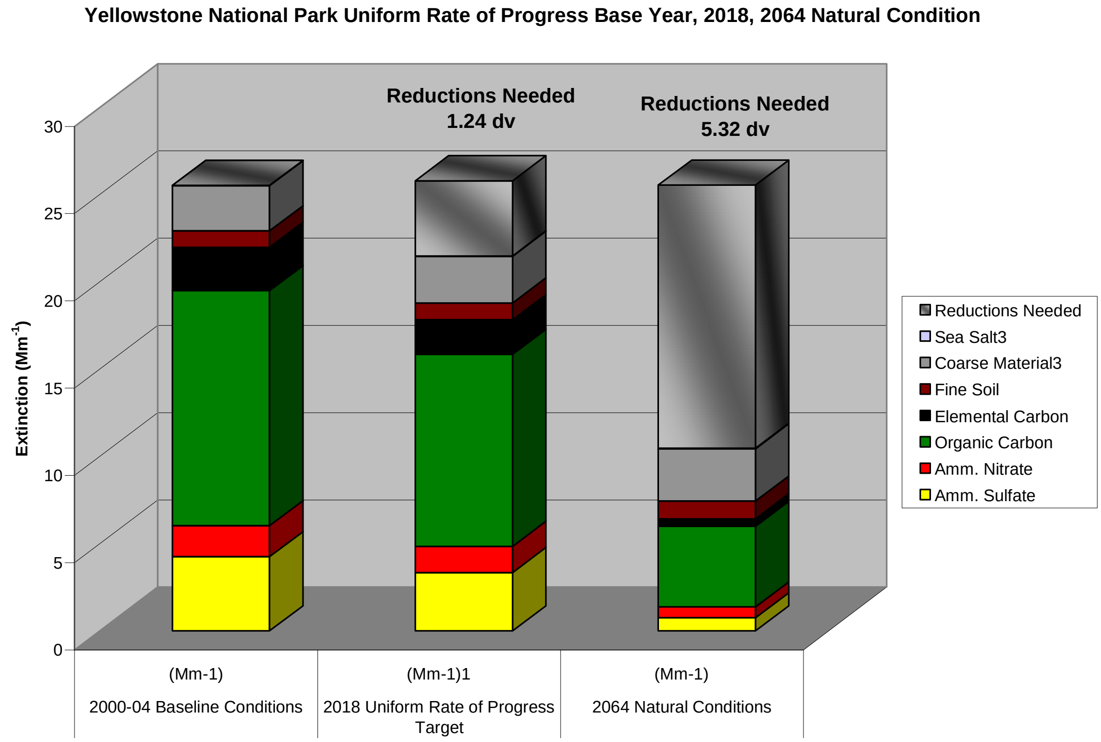

Figure 7-52. Yellowstone National Park Aerosol Light Extinction, Baseline (2000-2004), 2018 Target, 2064 Goal

Chapter 8. Emissions Source Inventory

8.1 Idaho Statewide Emissions Inventory

The root of visibility impairment in mandatory Class I areas is pollutant emissions. In determining what emissions to reduce to improve visibility, it is important to know the pollutant sources and have an understanding of the effect different pollutants have on visibility impairment. This chapter begins with a look at emissions and source types in Idaho. The second half of the chapter will look at emissions in the surrounding states that may be impacting visibility in mandatory federal Class I areas in Idaho. The focus will be on changes that are expected to occur during the first planning period starting in 2002 and ending in 2018. In an effort to be consistent with the following chapters, the emissions inventory was derived from the WRAP Plan "Plan02d" for the 2002 base year and "Plan Prp18b" for 2018. These are the most up-to-date emissions inventories developed by WRAP and the associated states and they are the inventories used for modeling in the following chapters. The emissions inventory was obtained from the WRAP technical Support System at: http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx.

EPA's Regional Haze Rule (40 CFR 51.308(d)(4)(v)) requires "a statewide emission inventory that are anticipated to cause or contribute to visibility impairment in any mandatory Class I Federal area." Progress in the future will be based on the reductions between the baseline emissions identified at the beginning of the planning period and changes in emissions at the end of the planning period. The Regional Haze Rule also requires a mid planning period tracking of emissions (40 CFR 51.308(f)(5)). In addition, IMPROVE monitoring sites will be check to see if pollutant emission reductions are having a positive improvement on visibility. The pollutants of concern are sulfur dioxide (SO_2), nitrogen oxide (NO_x), volatile organic compounds (VOCs), organic carbon (OC) elemental carbon (EC), fine particulate of 2.5 microns or less ($PM_{2.5}$), coarse particulate (PM_{10}), and ammonia (NH_3). In the following tables, SO_2 and NO_x will include both the gaseous form and the particles formed by these pollutants. Ammonia is included because of its catalyst effect in photochemical particle formation. As discussed in Chapter 4.2, each of these pollutants has a different effect on visibility impairment.

The emissions sources are divided into the following broad categories: point, area, on-road mobile and off-road (combined as mobile), anthropogenic (human caused) fire, natural fire, road dust, fugitive dust, and windblown dust. Some of these emissions amounts are based on actual source emissions that are tracked (measured and recorded) while others, such as mobile, windblown dust, and fire are estimated based on modeling. For a full discussion on how these emissions amounts were estimated, see Appendix D. In the following tables, each pollutant is looked at separately by source category3.

3 The information used to develop these tables was taken from the WRAP technical support system. This information can be obtained at: http://vista.cira.colostate.edu/tss/Results/HazePlanning.aspx by following these steps: When the window opens, click on the "Emissions and Source Apportionment" box at the bottom of the window. Next, under "Data Review," click on the "Emissions Review Tool." A screen will open up that allows you to select pollutants, source categories, emission inventories, and source regions. For the following tables in this plan, emissions from "Idaho" using the emission inventory from "2000-04 – Baseline (plan02d)&PRPb(prp18b)" was used. When these options are selected, a

Since each of the source categories doesn't necessarily contribute to the emissions of the pollutants listed above, the tables will only include those categories that do contribute. As an example, neither fugitive dust or windblown dust contributes to SO_x or NO_x emissions, so these dust categories are not included in the tables for SO_x (Table 8-1) and NO_x (Table 8-2).

8.1.1 SO_X Emissions

Sulfur dioxide emissions are usually associated with the burning of fossil fuels. This source category is largely attributed to anthropogenic (human–caused) activities and in many instances is the primary pollutant that can be reduced to improve visibility. The tables below show each of the pollutants' primary source categories and the reductions that are expected to occur between 2002 and 2018 due to control measures already on the books (rules and ordinances already in place require pollutant emission controls) or control strategies that are expected to be implemented during the first planning period. The emissions reduction amounts shown in the tables include both the gaseous form and the particulate form. As table 8-1 depicts, point source activity is the largest contributor to SO_x emissions in Idaho. The point source emissions primarily come from burning coal to heat industrial boilers and other industrial activities. The second largest source category is fire. Unfortunately, only 2% of the fire-related emissions come from anthropogenic sources, so there is very little control available for reducing the overall fire-related emissions. The third largest category is mobile (on-road and off-road), contributing a combined 13% in 2002.

There are major reductions expected by 2018. Emission reductions expected from point sources are largely associated with emissions reductions that will result from implementing Best Available Retrofit Technology (BART) according to requirements, which will be discussed in Chapter 9. A large majority of these reductions have already occurred. The emissions reductions from the mobile category are associated with reductions in the sulfur content of fuels required under the Federal Tier II mobile regulations and off-road diesel requirements. Overall, Idaho is reducing SOx emissions by 33.9%.

Table 8-1 Idaho SO_2 Statewide Emissions Inventory 2002-2018

Idaho Statewide Sulfate Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	17,613	9,395	-8,218	-46.7%	45%
Area	3,280	3,539	259	7.9%	8%
On-Road Mobile	1,662	209	-1,453	-87.4%	4%
Off-Road Mobile	3,702	290	-3,412	-92.2%	9%
Anthropogenic Fire	895	445	-450	-50.3%	2%
Natural Fire	12,008	12,008	0	0.0%	31%
Total	39,159	25,885	-13,274	-33.9%	100%

graph showing the pollutant by source category by base and future year will appear. The data used to develop these graphs and the following tables can be obtained by clicking on the "show data" choice at the bottom of each graph.

8.1.2 NO_X Emissions

Nitrogen oxide emissions, like SO_x emissions, also comes primarily from anthropogenic sources emissions, for which there is great promise in reductions to improve visibility in mandatory federal Class I areas. The NOx emissions in table 8-2 include both the gaseous and particulate forms of NO_x. NO_x emissions are usually attributed to burning of fuel which can range from fossil fuels to wood. The largest category contribution comes from mobile sources which, combined, contribute 46% of the overall NO_x emissions. The area source category is the second largest anthropogenic source and area emissions are associated with heating of buildings and other general population-based activities.

The 2018 emissions from mobile sources are expected to drop dramatically. The federal motor vehicle emissions standards are expected to ratchet down the levels of allowable NO_x emissions, so as vehicle fleets turn over and put newer vehicles on the road, large NO_x reductions will occur. Emissions from both point sources and area sources are expected to increase due to increases in population and startup of new industrial sources. Although the industrial sources will be required to meet New Source Review standards, there will be new industry and therefore additional NO_x emissions. The second largest category is fire, of which only 2% of the 2002 emissions were anthropogenic. Natural fire is held at a constant from the base year with only a slight overall change due to the 51% reduction from anthropogenic fire. Overall, Idaho has reduced NOx emissions by 20.6%.

Table 8-2 Idaho NOx Statewide Emissions Inventory 2002-2018

Idaho Statewide Nitrate Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	11,487	12,057	570	5.0%	7%
Area	30,318	42,068	11,750	38.8%	19%
On-Road Mobile	44,611	12,326	-32,285	-72.4%	28%
Off-Road Mobile	27,922	17,235	-10,687	-38.3%	18%
Anthropogenic Fire	3,461	1,693	-1,768	-51.1%	2%
Natural Fire	39,401	39,401	0	0.0%	25%
Total	157,199	124,780	-32,420	-20.6%	100%

8.1.3 VOC Emissions

Volatile organic compounds are highly evaporative and usually associated with industrial solvents, paints, refrigerants, pharmaceuticals, and other man-made chemicals. The same properties that make these chemicals excellent as solvents make them very reactive in secondary particle formation. Emissions of VOCs are separated out from the other forms of carbon emissions because VOCs are primarily associated with human-caused activities and should be tracked through the photochemical and other modeling approaches to identify visibility impairment due to human-caused carbon emissions. The largest source category for VOC emissions in 2002 was area source emissions, as shown in Table 8-3. These are primarily emissions associated with the general population and small business source activities.

These activities range from home painting to small businesses using solvents to clean parts. The second largest man-made source is mobile with a combined 2002 contribution of 19%. Sources in the on-road mobile category provide a larger contribution than off-road mobile sources due to the higher percentage of gasoline fuel vehicles in the on-road fleet and because of the higher evaporative effects of gasoline in comparison to diesel fuel.

The projected 2018 emissions inventory shows the expansive growth in emissions expected from area source emissions because of the direct link to population and business growth. However, this category shows great promise for future emissions reductions. There are numerous control strategies such as vapor recovery at gas stations, using ultrasound instead of solvents for parts cleaning, and using non-solvent based paint. Mobile VOC emissions are expected to decline in future years because of federal vehicle emissions standards and the turnover of the vehicle fleet from carbureted to fuel injected systems as well as other on-board vapor recovery systems. Emissions from anthropogenic fire is also expected to decrease in the future due to improvements in smoke management programs. Overall, Idaho's VOC emissions are expected to increase by 19.2%. Because of this increase, DEQ should investigate the possible implementation control strategies for area source VOC emissions during the first planning period.

Table 8-3 Idaho VOC Statewide Emissions Inventory 2002-2018

Idaho Statewide VOC Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	2,113	3,017	904	42.8%	1%
Area	124,137	203,867	79,729	64.2%	46%
On-Road Mobile	26,972	10,332	-16,640	-61.7%	10%
Off-Road Mobile	23,511	15,931	-7,580	-32.2%	9%
Anthropogenic Fire	8,316	3,967	-4,349	-52.3%	3%
Natural Fire	86,162	86,162	0	0.0%	32%
Total	271,211	323,275	52,064	19.2%	100%

8.1.4 Organic Carbon

Organic carbon is usually thought of as carbon associated with natural sources such as decaying bio-mass but this isn't always the case. Organic carbon can come from man-made sources such as wood stove combustion and transportation sources. Table 8-4 shows that the largest source of organic carbon is from fire with natural fire contributing 82% of the 2002 organic carbon emissions. The contributions from natural fire dwarf the contributions from all other emissions categories. Although natural fire is assumed to be constant in future years, the dramatic fluctuations in wildfires emissions from year to year can be extensive. Storm cycles, drought and fuel loading, and possibly global climate change could all contribute to changes in wildfire emissions. Because of organic carbon's ability to impact visibility more than other pollutants, small changes in concentrations greatly affect visibility.

Table 8-4 Idaho Organic Carbon Statewide Emissions Inventory 2002-2018

Idaho Statewide Primary Organic Aerosol Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	106	133	26	24.9%	0%
Area	425	617	192	45.2%	1%
On-Road Mobile	383	341	-42	-10.8%	1%
Off-Road Mobile	747	424	-322	-43.1%	1%
Anthropogenic Fire	8,454	4,089	-4,366	-51.6%	15%
Natural Fire	47,883	47,883	0	0.0%	82%
Road Dust	150	197	48	32.0%	0%
Fugitive Dust	156	203	47	30.1%	0%
Total	58,304	53,888	-4,416	-7.6%	100%

8.1.5 Elemental Carbon

Elemental carbon is usually associated with incomplete combustion of fuels. Elemental carbon comprises the fraction of carbon known as light-absorbing carbon (LAC) and has a visibility impairment effect 10 times greater than soil does. As with VOCs, the largest source of elemental carbon is natural fire at 72% of the 2002 emissions, as shown in Table 8-5. The second largest source category is off-road diesel at 14% and anthropogenic fire is the third largest with a 10% contribution in 2002. Elemental carbon can be seen emitting from diesel exhaust as black soot particles.

In the first planning period, Federal vehicle fuel standards are expected to reduce off-road diesel elemental carbon emissions by 64%. Changes in burning techniques, alternatives to burning, and advances in smoke management programs are expect to reduce elemental carbon from anthropogenic fire by 51% during the first planning period. Overall, Idaho elemental carbon emissions are expected to reduce by 15% by 2018. However, since natural fire is the largest source of elemental carbon, an increase in this category could overwhelm the overall reduction associated with off-road diesel and anthropogenic fire.

Table 8-5 Idaho Elemental Carbon Statewide Emissions Inventory 2002-2018

Idaho Statewide Elemental Carbon Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	11	15	4	32.3%	0%
Area	192	257	65	33.9%	1%
On-Road Mobile	390	102	-288	-73.8%	3%
Off-Road Mobile	1,859	663	-1,196	-64.3%	14%
Anthropogenic Fire	1,331	656	-675	-50.7%	10%

Idaho Statewide Elemental Carbon Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Natural Fire	9,938	9,938	0	0.0%	72%
Road Dust	11	15	4	32.0%	0%
Fugitive Dust	11	14	3	30.1%	0%
Total	13,743	11,659	-2,084	-15.2%	100%

8.1.6 Fine Particulate Matter - PM Fine Emissions

PM fine includes particulate matter of 2.5 microns and less. PM fine is composed of secondary aerosols formed by chemical reactions (excluding particulates of SO_x and NO_x), fine soil, or other materials ground to 2.5 microns or less. The $PM_{2.5}$ emissions from the mobile category are captured in the particulates accounted for in the NO_x and SO_x emissions. Table 8-6 shows the largest source category of PM fine is windblown dust at 26% (agriculture, mining, construction, and stockpiling of blowable material). Area source is the second largest source category with emissions attributed to things like woodstoves and small manufacturing and industrial source activities.

Future PM fine emissions from both area and point sources are expected to increase with the growth in population and industrial sources. Some of the increase is expected to be offset with the 54% reduction anticipated from anthropogenic fire. Overall, PM fine is expected to grow roughly 12% by 2018.

Table 8-6 Idaho PM Fine Statewide Emissions Inventory 2002-2018

Idaho Statewide Fine Particulate Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	305	386	82	26.8%	2%
Area	4,749	6,343	1,595	33.6%	24%
On-Road Mobile	0	0	0	0%	0%
Off-Road Mobile	0	0	0	0%	0%
Anthropogenic Fire	1,536	713	-823	-53.6%	8%
Natural Fire	3,013	3,013	0	0.0%	15%
Road Dust	2,153	2,841	688	32.0%	11%
Fugitive Dust	2,687	3,495	808	30.1%	14%
Wind Blown Dust	5,050	5,050	0	0.0%	26%
Total	19,492	21,842	2,350	12.1%	100%

8.1.7 PM Coarse Emissions

PM coarse is the fraction of particulate matter that includes particles between 2.5 and 10 microns in size. PM coarse is composed of larger particles of wind blown dust, and other particles ground through industrial grinding processes. Other sources include materials that have been stockpiled and available for wind transport, transporting materials, road dust from both paved and unpaved roads, agriculture, and mining, to name a few. Table 8-7 shows the largest source category for PM coarse emissions is windblown dust at 40%. Most of these emissions come from wind blowing over the vast undeveloped erodible lands in Idaho as well as lands left barren through agriculture, construction, and mining activities.

The only source of PM coarse emissions for which future reductions are indicated is anthropogenic fire. Point source, road dust, and fugitive dust are all expected to increase substantially during the first planning period. The reductions in future anthropogenic fire are outweighed by the increases in other categories with an overall increase in Idaho PM coarse emissions of 12% by 2018. The good news is that PM coarse has the least impact on visibility of any of the pollutants.

Table 8-7 Idaho PM Coarse Statewide Emissions Inventory 2002-2018

Idaho Statewide Coarse Particulate Matter Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	643	937	294	45.8%	1%
Area	2,933	3,216	283	9.6%	3%
On-Road Mobile	238	259	20	8.5%	0%
Off-Road Mobile	0	0	0	0.0%	0%
Anthropogenic Fire	1,354	655	-699	-51.7%	1%
Natural Fire	25,323	25,323	0	0.0%	22%
Road Dust	19,690	25,987	6,297	32.0%	17%
Fugitive Dust	17,496	24,807	7,311	41.8%	15%
Wind Blown Dust	45,451	45,451	0	0.0%	40%
Total	113,127	126,633	13,507	11.9%	100%

8.1.8 Ammonia Emissions

While ammonia emissions do not directly affect visibility impairment, ammonia does act as an agent in the formation of secondary aerosols such as ammonium nitrate and ammonium sulfate. It is important to track ammonia emissions amounts because both of the secondary aerosols mentioned above have major impacts on visibility impairment. As table 8-8 shows, area source is the predominant source category, contributing 85% of the ammonia in 2002. Most of the area source emissions of ammonia come from agriculture fertilizing and feedlot operations. It should be noted that this emissions inventory is highly variable due to the unknowns in science and monitoring data relating to ammonia.

Area source emissions of ammonia are expected to grow less than 1% over the first planning period with a total increase in Idaho of 1.3%.

Table 8-8 Idaho Ammonia Statewide Emissions Inventory 2002-2018

Idaho Statewide Ammonia Emissions (tons/year)					
Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	1,043	1,593	550	52.8%	1%
Area	67,293	67,898	605	0.9%	85%
On-Road Mobile	1,430	1,930	499	34.9%	2%
Off-Road Mobile	17	24	7	40.0%	0%
Anthropogenic Fire	1,253	584	-669	-53.4%	2%
Natural Fire	8,246	8,246	0	0.0%	10%
Total	79,282	80,275	993	1.3%	100%

8.2 Regional Emissions

8.2.1 Idaho vs. Surrounding States: Introduction

As mentioned at the beginning of the chapter, EPA's Regional Haze Rule requires states to look at pollutants that are anticipated to cause or contribute to visibility impairment in mandatory federal Class I areas. For each Class I area, the rule (40 CFR 51.308(d)(1)(B)(iv)) instructs states to, "consult with those States which may reasonably be anticipated to cause or contribute to visibility impairment in the mandatory Class I Federal area." Reviewing the emissions inventory of those states surrounding Idaho is the first step in determining if other states have the potential to cause or contribute to visibility impairment in Idaho's mandatory federal Class I areas.

Reviewing emissions levels from Washington, Oregon, Nevada, Utah, Wyoming, and Montana also provides an opportunity to analyze Idaho's relative emissions in relation to those of the surrounding states. Knowing the relative emissions provides better understanding of what can be expected from in-state emissions control strategies when considered in a broader sense. In-state emissions reductions may be offset by large emissions increases in upwind states and, conversely, in-state increases may be offset by large reductions in upwind states. The emissions inventory is the first step in understanding visibility impacts; applying air dispersion modeling and other weighted emissions factors will provide additional weight of evidence in future chapters.

The tables in the remainder of this chapter provide emissions amounts of each pollutant from sources in these categories: windblown dust (WB), fugitive dust, road dust, off –road mobile, on-road mobile, WRAP area oil and gas (O&G), area, biogenic, all fire, natural fire, anthropogenic fire and point source. The pollutant emissions will follow the same color coding as used in chapter 7. The emissions inventories used for this analysis are the 2002-2004 baseline from (plan02d) and 2018 from PRPb (prp18b). These graphs were taken from the same source as described in the footnote at the beginning of the chapter.

8.2.2 Surrounding States SO_2 Emissions

As depicted in Table 8-9, all of the states surrounding are projected to have declining emissions in future years. Idaho's emissions are smaller than those of surrounding states with the major emissions coming from point sources and natural fire. The other states emissions are primarily from point source with some from area and off-road sources. Both Oregon and Washington show major reductions expected in SOx.

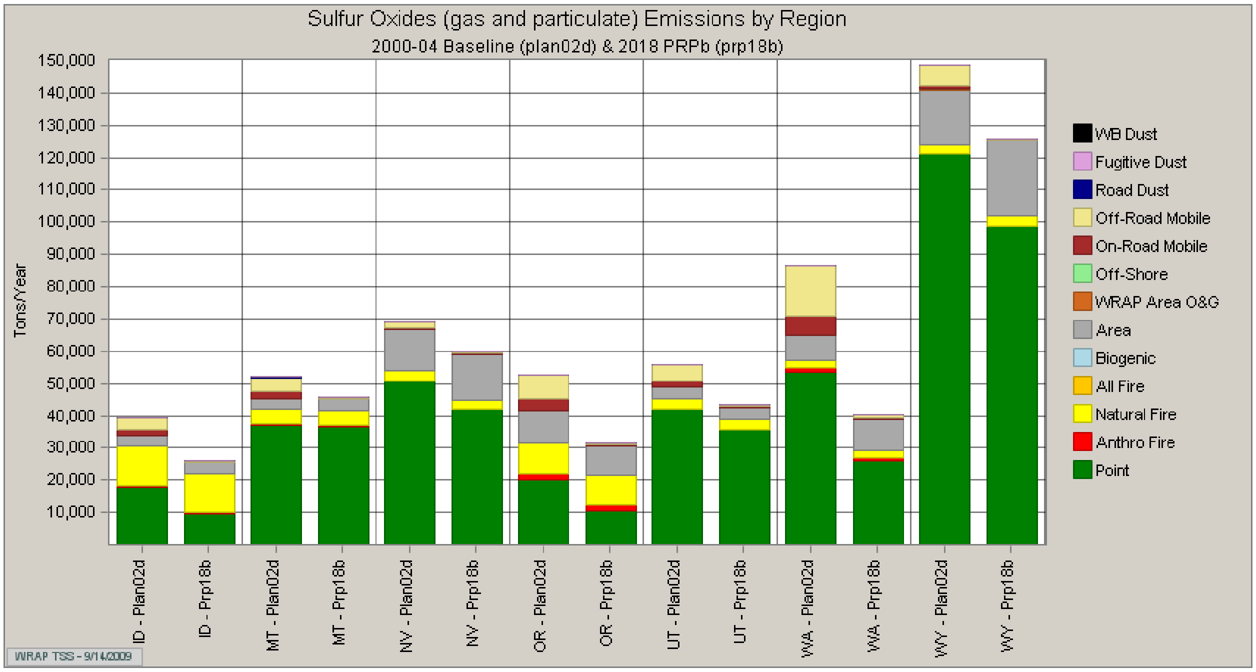

Table 8-9 Idaho vs. Surrounding States SO_2 Emissions Inventory

8.2.3 Surrounding States NOx Emissions

The NO_x 2002 baseline emissions and 2018 projected emissions show a difference in source contribution with on-road and off-road mobile sources contributing more than point sources. These reductions are projected to result from federal vehicle emissions standards and fleet turnover. All the surrounding states are reduced NOx emissions in future years. As table 8-10 indicates, Idaho is one of the only states expecting an increase in area source emissions in future years.

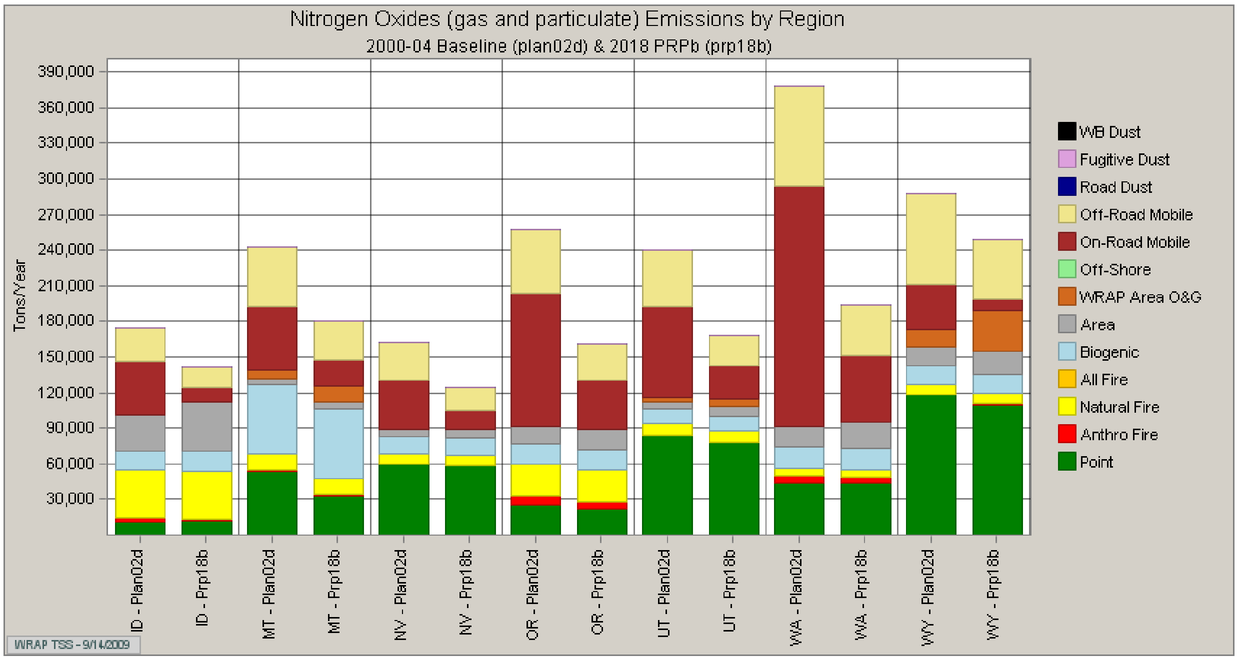

Table 8-10 Idaho vs. Surrounding States NOx Emissions Inventory

8.2.4 Surrounding States VOC Emissions

Table 8-11 shows biogenic emissions are the predominant source of VOC emissions. Washington seems to be the only state expecting declining future year emissions due to reductions in off-road mobile emissions. Although all states are expected to have reductions in future year emissions from on-road mobile, these decreases are offset by expected increases in area source emissions. Area source emissions are expected to increase in the future because of the close connection with population growth.

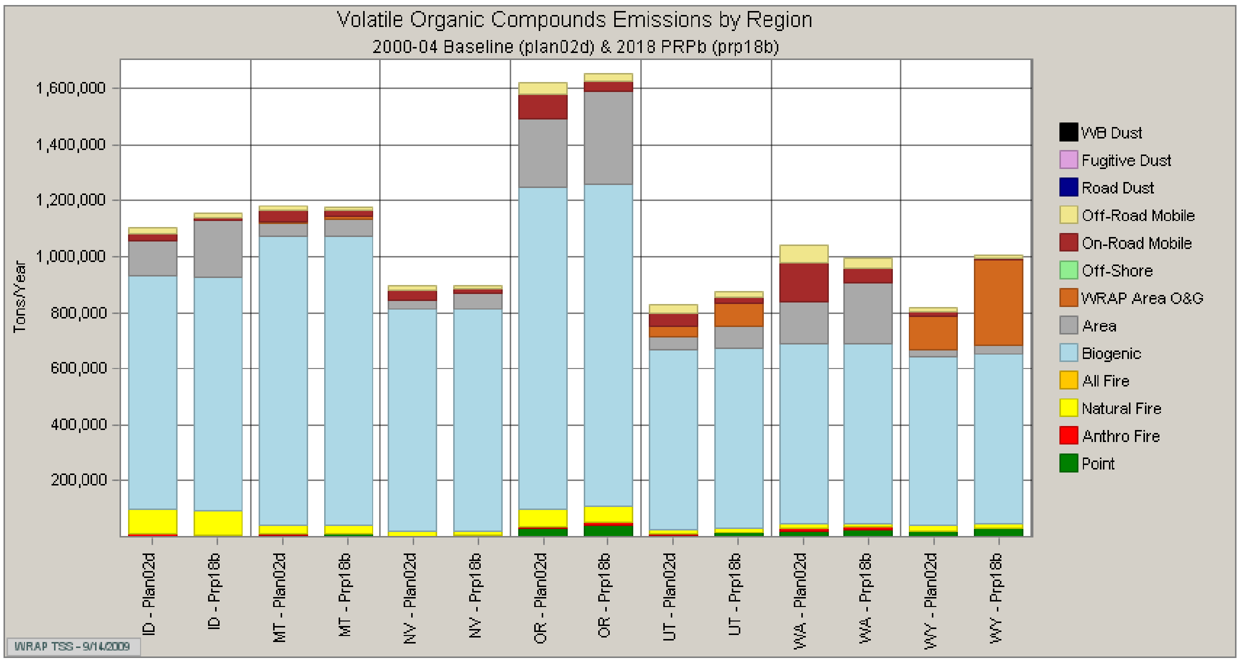

Table 8-11 Idaho vs. Surrounding States VOC Emissions Inventory

8.2.5 Surrounding States Organic Carbon Emissions

Like other carbon emissions, organic carbon is driven by fire sources with natural fire being the predominant source. Table 8-12 does show each state is expecting a very slight decrease in overall organic emissions due to reductions expected from anthropogenic fire. Oregon does stand out in the graph as the state with the largest emissions mostly coming from natural fire. This observation should be noted since a large fire year in Oregon in 2002 could affect visibility modeling results attributed to organic carbon from Oregon. Like Oregon, Idaho's 2002 natural fire emissions are larger than those of surrounding states. The huge variability in natural fire from year to year could be overstating emissions from some states and under-predicting the average year in other states. The impacts from natural fire were held constant since future changes to fire are difficult to project. However, droughts and the effects of climate change may drastically change future year organic carbon from natural fire. Unfortunately, because of organic carbon's heightened ability to impair visibility, greater than SO_x and NO_x, future controls on human-caused emissions may be overwhelmed by future increases from organic carbon.

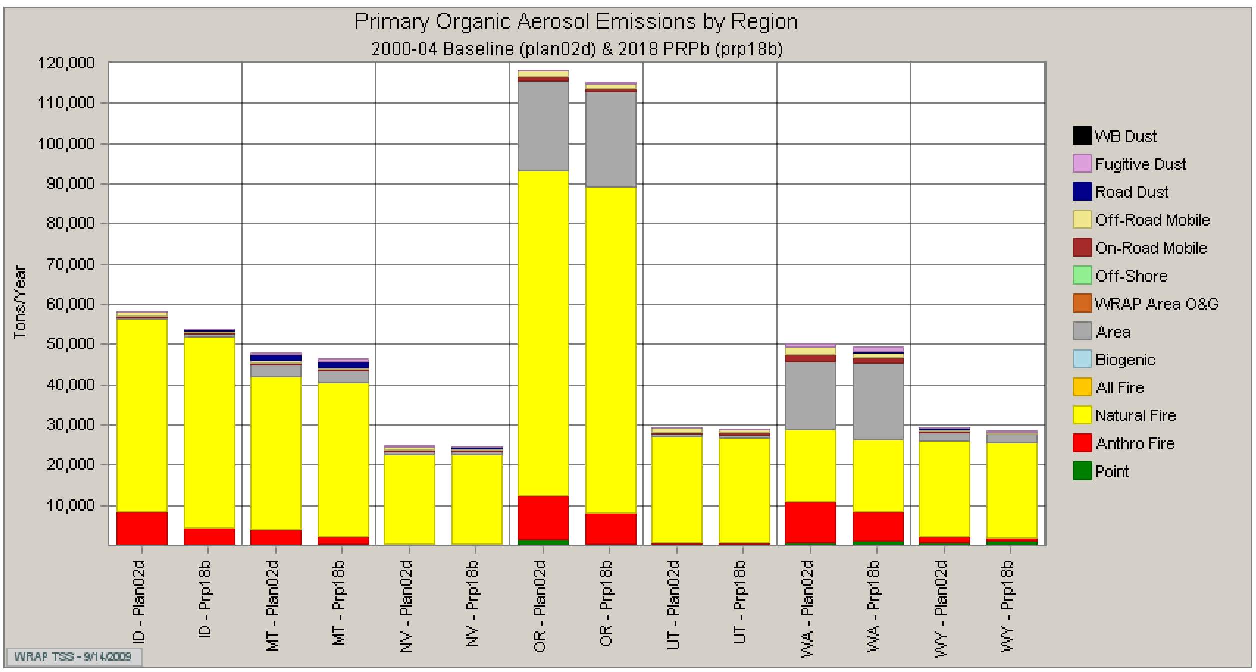

Table 8-12 Idaho vs. Surrounding States Organic Carbon Emissions Inventory

8.2.6 Surrounding States Elemental Carbon Emissions

Table 8-13 indicates elemental carbon emissions are similar to organic carbon emissions with a high percentage of the emissions coming from natural fires. Overall, there are greater reductions expected in elemental carbon than organic carbon due to reductions from off-road mobile sources. Most states with anthropogenic fire emissions in the base year are expecting emissions reductions in future years. Overall, most states appear to be reducing elemental carbon by roughly 2,000 tons per year.

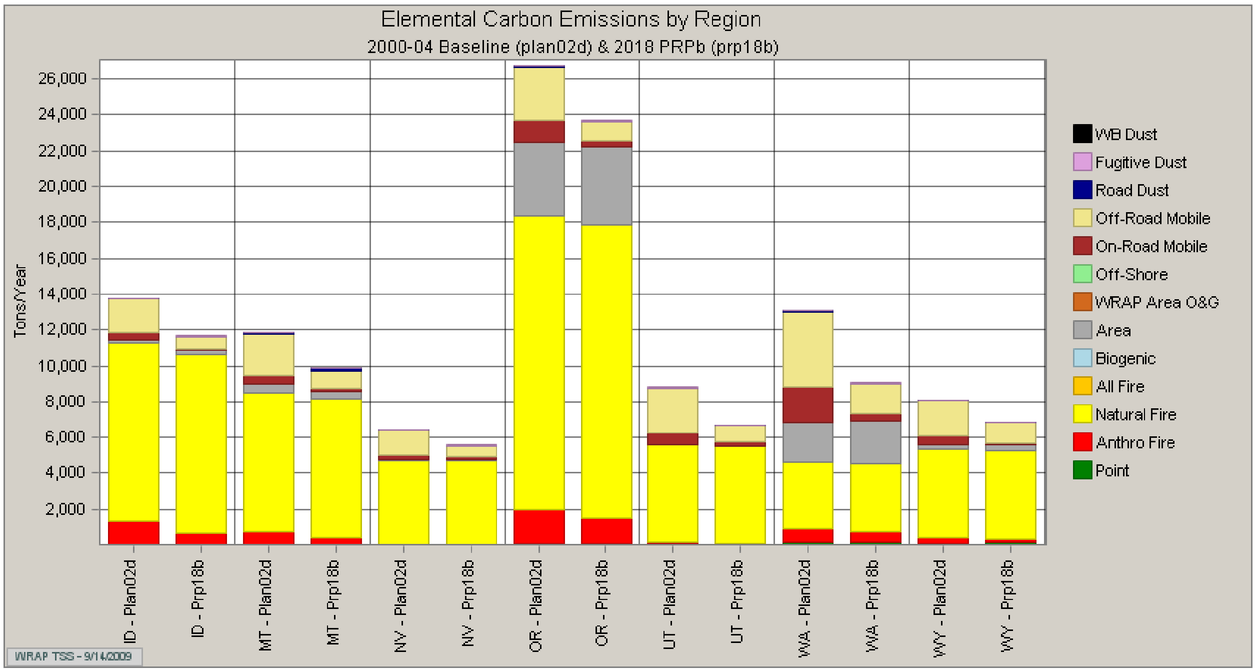

Table 8-13 Idaho vs. Surrounding States Elemental Carbon Emissions Inventory

8.2.7 Surrounding States PM Fine Emissions

Table 8-14 shows Oregon and Nevada as the only two states projecting a slight decrease in fine particulate. Idaho's emissions are smaller than most states with the exception of Utah which is only slightly lower. There is great variability in the relative contributions from the different source categories in each state. Montana appears to have much greater PM fine emissions than other states but this may be due to the way Montana calculates fugitive dust from its large number of unpaved roads.

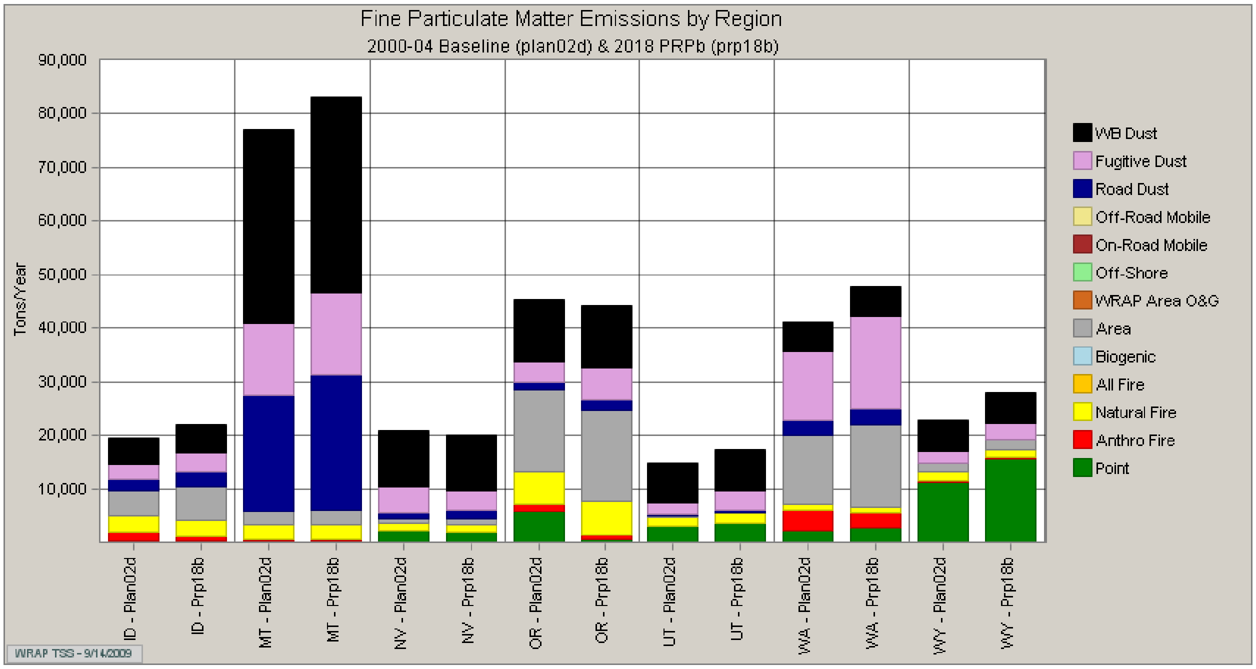

Table 8-14 Idaho vs. Surrounding States PM Fine Emissions Inventory

8.2.8 Surrounding States PM Coarse Emissions

With the exception of Montana, most of the surrounding states are showing coarse particulate between roughly 100,000 and 200,000 tons per year. Again, this may be the way Montana calculates emissions from unpaved roads and fugitive emissions. All of the states are expected to experience minor increases of PM coarse emissions for future years primarily from fugitive dust and windblown dust sources. When looking at coarse particulate matter emissions, it is important to keep in mind that coarse PM has a faster deposition rate than finer particulate; therefore, there is less interstate transport of coarse PM than fine PM as shown in Figure 8-15.

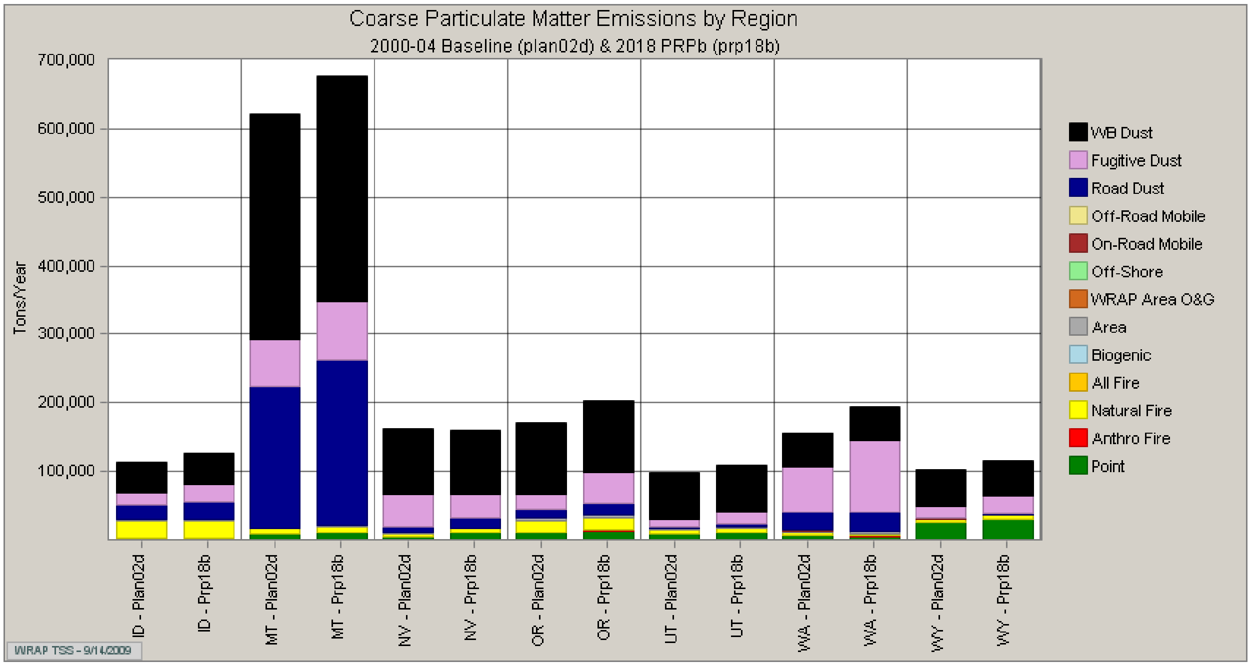

Table 8-15 Idaho vs. Surrounding States PM Coarse Emissions Inventory

8.2.9 Surrounding States Ammonia Emissions

As shown in Figure 8-16, Idaho's ammonia emissions are much larger than those of the surrounding states and are primarily coming from confined animal feedlot operations, agriculture, and other area sources. Over the first planning period, a small amount of increase in ammonia emissions is expected from on-road mobile sources, primarily due to population increases and the associated additional vehicle miles traveled.

Since ammonia plays a large part in visibility impact due to the formation of ammonium sulfate and ammonia nitrate, it should receive increased focus during the first planning period. This will require more research on the wet and dry deposition rates of ammonia and its chemical reactions with other pollutants. It may also require changes in monitoring for nitrogen and ammonia to get a better understanding how these pollutants are transported and the chemical reactions that are occurring. WRAP should be the centralized organization that compiles and helps coordinate the activities of the federal land managers, contractors, and the states so the information and studies are readily available for all of those interested.

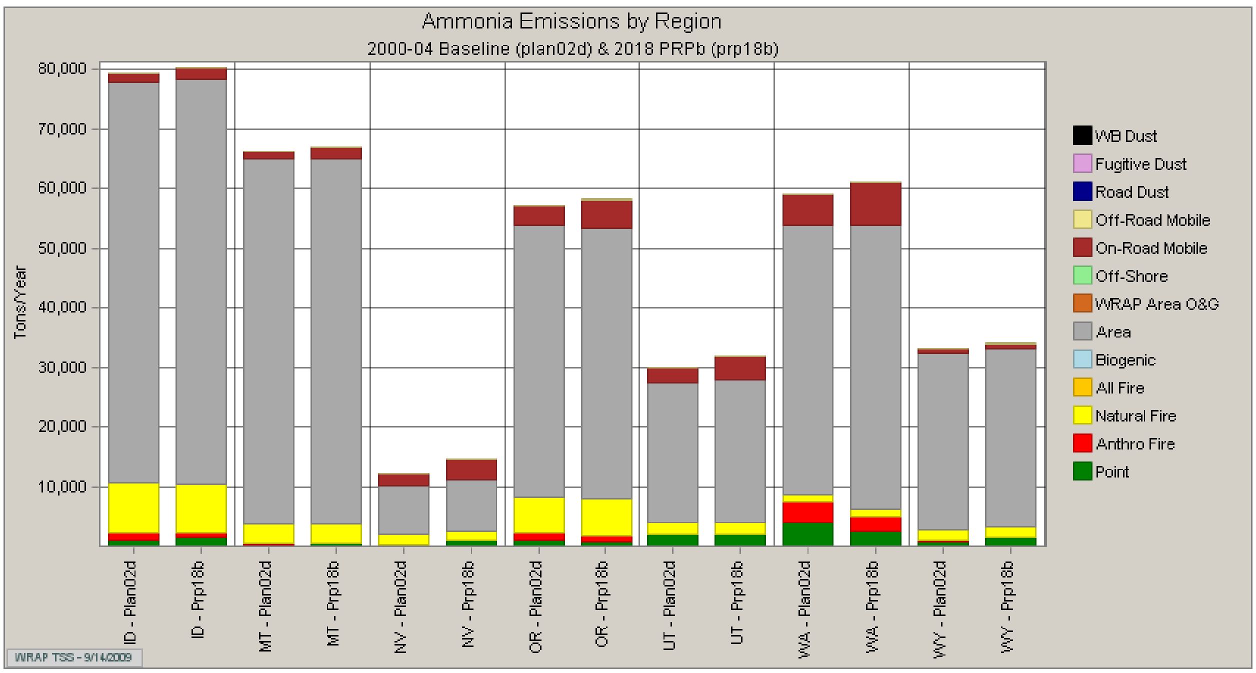

Table 8-16 Idaho vs. Surrounding States Ammonia Emissions Inventory

Chapter 9. Source Apportionment

9.1 Overview of Source Apportionment

EPA's Regional Haze Rule requires each state to submit a long-term strategy that addresses regional haze visibility impairment for each mandatory class I Federal area inside the state and outside the state which may be affected by emissions from the state (40 CFR 51.308(d)(3)). In establishing the long-term strategy for regional haze, the state must meet the following requirements:

> *Where the State has emission that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal area located in another State or States, the State must consult with the other State(s) in order to develop coordinated emission management strategies. The State must consult with any other State having emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal area within the State (40 CFR 308(d)(3)(i)).*
>
> *Where other States cause or contribute to impairment in a mandatory Class I Federal area, the State must demonstrate that it has included in its implementation plan all measures necessary to obtain its share of the emissions reductions needed to meet the progress goal for the area. If the state has participated in a regional planning process, the State must ensure it has included all measures needed to achieve its apportionment of emission reductions obligations agreed upon through the process (40 CFR 51.308(d)(3)(ii)).*
>
> *The State must document the technical basis, including modeling, monitoring and emissions information, on which the State is relying to determine its apportionment of emission reduction obligations necessary for achieving reasonable progress in each mandatory Class I Federal area it affects. The State may meet this requirement by relying on technical analyses developed by the regional planning organization and approved by all State participants. The State must identify the baseline emissions inventory on which its strategies are based. The baseline emissions inventory year is presumed to be the most recent year of the consolidated periodic emissions inventory (40 CFR 51.308(d)(3)(iii)).*

The state should consider major and minor sources, area sources, and mobile sources as part of the attribution process. This chapter will focus on each state's contribution to regional visibility impairment from the anthropogenic sources of point, area, mobile, and anthropogenic fire as well as the natural contributions from windblown dust and wild fire. In some instances, fugitives will be included in the apportionment.

Two different modeling approaches were used to develop a weight of evidence for each state's contribution of the visibility-impairing pollutants and source categories. Each Class I area within Idaho was reviewed using both CAMx PSAT and WEP approaches and then both sets of results were evaluated to determine which model provided more accurate results for each pollutant. For nitrates and sulfates, modeling results from the Comprehensive Air Quality Model with Extensions (CAMx) PM Source Apportionment Technology (PSAT) model were used to trace the sources, categories, and states of origin. For the carbon pollutants (primary organic aerosol) and both fine and coarse particulate matter, a weight of emissions potential (WEP) analysis was used to track the

sources, categories, and states of origin. Later in the chapter, Idaho's impacts on Class I areas residing outside the state or with shared borders will use a similar approach to investigate any contributions to visibility impairment in those areas that come from Idaho.

9.1.1 Introduction to Air Dispersion and Source Apportionment Modeling Using PM Source Apportionment Technology (PSAT)

The WRAP and member states relied upon two different gridded three-dimensional photochemical Eulerian models: EPA's Community Multi-Scale Air Quality Model (CMAQ) and ENVIRON Inc.'s Comprehensive Air Quality Model with Extensions (CAMx). Both of these models include mass-tracking algorithms to explicitly track the chemical transformations, transport, and removal of the particulate that was formed from a given emissions source. At the time of the apportionment modeling, the CAMx PSAT (PM Source Apportionment Technology) model did a better job of identifying total mass contribution than the CMAQ TSSA (Tagged Species Source Apportionment) model that was available at the time[4].

The CAMx PSAT apportionment modeling used the 2002 Plan02c emissions inventory for the baseline emissions and 2018 Base Case 18b emissions inventory for the future year emissions. The WRAP originally intended to conduct apportionment modeling again later when refined models and updated emissions inventories became available, but was not able to do so because of funding concerns. Therefore, this plan relies on the initial apportionment modeling performed by WRAP, and that creates at least one special concern for Idaho. Idaho's special concern with the WRAP apportionment modeling is that the 2018 Base Case 18b was an early version of the inventories and it used future electrical demand projections that included one coal-fired electrical generation unit (EGU) in Idaho[5]. The projected emissions from this anticipated EGU were removed from later versions of the 2018 emissions inventory due to the moratorium placed on EGU development by Idaho's governor while Idaho determines how to deal with mercury issues and rule development[6].

While the CAMx PSAT modeling was used to identify SO_x and NO_x source attributions at each relevant Class I area, the CMAQ model is used to summarize all of the pollutants' visibility impacts at each of the Class I areas. The CMAQ modeling summaries at the end of this chapter use the most up-to-date emissions inventories, specifically including the 2002(plan02d) and 2018(prp18b) emissions inventories for baseline and future projections, respectively. Since the modeling results don't match exactly with the pollutant species measured by the IMPROVE monitoring network, a relative reduction factor (RRF) was used to adjust the modeling results. For each Class I area and each PM species, an RRF was calculated as the ratio of the 2018 modeling results to the 2002

4 Air Quality Modeling, Western Regional Air Partnership, Joe Adlhock, December 2002, page 25. as available at: http://vista.cira.colostate.edu/docs/wrap/Modeling/AirQualityModeling.doc
5 WRAP Point and Area Source Emissions for the 2018 Base Case Version 1, Eastern Research Group, January 25, 2006, page 4-7. as available at: http://www.wrapair.org/forums/ssjf/documents/eictts/docs/WRAP_2018_EI-Version_1-Report_Jan2006.pdf
6 Tech Memo WRAP 2018 PRP – Final Revised 1, Eastern Research Group, June 18, 2007, page 53. as available at: http://www.wrapair.org/forums/ssjf/documents/eictts/Projections/PRP18_EI_tech%20memo_061607.pdf

modeling results. Future year PM levels were then projected by applying the appropriate RRF to the PM species levels observed under baseline conditions. The light extinction equation identified in section 4.2.2 was then applied to the concentration levels.

9.1.2 Introduction to Source Apportionment using Weight of Emissions Potential (WEP)

The Weight of Emissions Potential (WEP) method of analysis was developed as a screening tool for states to use in identifying source regions that have the potential to contribute to haze at specific Class I areas. The method relies on an integration of gridded emissions, residence times of air masses calculated by back trajectory, a one-over-distance factor to approximate deposition (an inverse distance factor, which accounts for the fact that, up to some limit, more of the pollutant is deposited further from the Class I area than nearer to it), and a normalization of the final results. This process is not as robust as PSAT because it doesn't account for chemistry or other deposition process.

The back trajectory residence times were provided by the WRAP Causes of Haze Assessment (COHA). The COHA used the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model (developed by the National Oceanic and Atmospheric Administration) to generate eight back trajectories daily for each WRAP Class I area for the entire base period (2000-2004). Residence times were generated for grid cells of one-degree latitude by one-degree longitude. Residence time analysis computes the amount of time in hours or percent of time an air parcel is in a horizontal grid cell. Residence time is shown on maps as a percent of the total hours that is spent in each grid cell across the domain, which can be interpreted as general air flow patterns for a given Class I area. Residence times were generated for both the 20% best days and 20% worst days.

The WEP analysis consists of weighting the annual gridded emissions (by pollutant and source category) by the worst and best extinction days' residence times for the five-year base period. The 2002 plan02d and 2018 prp18b emission inventories were used for the analysis. To account for rates of deposition along the trajectories, the results were weighted by a one-over-distance factor, using the distance in kilometers between the centroid of each emissions grid cell and the centroid of the cell containing the Class I area monitoring site under investigation.

9.2 Source Apportionments for Class I Areas in Idaho

9.2.1 Craters of the Moon National Monument Source Apportionment

Sulfate at Craters of the Moon National Monument Based on PSAT

The regional source contribution pie charts in Figure 9-1 show the WRAP states are only contributing roughly a third of the visibility impairment on the 20% worst days at Craters of the Moon. Through the consultation process, the WRAP states can work together on reducing contributions from within the WRAP region; the remaining contributions are outside the regulatory authority of the WRAP states.

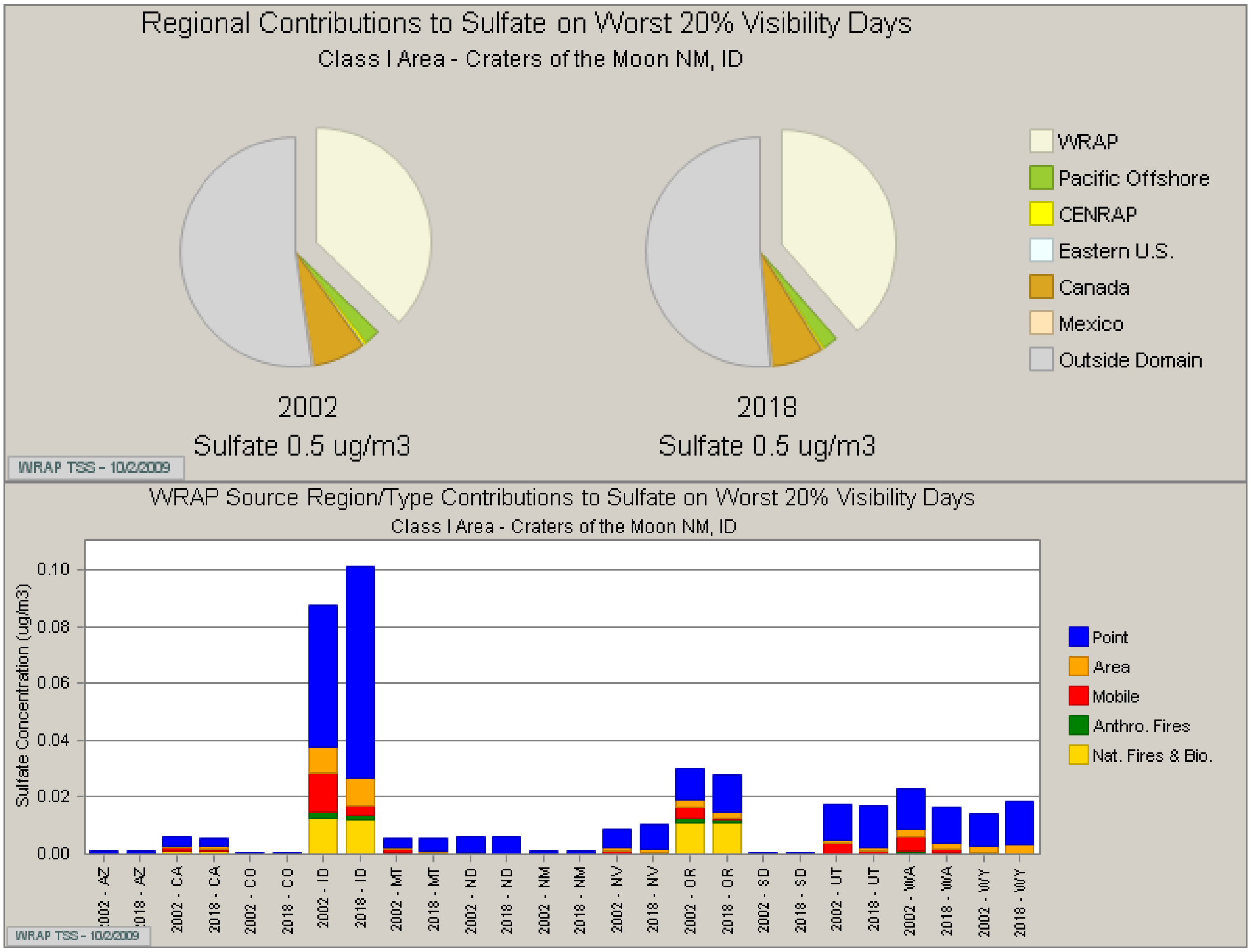

Figure 9-1 PSAT Sources of Sulfate Concentrations at Craters of the Moon National Monument 20% Worst Days

For the 20% worst days at Craters of the Moon National Monument, Figure 9-1 shows the largest contribution coming from Idaho's point sources. However, the graph shows an increase in emissions from point sources in 2018 that is overstated. During the development of the early versions of the 2018 emissions inventory, future electrical needs were identified and coal-fired power plants were anticipated throughout the west to fulfill electrical demands. Idaho was expected to get at least one new electrical generation unit (EGU) and for modeling purposes it was presumed located in Jerome County just north of the Jarbidge Wilderness area and slightly southwest of Craters of the Moon National

Monument. Even with the emissions from the projected EGU included, Idaho's anthropogenic emissions were estimated to be only 16% of the sulfate concentration at Craters of the Moon. The WRAP TSS emission inventory tools were used to produce the chart in Figure 9-2, which shows an expected increase in SOx emissions in Jerome County, based mostly on the anticipated EGU; however, as discussed below, the EGU is now unlikely to be built and almost certainly not within the first planning period ending in 2018.

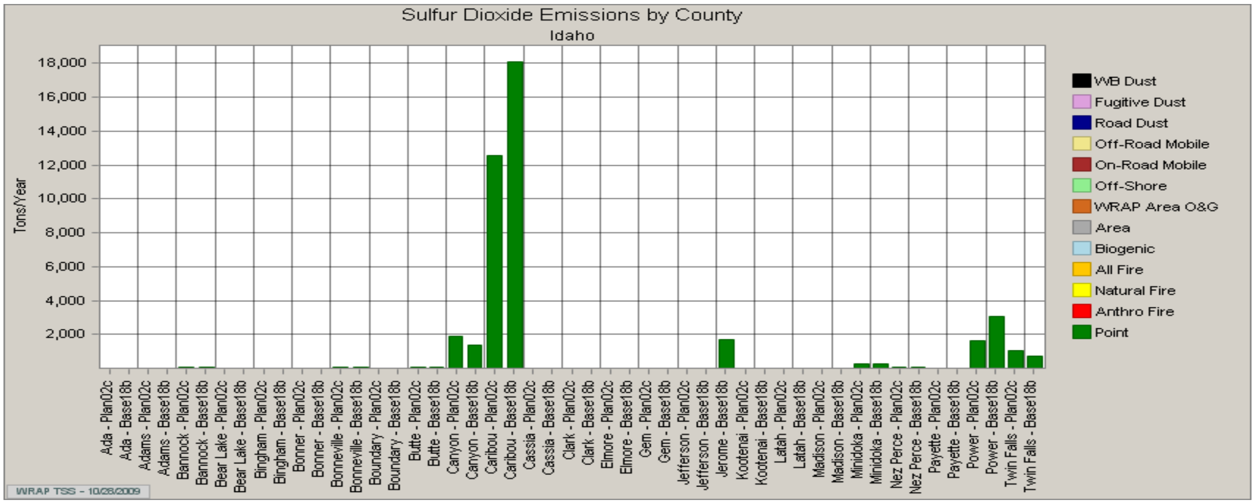

Figure 9-2 SOx Emissions, Difference Between 2002 Plan02c and 2018 Base18b

As stated in the introduction to PSAT modeling, the Idaho governor placed a moratorium on new coal-fired power plants to give the state an opportunity to make decisions about mercury emissions. The projected emissions from the once-anticipated power plant (EGU) slated for Jerome County were therefore removed from future emissions inventories including the 2018 prp18b represented in the chart in Figure 9-3. (In Figure 9-3, Jerome County does not appear at all because the expected emissions are too low to be seen at the scale of the chart.)

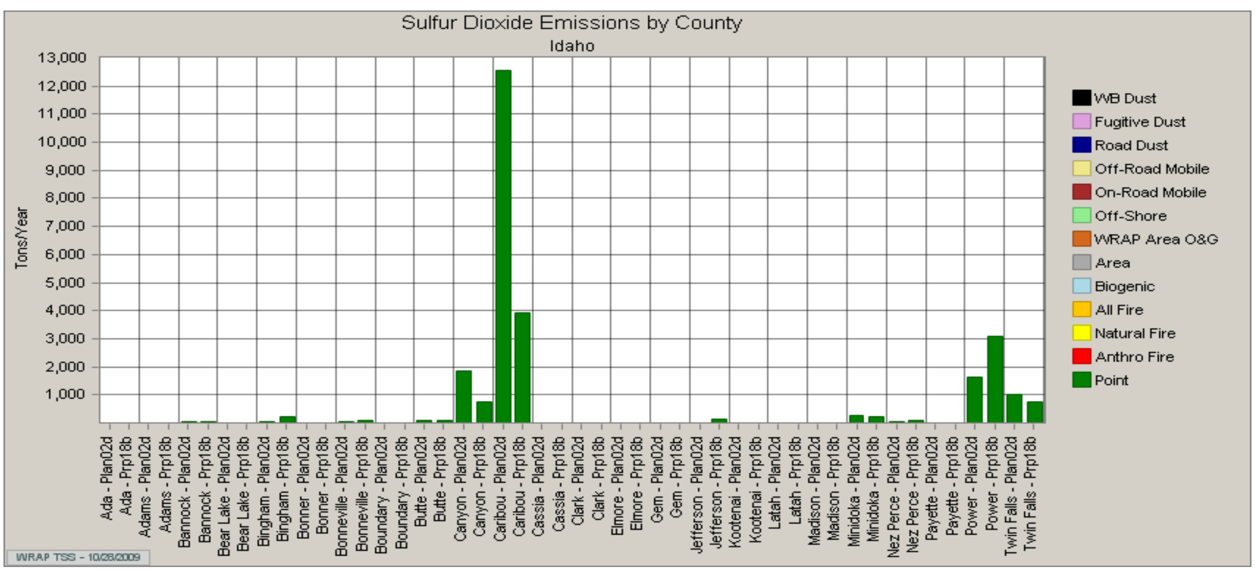

Figure 9-3 SOx Emissions, Difference Between 2002 Plan02d and 2018 Base Prp18b

Note that Figure 9-3 also shows the reduction of roughly 9,000 tons per year of SOx in Caribou County expected from the installation of BART technologies at P4 Production (formerly Monsanto).

The annual SOx emissions from the once-anticipated 500-megawatt coal-fired power plant were anticipated to be 1675 tons per year. Since the location of the anticipated power plant was so close to Craters of the Moon National Monument, even the relatively low concentration levels that would have resulted would have meant a relatively large change in sulfate levels expected from point sources, as project in the charts in Figure 9-1. In reality, the SOx impacts at Craters of the Moon National Monument should be declining due to large reductions from the point source category and from regulations that reduced the sulfur content in on- and off-road diesel fuel. Overall, there should be a reduction in future sulfate contributions coming from Idaho according to the WEP analysis as depicted in Figure 9-4 which shows roughly a 15% reduction.

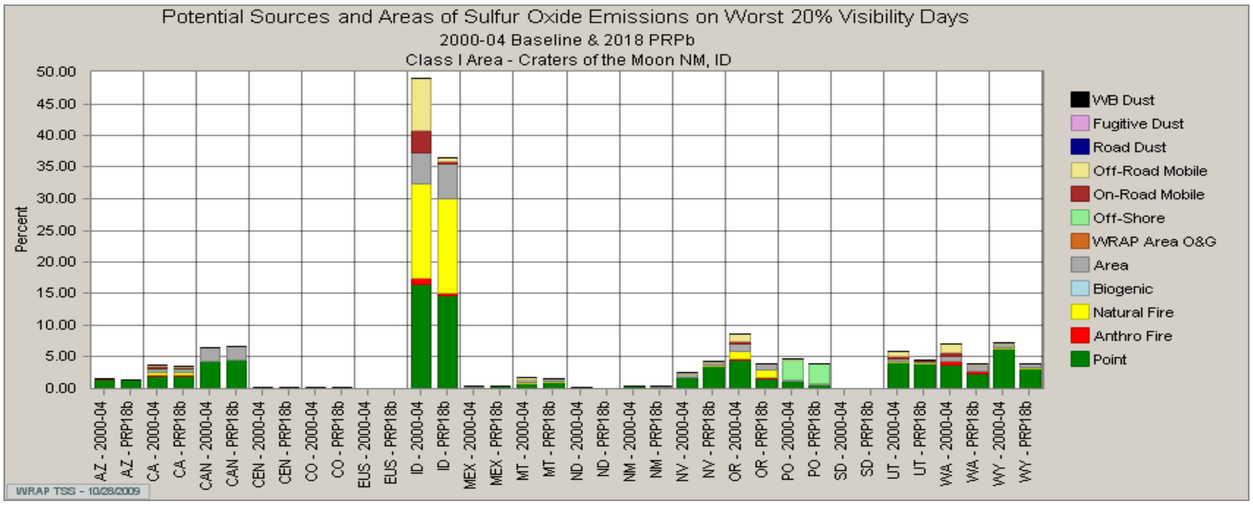

Figure 9-4 WEP SOx Craters of the Moon NM 20% Worst Days

The Regional Haze Rule requires no additional degradation during the 20% best days. Figure 9-5 shows improvement in sulfate contributions from all the WRAP states on the 20% best days from 2002 to 2018 (the 2002 bars on the chart are not labeled).

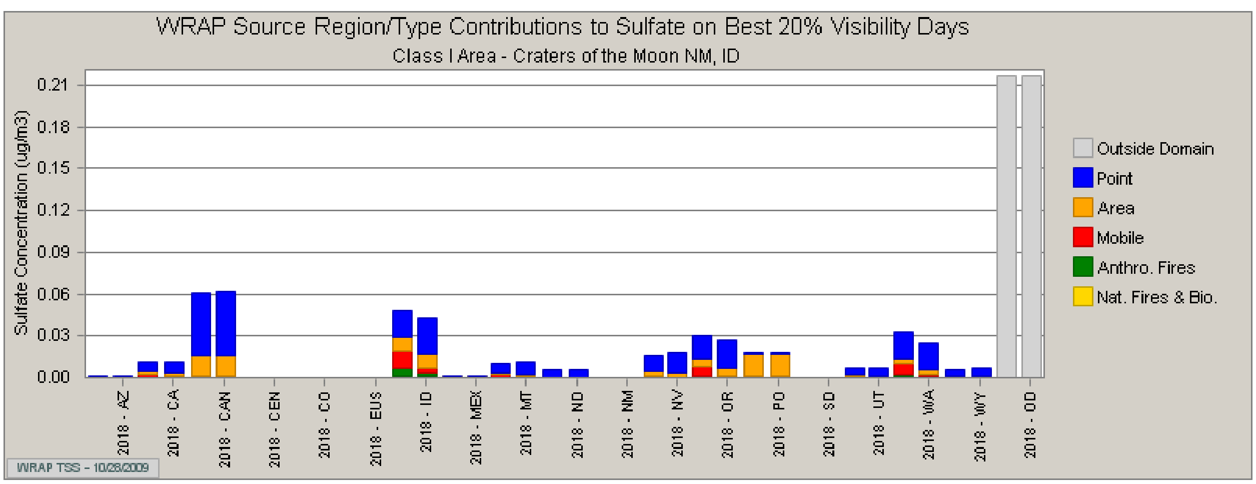

Figure 9-5 PSAT Sulfate Concentrations at Craters of the Moon National Monument 20% Best Days

Nitrate at Craters of the Moon National Monument Based on PSAT

Figure 9-6 shows the WRAP states contribute slightly more than 75% of the nitrates on the 20% worst days. As WRAP states reduce nitrate contributions over the first planning period ending in 2018, the contributions coming from outside the domain, offshore shipping, and Canadian emissions will have a greater impact. This will require regulator actions and negotiations outside the WRAP states control.

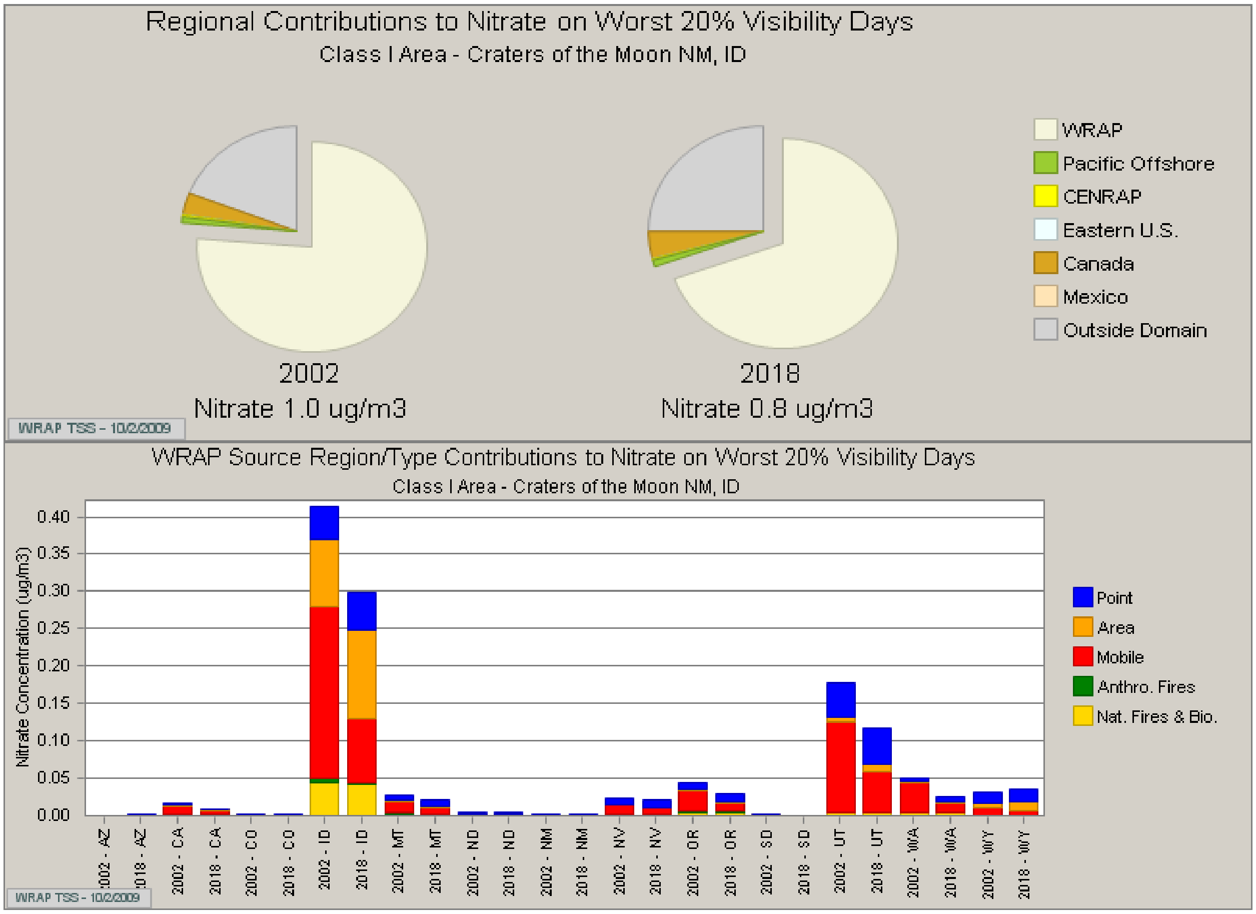

Figure 9-6 PSAT Sources of Nitrate Concentrations at Craters of the Moon National Monument
20% Worst days

Figure 9-6 shows Idaho as the largest contributor to nitrate concentrations at the Craters of the Moon National Monument on the 20% worst days. Overall, Idaho's nitrate emissions are expected to decline 28% over time primarily due to reductions in mobile emissions. Sulfate contribution from the WRAP states should drop 22%.

Because the overall nitrate concentrations are high and point source contributions from Idaho are not as large as contributions from other categories, the impact from adding an EGU in Jerome County did not show as significant an impact for nitrate as for sulfate. The combined graphs in figure 9-7 show the change in estimated emissions between the 2018 Base18b and the 2018 Prp18b emissions inventories. The 2018 Base 18b emissions inventory includes the once-anticipated power plant in Jerome County and is the emissions inventory that was used for the PSAT analysis. The 2018 Prp18b emissions inventory does not include the power plant in Jerome County due to the governor's

moratorium. (As with sulfate, the emissions projected in the 2018 Prp18b emissions inventory are too low to show at the scale of the chart.)

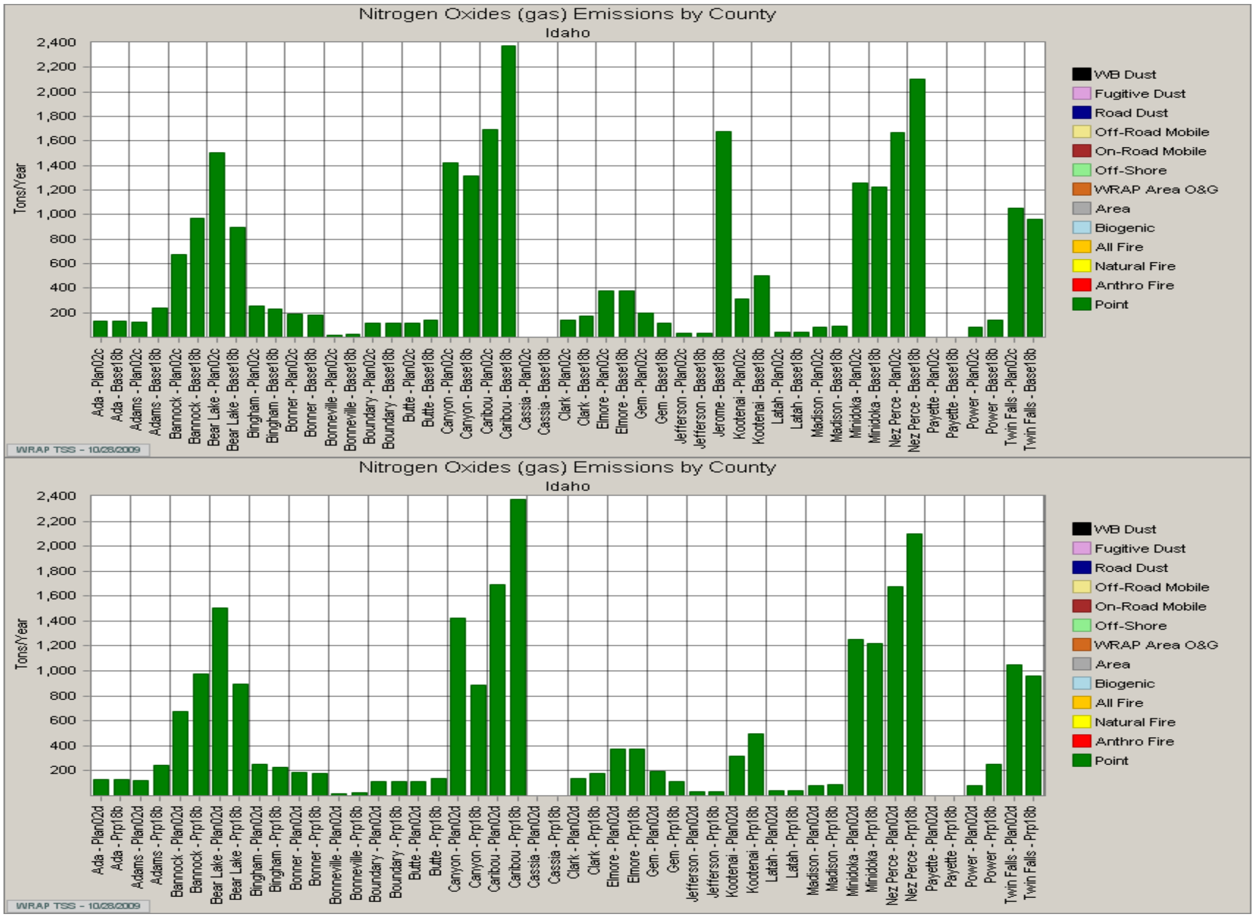

Figure 9-7 SOx Emissions Difference Between 2002 Plan02c and 2018base18b and Difference Between 2002 Plan02d and 2018base Prp18b

Figure 9-8 shows improvement in nitrate contributions coming from all states on the 20% best days at Craters of the Moon National Monument.

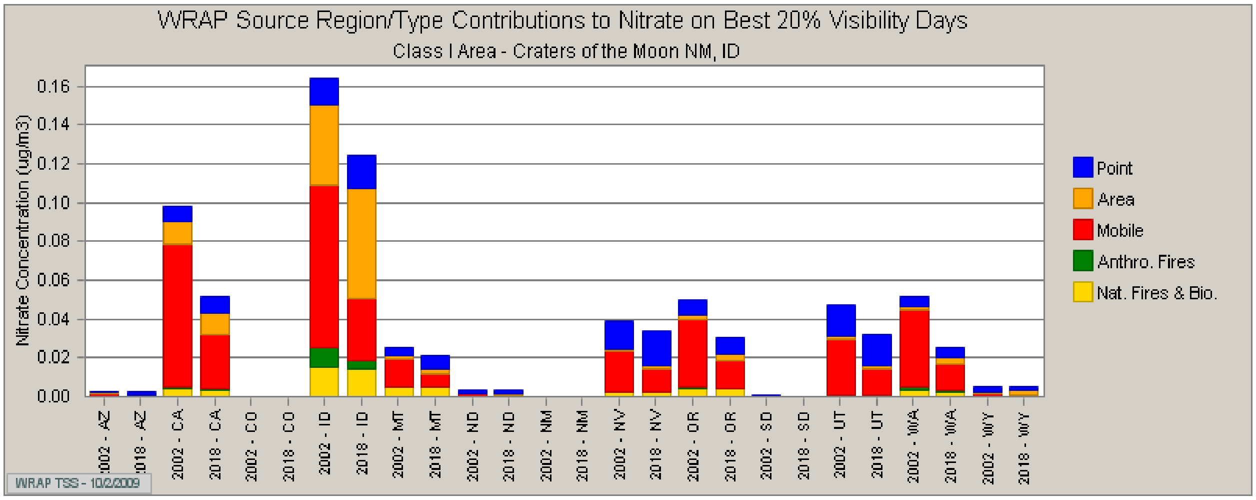

Figure 9-8 PSAT Nitrate Concentrations at Craters of the Moon National Monument 20% Best Days

Primary Organic Aerosol at Craters of the Moon National Monument Based on WEP

For the 20% worst days at Craters of the Moon National Monument, the chart in figure 9-9 shows Idaho as the largest contributor of primary organic aerosol, with almost all of of that contribution coming from natural fire. Reductions from anthropogenic fire are expected to reduce primary organic aerosol in the future.

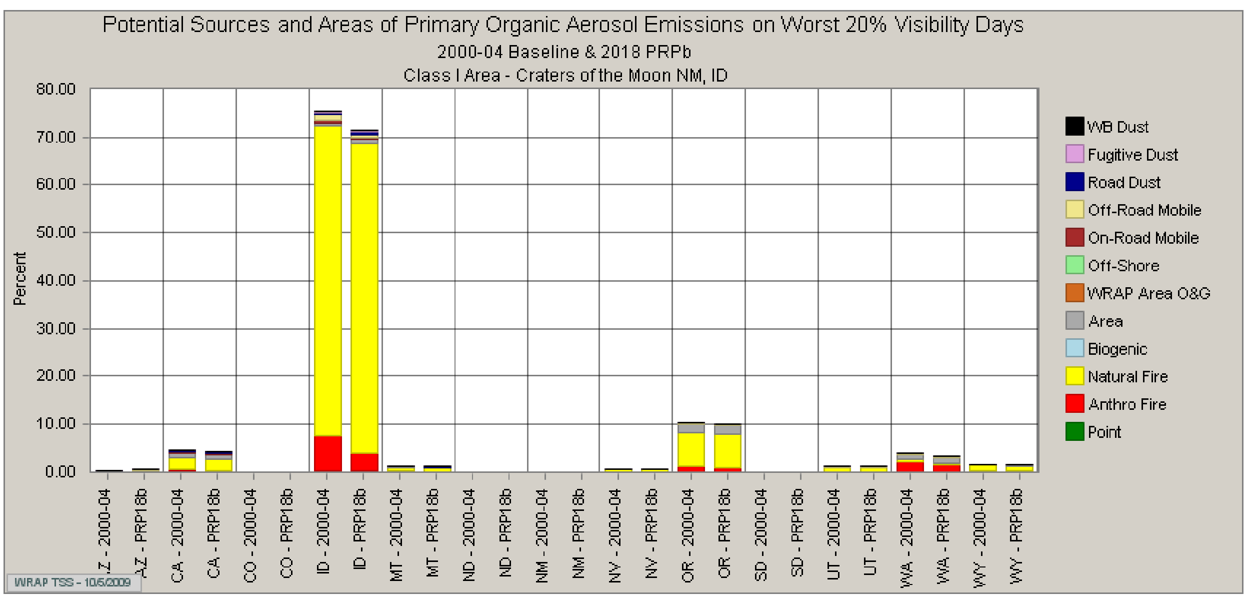

Figure 9-9 WEP Primary Organic Aerosol at Craters of the Moon NM 20% Worst Days

Figure 9-10 shows the largest percentage of primary organic aerosol on the 20% best days at Craters of the Moon National Monument is attributed to Idaho. Idaho's natural fire is the largest source, dwarfing all other sources. Overall, anticipated reductions from anthropogenic fire are the reasons for the expected improvement in most states.

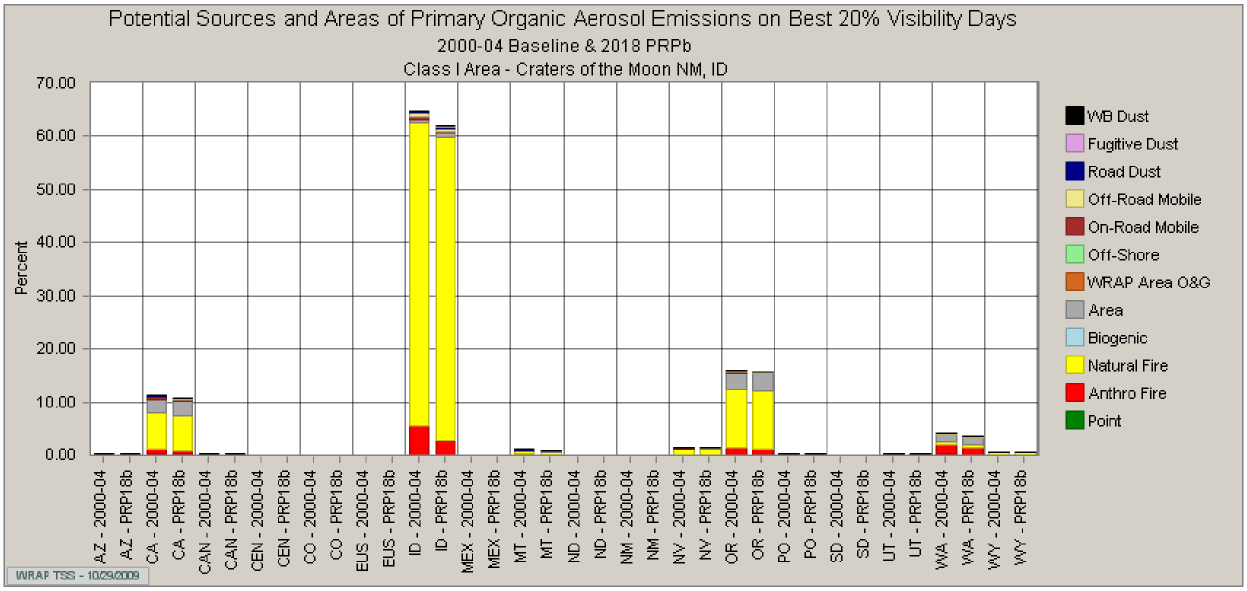

Figure 9-10 WEP Primary Organic Aerosol at Craters of the Moon NM 20% Best Days

Elemental Carbon at Craters of the Moon National Monument Based on WEP

For the 20% worst visibility days at Craters of the Moon National Monument, Idaho, there is a sizeable contribution of elemental carbon from natural fire. Idaho's overall elemental carbon contribution is expected to decline due to reductions from off-road mobile and anthropogenic fire as shown in figure 9-11.

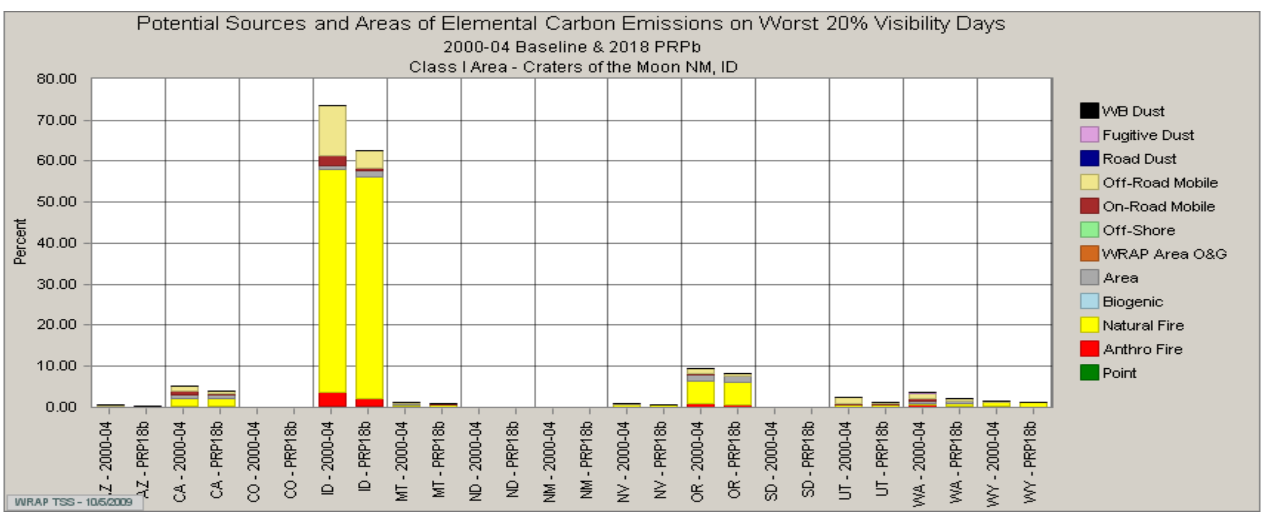

Figure 9-11 WEP Elemental Carbon at Craters of the Moon NM 20% Worst Days

For the 20% best visibility days at Craters of the Moon National Monument, Idaho also shows a sizeable contribution of elemental carbon from natural fire. Idaho's overall elemental carbon contribution is declining due to reductions from off-road mobile and

anthropogenic fire. All WRAP states showing an expected reduction in elemental carbon contributions over the first planning period as shown in figure 9-12.

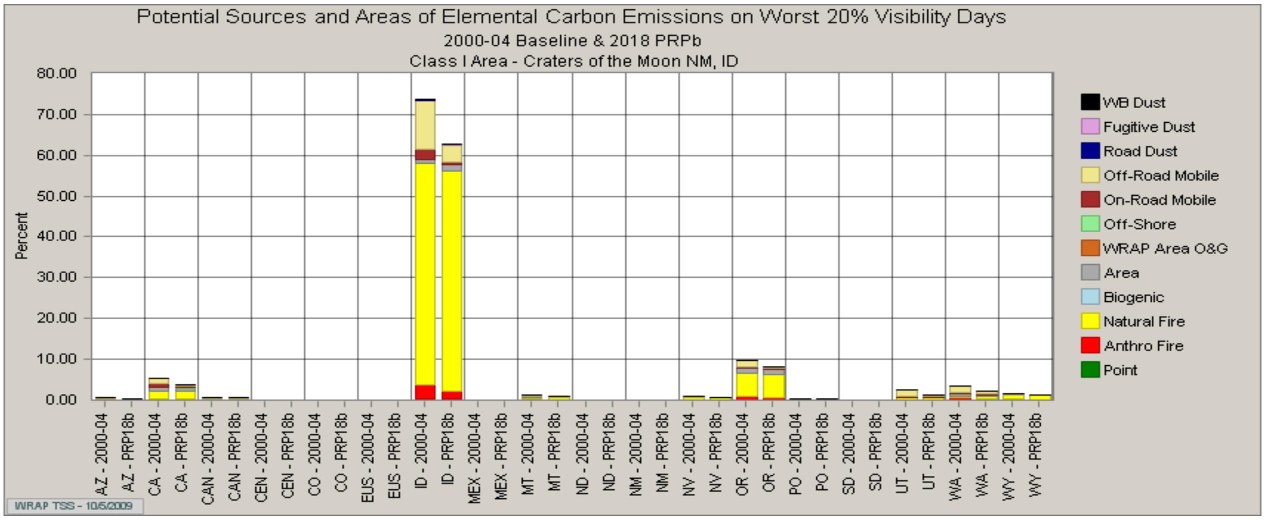

Figure 9-12 WEP Elemental Carbon at Craters of the Moon NM 20% Best Days

Fine Particulate Matter at Craters of the Moon National Monument Based on WEP

Figure 9-13 shows Idaho is by far the largest contributor of fine particulate matter at Craters of the Moon National Monument. The graph shows that future growth in area sources coming from Idaho is expected to outpace reductions from anthropogenic fire.

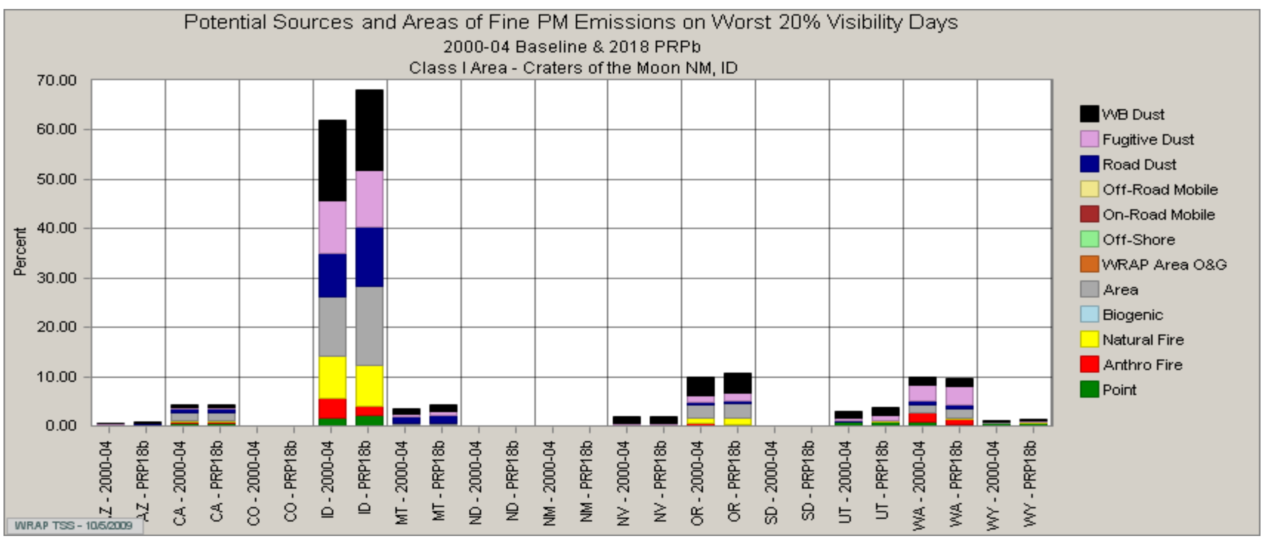

Figure 9-13 WEP Fine Particulate Matter at Craters of the Moon NM Worst 20% Days

Figure 9-14 shows expected future growth in fine particulate matter contributions on the 20% best visibility days at Craters of the Moon National Monument from the Idaho source categories of area and road dust.

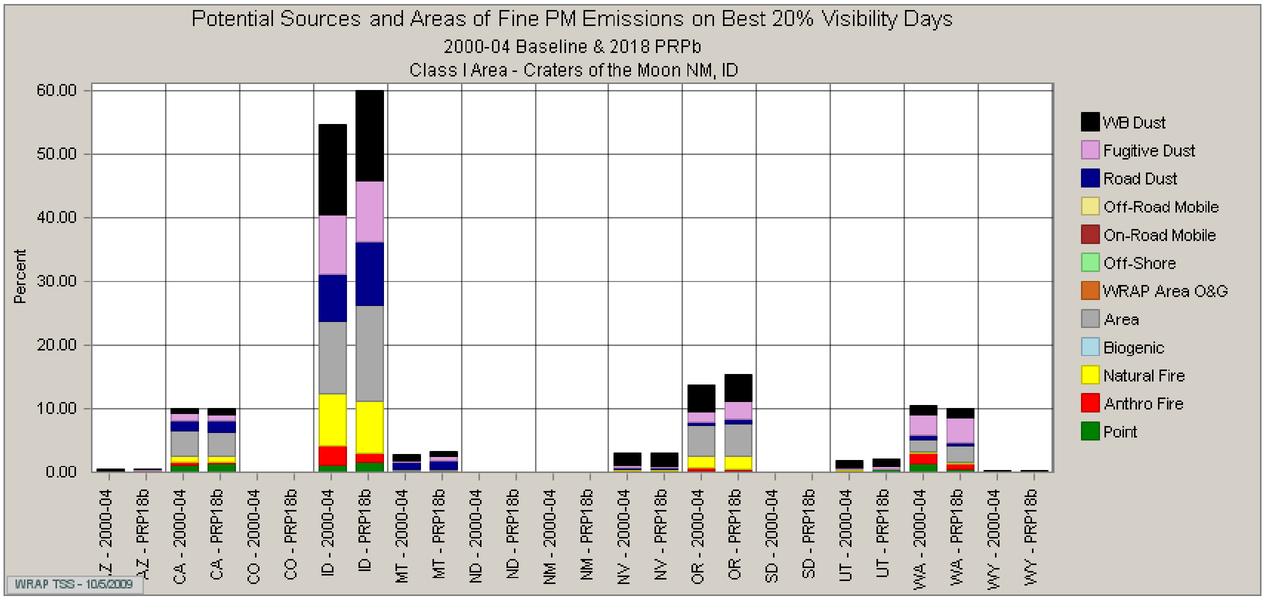

Figure 9-14 WEP Fine Particulate Matter at Craters of the Moon NM Best 20% Days

Coarse Particulate Matter at Craters of the Moon National Monument Based on WEP

As shown in Figure 9-15, for the 20% worst visibility days at Craters of the Moon National Monument, Idaho shows future growth in fine particulate matter contributions from vehicle miles traveled and the associated road dust. The increase is attributed to population growth that will be reflected in both area and road dust sources.

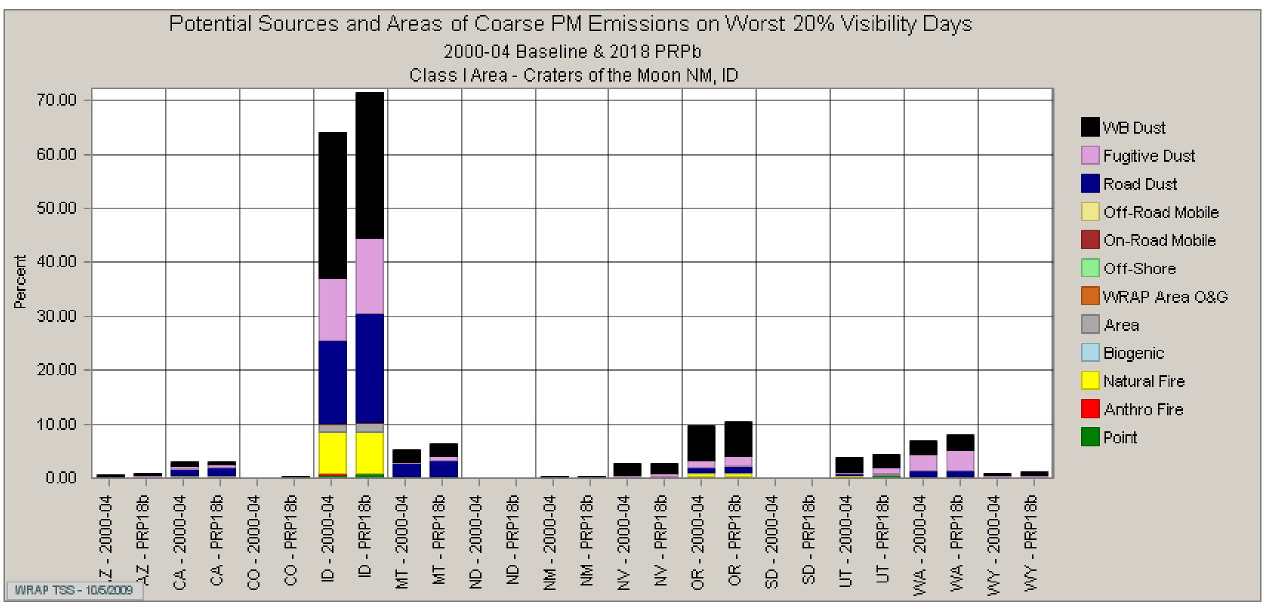

Figure 9-15 WEP Coarse Particulate Matter at Craters of the Moon NM 20% Worst Days

Figure 9-16 shows similar expected increases in coarse particulate matter from road dust on the 20% best visibility days.

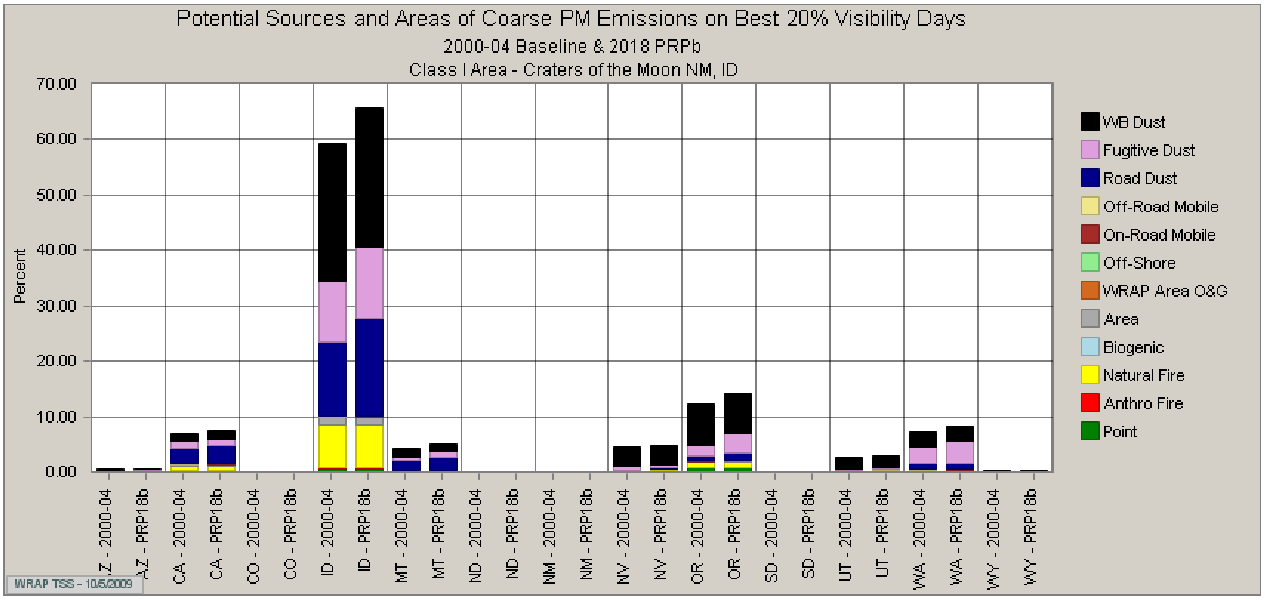

Figure 9-16 WEP Coarse Particulate Matter at Craters of the Moon National NM 20% Best Days

9.2.2 Hells Canyon Wilderness Source Apportionment

Sulfate at Hells Canyon Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-17 show the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-17 shows Idaho as the largest contributor of sulfate at Hells Canyon Wilderness with Oregon a close second. Overall, the concentration levels attributed to all the WRAP states is fairly low and decreasing over time due to reductions primarily from mobile sources. Idaho shows an overall reduction of roughly 6% expected over the first planning period and that is without the emissions from the EGU anticipated in Jerome County having been removed yet. (As discussed elsewhere in this plan, this EGU was a once-anticipated coal-fired power plant that is now unlikely to be built, so the anticipated emissions for it were removed from later projected emissions inventories.) The expected 6% reduction also does not include emission reductions expected from subject-to-BART sources. Idaho's anthropogenic sources will be contributing only 8% of the total sulfate at Hells Canyon Wilderness in 2018.

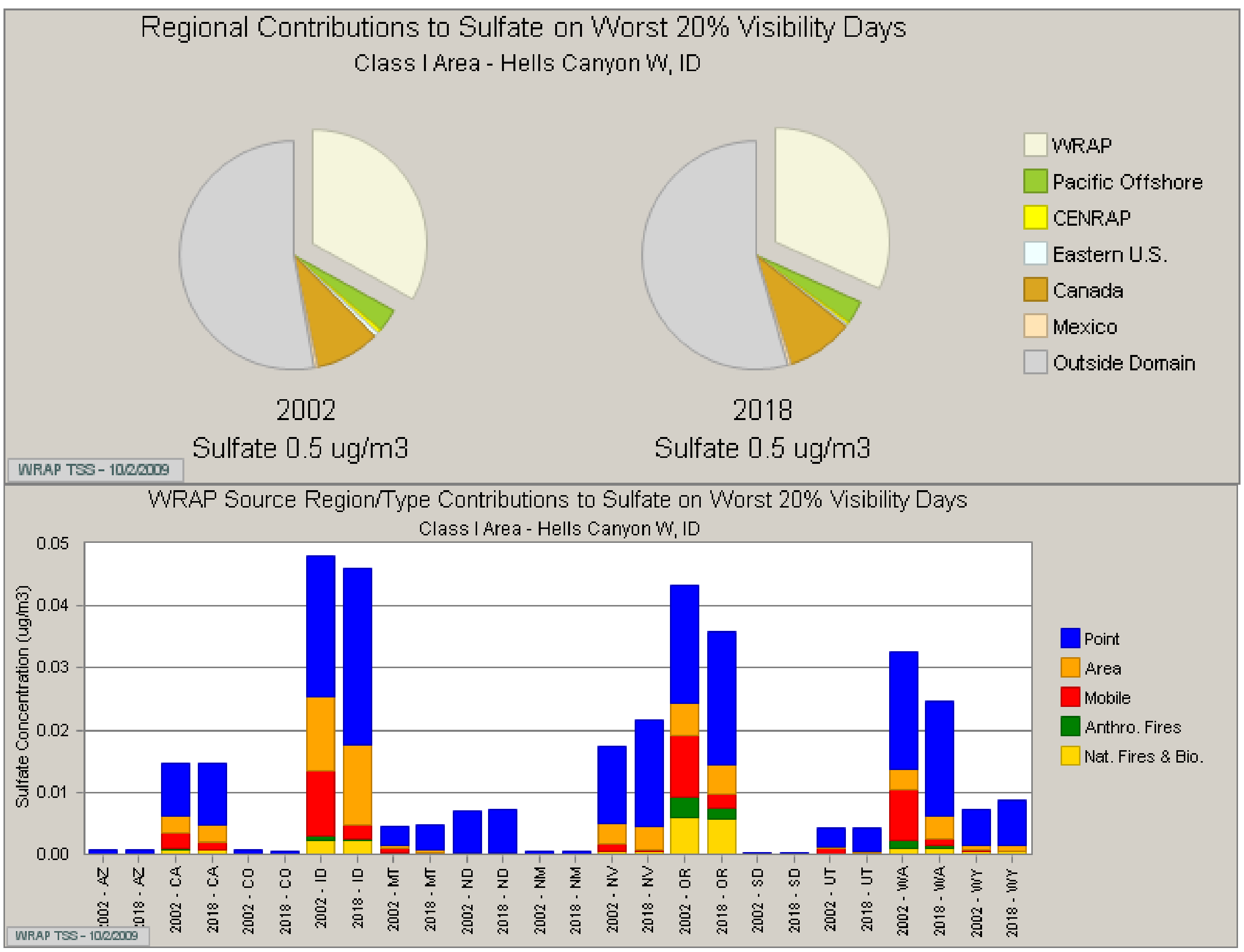

Figure 9-17 PSAT Sulfate Concentrations at Hells Canyon Wilderness 20% Worst Days

Figure 9-18 shows an overall expected improvement in sulfate concentrations attributed to all the WRAP states with the exception of Nevada. Future sulfate concentrations for the 20% best days are expected to drop during the first planning period.

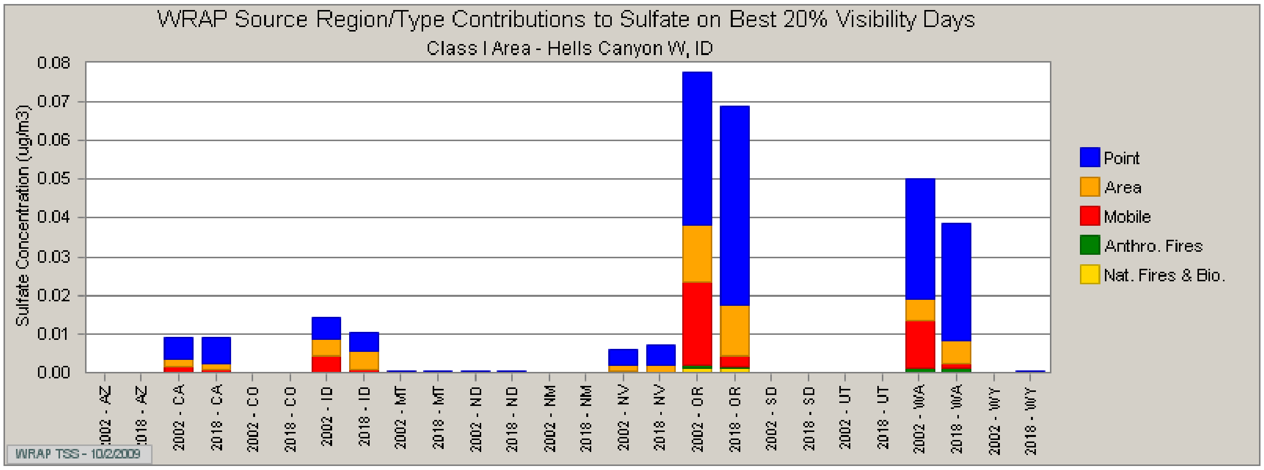

Figure 9-18 PSAT Sulfate Concentrations at Hells Canyon Wilderness 20% Best days

Nitrate at Hells Canyon Wilderness Based on PSAT Modeling

Figure 9-19 shows that overall expected concentrations of nitrates are much higher than for sulfates with a greater concentration of nitrates than sulfates coming from WRAP states. This is important to note because having higher concentrations and higher contributions from WRAP states offers the opportunity for more control over future visibility improvements.

Figure 9-19 also shows Idaho is expected to contribute 35% of the nitrates followed by Oregon with 12%. Idaho's higher expected concentrations are projected to occur during high stagnation periods where the air mass is slowly moving from the Treasure Valley and Snake River plain toward Hells Canyon. This is explained in the BART modeling analysis in Chapter 10. During the first planning period, Idaho is expecting to reduce nitrate concentration contributions to Hells Canyon Wilderness by roughly 20%. Overall, a 21% improvement from WRAP states is anticipated. See Appendix E (Hells Canyon Wilderness) for details.

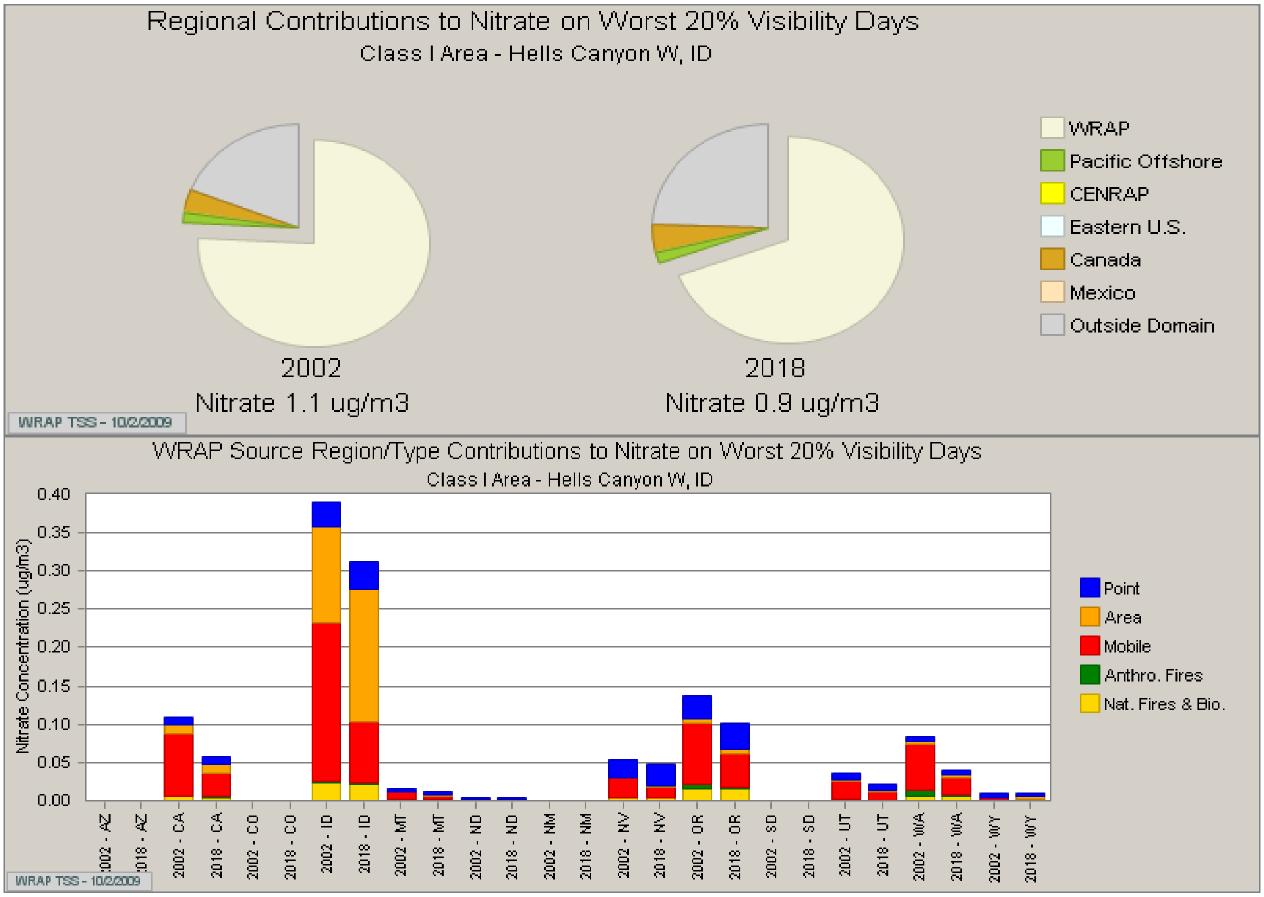

Figure 9-19 PSAT Nitrate Concentrations at Hells Canyon Wilderness 20% Worst Days

Figure 9-20 shows an expected decrease in nitrate concentrations from all WRAP states at Hells Canyon Wilderness on the 20% best visibility days.

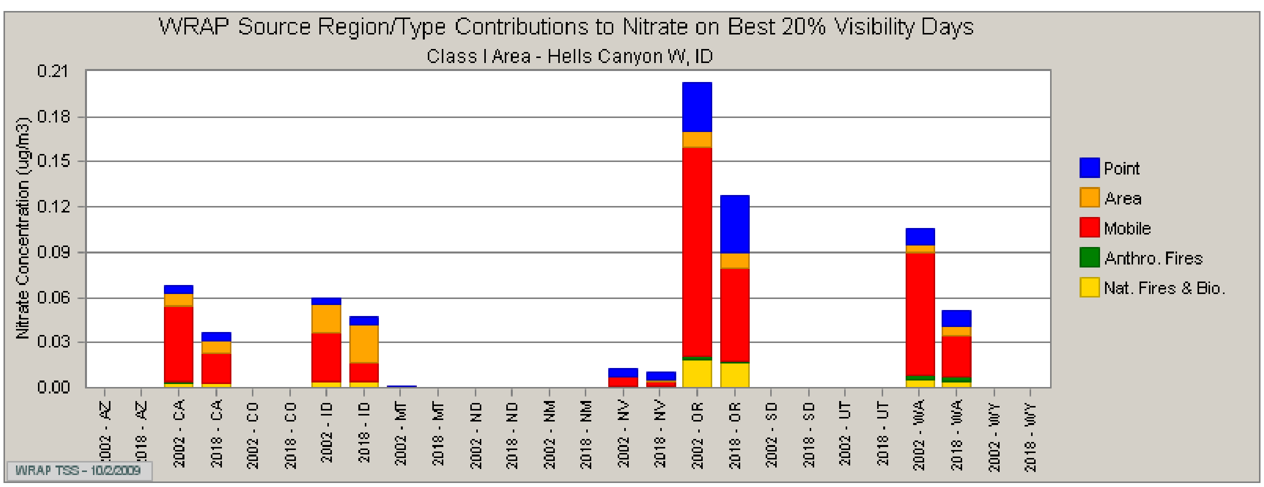

Figure 9-20 PSAT Nitrate Concentrations at Hells Canyon Wilderness 20% Best Days

Primary Organic Aerosol at Hells Canyon Wilderness Based on WEP

For the 20% worst visibility days at Hells Canyon Wilderness, Idaho shows a sizeable expected contribution of primary organic aerosol from natural fire as shown in figure 9-21. Idaho's overall contribution is expected to decline over time due to reductions from anthropogenic fire. Oregon shows less impact and similar reductions expected over time.

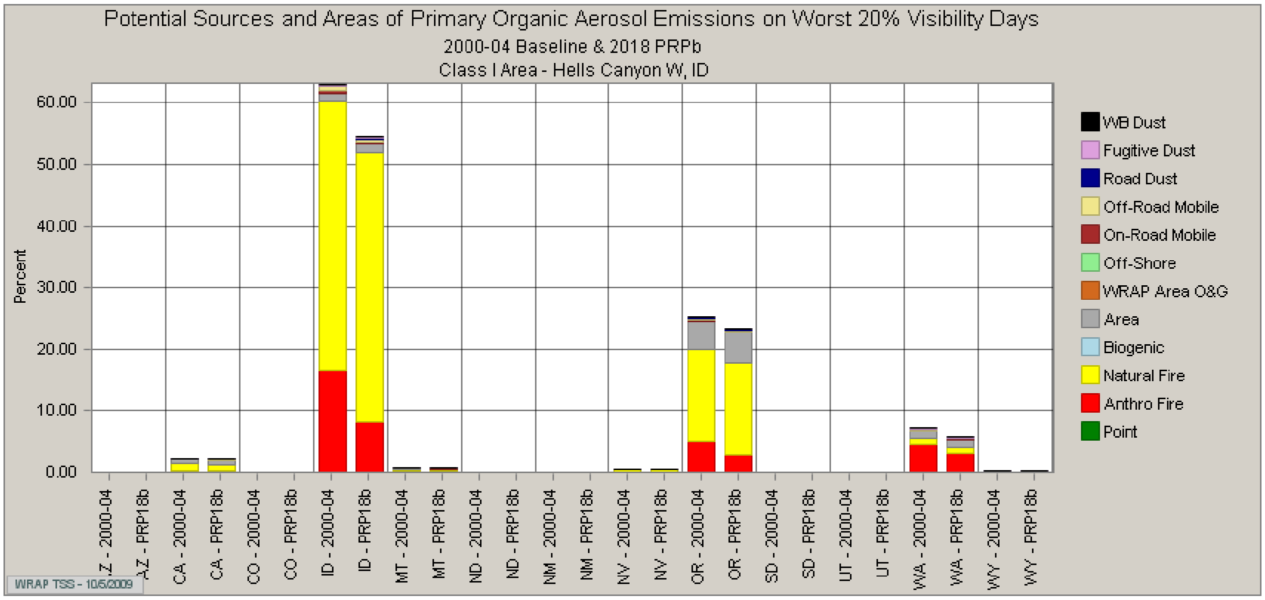

Figure 9-21 WEP Primary Organic Aerosol at Hells Canyon Wilderness 20% Worst Days

Figure 9-22 shows expected improvements in primary organic aerosols from all WRAP states on the 20% best visibility days.

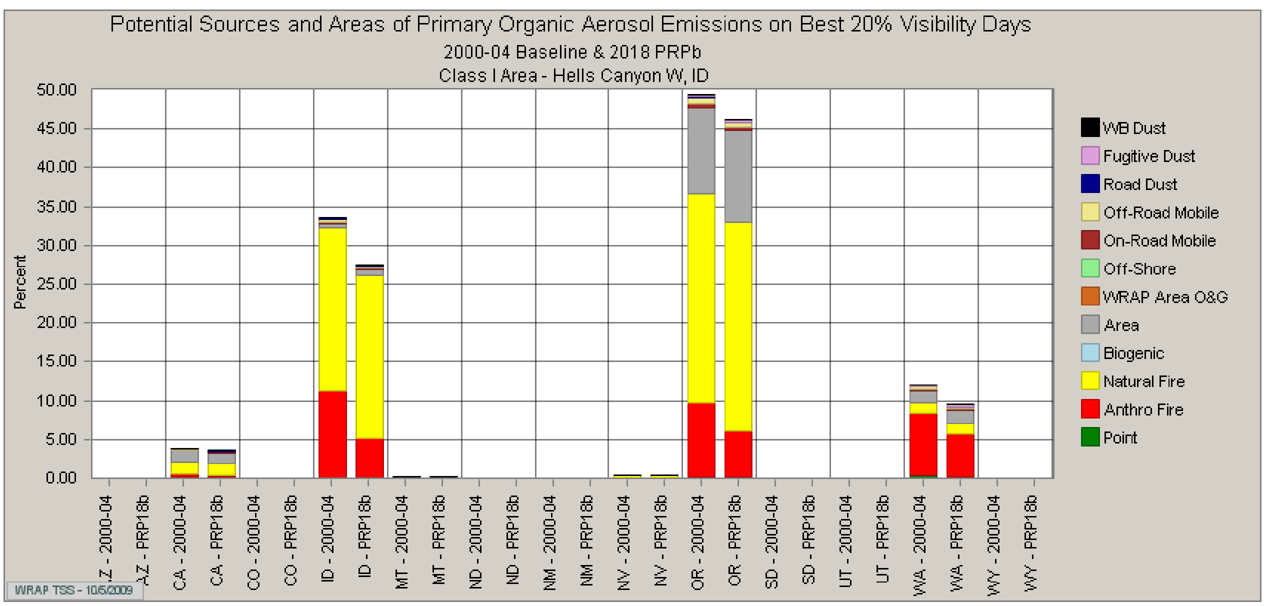

Figure 9-22 WEP Primary Organic Aerosol at Hells Canyon Wilderness20% Best Days

Elemental Carbon at Hells Canyon Wilderness Based on WEP

For the 20% worst visibility days at Hells Canyon Wilderness, Idaho shows a sizeable contribution of elemental carbon from natural fire is expected. Idaho's overall elemental carbon contribution is expected to decline due to reductions from off-road mobile and anthropogenic fire as shown in figure 9-23. Oregon shows less impact but similar results expected.

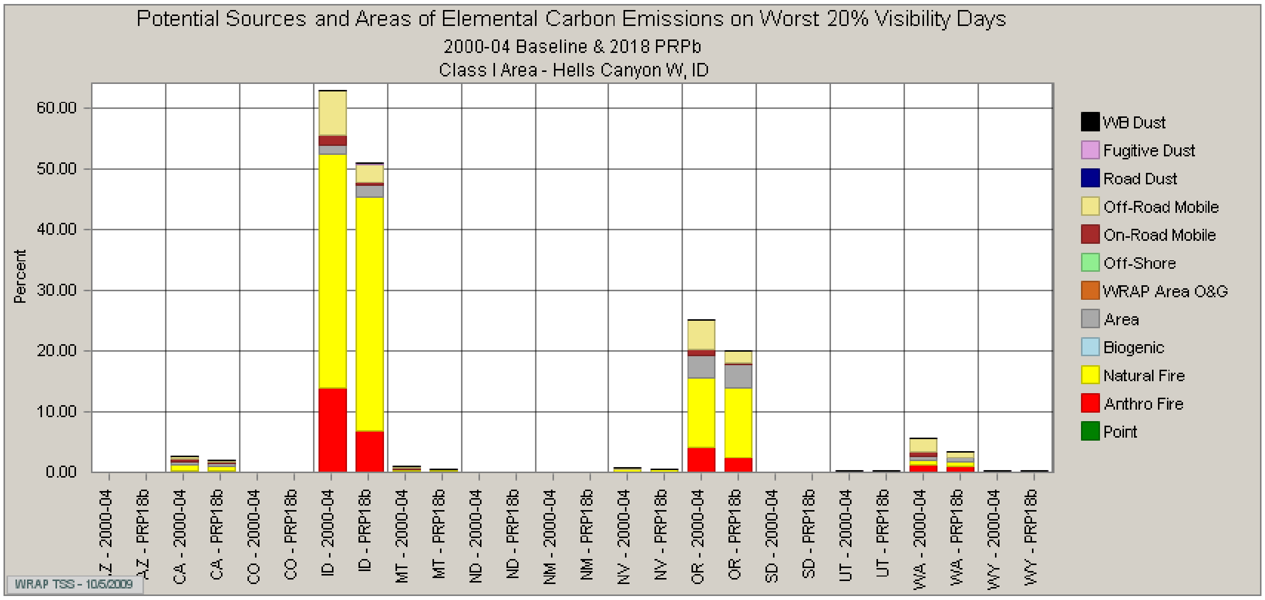

Figure 9-23 WEP Elemental Carbon at Hells Canyon Wilderness 20% Worst Days

Figure 9-24 shows expected improvements in elemental carbon from all WRAP states on the 20% best visibility days.

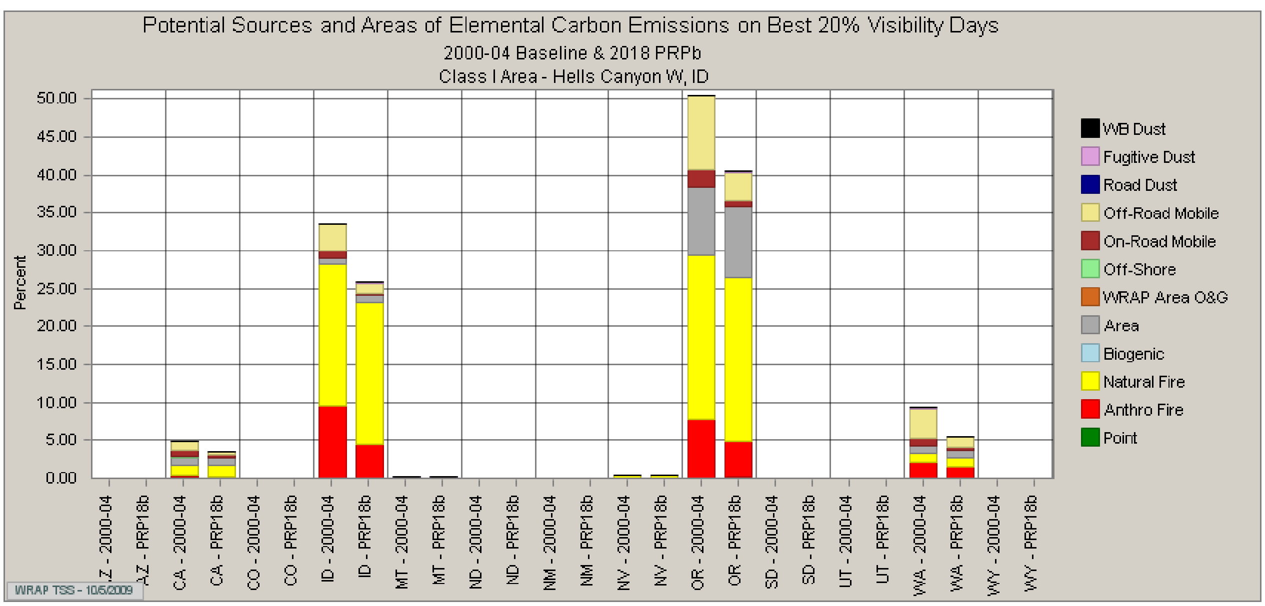

Figure 9-24 WEP Elemental Carbon at Hells Canyon Wilderness 20% Best Days

Fine Particulate Matter at Hells Canyon Wilderness Based on WEP

Figure 9-25 shows Idaho followed by Oregon are the largest contributors of fine particulate matter to Hells Canyon Wilderness on the 20% worst visibility days. Overall, Oregon and Idaho show increased contributions expected in the future due to growth in road dust even though there are slight decreases expected from anthropogenic fire.

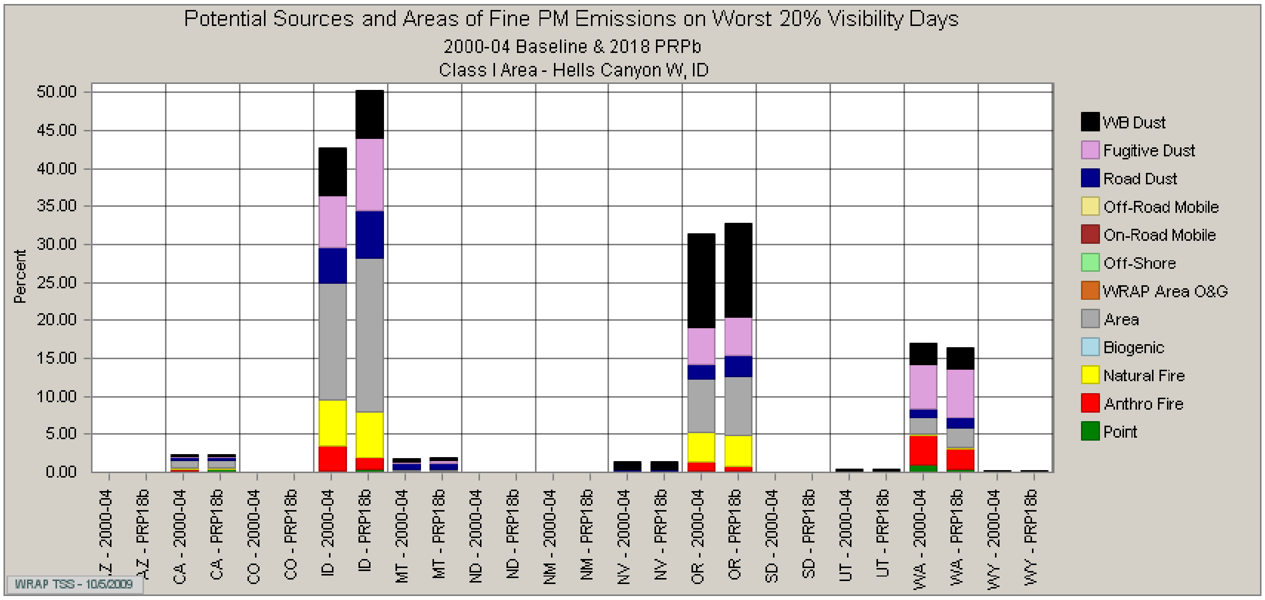

Figure 9-25 WEP Fine Particulate Matter at Hells Canyon Wilderness Worst 20% Days

On the 20% best visibility days at Hells Canyon Wilderness area, growth in contributions from both Idaho and Oregon and decreases coming from Washington are expected, as shown in Figure 9-26. The increases are expected to come from the source categories of area and point sources. Overall, Oregon and Washington are showing a greater impact than Idaho.

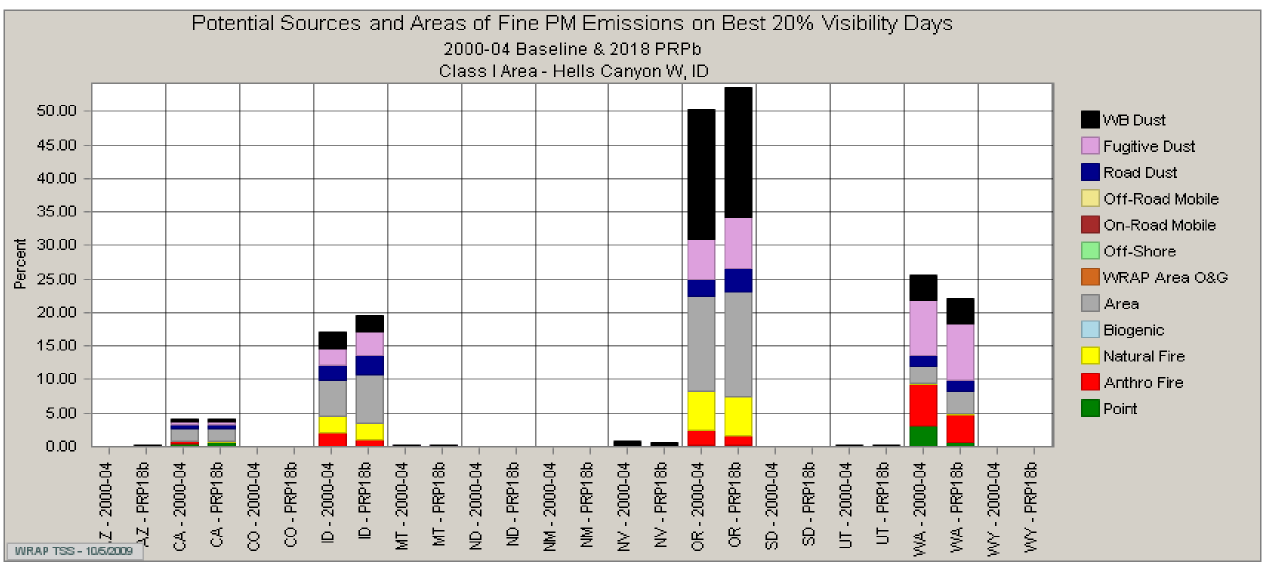

Figure 9-26 WEP Fine Particulate Matter at Hells Canyon Wilderness Best 20% Days

Coarse Particulate Matter at Hells Canyon Wilderness Based on WEP

Figure 9-27 shows the largest impact of coarse particulate on the 20% worst visibility days is coming from Idaho, followed by Oregon and then Washington. All three states are expecting future growth from fugitive dust and Idaho and Washington from road dust.

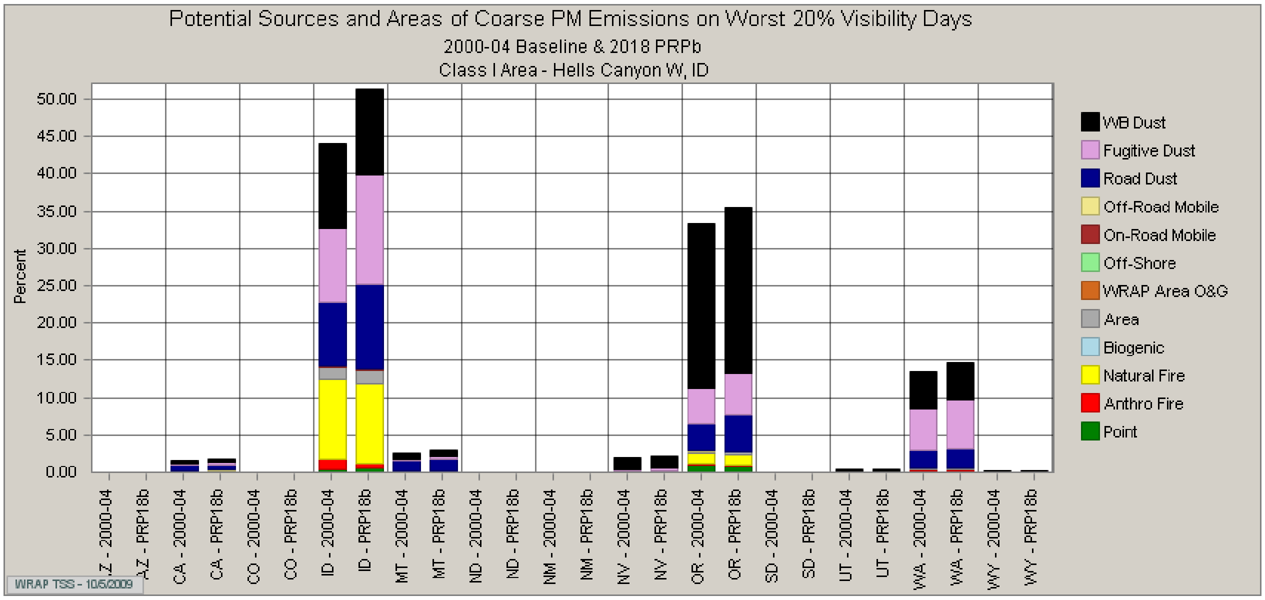

Figure 9-27 WEP Coarse Particulate Matter at Hells Canyon Wilderness 20% Worst Days

During the 20% best visibility days at Hells Canyon Wilderness, the air mass is primarily expected to come from the west as shown by the change in states' contributions with Oregon showing the greatest expected impact followed by Idaho and Washington. Figure 9-28 shows all three states are expecting growth in fugitive dust emissions. Idaho and Washington are also expecting to have slight increases in road dust.

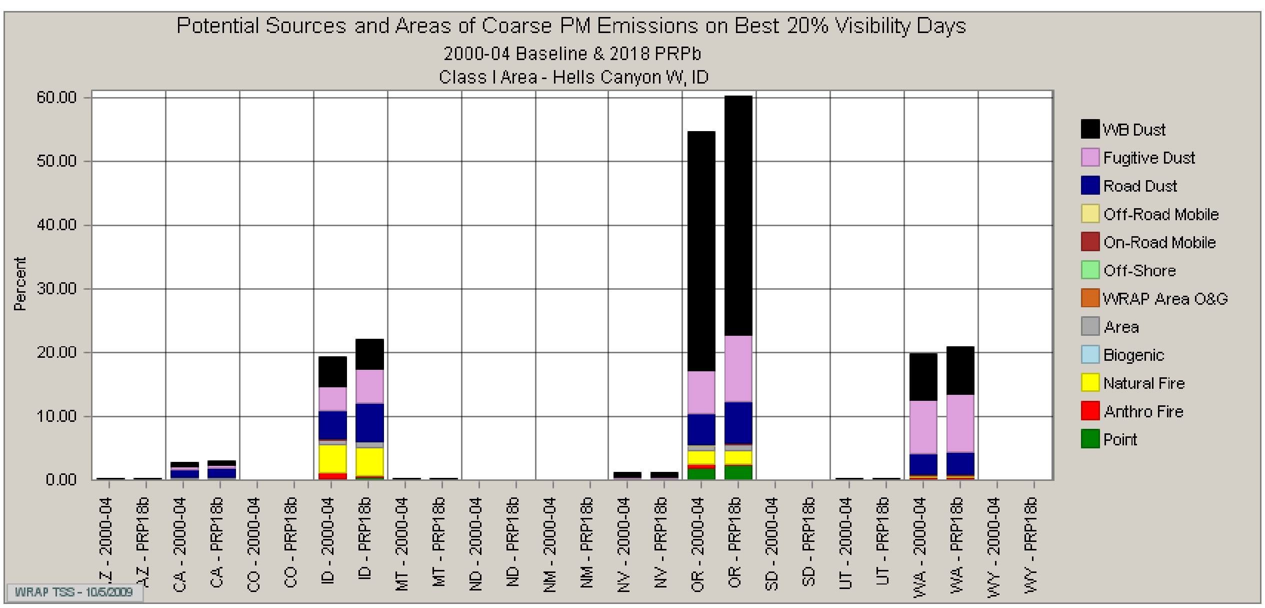

Figure 9-28 WEP Coarse Particulate Matter at Hells Canyon Wilderness20% Best Days

9.2.3 Sawtooth Wilderness Source Apportionment

Sulfate at Sawtooth Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-29 show the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-29 shows Oregon and then Idaho are the largest contributors of sulfate at Sawtooth Wilderness; from these two states, contributions from anthropogenic sources are 5%, which is slightly more than Pacific offshore contributions. See Appendix E (Sawtooth Wilderness) for details. Overall, the expected concentration levels attributed to all the WRAP states are fairly low and decreasing over time due to reductions expected primarily from mobile sources. Idaho shows an expected overall reduction of roughly 15% over the first planning period and that is without the emissions from the EGU anticipated in Jerome County having been removed yet. (As discussed elsewhere in this plan, this EGU was a once-anticipated coal-fired power plant that is now unlikely to be built, so the anticipated emissions for it were removed from later projected emissions inventories.) The expected 15% reduction also does not include emissions reductions expected from subject-to-BART sources. It is also worth noting that Idaho point sources are expected to contribute less emissions than the combination of areas that are offshore and outside the modeling domain.

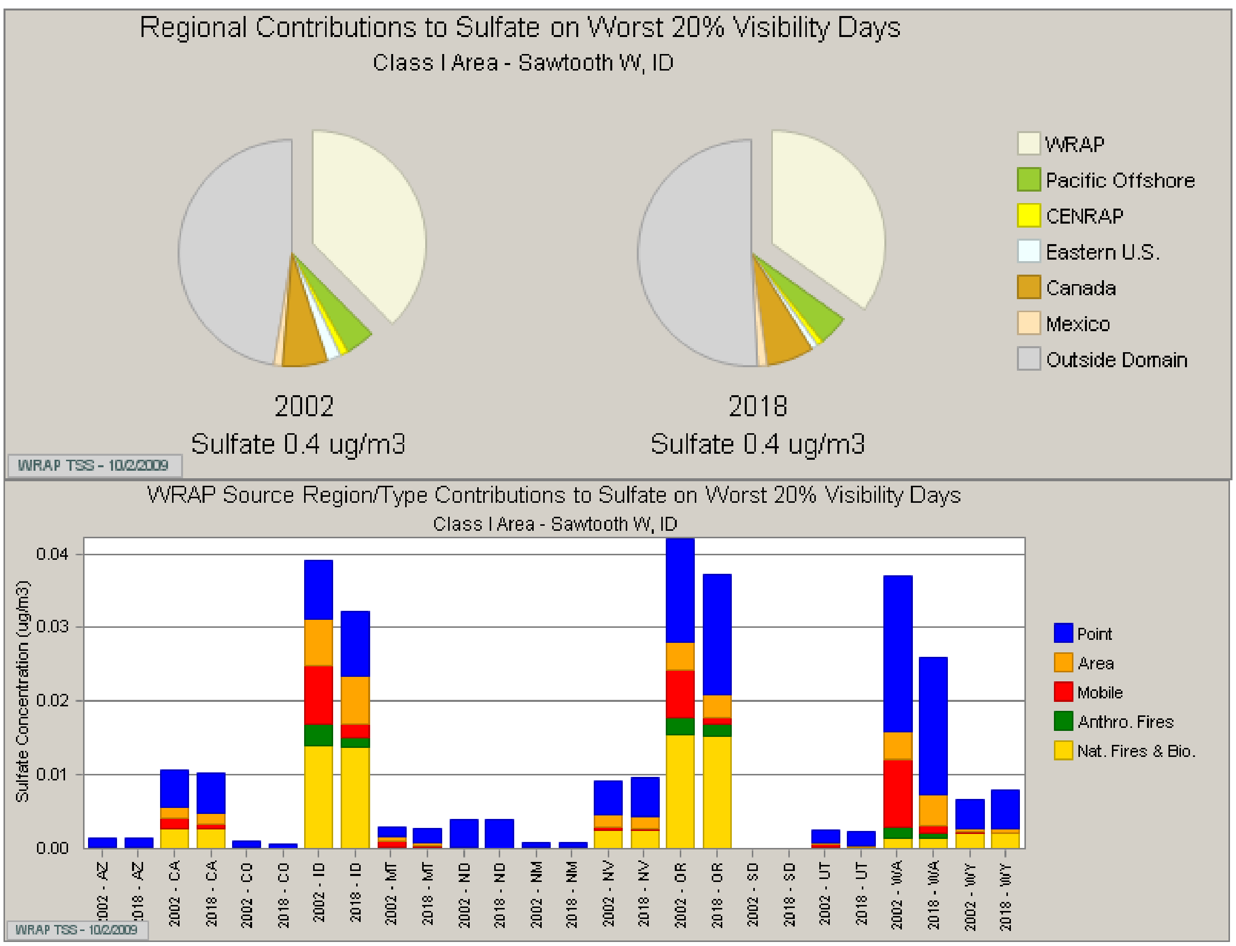

Figure 9-29 PSAT Sulfate Concentrations at Sawtooth Wilderness 20% Worst Days

Figure 9-30 shows very low concentrations of sulfate expected to come from all WRAP states during the 20% best visibility days. Overall, concentrations are expected to go down with only a slight increase expected from Nevada.

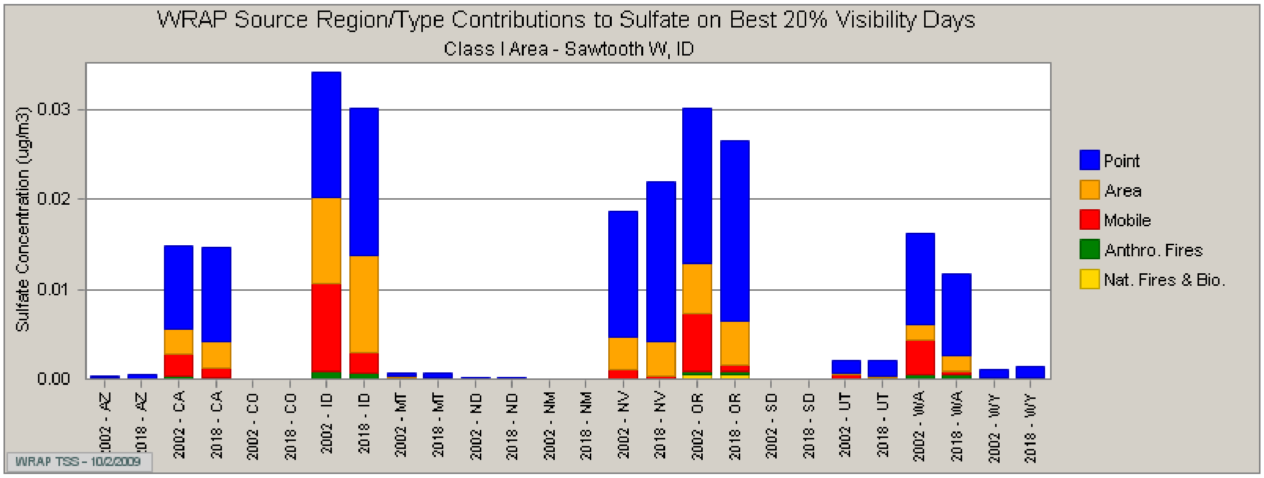

Figure 9-30 PSAT Sulfate Concentrations at Sawtooth 20% Best Days

Nitrate at Sawtooth Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-31 show the WRAP states are expected to contribute roughly two thirds of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-31 shows Idaho and then Washington and Oregon as the largest expected contributors of nitrate at Sawtooth Wilderness. Overall, the concentration levels attributed to all the WRAP states are very low and decreasing over time due to reductions primarily from mobile sources. Idaho shows an overall reduction of roughly 17% over the first planning period and that is without the emissions from the EGU anticipated in Jerome County having been removed yet (see discussion of the once-anticipated EGU on the previous page). The expected 17% reduction also does not include emissions reductions expected from subject-to-BART sources.

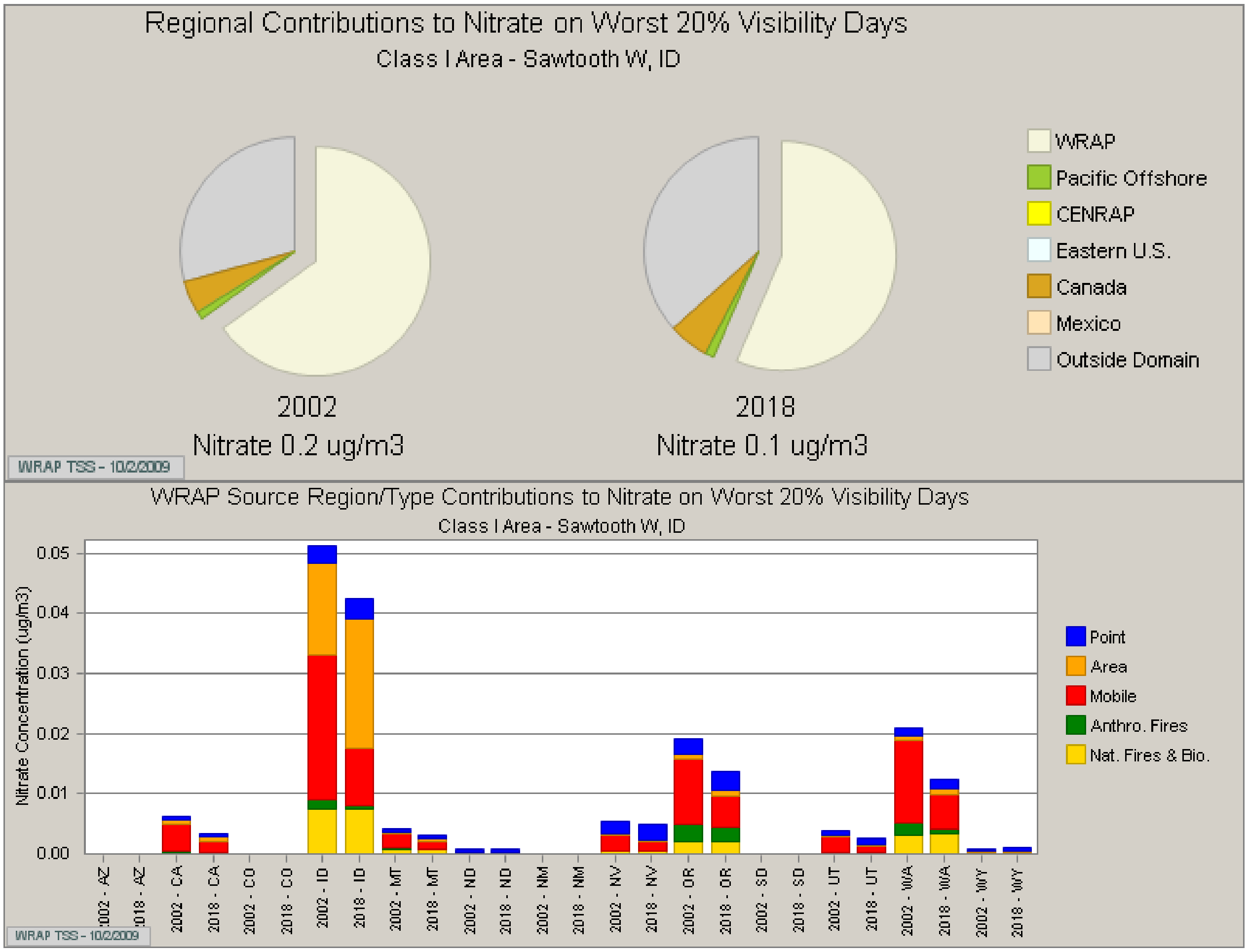

Figure 9-31 PSAT Nitrate Concentrations at Sawtooth 20% Worst Days

Figure 9-32 shows very low concentrations of nitrate expected from all WRAP states on the 20% best visibility days at Sawtooth Wilderness. All the WRAP states are expecting reductions in future contributions, so overall the 20% best days should be improving.

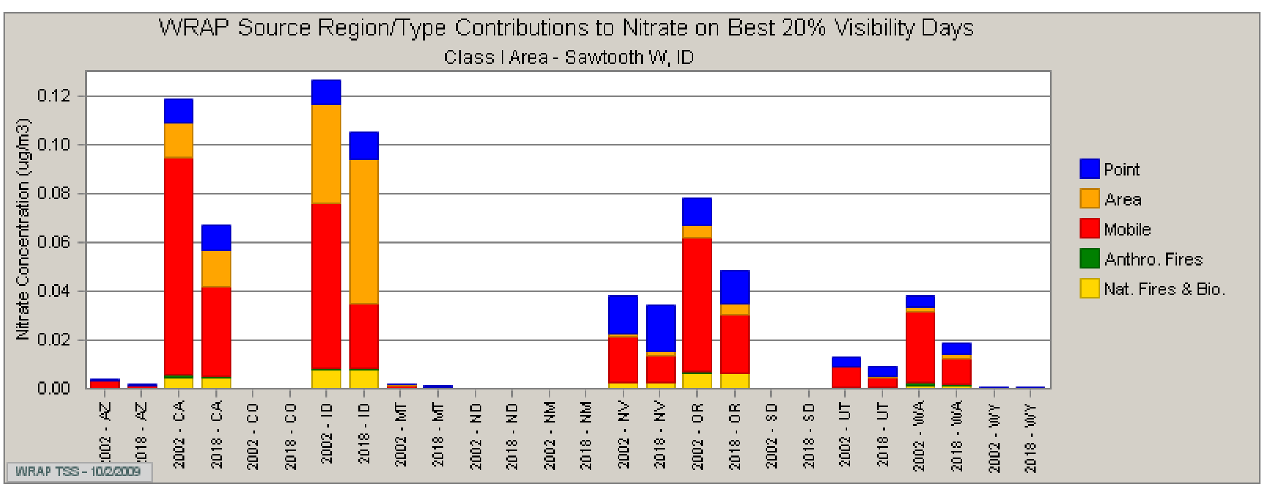

Figure 9-32 PSAT Nitrate Concentrations at Sawtooth 20% Best Days

Primary Organic Aerosol at Sawtooth Wilderness Based on WEP

For the 20% worst visibility days at Sawtooth Wilderness, Idaho shows a sizeable contribution of primary elemental aerosol coming from natural fire as shown in figure 9-33. Idaho's overall contribution is expected to decline over time due to reductions from anthropogenic fire as shown. Oregon is showing a small contribution and similar reductions expected over time.

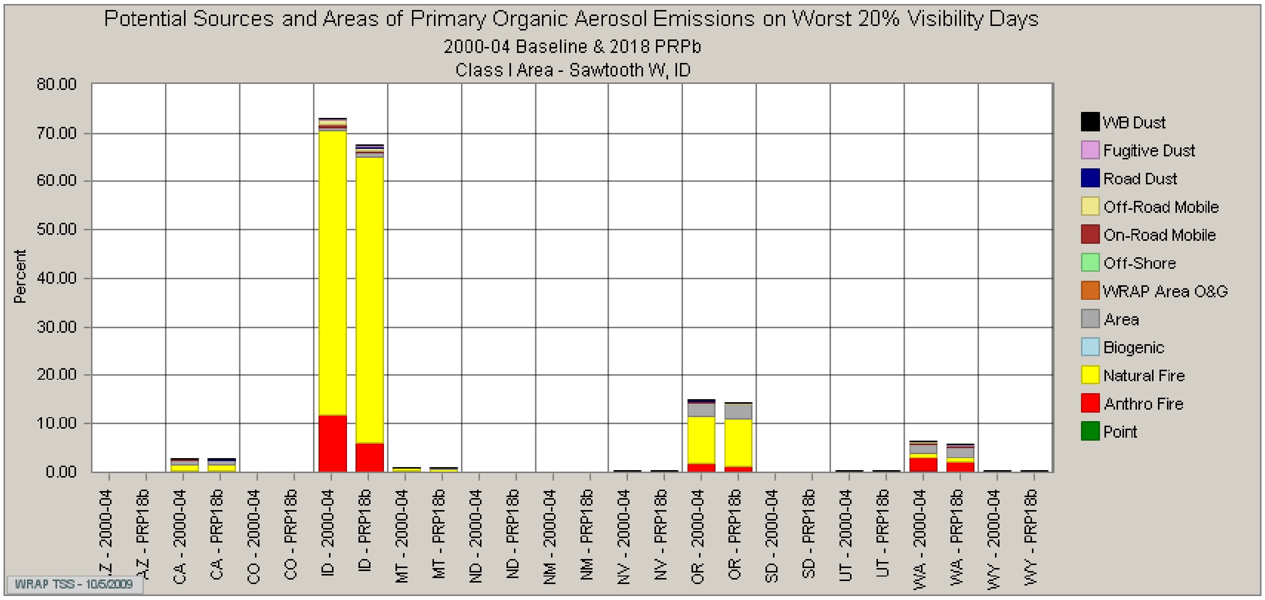

Figure 9-33 WEP Primary Organic Aerosol at Sawtooth Wilderness 20% Worst Days

Idaho is expected to contribute a large contribution of the primary organic aerosol at the Sawtooth Wilderness area on the 20% best visibility days as shown in figure 9-34. Overall, the primary organic aerosol is expected to go down at the Sawtooth Wilderness area on the 20% best visibility days.

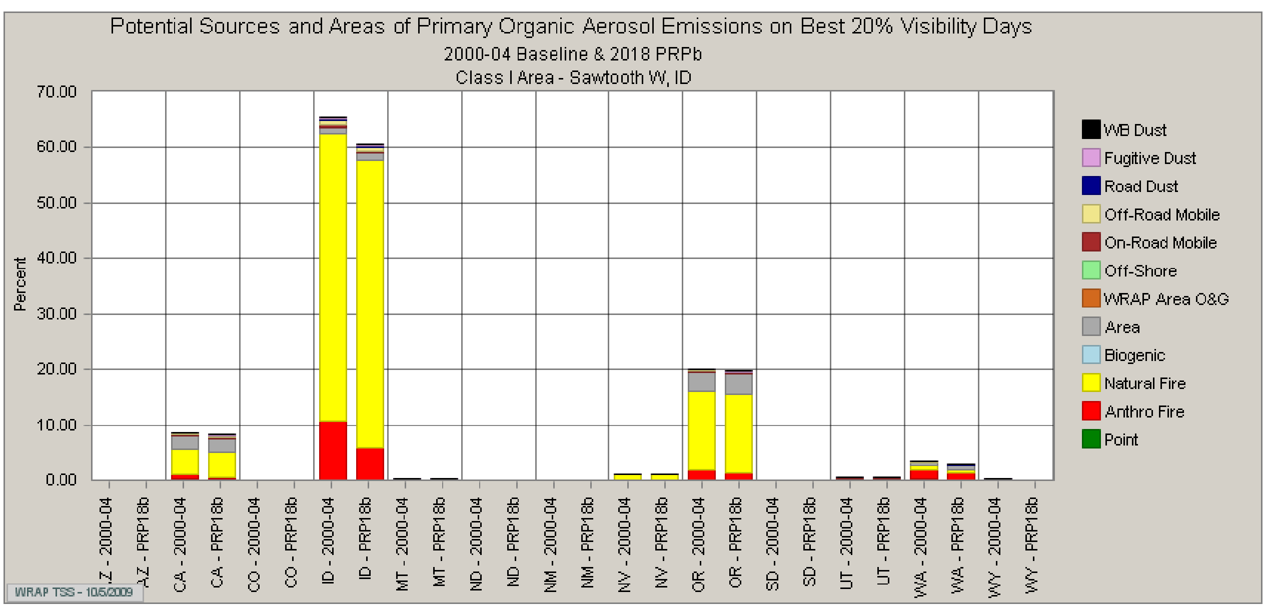

Figure 9-34 WEP Primary Organic Aerosol at Sawtooth Wilderness 20% Best Days

Elemental Carbon at Sawtooth Wilderness Based on WEP

For the 20% worst visibility days at Sawtooth Wilderness, Idaho shows a sizeable contribution to elemental carbon expected to come from natural fire as shown in Figure 9-35. Idaho and the other WRAP states' overall contribution is expected to decline over time due to reductions from anthropogenic fire.

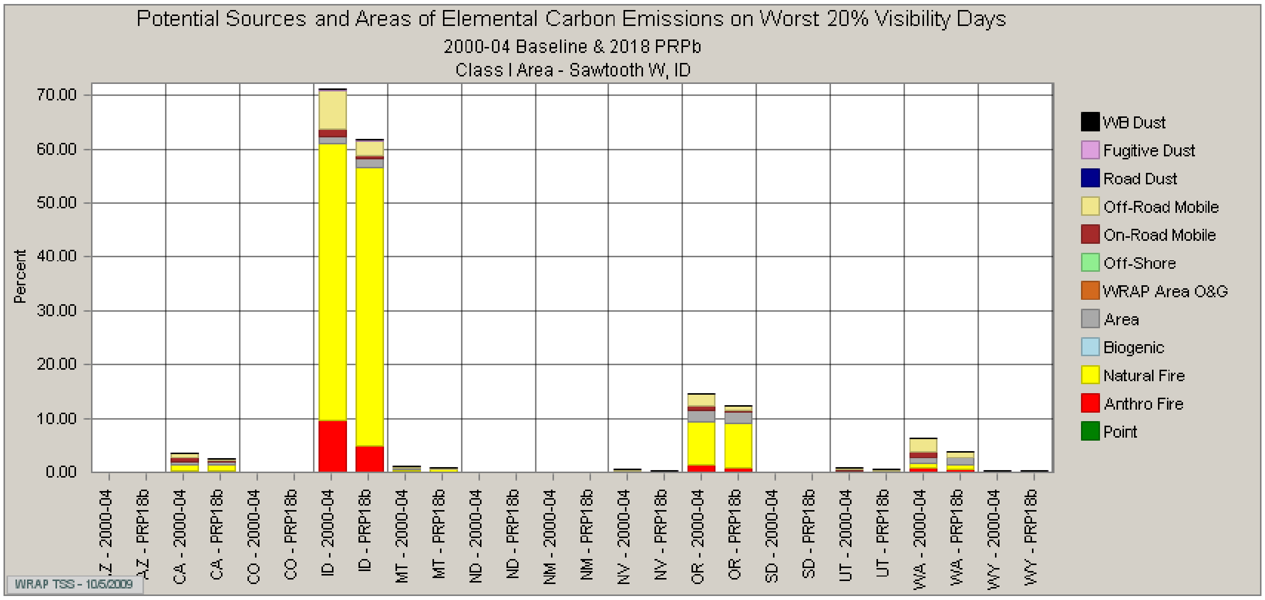

Figure 9-35 WEP Elemental Carbon at Sawtooth Wilderness 20% Worst Days

Figure 9-36 shows a large percentage of the contribution of elemental carbon in the Sawtooth Wilderness area on the 20% best visibility days is expected to come from Idaho natural fire. Overall, the WRAP states are expected to reduce elemental carbon on the 20% best visibility days in the Sawtooth Wilderness due to reductions from anthropogenic fire and mobile sources.

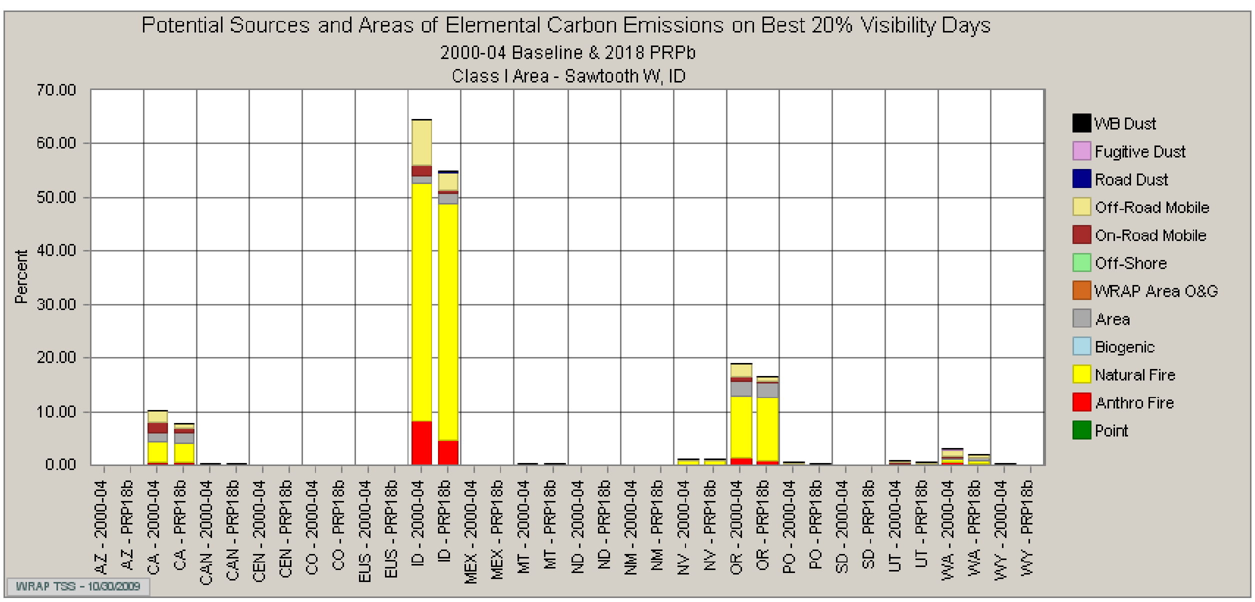

Figure 9-36 WEP Elemental Carbon at Sawtooth Wilderness 20% Best Days

Fine Particulate Matter at Sawtooth Wilderness Based on WEP

Figure 9-37 shows Idaho is expected to contribute roughly 50% of the fine particulate matter to Sawtooth Wilderness during the 20% worst visibility days. Oregon and Washington are showing almost equal contributions at around 20% of the fine particulate matter. Idaho's area source and road dust are expected to increase during the first planning period. Increases in Oregon's fugitive dust are also expected to cause future fine particulate matter increases. Overall, fine particulate should slightly increase over time.

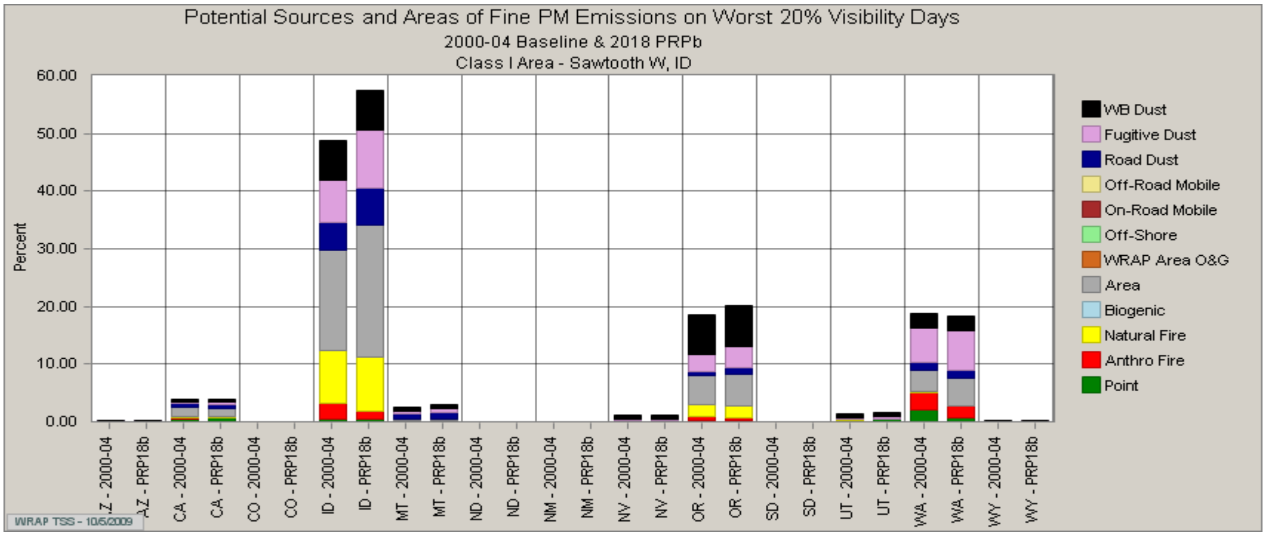

Figure 9-37 WEP Fine Particulate Matter at Sawtooth Wilderness Worst 20% Days

Figure 9-38 shows the same expected trends in fine particulate on the best visibility days as on the worst visibility days at the Sawtooth Wilderness.

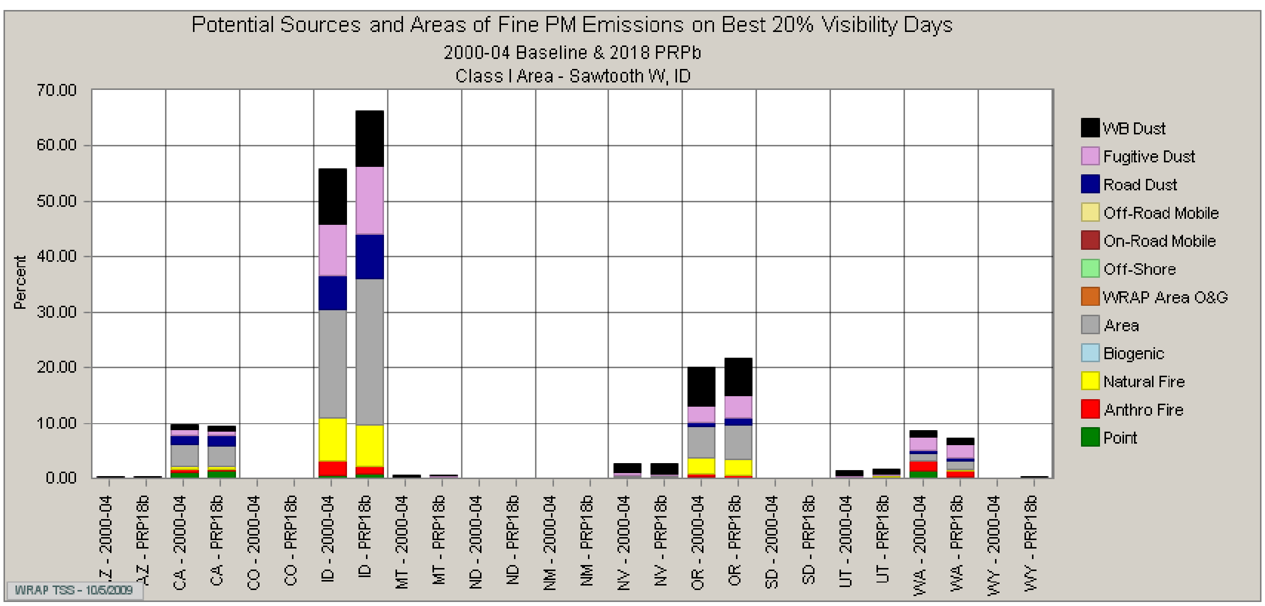

Figure 9-38 WEP Fine Particulate Matter at Sawtooth Wilderness Best 20% Days

Coarse Particulate Matter at Sawtooth Wilderness Based on WEP

Figure 9-39 shows coarse particulate on the 20% worst visibility days is expected to trend similar to fine particulate on the best visibility days at the Sawtooth Wilderness, with Idaho being the largest contributor. Idaho, Washington, and Oregon are all projecting increases in area fugitive dust with a slight decrease in anthropogenic fire. Overall, coarse particulate is expected to increase at Sawtooth Wilderness.

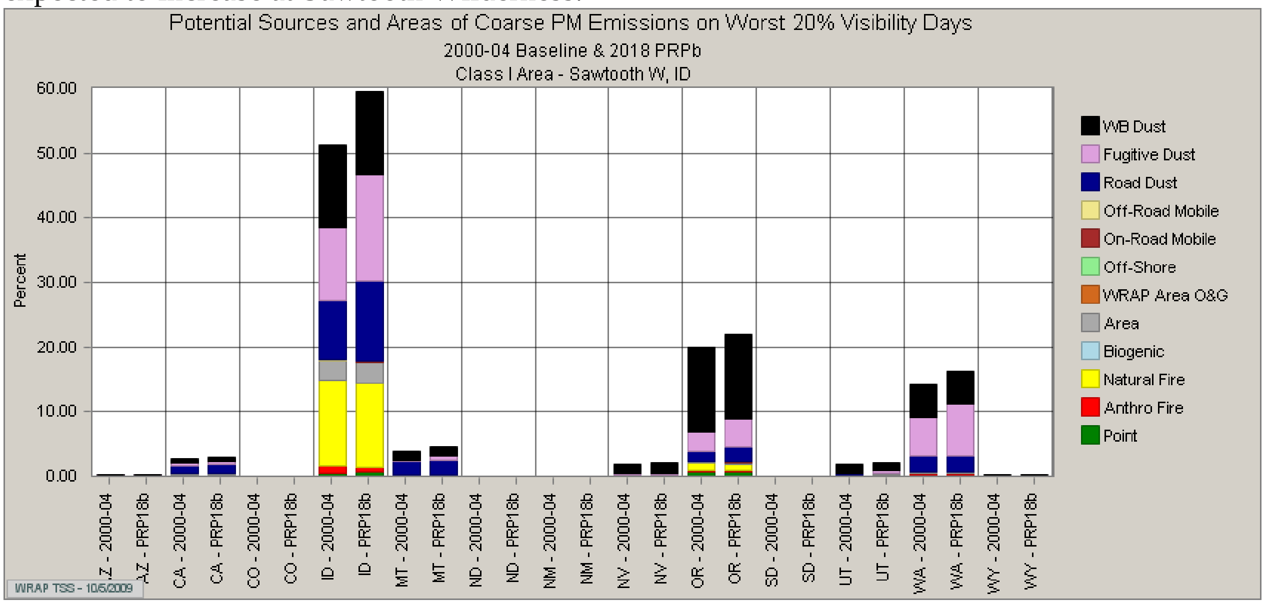

Figure 9-39 WEP Coarse Particulate Matter at Sawtooth Wilderness 20% Worst Days

Figure 9-40 shows 20% best visibility days at Sawtooth Wilderness are trending the same as the 20% worst visibility days at Sawtooth Wilderness, with similar contributions from Idaho, Oregon and Washington as for the 20% worst days. Coarse particulate is expected to increase at the Sawtooth Wilderness on the 20% worst days.

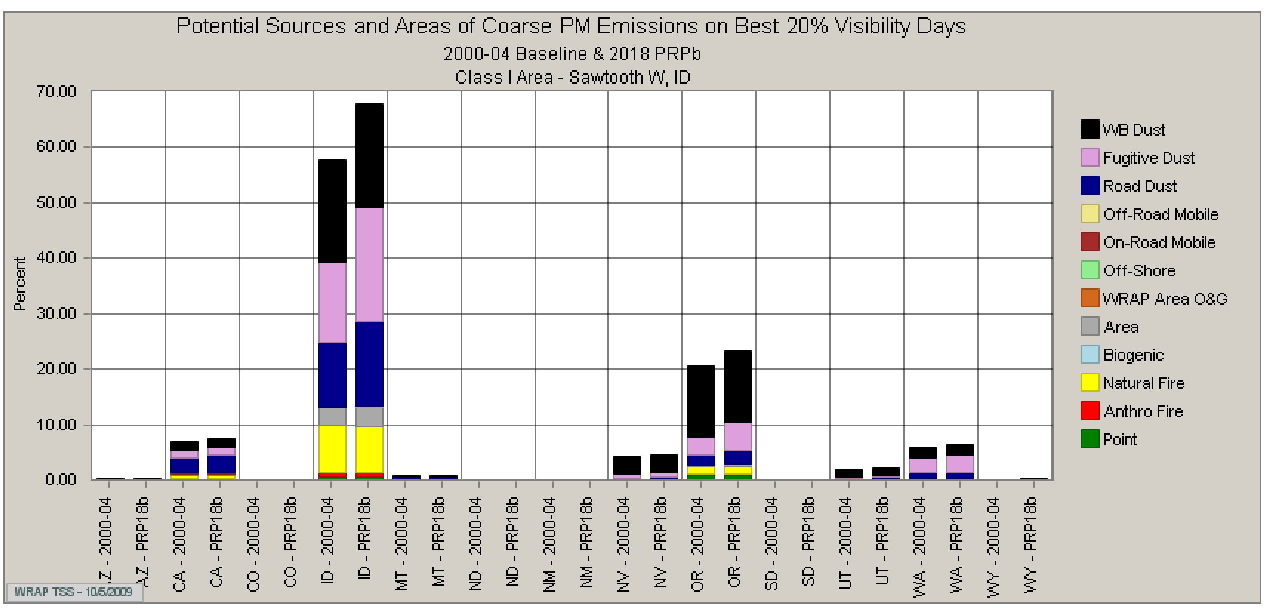

Figure 9-40 WEP Coarse Particulate Matter at Sawtooth Wilderness 20% Best Days

9.2.4 Selway – Bitterroot Wilderness Source Apportionment[7]

Sulfate at Selway-Bitterroot Wilderness Based on PSAT

The regional source contribution pie charts in Figure 9-41 show the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-41 shows Idaho and then Washington and Oregon as the largest contributors of sulfate at Selway Bitterroot Wilderness. Overall, the expected concentration levels attributed to all the WRAP states are fairly low and decreasing over time due to reductions expected primarily from mobile sources. Idaho shows an overall reduction of roughly 4 % expected over the first planning period. Idaho is contributing 12% of the total contribution of sulfate at Selway Bitterroot Wilderness. Natural fire from Idaho is projected to account for 10% of the sulfate and only roughly 2% of the total contribution will be from Idaho anthropogenic sources. This does not include emissions reductions expected from subject-to-BART sources. The large contribution of natural fire will make it difficult to show much progress in visibility improvement from Idaho's area, point, and mobile sources.

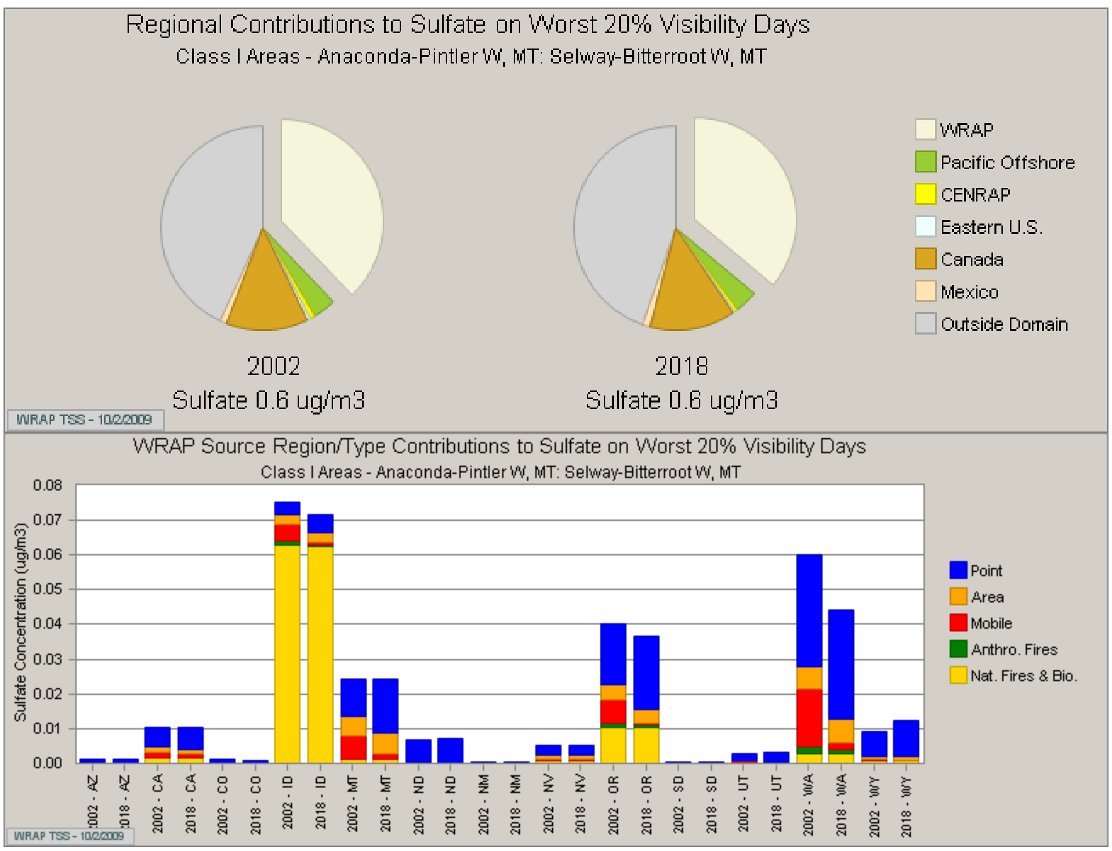

Figure 9-41 PSAT Sulfate Concentrations at Selway Bitterroot 20% Worst Days

7 Throughout the remainder of this document the Selway-Bitterroot Wilderness and Anaconda-Pintler Wilderness will be represented by the "Selway-Bitterroot" since they all share the same IMPROVE monitoring site.

Figure 9-42 shows an overall improvement expected in future sulfate contributions. The improvements are primarily expected to come from the mobile source category.

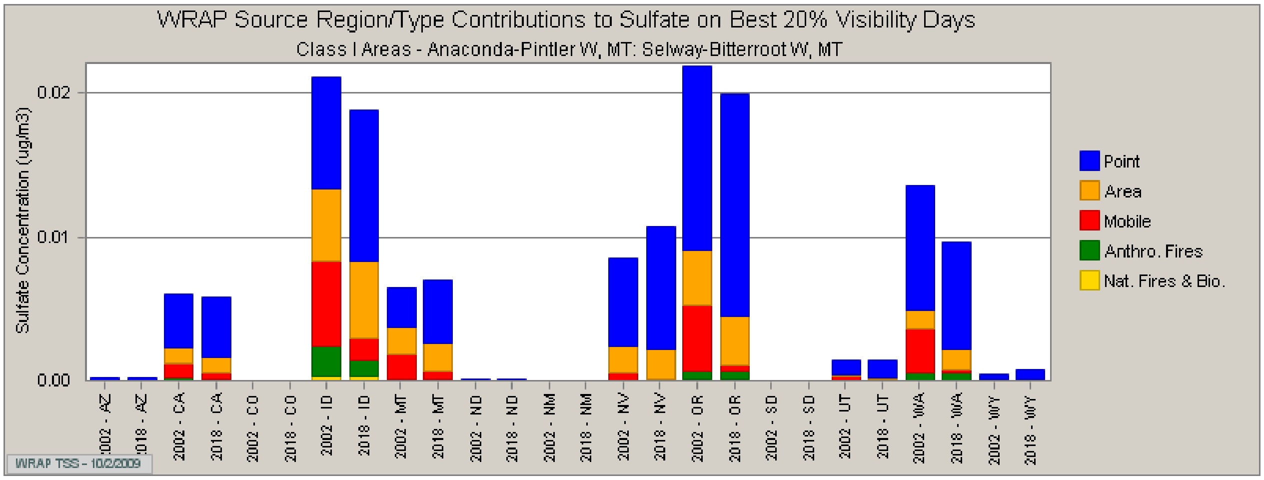

Figure 9-42 PSAT Sulfate Concentrations at Selway Bitterroot 20% Best Days

Nitrate at Selway-Bitterroot Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-43 show the WRAP states are only expected to contribute roughly two thirds of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-43 shows Montana then Washington and Idaho as the largest contributors of nitrate at Sawtooth Wilderness in 2002. Overall, the concentration levels attributed to all the WRAP states are expected to decrease over time due to reductions primarily from mobile sources. The overall contribution from Idaho is expected to be roughly 28% expected over the first planning period. The future Idaho anthropogenic contribution of the total nitrate concentrations is expected to be around 8%. This does not include all the emissions reductions expected from subject-to-BART sources.

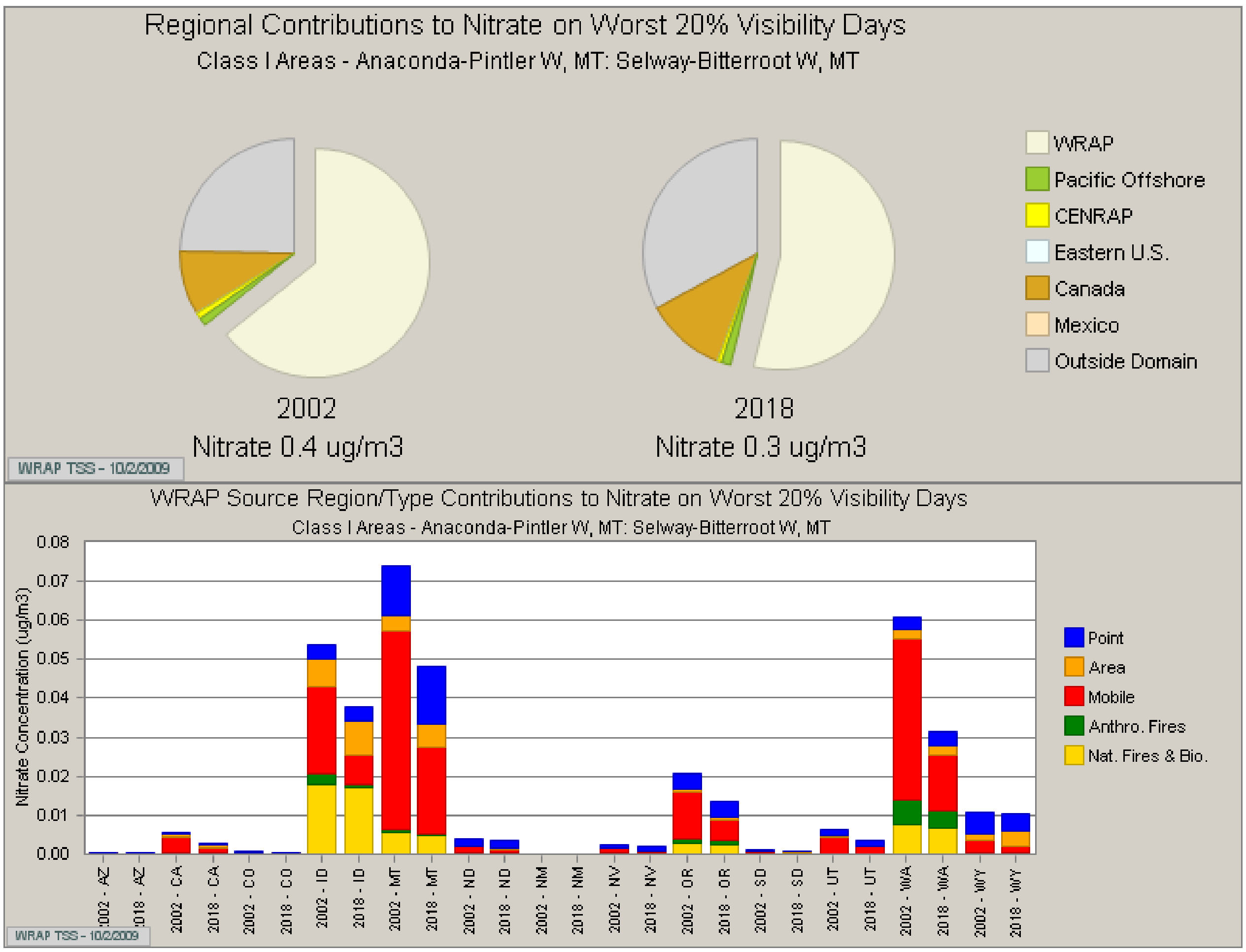

Figure 9-43 PSAT Nitrate Concentrations at Selway Bitterroot 20% Worst Days

Figure 9-44 shows an overall improvement in future nitrate contributions expected to come from all states. The improvements are primarily expected to come from the mobile source category.

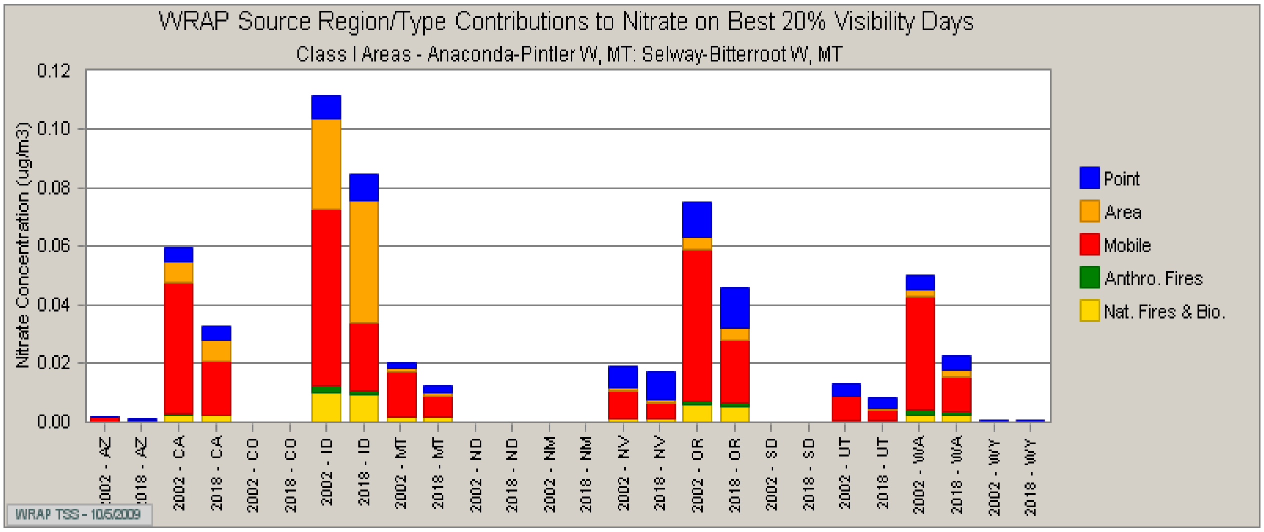

Figure 9-44 PSAT Nitrate Concentrations at Selway Bitterroot 20% Best Days

9.2.5

Primary Organic Aerosol at Selway-Bitterroot Wilderness Based on WEP

Figure 9-45 shows the preponderance of organic aerosol on the 20% worst days in the Selway-Bitterroot Wilderness is expected to come from Idaho natural fire. There are decreases anticipated from anthropogenic sources from most states but these are dwarfed by expected impacts from natural fire.

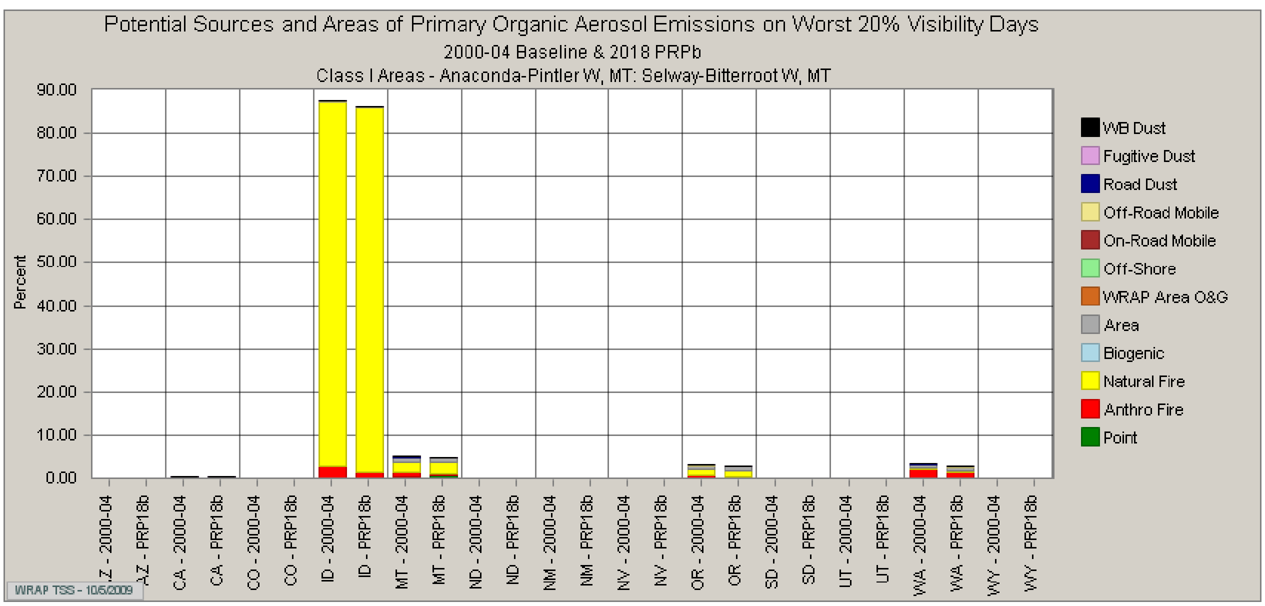

Figure 9-45 WEP Primary Organic Aerosol at Selway-Bitterroot Wilderness 20% Worst Days

Figure 9-46 shows similar results expected on the 20% best days in the Selway-Bitterroot Wilderness as on the 20% worst days. Natural fire from Idaho is by far the largest expected source.

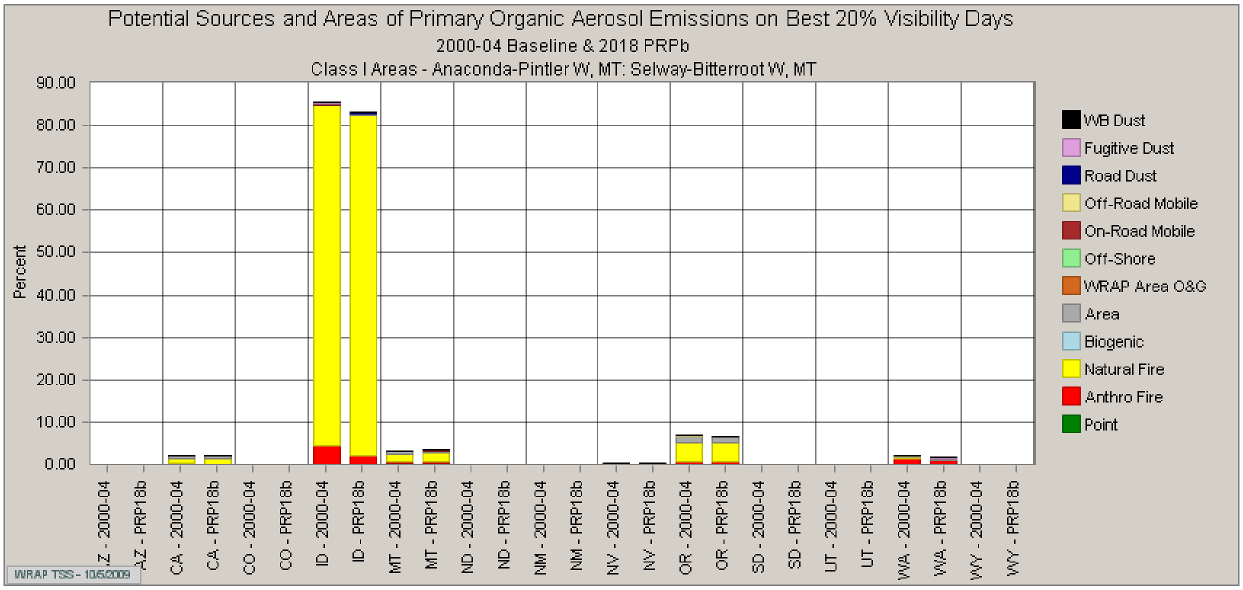

Figure 9-46 WEP Primary Organic Aerosol at Selway-Bitterroot Wilderness 20% Best Days

Elemental Carbon at Selway-Bitterroot Wilderness Based on WEP

Figure 9-47 shows natural fire from Idaho is the largest expected contributor to visibility impairment due to elemental carbon on the 20% worst days in the Selway-Bitterroot Wilderness. It is anticipated there will be future reductions from anthropogenic fire and an overall improvement in visibility impairment from elemental carbon on the 20% worst days.

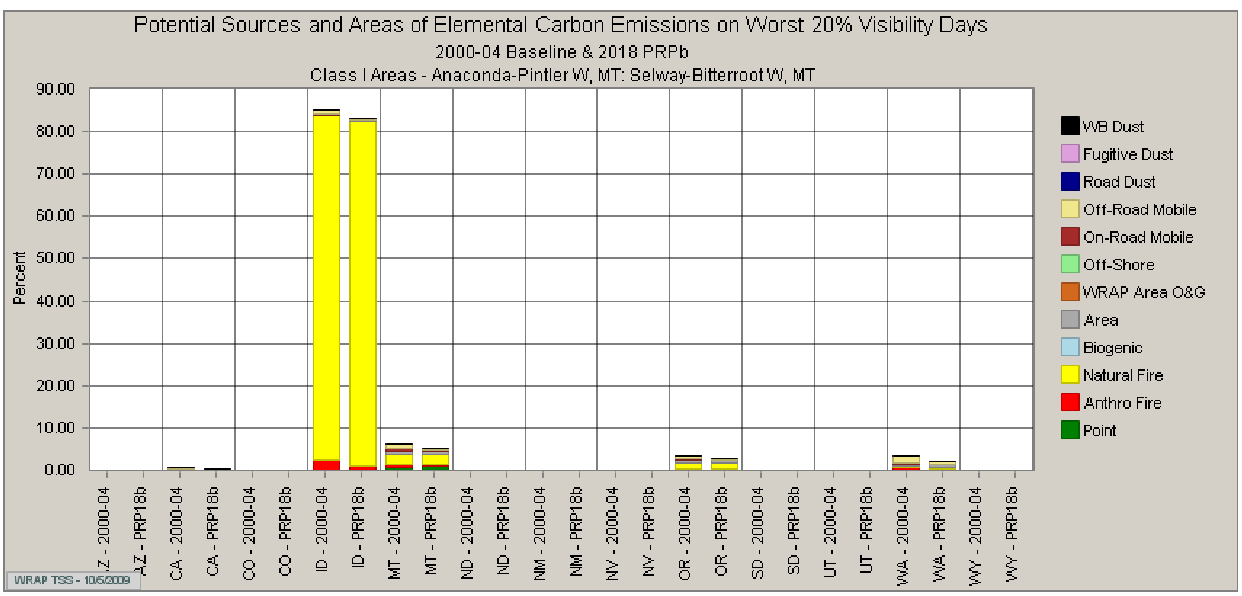

Figure 9-47 WEP Elemental Carbon at Selway-Bitterroot Wilderness 20% Worst Days

Figure 9-48 shows similar expected results on the 20% best days in the Selway-Bitterroot Wilderness as on the 20% worst days. Natural fire from Idaho is by far the largest source of elemental carbon expected in the Selway-Bitterroot Wilderness. It is expected elemental carbon will decrease in the future on the 20% best days due to improvements in smoke management programs and impacts from anthropogenic fire.

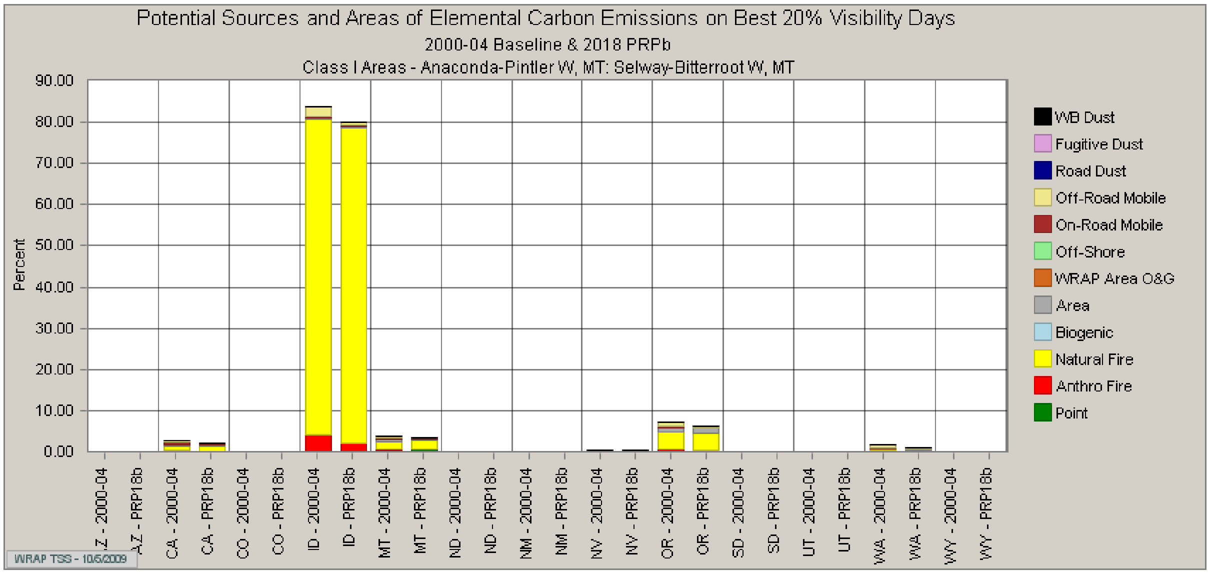

Figure 9-48 WEP Elemental Carbon at Selway-Bitterroot Wilderness 20% Best Days

Fine Particulate Matter at Selway-Bitterroot Wilderness Based on WEP

Figure 9-49 shows Idaho contributing roughly 36% of the fine particulate matter to Selway-Bitterroot Wilderness during the 20% worst visibility days in 2002. Montana and Washington are showing almost equal contributions at around 20% of the fine particulate matter. Idaho's area source and road dust emissions are expected to increase during the first planning period and outpace expected reductions from anthropogenic fire. Increases in Montana's fugitive dust and point sources are also expected to cause future fine particulate matter to increase. Overall, fine particulate should slightly increase over time.

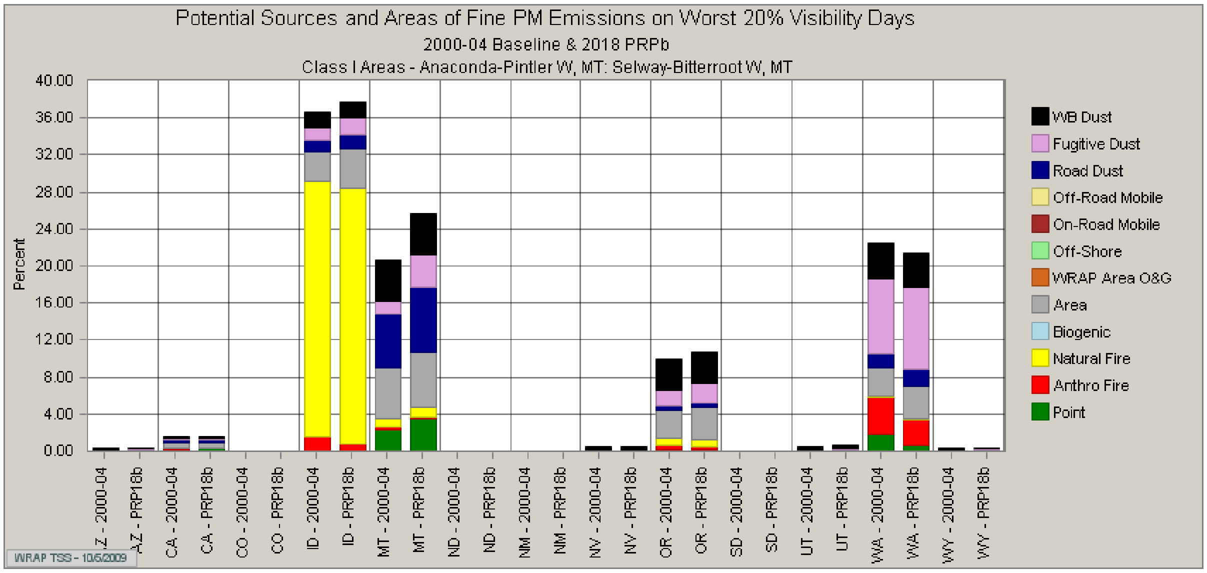

Figure 9-49 WEP Fine Particulate Matter at Selway-Bitterroot Wilderness Worst 20% Days

Figure 9-50 shows the same trends in fine particulate on the 20% best visibility days as on the 20% worst days in the Selway-Bitterroot Wilderness.

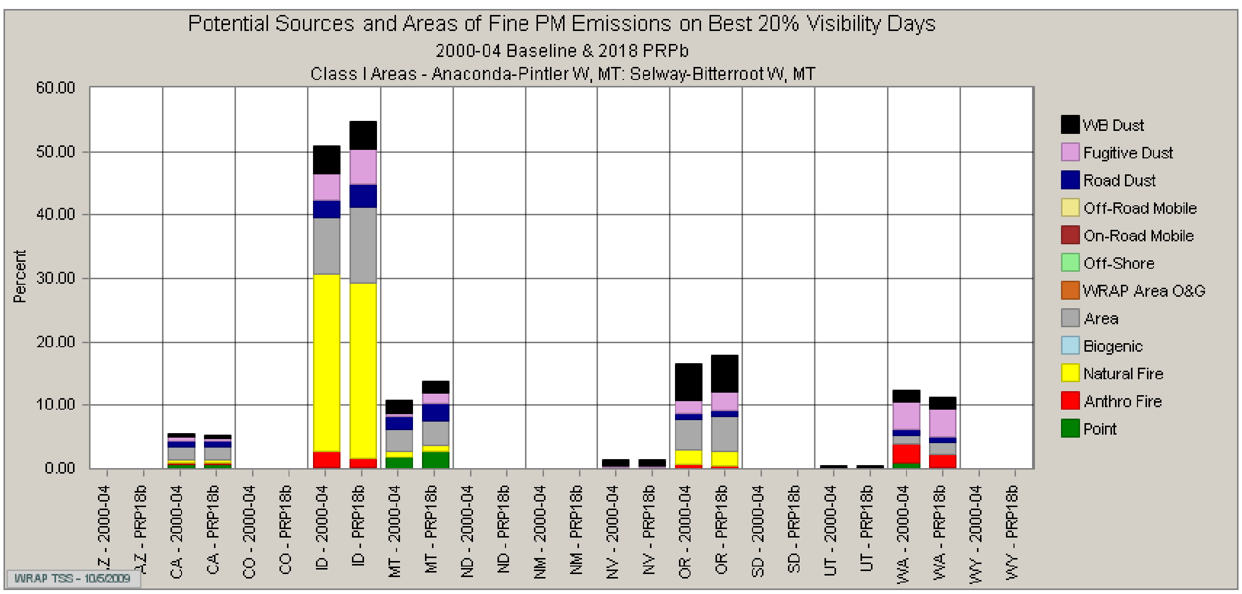

Figure 9-50 WEP Fine Particulate Matter at Selway-Bitterroot Wilderness Best 20% Days

Coarse Particulate Matter at Selway-Bitterroot Wilderness Based on WEP

Figure 9-51 shows coarse particulate is trending similar to fine particulate in the Selway-Bitterroot Wilderness on the 20% worst visibility days, with Idaho being the largest contributor. Idaho, Montana, Washington and Oregon are all projecting increases in fugitive dust and road dust with a slight decrease in anthropogenic fire. Overall, coarse particulate is expected to increase in the Selway-Bitterroot Wilderness.

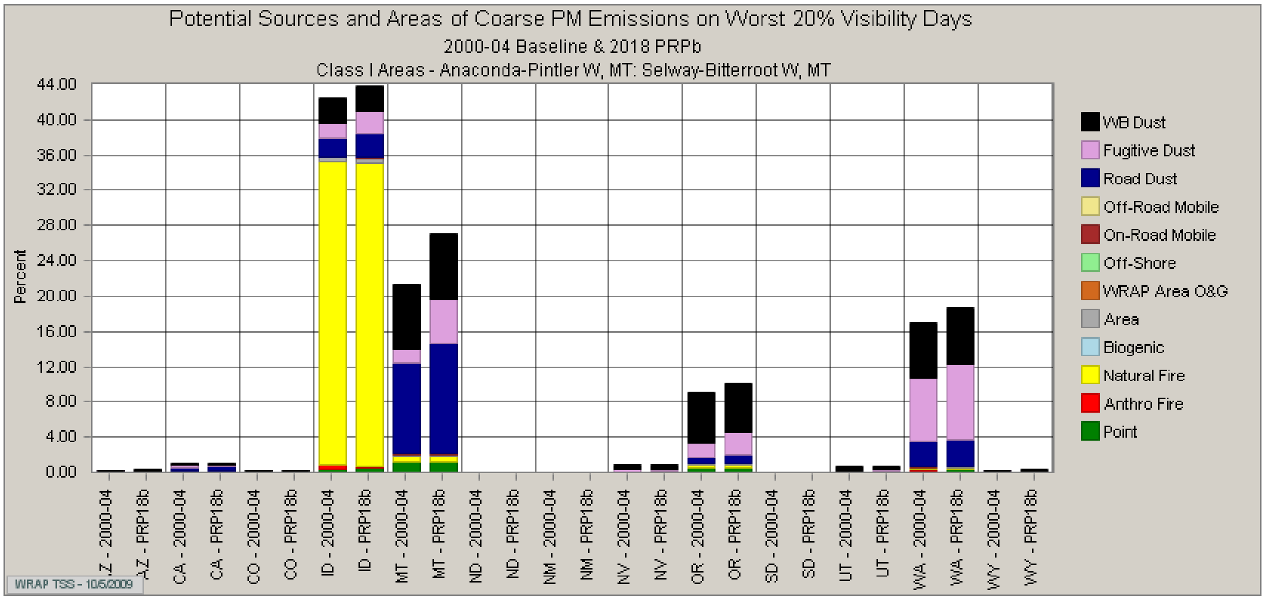

Figure 9-51 WEP Coarse Particulate Matter at Selway-Bitterroot Wilderness 20% Worst Days

Figure 9-52 shows an expected increase in coarse particulate on the 20% best days in the Selway-Bitterroot Wilderness due to expected increases in fugitive dust and road dust.

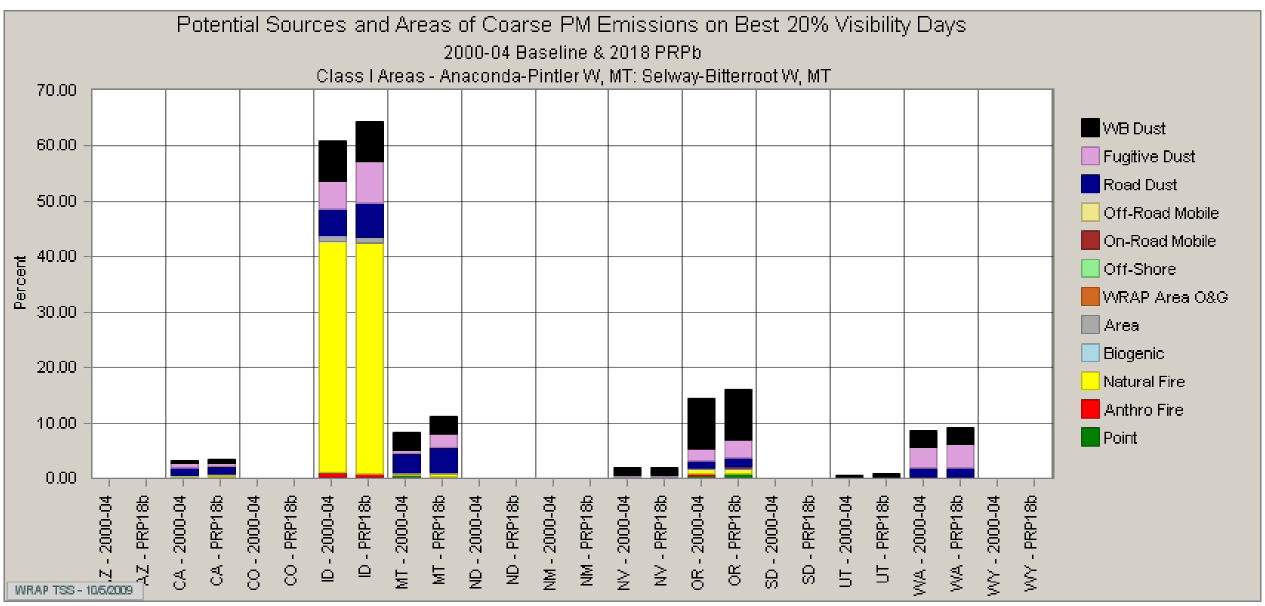

Figure 9-52 WEP Coarse Particulate Matter at Selway-Bitterroot Wilderness 20% Best Days

9.2.6 Yellowstone National Park Source Apportionment[8]

Sulfate at Yellowstone National Park Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-53 show the WRAP states are only expected to contribute roughly a third of the sulfate visibility impairment in Yellowstone National Park on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-53 shows Idaho and then Wyoming and Oregon as the largest contributors of sulfate in Yellowstone National Park. Idaho is expected to contribute roughly 9% of the sulfate with only 6% coming from Idaho anthropogenic sources. The PSAT modeling shows a 7% increase coming from Idaho but this does not include the emissions reductions of roughly 9,000 tons per year expected from P4 Production (formerly Monsanto) in Southeast Idaho. Also, these estimates include the emissions from a once-anticipated EGU, as mentioned before, that had not yet been removed from the emissions inventory used for this modeling. It is expected Idaho's contribution will actually drop when these emission reductions occur.

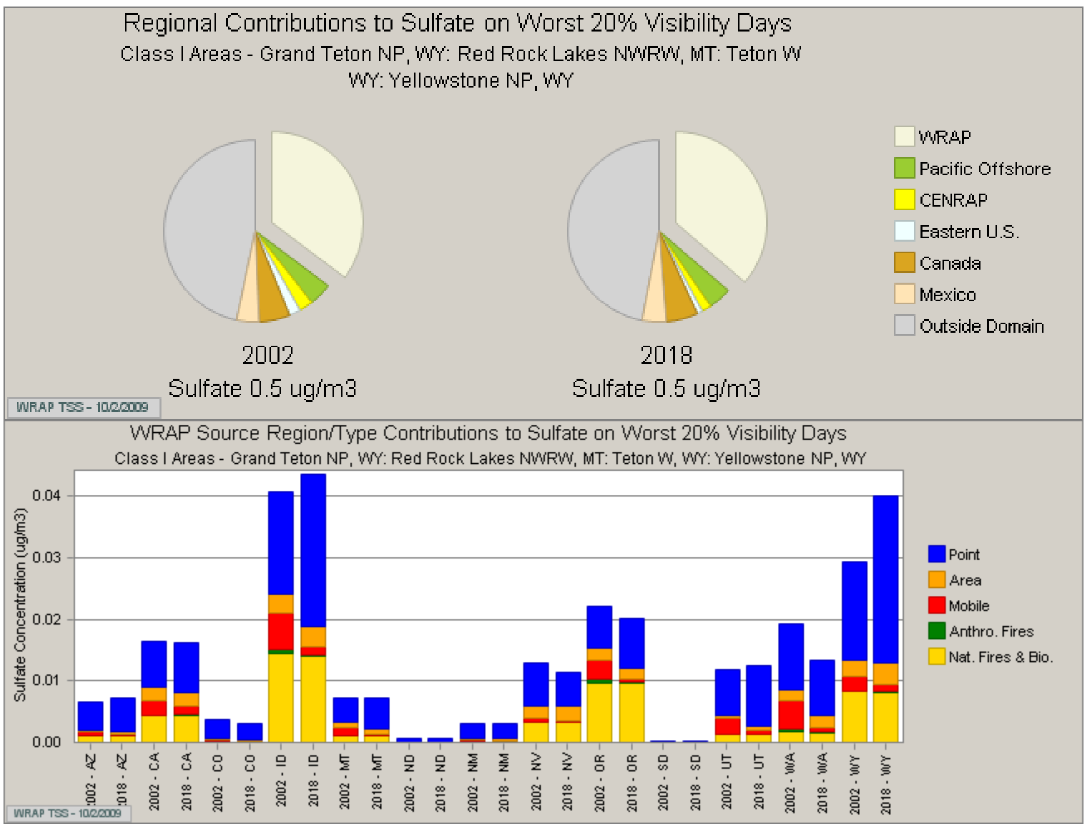

Figure 9-53 PSAT Sulfate Concentrations at Yellowstone National Park 20% Worst Days

8 Throughout the remainder of this document the Yellowstone National Park, Grand Teton National Park, Red Rock Lakes Wilderness and Teton Wilderness will be represented by the "Yellowstone National Park" since they all share the same IMPROVE monitoring site.

The graph in Figure 9-54 shows an expected decrease in emissions from Idaho point sources in 2018. Using WEP updated emissions inventory and back trajectories, Figure 9-54 shows sulfate emissions from point and mobile sources expected to decrease for Idaho and all other WRAP states.

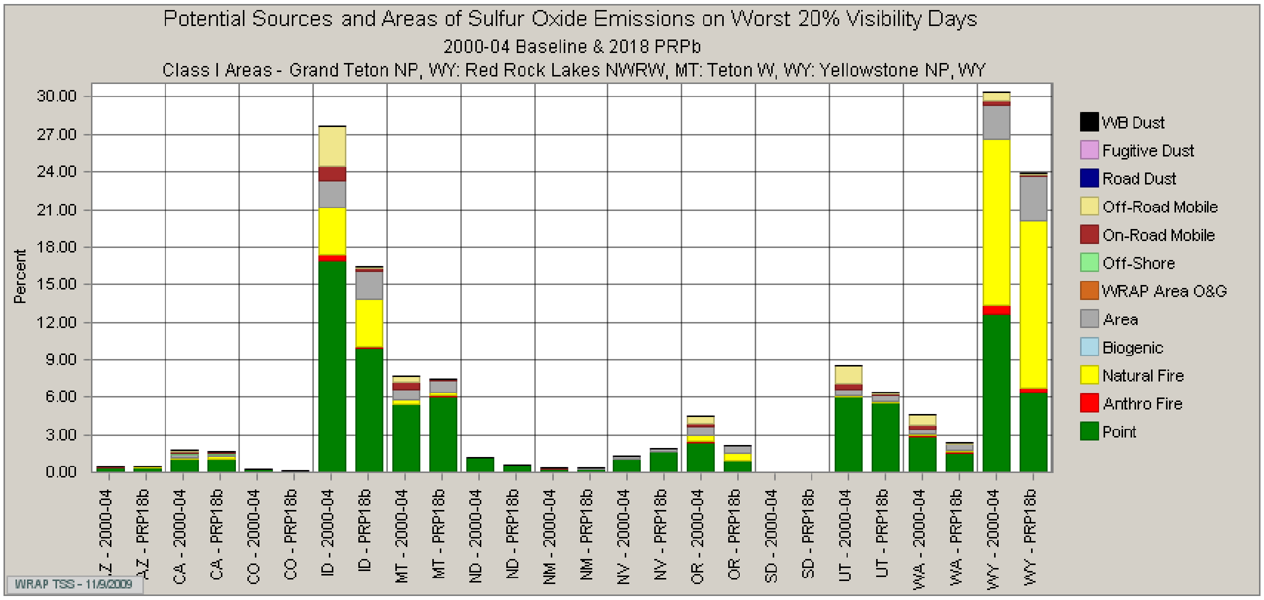

Figure 9-54 WEP Sulfate Concentrations at Yellowstone National Park 20% Worst Days

The PSAT results show an expected increase in visibility impairment form sulfate on the 20% best days at Yellowstone National Park. The updated emissions inventory used by the WEP shows an improvement in future sulfate visibility impacts on the best days. Figures 9-55 and 9-56 show the differences in expected visibility impacts based on using different emissions inventories.

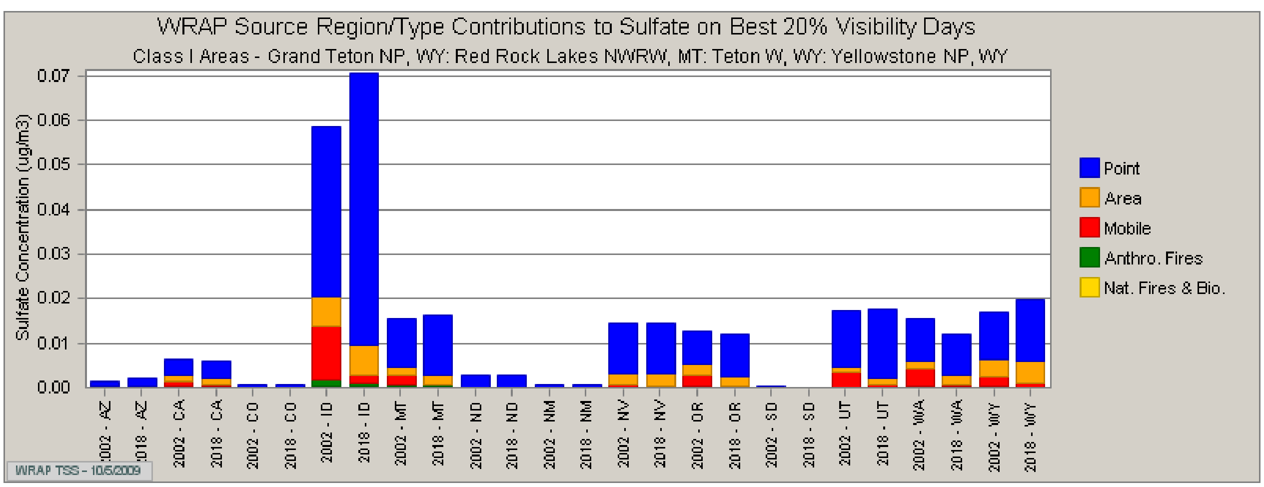

Figure 9-55 PSAT Sulfate Concentrations at Yellowstone National Park 20% Best Days

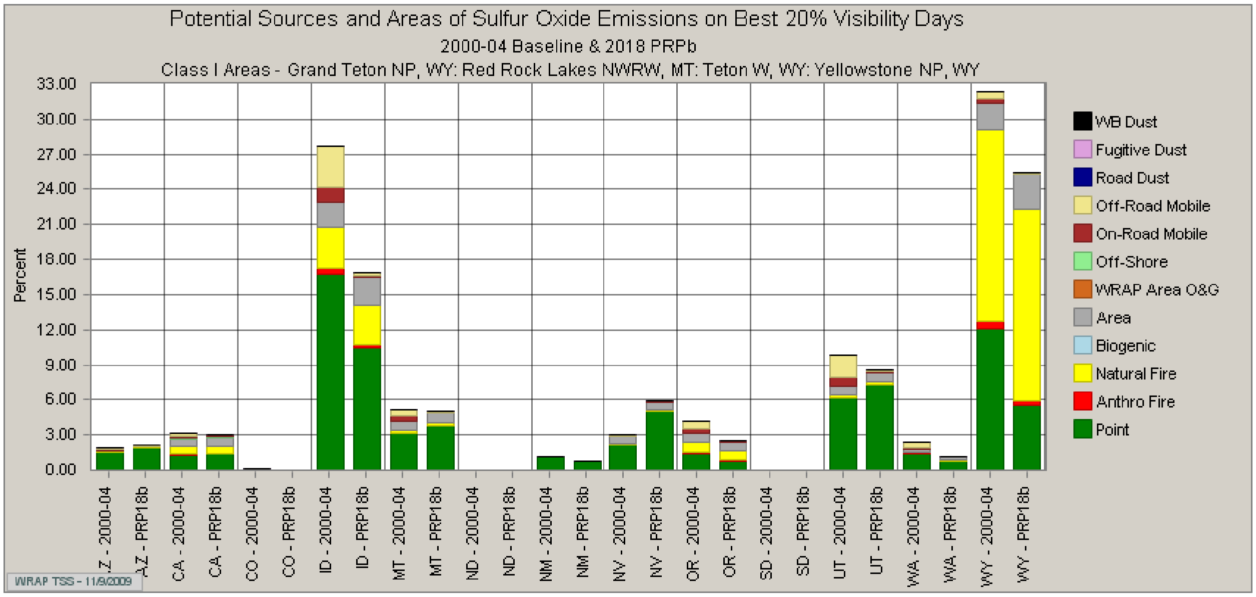

Figure 9-56 WEP Sulfate Concentrations at Yellowstone National Park 20% Best Days

Nitrate at Yellowstone National Park Based on PSAT Modeling

Figure 9-57 shows the WRAP States are expected to contribute roughly two thirds of the nitrates on the 20% worst days. As WRAP states reduce nitrate contributions over the first planning period ending in 2018, the contributions coming from outside the domain, Pacific offshore (shipping), and Canadian emissions will have a greater impact. This will require regulator actions and negotiations outside the WRAP states' control.

Figure 9-57 also shows Idaho as the largest expected contributor to nitrate concentrations at the Yellowstone National Park on the 20% worst days. Overall, Idaho's nitrate emissions are expected to decline by 26% over time primarily due to reductions in mobile emissions.

Because the point source contributions from Idaho are not as large as other categories, the impact from adding an EGU in Jerome County as mentioned above does not show such a significant impact. Overall, most WRAP states are expected to improve future visibility impairment due to nitrates on the 20% worst days in Yellowstone National Park.

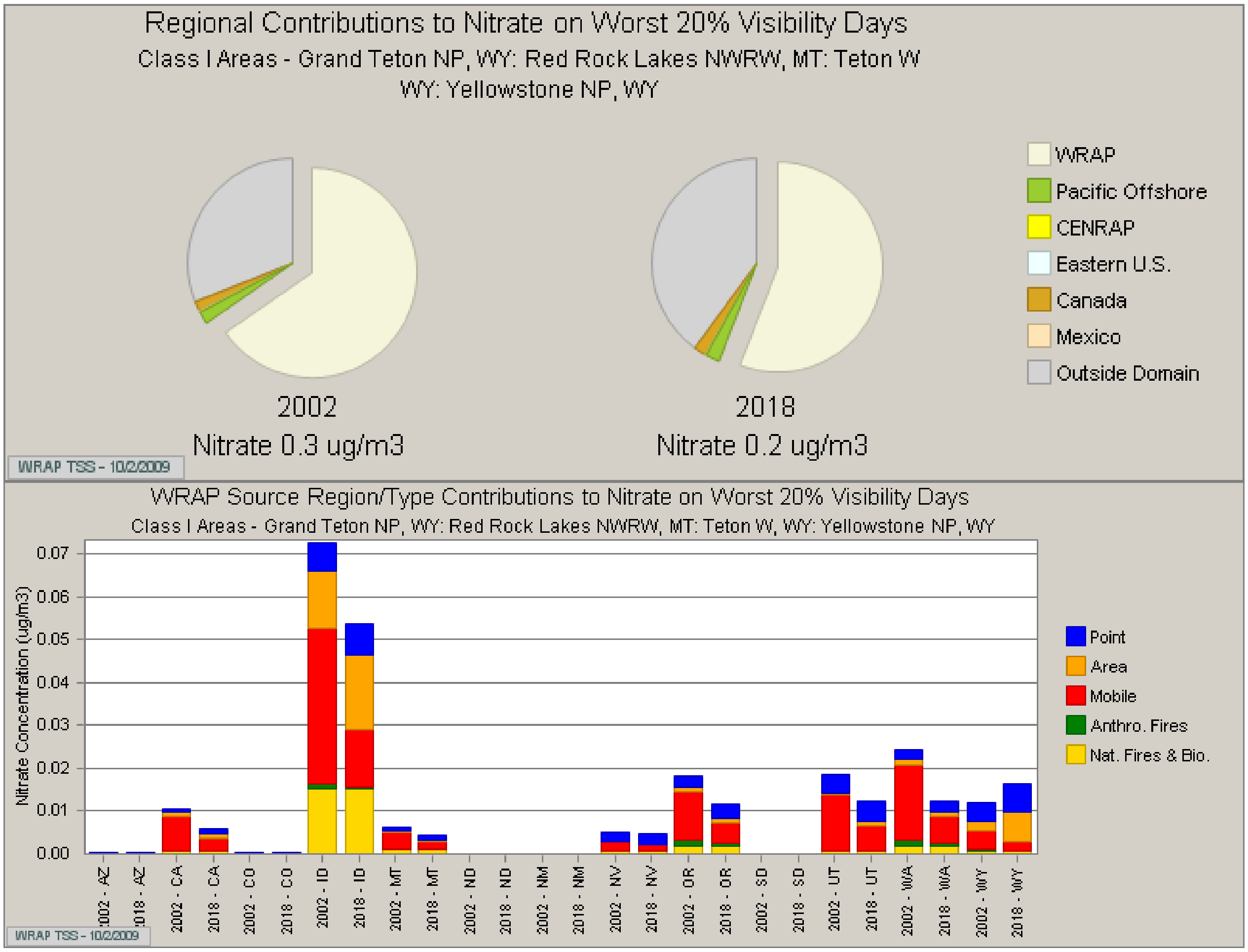

Figure 9-57 PSAT Nitrate Concentrations at Yellowstone National Park20% Worst Days

Figure 9-58 shows all WRAP states are expected to improve the visibility impairment due to nitrates on the 20% best days in Yellowstone National Park.

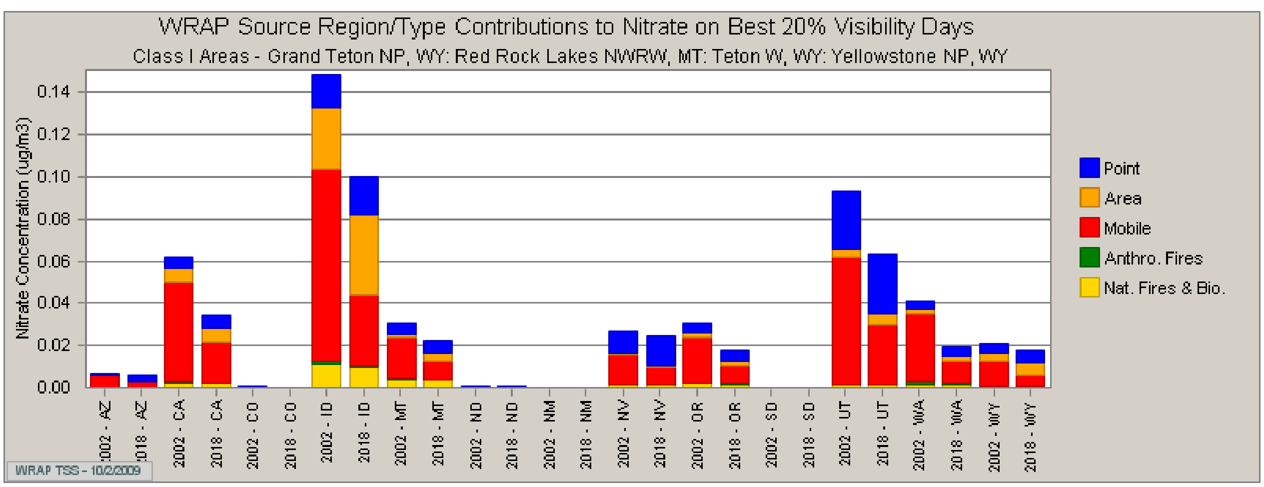

Figure 9-58 PSAT Nitrate Concentrations at Yellowstone National Park 20% Best Days

Primary Organic Aerosol at Yellowstone National Park Based on WEP

Figure 9-59 shows the preponderance of organic aerosol on the 20% worst days in Yellowstone National Park is coming from natural fire primarily from Wyoming. This is very similar to the organic mass carbon findings in Chapter 7, Figure 7-44. There are decreases anticipated from anthropogenic sources from most states but these are dwarfed by expected emissions from natural fire.

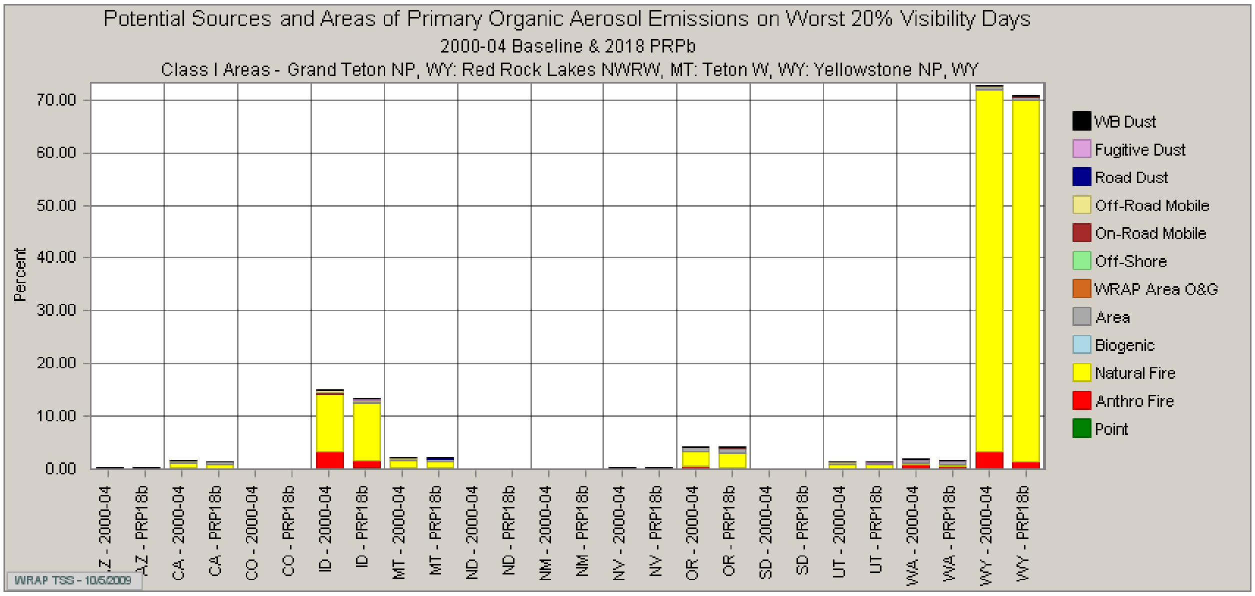

Figure 9-59 WEP Primary Organic Aerosol at Yellowstone National Park 20% Worst Days

Primary Organic Aerosol in Yellowstone National Park shows an overall improvement expected on the 20% best visibility days. Figure 9-60 shows an improvement on the best visibility days primarily coming from anthropogenic fire and better smoke management techniques anticipated in the future.

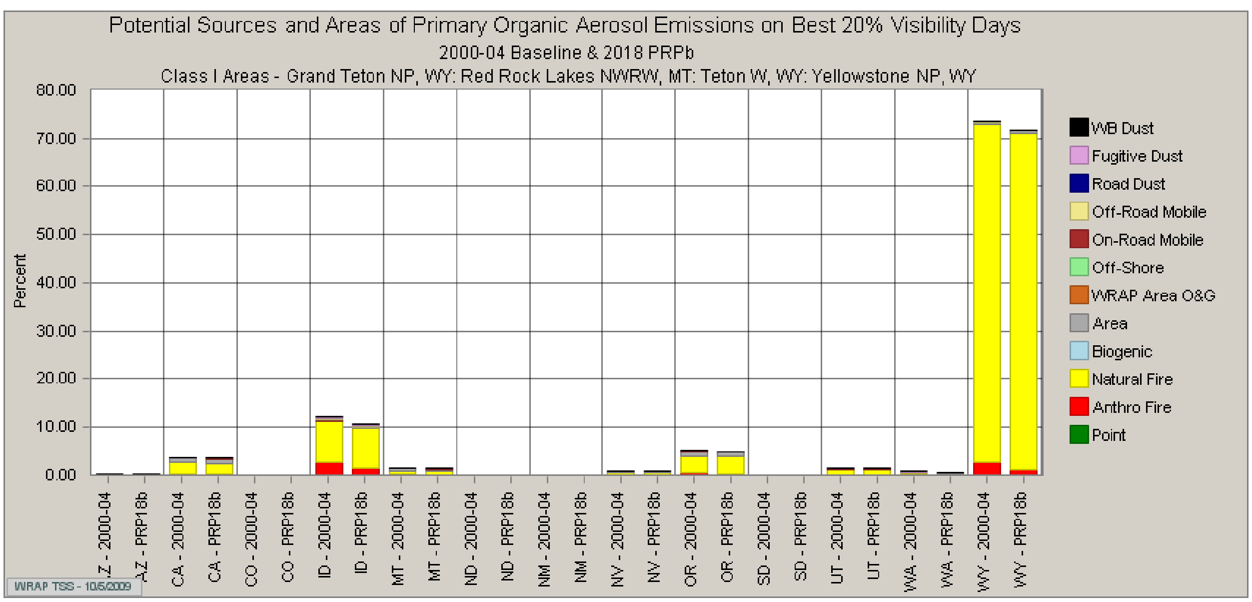

Figure 9-60 WEP Primary Organic Aerosol at Yellowstone National Park 20% Best Days

Elemental Carbon at Yellowstone National Park Based on WEP

Figure 9-61 shows natural fire from Wyoming is the largest expected contributor to elemental carbon visibility impairment on the 20% worst visibility days in Yellowstone National Park. According to the WEP analysis, Idaho is expected to contribute less than 2% of the visibility impairment associated with elemental carbon. They analysis shows all WRAP states are expected to make improvements to visibility impairments attributed to elemental carbon.

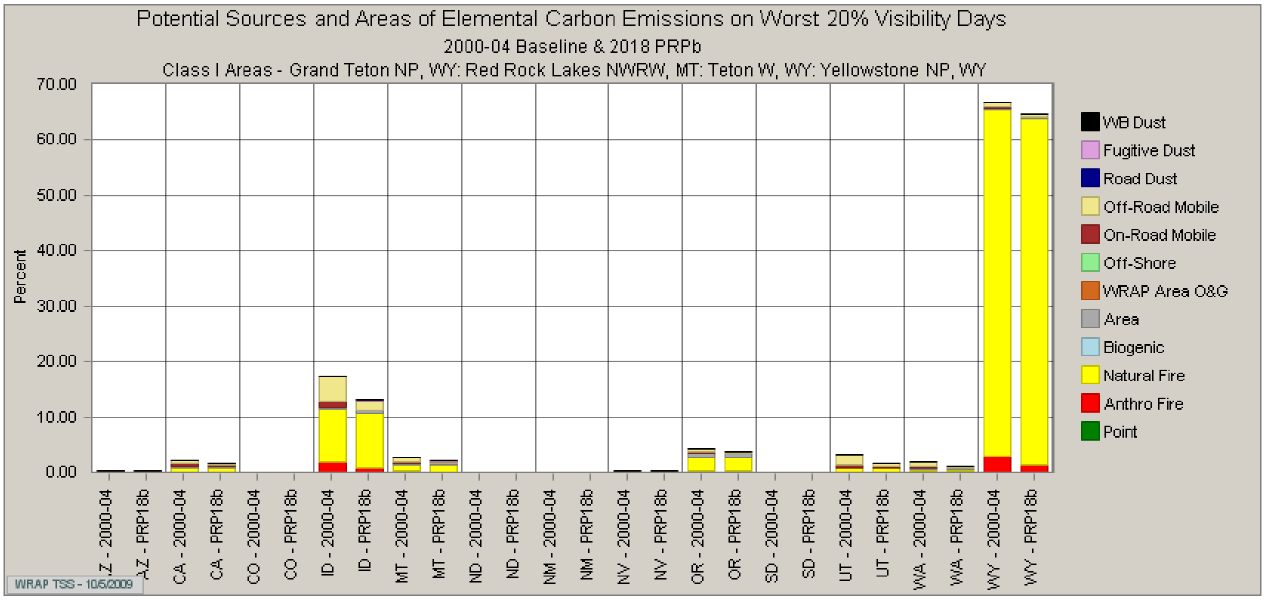

Figure 9-61 WEP Elemental Carbon at Yellowstone National Park 20% Worst Days

Figure 9-62 shows expected improvement to elemental carbon visibility impairment from all WRAP states on the 20% best days. Most of the improvement is expected to come from changes in smoke management and impacts from anthropogenic fire.

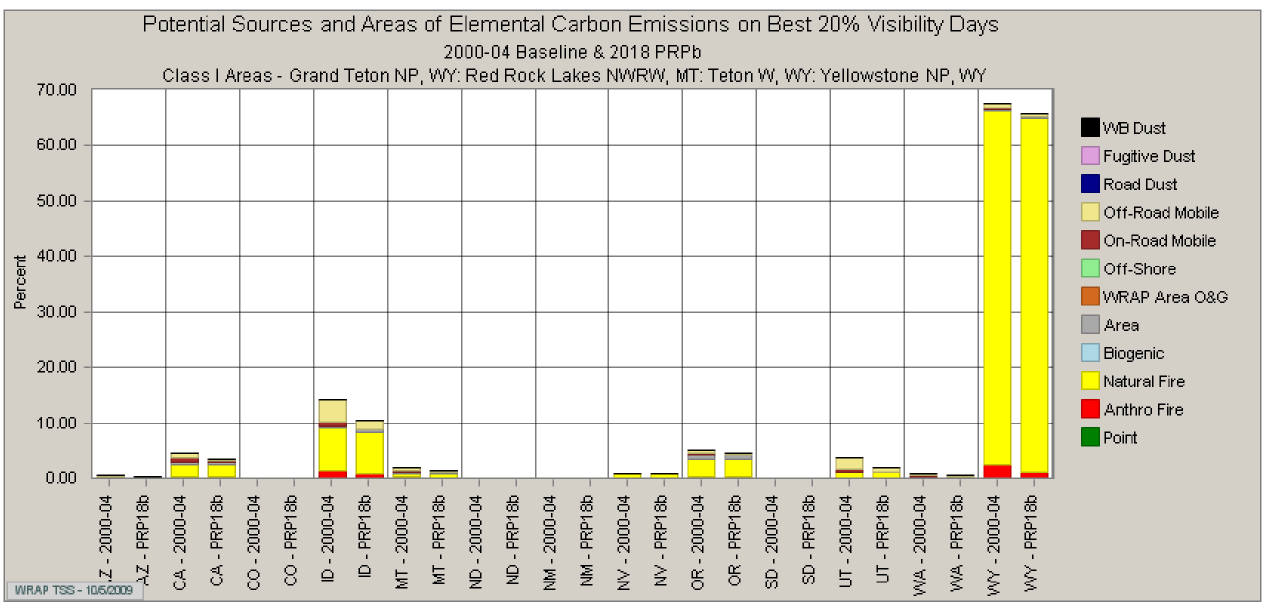

Figure 9-62 WEP Elemental Carbon at Yellowstone National Park 20% Best Days

Fine Particulate Matter at Yellowstone National Park Based on WEP

Figure 9-63 shows Idaho then Wyoming and Montana as the greatest expected contributors of fine particulate on the 20% worst visibility days in Yellowstone National Park. Idaho and Wyoming showing expected improvements in future contributions from anthropogenic fire but increases in area, road and fugitive dust are expected to cause overall future increases.

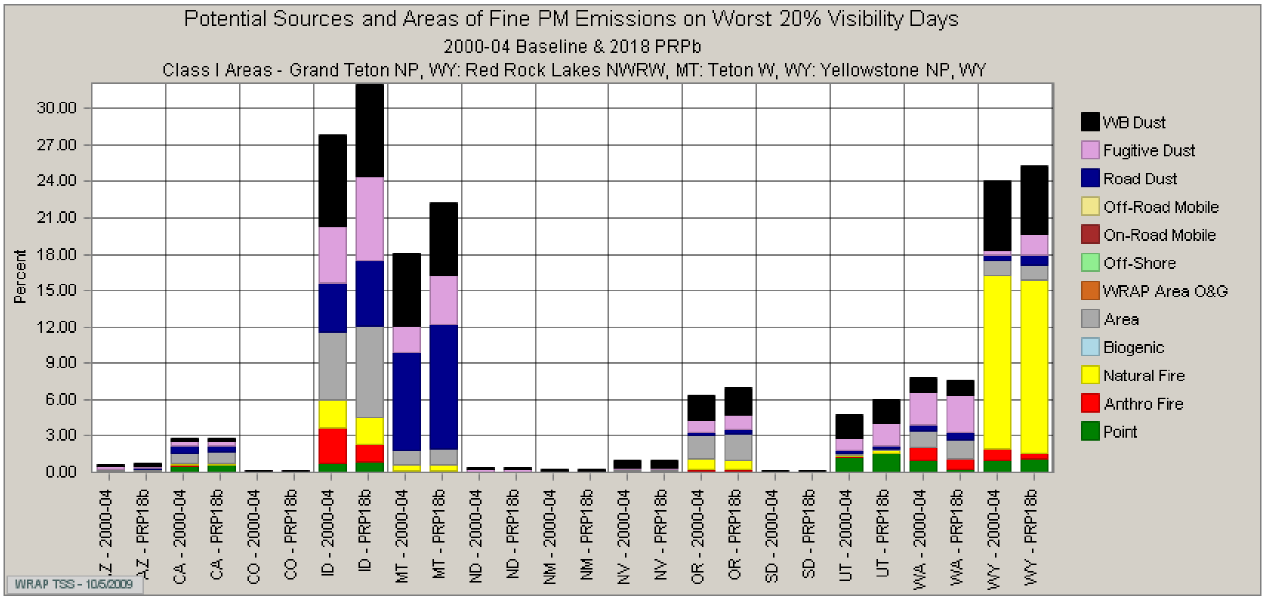

Figure 9-63 WEP Fine Particulate Matter at Yellowstone National Park Worst 20% Days

Figure 9-64 shows similar visibility impacts expected from fine particulate on the 20% best days in Yellowstone National Park. Future increases in area, road dust and fugitive dust are expected to outpace improvements from anthropogenic fire.

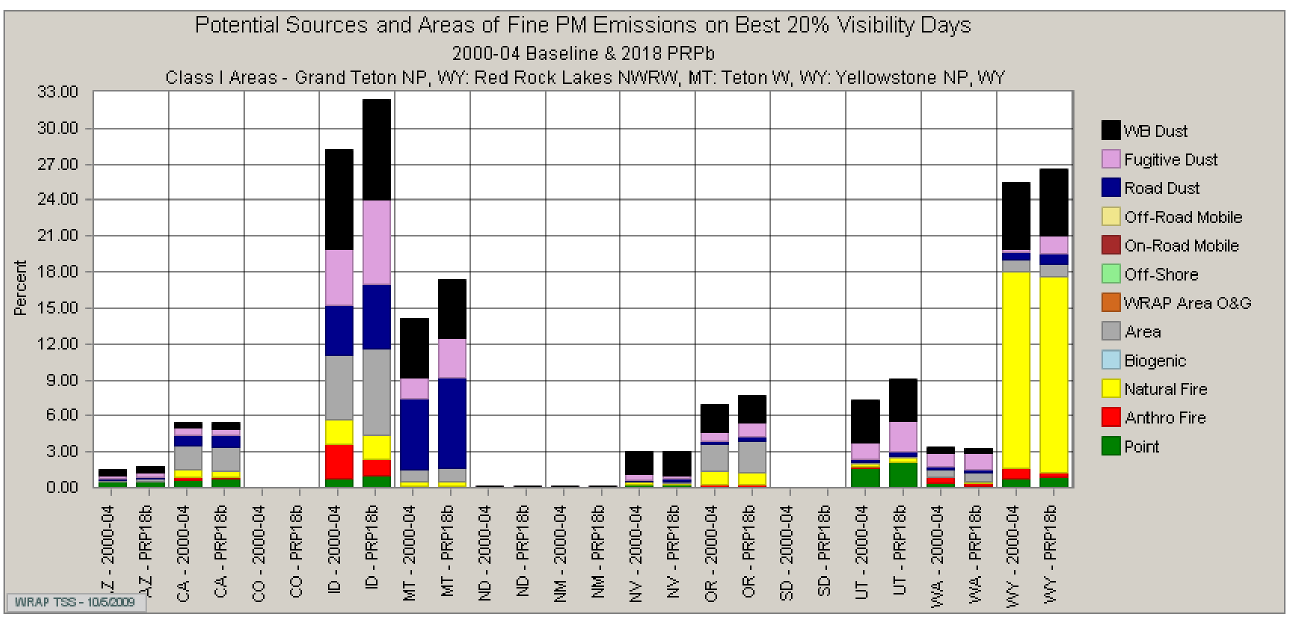

Figure 9-64 WEP Fine Particulate Matter at Yellowstone National Park Best 20% Days

Coarse Particulate Matter at Yellowstone National Park Based on WEP

Figure 9-65 shows Idaho and Montana having almost equal expected impacts of coarse particulate followed by Wyoming on the 20% worst visibility days at Yellowstone National Park. Based on WEP modeling, increases in fugitive dust and road dust are expected from most states.

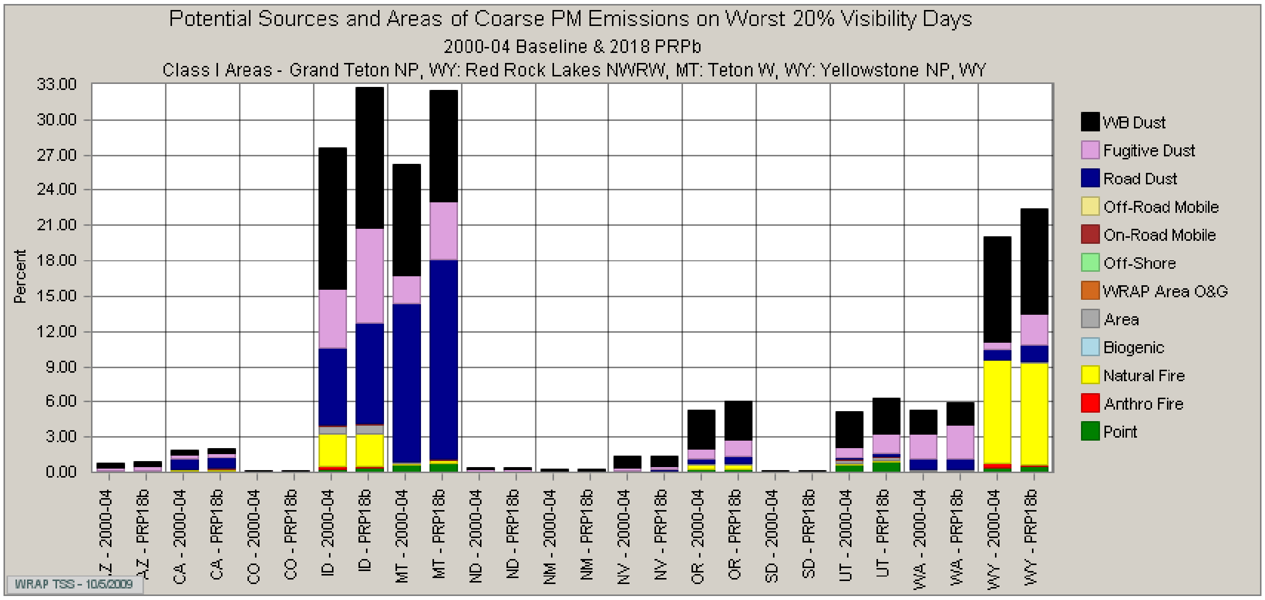

Figure 9-65 WEP Coarse Particulate Matter at Yellowstone National Park 20% Worst Days

Figure 9-66 shows an expected increase in contributions from coarse particulate coming from WRAP states on the 20% best days.

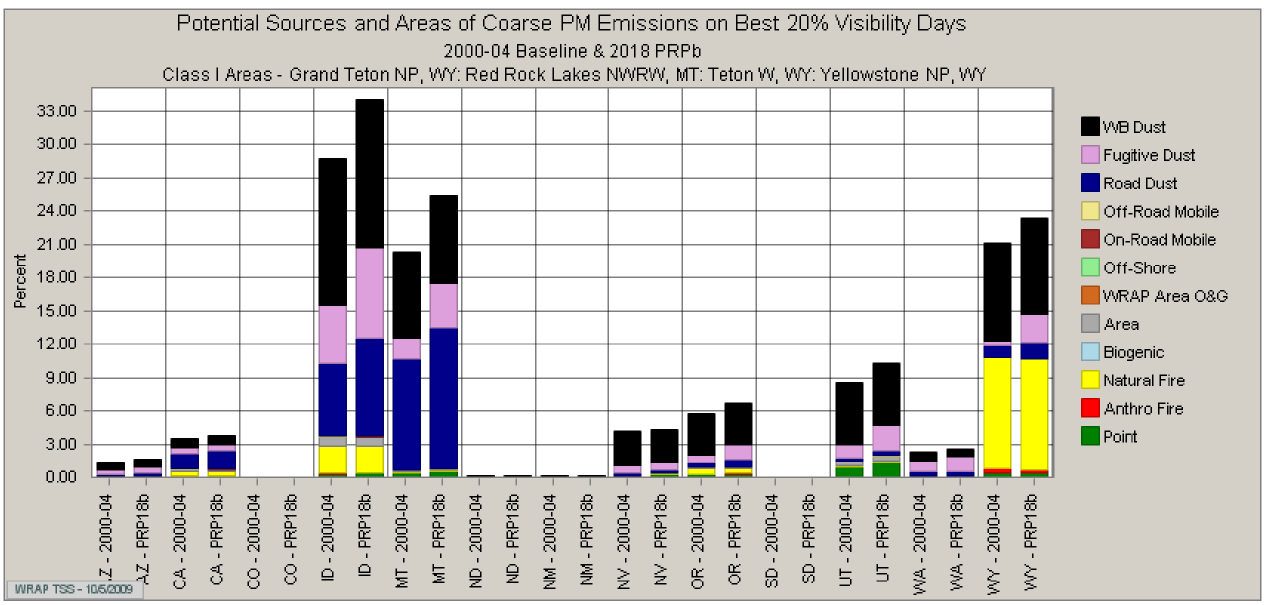

Figure 9-66 Coarse Particulate Matter at Yellowstone National Park 20% Best Days

9.3 Source Apportionment for Class I Areas Outside Idaho

As mentioned at the beginning of this chapter, Idaho is not only responsible for Class I areas residing within the state but must also be concerned with Idaho's impacts on Class I areas outside the state. Idaho is in a unique situation in that several Class I areas share borders with Idaho. The Class I areas of Selway-Bitterroot Wilderness, Hells Canyon Wilderness, and Yellowstone National Park all reside partially in Idaho and partially in other states. Idaho is responsible for setting reasonable progress goals (RPGs) for Craters of the Moon National Monument, Sawtooth Wilderness, and the Selway Bitterroot Wilderness. Hells Canyon Wilderness RPGs are set by Oregon and Yellowstone National Park goals are set by Wyoming. The responsible state is the one in which the largest portion of the Class I area resides. Although Idaho will not be setting the RPGs in the Class I areas discussed in this section, they are still very important in looking at Idaho's impact on Class I areas surrounding the state.

Idaho's source apportionment includes consideration of the Class I areas surrounding the state that have the potential to be impacted by Idaho emissions; specifically, the following Class I areas:

- Glacier National Park – represented by the Glacier I IMPROVE monitoring site.
- Anaconda-Pintler Wilderness – represented by the Sula-Selway IMPROVE monitoring site.
- The Cabinet Mountains Wilderness – represented by the Cabinet I IMPROVE monitoring site.
- The Bob Marshall Wilderness, Mission Mountain Wilderness, and Scapegoat Mountain Wilderness – represented by the Montur IMPROVE monitoring site.
- Gates of the Mountain Wilderness – represented by the Gates IMPROVE monitoring site.
- Red Rock Lakes Wilderness, Grand Teton National Park, and Teton Wilderness – represented by the Yellowstone IMPROVE monitoring site.
- Bridger Wilderness and Fitzpatrick Wilderness – represented by the Bridger IMPROVE monitoring site.
- North Absaroka Wilderness and Washakie Wilderness – represented by the North Absaroka IMPROVE monitoring site.
- Jarbidge Wilderness – represented by the Jarbidge IMPROVE monitoring site.
- Eagle Cap Wilderness and Strawberry Mountain Wilderness – represented by the Starky IMPROVE monitoring site.

As suggested by the information in the bullet items above there are some instances in which several Class I areas are represented by one IMPROVE monitoring site. Since the data from IMPROVE monitoring sites will be used to track progress, the same Reasonable Progress Goals have been established for all Class I areas sharing the same IMPROVE monitoring station. The source attribution for this Regional Haze plan follows the same logic in grouping together all Class I areas that are represented by the same IMPROVE monitoring site.

The source apportionment for Anaconda-Pintler Wilderness is included with the apportionment done for the Selway-Bitterroot Wilderness. Red Rock Lakes Wilderness, Grand Teton National Park, and Teton Wilderness is included with the source apportionment done for Yellowstone. For ease of review, the remainder of the Class I areas bulleted above will be based on the first Class I area listed for each IMPROVE monitoring station.

Washington is being excluded from this review based on the potential—the apparent lack of potential—for Idaho to impact the Class I areas within Washington. Looking at the WEP-based back-trajectory analysis for Pasayten Wilderness (located in the center of Washington), it appears that the air mass carrying visibility-impairing pollutants into that wilderness on the 20% worst days does not include any impact from Idaho. Figure 9-67 shows the residence time of the air mass carrying the pollutants is spent primarily over Washington.

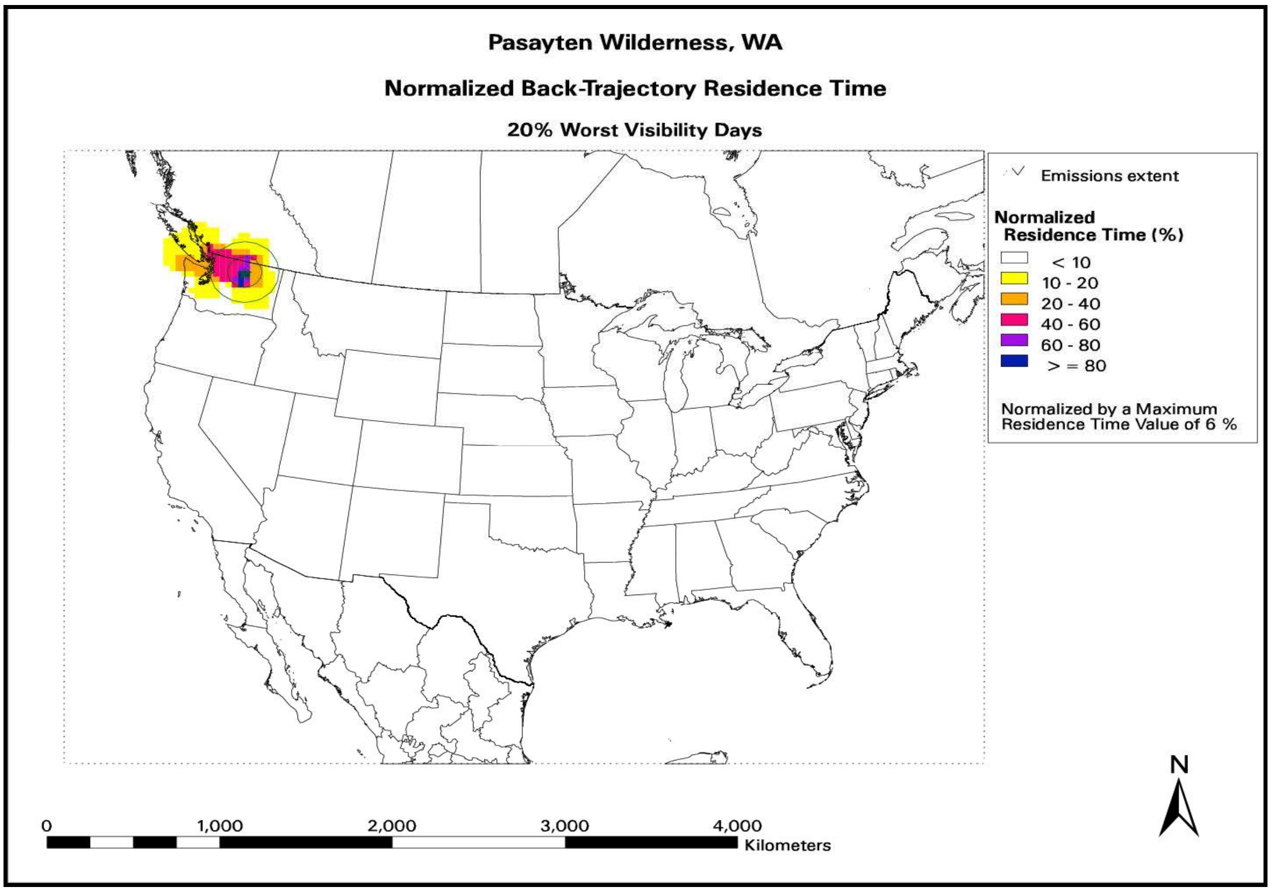

Figure 9-67 WEP Back Trajectory for Pasayten Wilderness on 20% Worst Days

9.3.1 Glacier National Park Source Apportionment

Sulfate at Glacier National Park Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-68 show the WRAP states are only expected to contribute roughly a quarter of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on

reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-68 shows Montana and then Washington and Oregon as the largest contributors of sulfate at Glacier National Park. Overall, the concentration levels attributed to all the WRAP states is fairly low and decreasing over time due to expected reductions primarily from mobile sources. Idaho's overall contribution is expected to be reduced by roughly 16% over the first planning period.

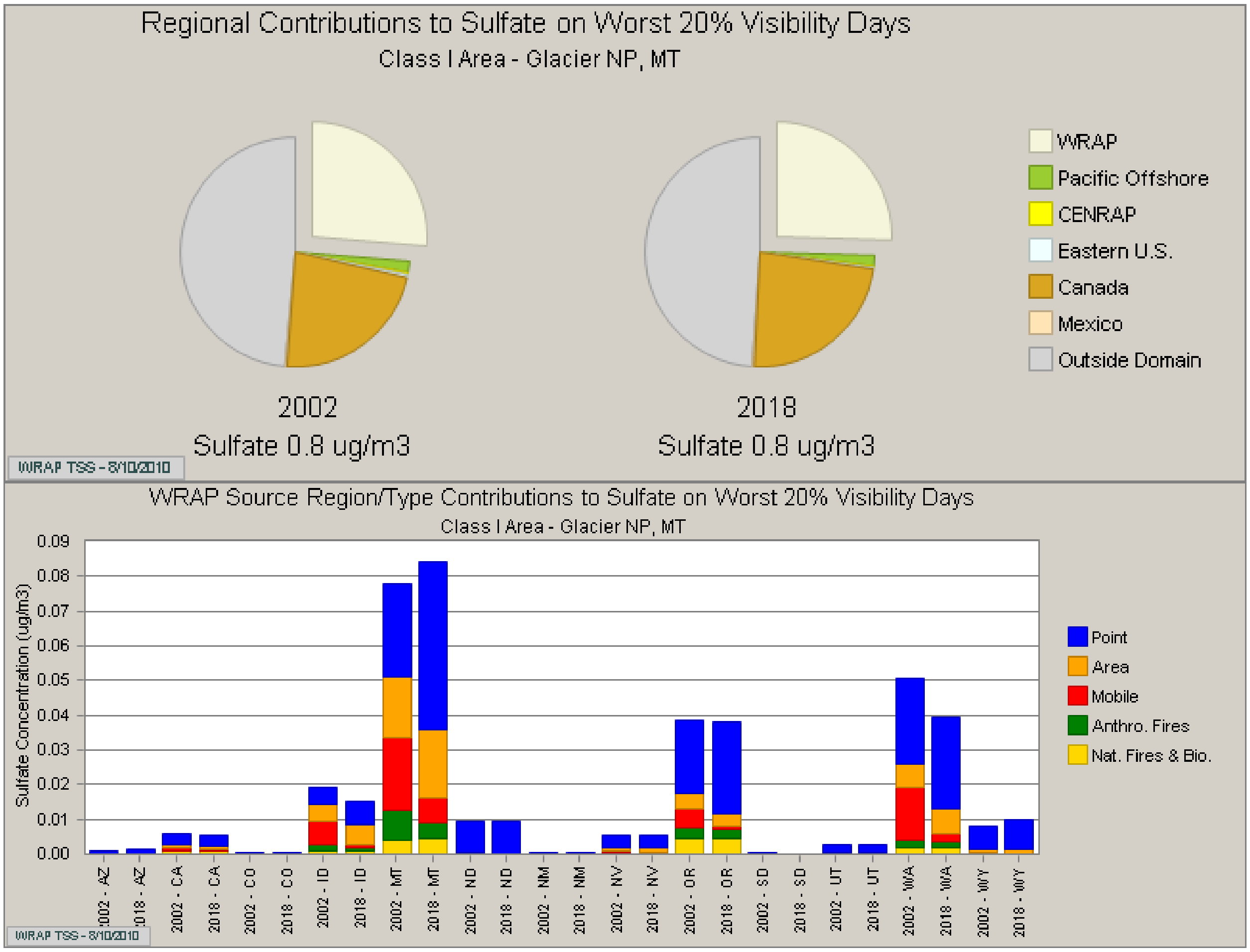

Figure 9-68 PSAT Sulfate Concentrations at Glacier National Park 20% Worst Days

Figure 9-69 shows that overall improvement in future sulfate contributions on the 20% best days from Idaho are due to expected improvements from mobile sources.

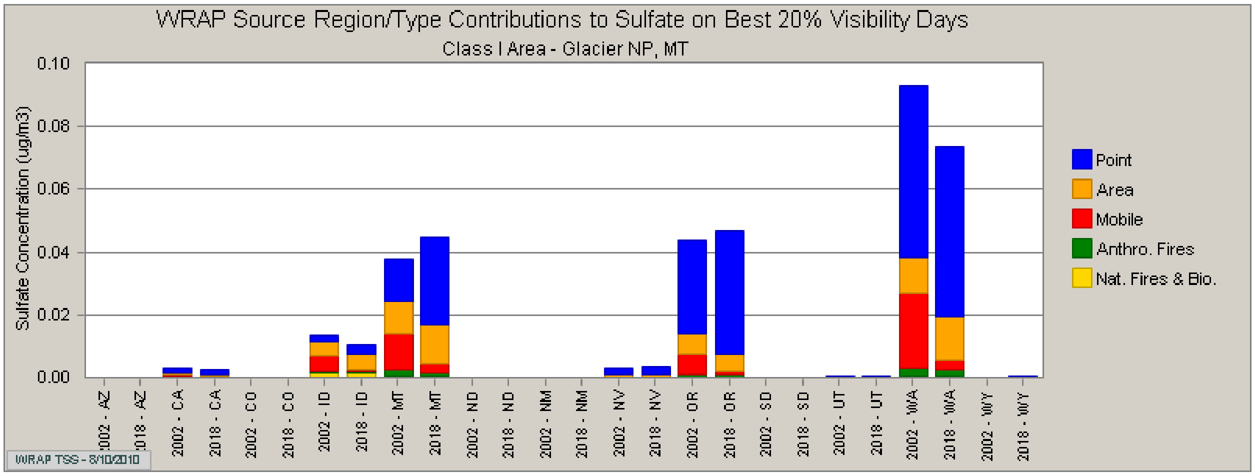

Figure 9-69 PSAT Sulfate Concentrations at Glacier National Park 20% Best Days

Nitrate at Glacier National Park Based on PSAT Modeling

The regional source contribution pie charts in figure 9-70 show the WRAP states are contributing roughly half of the visibility impairment on the 20% worst days in the Glacier National Park. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution and the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-70 shows Montana then Washington and Idaho as the largest contributors of nitrate in 2002. Overall, the concentration levels attributed to all the WRAP states is expected to decrease over time due to reductions primarily from mobile sources. Idaho's contribution is expected to show an overall reduction of roughly 35% over the first planning period with a future contribution of 8% of the total nitrate concentrations. This does not include emissions reductions expected from all the subject-to-BART sources.

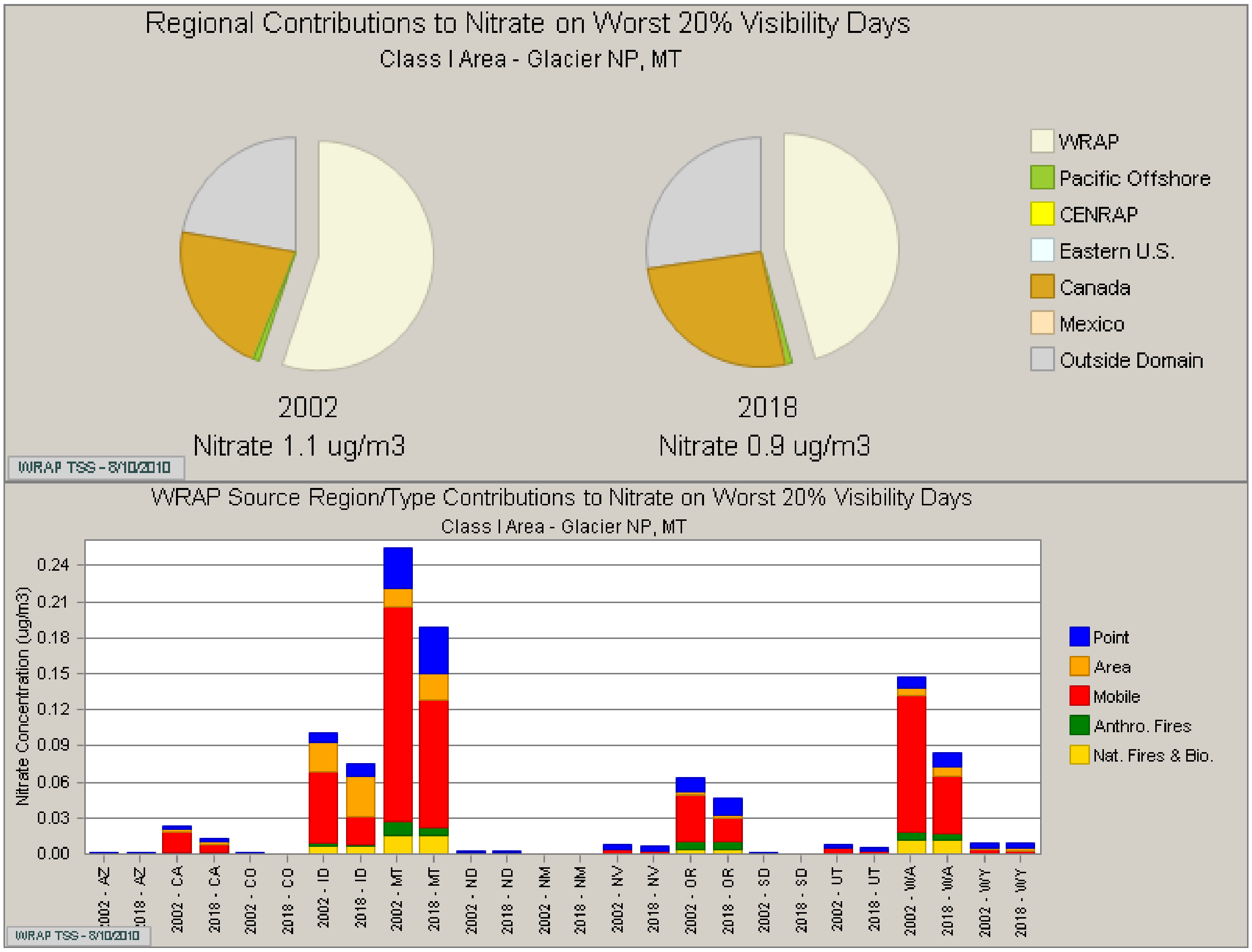

Figure 9-70 PSAT Nitrate Concentrations at Glacier National Park 20% Worst Days

Figure 9-71 shows an overall improvement in future nitrate contributions coming from all WRAP states on the 20% best days at Glacier National Park. The expected improvements are primarily from the mobile source category.

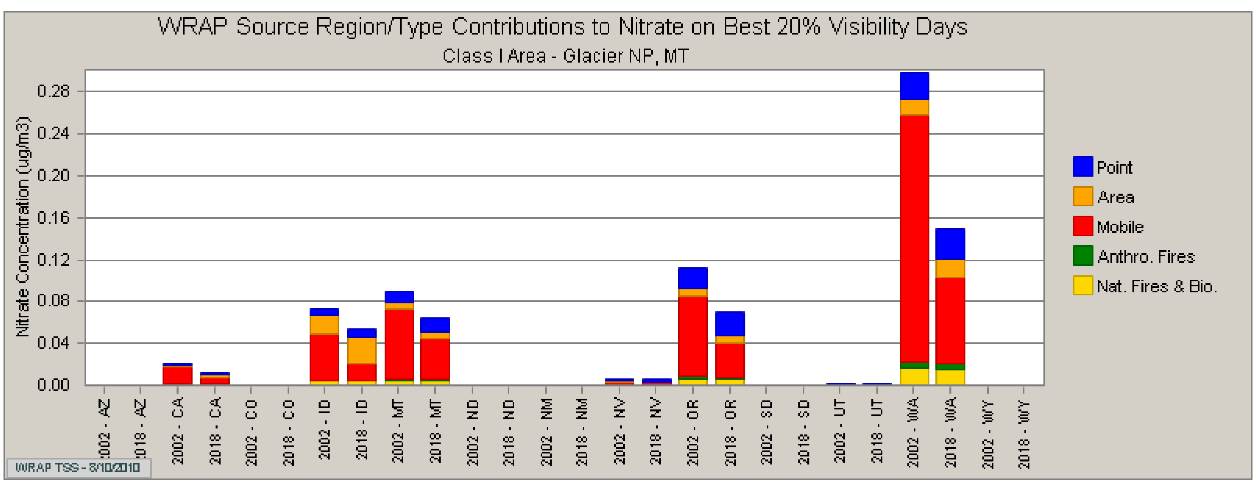

Figure 1-71 PSAT Nitrate Concentrations at Glacier National Park 20% Best Days

Primary Organic Aerosol at Glacier National Park Based on WEP

Figure 9-72 shows that the preponderance of organic aerosol on the 20% worst days in the Glacier National Park from Idaho is from natural fire with overall decreases expected primarily from anthropogenic fire. There are decreases anticipated from anthropogenic sources from most states. Overall, primary organic aerosol is expected to decrease because of reductions from anthropogenic fire.

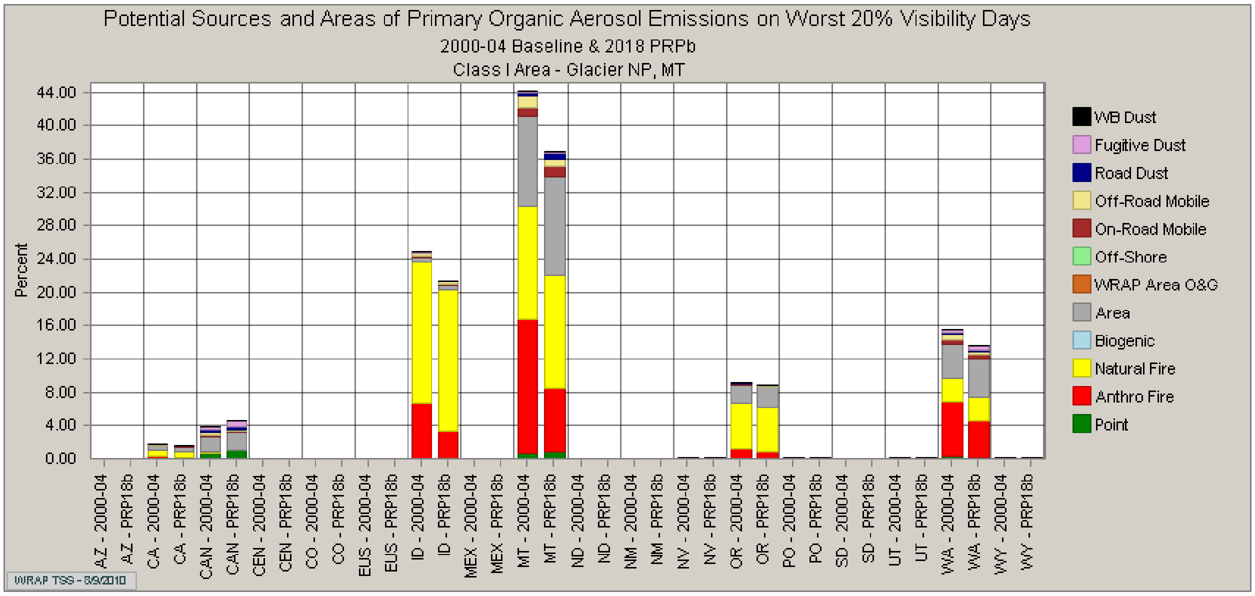

Figure 9-72 WEP Primary Organic Aerosol at Glacier National Park 20% Worst Days

Figure 9-73 shows similar results expected for the 20% best days in Glacier National Park as for the 20% worst days. Natural fire is by far the largest source. Overall, most states including Idaho are anticipating reductions coming from anthropogenic fire.

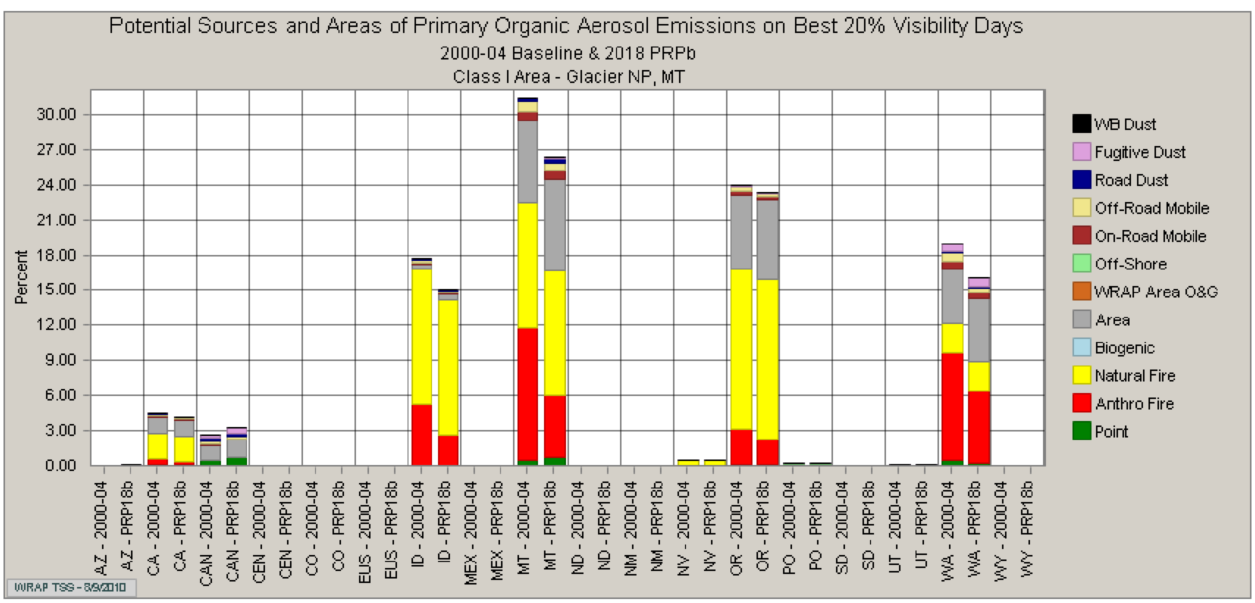

Figure 9-73 WEP Primary Organic Aerosol Glacier National Park 20% Best Days

Elemental Carbon at Glacier National Park Based on WEP

Figure 9-74 shows natural fire from Idaho is expected to be the largest contributor of Idaho visibility impairment on the 20% worst days in the Glacier National Park. It is anticipated there will be overall future visibility improvements from anthropogenic fire and off-road mobile.

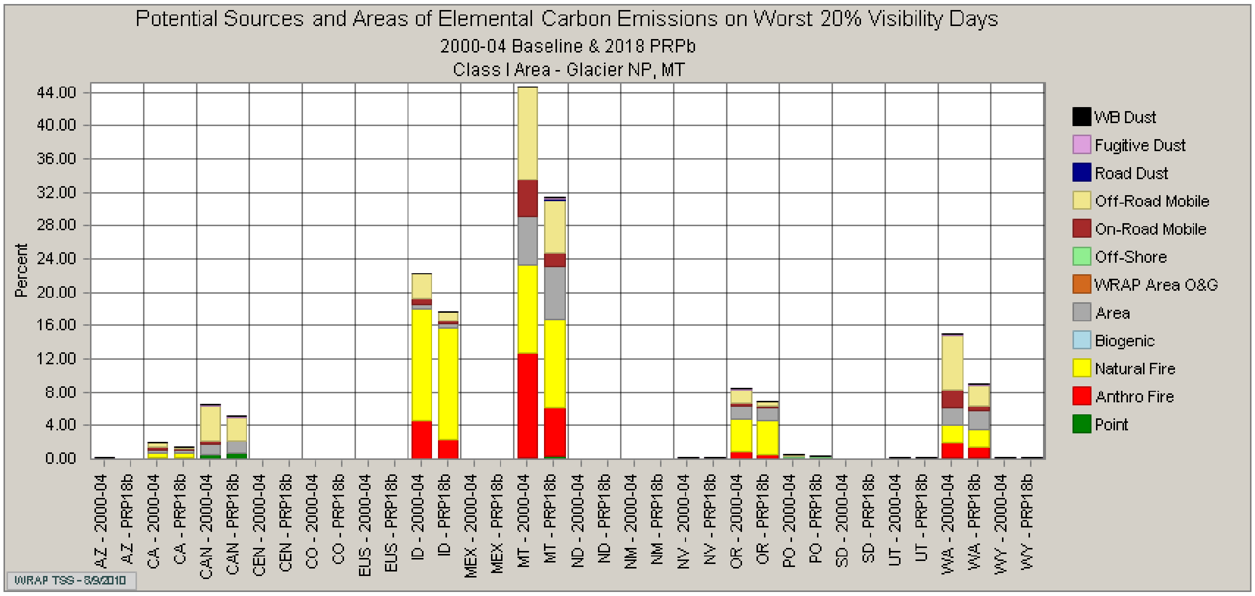

Figure 9-74 WEP Elemental Carbon at Glacier National Park 20% Worst Days

Figure 9-75 shows natural fire as the largest Idaho contributor of elemental carbon on the 20% best days in Glacier National Park. It is expected that elemental carbon will decrease in the future on the 20% best days due to improvements in smoke management programs reducing impacts from anthropogenic fire.

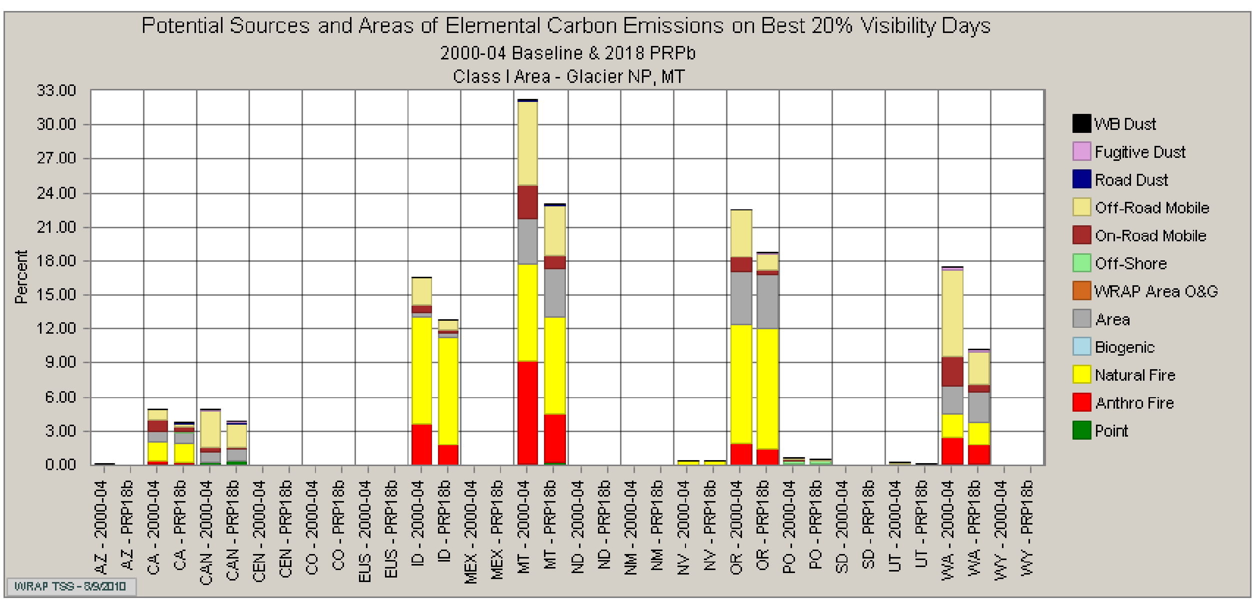

Figure 9-75 WEP Elemental Carbon at Glacier National Park 20% Best Days

Fine Particulate Matter at Glacier National Park Based on WEP

Figure 9-76 shows Montana's contribution of the fine particulate matter to Glacier National Park at over 36% during the 20% worst visibility days in 2002. Idaho shows contributions of about 8% of the fine particulate matter. Idaho's area source and fugitive dust are expected to increase during the first planning period and outpace reductions from anthropogenic fire.

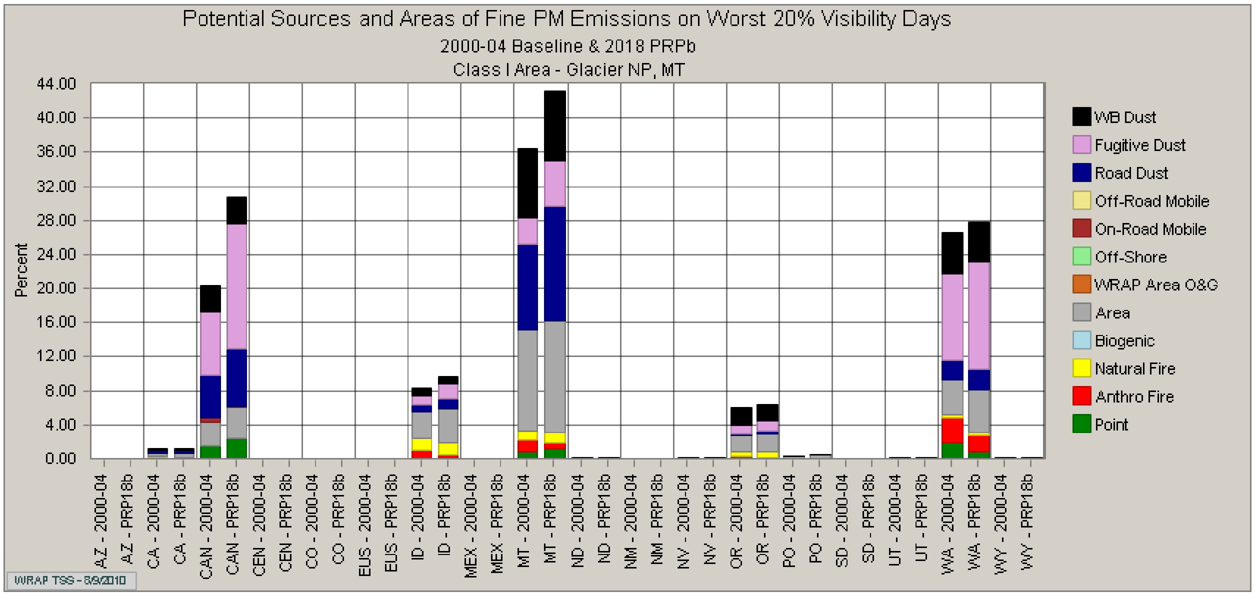

Figure 9-76 WEP Fine Particulate Matter at Glacier National Park Worst 20% Days

Figure 9-77 shows the same trends in fine particulate on the 20% best visibility days as on the 20% worst days in Glacier National Park. Overall, there is only a slight increase in visibility impact from area source and fugitive dust coming from Idaho.

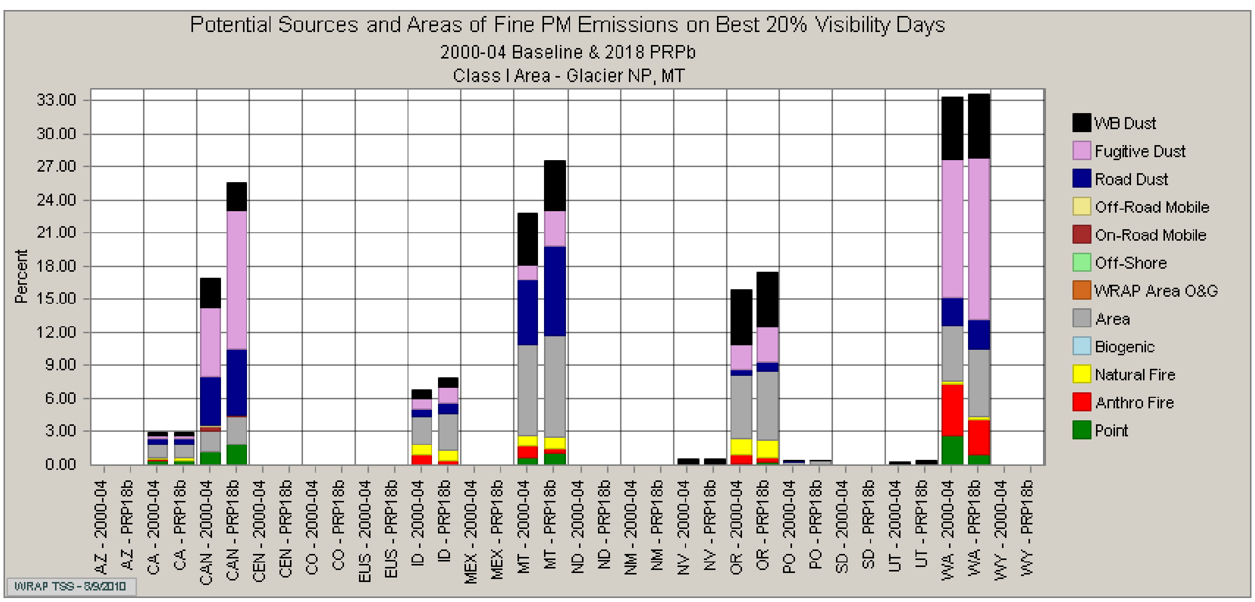

Figure 9-77 WEP Fine Particulate Matter at Glacier National Park Best 20% Days

Coarse Particulate Matter at Glacier National Park Based on WEP

Figure 9-78 shows coarse particulate from Idaho is trending similar to fine particulate in Glacier National Park on the 20% worst visibility days. Idaho, Montana, Washington and Oregon are all projecting increases in fugitive dust. Overall, coarse particulate is expected to increase in the Glacier National Park.

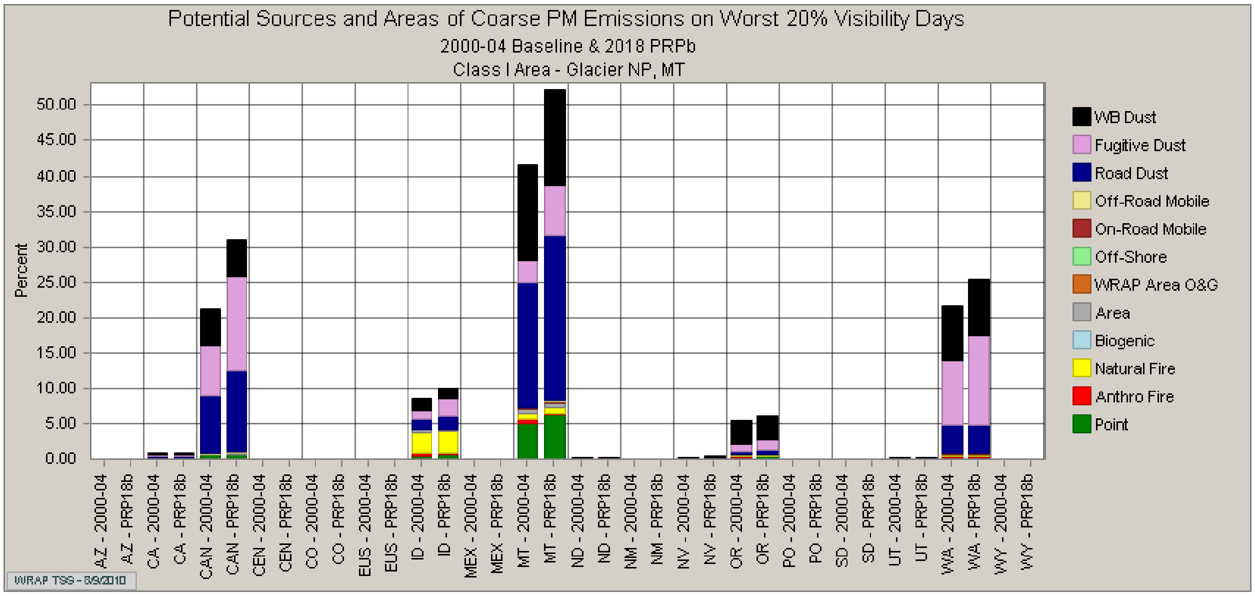

Figure 9-78 WEP Coarse Particulate Matter at Glacier National Park 20% Worst Days

Figure 9-79 shows an expected increase in coarse particulate on the 20% best days in Glacier National Park due to increases in fugitive dust and road dust.

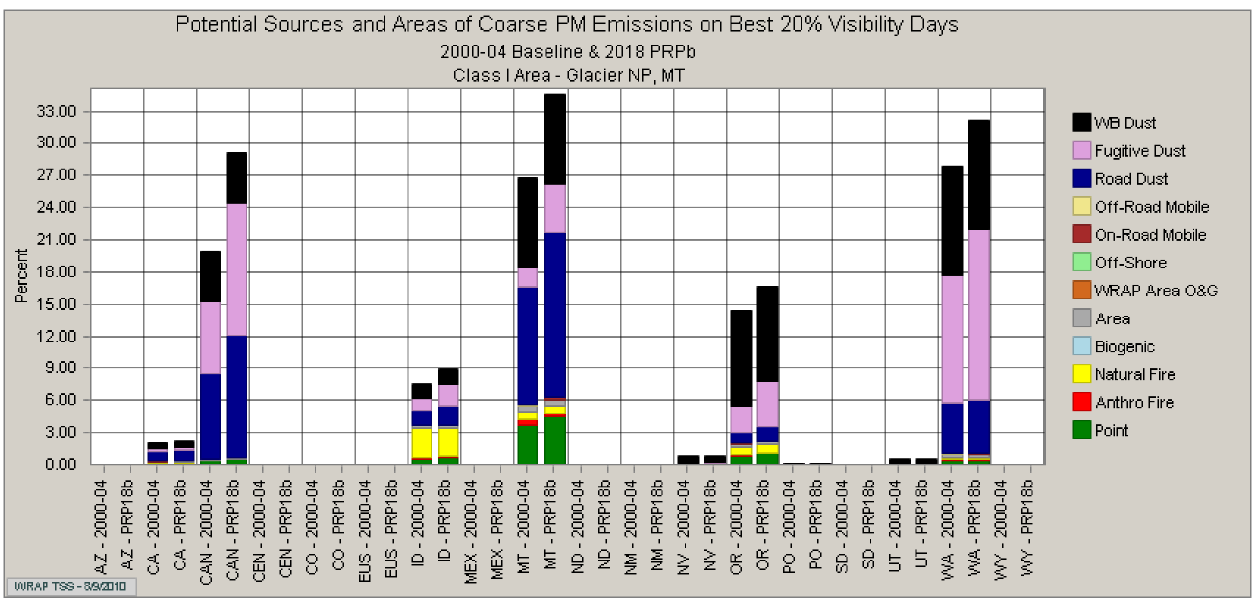

Figure 9-79 WEP Coarse Particulate Matter at Glacier National Park 20% Best Days

9.3.2 Cabinet Mountain Wilderness Source Apportionment

Sulfate at Cabinet Mountain Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-80 show the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-80 shows Washington and then Idaho and Oregon as the largest contributors of sulfate at Cabinet Mountain Wilderness. Overall, the concentration levels attributed to all the WRAP states is fairly low and decreasing over time due to expected reductions primarily from mobile sources. Idaho's contribution is expected to have an overall reduction of roughly 8% over the first planning period. Natural fire from Idaho is projected to account for 6% of the sulfate and only roughly 2% of the total contribution will be coming from Idaho anthropogenic sources. The large contribution from natural fire will make it difficult to show much progress in visibility improvement from Idaho area, point, and mobile sources.

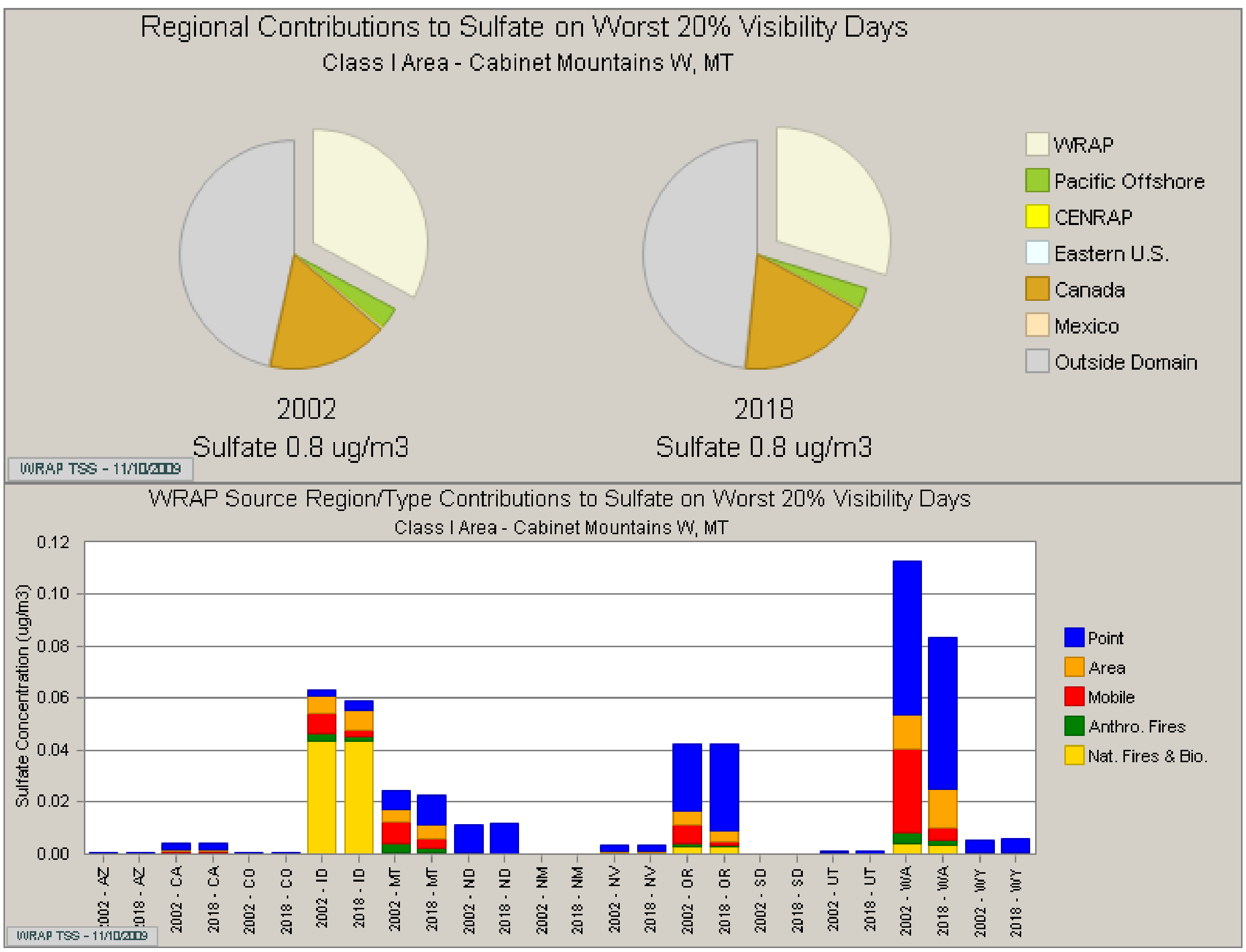

Figure 9-80 PSAT Sulfate Concentrations at Cabinet Mountain Wilderness 20% Worst Days

Figure 9-81 shows that overall improvement in future sulfate contributions on the 20% best days from Idaho are due to expected improvements from mobile sources. Washington and Nevada are expected to show slight increases due to point sources but this doesn't take into account all the BART controls that will be required to be added during this period.

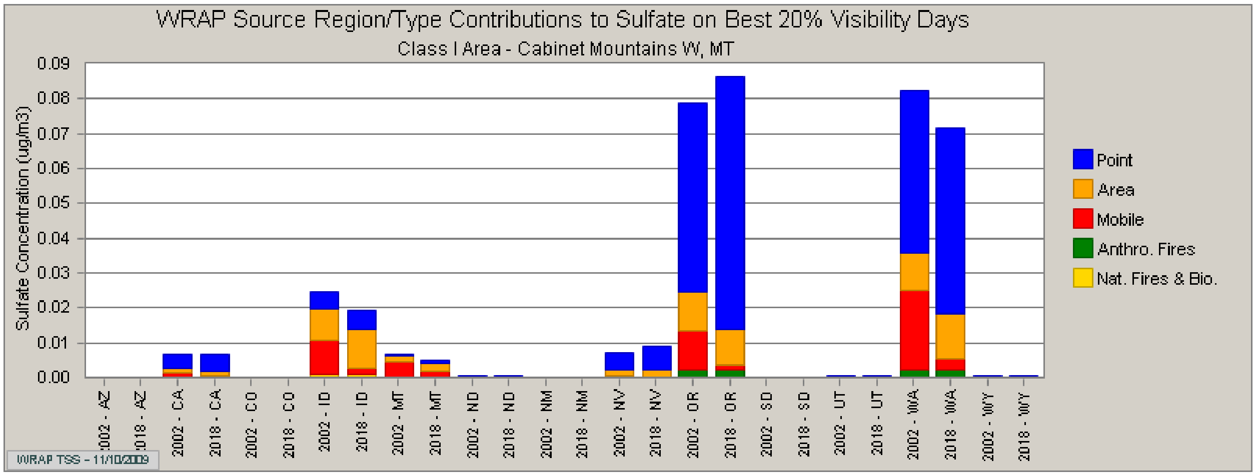

Figure 9-81 PSAT Sulfate Concentrations at Cabinet Wilderness 20% Best Days

Nitrate at Cabinet Mountain Wilderness Based on PSAT Modeling

The regional source contribution pie charts in figure 9-82 show the WRAP states are only contributing roughly two-thirds to three-quarters of the visibility impairment on the 20% worst days in the Cabinet Mountain Wilderness. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution and the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-82 shows Washington then Oregon and Idaho as the largest contributors of nitrate in 2002. Overall, the concentration levels attributed to all the WRAP states is expected to decrease over time due to reductions primarily from mobile sources. Idaho's contribution is expected to show an overall reduction of roughly 26% over the first planning period with a future contribution of 14% of the total nitrate concentrations. This does not include emission reductions expected from all the subject-to-BART sources.

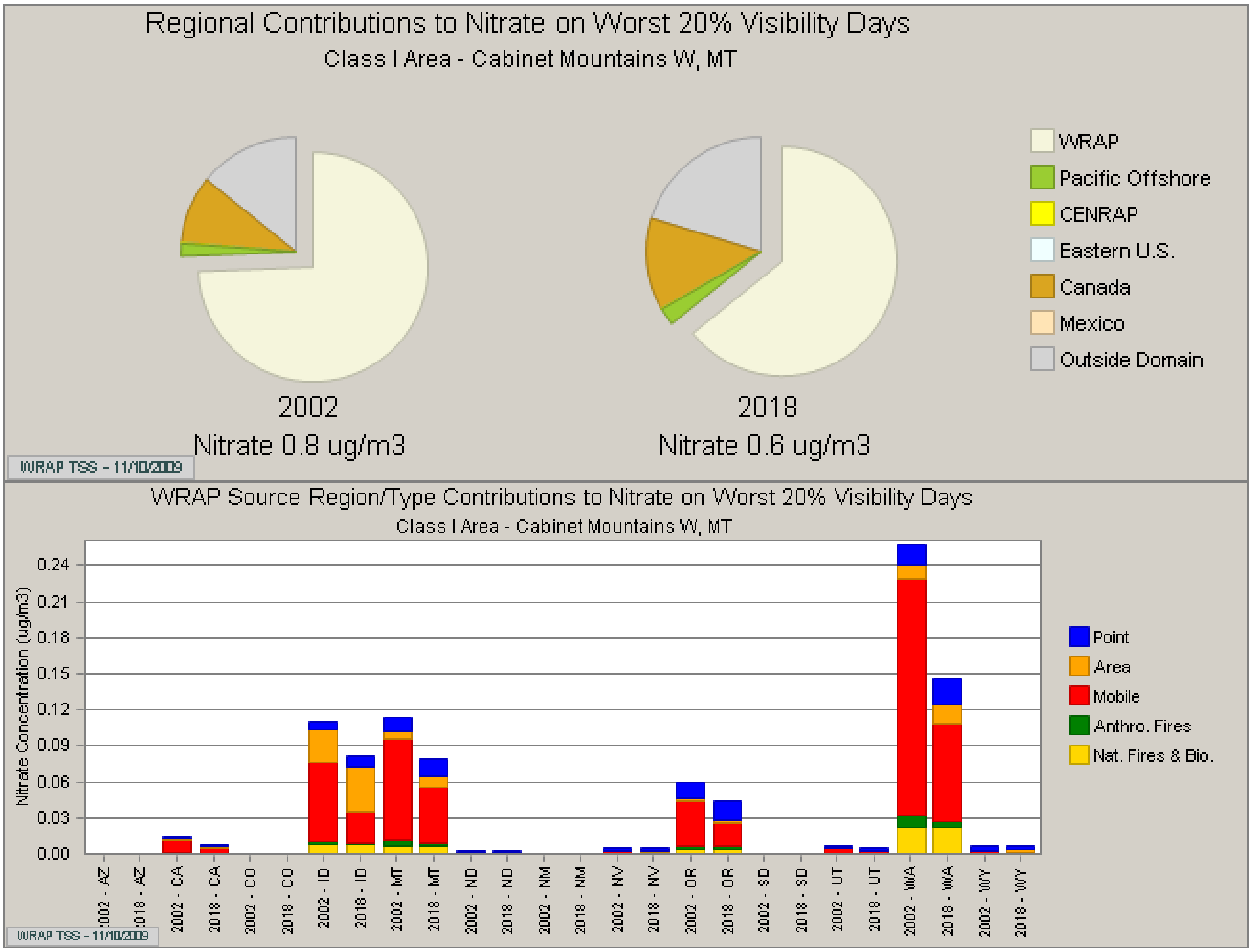

Figure 9-82 PSAT Nitrate Concentrations at Cabinet Mountain Wilderness 20% Worst Days

Figure 9-83 shows an overall improvement in future nitrate contributions coming from all WRAP states on the 20% best days at Cabinet Mountain Wilderness. The expected improvements are primarily from the mobile source category.

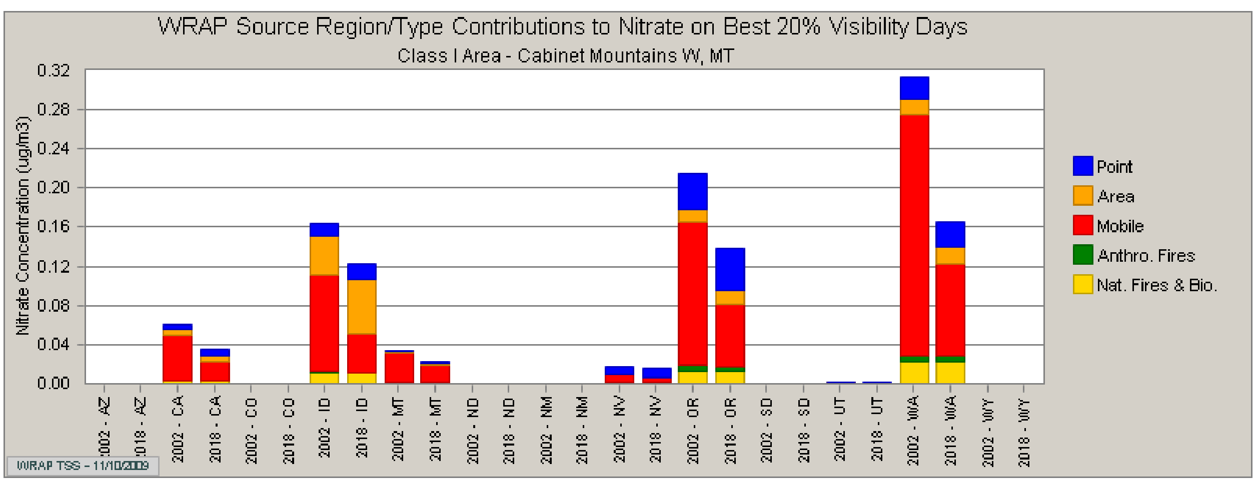

Figure 9-83 PSAT Nitrate Concentrations at Cabinet Mountain Wilderness 20% Best Days

Primary Organic Aerosol at Cabinet Mountain Wilderness Based on WEP

Figure 9-84 shows that the preponderance of organic aerosol on the 20% worst days in the Cabinet Mountain Wilderness is expected to come from Idaho natural fire. There are decreases anticipated from anthropogenic sources from most states. Overall, primary organic aerosol is expected to decrease because of reductions from anthropogenic fire.

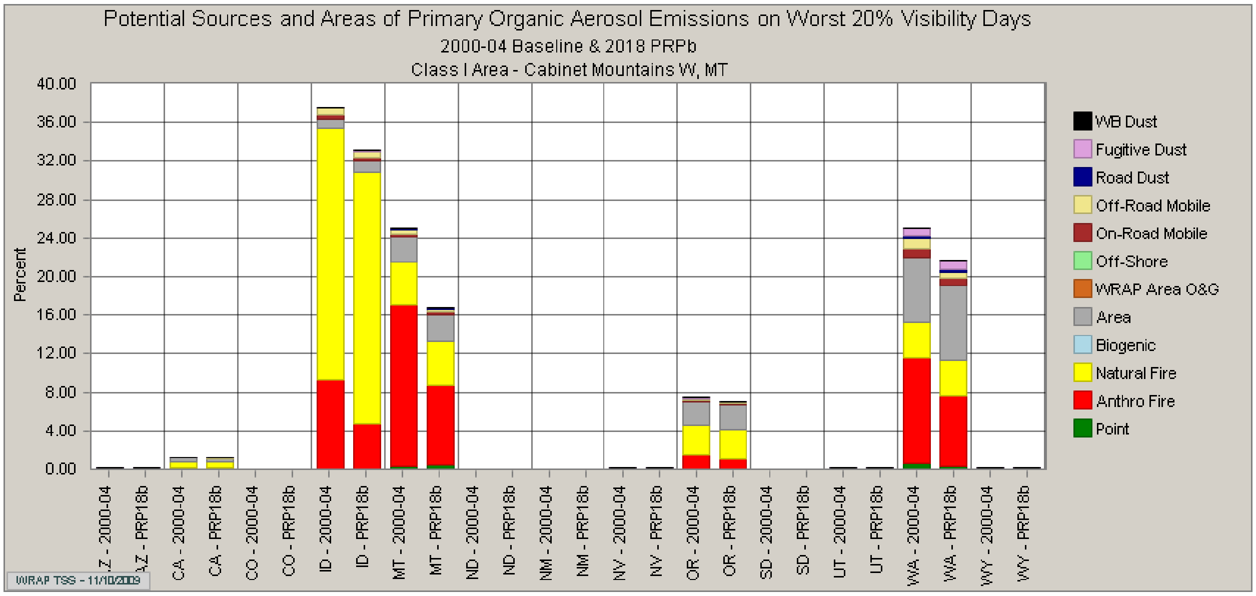

Figure 9-84 WEP Primary Organic Aerosol at Cabinet Mountain Wilderness 20% Worst Days

Figure 9-85 shows similar results for the 20% best days in the Cabinet Mountain Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. Overall, most states are anticipating reductions coming from anthropogenic fire.

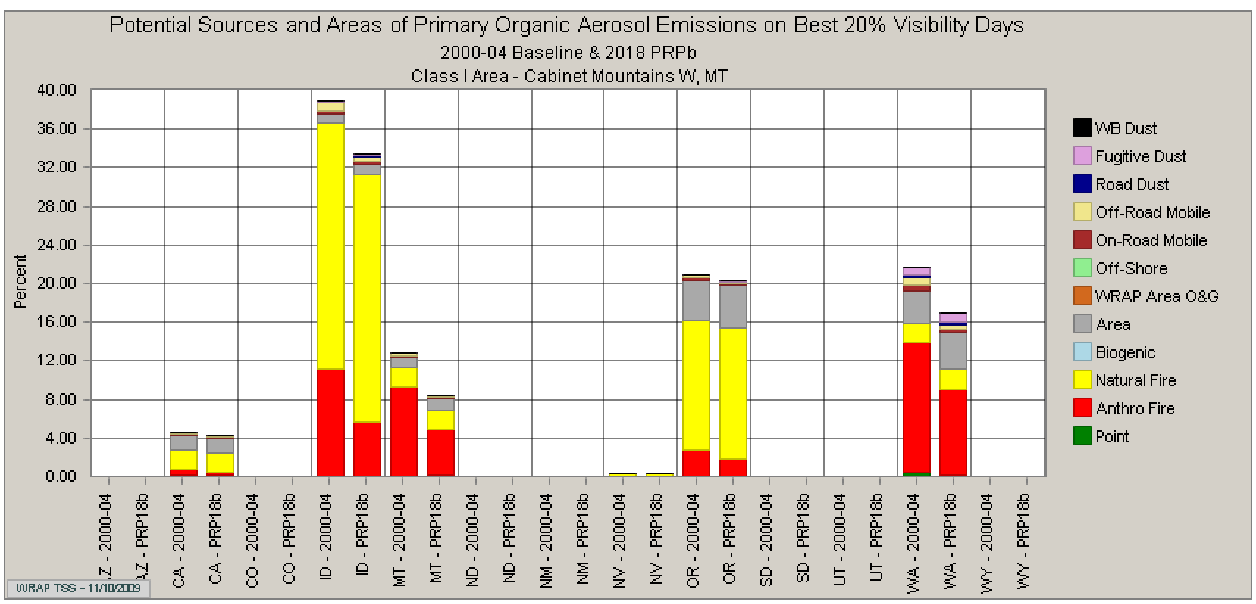

Figure 9-85 WEP Primary Organic Aerosol Cabinet Mountain Wilderness 20% Best Days

Elemental Carbon at Cabinet Mountain Wilderness Based on WEP

Figure 9-86 shows natural fire from Idaho is expected to be the largest contributor of elemental fire visibility impairment on the 20% worst days in the Cabinet Mountain Wilderness. It is anticipated there will be overall future visibility improvements from anthropogenic fire and off-road mobile.

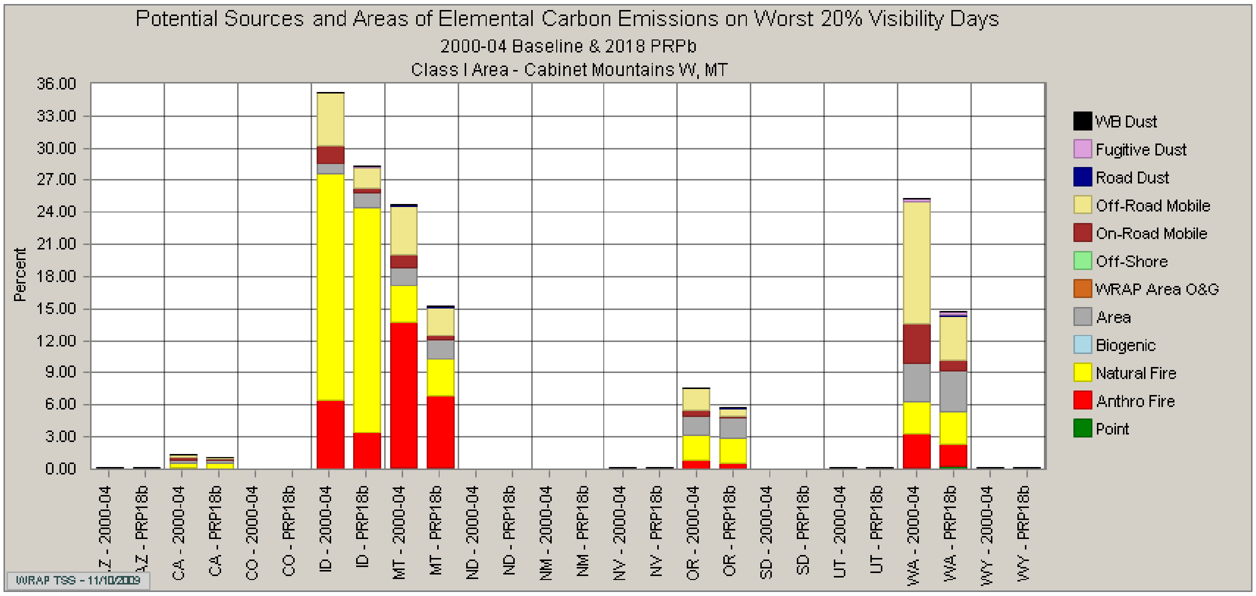

Figure 9-86 WEP Elemental Carbon at Cabinet Mountain Wilderness 20% Worst Days

Figure 9-87 shows similar expected results for elemental carbon for the 20% best days in the Cabinet Mountain Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. It is expected elemental carbon will decrease in the future on the 20% best days due to improvements in smoke management programs reducing impacts from anthropogenic fire.

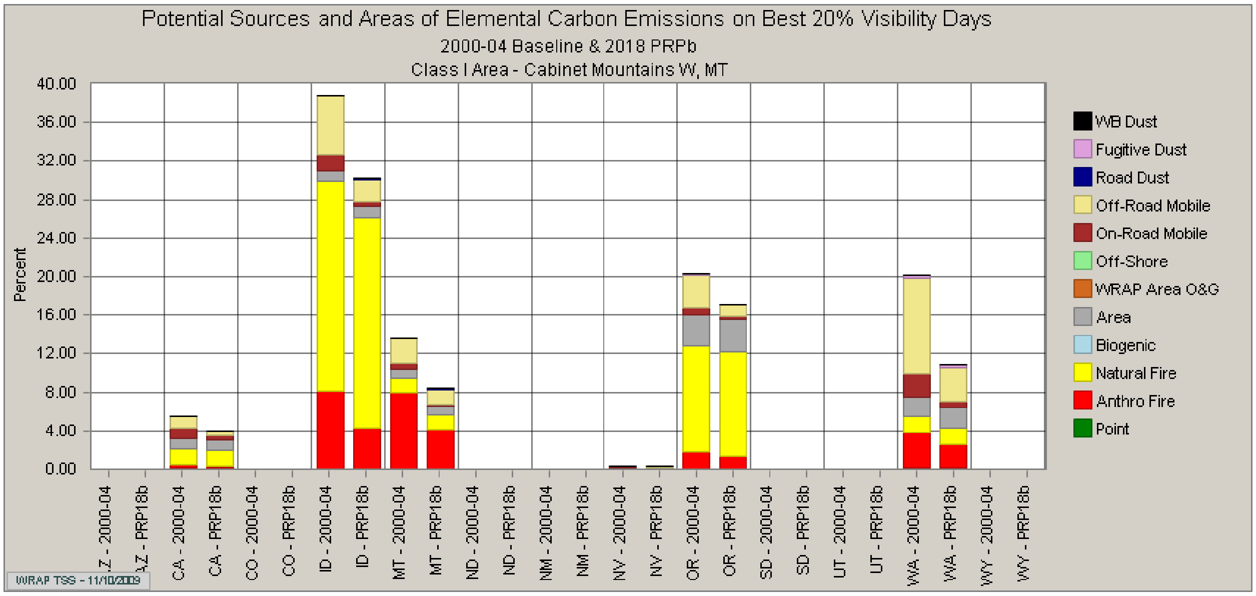

Figure 9-87 WEP Elemental Carbon at Cabinet Mountain Wilderness 20% Best Days

Fine Particulate Matter at Cabinet Mountain Wilderness Based on WEP

Figure 9-88 shows Washington is expected to contribute a little over 50% of the fine particulate matter to Cabinet Mountain Wilderness during the 20% worst visibility days 2002. Montana and Idaho are expected to show almost equal contributions with around 15% of the fine particulate matter contributed by each. Idaho's area source and road dust are expected to increase during the first planning period and outpace reductions from anthropogenic fire.

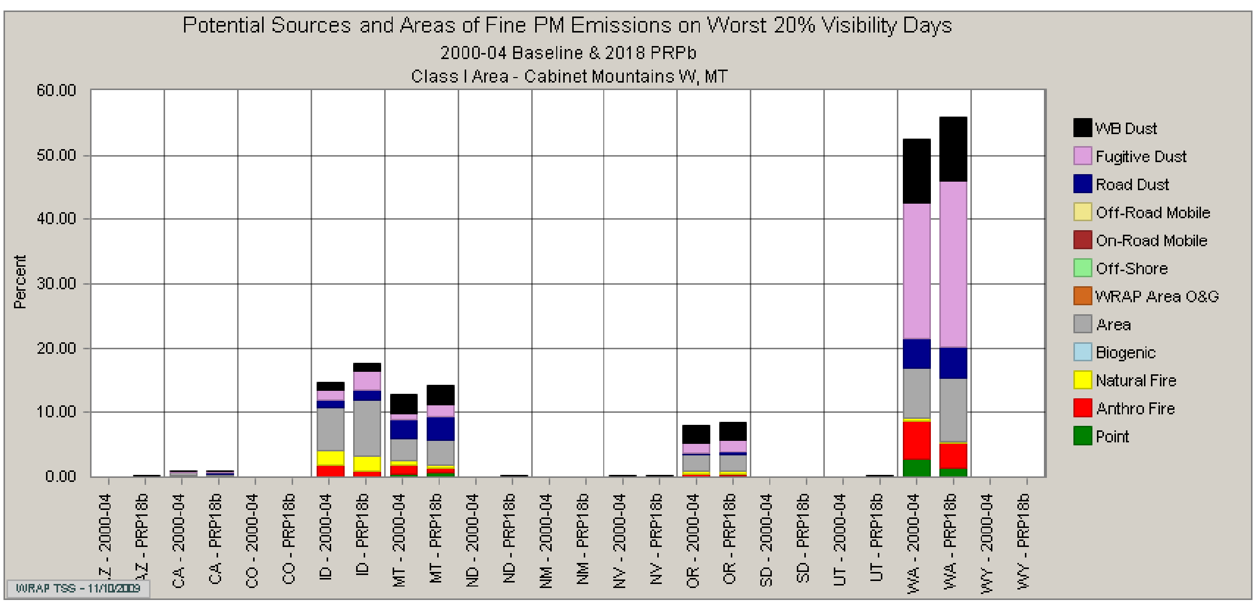

Figure 9-88 WEP Fine Particulate Matter at Cabinet Mountain Wilderness Worst 20% Days

Figure 9-89 shows the same trends in fine particulate on the best 20% visibility days as on the worst 20% days in the Cabinet Mountain Wilderness. Overall, there is only a slight increase in visibility impact from area source and fugitive dust coming from Idaho.

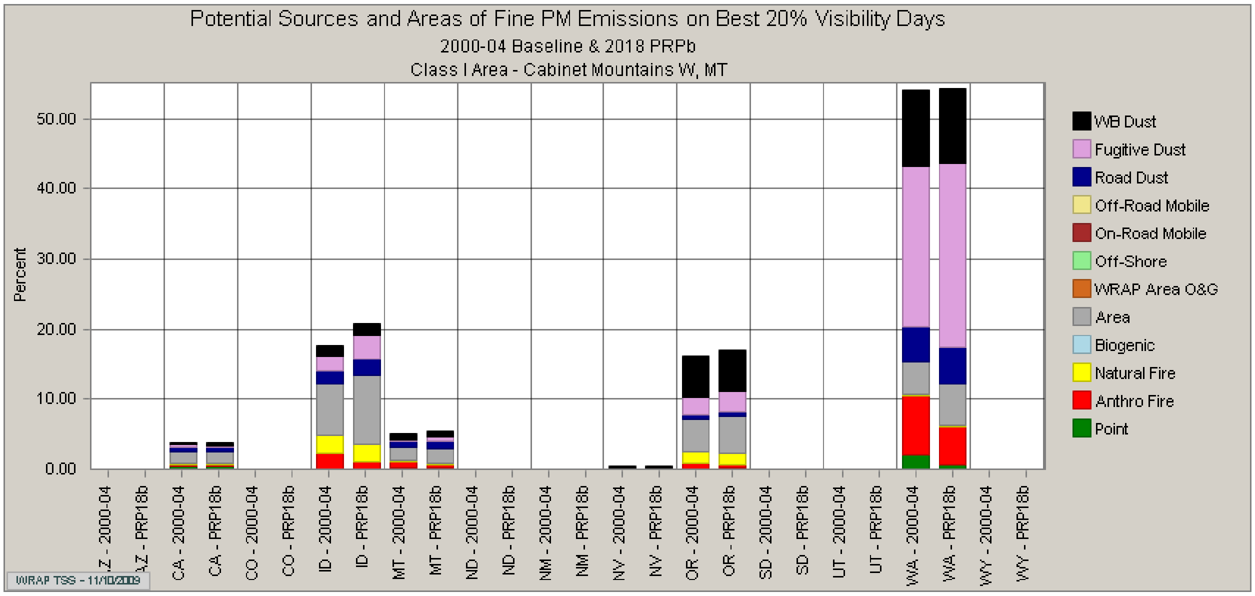

Figure 9-89 WEP Fine Particulate Matter at Cabinet Mountain Wilderness Best 20% Days

Coarse Particulate Matter at Cabinet Mountain Wilderness Based on WEP

Figure 9-90 shows coarse particulate is trending similar to fine particulate in the Cabinet Mountain Wilderness on the 20% worst visibility days with Washington being the largest contributor. Idaho, Montana, Washington, and Oregon are all projecting increases in fugitive dust and road dust with a slight decrease in anthropogenic fire. Overall, coarse particulate is expected to increase in the Cabinet Mountain Wilderness.

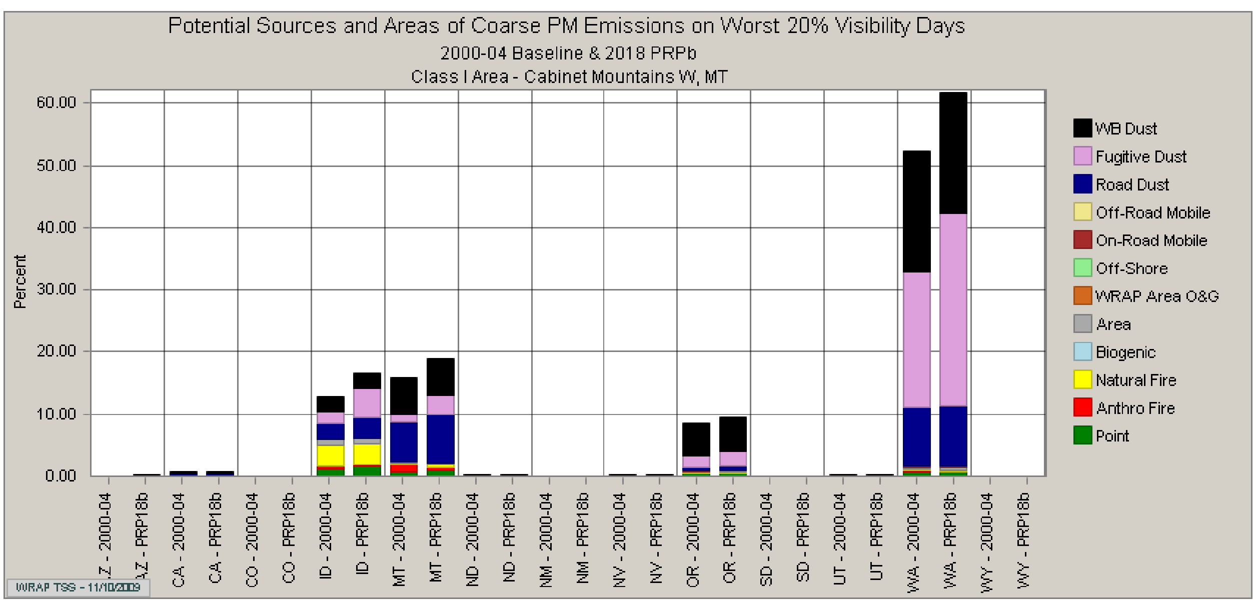

Figure 9-90 WEP Coarse Particulate Matter at Cabinet Mountain Wilderness 20% Worst Days

Figure 9-91 shows an expected increase in coarse particulate on the 20% best days in the Cabinet Mountain Wilderness due to increases in fugitive dust and road dust.

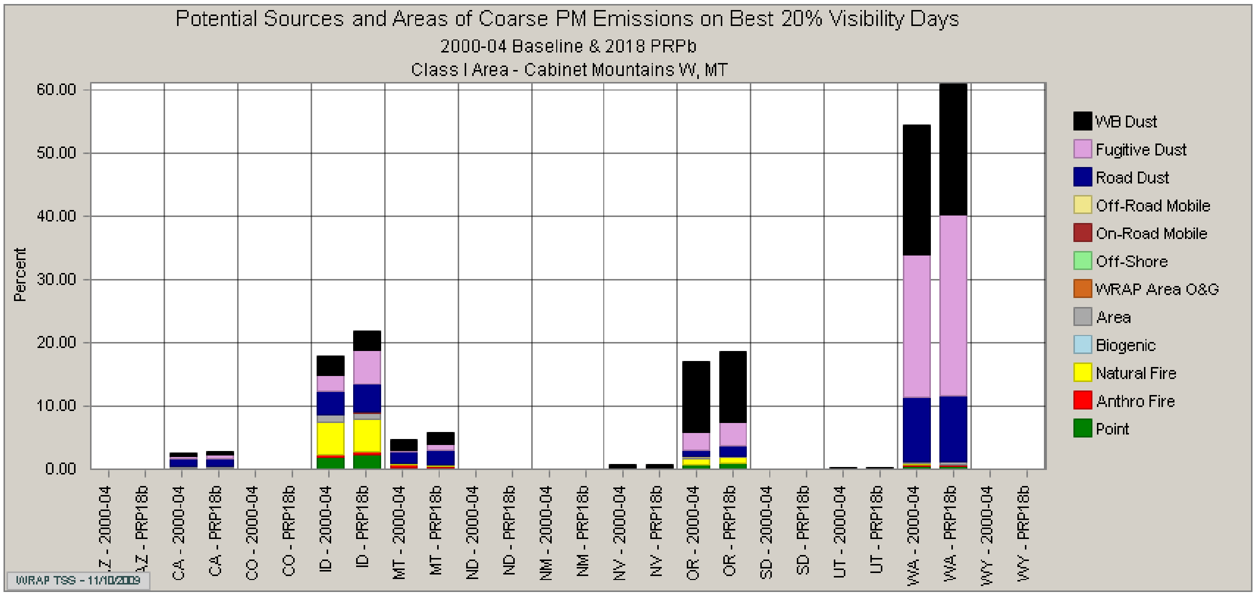

Figure 9-91 WEP Coarse Particulate Matter at Cabinet Mountain Wilderness 20% Best Days

9.3.3 Bob Marshall Wilderness, Mission Mountain Wilderness, and Scapegoat Wilderness Source Apportionment[9]

Sulfate at Bob Marshall Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-92 show the WRAP states are only expected to contribute roughly a little over 25% of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-92 shows Montana and then Washington and Idaho as the largest contributors of sulfate at Bob Marshall Wilderness. Overall, the concentration levels attributed to all the WRAP states are fairly low and decreasing over time due to expected reductions primarily from mobile sources. Idaho is expecting an overall reduction of roughly 3% over the first planning period. Natural fire from Idaho is projected to account for 3% of the sulfate and only roughly 2% of the total contribution will be coming from Idaho anthropogenic sources. The large contribution from natural fire will make it difficult to show much progress in visibility improvement from Idaho area, point, and mobile sources.

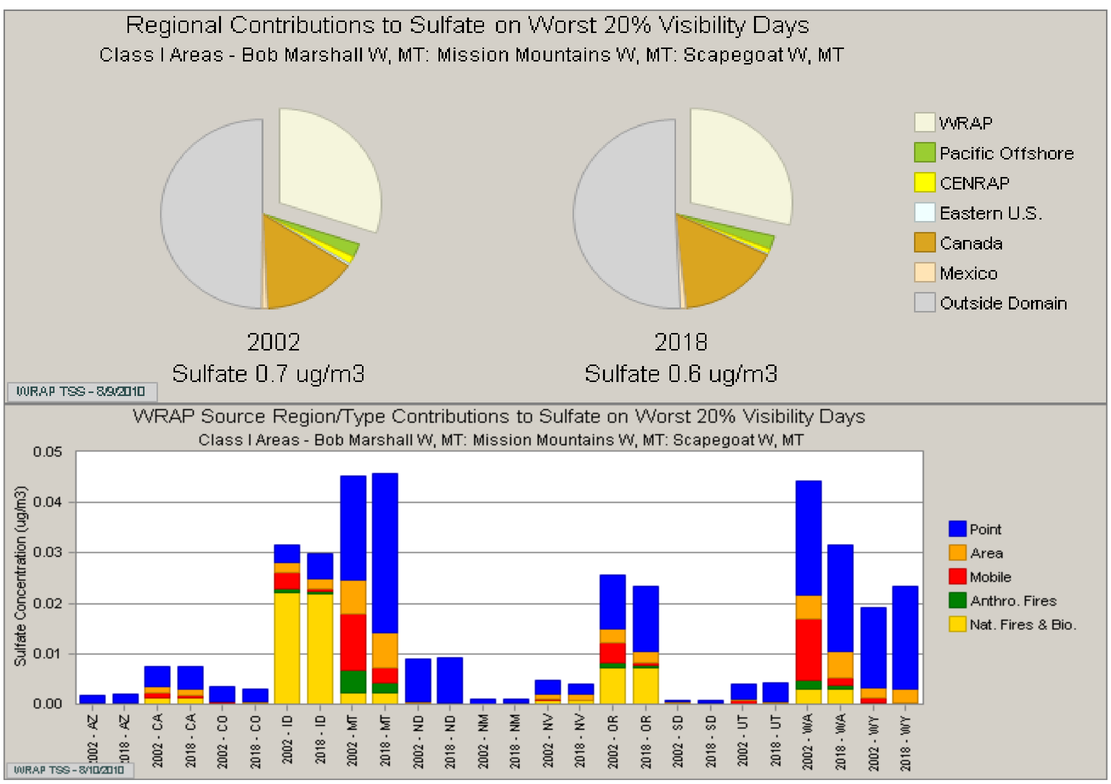

Figure 9-92 PSAT Sulfate Concentrations at Bob Marshall Wilderness 20% Worst Days

9 Throughout the remainder of this section the Bob Marshall Wilderness, Mission Mountain Wilderness and Scapegoat Wilderness will be represented by the "Bob Marshall Wilderness" since they all share the same IMPROVE monitoring site.

Figure 9-93 shows that overall improvement in future sulfate contributions from Idaho on the 20% best days are due to expected improvements from mobile sources.

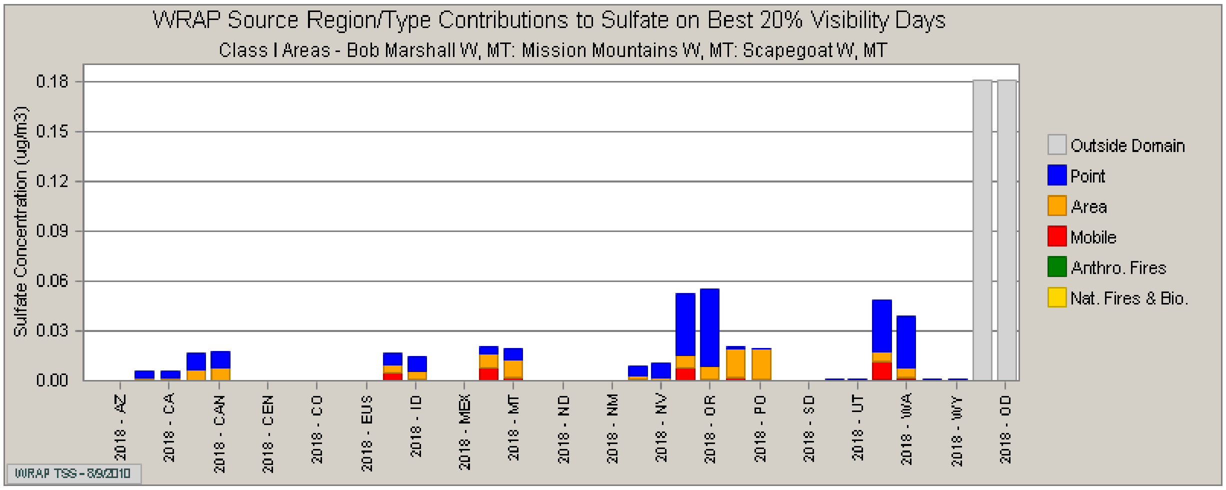

Figure 9-93 PSAT Sulfate Concentrations at Bob Marshall Wilderness 20% Best Days

Nitrate at Bob Marshall Wilderness Based on PSAT Modeling

The regional source contribution pie charts in figure 9-94 show the WRAP states are only contributing roughly half to two-thirds of the visibility impairment on the 20% worst days in the Bob Marshall Wilderness. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution and the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-94 shows Montana then Washington and Idaho as the largest WRAP contributors of nitrate in 2002. Overall, the concentration levels attributed to all the WRAP states are expected to decrease over time due to reductions primarily from mobile sources. Idaho is expecting an overall reduction of roughly 27% over the first planning period with a future contribution of 7% of the total nitrate concentrations. This does not include emission reductions expected from all the subject-to-BART sources.

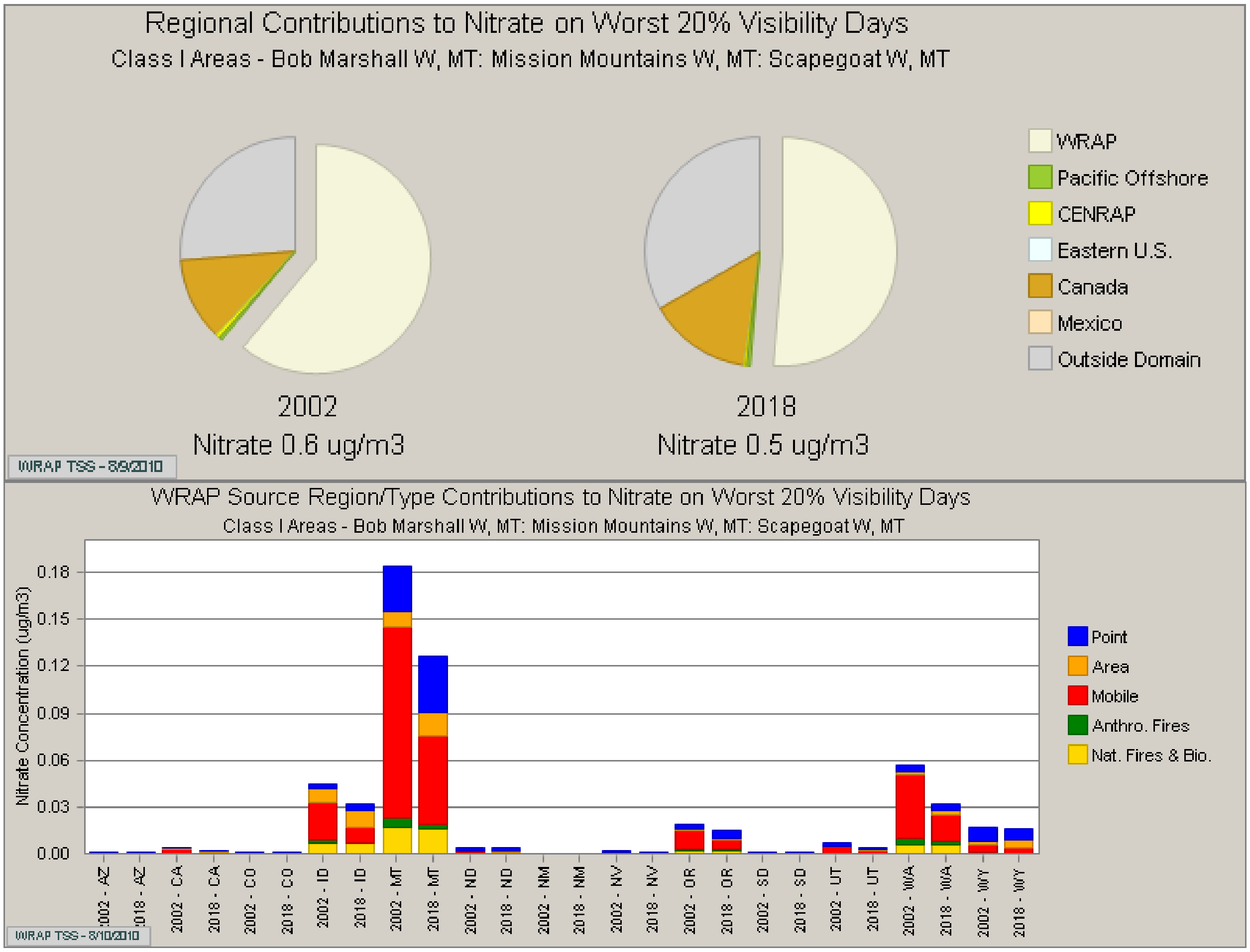

Figure 9-94 PSAT Nitrate Concentrations at Bob Marshall Wilderness 20% Worst Days

Figure 9-95 shows an overall improvement in future nitrate contributions coming from all WRAP states on the 20% best days at Bob Marshall Wilderness. The expected improvements are primarily from the mobile source category.

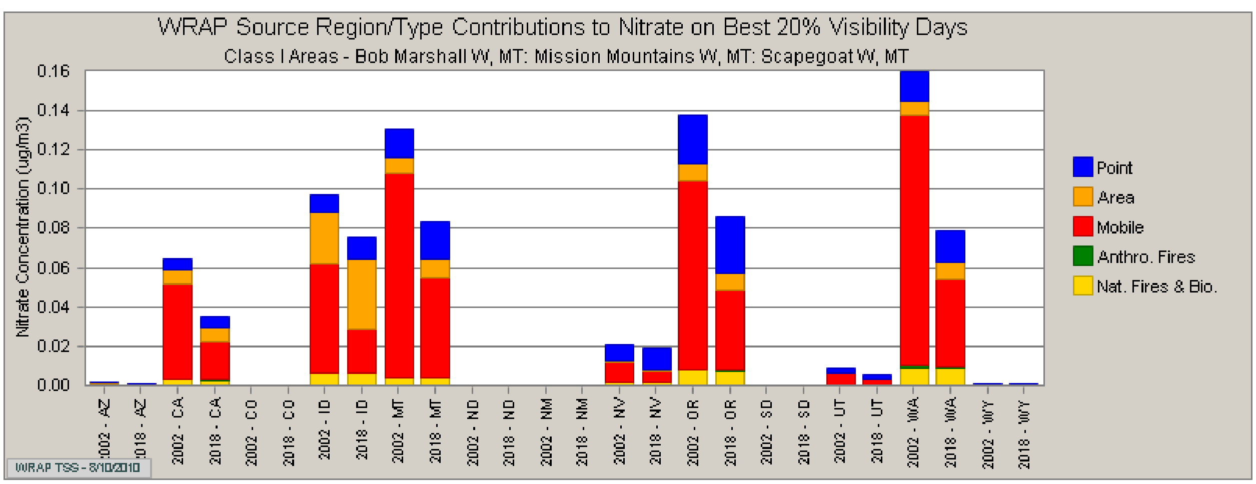

Figure 9-95 PSAT Nitrate Concentrations at Bob Marshall Wilderness 20% Best Days

Primary Organic Aerosol at Bob Marshall Wilderness Based on WEP

Figure 9-96 shows that the preponderance of organic aerosol on the 20% worst days in the Bob Marshall Wilderness is expected to come from Idaho natural fire. There are decreases anticipated from anthropogenic sources from most states. Overall, primary organic aerosol is expected to decrease because of reductions from anthropogenic fire.

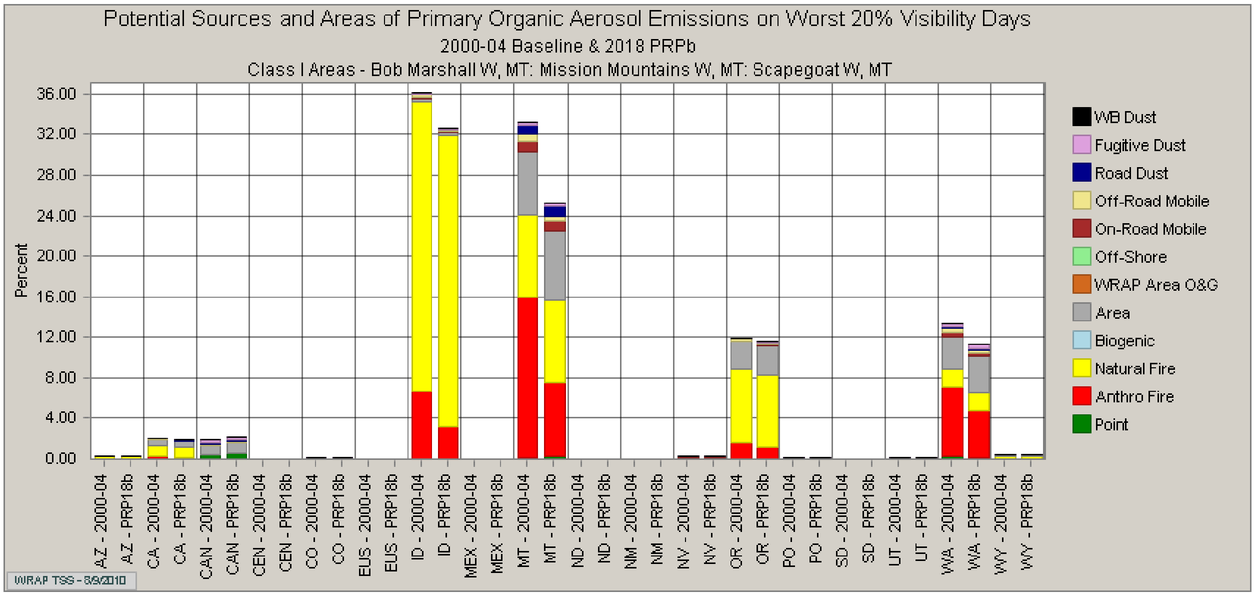

Figure 9-96 WEP Primary Organic Aerosol at Bob Marshall Wilderness 20% Worst Days

Figure 9-74 is showing similar results for the 20% best days in the Bob Marshall Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. Overall, most states are anticipating reductions coming from anthropogenic fire.

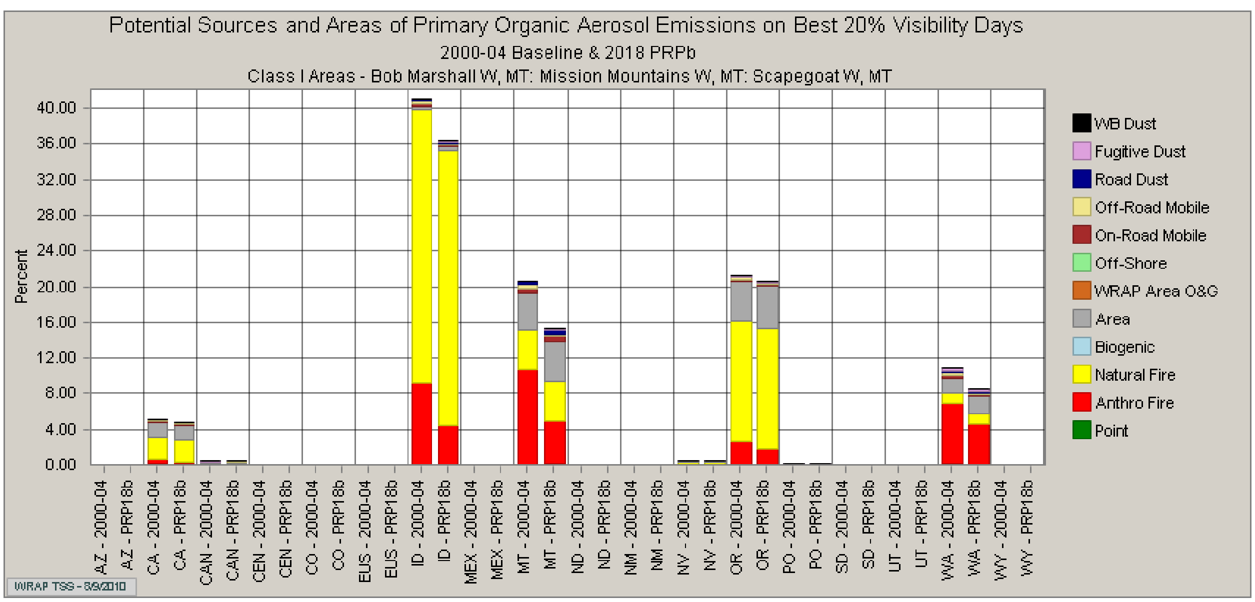

Figure 9-97 WEP Primary Organic Aerosol Bob Marshall Wilderness 20% Best Days

Elemental Carbon at Bob Marshall Wilderness Based on WEP

Figure 9-98 shows natural fire from Idaho is expected to be the largest contributor of elemental carbon visibility impairment on the 20% worst days in the Bob Marshall Wilderness. It is anticipated there will be overall future visibility improvements from anthropogenic fire and off-road mobile.

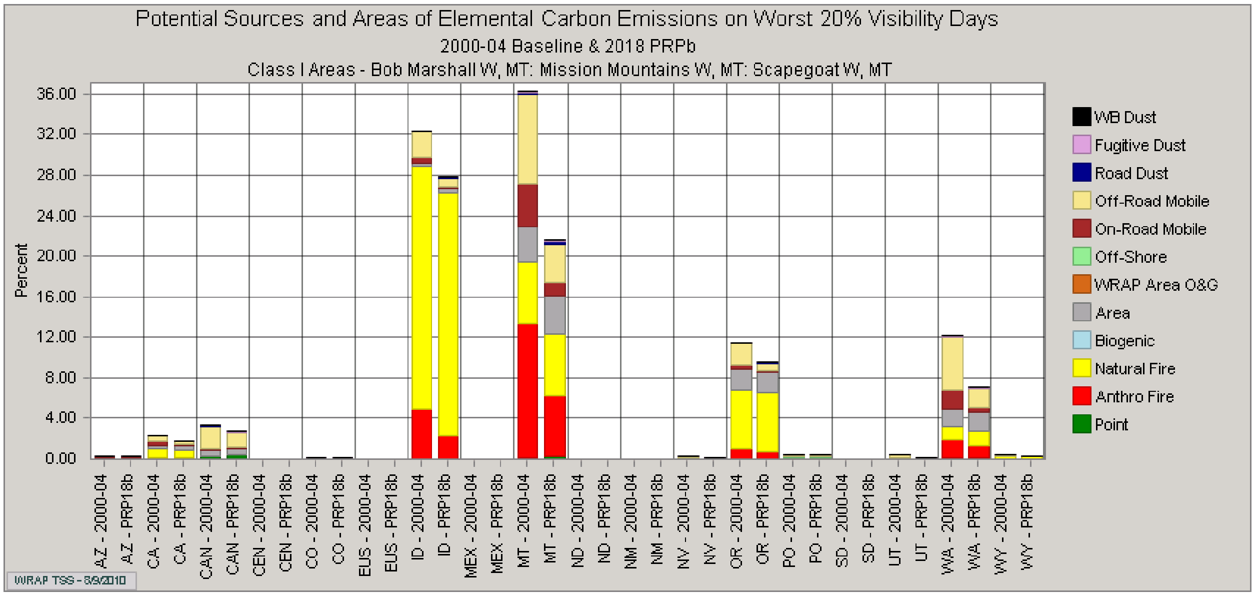

Figure 9-98 WEP Elemental Carbon at Bob Marshall Wilderness 20% Worst Days

Figure 9-99 shows similar expected results for elemental carbon for the 20% best days in the Bob Marshall Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. It is expected elemental carbon will decrease in the future on the 20% best days due to improvements in smoke management programs reducing impacts from anthropogenic fire.

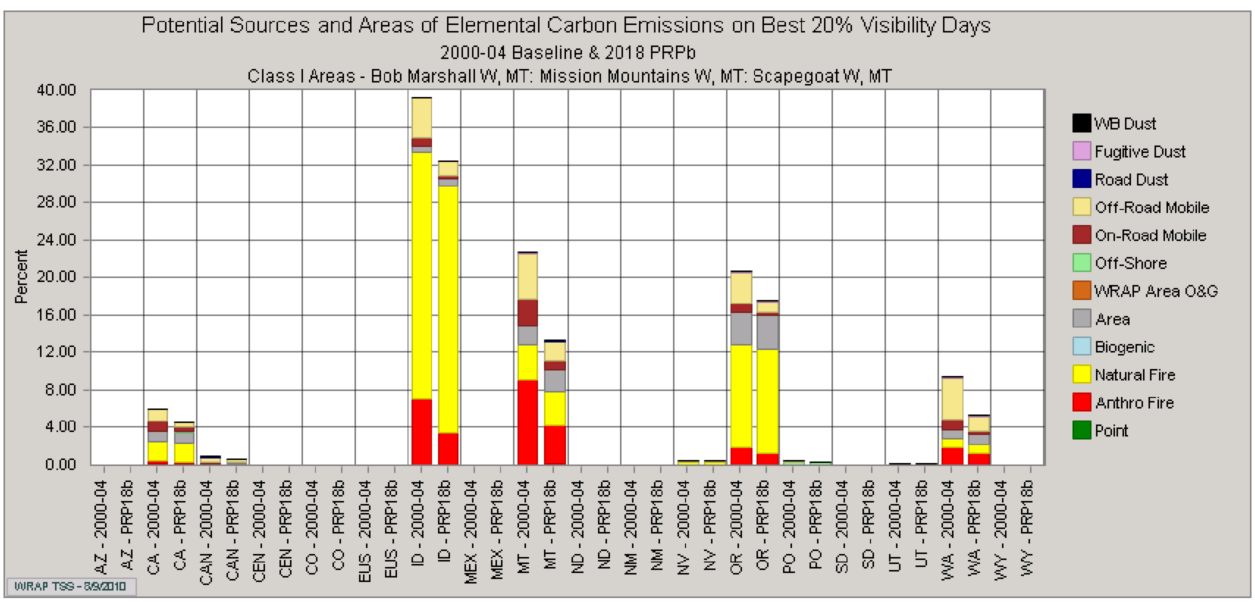

Figure 9-99 WEP Elemental Carbon at Bob Marshall Wilderness 20% Best Days

Fine Particulate Matter at Bob Marshall Wilderness Based on WEP

Figure 9-100 shows Montana is expected to contribute roughly 50% of the fine particulate matter to Bob Marshall Wilderness during the 20% worst visibility days. Oregon and Idaho contributions are expected to be almost equal with less than 10% each of the fine particulate matter contributions. Idaho's area source emissions and road dust are expected to increase during the first planning period and outpace reductions from anthropogenic fire.

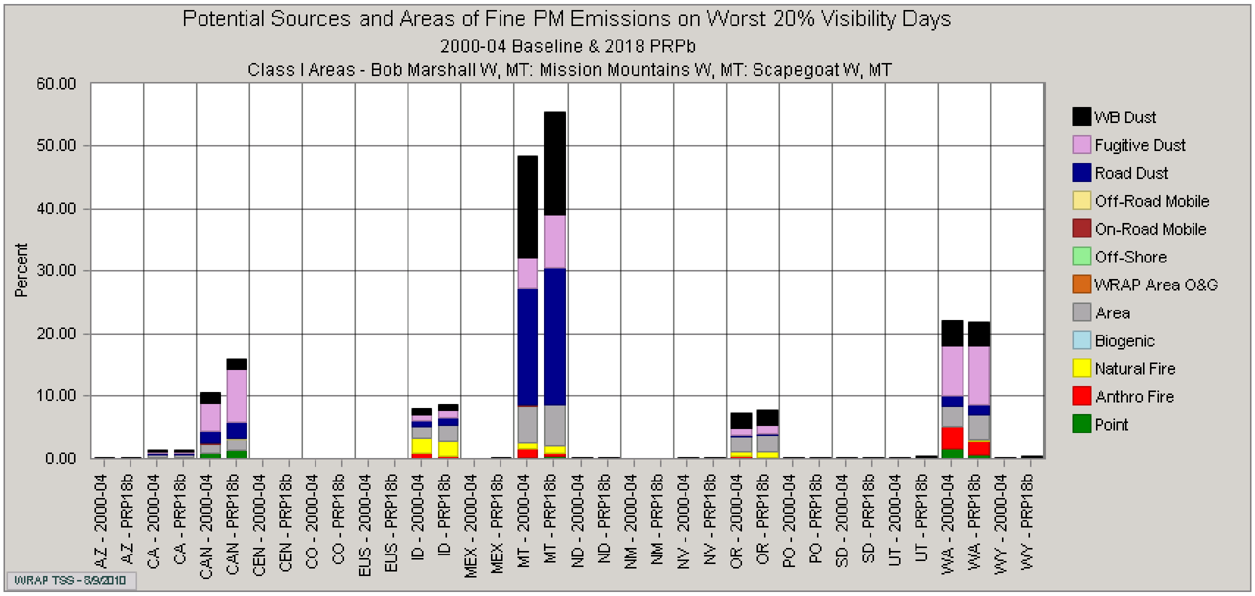

Figure 9-100 WEP Fine Particulate Matter at Bob Marshall Wilderness Worst 20% Days

Figure 9-101 shows the same trends in fine particulate on the 20% best visibility days as on the 20% worst days in the Bob Marshall Wilderness. Overall, there is only a slight increase expected in visibility impact from area source emissions and fugitive dust coming from Idaho.

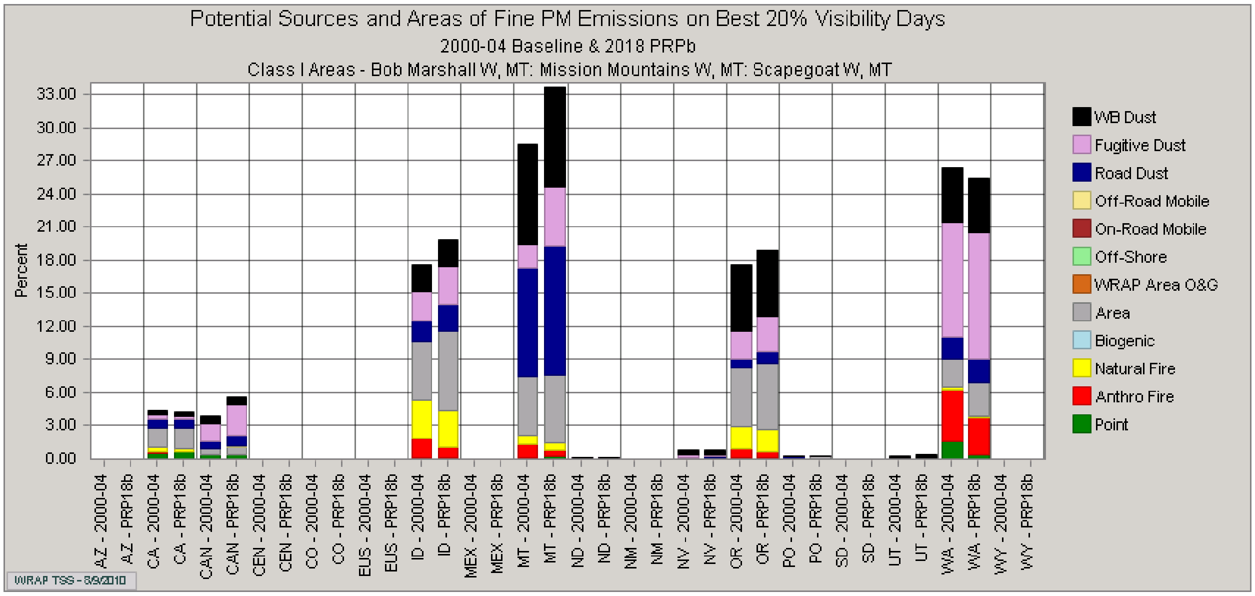

Figure 9-101 WEP Fine Particulate Matter at Bob Marshall Wilderness Best 20% Days

Coarse Particulate Matter at Bob Marshall Wilderness Based on WEP

Figure 9-102 shows coarse particulate in the Bob Marshall Wilderness on the 20% worst visibility days is primarily from Montana. Idaho, Montana, Washington, and Oregon are all projecting increases in fugitive dust and road dust. Overall, coarse particulate is expected to increase in the Cabinet Mountain Wilderness.

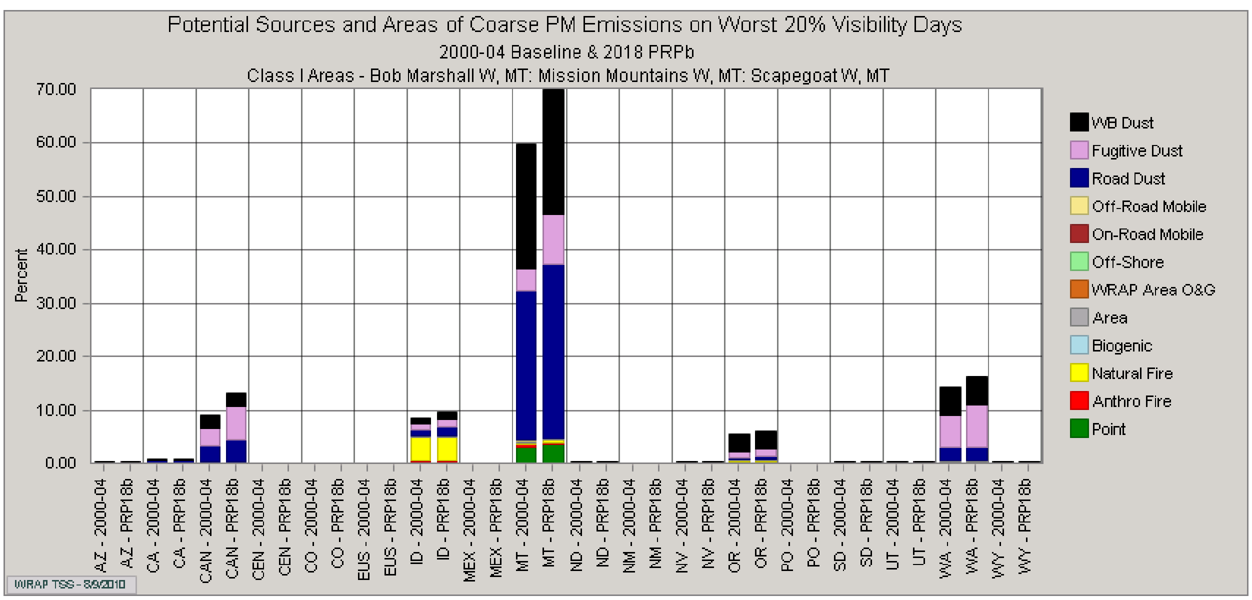

Figure 9-102 WEP Coarse Particulate Matter at Bob Marshall Wilderness 20% Worst Days

Figure 9-103 shows an expected increase in coarse particulate on the 20% best days in the Bob Marshall Wilderness due to increases in fugitive dust and road dust.

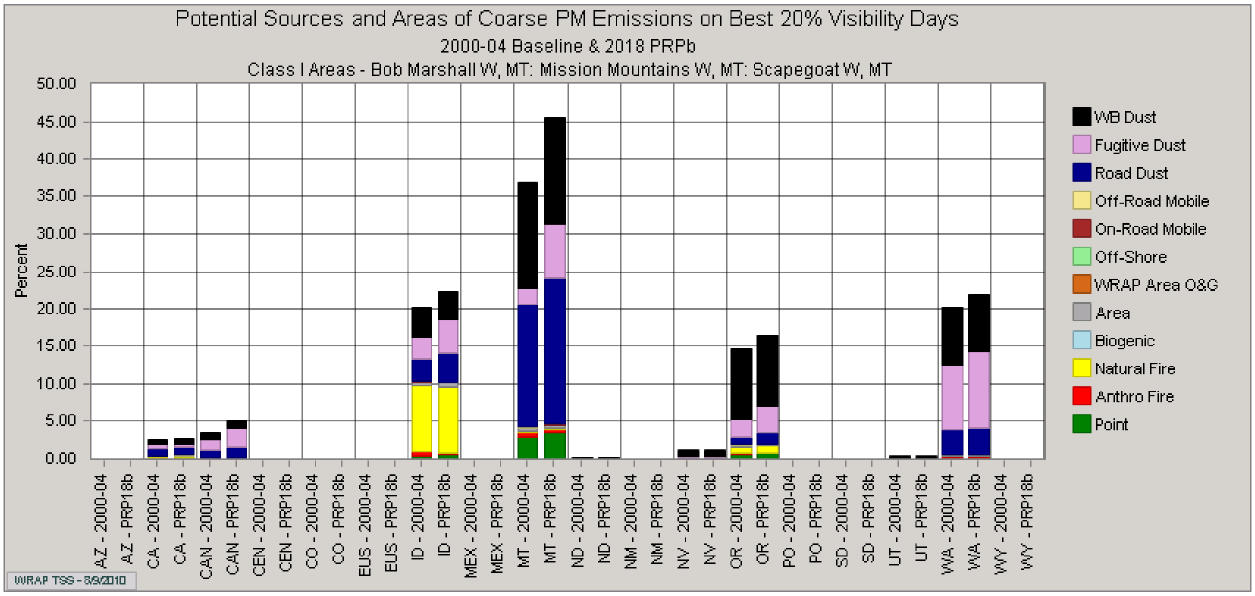

Figure 9-103 WEP Coarse Particulate Matter at Bob Marshall Wilderness 20% Best Days

9.3.4 Gates of the Mountain Wilderness Source Apportionment

Sulfate at Gates of the Mountain Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-104 show the WRAP states are only expected to contribute roughly 25% of the visibility impairment on the 20% worst days in Gates of the Mountain Wilderness. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-104 shows Montana and then Washington and Idaho as the largest contributors of sulfate at Gates of the Mountain Wilderness. Overall, the concentration levels attributed to all the WRAP states are fairly low and decreasing over time due to expected reductions primarily from mobile sources. Idaho shows an expected overall reduction of roughly 6% over the first planning period. Natural fire from Idaho is projected to account for 3% of the sulfate and only roughly 1% of the total contribution will be coming from Idaho anthropogenic sources. The large contribution from natural fire will make it difficult to show much progress in visibility improvement from Idaho area, point, and mobile sources.

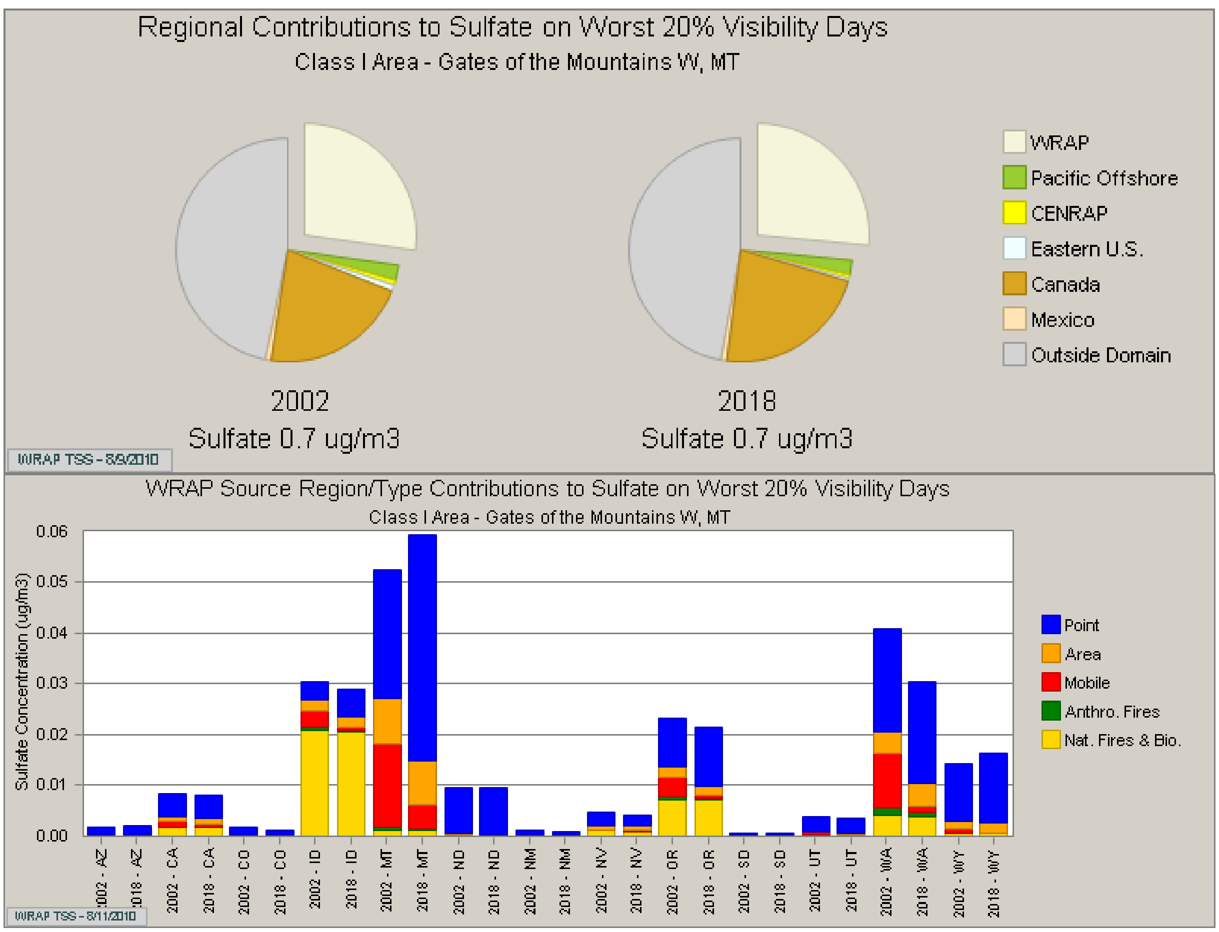

Figure 9-104 PSAT Sulfate Concentrations at Gates of the Mountain Wilderness 20% Worst Days

Figure 9-105 shows that overall improvement in future sulfate contributions from Idaho on the 20% best days are due to expected improvements from mobile sources. Washington and Nevada are showing slight increases due to point sources but this doesn't take into account all the BART controls that will be required to be added.

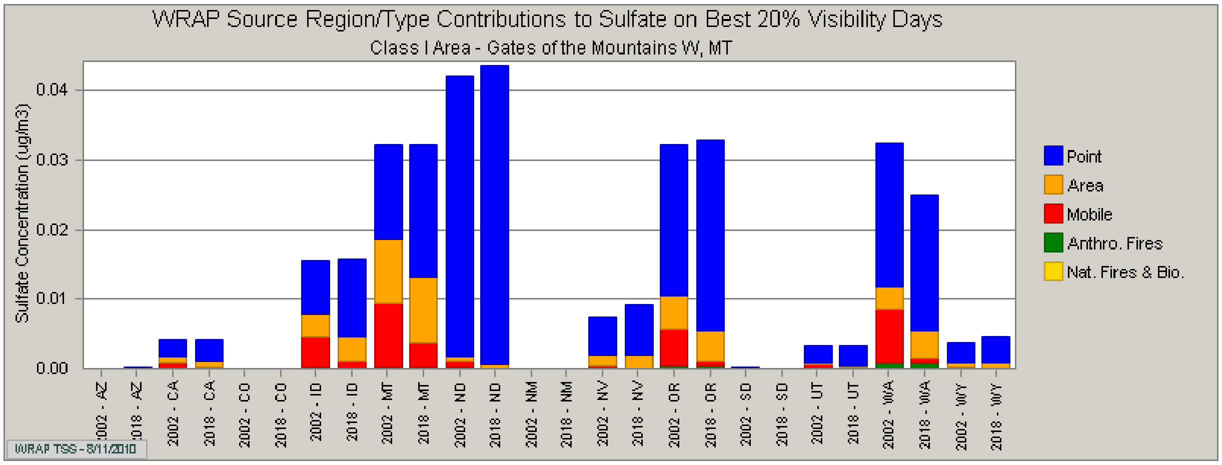

Figure 9-105 PSAT Sulfate Concentrations at Gates of the Mountain Wilderness 20% Best Days

Nitrate at Gates of the Mountain Wilderness Based on PSAT Modeling

The regional source contribution pie charts in figure 9-106 show the WRAP states are only expected to contribute close to 50% of the visibility impairment on the 20% worst days in the Gates of the Mountain Wilderness. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution and the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-106 shows Montana then Washington and Idaho as the largest contributors of nitrate in 2002. Overall, the concentration levels attributed to all the WRAP states are expected to decrease over time due to reductions primarily from mobile sources. Idaho is expected to show an overall reduction of roughly 26% over the first planning period with a future contribution of 6% of the total nitrate concentrations. This does not include emission reductions expected from all the subject-to-BART sources.

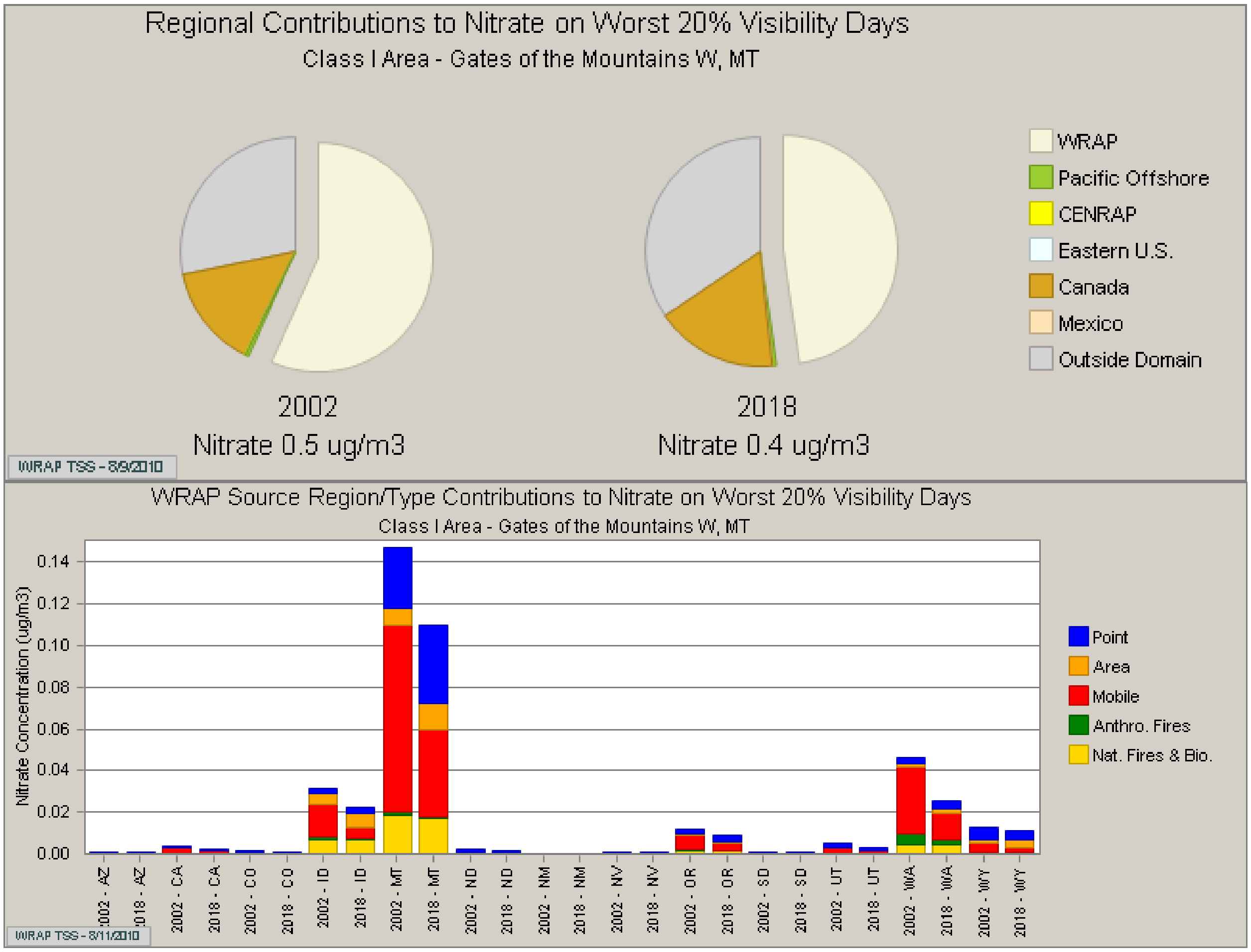

Figure 9-106 PSAT Nitrate Concentrations at Gates of the Mountain Wilderness 20% Worst Days

Figure 9-107 shows an overall improvement in future nitrate contributions expected from all WRAP states on the 20% best days at Cabinet Mountain Wilderness. The expected improvements are primarily coming from the mobile source category.

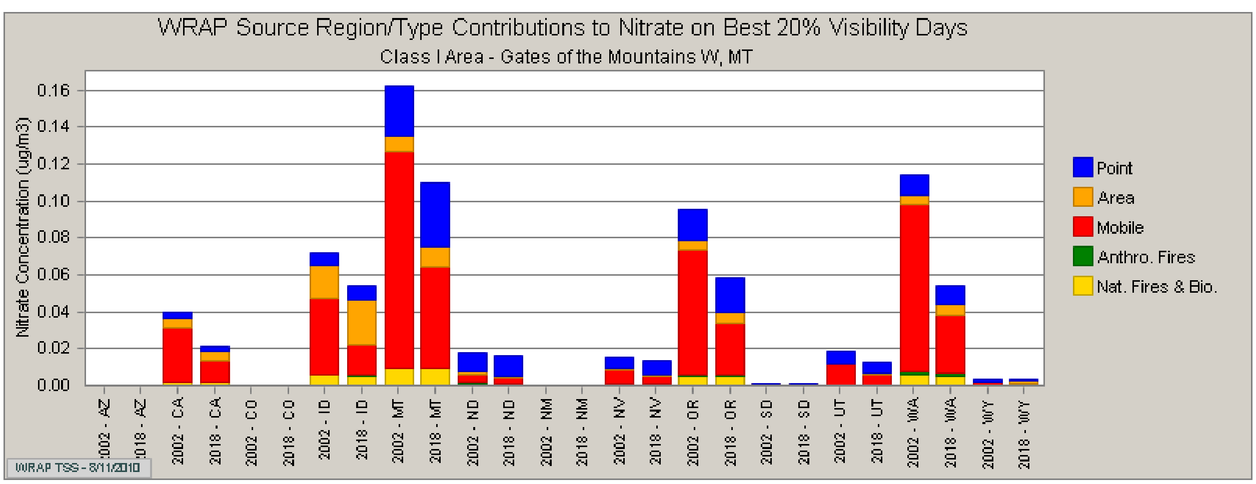

Figure 9-107 PSAT Nitrate Concentrations at Gates of the Mountain Wilderness 20% Best Days

Primary Organic Aerosol at Gates of the Mountain Wilderness Based on WEP

Figure 9-108 shows that the preponderance of organic aerosol on the 20% worst days in the Gates of the Mountain Wilderness is expected to come from Idaho natural fire. There are decreases anticipated from anthropogenic sources from most states. Overall, primary organic aerosol is expected to decrease because of reductions from anthropogenic fire.

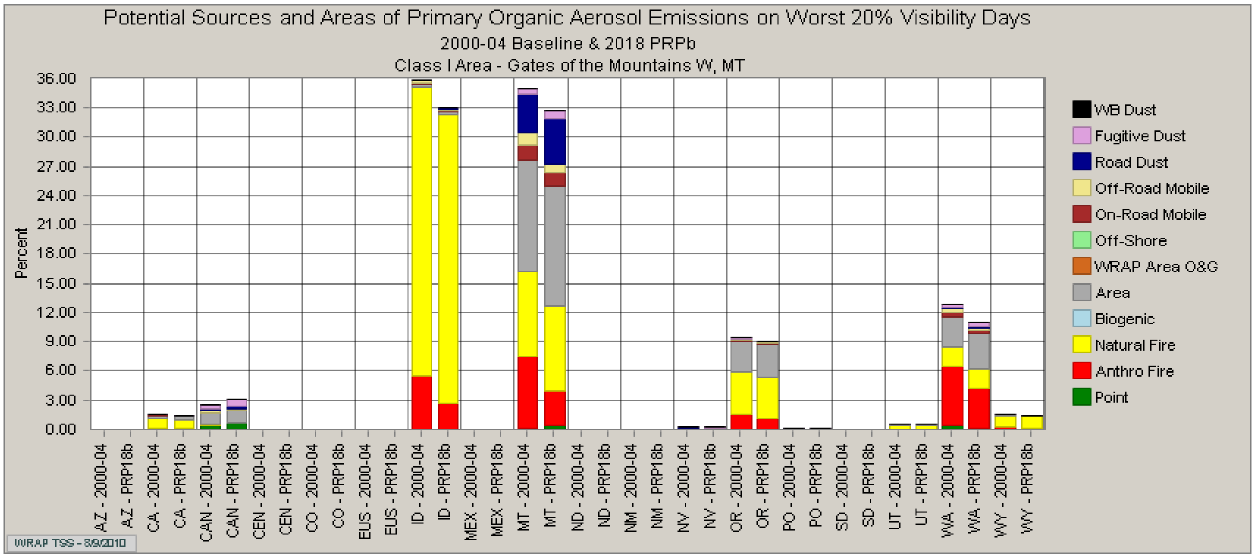

Figure 9-108 WEP Primary Organic Aerosol at Gates of the Mountain Wilderness 20% Worst Days

Figure 9-109 showing similar results expected for the 20% best days in the Gates of the Mountain Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. Overall, most states are anticipating reductions from anthropogenic fire.

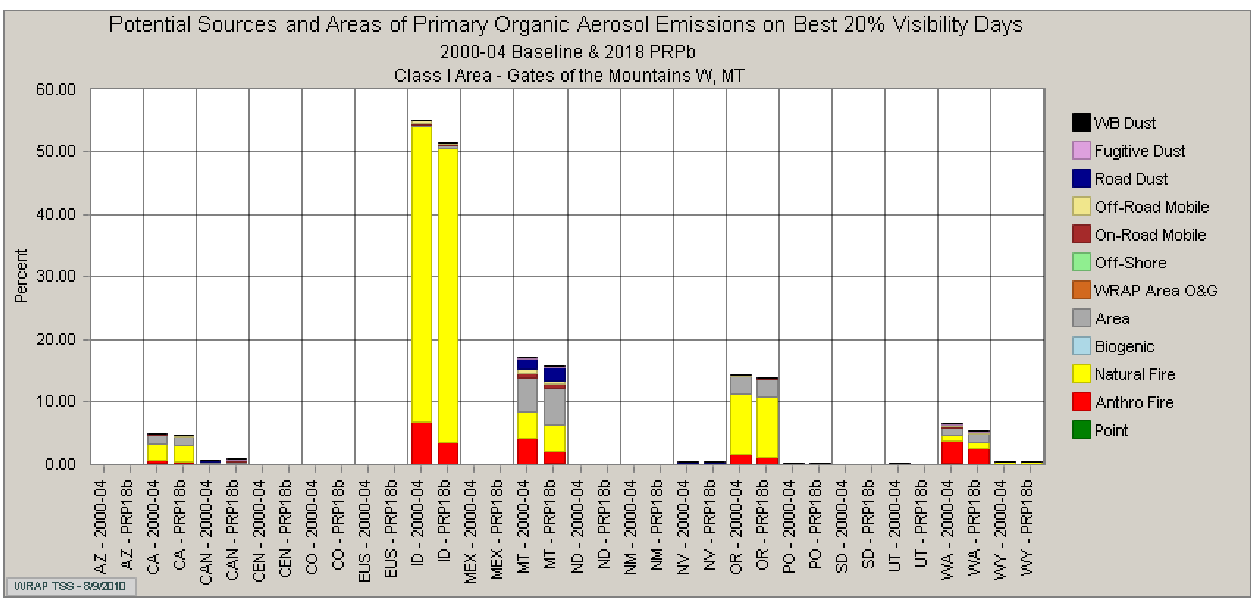

Figure 9-109 WEP Primary Organic Aerosol at Gates of the Mountain Wilderness 20% Best Days

Elemental Carbon at Gates of the Mountain Wilderness Based on WEP

Figure 9-110 shows natural fire from Idaho is expected to be the largest contributor of elemental fire visibility impairment on the 20% worst days in the Cabinet Mountain Wilderness. It is anticipated there will be overall future visibility improvements from anthropogenic fire and off-road mobile.

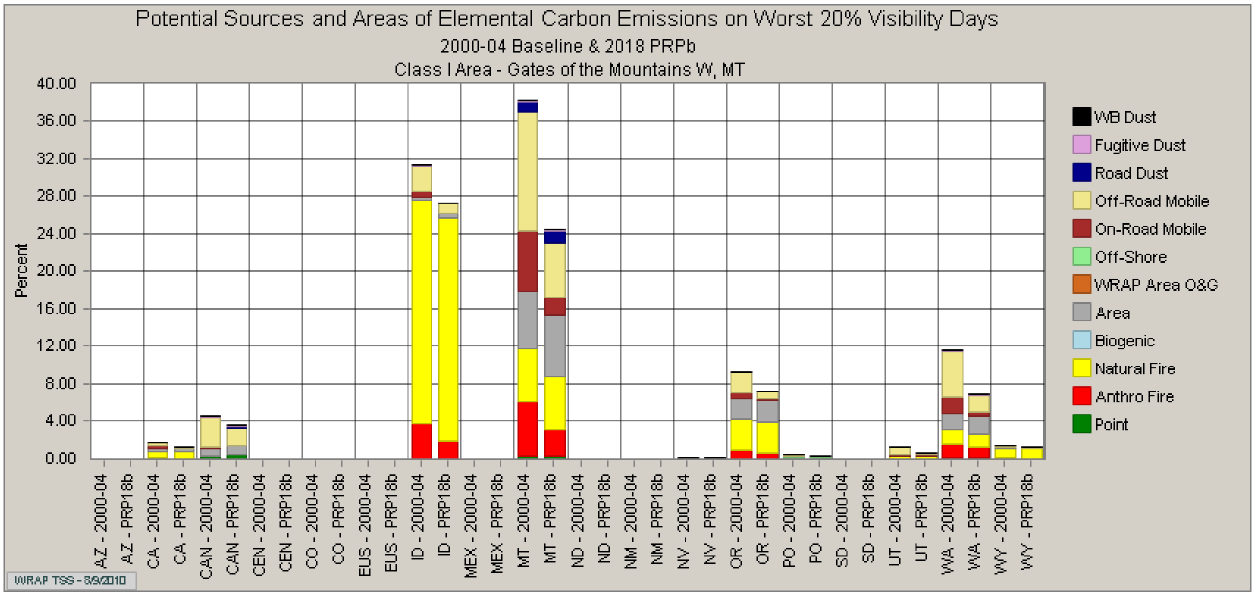

Figure 9-110 WEP Elemental Carbon at Gates of Mountain Wilderness 20% Worst Days

Figure 9-111 shows similar expected results for elemental carbon for the 20% best days in the Gates of the Mountain Wilderness as for the 20% worst days. Natural fire from Idaho is by far the largest source. It is expected elemental carbon will decrease in the future on the 20% best days due to improvements in smoke management programs reducing impacts from anthropogenic fire.

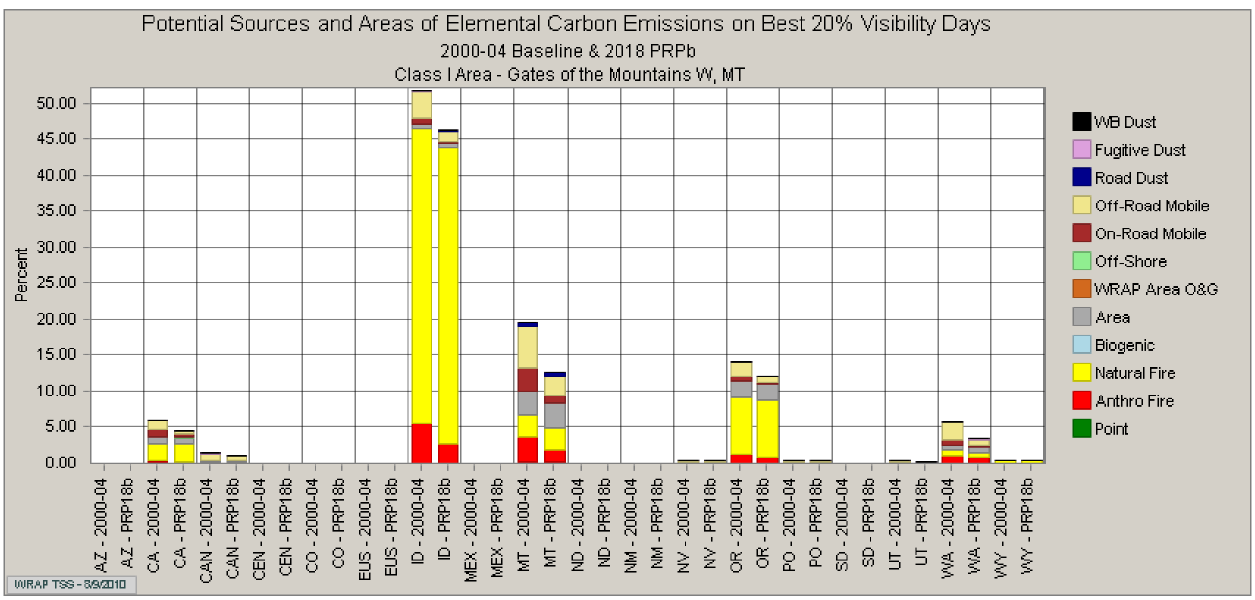

Figure 9-111 WEP Elemental Carbon at Gates of the Mountain Wilderness 20% Best Days

Fine Particulate Matter at Gates of the Mountain Wilderness Based on WEP

Figure 9-112 shows Montana is expected to contribute a little over 70% of the fine particulate matter to Gates of the Mountain Wilderness during the 20% worst visibility days. Oregon and Idaho are showing almost equal contributions at around 5% of the fine particulate matter.

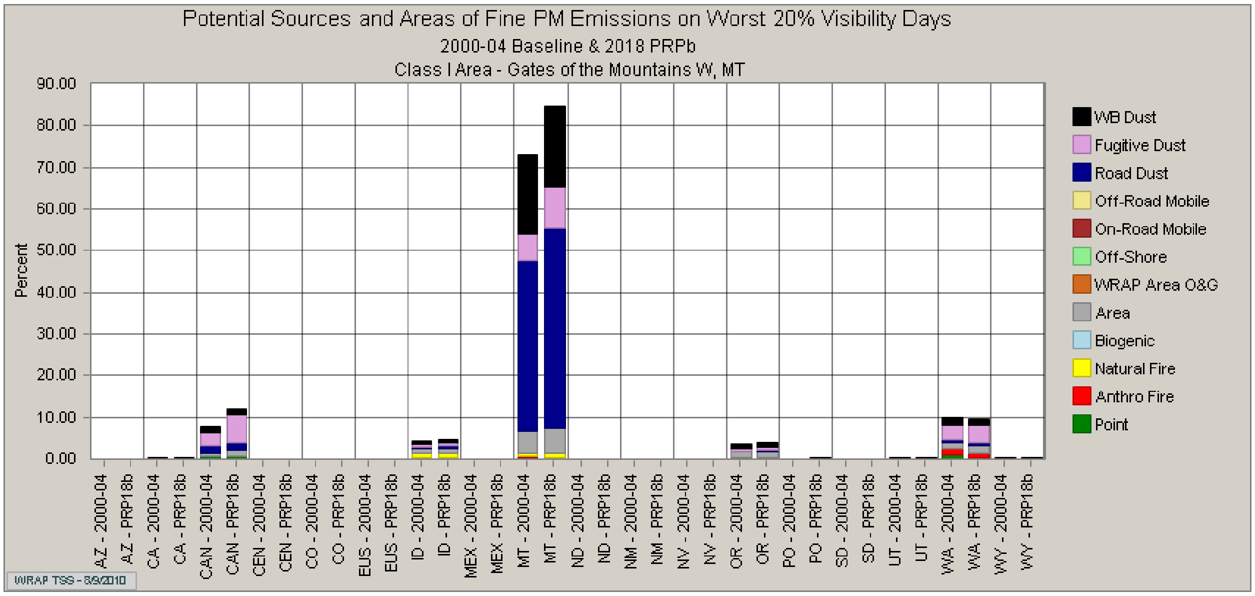

Figure 9-112 WEP Fine Particulate Matter at Gates of the Mountain Wilderness Worst 20% Days

Figure 9-113 shows Washington as the largest contributor of fine particulate on the 20% best visibility days in the Gates of Mountain Wilderness. Overall, there is only a slight increase in visibility impact expected from area source emissions and fugitive dust coming from Idaho.

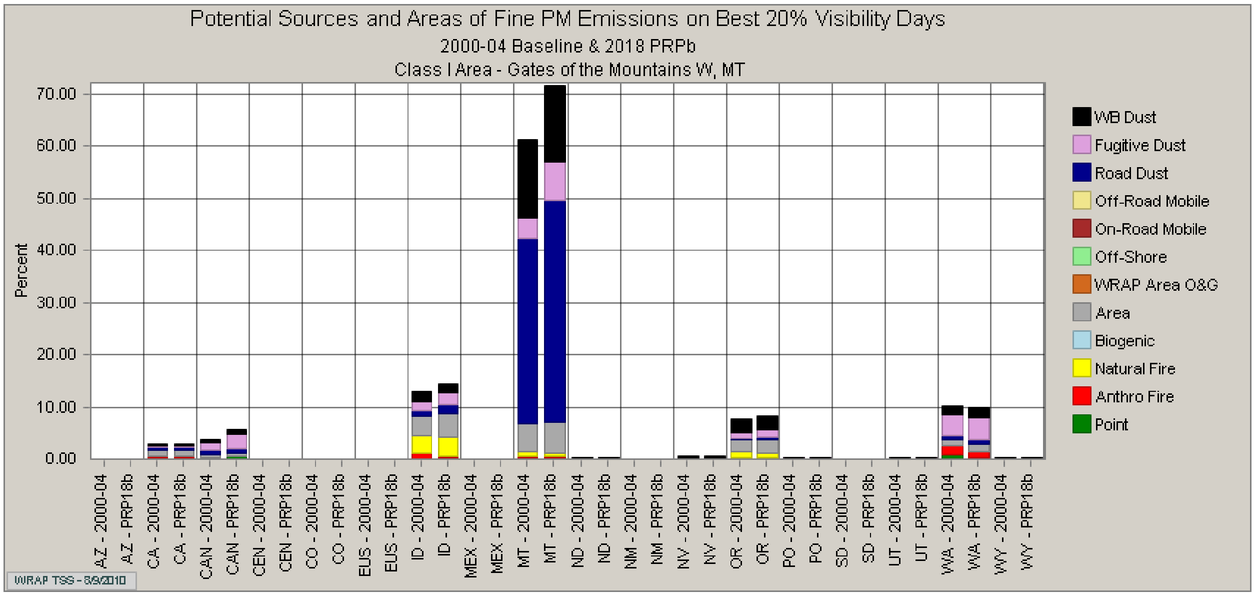

Figure 9-113 WEP Fine Particulate Matter at Gates of the Mountain Wilderness Best 20% Days

Coarse Particulate Matter at Gates of the Mountain Wilderness Based on WEP

Figure 9-114 shows coarse particulate is trending similar to fine particulate in the Gates of the Mountain Wilderness on the 20% worst visibility days with Montana being the largest contributor. Idaho, Washington, and Oregon are all projecting increases in fugitive dust and road dust with a slight decrease in contributions from anthropogenic fire. Overall, coarse particulate is expected to increase in the Gates of the Mountain Wilderness.

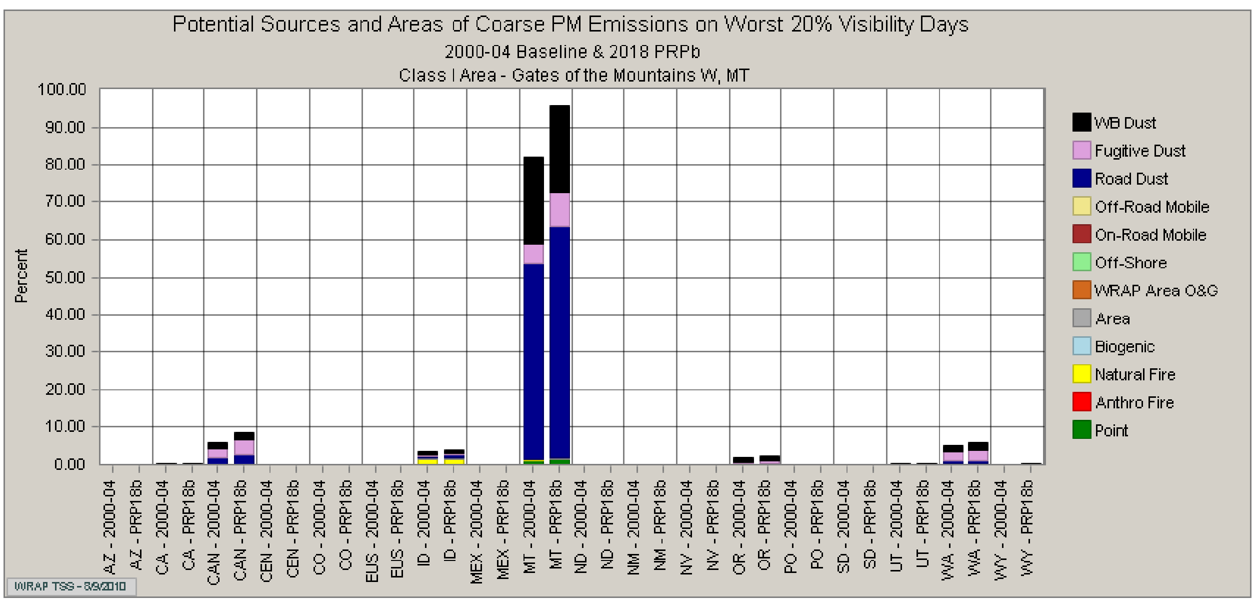

Figure 9-114 WEP Coarse Particulate Matter at Gates of the Mountain Wilderness 20% Worst Days

Figure 9-115 shows an expected increase in coarse particulate on the 20% best days in the Gates of the Mountain Wilderness due to increases in fugitive dust and road dust.

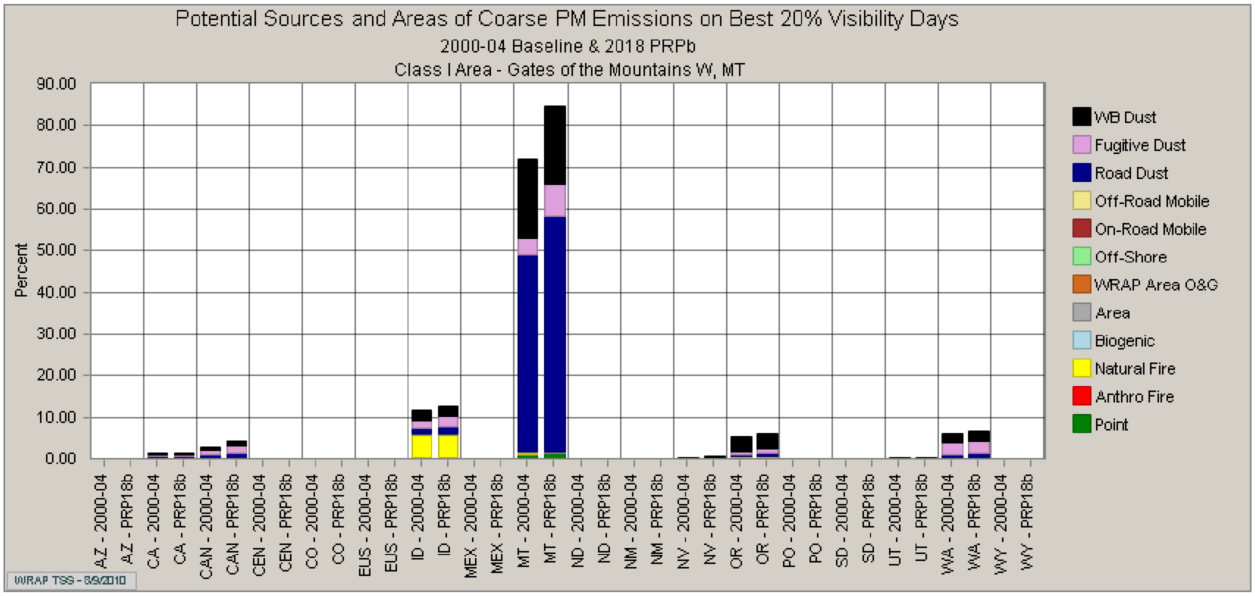

Figure 9-115 WEP Coarse Particulate Matter at Gates of the Mountain Wilderness 20% Best Days

9.3.5 North Absaroka Wilderness and Washakie Wilderness Source Apportionment[10]

Sulfate at North Absoroka Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-116 show the WRAP states are only expected to contribute roughly a third of the sulfate visibility impairment in the North Absaroka Wilderness on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-116 shows Montana and then Idaho as the largest contributors of sulfate in North Absaroka Wilderness. Idaho is expected to contribute roughly 6% of the sulfate with only 3% coming from Idaho anthropogenic sources. The PSAT modeling shows a 3% increase coming from Idaho but this does not include the emissions reductions of roughly 9,000 tons per year expected from P4 Production (formerly Monsanto) in Southeast Idaho. Also, these estimates include the emissions from a once-anticipated EGU, as mentioned before, that had not yet been removed from the emissions inventory used for this modeling. It is expected Idaho's contribution will actually drop when these emission reductions occur.

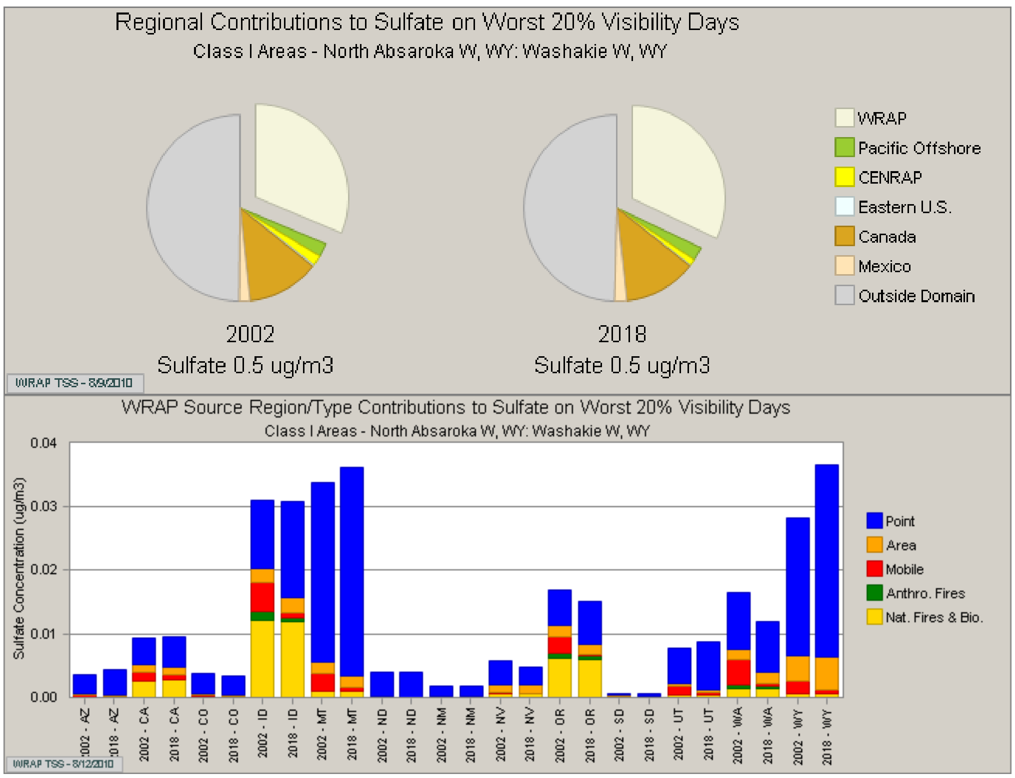

Figure 9-116 PSAT Sulfate Concentrations at North Absaroka Wilderness 20% Worst Days

10 Throughout the remainder of this section North Absaroka Wilderness, and Washakie Wilderness will be represented by the "Bob Marshall Wilderness" since they all share the same IMPROVE monitoring site.

The graph in Figure 9-117 shows an expected decrease in emissions from Idaho point sources in 2018. Using WEP updated emissions inventory and back trajectories, Figure 9-117 shows sulfate emissions from point and mobile sources expected to decrease for Idaho and all other WRAP states.

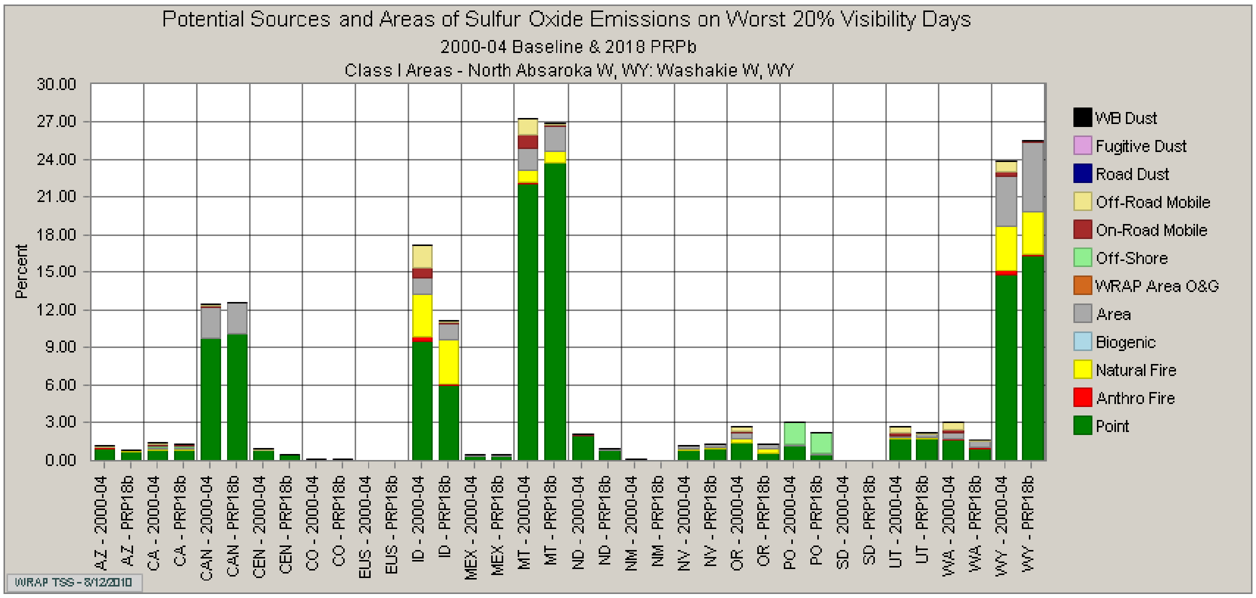

Figure 9-117 WEP Sulfate Concentrations at North Absaroka Wilderness 20% Worst Days

The PSAT results show an expected increase in visibility impairment form sulfate on the 20% best days at Absaroka Wilderness. The updated emissions inventory used by the WEP shows an improvement in future sulfate visibility impacts on the best days. Figures 9-118 and 9-119 show the differences in expected visibility impacts based on using different emissions inventories.

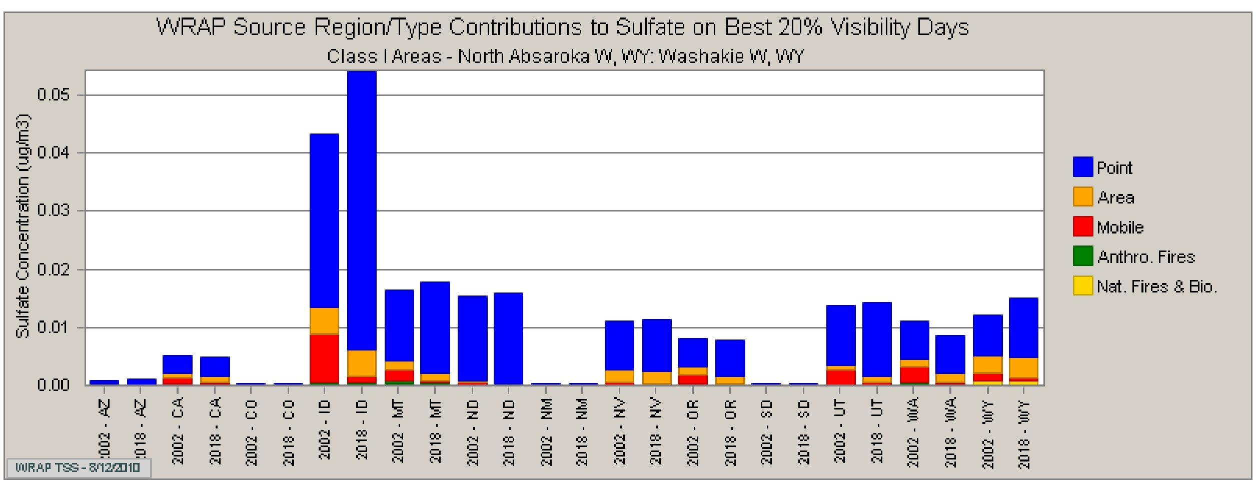

Figure 9-118 PSAT Sulfate Concentrations at North Absaroka Wilderness 20% Best Days

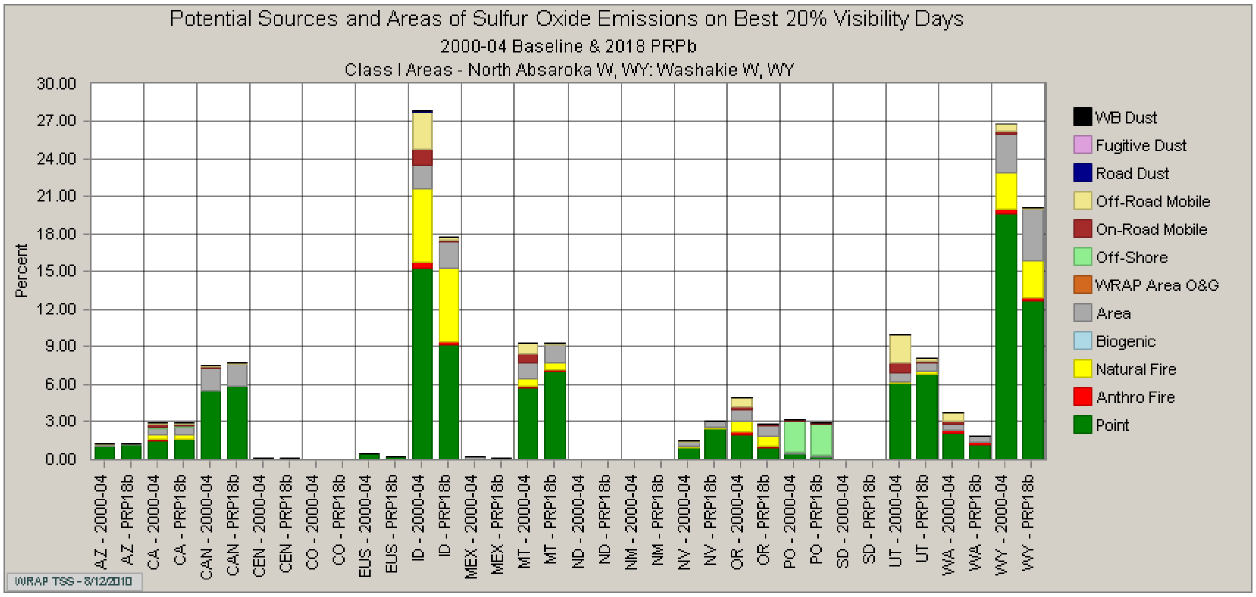

Figure 9-119 WEP Sulfate Concentrations at North Absaroka Wilderness 20% Best Days

Nitrate at North Absaroka Based on PSAT Modeling

Figure 9-120 shows the WRAP States are expected to contribute roughly two thirds to half of the nitrates on the 20% worst days. As WRAP states reduce nitrate contributions over the first planning period ending in 2018, the contributions coming from outside the domain, Pacific offshore (shipping), and Canadian emissions will have a greater impact. This will require regulator actions and negotiations outside the WRAP states' control.

Figure 9-120 also shows Idaho as the largest expected contributor to nitrate concentrations at the North Absaroka Wilderness on the 20% worst days. Overall, Idaho's nitrate emissions are expected to decline by 29% over time primarily due to reductions in mobile emissions.

Because the point source contributions from Idaho are not as large as other categories, the modeled contribution from a once-anticipated EGU in Jerome County as mentioned above did not show such a significant impact. Overall, most WRAP states are expected to improve future visibility impairment due to nitrates on the 20% worst days in North Absaroka Wilderness.

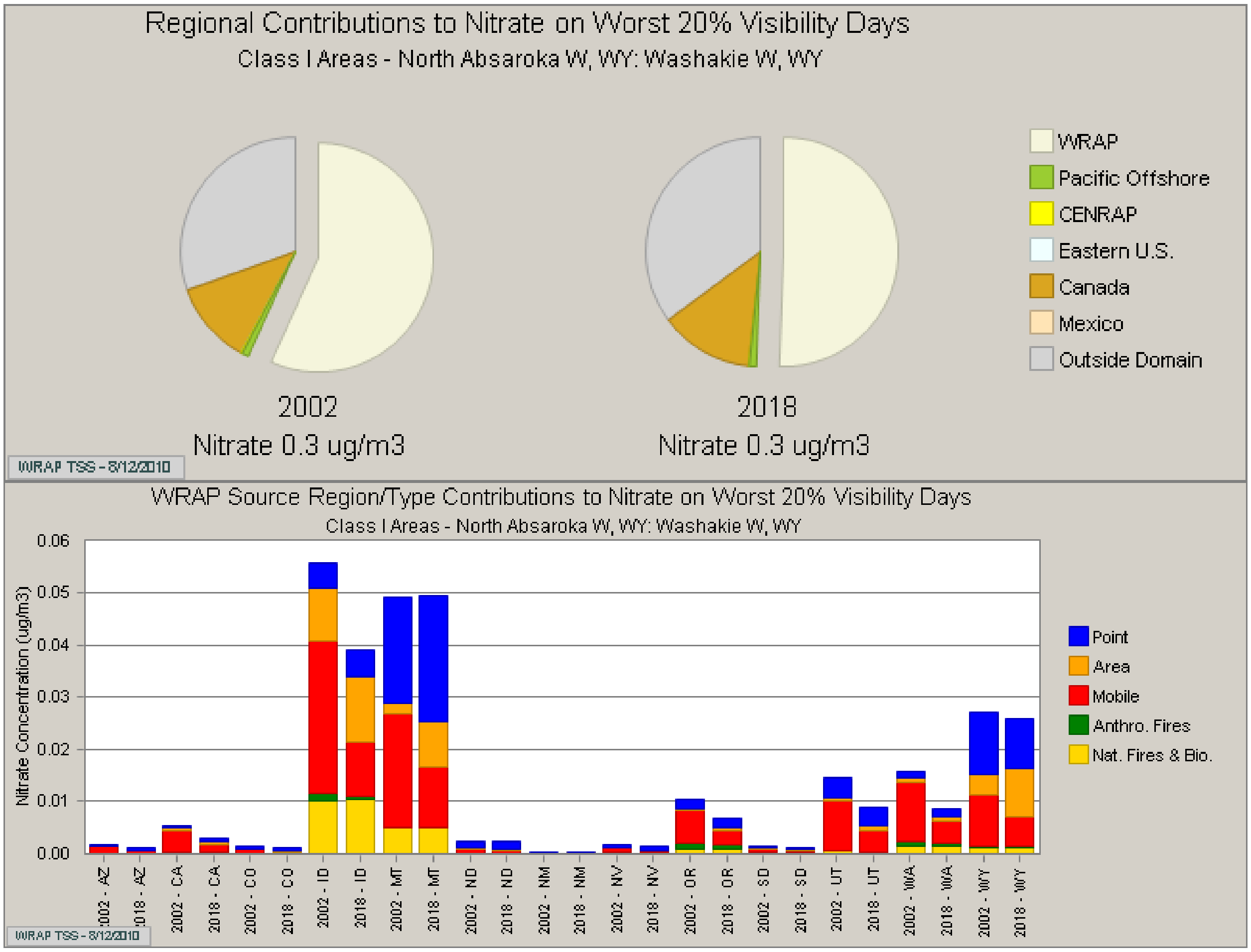

Figure 9-120 PSAT Nitrate Concentrations at North Absaroka Wilderness 20% Worst Days

Figure 9-121 shows all WRAP states are expected to improve the visibility impairment due to nitrates on the 20% best days in North Absaroka Wilderness.

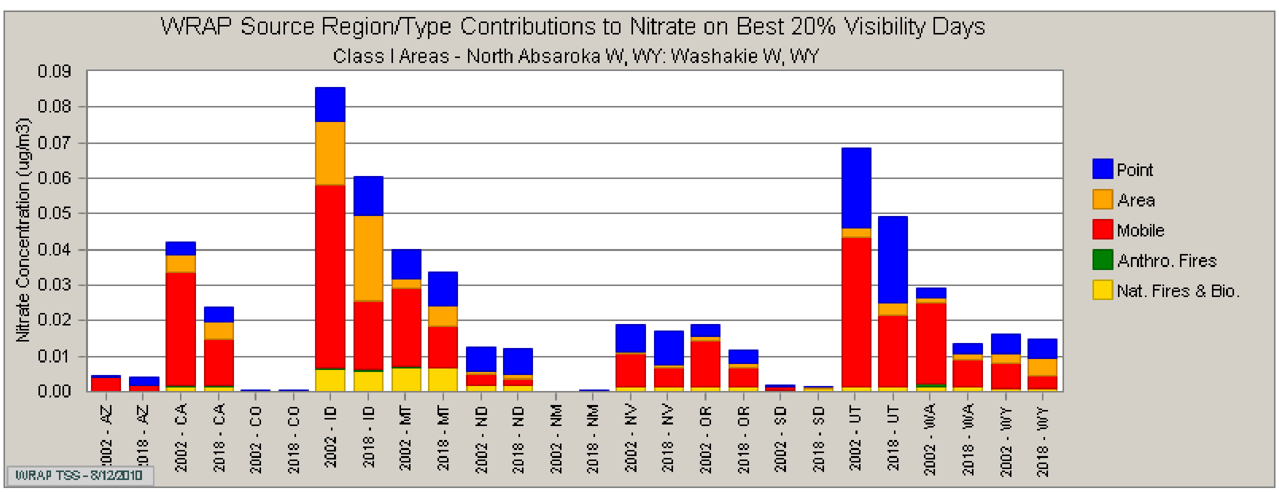

Figure 9-121 PSAT Nitrate Concentrations at North Absaroka Wilderness 20% Best Days

Primary Organic Aerosol at North Absaroka Wilderness Based on WEP

Figure 9-122 shows the preponderance of organic aerosol on the 20% worst days in North Absaroka Wilderness is coming from natural fire primarily from Wyoming. There are decreases anticipated from anthropogenic sources from most states but these are dwarfed by expected emissions from natural fire.

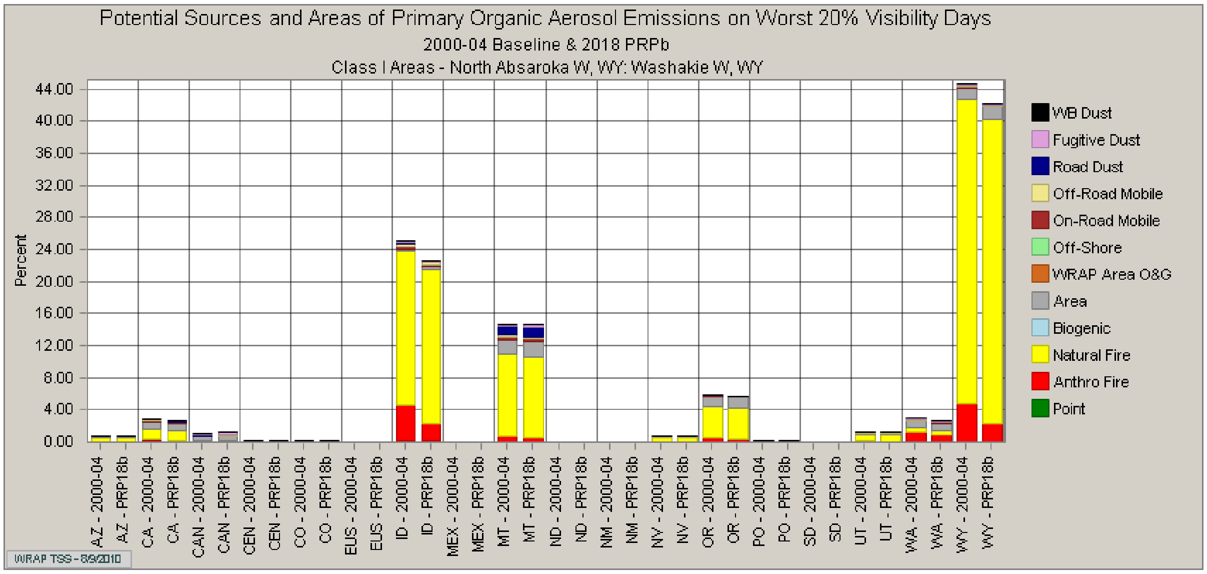

Figure 9-122 WEP Primary Organic Aerosol at North Absaroka Wilderness 20% Worst Days

Primary Organic Aerosol in North Absaroka Wilderness is expected to show an overall improvement on the 20% best visibility days. Figure 9-123 shows an improvement on the best visibility days primarily coming from anthropogenic fire and better smoke management techniques anticipated in the future.

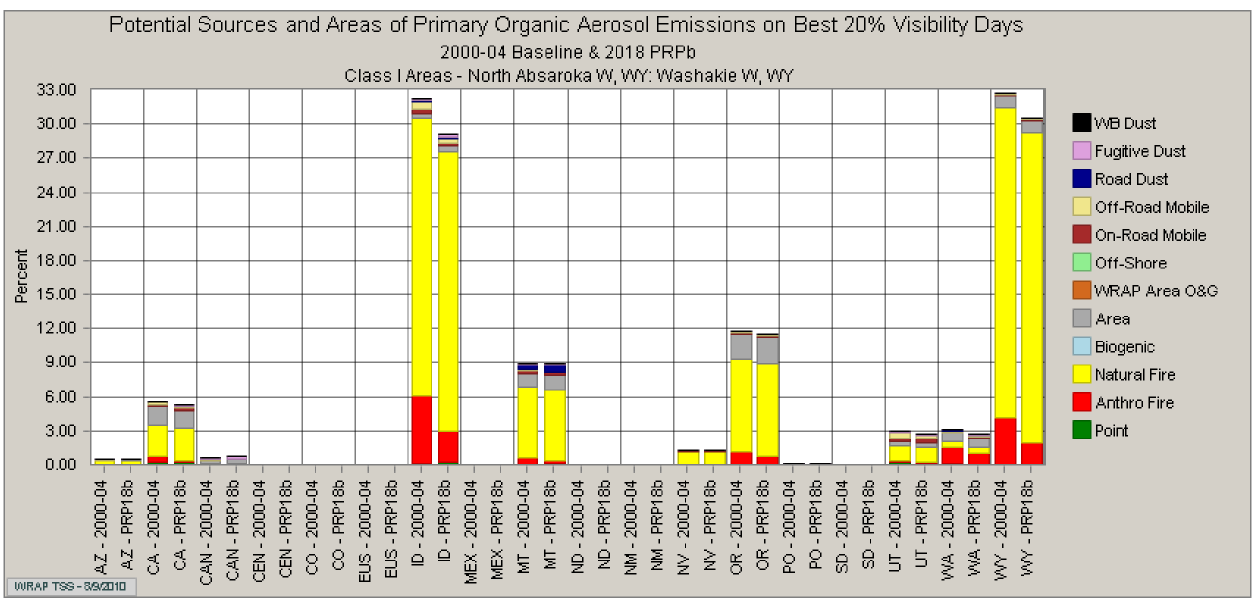

Figure 9-123 WEP Primary Organic Aerosol at North Absaroka Wilderness 20% Best Days

Elemental Carbon at North Absaroka Wilderness Based on WEP

Figure 9-124 is showing natural fire from Wyoming is the largest expected contributor to elemental carbon visibility impairment on the 20% worst visibility days in North Absaroka Wilderness. They analysis shows all WRAP states are expected to make improvements to visibility impairments attributed to elemental carbon.

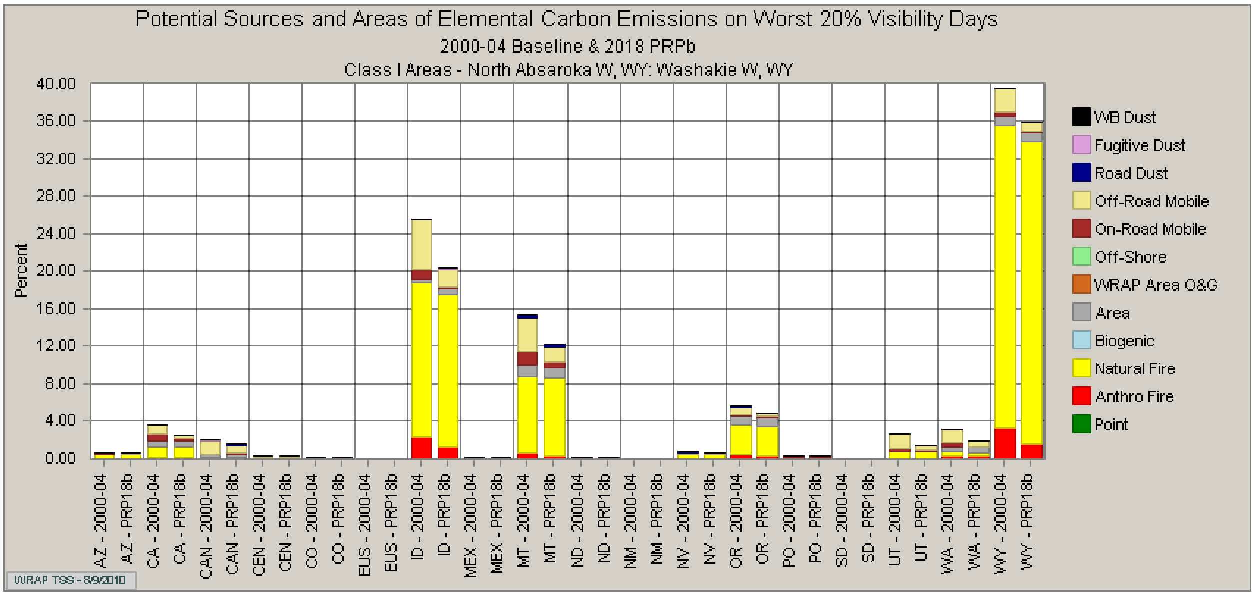

Figure 9-124 WEP Elemental Carbon at North Absaroka Wilderness 20% Worst Days

Figure 9-125 is showing all WRAP states with expected improvement to elemental carbon visibility impairment on the 20% best days. Most of the improvement is expected to come from changes in smoke management and impacts from anthropogenic fire.

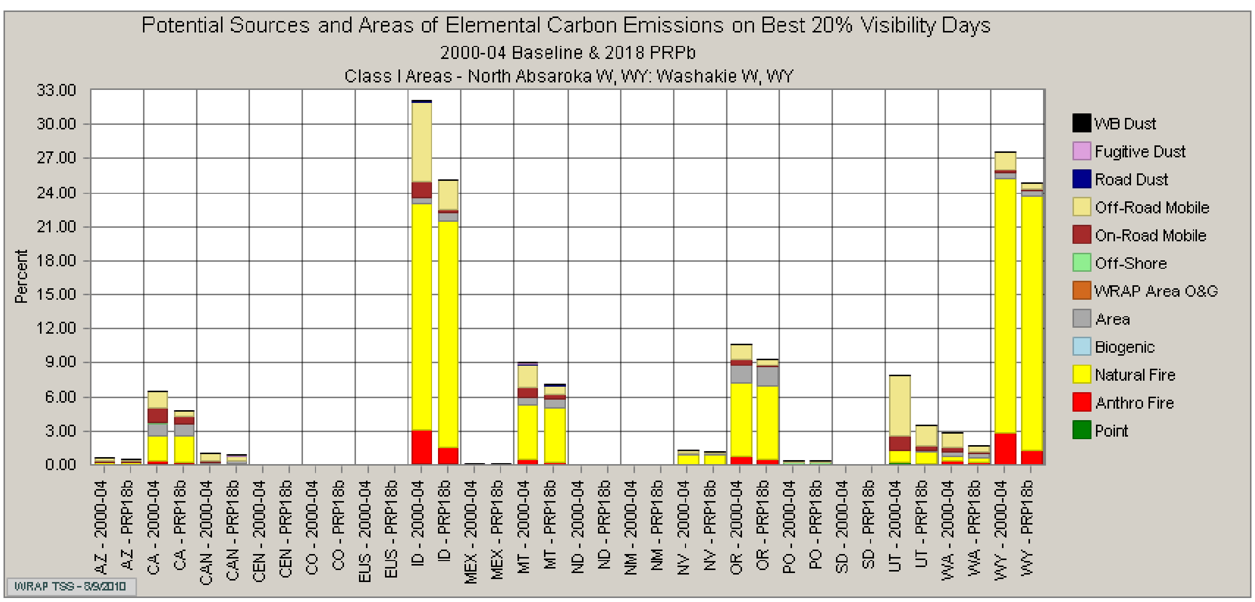

Figure 9-125 WEP Elemental Carbon at North Absaroka Wilderness 20% Best Days

Fine Particulate Matter at North Absaroka Wilderness Based on WEP

Figure 9-63 shows Idaho then Wyoming and Montana as the greatest expected contributors of fine particulate on the 20% worst visibility days in North Absaroka Wilderness. Idaho and Wyoming are showing expected improvements in future contributions from anthropogenic fire but increases in area source emissions, road dust, and fugitive dust are expected to cause overall future increases.

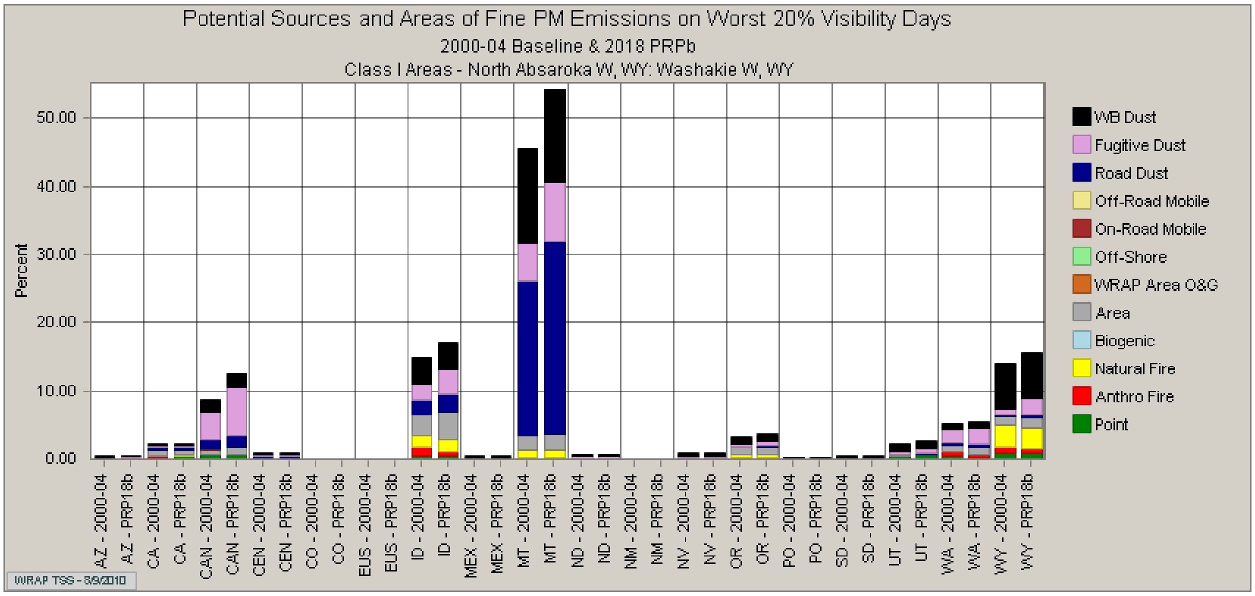

Figure 9-126 WEP Fine Particulate Matter at North Absaroka Wilderness Worst 20% Days

Figure 9-127 shows similar visibility impacts expected from fine particulate on the 20% best days in North Absaroka Wilderness. Future increases in area source emissions, road dust and fugitive dust are expected to outpace improvements from anthropogenic fire.

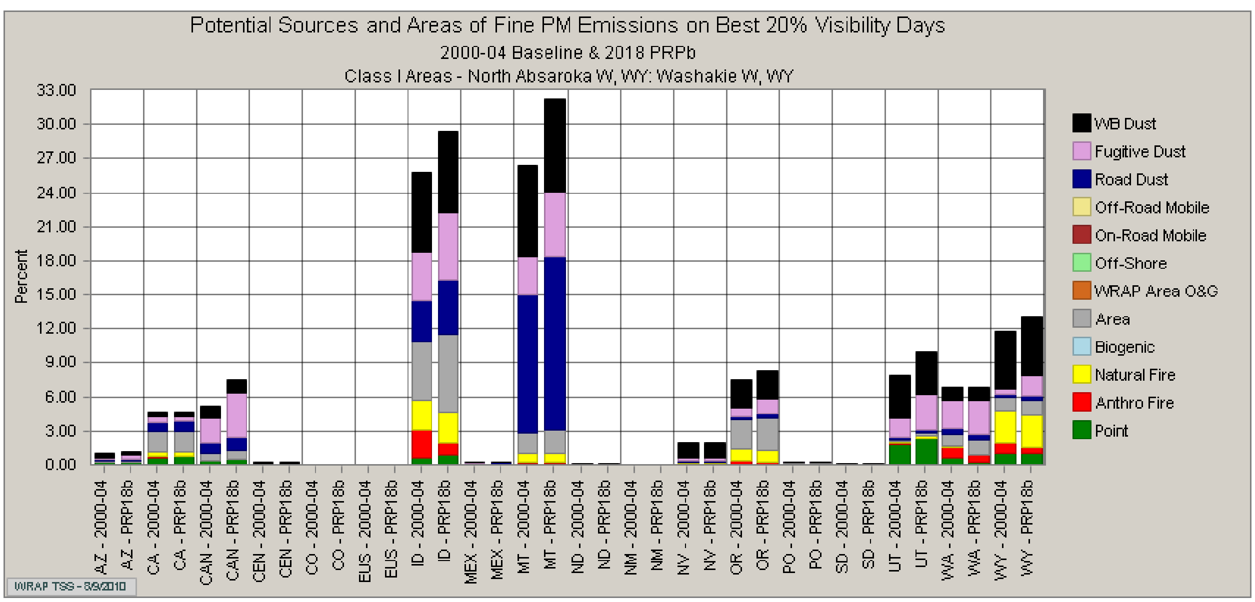

Figure 9-127 WEP Fine Particulate Matter at North Absaroka Best 20% Days

Coarse Particulate Matter at North Absaroka Wilderness Based on WEP

Figure 9-128 shows Idaho and Montana having almost equal expected impacts of coarse particulate, followed by Wyoming, on the 20% worst visibility days at North Absaroka Wilderness. Most states are showing expected increases in fugitive dust and road dust based on WEP modeling.

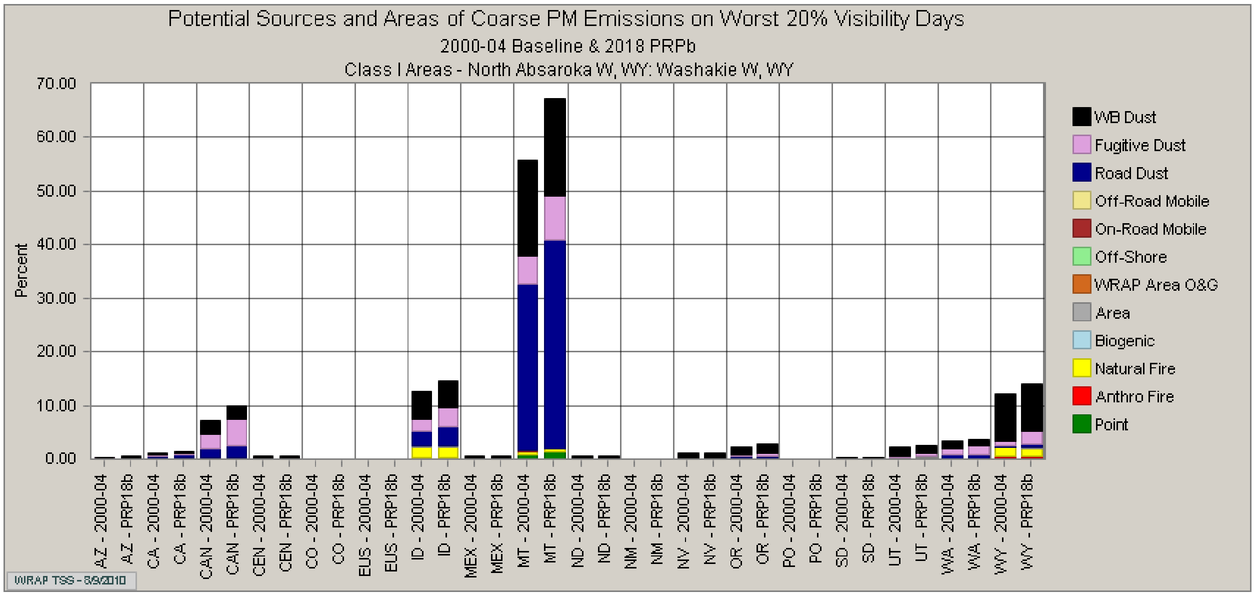

Figure 9-128 WEP Coarse Particulate Matter at North Absaroka Wilderness 20% Worst Days

Figure 9-129 is showing an increase in contributions from coarse particulate coming from WRAP states on the 20% best days are expected to increase in the future.

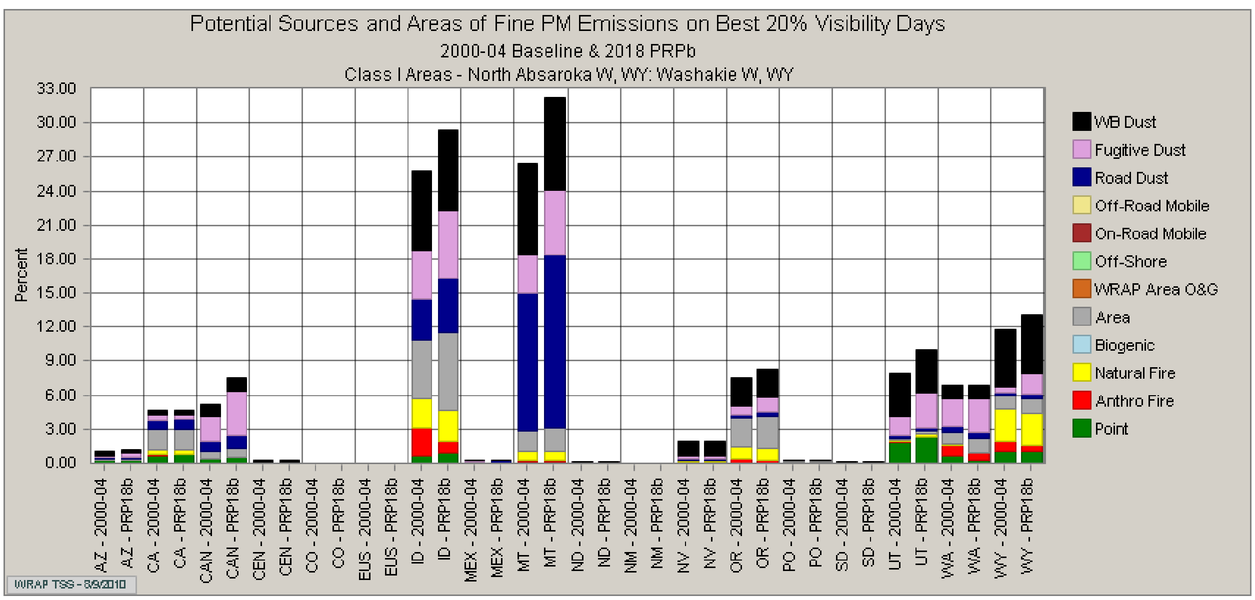

Figure 9-129 Coarse Particulate Matter at North Absaroka 20% Best Days

9.3.6 Bridger Wilderness and Fitzpatrick Wilderness Source Apportionment[11]

Sulfate at Bridger Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-130 show the WRAP states are only expected to contribute roughly half of the sulfate visibility impairment in Bridger Wilderness on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-130 shows Wyoming and then Idaho and Utah as the largest contributors of sulfate in Bridger Wilderness. Idaho is expected to contribute roughly 9% of the sulfate with only 7% coming from Idaho anthropogenic sources. The PSAT modeling shows a 24% increase coming from Idaho but this does not include the emissions reductions of roughly 9,000 tons per year expected from P4 Production (formerly Monsanto) in Southeast Idaho. Also, these estimates include the emissions from a once-anticipated EGU, as mentioned before, that had not yet been removed from the emissions inventory used for this modeling. It is expected Idaho's contribution will actually drop when these emissions reductions occur.

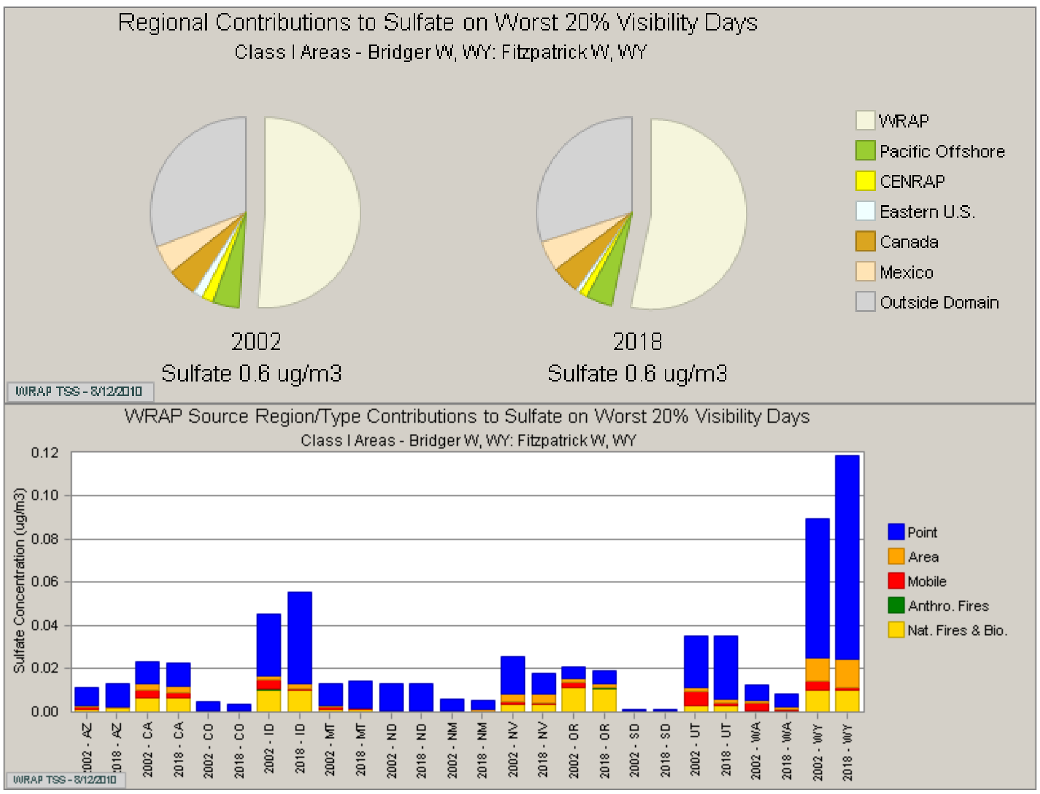

Figure 9-130 PSAT Sulfate Concentrations at Bridger Wilderness 20% Worst Days

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11 Throughout the remainder of this section Bridger Wilderness, and Fitzpatrick Wilderness will be represented by the "Bridger Wilderness" since they all share the same IMPROVE monitoring site.

The graph in Figure 9-131 shows an expected decrease in emissions from Idaho point sources in 2018. Using WEP updated emissions inventory and back trajectories, Figure 9-131 shows sulfate emissions from point and mobile sources expected to decrease for Idaho and all other WRAP states.

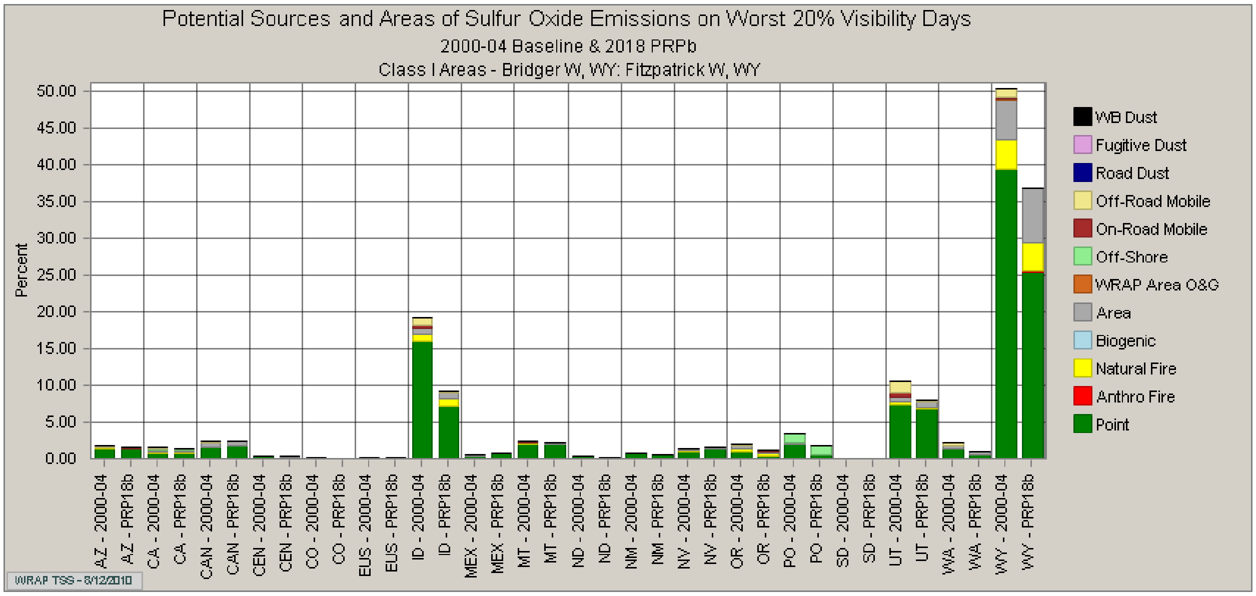


Figure 9-131 WEP Sulfate Concentrations at Bridger Wilderness 20% Worst Days

The PSAT results show an expected increase in visibility impairment form sulfate on the 20% best days at Bridger Wilderness. The updated emissions inventory used by the WEP shows an improvement in future sulfate visibility impacts on the best days. Figures 9-132 and 9-133 show the differences in expected visibility impacts based on using different emissions inventories.

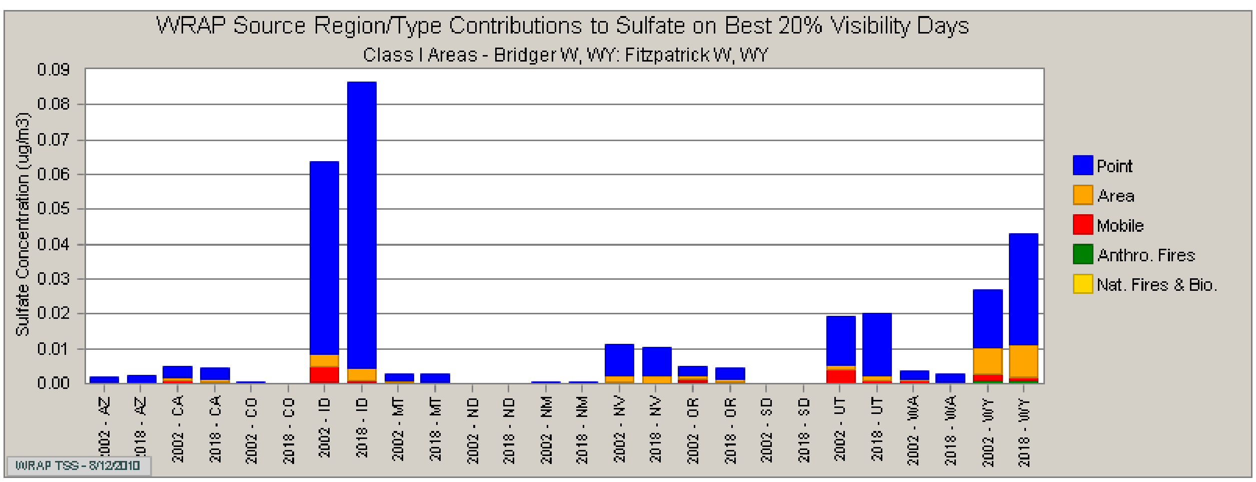


Figure 9-132 PSAT Sulfate Concentrations at Bridger Wilderness 20% Best Days

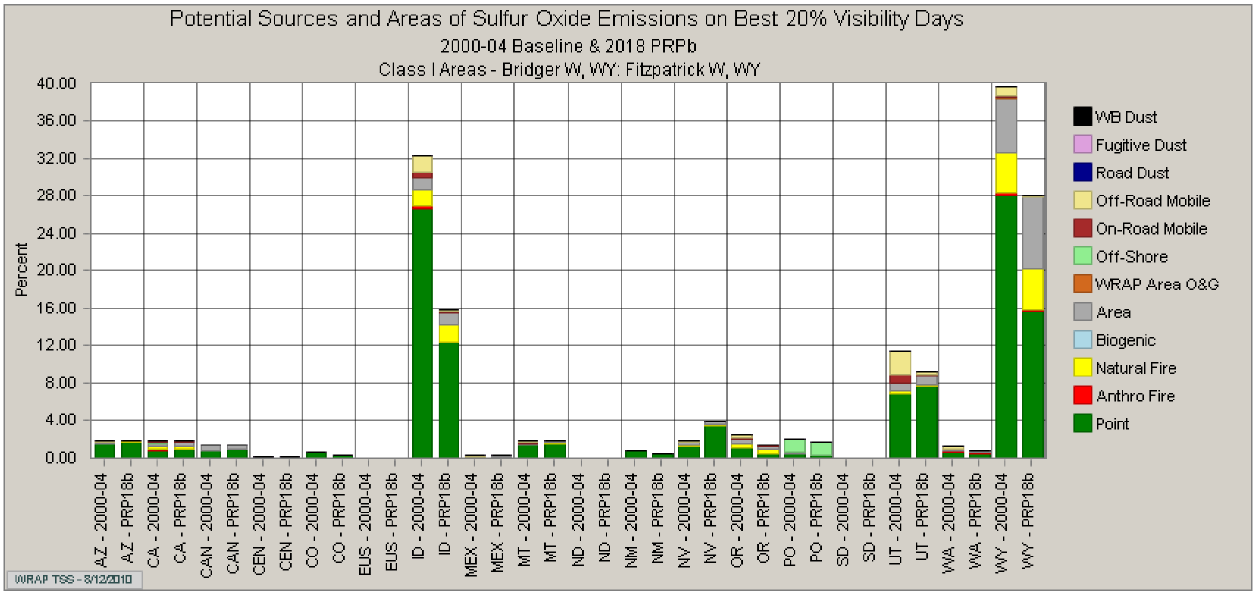


Figure 9-133 WEP Sulfate Concentrations at Bridger Wilderness 20% Best Days

Nitrate at Bridger Wilderness Based on PSAT Modeling

Figure 9-134 shows the WRAP States are expected to contribute roughly two thirds of the nitrates on the 20% worst days. As WRAP states reduce nitrate contributions over the first planning period ending in 2018, the contributions coming from outside the domain, Pacific offshore (shipping) and Canadian emissions, will have a greater impact. This will require regulator actions and negotiations outside the WRAP states' control.

Figure 9-134 also shows, Idaho's nitrate emissions are expected to decline by 35% over time primarily due to reductions in mobile emissions.

Because the point source contributions from Idaho are not as large as other categories, the contribution modeled from a once-anticipated EGU in Jerome County as mentioned above does not show such a significant impact. Overall, most WRAP states are expected to improve future visibility impairment due to nitrates on the 20% worst days in Bridger Wilderness.

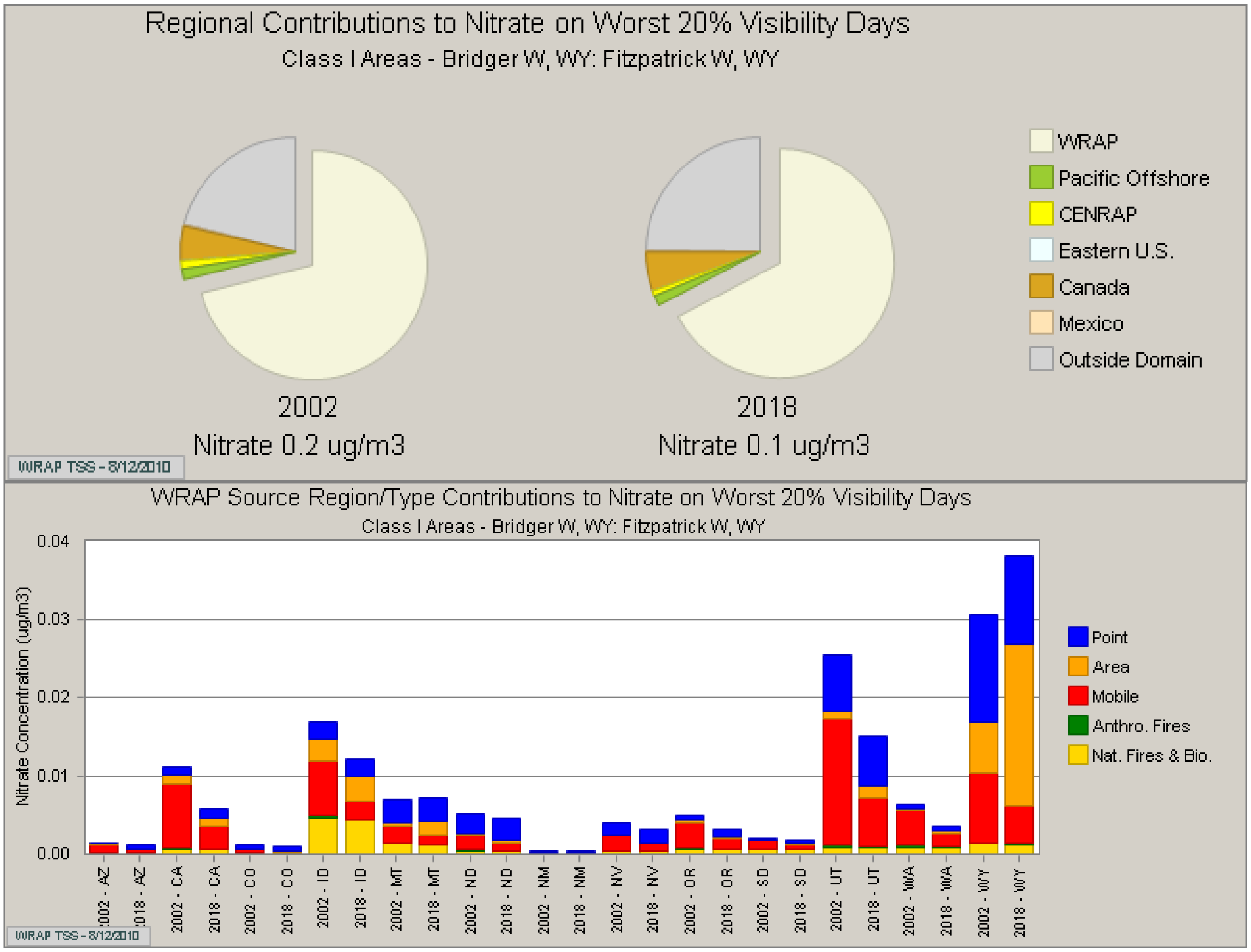


Figure 9-134 PSAT Nitrate Concentrations at Bridger Wilderness 20% Worst Days

Figure 9-135 shows most of the WRAP states are expected to improve the visibility impairment due to nitrates on the 20% best days in Bridger Wilderness.

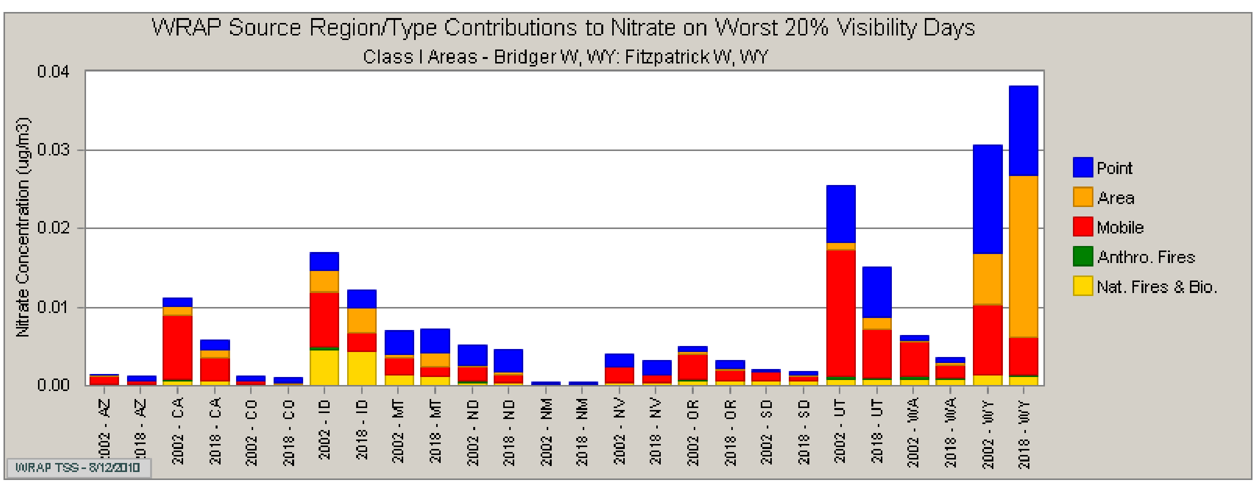


Figure 9-135 PSAT Nitrate Concentrations at Bridger Wilderness 20% Best Days

Primary Organic Aerosol at Bridger Wilderness Based on WEP

Figure 9-136 shows the preponderance of organic aerosol on the 20% worst days in Bridger Wilderness is coming from natural fire primarily from Wyoming. There are decreases anticipated from anthropogenic sources from most states but these are dwarfed by expected emissions from natural fire.

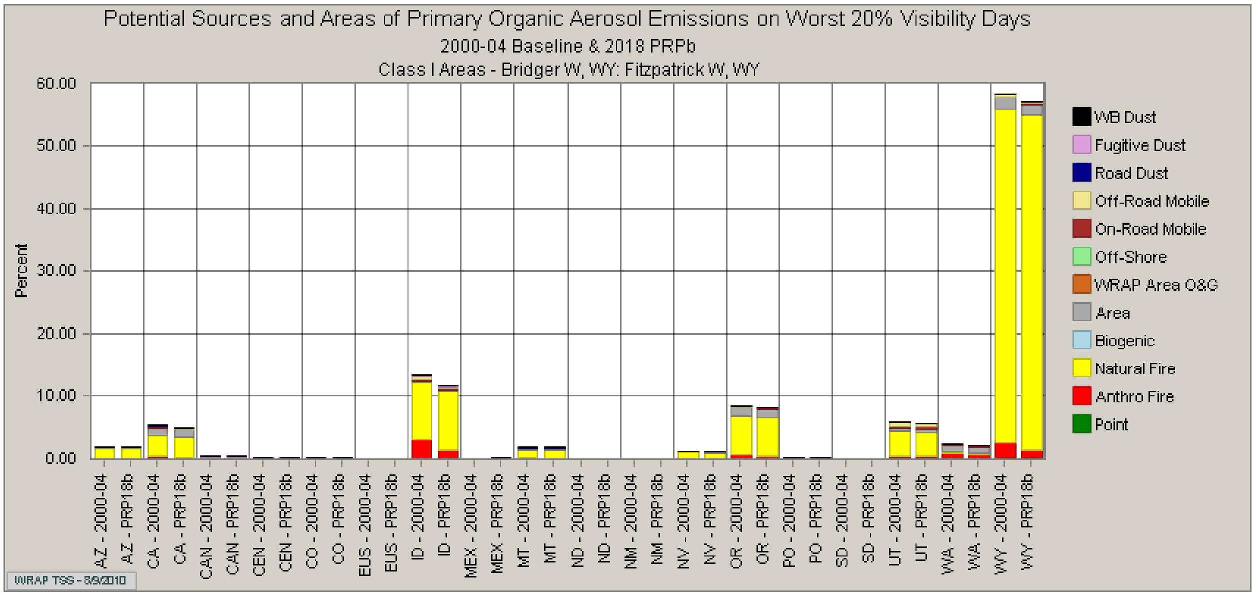


Figure 9-136 WEP Primary Organic Aerosol at Bridger Wilderness 20% Worst Days

Primary Organic Aerosol in Bridger Wilderness shows an overall improvement expected on the 20% best visibility days. Figure 9-137 shows an improvement on the best visibility days primarily coming from anthropogenic fire and better smoke management techniques anticipated in the future.

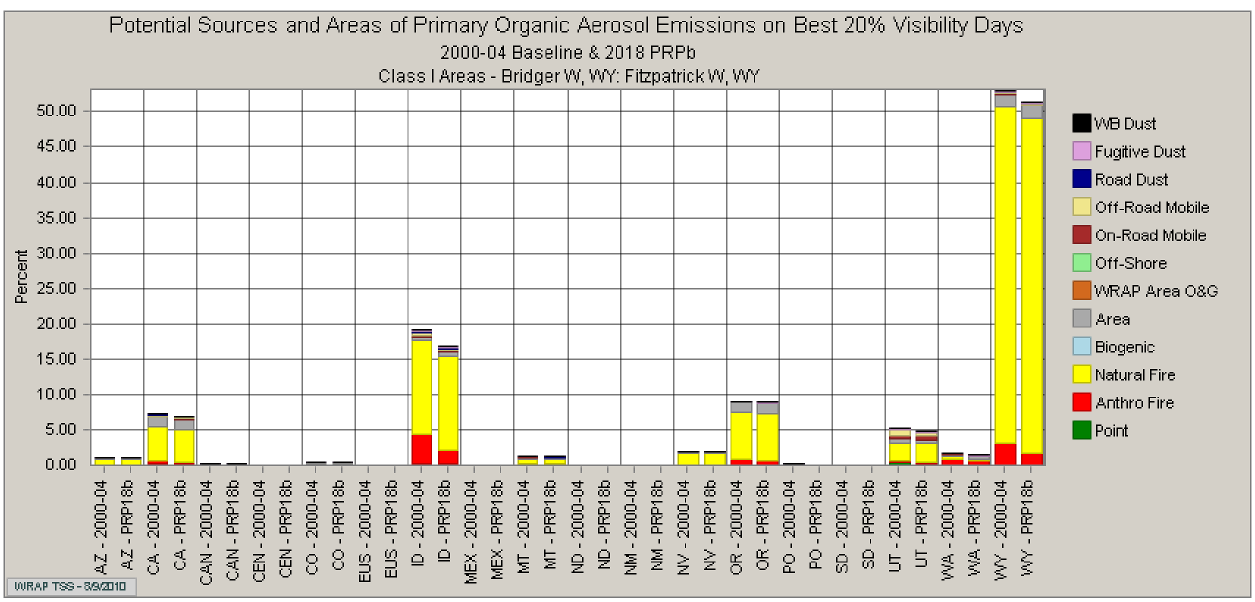


Figure 9-137 WEP Primary Organic Aerosol at Bridger Wilderness 20% Best Days

Elemental Carbon at Bridger Wilderness Based on WEP

Figure 9-138 shows natural fire from Wyoming is the largest expected contributor to elemental carbon visibility impairment on the 20% worst visibility days in Bridger Wilderness. They analysis shows all WRAP states are expected to make improvements to visibility impairments attributed to elemental carbon.

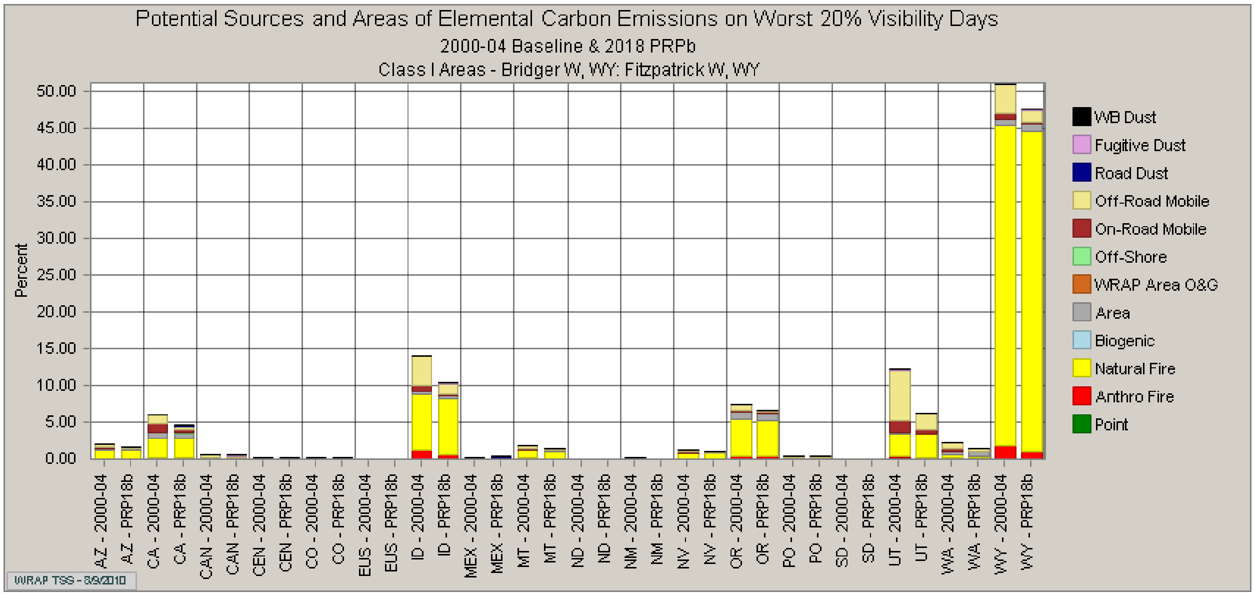


Figure 9-138 WEP Elemental Carbon at Bridger Wilderness 20% Worst Days

Figure 9-139 is showing all WRAP states with expected improvement to elemental carbon visibility impairment on the 20% best days. Most of the improvement is expected to come from changes in smoke management and impacts from anthropogenic fire.

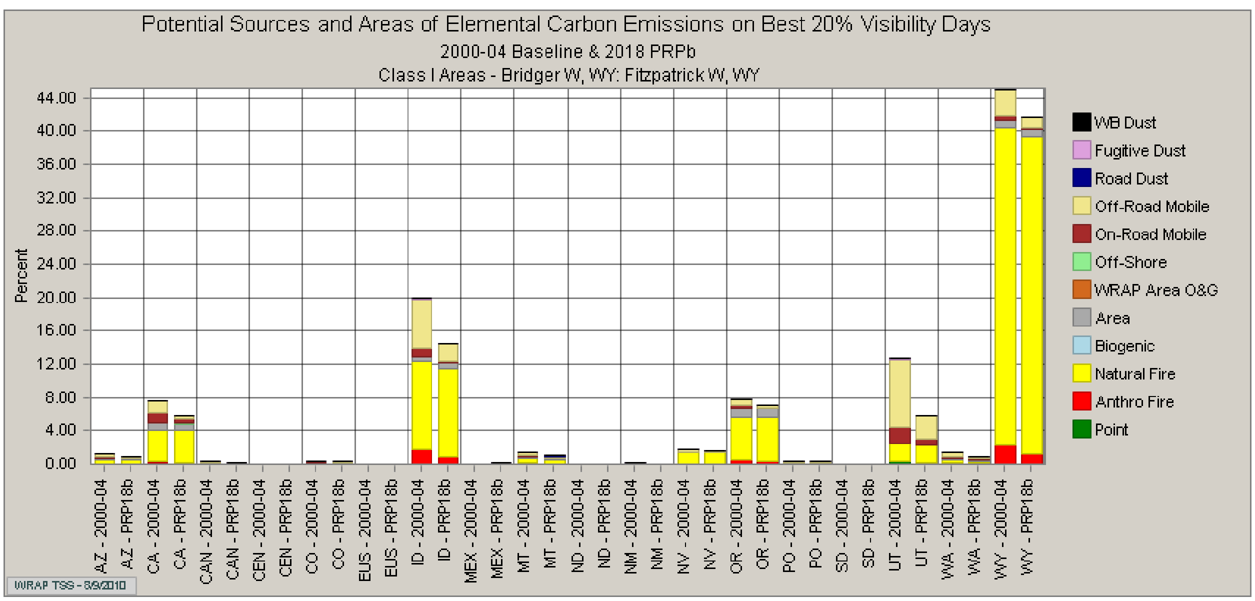


Figure 9-139 WEP Elemental Carbon at Bridger Wilderness 20% Best Days

Fine Particulate Matter at Bridger Based on WEP

Figure 9-140 shows Wyoming and then Idaho as the greatest expected contributors of fine particulate on the 20% worst visibility days in Bridger Wilderness. Idaho and Wyoming are showing expected improvements in future contributions from anthropogenic fire but increases in area source emissions, road dust, and fugitive dust are expected to cause overall future increases.

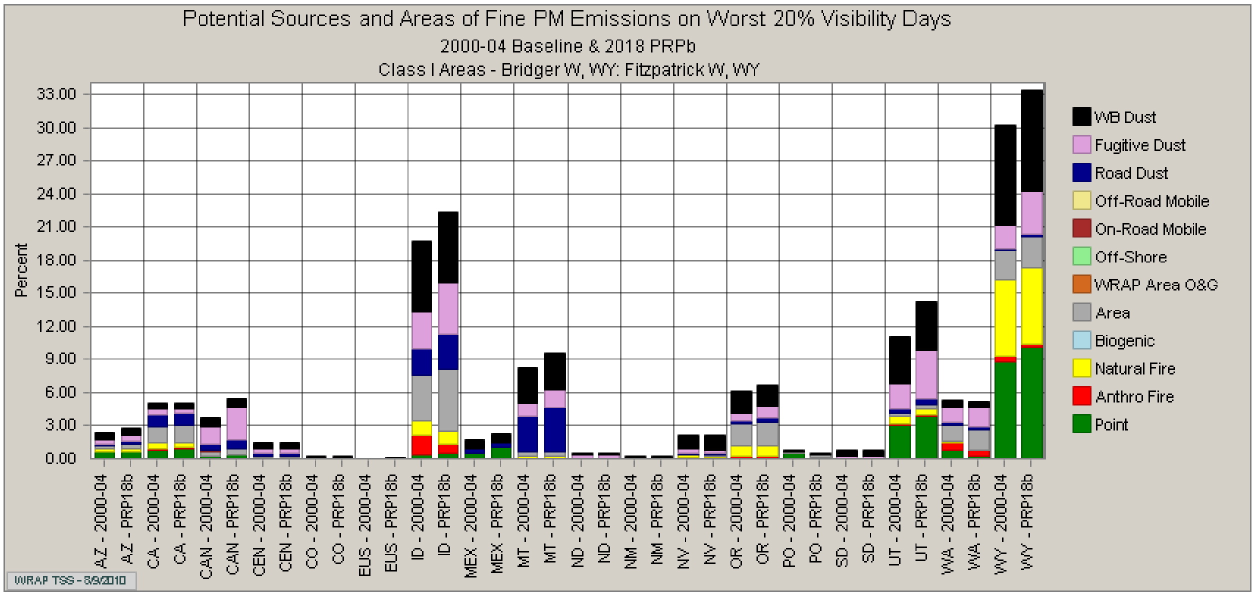


Figure 9-140 WEP Fine Particulate Matter at Bridger Wilderness Worst 20% Days

Figure 9-141 is showing similar visibility impacts expected from fine particulate on the 20% best days in Bridger Wilderness. Future increases in area source emissions, road dust, and fugitive dust are expected to outpace improvements from anthropogenic fire.

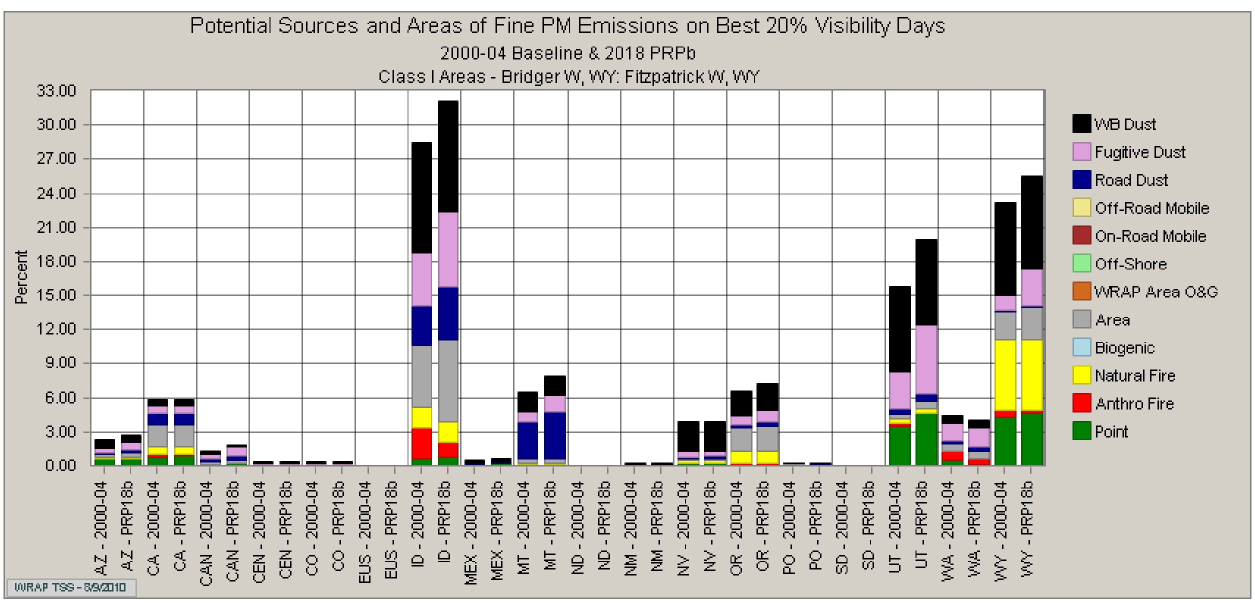


Figure 9-141 WEP Fine Particulate Matter at Bridger Wilderness Best 20% Days

Coarse Particulate Matter at Bridger Wilderness Based on WEP

Figure 9-142 shows Idaho and then Montana as having the greatest impacts of coarse particulate matter on the 20% worst visibility days at Bridger Wilderness. Most states are showing expected increases in fugitive dust and road dust based on WEP modeling.

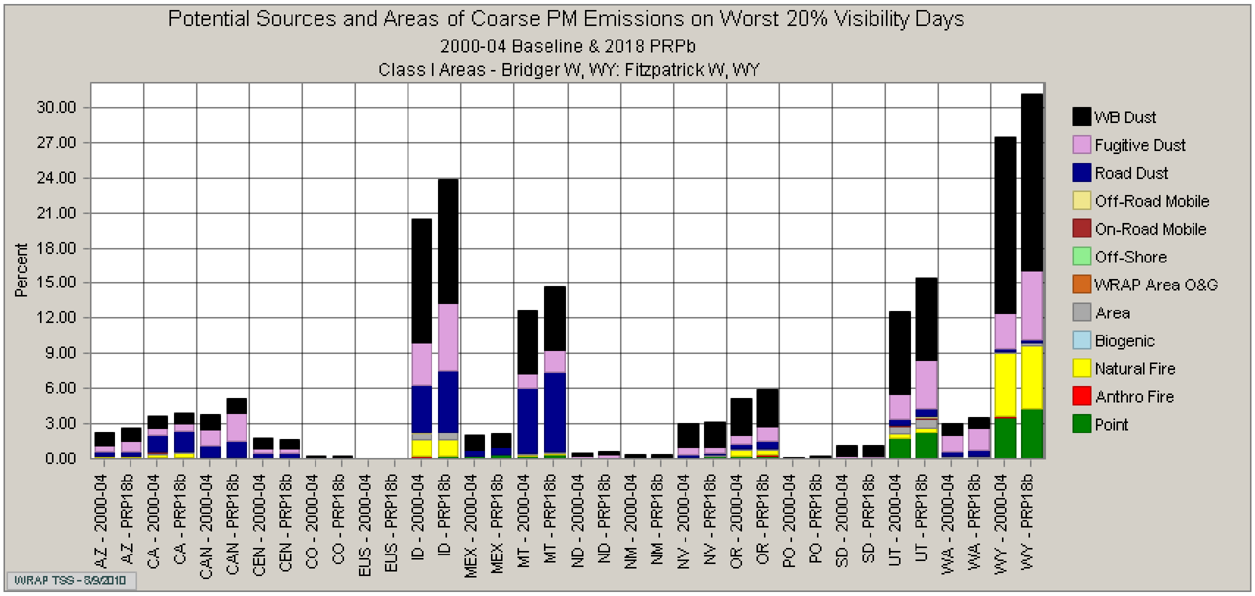


Figure 9-142 WEP Coarse Particulate Matter at Bridger Wilderness 20% Worst Days

Figure 9-143 shows an expected increase in contributions from coarse particulate coming from WRAP states on the 20% best days.

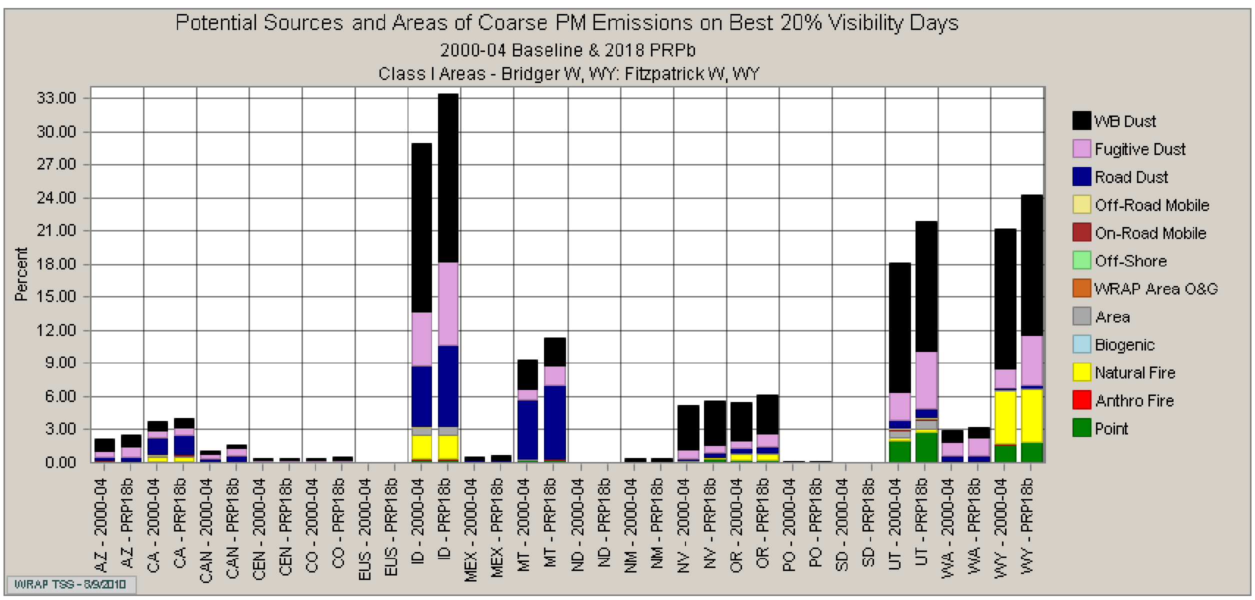


Figure 9-143 Coarse Particulate Matter at Bridger Wilderness 20% Best Days

9.3.7 Eagle Cap Wilderness Source Apportionment[12]

Sulfate at Eagle Cap Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-144 show the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-144 shows Washington as the largest expected contributor of sulfate at Eagle Cap Wilderness with Oregon second and Idaho third. Overall, the concentration levels attributed to all the WRAP States are expected to be fairly low and decreasing over time due to reductions primarily from mobile sources. Idaho is showing an overall reduction of roughly 8% over the first planning period. The projected reductions do not include emissions reductions expected from all the subject-to-BART sources.

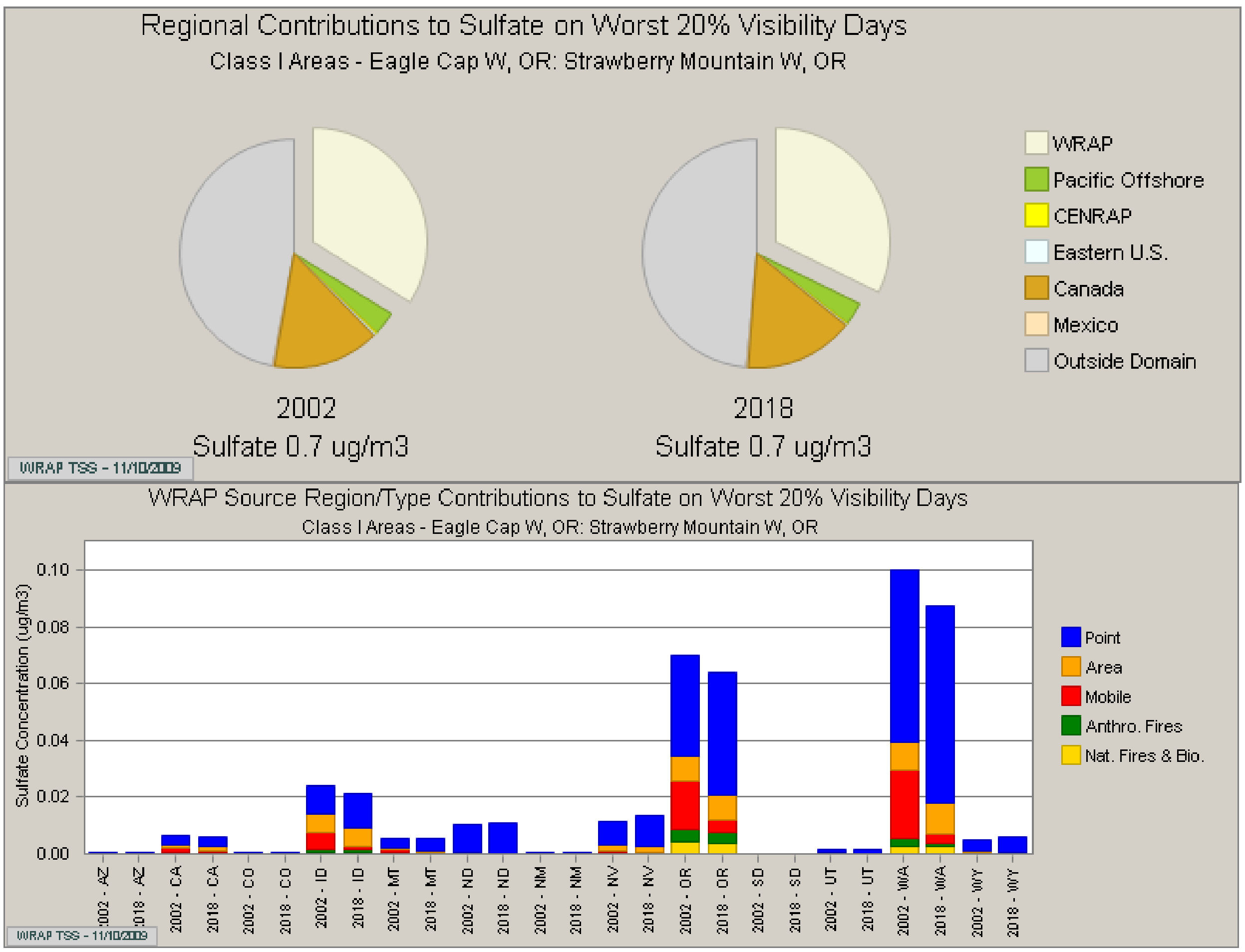


Figure 9-144 PSAT Sulfate Concentrations at Eagle Cap Wilderness 20% Worst Days

12 Throughout the remainder of this document the Eagle Cap Wilderness and Strawberry Mountain Wilderness will be represented by the "Eagle Cap Wilderness" since they all share the same monitoring site.

Figure 9-145 shows an overall expected improvement in sulfate concentrations attributed to most WRAP states with the exception of a very slight increase from Nevada. Sulfate concentrations on the 20% best day are expected to drop during the first planning period.

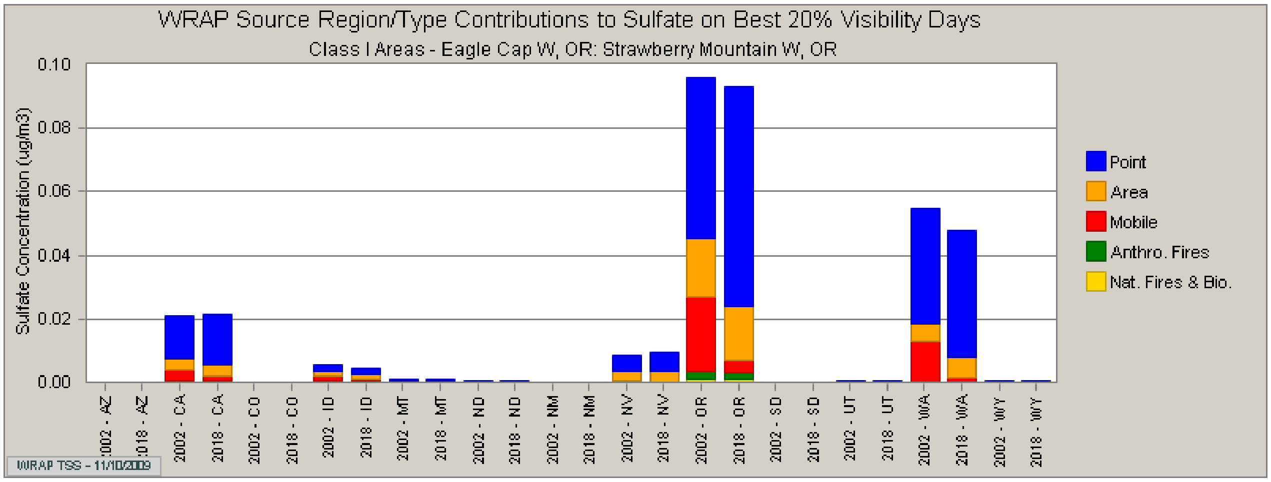


Figure 9-145 PSAT Sulfate Concentrations at Eagle Cap Wilderness 20% Best days

Nitrate at Eagle Cap Wilderness Based on PSAT Modeling

Figure 9-146 shows that overall concentrations of nitrates are expected to be higher than sulfates with a greater concentration coming from WRAP states. This is important to note because higher concentrations and higher contributions from WRAP states carries the opportunity for more control over future visibility improvements.

It also shows the expected highest contribution of nitrates is coming from Oregon followed by Idaho then closely by Washington. It is believed Idaho's higher expected concentrations would occur during high stagnation periods where air mass is slowly moving from the Treasure Valley and Snake River plan toward Hells Canyon and Eagle Cap Wilderness. This is explained in the Best Available Retrofit Technology Evaluation discussion in Chapter 10. During the first planning period, Idaho is expecting to reduce nitrate concentration contributions to Eagle Cap Wilderness by roughly 22%. See Appendix E (Eagle Cap Wilderness) for details.

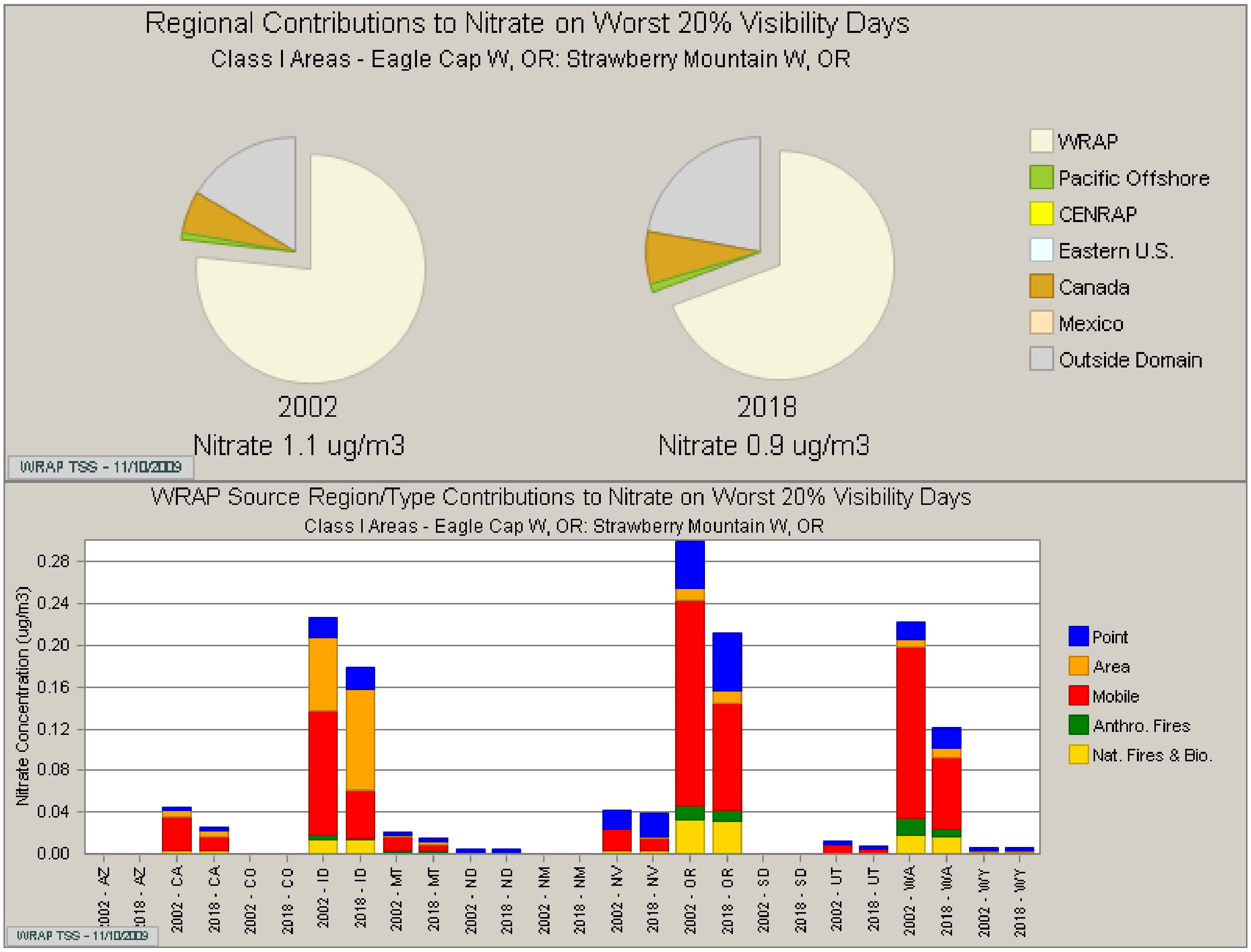


Figure 9-146 PSAT Nitrate Concentrations at Eagle Cap Wilderness 20% Worst Days

Figure 9-147 shows an expected decrease in nitrate concentrations from all WRAP states at Eagle Cap Wilderness on the 20% best visibility days.

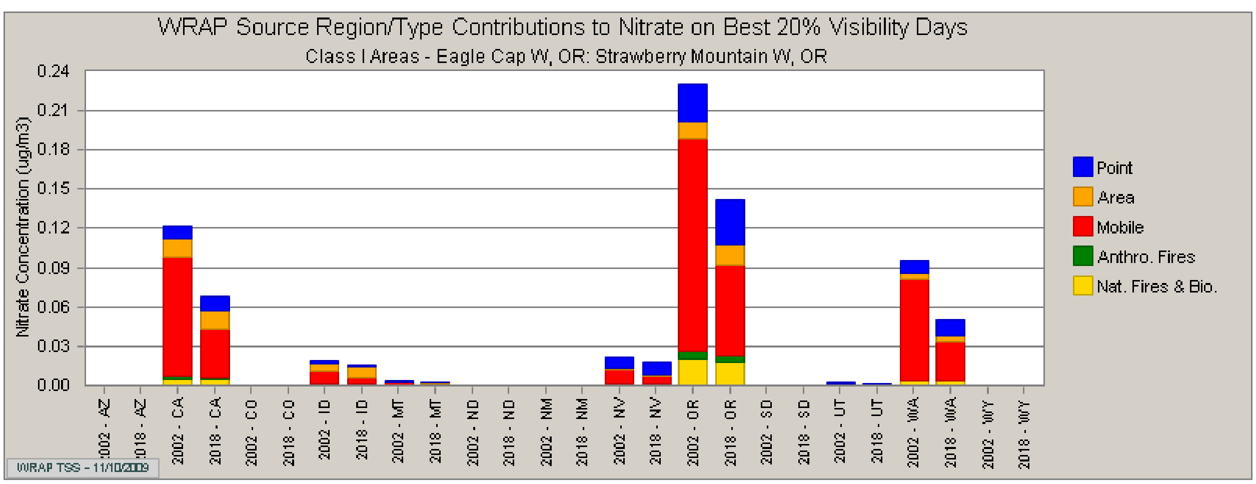


Figure 9-147 PSAT Nitrate Concentrations at Eagle Cap Wilderness 20% Best Days

Primary Organic Aerosol at Eagle Cap Wilderness Based on WEP

For the 20% worst visibility days at Eagle Cap Wilderness, Idaho is showing a minimal expected contribution of primary organic aerosol. Idaho's overall contribution is expected to decline over time due to reductions from anthropogenic fire as shown in figure 9-148. Oregon is showing a larger expected impact with similar reductions over time.

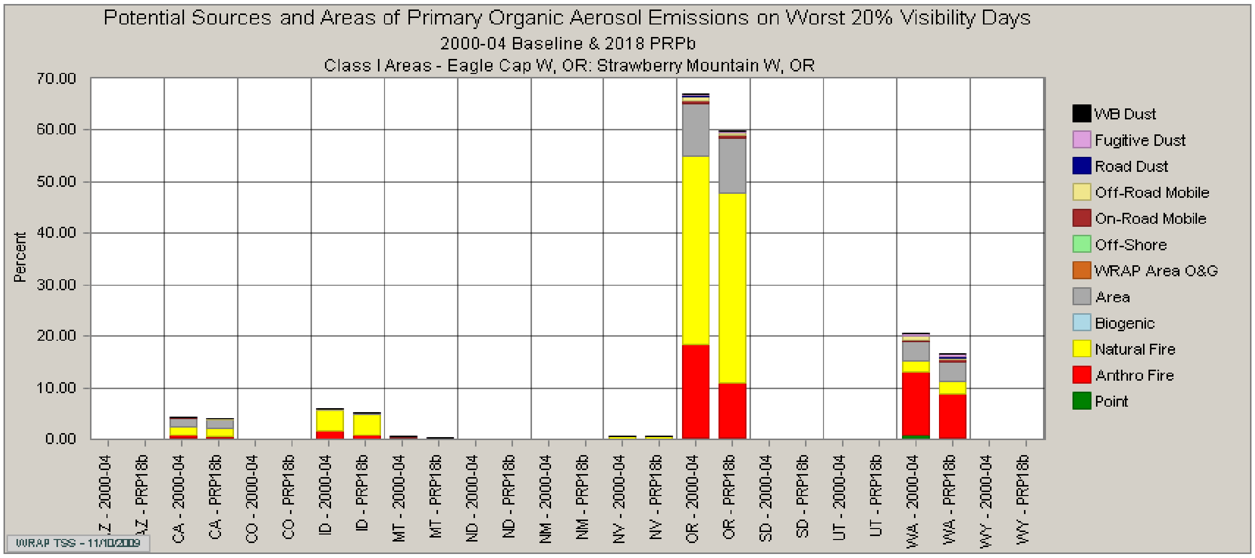


Figure 9-148 WEP Primary Organic Aerosol at Eagle Cap Wilderness 20% Worst Days

Figure 9-149 showing expected improvements in primary organic aerosols from all WRAP states on the 20% best visibility days.

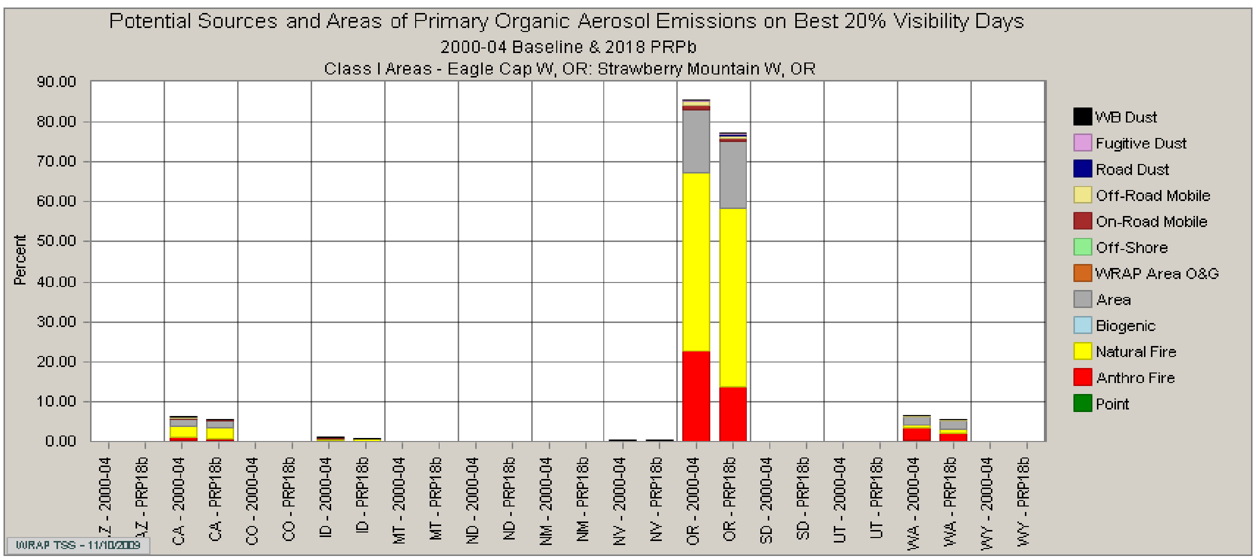


Figure 9-149 WEP Primary Organic Aerosol at Eagle Cap Wilderness20% Best Days

Elemental Carbon at Eagle Cap Wilderness Based on WEP

For the 20% worst visibility days at Eagle Cap, Idaho shows a minimal expected contribution of elemental carbon. Idaho's overall elemental carbon contribution is declining due to reductions from off-road mobile and anthropogenic fire as shown in figure 9-150. Oregon show greater expected impact but similar trends.

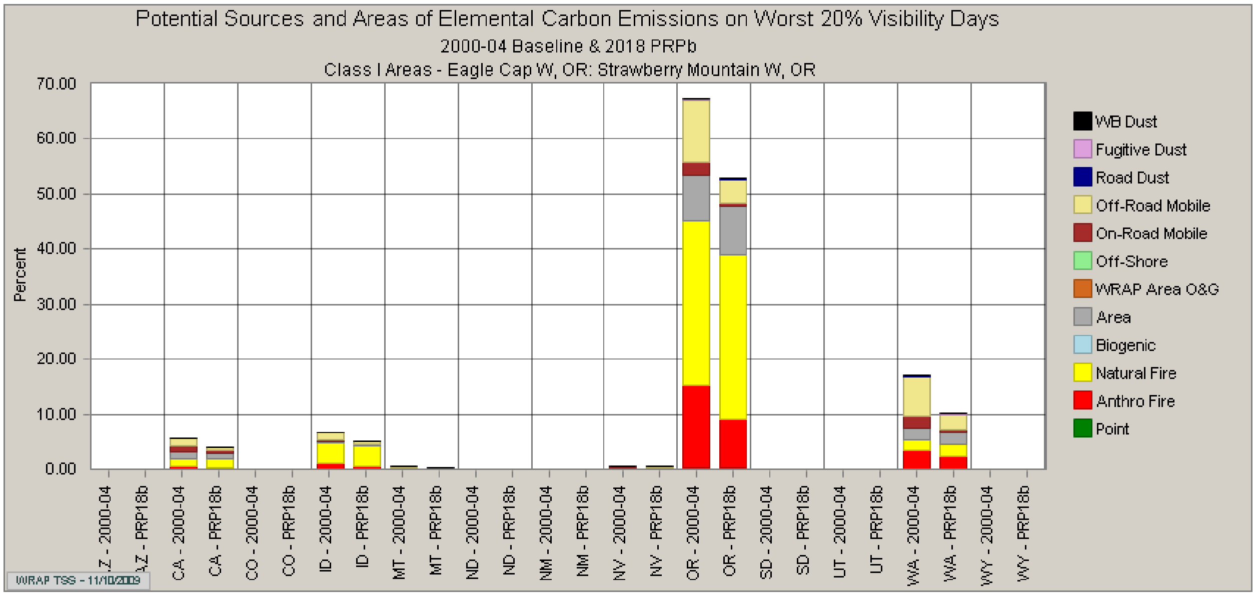


Figure 9-150 WEP Elemental Carbon at Eagle Cap Wilderness 20% Worst Days

Figure 9-151 shows expected improvements in elemental carbon from all WRAP states on the 20% best visibility days at Eagle Cap Wilderness.

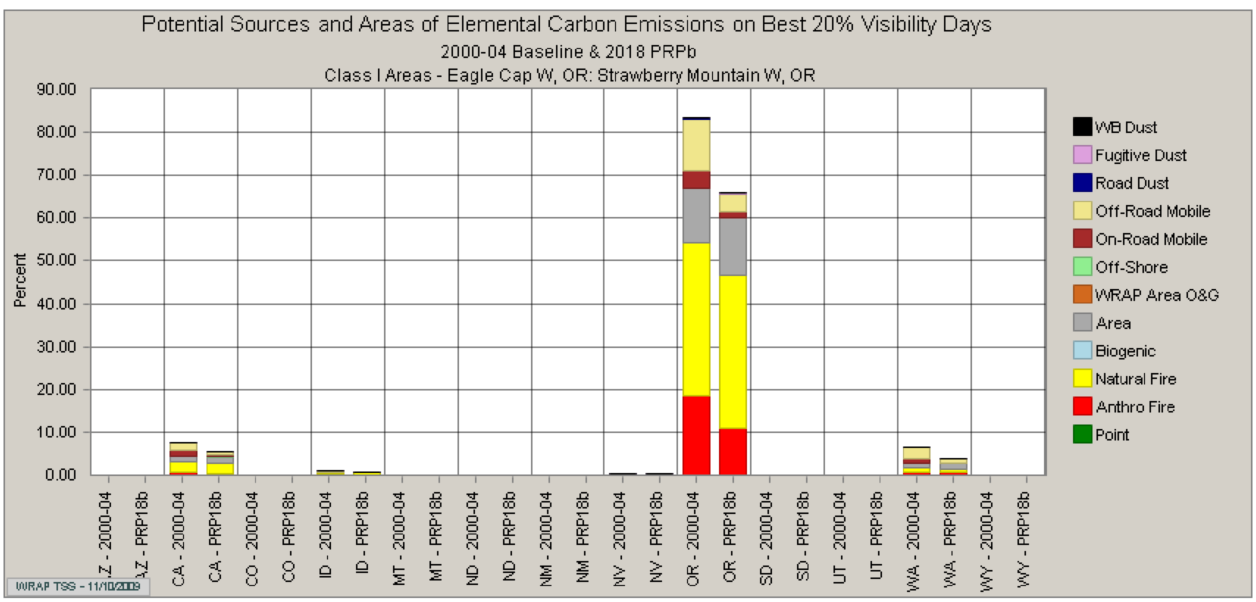


Figure 9-151 WEP Elemental Carbon at Eagle Cap Wilderness 20% Best Days

Fine Particulate Matter at Eagle Cap Wilderness Based on WEP

Figure 9-152 shows Oregon followed by Washington as the largest expected contributors of fine particulate matter to Eagle Cap Wilderness on the 20% worst visibility days. Idaho's expected contribution of fine particulate is very small but expected to grow slightly in the future due to increases in area sources and road dust.

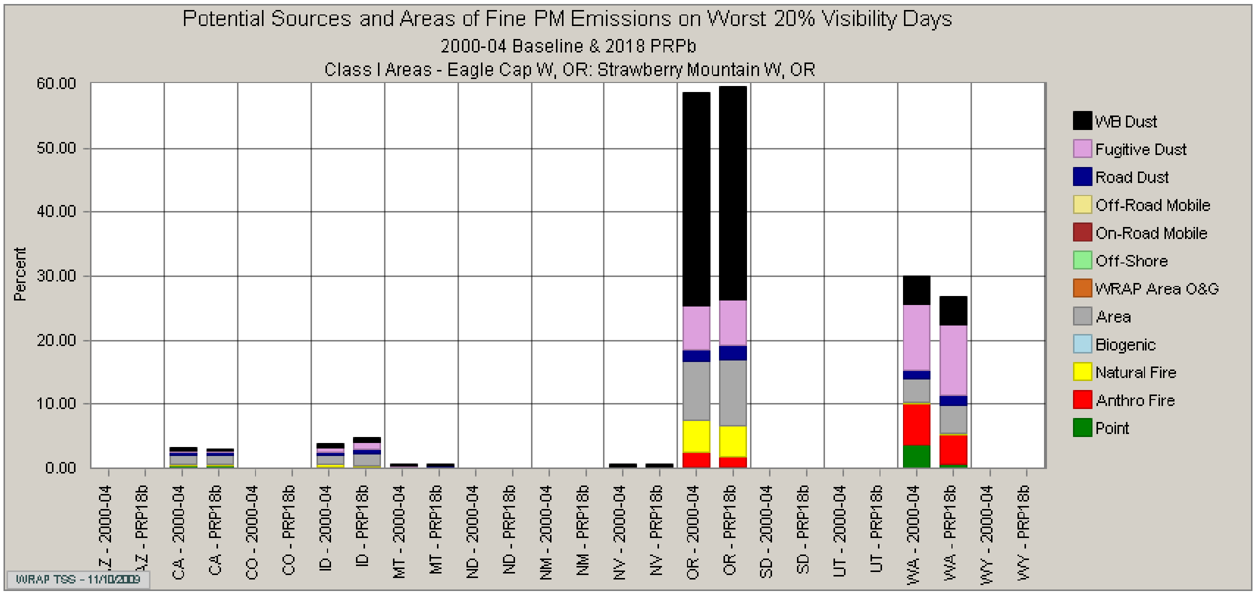


Figure 9-152 WEP Fine Particulate Matter at Eagle Cap Wilderness Worst 20% Days

On the 20% best visibility days at Eagle Cap Wilderness area, Figure 9-153 is showing increases in contributions from Oregon and decreases from Washington. Idaho's expected contribution of fine particulate on the 20% best days is very minimal.

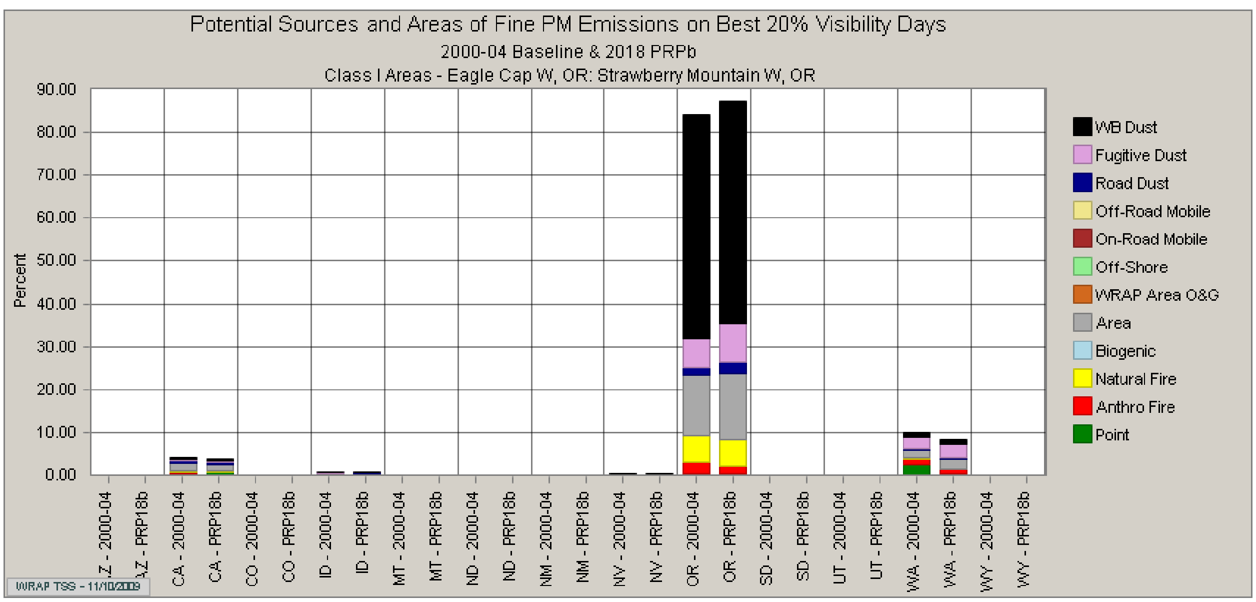


Figure 9-153 WEP Fine Particulate Matter at Eagle Cap Wilderness Best 20% Days

Coarse Particulate Matter at Eagle Cap Wilderness Based on WEP

Figure 9-154 is showing the largest impact from coarse particulate on the 20% worst visibility days is expected to come from Oregon, followed by Washington and then Idaho. Oregon is expecting future increases in fugitive dust and road dust. Washington is showing future increases in fugitive dust visibility impacts.

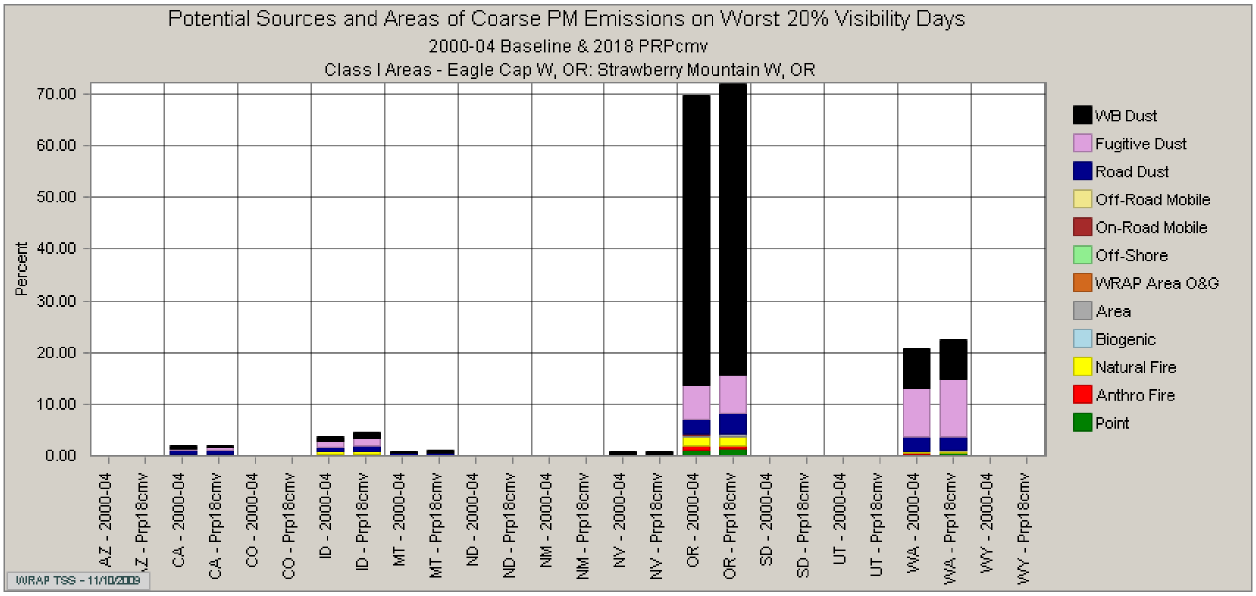


Figure 9-154 WEP Coarse Particulate Matter at Eagle Cap Wilderness 20% Worst Days

During the 20% best visibility days at Eagle Cap Wilderness, the air mass is primarily expected to come from the west as shown by the change in states' contributions with Oregon showing the greatest impact followed by Washington. Figure 9-155 shows Oregon is expecting increases in fugitive dust and road dust impacts. Washington is also expecting to have slight increases in fugitive dust. Idaho's expected impact is very minimal.

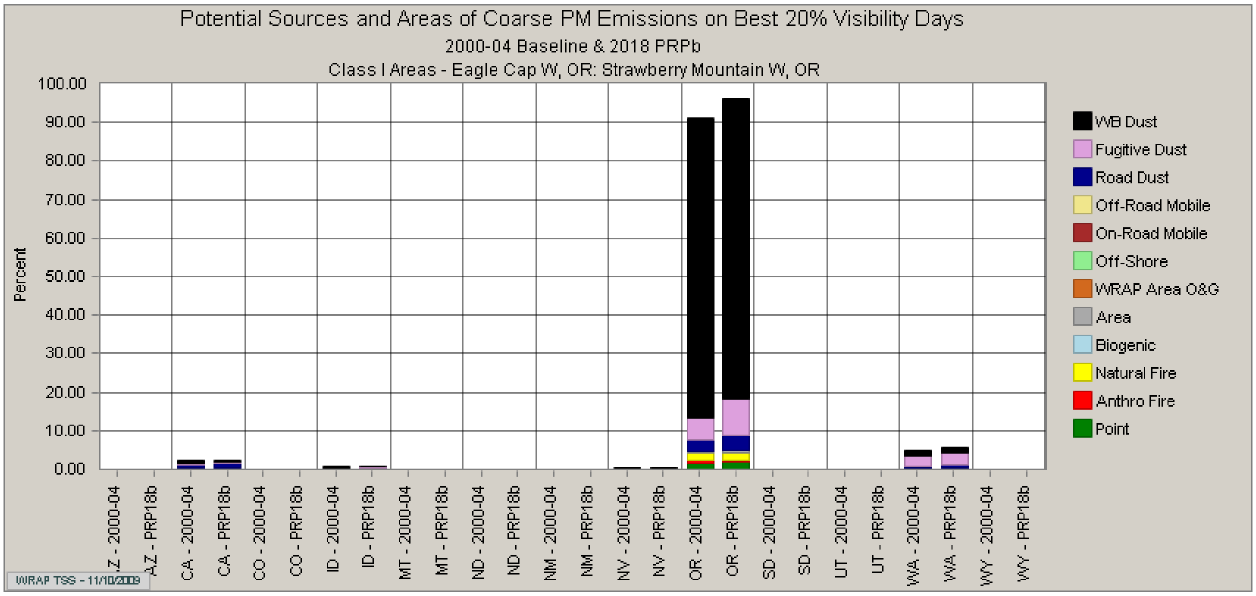


Figure 9-155 WEP Coarse Particulate Matter at Eagle Cap Wilderness20% Best Days

9.3.8 Jarbidge Wilderness Source Apportionment

Sulfate at Jarbidge Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-156 shows the WRAP states are only expected to contribute roughly a third of the visibility impairment on the 20% worst days. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-156 shows Idaho as the largest expected contributor of sulfate at Jarbidge Wilderness. Overall, the concentration levels attributed to individual WRAP states is relatively low. Idaho is showing an overall contribution of roughly 10% in 2018. As previously mentioned, the emissions from a once-anticipated EGU in Jerome County were included but because the plant is unlikely to be built, those emissions were removed from later emissions inventories.

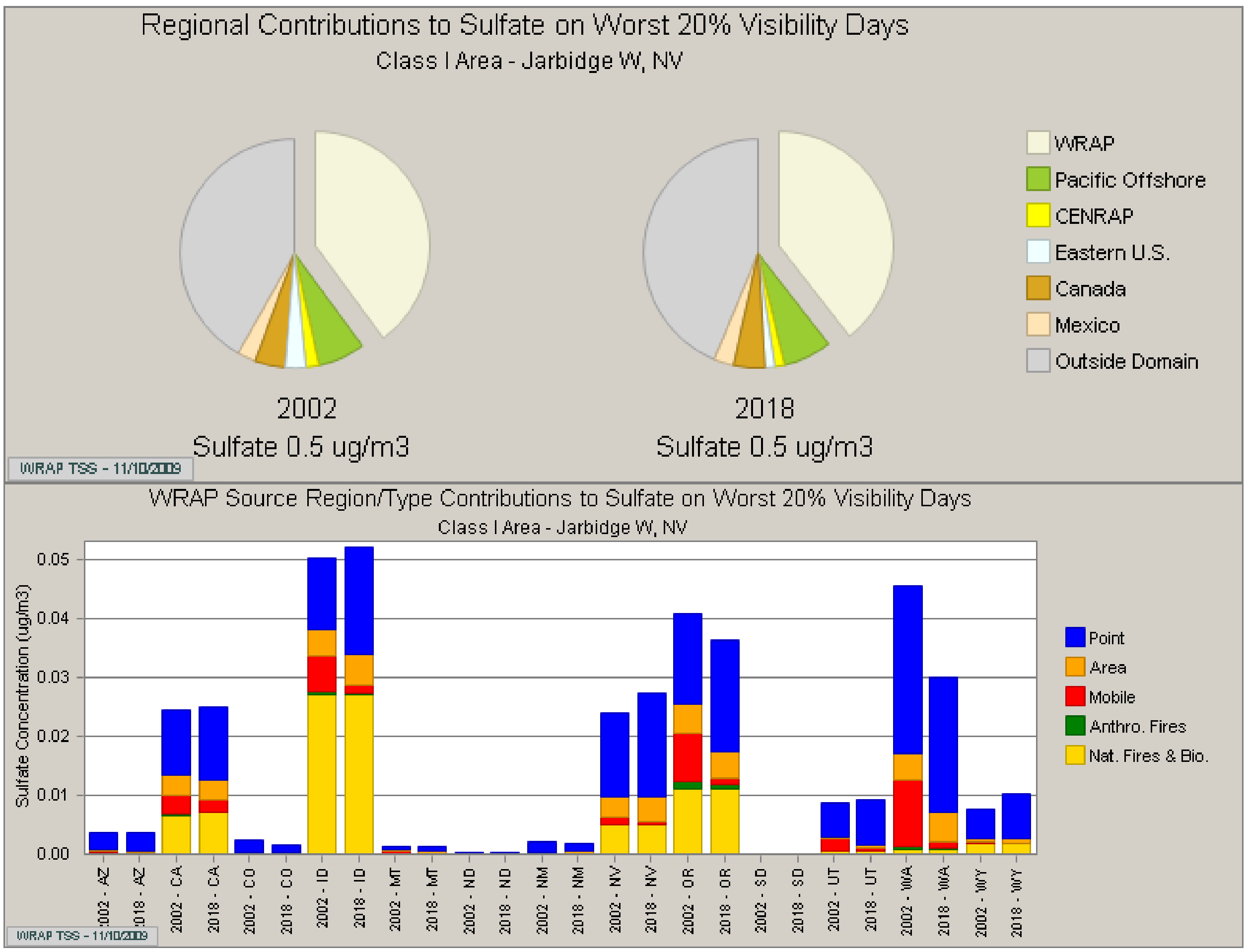


Figure 9-156 PSAT Sulfate Concentrations at Jarbidge Wilderness 20% Worst Days

Since we know it is highly unlikely that an EGU will be built in Idaho during the first planning period, and the updated emissions inventory is showing a reduction in future

sulfate coming from point sources, actual sulfate concentrations coming from Idaho should be decreasing over time and not increasing as shown in the graphics. As shown in figure 9-157, the WEP analysis depicts roughly a 6% expected reduction in sulfates coming from Idaho.

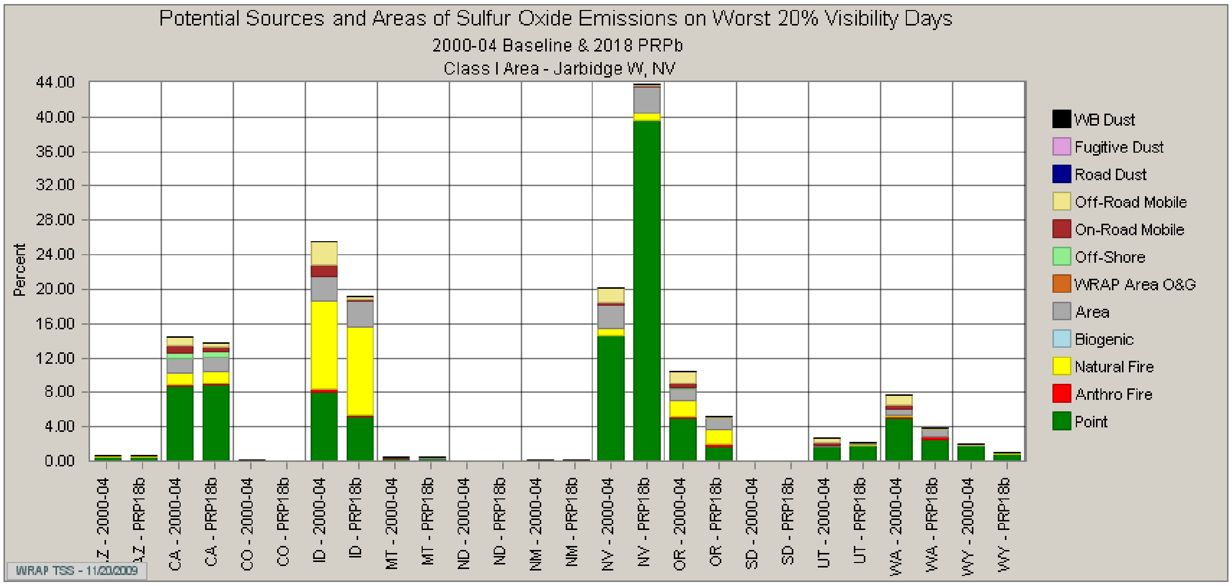


Figure 9-157 WEP Sulfate at Jarbidge Wilderness 20% Worst Days

Figure 9-158 shows very low concentrations of sulfate expected to come from individual WRAP states during the 20% best visibility days. Overall, concentrations are expected to decrease in most states with only a slight increase expected from Nevada and Idaho. These increases are overstated since the emissions inventory includes future EGU growth that is very unlikely to occur and it also does not include the expected reductions from installation of BART in Idaho.

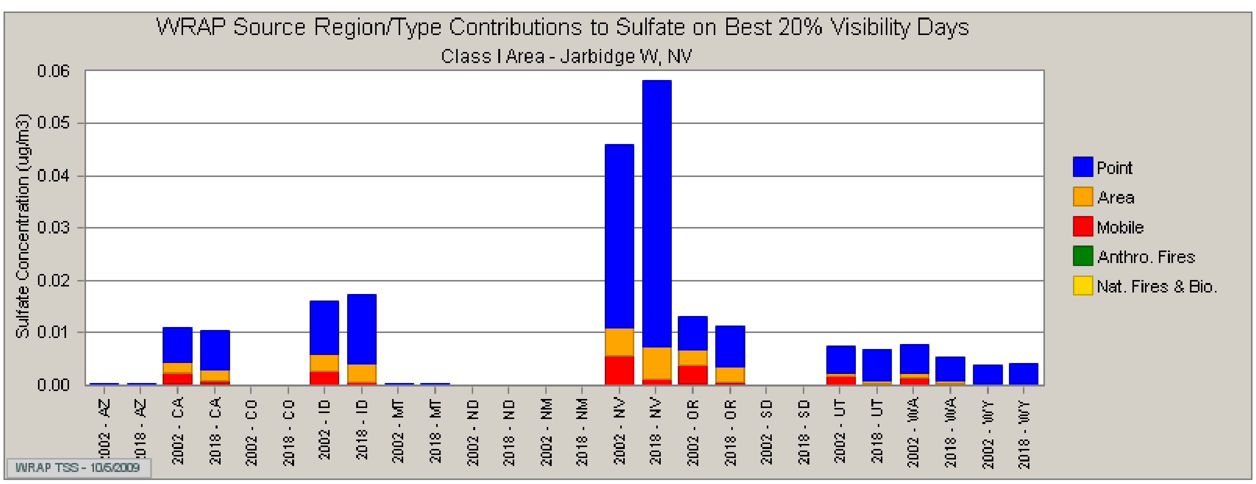


Figure 9-158 PSAT Sulfate Concentrations at Jarbidge 20% Best Days

Nitrate at Jarbidge Wilderness Based on PSAT Modeling

The regional source contribution pie charts in Figure 9-159 show the WRAP states are expected to contribute roughly two thirds of the nitrate concentrations on the 20% worst days in the Jarbidge Wilderness. Through the consultation process, the WRAP states can work together on reducing the WRAP region's contribution; the remaining contributions are outside the regulatory authority of the WRAP states.

Figure 9-159 shows Idaho and then Utah and Nevada as the largest expected contributors of nitrate at Jarbidge Wilderness in 2002. Overall, the expected concentration levels attributed to individual WRAP states are very low and decreasing over time due to reductions from primarily mobile sources. Idaho is showing an overall reduction in contribution of roughly 25% over the first planning period and that is with the emissions from the EGU for future demand placed in Jerome County, still included, although they were removed from later emissions inventories and are now not expected, as discussed earlier. It also does not include emission reductions expected from all the subject-to-BART sources.

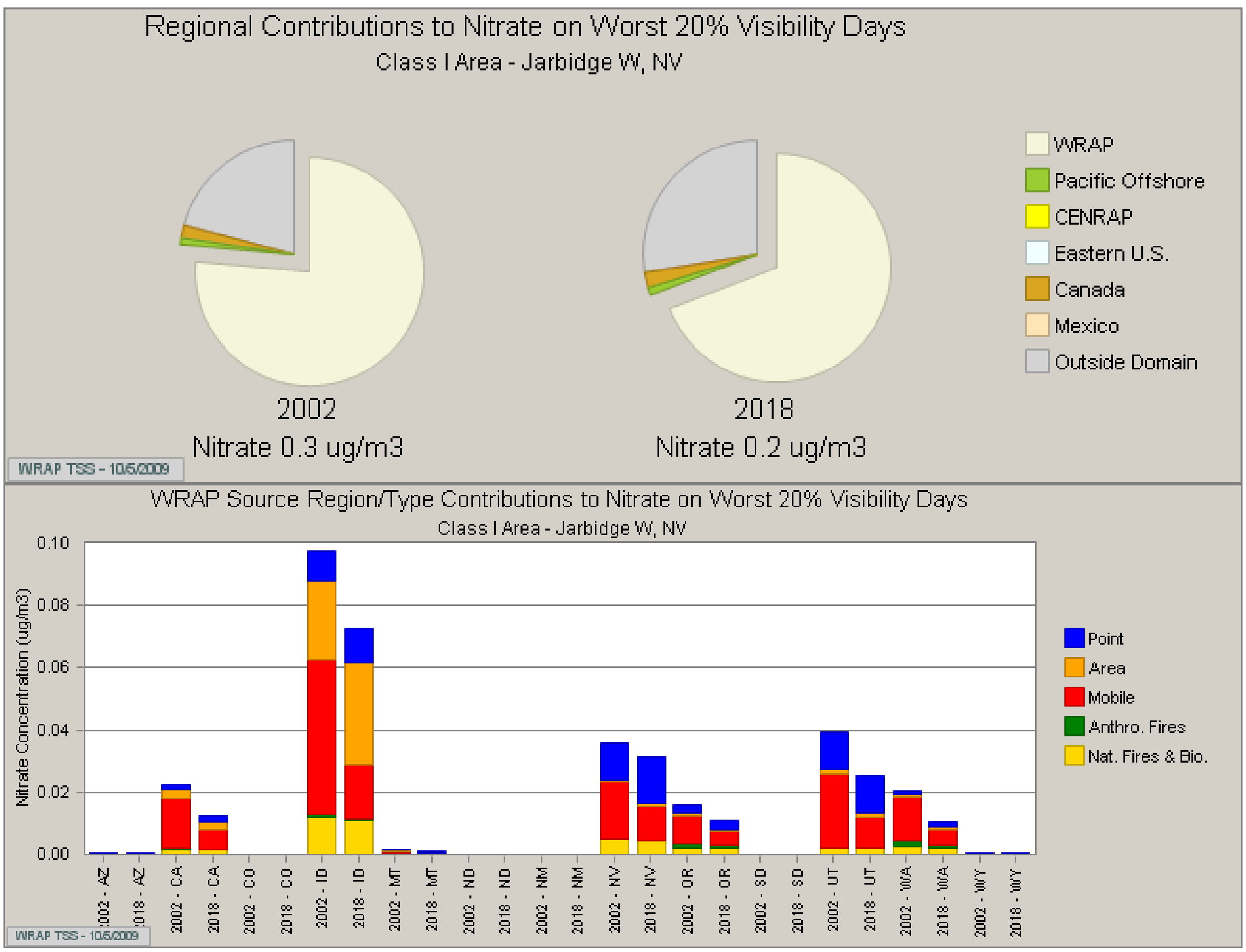


Figure 9-159 PSAT Nitrate Concentrations at Jarbidge 20% Worst Days

Figure 9-160 shows all WRAP states are expecting reductions in future contributions to Jarbidge Wilderness, so overall the 20% best days should be improving.

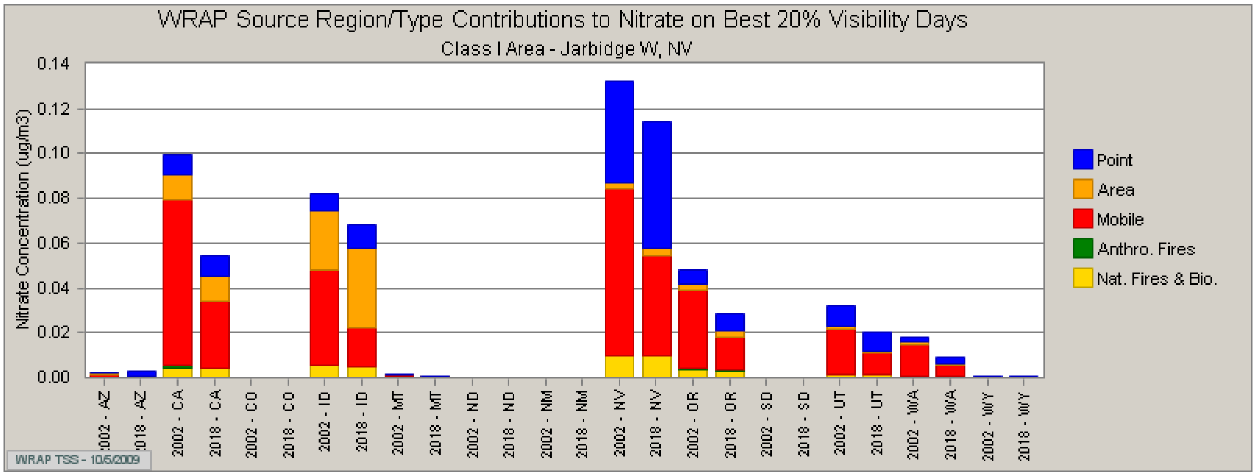


Figure 9-160 PSAT Nitrate Concentrations at Jarbidge 20% Best Days

Primary Organic Aerosol at Jarbidge Wilderness Based on WEP

For the 20% worst visibility days at Jarbidge Wilderness, Idaho shows a sizeable expected contribution to the primary elemental aerosol coming from natural fire. Idaho's overall contribution is expected to decline over time due to reductions from anthropogenic fire as shown in figure 9-161.

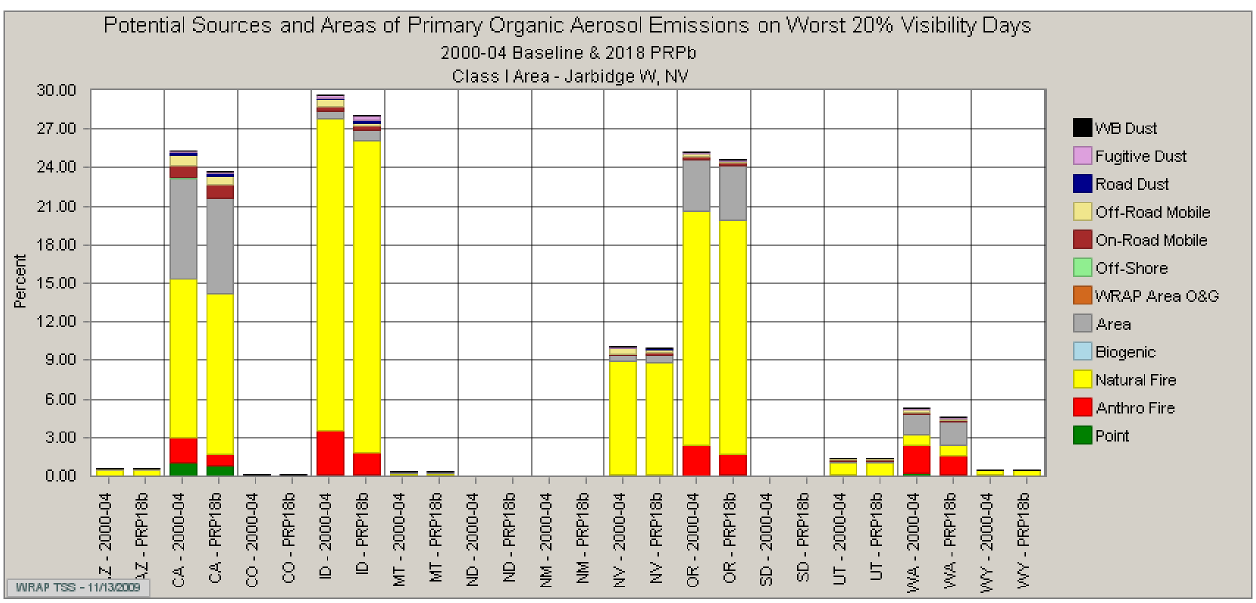


Figure 9-161 WEP Primary Organic Aerosol at Jarbidge Wilderness 20% Worst Days

Similar to the worst days, Idaho is showing a large expected contribution of the primary organic aerosol at Jarbidge Wilderness area on the 20% best visibility days. Overall, the primary organic aerosol is expected to go down at Jarbidge Wilderness area on the 20% best visibility days as shown in figure 9-162.

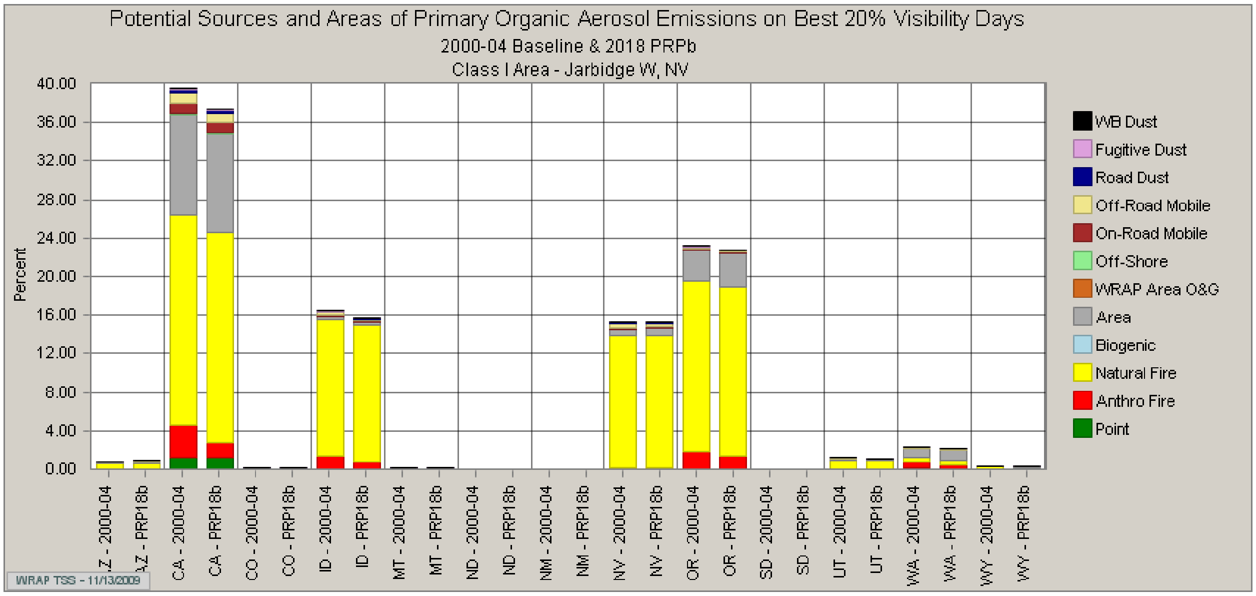


Figure 9-162 WEP Primary Organic Aerosol at Jarbidge Wilderness 20% Best Days

Elemental Carbon at Jarbidge Wilderness Based on WEP

For the 20% worst visibility days at Jarbidge Wilderness, Idaho is showing a sizeable expected contribution to the elemental carbon coming from natural fire. Idaho and the other WRAP states' overall contribution is expected to decline over time due to reductions from anthropogenic fire as shown in figure 9-163.

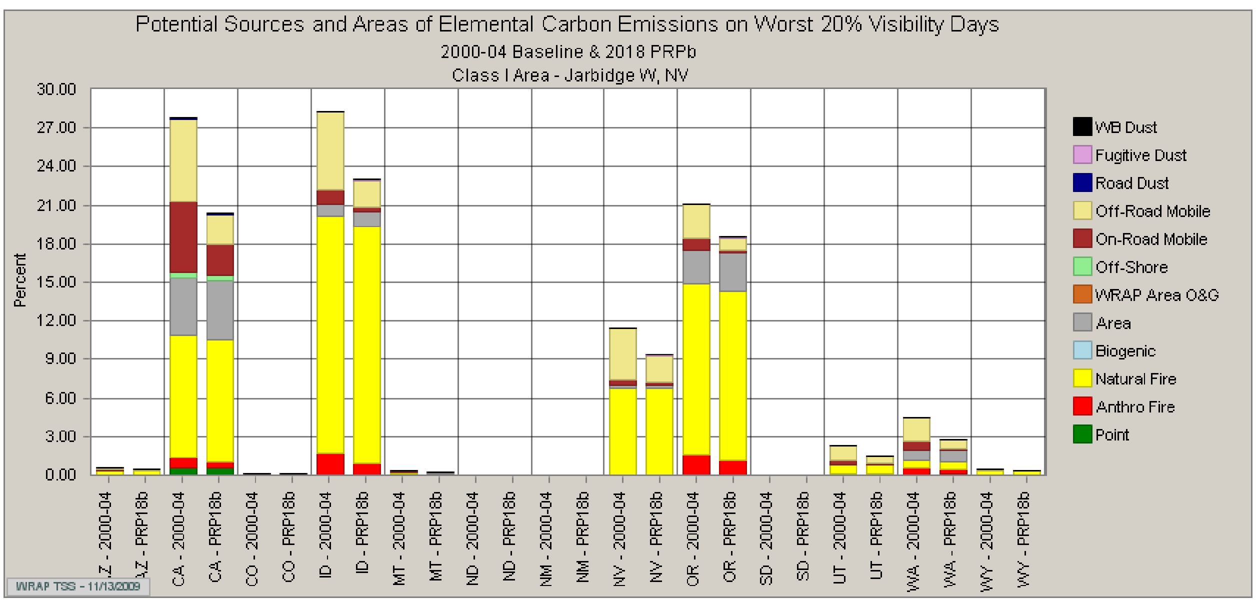


Figure 9-163 WEP Elemental Carbon at Jarbidge Wilderness 20% Worst Days

Figure 9-164 is showing a large percentage of the expected contribution of elemental carbon in the Jarbidge Wilderness area on the 20% best visibility days is from natural fire. Overall, the WRAP states are expected to reduce elemental carbon on the 20% best visibility days in the Jarbidge Wilderness.

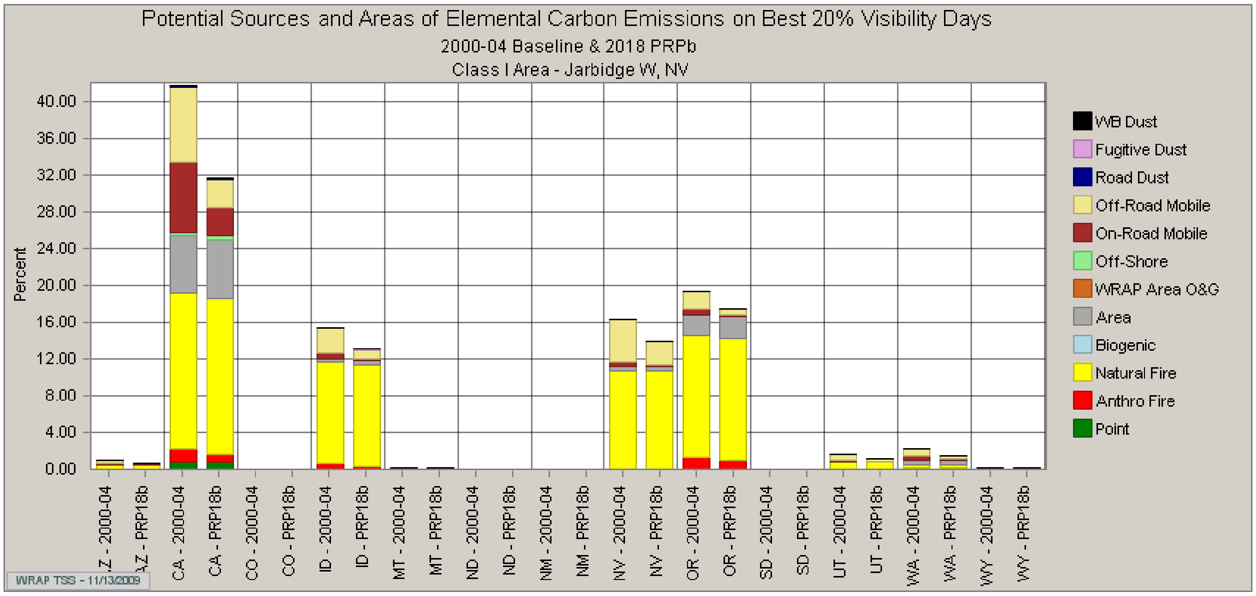


Figure 9-164 WEP Elemental Carbon at Jarbidge Wilderness 20% Best Days

Fine Particulate Matter at Jarbidge Wilderness Based on WEP

Figure 9-165 shows Idaho is expected to contribute over 30% of the fine particulate matter to Jarbidge Wilderness during the 20% worst visibility days. Idaho's emissions from area sources and road dust are expected to increase during the first planning period. Overall, fine particulate should slightly increase over time.

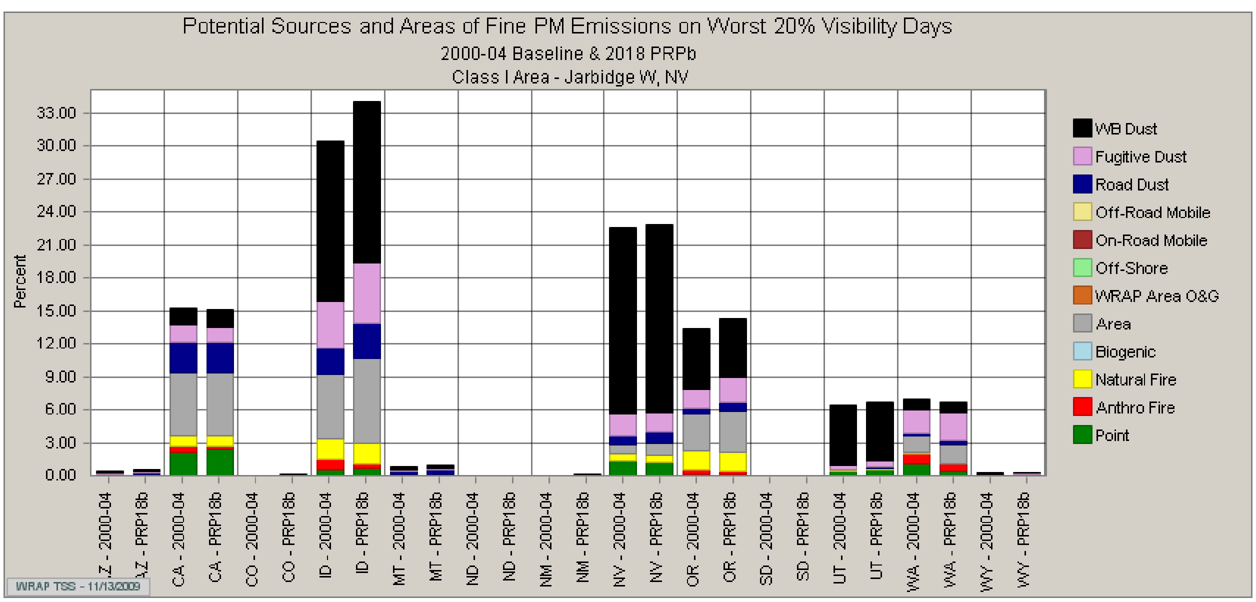


Figure 9-165 WEP Fine Particulate Matter at Jarbidge Wilderness Worst 20% Days

Figure 9-166 shows Nevada is expected to contribute over 30% in fine particulate on the best visibility days and Idaho is expected to contribute over 20%. Because of increases in emission from area sources and fugitive dust the contributions from fine particulate is expected to increase in the future.

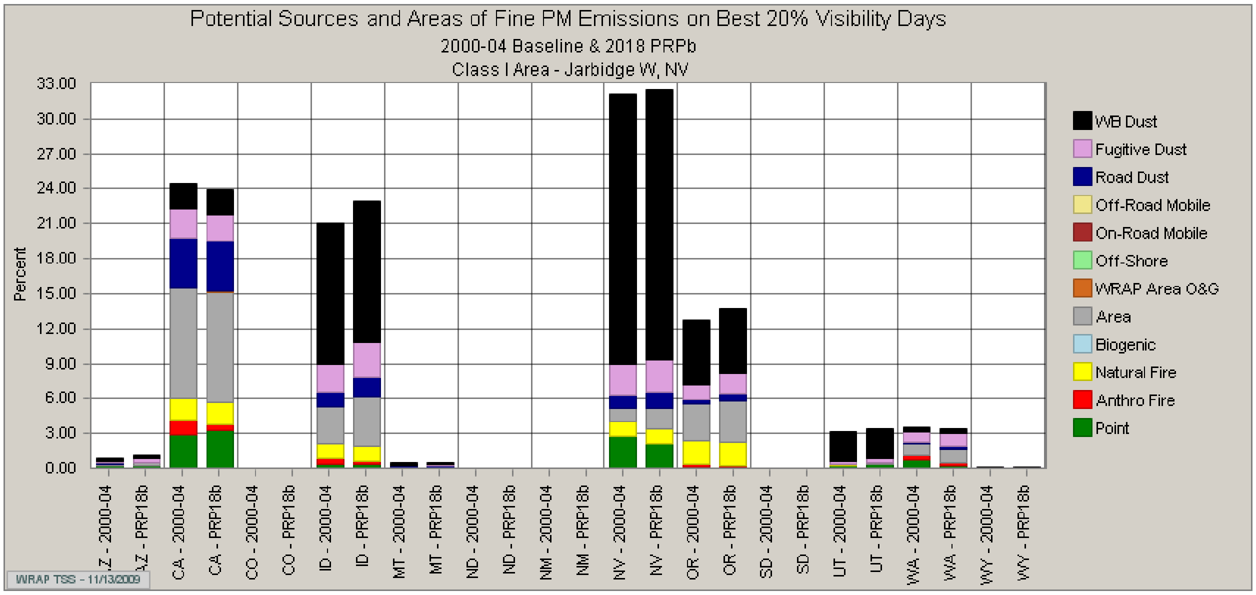


Figure 9-166 WEP Fine Particulate Matter at Jarbidge Wilderness Best 20% Days

Coarse Particulate Matter at Jarbidge Wilderness Based on WEP

Figure 9-167 is showing wind blown dust from all WRAP states is expected to be the highest contributing source category of coarse particulate at the Jarbidge Wilderness on the 20% worst visibility days. Idaho and Nevada are projecting increases in area fugitive dust. Overall, coarse particulate is expected to increase at Jarbidge Wilderness.

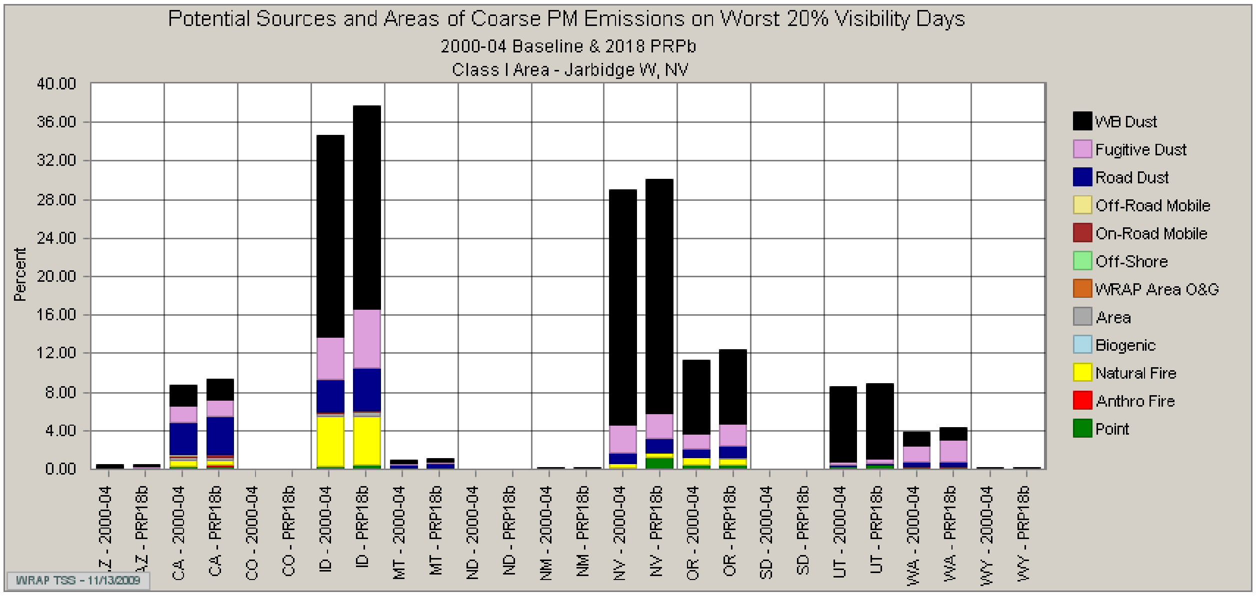


Figure 9-167 WEP Coarse Particulate Matter at Jarbidge Wilderness 20% Worst Days

Figure 9-168 is showing 20% best visibility days at Jarbidge Wilderness are trending the same as the 20% worst visibility days with similar contributions from Nevada and Idaho.

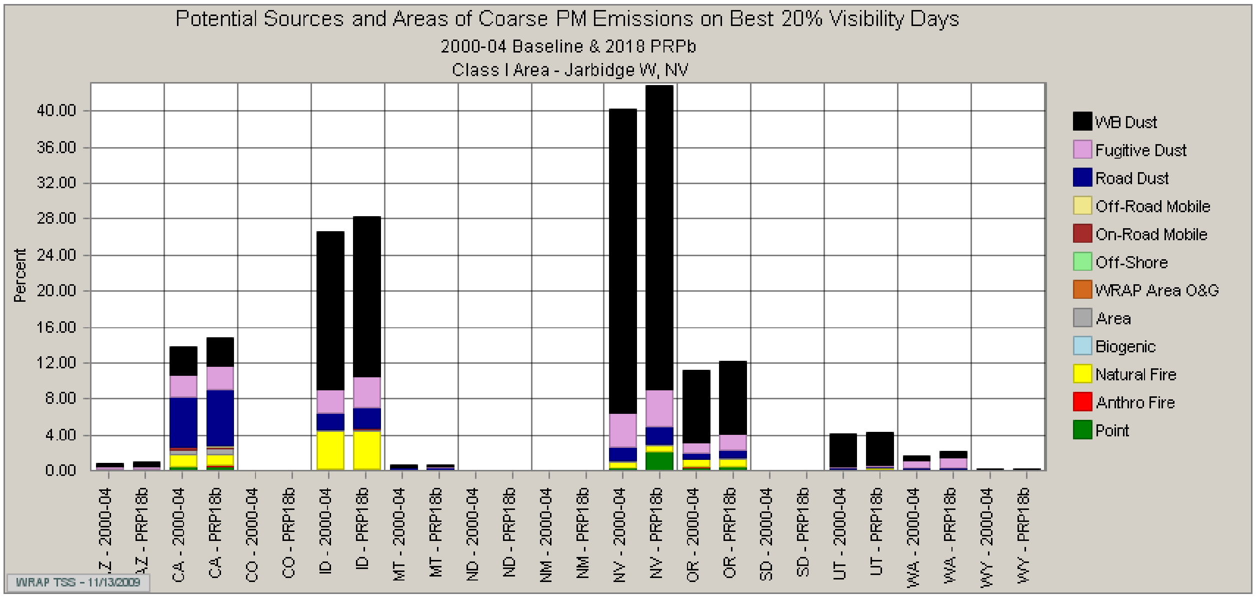


Figure 9-168 WEP Coarse Particulate Matter at Jarbidge Wilderness 20% Best Days

9.4 2018 Projected Visibility in Idaho Class I Areas Based on CMAQ Modeling

Before jumping into the modeling results, a review of the models that were used and how the information is used in this section may be helpful. As discussed in the first section of this chapter, CAMx PSAT modeling was used to track each visibility-impairing pollutant from the emissions source. Based on the tracking of visibility-impairing pollutants from the sources, the concentrations of the visibility-impairing pollutants were allocated to the state of origin and the emissions source category. This process is known as source apportionment. The PSAT modeling used early versions of emissions inventories so it is a good source of information for the source apportionment of visibility-impairing pollutants.

The CMAQ model was run using more up-to-date emissions inventories that included control strategies such as BART. Because of limited funding, WRAP was unable to rerun source apportionment using the later versions of the emissions inventories. The CMAQ model was therefore used for projecting future visibility-impairing pollutant concentrations at Class I areas based on the updated emission inventory. This information was used to compare the projected visibility-impairing pollutant concentrations and associated visibility impacts to the uniform rate of progress (URP) for each Class I area. The URP is discussed further in Chapter 11.

Based on CMAQ modeling, most of the Class I areas analyzed in this chapter are expected to have similar outcomes in meeting the URP. Of all the visibility-impairing pollutants, sulfate and nitrate have the greatest potential to be controlled because they are usually closely linked to anthropogenic sources, which can be controlled while natural sources cannot.

The PSAT modeling results show small reductions in sulfate by 2018 in Idaho's Class I areas due to the relatively small sulfate contributions from WRAP states and the influence of natural fire. A concern with the PSAT modeling for sulfate is that it used an older emissions inventory that included the emissions for an anticipated coal-fired electrical generation unit (EGU) to meet future demand that won't be built during the timeframe of this plan. Although the WEP analysis isn't as robust as the PSAT modeling, it does give an indication of future potential percentage reductions. Based on WEP analysis, the change in emissions from Idaho's anthropogenic sources in most Class I areas are expected to be greater than 40%. In general, WRAP states are contributing roughly one-third of the sulfate contributions. So even if the WRAP states were to reduce their sulfate visibility impairment contributions by 20% on the worst days, it is unlikely that the CMAQ-projected 2018 visibility impacts from sulfate would meet the sulfate URP, because of sulfate emissions contributions from areas outside of the WRAP states.

The PSAT modeling shows expected improvements between 15 and 28% for nitrate concentrations from on- and off-road mobile and point sources coming from Idaho. In general, the WRAP states are contributing roughly three-quarters of the total nitrate contribution so the total reduction made by WRAP states has a greater impact on the overall nitrate concentrations and visibility improvement than for sulfate. In some cases, the expected nitrate improvements are better than would be achieved in accordance with the URP.

As seen throughout this document, impacts from fire are expected to overshadow reductions expected from anthropogenic carbon sources. The CMAQ modeling further illustrates the impacts from organic mass carbon.

The remainder of this chapter will review the CMAQ modeling results for each Class I area in Idaho and several Class I areas in surrounding states. The review will look at the URP for each visibility-impairing pollutant and the progress projected to have occurred by 2018. For each Class I area, there is a graph followed by a table that display the progress projected by 2018 as a percentage of the progress that would have been achieved by 2018 according to the URP.

The 2018 projections include emissions reductions expected from the addition of best available control technologies on facilities subject to the Regional Haze BART requirements (covered in Chapter 10), and reductions expected due to both federal and state regulations currently on the books or expected to take effect during the first planning period (covered in Chapter 11). In Chapter 12 on Long Term Strategies, several source categories have been identified as candidates for future controls. If these categories prove to be causing or contributing to visibility impairment at Class I areas, and the emissions from these sources can reasonably be controlled, some facilities within these source categories may need to install additional emission controls. The emissions reductions from the source categories have not been included during this planning period because of the time necessary to show these source categories may be causing or contributing to visibility impairment through modeling and then develop state rules to implement control strategies.

As the following tables and graphs will show, in most instances the URP has been met for NO_x. Reviewing the emission inventory information in Chapter 8 for NO_x, most of these expectedemission reductions can be attributed to reductions coming from emission controls on motor vehicles. There is a slight increase in point sources emissions (570 tons) over the first planning period based on growth factors. The increases coming from point sources will be subject to New Source Review and prevention of significant deterioration (PSD) requirements as explained in Chapter 12. Concentrations of NO_x from areas sources are also expected to increase during the first planning period based on population growth factors. Home heating and other minor source activities that require the burning of fossil fuels is the primary cause of this growth. Because of the rising cost of fossil fuels, homeowners and small business owners are installing more fuel-efficient equipment as a cost-saving measure so the projections for NO_x coming from area sources may prove to be overstated. Even with increases expected from point and area sources, the overall NOx emissions from Idaho as well as most other WRAP states is expected to drop which translates into meeting the URP for most Class I areas impacted by Idaho emissions.

Idaho and most other WRAP states showing expected reduction in SO_x anthropogenic emissions greater than 20%. Unfortunately, the large contribution from natural fire at 31% (which is held constant as recommended by the WRAP Fire Forum) and sources outside the WRAP region are expected to overwhelm the overall emissions, preventing the Class I areas from meeting the URP for SO_x.

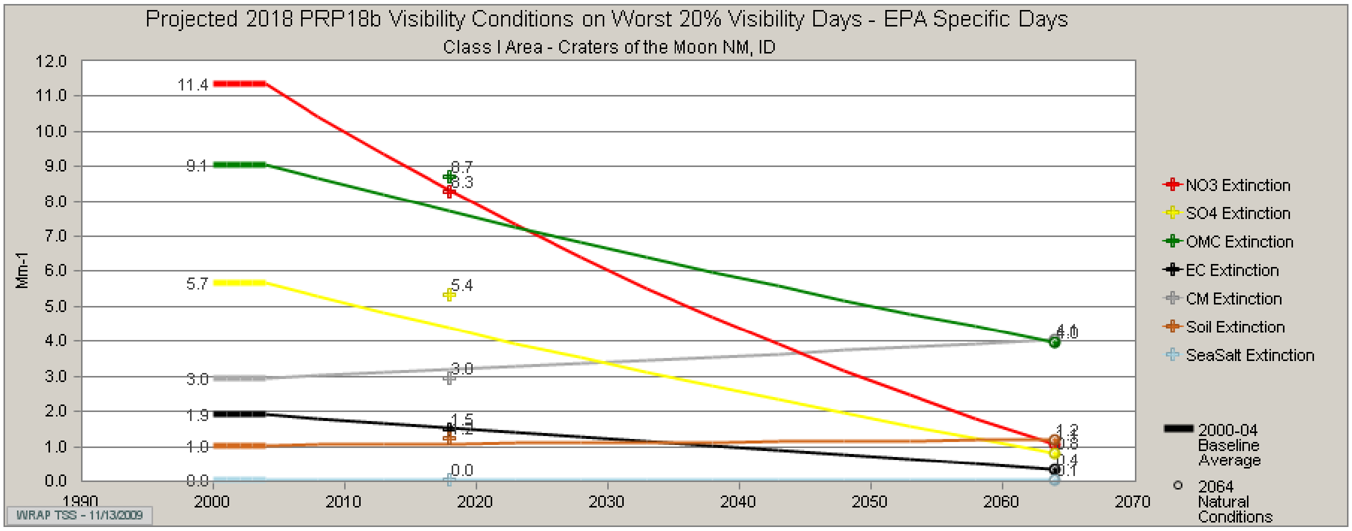
As mentioned in Chapter 8, future area source VOC emissions are expected to increase based on future population growth factors. This source category includes a multitude of activities ranging from dry cleaners and personal care products to road-building. Most of

the area source categories contribute less than 500 tons each which is not very conducive to rule development for control strategies and enforcement actions. This category is better suited to best management practices which will more than likely occur on its own due to the cost of paints and solvents. Businesses are finding cost savings in replacing things like paint sprayer nozzles with more efficient equipment. Even if the emissions from area source were to remain flat and not grow due to population increases, the expected emissions from natural fire overwhelm the organic carbon categories, which makes reaching the URP extremely difficult. Natural fire contributes 32% of the VOC emissions and 82% of the organic carbon emissions as shown in Chapter 8. Because of the influence of natural fire on organic mass carbon and sulfate, meeting the URP is not expected in Idaho Class I areas and those surrounding the state, as shown in the following figures.

Fine and coarse particulate are very interesting in the fact that many of the Class I areas in Idaho and surrounding states are cleaner during the baseline period than projected natural conditions. This creates a situation where the amounts of pollutants that would exist under the URP are actually greater than during the baseline period. In comparison to other visibility-impairing pollutants, fine and coarse particulate are not large contributors to visibility impairment. Because of these issues, fine and coarse particulate have not been included in the following tables shown with the figures.

9.4.1 CMAQ-Projected Visibility on 20% Worst Days at Craters of the Moon National Monument

Figure 9-169 shows nitrates and elemental carbon are expected to meet the uniform rate of progress. Even though Idaho and WRAP states have reduced upwind emissions more than 25%, it isn't enough to overcome the 75% of the emissions coming from outside the WRAP states' regulatory area. Expected organic mass carbon is also above the URP due to the major contribution coming from natural fire. Coarse matter and fine soil are unique since natural conditions are actually higher than baseline.



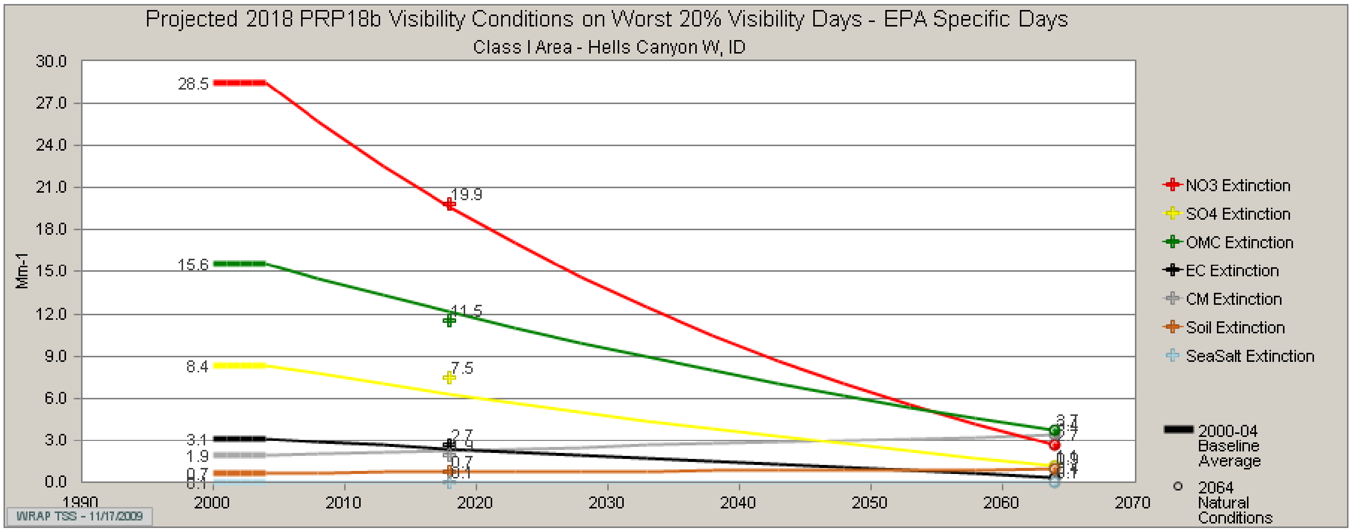
	Craters of the Moon National Monument				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	5.69	4.39	0.83	5.35	26.15%
Ammonium Nitrate	11.35	8.31	1.05	8.3	100.33%
Organic Carbon	9.06	7.73	3.98	8.73	24.81%
Elemental Carbon	1.92	1.54	0.36	1.51	107.89%
Fine Soil	1.04	1.08	1.2	1.23	*%
Coarse Material[3]	2.95	3.2	4.05	Not Applicable	
Sea Salt[3]	0.03	0.04	0.06		

1. MM-1 – inverse megameters

Figure 9-169 CMAQ Pollutant Projections 20% Worst Days at Craters of the Moon National Monument

9.4.2 CMAQ-Projected Visibility on 20% Worst Days at Hells Canyon Wilderness

Figure 9-170 is shows many of the pollutants expected to meet the URP for Hells Canyon Wilderness. Expected levels of Elemental Carbon are above the URP primarily due to the large contribution from natural fire. Sulfate projections may be overstated because expected emissions were included from a once-anticipated EGU in Idaho that is now not expected to be built.



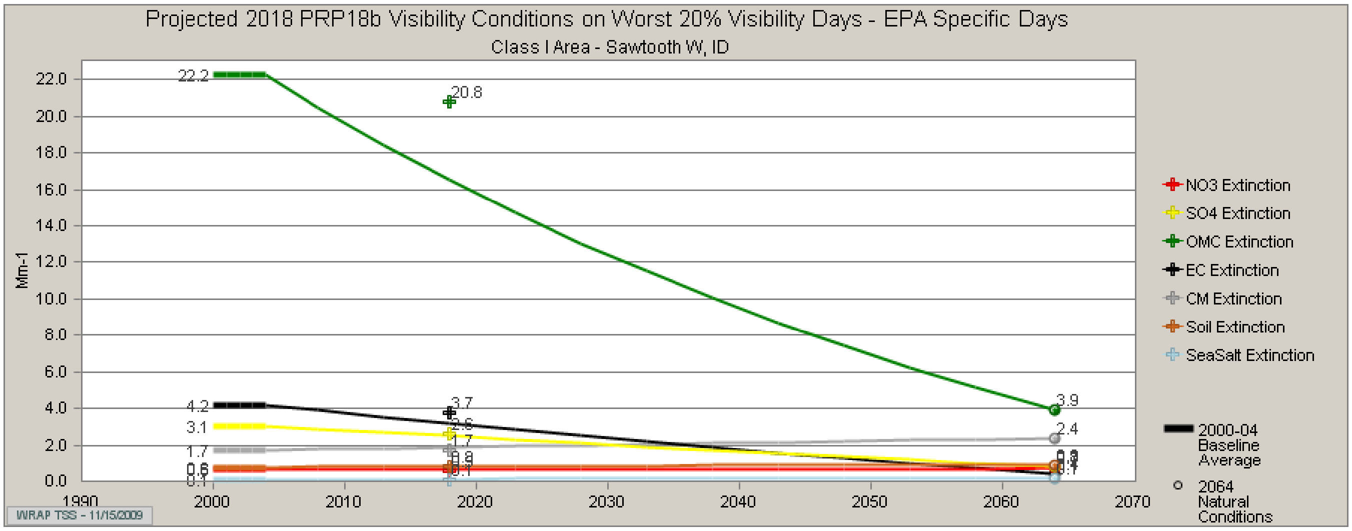
	Hells Canyon Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	8.37	6.35	1.14	7.49	43.56%
Ammonium Nitrate	28.47	19.69	2.67	19.91	97.49%
Organic Carbon	15.6	12.12	3.69	11.54	116.67%
Elemental Carbon	3.06	2.37	0.37	2.65	59.42%
Fine Soil	0.66	0.72	0.92	0.74	*%
Coarse Material[3]	1.93	2.26	3.4	Not Applicable	
Sea Salt[3]	0.05	0.05	0.05		

1. MM-1 – inverse megameters

Figure 9-170 CMAQ Pollutant Projections 20% Worst Days at Hells Canyon Wilderness

9.4.3 CMAQ-Projected Visibility on 20% Worst Days at Sawtooth Wilderness

The visibility-impairing pollutants sulfate and nitrate are the two pollutants for which we have the greatest control over emissions reductions since they are usually closely linked to anthropogenic sources. Figure 9-171 shows excellent improvements expected due to reductions of sulfate and nitrate. Sawtooth Wilderness is not expected to meet the overall URP because of organic mass carbon and the contributions of natural fire.



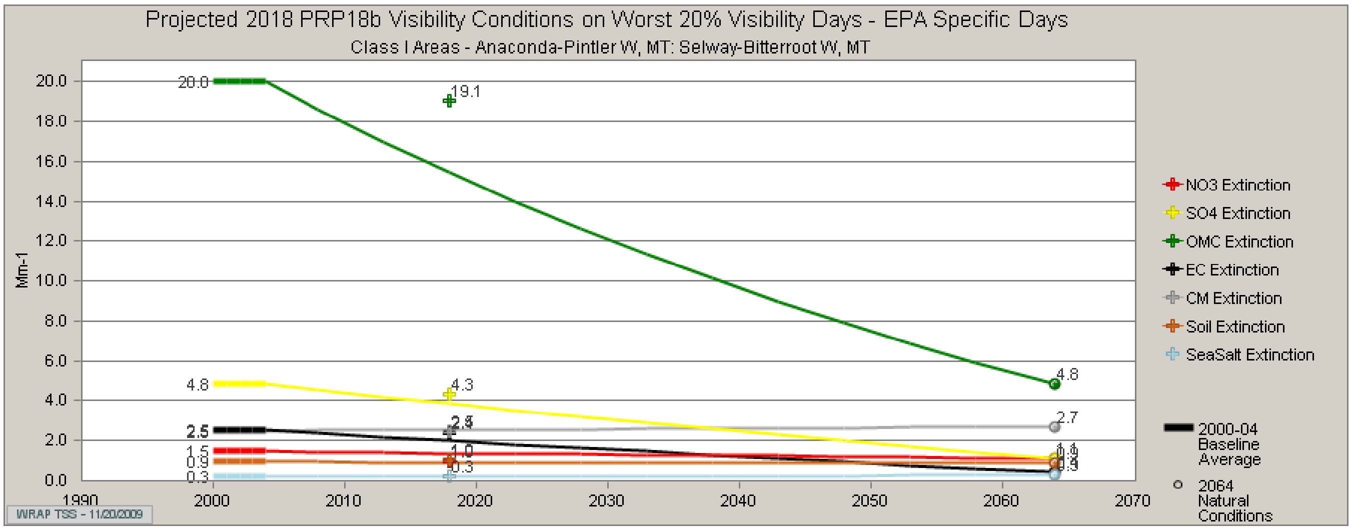
`	Sawtooth Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	3.06	2.5	0.81	2.59	83.93%
Ammonium Nitrate	0.63	0.65	0.7	0.54	-450.00%
Organic Carbon	22.24	16.51	3.94	20.81	24.96%
Elemental Carbon	4.2	3.2	0.38	3.73	47.00%
Fine Soil	0.77	0.81	0.94	0.79	*.%
Coarse Material[3]	1.74	1.89	2.39	Not Applicable	
Sea Salt[3]	0.12	0.12	0.13		

1. MM-1 – inverse megameters

Figure 9-171 CMAQ Pollutant Projections 20% Worst Days at Sawtooth Wilderness

9.4.4 CMAQ-Projected Visibility on 20% Worst Days at Selway-Bitterroot Wilderness

The Selway-Bitterroot Wilderness is very similar to the Sawtooth Wilderness in the pollutants impacting the area. The reductions in ammonium nitrate are expected to improve beyond the natural condition. The expected anthropogenic reductions in sulfate and organic carbon are overshadowed by expected increases attributed to natural fire as seen in Figure 9-172.



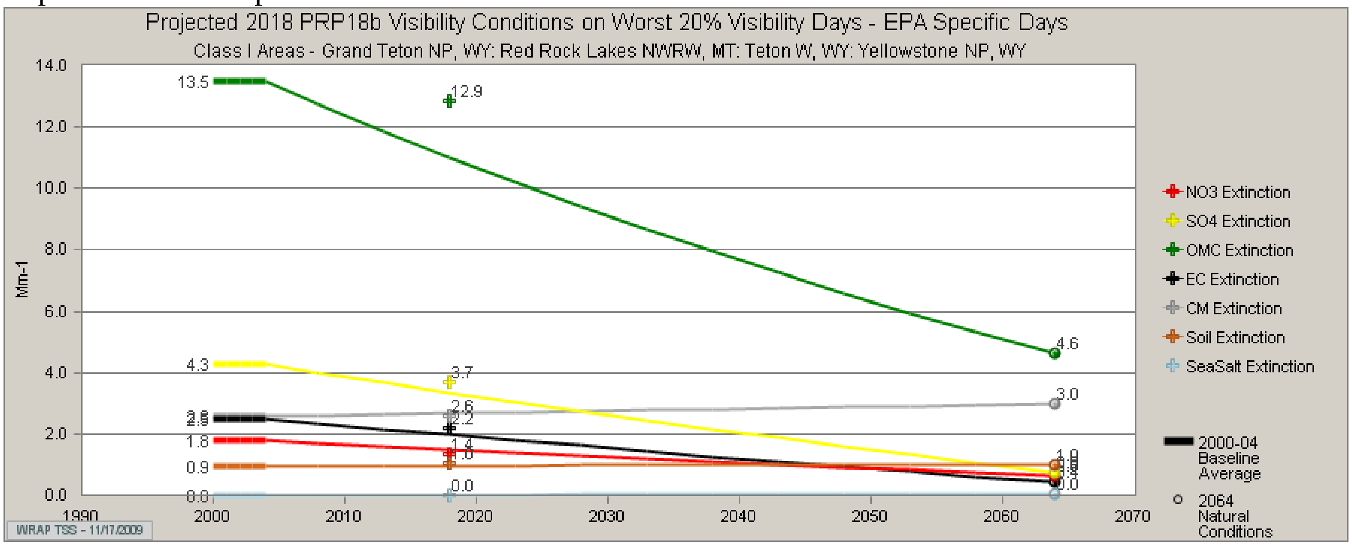
	Selway-Bitterroot Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	4.83	3.86	1.1	4.32	52.58%
Ammonium Nitrate	1.46	1.38	1.12	0.96	625.00%
Organic Carbon	20.01	15.46	4.84	19.09	20.22%
Elemental Carbon	2.52	2	0.43	2.4	23.08%
Fine Soil	0.94	0.93	0.91	1.02	-800.00%
Coarse Material[3]	2.49	2.54	2.7	Not Applicable	
Sea Salt[3]	0.26	0.26	0.27		

1. MM-1 – inverse megameters

Figure 9-172 CMAQ Pollutant Projections 20% Worst Days at Selway-Bitterroot Wilderness

9.4.5 CMAQ-Projected Visibility on 20% Worst Days at Yellowstone National Park, Grand Teton NP, Red Rock Lakes Wilderness, and Teton Wilderness

The CMAQ analysis for Yellowstone National Park on the 20% worst days show large expected improvements in sulfate; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-173 shows expected improvements in nitrate visibility impairment that surpass the URP in Yellowstone National Park.



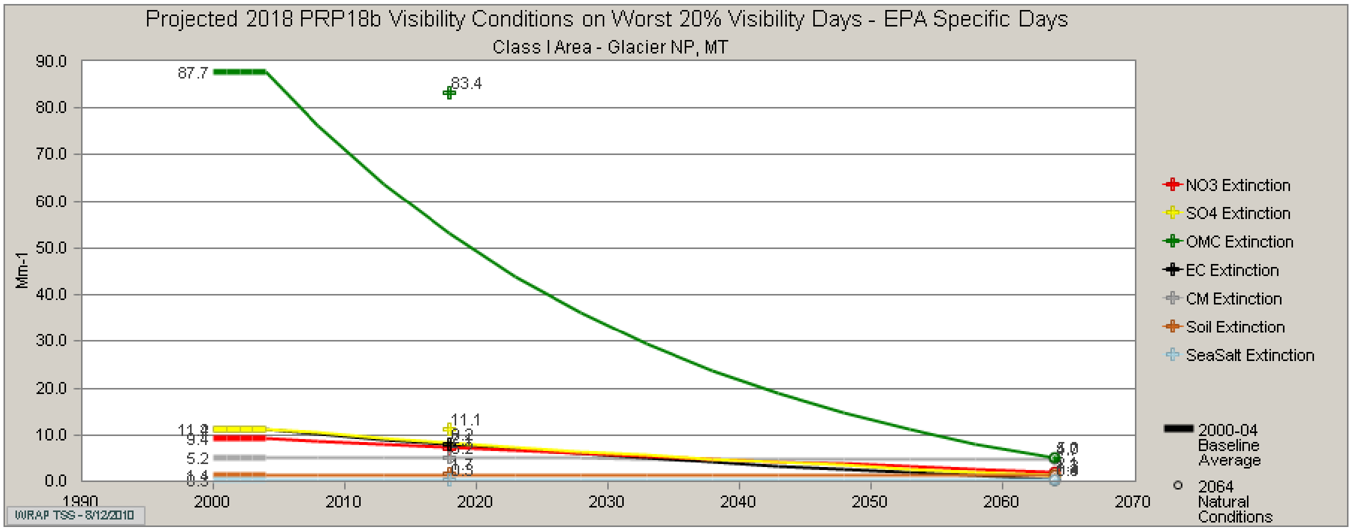
	Yellowstone National Park				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	4.26	3.35	0.76	3.71	60.44%
Ammonium Nitrate	1.77	1.5	0.63	1.36	151.85%
Organic Carbon	13.48	11.02	4.61	12.87	24.80%
Elemental Carbon	2.48	1.97	0.43	2.2	54.90%
Fine Soil	0.95	0.97	1.02	1.04	450.00%
Coarse Material[3]	2.58	2.67	2.99	Not Applicable	
Sea Salt[3]	0.02	0.02	0.03		

. MM-1 – inverse megameters

Figure 9-173 CMAQ Pollutant Projections 20% Worst Days at Yellowstone National Park

9.4.6 CMAQ-Projected Visibility on 20% Worst Days at Glacier National Park

The CMAQ analysis for Glacier National Park on the 20% worst days show large improvements in nitrate are expected; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-174 shows expected improvements in nitrate visibility impairment that surpass the URP in Glacier National Park.



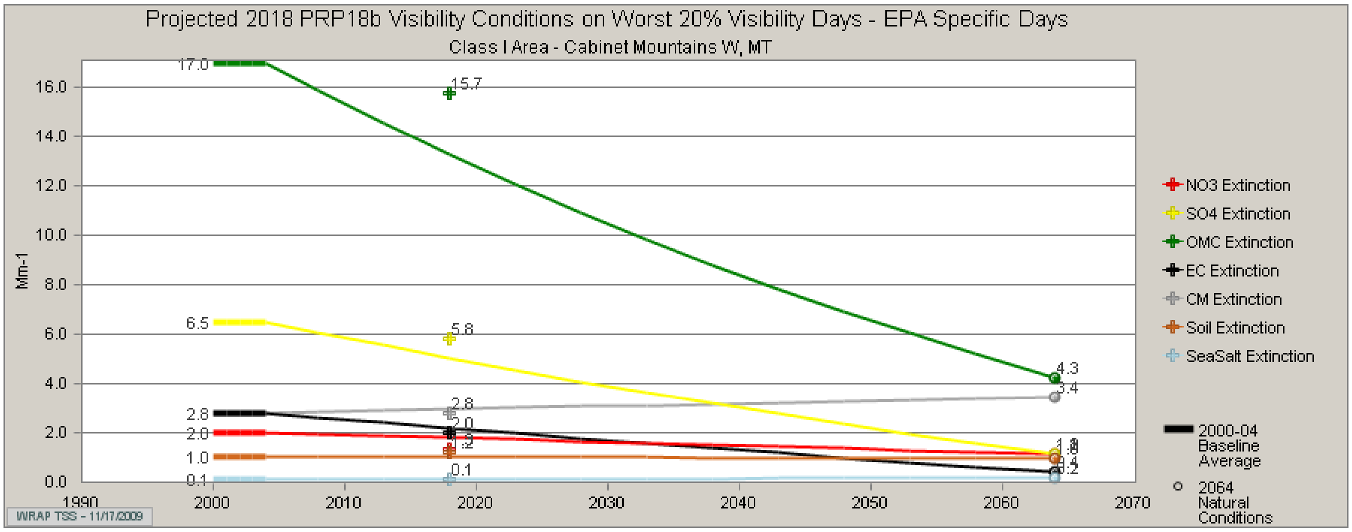
	Glacier Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	11.37	8.41	1.29	11.09	9.46%
Ammonium Nitrate	9.36	7.34	2.07	7.1	111.88%
Organic Carbon	87.68	53.08	4.99	83.36	12.49%
Elemental Carbon	11.2	7.95	0.39	8.16	93.54%
Fine Soil	1.4	1.38	1.32	1.74	*%
Coarse Material[3]	5.22	5.08	4.65	Not Applicable	
Sea Salt[3]	0.28	0.28	0.27		

1. MM-1 – inverse megameters

Figure 9-174 CMAQ Pollutant Projections 20% Worst Days at Glacier

9.4.7 CMAQ-Projected Visibility on 20% Worst Days at Cabinet Mountain Wilderness

Figure 9-175 shows expected results similar to Idaho's other Class I areas. Nitrate and elemental carbon are expected to meet the URP. Natural fire is expected to prevent sulfate and organic carbon from reaching the URP in the Cabinet Mountain Wilderness.



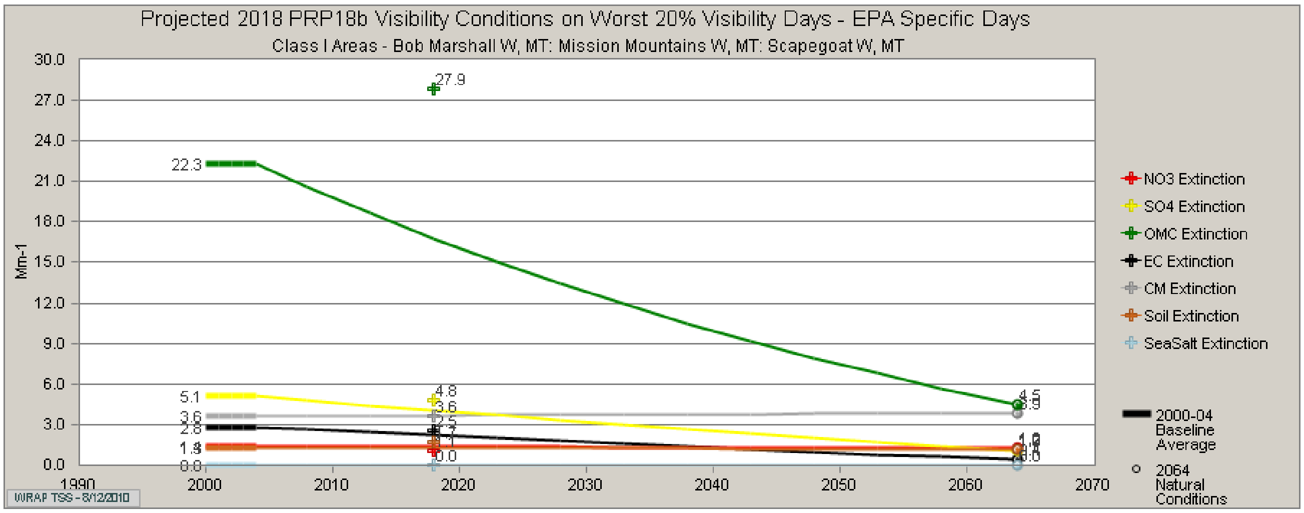
	Cabinet Mountain Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Variance from 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	6.48	5.03	1.12	5.81	46.21%
Ammonium Nitrate	2.02	1.81	1.15	1.31	338.10%
Organic Carbon	16.95	13.22	4.25	15.73	32.71%
Elemental Carbon	2.79	2.19	0.4	2	131.67%
Fine Soil	1.03	1.01	0.97	1.18	-750.00%
Coarse Material[3]	2.81	2.95	3.43	Not Applicable	
Sea Salt[3]	0.1	0.12	0.2		

1. MM-1 – inverse megameters

Figure 9-175 CMAQ Pollutant Projections 20% Worst Days at Cabinet Mountain Wilderness

9.4.8 CMAQ-Projected Visibility on 20% Worst Days at Bob Marshall Wilderness, Mission Mountain Wilderness, Scapegoat Wilderness

The CMAQ analysis for Bob Marshall Wilderness on the 20% worst days shows expected improvements in nitrate and sulfate; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-176 shows expected improvements in nitrate visibility impairment that surpass the URP in Bob Marshall Wilderness.



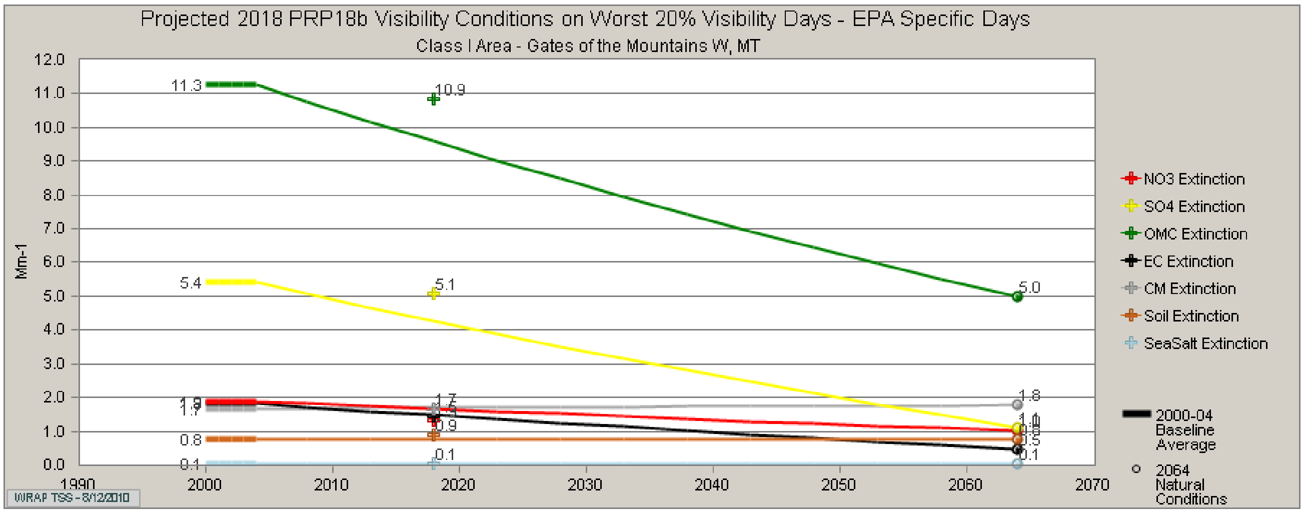
	Bob Marshall Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	5.12	4.05	1.04	4.84	26.17%
Ammonium Nitrate	1.43	1.38	1.23	1.06	740.00%
Organic Carbon	22.29	16.78	4.48	27.85	-100.91%
Elemental Carbon	2.8	2.19	0.39	2.53	44.26%
Fine Soil	1.29	1.27	1.19	1.71	-2100.00%
Coarse Material[3]	3.6	3.67	3.89	Not Applicable	
Sea Salt[3]	0.03	0.02	0.02		

1. M-1 – inverse megameters

Figure 9-176 CMAQ Pollutant Projections 20% Worst Days at Bob Marshall Wilderness

CMAQ-Projected Visibility on 20% Worst Days at Gates of the Mountains Wilderness

The CMAQ analysis for Gates of the Mountains Wilderness on the 20% worst days show expected improvements in nitrate and sulfate; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-177 shows expected improvements in nitrate visibility impairment that surpass the URP in Gates of the Mountain Wilderness.



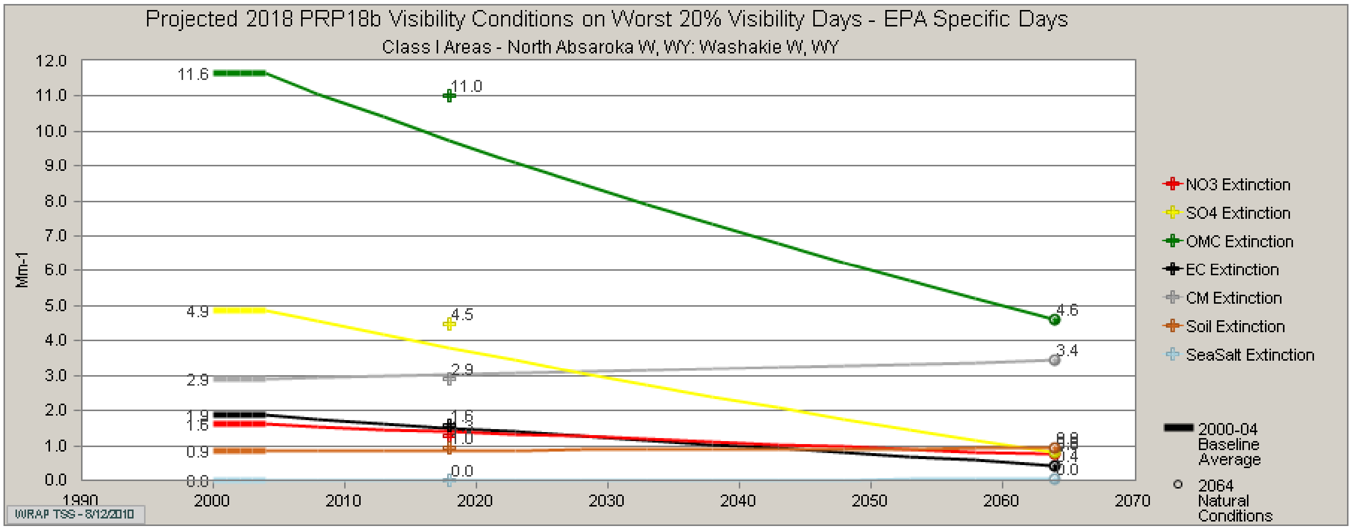
	Gates of the Mountains Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	5.41	4.28	1.12	5.1	27.43%
Ammonium Nitrate	1.88	1.67	1.01	1.34	257.14%
Organic Carbon	11.26	9.59	4.98	10.85	24.55%
Elemental Carbon	1.82	1.48	0.45	1.45	108.82%
Fine Soil	0.75	0.76	0.79	0.89	*%
Coarse Material[3]	1.68	1.7	1.78	Not Applicable	
Sea Salt[3]	0.06	0.06	0.65		

1. MM-1 – inverse megameters

Figure 9-177 CMAQ Pollutant Projections 20% Worst Days at Gates of the Mountains Wilderness

9.4.10 CMAQ-Projected Visibility on 20% Worst Days at North Absaroka Wilderness

The CMAQ analysis for North Absaroka Wilderness on the 20% worst days show expected improvements in nitrate and sulfate; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-178 shows expected improvements in nitrate visibility impairment that surpass the URP in Gates of the Mountain Wilderness.



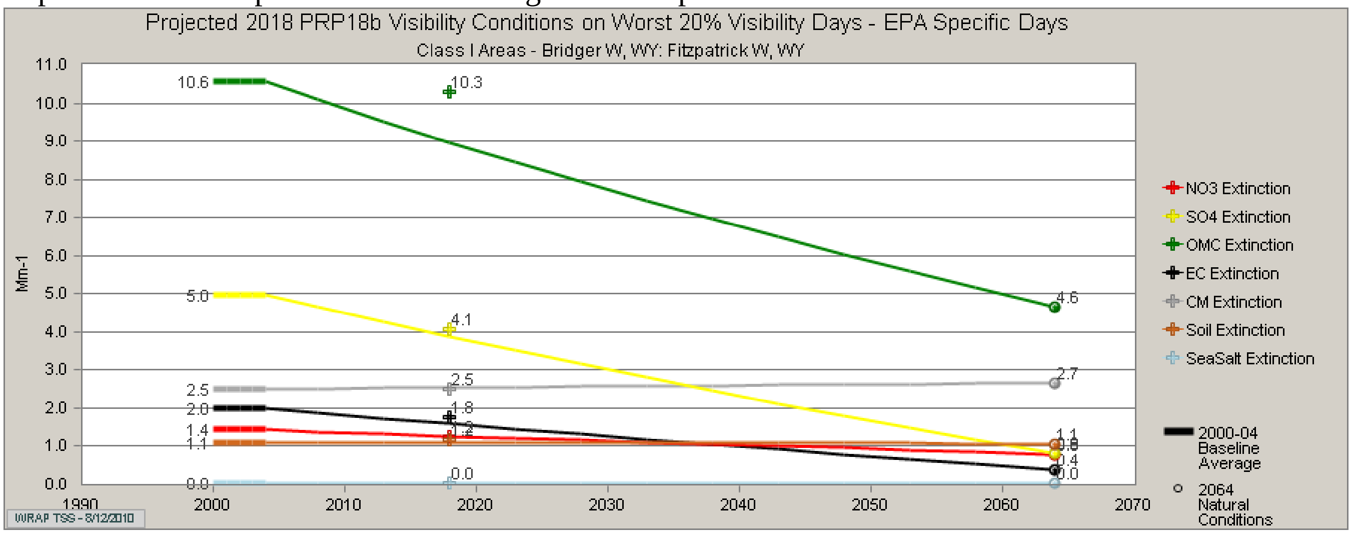
	North Absaroka Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	4.87	3.8	0.81	4.5	34.58%
Ammonium Nitrate	1.61	1.4	0.75	1.29	152.38%
Organic Carbon	11.64	9.75	4.62	11	33.86%
Elemental Carbon	1.86	1.51	0.44	1.59	77.14%
Fine Soil	0.85	0.86	0.92	0.95	*%
Coarse Material[3]	2.91	3.03	3.44	Not Applicable	
Sea Salt[3]	0.01	0.01	0.03		

2. MM-1 – inverse megameters

Figure 9-178 CMAQ Pollutant Projections 20% Worst Days at North Absaroka Wilderness

9.4.11 CMAQ-Projected Visibility on 20% Worst Days at Bridger Wilderness and Fitzpatrick Wilderness

The CMAQ analysis for Bridger Wilderness on the 20% worst days shows expected improvements in nitrate and sulfate; however, these may not translate into meeting the URP because of the contributions from outside the WRAP region and natural fire. Similar to other Class I areas, Figure 9-179 shows expected improvements in nitrate visibility impairment that surpass the URP in Bridger and Fitzpatrick Wildernesses.



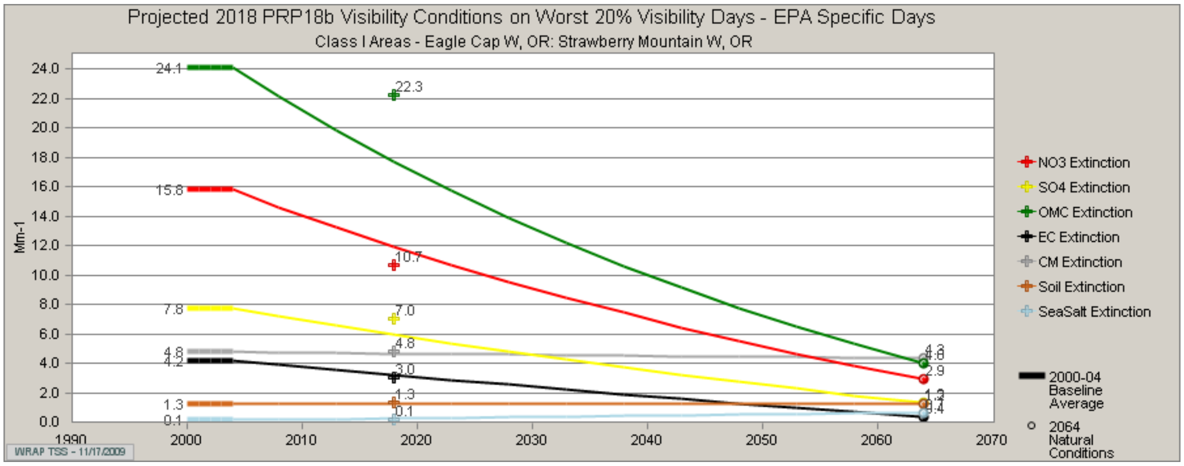
	Bridger Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	4.99	3.89	0.82	4.06	84.55%
Ammonium Nitrate	1.43	1.27	0.79	1.24	118.75%
Organic Carbon	10.55	8.98	4.64	10.31	15.29%
Elemental Carbon	1.99	1.59	0.39	1.77	55.00%
Fine Soil	1.1	1.1	1.07	1.19	*%
Coarse Material[3]	2.51	2.55	2.67	Not Applicable	
Sea Salt[3]	0.04	0.04	0.04		

3. MM-1 – inverse megameters

Figure 9-179 CMAQ Pollutant Projections 20% Worst Days at Bridger Wilderness

9.4.12 CMAQ-Projected Visibility on 20% Worst Days at Eagle Cap Wilderness and Strawberry Mountain Wilderness

Figure 9-180 shows expected results similar to Idaho's other Class I areas. Natural fire is expected to prevent sulfate, organic carbon, and elemental carbon from reaching the URP in the Eagle Cap Wilderness.



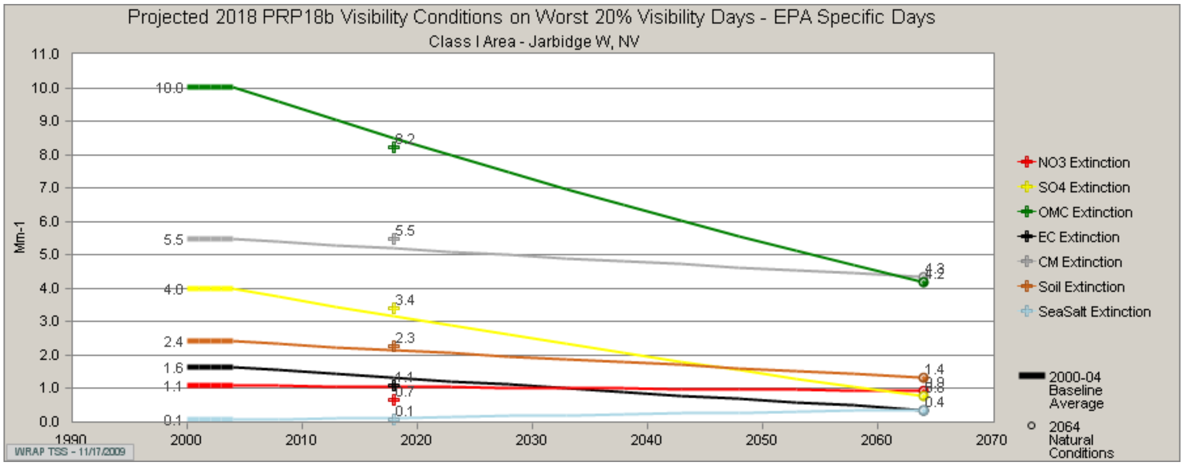
	Eagle Cap Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	5.12	4.05	1.04	4.84	26.17%
Ammonium Nitrate	1.43	1.38	1.23	1.06	740.00%
Organic Carbon	22.29	16.78	4.48	27.85	-100.91%
Elemental Carbon	2.8	2.19	0.39	2.53	44.26%
Fine Soil	1.29	1.27	1.19	1.71	-2100.00%
Coarse Material[3]	3.6	3.67	3.89	Not Applicable	
Sea Salt[3]	0.03	0.02	0.02		

1. MM-1 – inverse megaview

Figure 9-180 CMAQ Pollutant Projections 20% Worst Days at Eagle Cap Wilderness

9.4.13 CMAQ projected Visibility on 20% Worst Days at Jarbidge Wilderness

Figure 9-181 shows expected results similar to Idaho’s other Class I areas. Natural fire is expected to prevent sulfate, organic carbon, and elemental carbon from reaching the URP in the Jarbidge Wilderness.



	Jarbidge Wilderness				
Pollutant	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Percent of 2018 URP Goal
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	
Ammonium Sulfate	4	3.17	0.78	3.41	71.08%
Ammonium Nitrate	1.1	1.06	0.94	0.68	1050.00%
Organic Carbon	10.04	8.49	4.2	8.21	118.06%
Elemental Carbon	1.65	1.34	0.37	1.11	174.19%
Fine Soil	2.41	2.15	1.35	2.27	53.85%
Coarse Material[3]	5.47	5.2	4.34	Not Applicable	
Sea Salt[3]	0.06	0.13	0.37		

1. MM-1 – inverse megaview

Figure 9-181 CMAQ Pollutant Projections 20% Worst Days at Jarbidge Wilderness

Chapter 10. BEST AVAILABLE RETROFIT TECHNOLOGY (BART) EVALUATION

10.1 Description of Process for Determining BART in Idaho

10.1.1 History of BART Process

The 1977 Clean Air Act amendments created Part C of the act, entitled Prevention of Significant Deterioration of Air Quality, which includes Sections 160-169. The intent of the Prevention of Significant Deterioration (PSD) provisions is to maintain good air quality in areas that attain the national air quality standards and provide special protections for national parks and wilderness areas. Part C is divided into two subparts.

Subpart 1

Subpart 1 established the initial classification of Class I and Class II areas. Class I areas include:

> *"(1)International Parks,*
>
> *(2) national wilderness areas which exceed 5,000 acres in size,*
>
> *(3) national memorial parks which exceed 5,000 acres in size, and*
>
> *(4) national parks which exceed six thousand acres in size and which are in existence on the date of the enactment of the Clean Air Act Amendments of 1977 shall be class I areas and may not be redesignated….*
>
> *(b) All areas in such State designated … as attainment or unclassifiable which are not established as class I under subsection (a) shall be class II areas …"*

The Class I areas that met this criteria and were in existence in or before 1977 became known as "mandatory class I federal areas." Although states could designate other areas as Class I areas after 1977, PSD and other portions of the Regional Haze Rule focus on those Class I areas in existence in or before 1977.

Based on the classification of an area, the allowable amount of degradation caused by new or modified air pollution sources is determined. In national parks and other Class I areas, smaller amounts of degradation known as "increment" are allowed. The PSD program under Part C, Subpart 1 primarily focuses on emissions from 1977 forward and will be further discussed in the chapters on Reasonable Progress and Long Term Strategies.

Subpart 2

Visibility is called out much stronger in Subpart 2, which sets the following 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 manmade air pollution" (CAA Section 169(A). In an effort to remediate the existing impairments to visibility, Section 169(A)(2)(A) include "a requirement that each major stationary source which is in existence on the date of enactment of this section, but which has not been in operation for more than fifteen years as of such date, … emits any air pollutant which

may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area, shall procure, install and operate, as expeditiously as practicable (and maintain thereafter) the Best Available Retrofit Technology (BART), as determined by the state."

To carry out Congress's intent to have BART installed on certain emission sources, EPA promulgated the "Regional Haze Rule" [64 FR 35714 (July 1, 1999)]. The rule was challenged and on May 24, 2002, the U.S. Court of Appeals for the District of Columbia vacated the Regional Haze Rule and remanded the BART provisions in the Rule. Revisions to the rule were published on July 6, 2005 [70 FR 39104 (July 6, 2005)]. The BART rule can also be found under 40 CFR 51.308(e). As part of the July 6, 2005, rule revisions, EPA published Appendix Y guidance for the implementation of BART, which is typically Appendix Y. The Appendix Y guidance can be found beginning at 70 FR 39156 (July 6, 2005).

10.1.2 Summary of BART Process

BART-eligible

The BART provision applies to "major stationary sources" from 26 identified source categories which have the potential to emit 250 tons per year or more of any visibility impairing pollutant. As amended, the Clean Air Act (CAA) requires only sources which were built or in operation during a specific 15-year time interval to be subject to BART. The BART provision applies to sources that existed as of August 7, 1977, and extended back 15 years to August 7, 1962. The first phase of the BART process is the development of a list of "BART-eligible" facilities that identifies those major facilities from the 26 identified source categories that have a potential to emit 250 tons per year of any light-impairing pollutant and were in operation during that period.

Subject to BART

The CAA requires BART review when any source meeting the above description "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in any Class I area. In most cases, the determination of whether a facility is causing or contributing to visibility impairment is based on modeling, using the following threshold values: Any BART-eligible facility with an impact of 1 deciview is considered to be "causing" visibility impairment; anyBART-eligible facility with an impact of 0.5 deciview is considered to be "contributing" to visibility impairment. Any BART-eligible facility causing or contributing to visibility impairment is considered a source that is "subject" to BART."

For each source that is subject to BART, 40 CFR 308(e)(1)(ii)(A) requires that States identify the level of control representing BART after considering the factors set out in CAA section 169A(g), as follows:

> *"States must identify the best system of continuous emission control technology for each source subject to BART taking into account the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of visibility improvement that may be expected from available control technology."*

Idaho followed the Appendix Y guidance in the determination phase of the BART as described above. As with all states, the control technologies that were determined appropriate and technically feasible during the BART determination for Idaho sources are required to be installed no later than five years after the regional haze SIPs are approved by EPA.

Idaho has satisfied the BART requirements in the Regional Haze Rule. The following sections lists which facilities were identified as BART-eligible sources; facilities are subject to BART including the modeling procedures. and the determination process to identify emissions control technologies that satisfy BART.

10.2 Idaho BART-Eligible Sources

The three steps in determining if a major facility is a BART-eligible source are:
1) determine if it is in one of 26 predetermined categories, 2) determine when it was built, and 3) determine the amount of pollution emitted (known as the "potential to emit" [PTE]). Idaho followed EPA's Appendix Y Guidance under the Regional Haze Rule to identify BART-eligible sources.

Step 1

Is the facility or any unit at the facility in one of the following 26 categories?

(1) Fossil-fuel fired steam electric plants of more than 250 million British thermal units (MMBtu) per hour heat input,

(2) Coal cleaning plants (thermal dryers),

(3) Kraft pulp mills,

(4) Portland cement plants,

(5) Primary zinc smelters,

(6) Iron and steel mill plants,

(7) Primary aluminum ore reduction plants,

(8) Primary copper smelters,

(9) Municipal incinerators capable of incinerating more than 250 tons of refuse per day,

(10) Hydrofluoric, sulfuric, and nitric acid plants,

(11) Petroleum refineries,

(12) Lime plants,

(13) Phosphate rock processing plants,

(14) Coke oven batteries,

(15) Sulfur recovery plants,

(16) Carbon black plants (furnace process),

(17) Primary lead smelters,

(18) Fuel conversion plants,

(19) Sintering plants,

(20) Secondary metal production facilities,

(21) Chemical process plants,

(22) Fossil-fuel boilers of more than 250 MMBtu per hour heat input,

(23) Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels,

(24) Taconite ore processing facilities,

(25) Glass fiber processing plants, and

(26) Charcoal production facilities.

Step 2

Determine whether the unit or source was "in existence" on August 7, 1977 but not "in operation" before August 7, 1962, according to the following definitions.

- "In existence": "the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or(2) entered into binding agreements or contractual obligations , which cannot be canceled or modified without substantial loss to the owner or operator …"
- "In operation": "engaged in activity related to the primary design function of the source."

Step 3

Determine whether the total emissions represent a current potential to emit that is greater than 250 tons per year of any single visibility-impairing pollutant. Fugitive emissions, to the extent quantifiable, must be counted.

Visibility impairing pollutants include the following:

(1) Sulfur dioxide (SO_2),

(2) Nitrogen oxides (NO_x), and

(3) Particulate matter.

As directed in Appendix Y, judgment should be used to determine whether the following pollutants impair visibility

(4) Volatile organic compounds (VOC), and

(5) Ammonia and ammonia compounds.

If a facility has a combined total of potential to emit 250 tons of any one of the above visibility impairing pollutants, it is BART-eligible. If a facility or unit is BART-eligible under one pollutant(emits 250tpy), the other pollutants it emits are also included even though the other pollutants emissions may be less that 250 tons per year.

Sources likely to be subject to BART

In an effort to be consistent with other WRAP states, Idaho participated in a study conducted by Eastern Research Group (ERG) to identify BART-eligible sources and units. The study identified 46 possible BART-eligible sources in Idaho which were refined to six sources confirmed, one potential and four facilities with several unknowns to be answered (See table 10-1).

Company Name	Category	Date	Date Eligible?	Size (PTE) Eligible?
TASCO (Amalgamated Sugar), Twin Falls	BART 12	1973	Y	Y
J. R. Simplot Company Don Siding Complex	BART 13	1966, 1965-1974, 1976, 1977, 1986	Y	Y
Nu West Industries	BART 13	1974	Y	Y
TASCO (Amalgamated Sugar), Nampa	BART 12		Y	Y
TASCO (Amalgamated Sugar), Paul	BART 12		Y	Y
Evergreen Forests & Tamarack Energy Partnership	BART 01	1983	M	D
Ash Grove Cement Co.	BART 04	Pre-1997.	D	D
Lignetics of Idaho	BART 18		D	D
P4 Production LLC	BART 13		D	D
Potlatch Corp - Potlatch Idaho	BART 03, BART 22	1950, 1977, 1981, and 1991	D	D
Sinclair Oil Corp	BART 23		D	D

Table 10-1 BART-Eligible Source Determinationss (ERG List)*

* Y – Yes, M – Maybe, D- Do not Know, N-NO

DEQ engineers requested additional information from the 11 likely sources to confirm dates of operation and emissions amounts. Evergreen/Tamarack Energy, Lignetics of Idaho, and Sinclair Oil were removed from the list because their potential to emit (PTE) was less than 250 tons per year for any single BART eligible pollutant. Ash Grove Cement was removed from the eligible list because the plant was built before 1952 and therefore pre-dates the BART requirements.

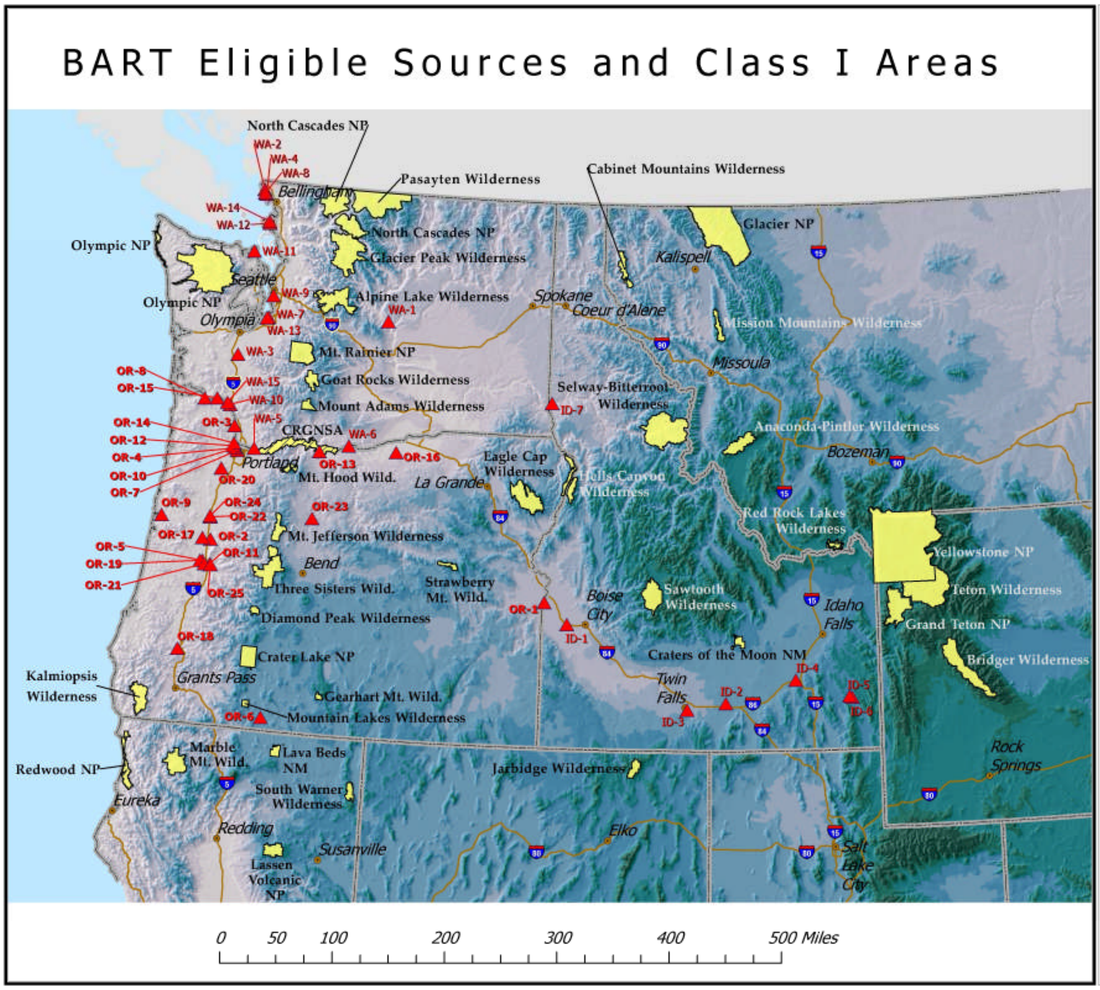
The final list was reduced to seven BART-eligible sources, which are: Amalgamated Sugar Company in Rupert, in Twin Falls, and in Nampa, Potlatch Corporation, Nu West/Agrium, Monsanto/P4 Production, and Simplot Don Plant (Don Siding Complex). The table below lists the BART-eligible sources and pollutants.

Table 10-2 List of BART Eligible Sources

Company Name	BART Units (Year in Operation)	Tons per year		
		NOx	SOx	PM
Amalgamated Sugar (Nampa)	Riley Boiler (1969)	1,708	2,770	55
Amalgamated Sugar (Paul)	Erie City Boiler (1964)	1,314	1,051	272
Amalgamated Sugar (Twin Falls)	Foster Wheeler Boiler (1973)	962	1,648	138
Nu West/ Agrium	East Sulfuric Acid Plant (1973)		945	
J. R. Simplot Don Plant	Granulation No 2 (1964), East Cooling Tower (1966), West Cooling Tower(1976), Ammonium (1964) Sulfate ID1, ? Ammonia Plant ID1 (1964)	7.4		842.4
Monsanto/P4 Production LLC	No. 5 Kiln (1965) No. 9 Furnace and flare(1960)	1,625	1,230	51
Potlatch Pulp & Paper	No 4. Recovery Furnace (1970), No 4. Smelt Dissolving Tank (1970), No. 4 Lime Kiln (1976)	237	821	289

The seven BART-eligible sources are located throughout Idaho. Figure 10-1 displays the locations of BART-eligible sources throughout the Northwest.

Figure 10-1 BART Eligible Sources in Idaho and Washington



10.3 Sources Subject to BART

A source is *subject to BART* if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Appendix Y guidance (Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51), a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews* (delta-deciview) is equal to or greater than a contribution threshold of 0.5 deciviews. Although the Appendix Y guidance does provide for thresholds less than 0.5 deciviews and cumulative impacts, it was determined through negotiated rulemaking with industry, federal land management agencies, DEQ, and the public that the "contribute" threshold for a single source would be established at 0.5 deciviews. (See IDAPA 58.01.01.668.02.b.) As suggested in the Appendix Y guidance, the determination was made by modeling.

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5-deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol13*, which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision. Refer to the *BART Modeling Protocol* for details on the modeling methodology used in this subject-to-BART analysis (see Appendix F).

Idaho DEQ, in cooperation with Washington State of Ecology and Oregon Department of Environmental Quality, contracted with Geomatrix Consultants to develop CALMET datasets to use for the CALPUFF BART modeling. The CALMET datasets were based on runs of the Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) performed at Washington University. There were two CALMET datasets produced, one using 12-kilometer (km) mesh size and another using 4-km mesh size14 (See Appendix F).

As part of the contract, Geomatrix Consultants ran MESTAT (meteorology model) to quantify the quality of the MM5 files used as the meteorological dataset in CALMET, which was used in the CALPUFF modeling. MESOSTAT pairs the MM5 forecasted data with meteorological observations and then performs various statistical manipulations and aggregates the results for output15 (see Appendix F).

Subject-to-BART analysis results with the two threshold values:

- 8th highest value for each of the years modeled (2003-2005; 365 days each), representing the 98th percentile (8/365 = 0.02) cutoff for delta-deciview in the each year.

1. 22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 days = 0.02) cutoff for delta-deciview over three years.

10.3.1 Pollutants to Consider

The Appendix Y guidance specifies that sulfur dioxide (SO_2), oxides of nitrogen (NOx), and direct particulate matter (PM) emissions, including both PM_{10} and $PM_{2.5}$, should be included for BART exemption and BART determination modeling analyses.

The Appendix Y guidance also discusses the inclusion of volatile organic compounds (VOCs), and ammonia and ammonia compounds, and suggests the pollutants be included if it is determined that they are reasonably anticipated to cause or contribute to visibility impairment. During the development of the Modeling Protocol, Idaho and Oregon

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13 *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.*
http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

14 *Modeling Protocol for BART CALMET datasets, Idaho Oregon and Washington,*Geomatrix Consultants Inc., July 12, 2006

15 *INITIAL METSTAT REPORT CALMET Fields for BART Idaho, Oregon and Washington,* Geomatrix Consultants

determined that they have no significant sources of VOC, ammonia, or ammonia compounds that require a full BART exemption analysis.

10.3.2 Emissions and Facility Parameters

The Appendix Y guidance states, *"the emission estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization."* These emissions estimates should not generally include start-up, shutdown, or malfunction conditions. The Appendix Y guidance recommends that states use the 24-hour average actual emission rate from the highest-emitting day of the meteorological period modeled. The meteorological period is 2003 – 2005.

Throughout 2006, DEQ worked with BART-eligible sources to identify the maximum 24-hour emissions and facility parameters such as stack heights, stack velocities, and temperatures. This information was refined and used in the subject-to-BART modeling. A separate "Subject-to-BART Analysis" was developed for each of the BART-eligible facilities (See Appendix F). The analysis shows all but Amalgamated Sugar's (TASCO's) Nampa facility were exempt from BART with a threshold of less than 0.5 deciviews. For each of the BART-eligible facilities, the following tables show the subject-to-BART modeling results for the Class I areas within 300 kilometers.

Table 10-3 Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the TASCO Riley Boiler, Nampa.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.161	2	0.224	2	0.153	0	0.196	2
Eagle Cap Wilderness, OR	0.87	20	1.355	46	1.302	46	1.325	112
Hells Canyon Wilderness, ID-OR	0.772	13	1.031	27	0.9	21	0.936	61
Jarbidge Wilderness, NV	0.151	0	0.198	1	0.201	1	0.179	2
Sawtooth Wilderness, ID	0.239	2	0.294	4	0.265	0	0.271	6
Selway-Bitterroot Wilderness, ID and MT	0.186	0	0.305	1	0.264	2	0.243	3
Strawberry Mountain Wilderness, OR	0.782	12	0.639	13	1.596	31	0.943	56

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Table 10-4. Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the TASCO Erie City Boiler, Paul, Idaho.

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value greater than 0.5 from one year period						Delta-Deciview Value greater than 0.5 from 3 year period	
	2003		2004		2005			
Class I Area	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003, 2004, 2005)
Yellowstone NP, WY	0.079	1	0.087	0	0.1	0	0.086	1
Red Rock Lakes, MT	0.073	0	0.088	0	0.08	0	0.081	0
Sawtooth, ID	0.046	0	0.045	0	0.063	0	0.053	0
Teton Wilderness, WY	0.051	0	0.053	0	0.067	0	0.056	0
Jarbidge Wilderness, NV	0.05	0	0.061	0	0.071	0	0.061	0
Yellowstone NP, WY	0.079	1	0.087	0	0.117	0	0.086	1
Craters of the Moon, ID	0.398	4	0.412	3	0.324	4	0.380	11

Table 10-5. . Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
Class I Area	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003,2004,2005)
Great Teton NP, WY	0.076	0	0.073	0	0.085	0	0.073	0
Red Rock Lakes, MT	0.072	0	0.072	0	0.066	0	0.072	0
Sawtooth Wilderness, ID	0.033	0	0.061	0	0.05	0	0.047	0
Jarbidge Wilderness, NV	0.107	0	0.152	2	0.101	0	0.124	2
Craters of the Moon, ID	0.211	0	0.381	3	0.256	1	0.270	4

Table 10-6. . Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the Nu-West East Sulfuric Acid Plant.

Source Name: ID6, Nu-West East Sulfuric Acid Plant								
Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003-2005)
Sawtooth Wilderness, ID	0.012	0	0.029	0	0.035	0	0.027	0
Red Rock Lakes Wilderness, MT	0.051	0	0.069	0	0.059	0	0.057	0
North Absaroka Wilderness, WY	0.024	0	0.038	0	0.044	0	0.038	0
Craters of the Moon Wilderness, ID	0.048	0	0.056	0	0.08	0	0.073	0
Bridger Wilderness, WY	0.046	0	0.044	0	0.051	0	0.049	0
Fitzpatrick Wilderness	0.032	0	0.022	0	0.038	0	0.032	0
Grand Teton National Park, WY	0.099	0	0.114	0	0.126	0	0.120	0
Teton Wilderness, WY	0.057	0	0.072	0	0.073	0	0.069	0
Washakie Wilderness, WY	0.026	0	0.041	0	0.045	0	0.038	0
Yellowstone National Park, WY	0.062	0	0.102	0	0.11	0	0.101	0

Table 10-7. . Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the J.R. Simplot Pocatello facility, Idaho.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days
Bridger Wilderness, WY	0.048	0	0.033	0	0.041	0	0.041	0
Craters of the Moon, ID	0.237	0	0.376	4	0.244	0	0.278	4
Fitzpatrick Wilderness	0.036	0	0.027	0	0.03	0	0.031	0
Grand Teton NP, WY	0.121	0	0.084	0	0.101	0	0.105	0
Jarbidge Wilderness, NV	0.026	0	0.015	0	0.039	0	0.028	0
North Absaroka Wilderness, WY	0.035	0	0.025	0	0.034	0	0.033	0
Red Rock Lakes, MT	0.11	0	0.11	0	0.107	0	0.11	0
Sawtooth, ID	0.024	0	0.038	0	0.039	0	0.038	0
Teton Wilderness, WY	0.06	0	0.055	0	0.063	0	0.06	0
Washakie Wilderness, WY	0.038	0	0.031	0	0.038	0	0.037	0
Yellowstone NP, WY	0.117	0	0.106	0	0.139	0	0.116	0

Table 10-8. . Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho.

Source Name: ID7 Potlatch, ID								
Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days
Alpine Lakes Wilderness, WA	0.115	0	0.176	0	0.166	0	0.159	0
Anaconda-Pintler Wilderness, WY	0.058	0	0.057	0	0.051	0	0.057	0
Bob Marshall Wilderness, MT	0.056	0	0.065	0	0.049	0	0.057	0
Cabinet Mountains Wilderness, MT	0.101	0	0.137	0	0.1	0	0.109	0
Eagle Cap, OR	0.14	0	0.17	1	0.209	0	0.171	1
Hells Canyon, ID	0.31	2	0.323	5	0.213	1	0.292	8
Mission Mountain Wilderness, MT	0.08	0	0.08	0	0.056	0	0.078	0
Saw Tooth, ID	0.023	0	0.033	0	0.028	0	0.028	0
Scapegoat Wilderness, MT	0.036	0	0.056	0	0.039	0	0.044	0
Selway-Bitterroot, ID-MT	0.196	0	0.224	1	0.173	1	0.207	2
Strawberry Mountain, OR	0.064	0	0.055	0	0.1	0	0.07	0

Monsanto/P4 Production (P4 Production) did not go through the subject-to-BART determination process because the facility had recently undertaken a Best Available Control Technology (BACT) analysis and it was believed the “Best” BART control technologies had been installed during this process. DEQ and P4 agreed to move directly to the BART determination process.

All of the Idaho BART-eligible facilities were exempted from the BART determination process because they were below the 0.5 deciview threshold with the exceptions of TASCO Nampa and P4 Production.

10.4 BART Control Determination Process

The third phase of the BART process is the determination of technically feasible control technologies. The Clean Air Act defines five factors in making this determination. They include:

- The cost of compliance,
- The energy and non-air quality environmental impacts of compliance,
- Any existing pollution control technology in use at the source,
- The remaining useful life of the source, and
- The degree of visibility improvement which may reasonably be anticipated from the use of BART.

To make the BART determination, DEQ asked TASCO and P4 Production to follow the Appendix Y guidance for the implementation of BART as found at 70 FR 39156 (July 6, 2005). Although use of this guidance was required for electrical generation units (EGUs), EPA has determined there is no reason the guidance cannot be used for other BART categories.

The five BART determination steps described in the Appendix Y guidance can be summarized as follows:

Step 1 – Identify all available retrofit emissions control techniques (three categories)

- Pollution prevention (use of inherently lower-emitting processes/practices)
- Use of (and where already in place, improvement in the performance of) add-on controls
- Combination of pollution prevention and add-on controls

Step 2 – Determine technically feasible options – those that are

- Available (commercial availability)
- Applicable (Has it been used on the same or a similar source type?)

Step 3 – Evaluate technically feasible options

- Express the degree of control using a metric that ensures an "apples to apples" comparison of emissions performance levels among options; one example would be to evaluate all options in terms of pound of sulfur dioxide per million British thermal units (lb SO_2/MMBtu).
- Give appropriate treatment and consideration of control techniques that can operate over a wide range of emissions performance levels (evaluate the most stringent control level that the technology is capable of achieving plus other scenarios).

Step 4 – Impact analysis

- Cost of compliance (Identify emissions units and design parameters, and develop cost estimates.)
  - The baseline emissions rate should represent a realistic depiction of anticipated annual emissions from the source. In general, for the existing sources that are subject to BART, estimate the anticipated annual emissions based upon actual emissions from a baseline period.
- Energy impacts
  - Include only the direct energy consumption for the control device, not indirect energy impacts
- Non-air quality environmental impacts
  - Include solid or hazardous waste generation or discharges of polluted water from a control device
- Remaining useful life
  - Can be included in the cost analysis

Step 5 – Determine visibility impacts (improvements projected by modeling)

- Run the model at pre-control and post-control emissions rates
  - Pre-control emissions rates = max 24-hour used in subject-to-BART modeling
  - Post-control emissions rates = % of pre-control rates (e.g., if the technology has 95% control efficiency, the post-control emissions rate equals 95% of pre-control rate)
  - Calculate results for each receptor as the change in deciviews compared against natural visibility
- Determine net visibility improvement
  - Consider frequency, magnitude, and duration components of impairment
  - Can compare 98th percent days

10.5 TASCO BART Determination

After numerous consultations between DEQ and TASCO concerning emissions rates, facility parameters, and the BART process, TASCO submitted a "Best Available Retrofit Technology Determination – Riley Boiler" on November 20, 2007. After reviewing TASCO's proposed determination, DEQ requested that TASCO revise it to include some additional control technologies that DEQ considered technically feasible, evaluate them using the five steps listed above, and provide additional cost and financial detail. TASCO revised their proposed determination and resubmitted the information on February 6, 2009 (This document is included in Appendix F). As part of the revisions, DEQ performed the CALPUFF modeling to identify changes in visibility based on the emissions estimates and facility parameters provided by TASCO for each of the technically feasible control technologies for each pollutant identified as requiring BART determination.

The TASCO BART determination involves only the Riley Boiler at the TASCO facility in Nampa, Idaho. The other units at TASCO were not constructed or started production within the BART eligible time frame.

Throughout the BART determination process, TASCO has claimed financial hardship and the inability to pay for BART controls. DEQ relied upon an EPA Region X economist to provide the technical expertise in reviewing TASCO's claims and the supporting documentation. The economist's executive summary can be found in Appendix F.

10.5.1 TASCO NO_x Controls

In 2006, TASCO installed a new pulp steam dryer system which better utilized current steam production and allowed several old pulp dryers to shut down. The pulp drying typically occurs during the fall and winter months, which is when TASCO's emissions have the greatest impact on the 20% worst days. Table 10-9 is a summary of the emission reductions attributed to the shutdown of the old pulp dryers.

Table 10-9 Pollution Reductions from Shutdown of Old Pulp Dryers

Pollutant	Maximum Hourly (lbs/hr)	Average Annual (tons/year)
Particulate Matter (PM)	98.1	113
SO_2	17.8	20.6
NO_x	191	221

There are no incremental costs associated with the shutdown of the old pulp dryers since they were installed in 2006 and actually save the company money. As part of the determination of impact and visibility improvements TASCO requested that DEQ consider the visibility improvements associated with shutting down the old pulp dryers and determine that the emissions reductions resulting from using the new steam dryers instead could be accepted as an alternative to BART.

As part of the BART determination modeling, DEQ ran the model with and without emissions from the old pulp dryers and compared the visibility to determine the amount of improvement expected. Since some of the old pulp dryers have been shut down since 2006, the modeling scenario for establishing the baseline included the reductions from shutting

them down. For each control scenario, plant-specific parameters were taken into consideration. The different control scenarios include changes in stack flow and temperatures. Table 10-10 depicts the modeled visibility changes for several scenarios with different combinations of technically feasible NOx controls and the shutdown of the old pulp dryers, and the costs associated with each scenario. The highest impacts from TASCO occur at Eagle Cap Wilderness. Although Eagle Cap Wilderness is outside of Idaho, the regional haze rule requires the state to address impacts in other states.

Table 10-10. NO_x Visibility Improvements Expected from BART at TASCO Nampa

Eagle Cap Wilderness, OR	Change in Visibility Compared Against 20% Best Days Natural Background Conditions									
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period		Change in Visibility	Incremental Cost
	2003		2004		2005		2003-2005		2003-2005	($/ton)
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days[d] (2003-2005)		
Baseline Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzl10469)	0.956	23	1.454	49	1.388	55	1.399	127	0.000	
Baseline Riley Boiler Scenario (wzl10471)	0.721	15	1.086	41	1.109	41	1.086	97	0.313	$0
NOx Control Scenario 1 – LNB* (wzl10472)	0.511	11	0.822	29	0.871	29	0.816	69	0.270	$0
NOx Control Scenario 2 – LNB w/ OFA* (wzl10473)	0.454	7	0.743	24	0.803	25	0.736	56	0.350	$2,431
NOx Control Scenario 3 – SCR* (wzl10474)	0.383	6	0.625	16	0.653	18	0.613	40	0.473	$10,245

LNB – Low NOx burners; LNB w/ OFA -- Low NOx burners with Over-Fire Air; SCR – selective catalytic reduction

Looking at projected changes in visibility improvements, the shutdown of the old pulp dryers has provided more visibility improvement than low NO_x burners (LNB) would and nearly the improvement that would be expected from LNB with over-fire-air (LNB w/ OFA). The largest expected improvement in visibility attributed to NO_x controls would come from selective catalytic reduction (SCR). However, the incremental cost of $10,000 per ton for the additional 15% removal efficiency is relatively high. An option for TASCO would be to accept permanent permit limits that account for the shutdown of all the old pulp dryers and installation of LNB w/OFA.

10.5.2 TASCO SO_x Controls

Options among potential controls for SO_x were not as clear-cut. As part of the impact analysis, non-air quality environmental concerns msut be taken into consideration, as directed in the Appendix Y guidance. Wet flue gas desulfurization (FGD) has a 15% greater efficiency for removal of SO_x compared with the next most-efficient SOx removal control technology, which is spray-dry FGD. However, using wet FGD has the potential to reverse the current trend of improvements in ground water quality due to TASCO land-applying some of their wastewater, and the need to avoid this reversal outweighs the environmental benefits that could be expected with wet FGD. TASCO is currently sending

pretreated wastewater to the City of Nampa (in addition to land-applying a different portion of their wastewater). There is a high likelihood that an increase in TASCO's wastewater stream would be greater than the city can currently handle. This would more than likely lead to TASCO requesting an increase in the amount of wastewater they are permitted to land-apply, which would have a negative impact on ground water quality. For these reasons, DEQ has not included wet FGD in the control options considered even though the technology is technically feasible for improvements in air quality and visibility.

10.5.3 TASCO Particulate Matter Controls

For particulate matter (PM) controls, it was determined that the current baghouse (particulate filtration system) at TASCO provides the same emissions reductions as all other technically feasible control technologies. Therefore, it was determined the current baghouse is the "best" BART control technology.

10.5.4 TASCO BART Determination Conclusion

DEQ recommends the following BART controls for TASCO Nampa.

- *NOx controls*. TASCO has two options for NO_x controls. It can install SCR on the Riley Boiler or install LNB w/ OFA and accept permanent permit limits that account for shutting down all the old pulp dryers.
- *SOx controls.* Although wet FGD has the promise of providing greater emissions reductions than spray-dry FGD, the benefits of wet FGD are outweighed by the likelihood of requiring additional land application of wastewater.
- *Particulate matter controls*. The current baghouse provides the same emissions reductions as other options would, at no additional expense.

All together, DEQ recommends a combination of retaining the current baghouse, adding low NOx burners with over-fire-air (plus permit limits reflecting shut down of all pulp dryers), and adding spray-dry FGD as the "best" of BART technologies for TASCO Nampa. Below is a summary table showing the visibility improvements expected from the "best" of BART control technologies identified in this determination and recommended by DEQ. It should be noted the Base Riley Boiler scenario includes the current baghouse and pulp dryer shutdown.

Based on the "best" BART controls recommended by DEQ (current baghouse, LNB w/ OFA, spray-dry FGD), Table 10-11 shows visibility improvements expected at Eagle Cap Wilderness (the Class I area with the greatest impact from TASCO Nampa emissions).

TASCO Nampa BART permits can be found on the DEQ website at the following locations:

http://www.deq.idaho.gov/air/permits_forms/t2_final/amalgamated_sugar_nampa_t2_0910_statement.pdf

http://www.deq.idaho.gov/air/permits_forms/t2_final/amalgamated_sugar_nampa_t2_0910_permit.pdf

Table 10-11 Visibility Improvement – TASCO Nampa Best BART Alternatives

Eagle Cap Wilderness, Oregon	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-deciview value larger than 0.5 from one year period						Delta-deciview value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Baseline Riley Boiler* Scenario (wzi10471)	0.721	15	1.086	41	1.109	41	1.086	97
Baseline Riley Boiler Plus Pulp Dryer Full Operation Scenario** (wzi10469)	0.956	23	1.454	49	1.388	55	1.399	127
NO_x Scenario 2 + SO2 Scenario 4 (wzi10484)	0.228	1	0.319	1	0.330	1	0.319	3

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

The baseline Riley Boiler scenario includes operation of the current baghouse and shutdown of the old pulp dryers/

** This scenario does not include shutdown of the old pulp dryers

10.6 P4 Production BART determination

In September of 2006, DEQ began discussion with P4 Production, LLC (P4; formerly Monsanto/P4) regarding whether their facility was BART-eligible and what controls would be required if it was determined they were subject to BART. At the time, DEQ was reviewing a BACT permit application for P4 and it was believed the BACT controls were equivalent to the “best” of BART controls. To streamline the process, DEQ requested that P4 provide documentation showing that no other technically feasible emissions control systems had the potential to provide greater emissions reductions than those controls installed to meet BACT. A BART determination was still done.

The two emissions units identified in Table 10-12 were identified as fitting the BART-eligible time frames and emissions.

Table 10-12 P4 Potential BART-Eligible Emissions Units

P4 Production LLC				
Emission Units	Original Installation Date	Regional Haze Pollutant	2004 CEER Actual Emissions (typ)	Current Potential to Emit
#5 Rotary Kiln	1965	SO_2	12,252	626
		NO_x	1,625	2,721
		PM_{10}	38	89

# 9 Furnace and Flare	1966	SO_2	0.12	48
		NO_x	0.13	53
		PM_{10}	0.65	256

10.6.1 P4 NO_x Controls

P4 conducted and DEQ reviewed a search of EPA's RACT/BACT/LEAR[16] clearinghouse (RBLC) in an effort to identify BART control options for NO_x. P4's search identified selective non-catalytic reduction (SNCR) as the only potential NO_x control for rotary kilns as listed in the clearing house. Upon further investigation, it was determined the off gas temperatures of the #5 rotary kiln (#5 kiln) are too low for SNCR to function properly. Low NO_x burner (LNB) technology was also reviewed but it was determined the LNB burner temperatures are too low for P4's purposes.

The clearinghouse also did not identify any technically feasible NO_x control options for #9 furnace and flare. There may be some control technologies that might work on the #9 furnace flare but DEQ concluded that reducing the flare emissions, which are already less than 23 tons per year, is not economically feasible. Since there are no technically feasible NOx control options for either of these two units, no new BART controls will be required for that purpose.

10.6.2 P4 SO_x Controls

The #5 kiln uses four parallel hydro-sonic scrubbers for removal of submicron particles. The exhaust gases exit the scrubbers and pass through cyclonic separators and fans prior to exiting the atmosphere. In addition, a lime-concentrated dual-alkali (LCDA) scrubber to control SO_2 emissions from the kiln was installed by P4 in 2005. The LCDA scrubbing process uses the hydro-sonic scrubbers to absorb SO_2 with a solution of sodium salts.

In support of a BACT analysis submitted in 2006, P4 searched the RBLC for all permits issued since 2001 that included SO_2 controls. After reviewing all the technically feasible options, it was determined, that because the current control efficiency of the LCDA scrubber, at roughly 97%, is similar to the control efficiencies of the other technologies, the additional expense of installing other technologies and disposing of current technologies wasn't warranted.

The #9 furnace and flare were also reviewed for BART controls. Emissions from this source can be vented through the existing Tap Hole Fume Collector Scrubber, or through the existing CO Flare. After reviewing the available controls listed in the RBLC, it was determined there are no technically feasible control technologies for the #9 furnace and CO flare.

10.6.3 P4 Particulate Matter Controls

Currently, particulate emissions from the #5 kiln are controlled by four Hydro-Sonic scrubbers. The #9 furnace is controlled by a cyclonic separator and venturi scrubber unit known as the Tap Hole Fume Collector Scrubber. The current control technologies in place

16 Information on EPA's clearinghouse is available at: http://www.epa.gov/ttncatc1/

at P4 provide emissions reductions similar to those provided by the other options, so no additional controls are required for this purpose at P4.

10.6.4 P4 BART Determination Conclusion

The "four factor analysis" shows there are no technically feasible NO_x controls and the controls included in P4's BACT determination also meet the "best" of BART for particulate and SO_x controls. The hydro-sonic and LCDA scrubbers on Kiln #5 have reduced emissions from 12,252 tons per year (tpy) in 2004 to a permitted potential to emit of only 626 tpy as shown in table 10-12. The emissions reductions from the #5 kiln are substantial and account for a reduction of more than 50% of the base year point source emissions shown in table 8-1 in Chapter 8. Table 10-14 below shows the number of days that are no longer have visibility impacts greater than 0.5 deciview due to the SOx control technologies that have been put in place at P4. The P4 BART determination is available in Appendix F.

P4's BART permits can be found on the DEQ website at the following locations:

http://www.deq.idaho.gov/air/permits_forms/t2_final/p4_soda_springs_t2_1109_statement.pdf

http://www.deq.idaho.gov/air/permits_forms/t2_final/p4_soda_springs_t2_1109_permit.pdf

10.7 BART Enforceable Emissions Limits

Based on the "best" BART controls at TASCO Nampa and P4 Production, the enforceable emissions limits shown in Table 10-14 are established as found in federally enforceable permits. (The TASCO permit is currently in draft, so those limits are included here as an example.) While these permits may change over time, the underlying BART permit requirements will be retained and included in federally enforceable permits.

Table 10-13 BART Enforceable Emission Limits

TASCO Nampa	Emissions Unit	In Lb/hr	In Other Units	Notes
NOx	Riley Boiler	186		
SOx		115		
PM		14		
P4 Production	#5 Kiln			
NOx				
SOx		143	626 tpy	
PM				

10.8 Visibility Improvements Based on Emission Limits

The following tables show the visibility improvements at Monsanto/P4 and TASCO based on the before emission controls and after BART technologies have or will be installed. These tables look at the visibility improvements at all of the class I areas within 300km from the source. The BART controls at P4 reduced the total number of days over 0.5 deciviews impact by 317 days as shown in table 10-14.

Table 10-14 Difference in the number of days with visibility impairment of more than 0.5 decivew between base year and future controls

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Improvement in Highest Delta-Deciview Values and Reduction in Days > 0.5ΔDV for Individual Years						Improvement over 3 year Period	
	2003		2004		2005		2003-2005	
	Decrease in 8th Highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 22nd Highest	Total days > 0.5ΔDV Reduced
Bridger Wilderness, WY	0.207	14	0.219	8	0.285	19	0.237	41
Craters of the Moon NM, ID	0.147	4	0.517	10	0.963	19	0.595	33
Fitzpatrick Wilderness, WY	0.185	5	0.155	4	0.211	8	0.199	17
Grand Teton NP, WY	0.484	10	0.578	16	0.585	16	0.542	42
Jarbidge Wilderness, NV	0.064	1	0.073	1	0.273	3	0.159	5
North Absaroka Wilderness, WY	0.095	4	0.27	7	0.265	7	0.241	18
Red Rock Lakes Wilderness, MT	0.39	6	0.553	9	0.602	15	0.404	30
Sawtooth Wilderness, ID	0.099	1	0.247	5	0.297	9	0.224	15
Teton Wilderness, WY	0.311	11	0.4	19	0.373	20	0.383	50
Washakie Wilderness, WY	0.144	3	0.269	9	0.262	8	0.254	20
Yellowstone NP, WY	0.366	13	0.498	11	0.569	22	0.572	46
Total Reduction in Days > 0.5 ΔDV		**72**		**99**		**146**		**317**

The visibility modeling for TASCO looked at the scenarios of the Riley boiler emissions with the shutdown of the old pulp dryers (present emissions), the Riley boiler emissions including the old pulp dryer (baseline conditions), and the Riley Boiler with projected emission reductions from the selected BART technologies. The modeling analysis included all of the class I areas within 300km.

Table 10-15 TASCO, Nampa - BART Visibility Improvements

Class I Area/Scenario	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Eagle Cap Wilderness, Oregon								
Base Riley Boiler Scenario (wzl10471)	0.721	15	1.086	41	1.109	41	1.086	97
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.956	23	1.454	49	1.388	55	1.399	127
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.228	1	0.319	1	0.330	1	0.319	3
Hells Canyon National Recreation Area, ID/OR								
Base Riley Boiler Scenario (wzl10471)	0.577	9	0.888	20	0.763	19	0.786	48
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.799	16	1.056	30	0.954	32	1.018	78
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.187	1	0.255	0	0.214	0	0.228	1
Sawtooth Wilderness Area								
Base Riley Boiler Scenario (wzl10471)	0.207	1	0.249	1	0.208	0	0.224	2
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.318	2	0.327	3	0.268	0	0.317	5
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.064	0	0.066	0	0.057	0	0.064	0
Jarbidge Wilderness, NV								
Base Riley Boiler Scenario (wzl10471)	0.131	0	0.181	0	0.202	0	0.172	0
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.166	1	0.237	2	0.251	2	0.230	5
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.038	0	0.047	0	0.054	0	0.047	0
Craters of the Moon National Monument, ID								
Base Riley Boiler Scenario (wzl10471)	0.183	0	0.197	0	0.144	0	0.192	0
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.215	0	0.245	3	0.208	1	0.232	4
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.054	0	0.060	0	0.041	0	0.054	0
Selway-Bitterroot, ID								
Base Riley Boiler Scenario (wzl10471)	0.151	0	0.289	0	0.235	1	0.219	1

Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.197	0	0.337	1	0.294	2	0.255	3
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.042	0	0.076	0	0.064	0	0.058	0
Strawberry Mountain Wilderness, OR								
Base Riley Boiler Scenario (wzl10471)	0.517	8	0.410	6	1.168	23	0.685	37
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.912	13	0.680	16	1.550	31	0.992	60
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.189	0	0.112	0	0.351	2	0.217	2

Chapter 11. Idaho REASONABLE PROGRESS GOAL DEMONSTRATION

11.1 Overview

The intent of the Regional Haze Rule is to improve visibility back to natural conditions over a 60-year time frame. The starting point for this improvement is the base period from 2000 through 2004 with the goal of reaching natural conditions by 2064. Over this time period, states are required to show "reasonable progress" every ten years with the first planning period ending in 2018.

For each planning period, the State is required to establish reasonable progress goals (RPGs; expressed in deciviews) for each Class I area. These goals must show an improvement in the 20% worst visibility-impaired days and not allow any degradation of visibility on the 20% best visibility days.

In developing the RPGs, the state must take four factors into consideration: the cost of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of the potentially affected sources. The state must provide a demonstration that describes how these four factors were considered.

In establishing RPGs, the states must also take into consideration the Uniform Rate of Progress (URP) which is the slope of the line between the starting point of the baseline visibility conditions and the end point of natural visibility conditions. This is also referred to as the glide slope. If the state establishes an RPG with a slower rate of improvement than the URP, the state must provide an assessment of the number of years it will take to reach natural conditions based on the rate of progress established by the URP. The state must also demonstrate why the URP is unreasonable based on the four factors.

As noted before, each state is required to consult with other states regarding those other states' visibility impacts on Class I areas within the state and also regarding the state's visibility impacts on Class I areas residing in other states. There have been a number of Class I areas included in this SIP as part of analyzing Idaho's impacts on Class I areas outside the State. However, Idaho is only responsible for setting the reasonable progress goals for Craters of the Moon, Sawtooth Wilderness Area, and Selway-Bitterroot Wilderness Area. The state responsible for setting the RPGs for each Class I area is the state that contains the largest portion of the Class I area. For the other Class I areas that are partially in Idaho, the largest portion of Hells Canyon Wilderness Area resides in Oregon and Yellowstone National Park is primarily within Wyoming.

11.2 Steps in Demonstrating Reasonable Progress

The following steps were followed in setting the RPGs for each Class I area in Idaho:

1. Compare baseline conditions to natural conditions and establish the uniform rate of progress

Identify visibility levels during the baseline period (2000-2004) and natural conditions to be reached in 2064 for the 20% worst and 20% best days at each of the Class I areas for

which Idaho has responsibility for the reasonable progress goals. The URP, which is the slope of the line between the baseline conditions and natural conditions was also determined for each of Idaho's Class I areas. For a full description of the IMPROVE monitoring network that provided the data used to establish baseline conditions and the estimates of natural conditions, see Chapter 6.

2. Identify the uniform rate of progress

For each Class I area, calculate the URP glide path from baseline to 2064 including the 2018 planning milestone, for the 20% worst days. Then identify the improvement needed in deciviews by 2018 and 2062. Details are presented in Chapter 6.

3. Identify contributing pollutant species

Analyze the IMPROVE monitoring data to determine the contribution of each visibility impairing pollutant species to the baseline period 20% best and 20% worst days. The full analysis of the pollutants contributing to visibility impairment is presented in Chapter 7.

4. Identify significant emissions sources

Analyze visibility-impairing pollutants coming from point, area, mobile, and fires sources. The base year of 2002 emissions inventory was developed from the emissions inventory submitted by states for EPA's National Environmental Inventory and adjusted by WRAP based on input from the States. Emission inventories projected for 2018 were developed by WRAP in conjunction with states. Details are presented in Chapter 8.

5. Analyze significant sources contributing to impairment

For each Class I area, identify contribution of anthropogenic and natural visibility-impairing pollutants coming from Idaho and from the surrounding states for the 20% worst and 20% best days. Chapter 9 reviews the base year attributions using IMPROVE monitoring data. Also in Chapter 9, the 2018 attribution projections based on reductions resulting from BART controls and "on-the-books" reductions were analyzed using a combination of source apportionment and Weight of Evidence Projection (WEP) modeling.

6. Document the emissions reductions from BART

Determine the emissions reductions associated with BART control strategies that have been or will be installed at the subject-to-BART facilities. Chapter 10 reviews the modeling results for BART-eligible and subject-to-BART facilities and documents the required BART controls that expected to be installed during the first planning period.

7. Identify significant contributing sources and/or source categories and apply the four factor analysis

For each Class I area, review the source attribution information gathered in Chapter 9, and identify significant contributions from anthropogenic source categories for each pollutant. Apply the four factor analysis to those sources and source categories that are identified as significant contributors. A discussion of the source categories identified as significant contributors is provided in section 11.4

8. Establish the reasonable progress goals

Set RPGs (in deciviews) for the 20% worst and 20% best days for each of Idaho's Class I areas. The RPGs will be based on expected BART controls, "on-the-books" controls both in place and expected, and reductions from long term strategies identified in Chapter 12. The RPGs for each of Idaho's Class I areas can be found in Section 11.5

9. Compare the RPG to the 2018 URP milestone.

For each Class I area, compare the established RPG with the milestone that would be achieved in 2018 according to the URP. As described in the opening summary, if the rate represented by the RPG is less than the URP, the state must identify how long it would take to reach natural conditions at the rate represented by the RPG and explain why meeting the URP is not reasonable based on the four factor analysis. This information can be found in section 11.5

11.3 Summary of Four Factor Analysis for Significant Anthropogenic Source Categories

The previous chapters have laid the foundation for establishing reasonable progress. The URP was identified in Chapter 6. The pollutants impacting visibility were analyzed in Chapter 6 and the emissions were outlined in Chapter 7. Chapter 8 was an in-depth analysis of the sources and source categories to which visibility impairments are attributed and the states where the pollutants originated. The next step in establishing RPGs is to determine the visibility impacts of BART, long term strategies, and additional control strategies on anthropogenic sources that are reasonable.

In identifying additional control strategies, EPA's guidance states,

> *"There are numerous possible conceptual approaches that you can use to identify control measures for the long-term strategy and the related RPG. We suggest beginning* ***by concentrating on possible emissions reductions of several pollutant species*** *from a few* ***selected source sectors****,* ***focusing on those source categories that may have the greatest impact on visibility at Class I areas****,* ***considering cost and the other factors …"***
>
> *"The RHR gives the States wide latitude to determine additional control requirements, and there are many ways to approach identifying additional reasonable measures: however, you must at a minimum, consider the four statutory factors. Based on the contribution from certain source categories and the magnitude of their emissions you may determine that little additional analysis is required to determine further controls are not warranted for that category. As discussed further, you have considerable flexibility in how you take these factors into consideration" 17*

Boiled down, the guidance suggests looking at several pollutant species, determining source categories and controls with the greatest impacts on visibility at Class I areas, and using the four factor analysis to determine what is reasonable. Section 308(d)(1)(i)(A) of

17 U.S. Environmental Protection Agency, Guidance for Setting Reasonable Progress Goals under the Regional Haze Program", page 4-1, June 1, 2007.

the Regional Haze Rule instructs that the following four factors be taken into consideration in selecting the goal:

1. cost of compliance,
2. time necessary for compliance,
3. the energy impacts of compliance,
4. and the remaining useful life of any potentially affected sources.

11.3.1 Review of Pollutants and Source Apportionment for the 20% Worst Days

In selecting which visibility-impairing pollutants that should be included as part of the "source sector selection," a review of the pollutants impacting Idaho's Class I areas should be done. The following graphs18, which are taken from Chapter 7, show the major pollutants and their contribution to visibility impairment at Craters of the Moon National Monument, Sawtooth Wilderness, and Selway-Bitterroot Wilderness.

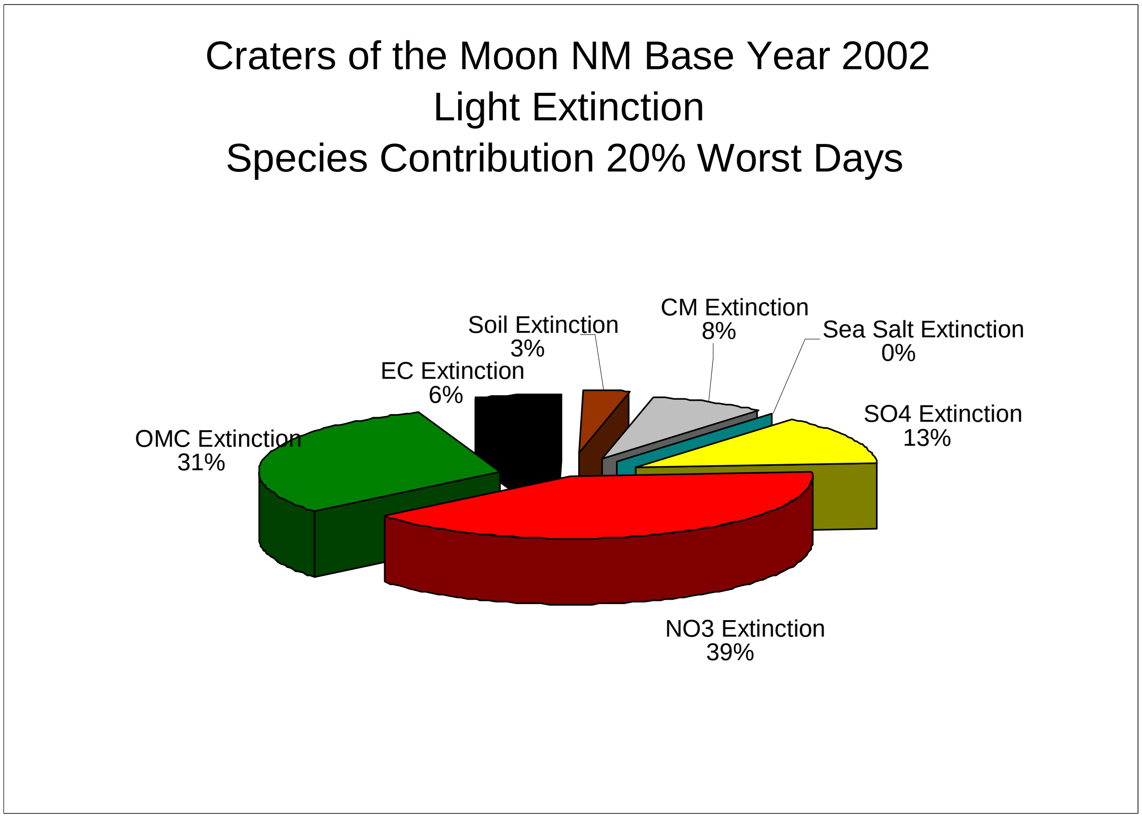

Figure 11-1 Craters of the Moon National Monument 2002 20% Worst Days Species Contribution

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18 The visibility pie charts were created using data gathered from the WRAP TSS at: http://vista.cira.colostate.edu/tss/. To view the data, click on "Monitoring", then select the location from the map and select "total light extinction" from the pull down table .

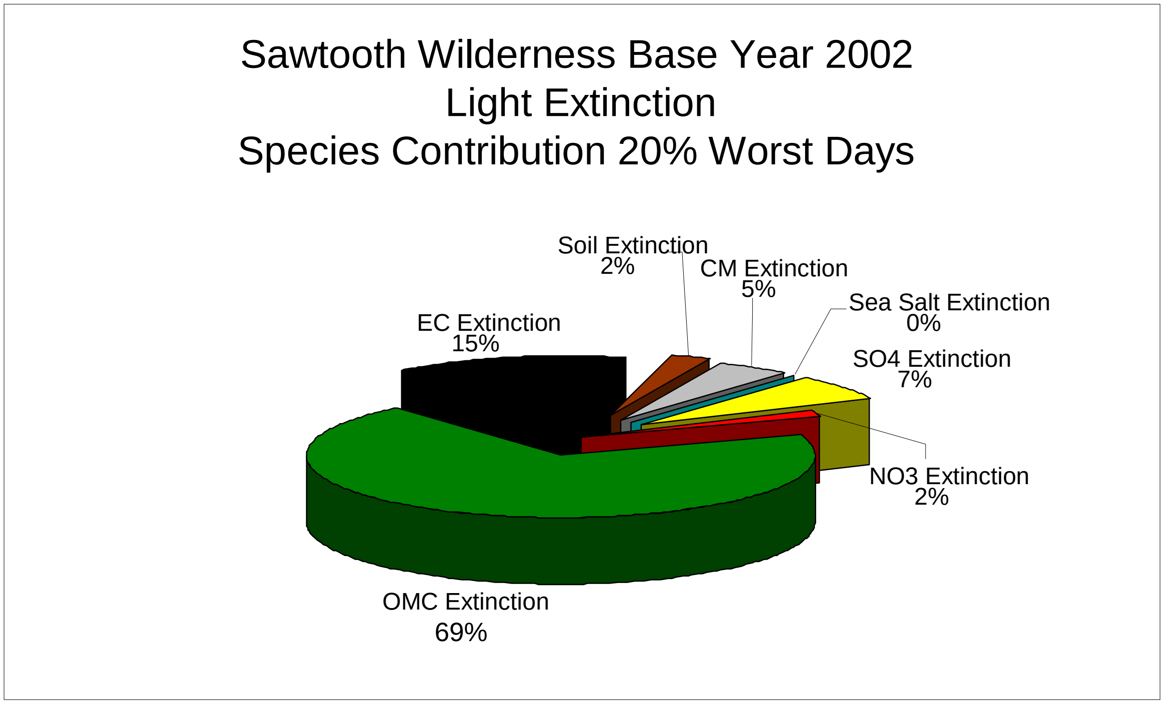

Figure 11-2 Sawtooth Wilderness 20% Worst Days Species Contribution

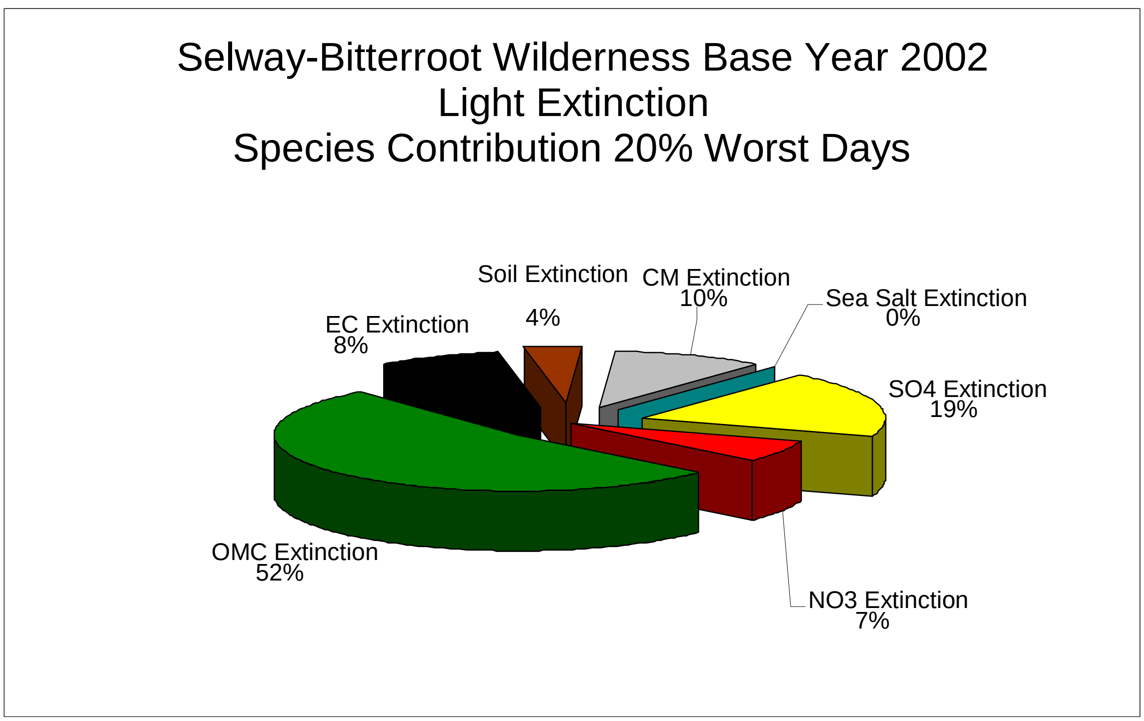

Figure 11-3 Selway-Bitterroot Wilderness 20% Worst Days Species Contribution

The organic mass carbon (OMC) contribution to visibility impairment at The Sawtooth Wilderness and Selway Bitterroot Wilderness is more than 50% (Figures 11-2 and 11-3). At Craters of the Moon National Monument (Figure 11-1), OMC's contribution to visibility impairment is more than 30%. While organic carbon may be a major contributor

of visibility impairment, it is almost exclusively from wildfire and therefore isn't a prime pollutant to look at for reductions from anthropogenic sources at this time. However, organic carbon emissions during the winter months deserve further investigation to see if a woodstove program may be helpful in the Sawtooth Wilderness due to the location of the monitor and the proximity of Stanley, Idaho. The state will work with the U.S Forest Service visitor center for local observations during air stagnation periods. The contribution to organic carbon from wild fire was discussed in Chapter 9 and figures 9-10, 9-33, and 9-45 visually show the impacts from wild fire. Anthropogenic fire, is also discussed in the long term strategies in Chapter 12.

Elemental carbon is contributing between 6 and 15% of the visibility impairment in Idaho's Class I areas as shown in figures 11-1, 11-2, and 11-3 above. Referring back to Chapter 9, the WEP analysis shows that wild fire is by far the largest contributor of elemental carbon. Figures 9-23, 9-35, and 9-47 are showing that anthropogenic fire and off-road mobile are slight contributors. Controls for these two source categories will be included in the long term strategies (Chapter 12), so elemental carbon is not a good candidate for additional controls on anthropogenic sources.

Fine soil is contributing between 2 and 4% of visibility impairment in Idaho's Class I areas as shown in figures 11-1, 11-2, and 11-3 above. Since fine soil comes from a variety of sources such as windblown dust from agriculture or storage piles, and it contributes such a small percentage of the visibility impairment, this pollutant is also not a prime candidate for additional controls on source categories at this time. However, there are rules in place that will address these emissions in the long term strategies.

The coarse matter is contribution slightly more than the fine soil contribution, which is between 5 and 10% of the visibility impairment. The WEP analysis in Chapter 9 is showing windblown dust, fugitive dust, and road dust, in that order, as the primary sources of coarse matter (see figures 9-15 and 9-39) contributing to visibility impairment on the 20% worst days, except in the Selway-Bitterroot Wilderness, where the primary coarse matter impacts are coming from wild fire as shown in figure 9-51. Since the fugitive dust and road dust coming from Idaho are small percentages of the overall contribution of coarse matter, and coarse matter itself is a smaller contributor of visibility impairment, these categories are not good candidates for the four factor analysis. They will, however, be addressed in the long term strategies.

The remaining pollutants to review for inclusion in the four factor analysis for RPGs are sulfate, nitrate, and the fine particulate created when these pollutants interact with ammonia. Sulfate and nitrate are include because there is usually an ample amount of ammonia available for the conversion of sulfate and nitrate into ammonium sulfate and ammonium nitrate, both of which cause visibility impairment. Sulfate and nitrate are the two pollutants most closely associated with human caused visibility impairment. The source pie charts in figures 11-1, 11-2, and 11-3 show that combined visibility impairment on the 20% worst days in Idaho's Class I areas ranges between a high of 52% at the Craters of the Moon National Monument to a low of 9% at the Sawtooth Wilderness. Because of the contribution to visibility impairment and the association of these two pollutants with human cause visibility impairment, they will be the primary focus of the four factor analysis used to establish the RPGs.

11.3.2 Review of Idaho's 2002 Anthropogenic Emissions

Reviewing Idaho's 2002 emissions inventory is another way of re-affirming the selection of pollutants and anthropogenic source categories that should undergo the "four factor analysis." Table 11-1 shows source contributions by pollutant and by source category.

Table 11-1 Idaho 2002 Statewide Emissions by Pollutant and Source Category19

Idaho Statewide Emissions (tons/year) Plan02d (2002)								
Source Category	Pollutant							
	SO_2	NO_x	VOC	Primary Organic Aerosol	Elemental Carbon	Fine Particulate	Coarse Particulate	Ammonia
Point	45%	7%	1%	0%	0%	2%	1%	1%
Area	8%	19%	46%	1%	1%	24%	3%	85%
On-Road Mobile	4%	28%	10%	1%	3%	0%	0%	2%
Off-Road Mobile	9%	18%	9%	1%	14%	0%	0%	0%
Anthropogenic Fire	2%	2%	3%	15%	10%	8%	1%	2%
Natural Fire	31%	25%	32%	82%	72%	15%	22%	10%
Road Dust	0%	0%	0%	0%	0%	11%	17%	0%
Fugitive Dust	0%	0%	0%	0%	0%	14%	15%	0%
Wind Blown Dust	0%	0%	0%	0%	0%	26%	40%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

This table also provides further support for the selection of sulfate and nitrate as the primary pollutants to focus on. Sulfate and nitrate are the two pollutants showing the highest emissions coming from anthropogenic sources. As stated above, ammonia is heavily impacted by area sources but this source will be dealt with in the long term strategies. Open burning is the primary area source contributing to volatile organic carbon, which will also be discussed in the long term strategies.

11.3.3 Selection of Source Categories for the Four Factor Analysis

The third step in this process is to look at the source categories that are the largest contributors of sulfate and nitrate. On-road and off-road mobile sources are controlled under federal regulations and are showing dramatic decreases expected over the first planning period. The state is in the process of implementing Idaho rules for on-road mobile sources, which will be discussed in the long term strategies. That leaves point and area source categories to be reviewed to see if they merit undergoing the four factor analysis.

The WRAP has developed pivot tables that provide source emissions data by standard industrial classification (SIC) for point and area sources. This information can be used to identify key industries and area source actives that are contributing to visibility impairment and are candidates for the four factor analysis. These WRAP pivot tables for Idaho are presented here as Table 11-3 through 11-5.

Table 11-2 identifies several source categories that contribute 250 tons or more of sulfate. The three source categories above this threshold include "elemental phosphate" (12,210

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19 The percentages of Idaho emissions were determined from information taken from the WRAP technical support document at: http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx. To view the data, first choose Emissions and Source Apportionment, then choose the Emissions Review Tool, and then select pollutants, source times, and states.

tons per year [tpy]), "sulfuric acid contact processing plants" (364 tpy), and "external combustion boilers using coal" (2,976 tpy) which together total 5,460 tpy. Sulfate from all point source categories totals 17,597 tpy, which means the three categories listed above account for 88% of the total point source emissions of sulfate. Since these three categories are above the threshold and account for a majority of the emissions they should undergo the four factor analysis.

Table 11-2 Idaho Statewide 2002 Point Source SO_2 Emissions[20]

State	ID		
Sum of SumOfSO2_ANN			
SCC1_DESC	SCC3_DESC	SCC6_DESC	Total tpy
Industrial Processes	Chemical Manufacturing	Elemental Phosphorous Total	12,210
		Sulfuric Acid (Contact Process) Total	364
External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal Total	3,118
All other point sources			1,905
Grand Total			17,597

Nitrogen oxides are usually associated with combustion of various fuels. There are a number of source categories more than 250 tpy of NOx emissions that use a variety of fuels and combustion methods to support a wide range of industrial processes. The point source categories shown in table 11-3 that exceed the threshold of 250 tpy of NOx include:

- external combustion industrial boilers burning coal, natural gas, and wood/bark waste
- industrial processes
  elemental phosphate production
  pulp paper and wood products – pulp board and Kraft pulping
  cement manufacturing (wet process)
  sugar beet processing
- Industrial combustion engines natural gas compressor stations

These NO_x point source categories account for 92% of the NOx emissions and should undergo the four factor analysis.

Table 11-3 Idaho Statewide 2002 Point Source NO_x Emissions

State	ID		
Sum of SumOfNOX_ANN			
SCC1_DESC	SCC3_DESC	SCC6_DESC	Total tpy
External Combustion Boilers	Industrial	Bituminous/Subbituminous Coal Total	3,268
		Natural Gas Total	919
		Wood/Bark Waste Total	460
Industrial Processes	Chemical Manufacturing	Elemental Phosphorous Total	1,551

20 Idaho 2002 statewide point source emissions as shown in Tables 11-2 through 11-5, are available on the WRAP website at: http://www.wrapair.org/forums/ssjf/pivot.html The most recent and up to date version, Plan02d, is represented in Tables 11-2 through 11-5..

State	ID		
Sum of SumOfNOX_ANN			
SCC1_DESC	SCC3_DESC	SCC6_DESC	Total tpy
	Pulp and Paper and Wood Products	Pulpboard Manufacture & Sulfate Pulping Total	861
	Mineral Products	Cement Manufacturing (Wet Process)	461
	Food and Agriculture	Sugar Beet Processing	401
Internal Combustion Engines	Industrial	Natural Gas Total	2,590
All other point sources			975
Grand Total			11,486

In addition to point sources, area sources should be reviewed to determine which nitrate and sulfate sources should be reviewed to determine whether they should undergo the four factor analysis as part of establishing the RPG for Idaho's Class I areas. Tables 11-4 and 11-5 shows the largest Idaho area sources and emissions levels.

Table 11-4 Idaho Statewide 2002 Area Source SO_2 Emissions

Pollutant	SO2			
Sum of Emissions				State-ID
SCC_L1_DESC	SCC_L2_DESC	SCC_L3_DESC	SCC_L4_DESC	tpy
Stationary Source Fuel Combustion	Industrial	Bituminous/Sub bituminous Coal	Total: All Boiler Types	1,746
		Distillate Oil		90
		Residual Oil		7
		Natural Gas	Total: Boilers and IC Engines	2
		Kerosene		1
		Wood		1
	Residential	Distillate Oil		750
		Wood		26
		Natural Gas	Residential Furnaces	6
		Liquefied Petroleum Gas (LPG)		3
	Commercial/Institutional			131
Waste Disposal, Treatment, and Recovery				153
Grand Total				2,916

Table 11-5 Idaho Statewide 2002 Area Source NOx Emissions

Pollutant	NOX			
Sum of Emissions				State-ID
SCC_L1_DESC	SCC_L2_DESC	SCC_L3_DESC	SCC_L4_DESC	tpy
Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	22,057
		Bituminous/Sub bituminous Coal	Total: All Boiler Types	1,631
		Distillate Oil		1,508
		Natural Gas	Total: Boilers and IC Engines	1,067
		Liquefied Petroleum Gas (LPG)		160
		Residual Oil		2
		Kerosene		1
	Residential	Natural Gas	Residential Furnaces	958
		Liquefied Petroleum Gas (LPG)		421
		Distillate Oil		190
		Wood	Total: Woodstoves and Fireplaces	170
	Commercial/Institutional			1,212
Waste Disposal, Treatment, and Recovery				919
Miscellaneous Area Sources				23
Grand Total				30,318

At this time, DEQ believes the amount of emissions from industrial wood combustion boilers is overstated and believes that most of these emissions should be captured in the point source emissions inventory that will be reviewed under a four factor analysis for point source boilers and not area source.

Table 11-8 summarizes Idaho's source categories that will undergo the four factor analysis.

Table 11-6 Idaho Sources for Four-Factor Analysis.

Sulfate	Nitrate
External Combustion Boilers (coal)	External Combustion Boilers coal, natural gas, wood/bark waste
Elemental Phosphate Production	Elemental Phosphate Production
Sulfuric Acid Contact Processing Plants	Pulp and Paper Wood Products
	Cement Manufacturing
	Sugar Beet Processing
	Industrial Combustion Natural Gas (compressor stations)

11.4 The Four Factor Analysis

In an effort to provide some consistency in the four factor analyses among the WRAP states, ER/C Incorporated was contracted to analyze the source categories defined by the states. The important source categories were compiled and a list of potential additional control technologies was identified using a number of publications and guidance documents21. The considerations used to analyze the four factors included:

- **Cost of compliance**

  Control costs include both the capital costs associated with the purchase and installation of the technology and the annual costs associated with running the equipment. The information on costs followed the EPA's *Guidance for Setting Reasonable Progress Goals under Regional Haze Rule (June 1, 2007)* as well as the methodologies provided in *EPA Air Pollution Control Cost Manual.*

- **Time necessary for compliance**

The amount of time needed for full implementation of the different control strategies. This includes the time needed to develop and implement the regulations and the time needed to install the necessary control equipment.

- **Energy and non-air quality impacts of compliance**

The direct energy consumption of the emission control device, solid waste generated, wastewater discharged, acid deposition, nitrogen deposition and climate impacts (e.g. generation and mitigation of greenhouse gas emissions).

- **Remaining useful life of any potentially affected sources**

Economic impact that will occur if the remaining expected life of a particular emissions source is less than the expected useful life of the proposed pollution control device. The capital costs of the emission control equipment can only be amortized over the remaining useful life of the emission source.

Each of the following sections provides a summary of the four factor analysis for one of the source categories identified in section 11.3.3.

11.4.1 External Combustion Boilers Four Factor Analysis

This category includes boilers that are used in manufacturing, process, mining, refining or any other industry to provide steam, hot water, and/or electricity. It includes boilers using coal, natural gas, and bark/wood waste. As discussed above, the significant pollutants from boilers are sulfate.

- Cost of compliance

21 EC/R Incorporated, "Supplementary Information for Four Factor Analysis by WRAP States, May 4, 2009. This document is available at: http://www.wrapair.org/forums/iwg/documents/2009-05_Draft_report_for_4-Factor_Analysis-Source_Categories_5-04%20rev5.pdf

Table 11-7 identifies the controls for each pollutant based on the fuel used and summarizes the associated costs.

Table 11-7 Summary of External Boiler Controls and Costs

Source Type	Pollutant Controlled	Control Technology	Estimated Control Efficiency (%)	Estimated Capital Cost per heat unit (lbs/MMBtu**)	Estimated Annual Cost ($Million)	Cost Effectiveness ($/ton)
Coal-Fired	NO_x	Low NOx Burners (LNB)	50	3,435 – 6,856	0.175 – 0.317	344 – 4,080
		LNB w/ Over Fire Air (OFA)	50-60	4,908 – 9,794	NA	412 – 4,611
		Selective Non-Catalytic Reduction (SNCR)	30-75	3,550 – 7,083	0.333 – 0.419	1,728 – 6,685
		Selective Catalytic Reduction (SCR)	40-90	9,817 – 19,587	0.738 – 1.32	1,178 – 7,968
	SO_2	Physical coal cleaning	10-40	NA	NA	70 - 563
		Chemical coal cleaning	50-89	NA	NA	NA
		Switch to low-sulfur fuel	20-90	NA	NA	NA
		Dry sorbent injection	50-90	11,633 - 39,096	NA	851 – 5,761
		Spray dryer absorber	90	27,272 – 73,549	7.93 – 9.26	3,885 – 8,317
		Wet Flue Gas Desulfurization (FGD)	90	40,203 – 86,410	10.10 – 11.71	4,687 – 10,040
Natural Gas-Fired	NO_x	LNB	40	1,722 – 3,435	0.190 – 0.346	412 – 7,075
		LNB w/ OFA	30 – 50	1,722 – 3,435	NA	412 – 7,075
		LNB w/ OFA an Flue Gas Reduction FGR	30-50	2,690 – 5,368	NA	439 – 6,689
		SNCR	30 – 75	2,840 – 5,666	0.206 – 0.355	1,997 – 9,952
		SCR	40- 90	5,399 – 10,773	0.484 – 0.831	1,022 – 24,944
Wood-Fired	NO_x	LNB w/ OFA	30 – 50	1,722 – 3,435	NA	412 – 7,075
		LNB w/ OFA and FGR	30-50	2,690 – 5,368	NA	439 – 6,689
		SNCR	30 – 75	2,840 – 5,666	0.206 – 0.355	1,997 – 9,952
		SCR	40- 90	5,399 – 10,773	0.484 – 0.831	1,022 – 24,944

* MMBtu – million British thermal units

- Time necessary for compliance

It is estimated to take 4 -5 years for compliance if it is determined external combustion boilers are a significant source category. It would take 1-2 years to model the possible impacts and adopt appropriate rules. It would take another 2-3 years for facilities to secure the necessary capital and install emission controls.

- Energy and non-air quality impacts

In general low NOx burners (LNB), over-fire air (OFA), and flue gas reduction (FGR) do not require steam or generate solid waste or wastewater. Controls using SNCR and SCR require additional power to operate, which would cause an increase in CO_2 emissions, given the sources of power used in Idaho. Some of the potential SO_x controls may cause an increase in solid waste and/or wastewater volume.

- Remaining useful life

The remaining useful life of industrial boilers is not expected to affect the cost impact of control technologies.

11.4.2 Elemental Phosphate Production Four Factor Analysis

While emissions from this source category were large enough to merit the four factor analysis based on size, the analysis isn't necessary because the primary point source in this category has undergone a review for considerations relating to prevention of significant deterioration (PSD) and for a BART permit. The BART controls at P4 reduced SO_x emissions by roughly 9,000 tons per year (tpy) which was over half the total point source SO_x emissions in 2002. The BART review of technically feasible technologies also determined that there is not an appropriate NOx technology at this time due to the high temperatures involved in the industrial process at this point source.

11.4.3 Sulfuric Acid Contact Processing Plants Four Factor Analysis

Sulfuric acid is a strong mineral acid and is one of the top products of the chemical industry. Sulfuric acid is primarily used in lead acid batteries for cars.

- Cost of compliance.

A summary of costs for potential controls is shown in table 11-8.

Table 11-8 Summary of Sulfuric Acid Contact Processing Controls and Costs

Source Type	Pollutant Controlled	Control Technology	Estimated Control Efficiency (%)	Estimated Total Capital Cost($M)	Estimated Annual Cost ($Million)	Cost Effectiveness ($/ton)
Sulfuric Acid Manufacturing at 93% baseline efficiency	SO_x	Increase absorption efficiency to NSPS level	96.4	NA	NA	1,600
		Tail gas treatment unit	98.6			928

- Time necessary for compliance

It is estimated it would take 4 -5 years for compliance if it is determined sulfuric acid plants are a significant source category. It would take 1-2 years to model the possible impacts and adopt appropriate rules. It would take another 2-3 years for facilities to secure the necessary capital and install emission controls.

- Energy and non-air quality impacts

Adding absorption stages to increase efficiency would require additional electricity and steam as would a tail gas treatment unit. Depending on the source of electricity, this could increase CO_2 emissions.

- Remaining useful life

The remaining useful life expectancy of most equipment is expected to exceed the lifetime of the control equipment. Therefore, there are no increases in the amortized capital cost of the pollution controls.

11.4.4 Cement Manufacturing Four Factor Analysis

The main emissions sources at cement plants are the kilns used to heat limestone to form clinkers. The clinkers are cooled, ground, and mixed with gypsum to form cement.

- Cost of compliance

A cost summary is shown in table 11-8.

Table 11-9 Summary of Cement Kilns Controls and Costs

Source Type	Pollutant Controlled	Control Technology	Estimated Control Efficiency (%)	Estimated Total Capital Cost (M$)	Estimated Annual Cost ($Million)	Cost Effectiveness ($/ton) ton clinker
Cement Wet Kiln	NO_x	Low NO_x Indirect fire	20 – 47	401 – 564	83,000 – 135,000	270 - 620
		Low NO_x Direct fire	20 – 47	1,910	376,000 – 343,500	855 – 1,005
		Mid-kiln firing	20 – 50	613 – 3,205	183,500 – (192,300	(460) – 730
		SCR* w/ ammonia	80 – 90	15,100	5,780 – 4,105,000	3,370
		LoTOx*	80 – 90	N/A		3,155 – 3,891

* SCR – Selective catalytic reduction

- Time necessary for compliance

It is estimated it would take 4 -5 years for compliance if it is determined cement plants are a significant source category. It would take 1-2 years to model the possible impacts and adopt appropriate rules. It would take another 2-3 years for facilities to secure the necessary capital and install emission controls.

- Energy and non-air quality impacts

In general, control technologies on cement plants would require additional electricity. Depending on the source of electricity, this could increase CO_2 emissions.

- Remaining useful life

The remaining useful like expectancy of most equipment is expected to exceed the lifetime of the control equipment. Therefore, there are no increases in the amortized capital cost of the pollution controls.

11.4.5 Sugar Beet Processing Four Factor Analysis

Boilers and pulp dryers are the two primary emissions sources involved in sugar beet processing. The boilers for sugar beet processing are addressed under the “four factor analysis” of external fired boilers.

11.4.6 Industrial Combustion Natural Gas (Compressor Stations)

There are several natural gas processing operations in Idaho where turbines and natural gas reciprocating engines compress and drive natural gas along transmission pipelines.

- Cost of compliance

Table 11-10 shows a summary of natural gas compressor controls and costs.

Table 11-10 Summary of Natural Gas Compressor Controls and Costs

Source Type	Pollutant Controlled	Control Technology	Estimated Control Efficiency (%)	Estimated Total Capital Cost	Estimated Annual Cost ($Million)	Cost Effectiveness ($/hp)
Reciprocating engines	NO_x	Air-fuel ratio adjustment	10 – 40	5.3 – 42	0.9 – 6.8	68 – 2,500
		Ignition timing retard	15 – 30	Not available	1 – 3	42 – 1,200
		Low Emission Combustion LEC* retrofit	80 – 90	120 – 820	30 – 120	320 - 210
		SCR*	90	100 – 450	40 – 270	870 – 31,00
		NSCR*	90 – 99	17 – 35	3 – 6	16 - 36
Turbines Units-TU/hr		Water or steam injection	68 – 90	4.4 – 16	2 – 5	560 – 3,100
		Low NO_x burners	68 – 84	8 – 22	2.7 – 8.5	5,200 – 16,200
		SCR	90	13 – 24	5.1 – 33	1,000 – 6,700
		Water/Steam injection w/ SCR	93 – 96	13 – 34	5.1 – 33	1,000 – 6,700

* LEC – Low Emission Combustion________; SCR – selective catalytic reduction; NSCR – non-selective catalytic reduction

- Time necessary for compliance

It is estimated to take 4 -5 years for compliance if it is determined that natural gas combustion for compressor stations are a significant source category. It would take 1-2 years to model the possible impacts and adopt appropriate rules. It would take another 2-3 years for facilities to secure the necessary capital and install emission controls.

- Energy and non-air quality impacts

Some of the control technologies require an increase in fuel consumption of up to 5%, which may result in an increase in CO_2 consumption.

- Remaining useful life

The remaining useful life expectancy of most equipment is expected to exceed the lifetime of the control equipment. Therefore, there would be no increases in the amortized capital cost of the pollution controls.

11.4.7 Summary and Conclusion of Point Source Four Factor Analysis and RPG Conclusion

As discussed at the beginning of this chapter, NO_x and SO_x emissions from anthropogenic sources are the two visibility impairing pollutants that Idaho has the greatest control over. Although Idaho is expecting to reduce NO_x emissions by 21% and SO_x emissions by 34% (see Tables 8-1 and 8-2),

under implementation of BART, and other on-the-books controls, the state must look at additional controls for RPG.

At first glance, table 11-11 is showing minor contributions from point sources. Idaho's point source NO_x contribution ranges from 1.41% at Selway-Bitterroot Wilderness to 5.96% at Craters of the Moon National Monument. The point source SO_x contribution ranges from 0.83% at the Selway Bitterroot Wilderness to 13.5% at Craters of the Moon. The contributions at Craters of the Moon are elevated due to an EGU that was proposed, but ultimately not constructed, in Jerome which is in close proximity to the Monument.

Table 11-11 Idaho Future Contribution of SO_x NO_x

2018 Idaho Percent Contribution and Change 2002/2018 PSAT modeling										
State	**Class I Area**	**Pollutant**	**Nat. Fires & Bio.**	**Anthro. Fires**	**Mobile**	**Area**	**Point**	**Outside Domain**	**Idaho Total**	**Percent Change 02/018**
Idaho	**Sawtooth**	SOx	**3.60%**	**0.26%**	**0.51%**	**1.80%**	**2.31%**	**0.00%**	8.48%	-15.38%
		NOx	4.70%	0.67%	6.71%	14.77%	2.01%	0.00%	28.86%	-17.31%
	Craters Of the Moon	SOx	**2.19%**	**0.18%**	**0.73%**	**1.82%**	**13.50%**	**0.00%**	18.43%	14.77%
		NOx	5.21%	0.37%	10.55%	14.89%	5.96%	0.00%	36.97%	-28.02%
	Selway-Bitterroot	SOx	10.41%	0.17%	0.17%	0.50%	0.83%	0.00%	12.07%	-3.95%
		NOx	5.99%	0.35%	2.82%	3.17%	1.41%	0.00%	13.73%	-27.78%

The point source contributions at Craters of the Moon National Monument may be similar to the other Idaho Class I areas once the BART emission reductions from Amalgamated Sugar and Monsanto are included.

The state is still required to identify significant sources or source categories causing or contributing to impairment in Class I areas, and apply the four factor analysis. As part of that process, Idaho has identified, external boilers, elemental phosphate production, sulfuric acid contact processing plants, pulp and paper production, cement manufacturing, sugar beet processing, and internal combustion natural gas compressor stations as source categories that should under go the four factor analysis. The preliminary search shows several control strategies may be cost effective based on the WRAP contract that identified potential controls for source categories. Unfortunately the WRAP analysis considered a wide range of specific sources (i.e. different source locations and configurations) with a wide range of costs. In order to complete the cost effectiveness analysis and "cost of compliance" the state must first determine if the individual source categories located within Idaho are causing or contributing to visibility impairment.

It is anticipated that if a source category is causing or contribution to visibility impairment, the facilities within that category may have difficulty meeting the new National Ambient Air Quality Standards for $PM_{2.5}$, NO_x or SO_x. In the event a source within the category is causing or contributing to visibility impairment and meeting all the new NAAQS, Idaho will be required to undertake a negotiated rule making process to develop rules to implement cost effective emission controls on those facilities. The negotiated rule making process giving Idaho the authority to require those emission controls would take an additional 2 years to develop.

To determine the "cost of compliance," it will take 1-2 years to model all the identified source categories to see if they are causing or contributing to visibility impairment, and identify costs associated with the installation of control technologies at individual facilities within the source

category. The "time necessary for compliance" may include an additional 2 years to develop Idaho rules that would require the installation of controls for the sources causing or contributing to visibility impairment, and another 2-3 years for facilities to secure the necessary capitol and install the emission controls. Developing the "cost of compliance" and the "time necessary for compliance" will take between 3 to 7 years. Based on the four-factor analysis and the time "necessary for compliance," Idaho is not requiring additional controls for source categories at this time so they have not been included in establishing the RPG. The state will be developing a process for conducting a more thorough review of the categories listed above and as briefly described in section 12.6.3.

While Idaho would have preferred completing this process prior to submitting the Regional Haze SIP, the State's experience with the "time necessary for compliance" to implement BART is a prime example of how much time is need to implement controls even when the process is fairly well prescribed. Since Idaho will be developing state specific rules, additional time is warranted. EPA's Reasonable Progress Guidance (June, 2007 p. 5-2) seems to anticipate these issues in the statement, "It may be appropriate for you to use this factor (time necessary for compliance) to adjust the RPG to reflect the degree of improvement in visibility achievable within the period of the first SIP if the time needed for full implementation of a control measure (or measure) will extend beyond 2018."

11.5 Determination of Reasonable Progress Goals for Idaho's Class I Areas.

The Regional Haze Rule section 308(d)(1) requires, "For each mandatory Class I Federal area located within the State, The State must establish goals (expressed in deciviews) that provide for reasonable progress towards achieving natural visibility conditions." These goals must provide for improvement on the 20% worst visibility days and not allow degradation on the 20% best visibility days. For the Class I areas for which Idaho is responsible for establishing reasonable progress goals, the goals for the first planning period ending in 2018, are presented below in table 11-11. The goals are based on steps outlined in section 11.2 of this chapter.

The expected visibility improvements during the first planning period are based on expected emissions reductions associated with:

- BART controls at TASCO Nampa and P4 Production,
- current regulations,
- on-going control strategies, and
- results of the four factor analysis/long term strategies.

These emissions reductions were taken together and included in the visibility projections on a per-pollutant basis using "weighted emission potential" (WEP) and CMAQ modeling as described in Chapter 9. The results shown in table 11-12 are the projected cumulative impacts of those emissions reductions based on CMAQ modeling estimates of visibility improvement.

Table 11-12 Reasonable Progress Goals for Idaho Class I Areas22.

Idaho Class I Area	20% Worst Days			20% Best Days	
	Baseline Condition [deciviews]	2018 Goal Based on Uniform Rate of Progress [deciviews]	2018 Reasonable Progress Goal [deciviews]	Baseline Condition [deciviews]	2018 Reasonable Progress Goal [deciviews]
Craters of the Moon National Monument	14	12.49	13.06	4.31	3.886
Sawtooth Wilderness	13.78	12.06	13.22	3.99	3.78
Selway-Bitterroot Wilderness Area	13.41	12.02	12.94	2.58	2.48

As shown in Table 11-11, the goals are set to achieve visibility improvements at all three Class I areas on the 20% best days. The table also shows the goals for improvement in the 20% worst days but these goals are less than the URP.

11.5.1 Demonstration Indicating That the RPGs for the 20% Worst Days are Reasonable

The Regional Haze Rule section 308(d)(1)(B)(ii) requires, "the State must demonstrate, based on the factors in paragraph (d)(1)(A) of this section that the rate of progress for the implementation plan to attain natural conditions by 2064 is not reasonable, and the progress goal is reasonable." The state believes the goals established for each of Idaho's Class I areas are reasonable based upon the review of the controls of anthropogenic sources, the four factor analysis as required under 308(d)(1)(A), long term strategies, and the substantial but uncontrollable impacts from natural emissions sources.

Impacts from natural emissions sources

The pie charts at the beginning of section 11.3.1 show the large impacts of organic mass carbon and elemental carbon during the base year of 2002. The Sawtooth and Selway-Bitterroot Class I areas are showing impacts from organic and elemental carbon ranging from 84% to 60%. At the Craters of the Moon Class I area, impacts from organic and elemental carbon account for 37% of the visibility impact. Table 11-1 shows natural fire as the primary source of Idaho's organic carbon (82%) and elemental carbon (72%). The contribution from natural fires to primary organic carbon and elemental carbon makes achieving the URP unreasonable.

Impacts from anthropogenic sources

The focus of the Regional Haze Rule is to identify anthropogenic sources of emissions and establish reasonable progress goals toward achieving natural conditions based upon controlling those emissions through the application of the four factor analyses, reductions

22 Reasonable Progress Goals are based on baseline IMPROVE monitoring data and CMAQ modeling using the plan02d & 2018 PRP18d emissions inventories. The data is available on the TSS website at: http://vista.cira.colostate.edu/tss/. To view the data, select modeling visibility, projection tools, the Class I site from the map, and summary tables.

associated with the application of CAA requirements, on-the-books controls, and long term strategies. Table 11-1 shows that nitrates and sulfates are the two pollutants with the largest impacts from anthropogenic sources, and sections ll.3.1 and 11.3.2 identify nitrates and sulfates as the two pollutants that should be the focus of anthropogenic emissions reductions. The question is whether Idaho would achieve a 20% reduction in sulfate and nitrate emissions, which would be required for each planning period according to the URP.

While Idaho's Class I areas are not meeting the URP overall, Table 11-13 shows expected emissions reductions for nitrates and sulfates from Idaho are near or greater than the URP for these two individual pollutants. The expected reduction in emissions for the combination of nitrates and sulfates from Idaho is well above 20%. The WEP analysis also shows an improvement greater than 20% in upwind anthropogenic emissions. That means Idaho and those states upwind of Idaho's Class I areas are expected to exceed the emissions reductions from anthropogenic sources of sulfate and nitrate that would be required by the URP.

Table 11-13 Summary of Idaho Class I Area Sulfate and Nitrate Visibility Improvement 20% Worst Days23

	Visibility Conditions: Worst 20% Days						
	RRF Calculation Method: Specific Days (EPA)						
	Monitored	Estimated		Projected			
	2000-04 Baseline Conditions	2064 Natural Conditions	2018 Uniform Rate of Progress Target	2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions[2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm^{-1})*	(Mm^{-1})	(Mm^{-1})[1]	(Mm^{-1})	(tons / %)	(%)	(%)
	Craters of the Moon NM						
Sulfate	5.69	0.83	4.39	5.35	-13,272 -34%	-25%	-30%
Nitrate	11.35	1.05	8.31	8.3	-32,418 -19%	-27%	-34%
	Sawtooth Wilderness						
Sulfate	3.06	0.81	2.5	2.59	-13,272 -34%	-27%	-35%
Nitrate	0.63	0.7	0.65	0.54	-32,418 -19%	-25%	-32%
	Selway-Bitterroot Wilderness						
Sulfate	4.83	1.1	3.86	4.32	-6,128 -12%	-15%	-29%
Nitrate	1.46	1.12	1.38	0.96	-63,099 -26%	-21%	-37%

* Inverse megameters

* RRF – Relative Reduction Factor – see section 9.1.1 or Appendix E page 15 and 19

Four Factor Analysis and Long Term Strategies

Section 11.4 of this chapter summarized the four factor analysis. Based upon the "time necessary for compliance," additional controls are unreasonable at this time. A discussion of the process used to determine if a source category is significantly contributing to visibility impairment and should undergo rule development and implementation will be discussed in the long term strategies in Chapter 21.

Based on the contribution of visibility impairment coming from natural sources rather than anthropogenic sources, the emissions reductions that can be expected from anthropogenic

23 Information was compiled based on CMAQ and WEP modeling using plan02(d) & 2018PRP(18d) emission inventory. This information is available on the WRAP TSS website as described in the previous footnote.

sources of nitrate and sulfate, the results of the four factor analysis, and "on-the-books" controls and long term strategies, Idaho's visibility goals are reasonable.

11.5.2 Number of Years Needed to Reach Natural Conditions at Goal Rate

While states are allowed to set reasonable progress goals which allow for a slower rate of progress than the URP, there are additional requirements. The Regional Haze Rule section 308(d)(1)(B)(ii) requires, "an assessment of the number of years it would take to attain natural conditions if visibility improvements continues at the rate of progress selected by the State as reasonable." This information must be provided to the public as part of the review process.

The formula for determining the number of years necessary to meet natural conditions is:

(Base Line – RPG)/ 14 years (n years in first planning period) = Annual Rate of Progress

Base Line – Natural Conditions = Needed Improvement from Baseline to Natural Conditions

Needed Improvement / Annual Rate of Progress = Years Needed to Meet Natural Conditions

Table 11-14 Reasonable Progress Goals – Years Needed to Meet Natural Conditions

Class I Area	2000-04 Baseline Conditions	Proposed Reasonable Progress Goal	Annual Rate of ProgressBased on Reasonable Progress Goal	Natural Conditions	Needed Improvement From Baseline to Natural Conditions	Years Need to Meet Natural Conditions Based on Idaho's Reasonable Progress Goal
	(dv)*	(dv)	(dv)	(dv)	(dv)	Years
Craters of the Moon National Monument	14	13.06	0.07	7.53	6	112
Sawtooth Wilderness	13.78	13.22	0.04	6.42	7	161
Selway-Bitterroot Wilderness	13.41	12.94	0.03	7.43	6	221

* deciview

Table 11-14 shows it would take 112 years to meet natural conditions at Craters of the Moon, 161 years at Sawtooth Wilderness, and 221 years at Selway-Bitterroot Wilderness based on the proposed reasonable progress goals.

Chapter 12. LONG TERM STRATEGY

12.1 Overview of the Long Term Strategy

The Regional Haze Rule requires each state to submit an implementation plan (generally called a state implementation plan [SIP]) to address visibility impairment every 10 years. As part of its regional haze plan, each state must include a long term strategy (LTS) to address regional haze visibility impairment in each Class I area in the state, and for each Class I area outside the state that may be affected by emissions from the state. The LTS must include enforceable measures necessary to achieve reasonable progress goals. It must identify all anthropogenic sources of emissions, including major and minor stationary sources, mobile sources, and area sources. If a state's emissions are contributing to visibility impairment in other states, the state must consult with those states and coordinate all measures necessary to address its portion of necessary emissions reductions. If the state has participated in a regional haze planning process, the state must ensure it has included all measures needed to achieve its apportionment of emissions-reduction obligations agreed upon through that process.

The state must document the technical basis, including modeling and emissions information, that the state has relied on to determine its apportionment of emissions reduction obligations necessary for achieving reasonable progress in each mandatory Class I area it affects. The state may meet this requirement by relying on technical analyses developed by the regional planning organization and approved by all state participants.

Idaho participated in the WRAP regional haze planning process and the development of the model, emissions inventory, monitoring information, and technical information used to develop this SIP. Full documentation and explanation of the WRAP consultation process and meetings can be found in Chapter 2 and Appendix B. Information on modeling, monitoring, and emissions can be found in the following locations:

- Modeling (Apportionment) Chapter 9 and Appendix E
- Monitoring (IMPROVE) Chapter 4 and 5
- Emissions Inventory Chapter 8 and Appendix D

12.2 Summary of All Anthropogenic Sources of Visibility Impairment Considered in Developing the Long Term Strategy

Section 51.308(d)(3)(iv) of the Regional Haze Rule requires states to identify all anthropogenic sources of visibility impairment when developing the LTS. Chapter 8 of this plan identifies all the anthropogenic sources for 2002 and projections for 2018. In Chapter 8, section 8.1 identifies all the key pollutants and the emissions amounts by source category from Idaho and section 8.2 looks at emissions from surrounding states. Chapter 9 of this plan analyzed both natural and anthropogenic sources and used modeling to determine an apportionment of those emissions among those sources. Chapter 10 identified BART-eligible facilities and determined what control equipment met the BART requirements for subject-to-BART facilities. Chapter 11 identified major source categories of SO_x and NO_x and include a four factor analysis for each of those source categories. A summary of emissions source categories and pollutants can be found in table 11-1.

12.3 Summary of Interstate Transport and Contribution

12.3.1 Class I Areas in Other States Affected by Idaho Emissions

The Regional Haze Rule (40 CFR 51.308(d)(i) and (ii)) requires any state that is causing or contributing to visibility impairment in any mandatory Class I area to implement all measures necessary to achieve its share of the emission reductions needed to meet progress goals for that Class I area. When a state has emissions that are reasonably anticipated to cause or contribute to visibility impairment in other states' Class I areas, the state must consult with the other states and participate in the development of coordinated emissions management strategies.

Section 8.2 of this plan compares Idaho's visibility-impairing pollutants with those of the surrounding states. Chapter 9 looks at source apportionment for each visibility- impairing pollutant and the sources and origins of the pollutants. Section 9.7 specifically looks at Class I areas in surrounding states that do not share a common border with Idaho, which are: Cabinet Mountain Wilderness, Eagle Cap Wilderness, and Jarbidge Wilderness. Section 9.7 also explains how these Class I areas mentioned above were selected to represent other near by Class I areas based on Clustered Source Region Attribution (see figure 9-67).

Although it is important to review all visibility-impairing pollutants to determine whether reductions could be made, the focus is on those from anthropogenic sources because they can be controlled. Sections 11.2 and 11.3 explain why SO_x and NOx are the primary focus of that investigation in this SIP. Specifically, Table 11.1 shows that SO_x and NO_x emissions are primarily from anthropogenic combustion type source categories while the emissions of other pollutants are heavily influenced by natural fire and fugitive dust24.

While the Regional Haze Rule requires states to improve visibility on the 20% worst visibility days and also not allow additional visibility degradation during the 20% best days, the LTS will focus on improvements to the 20% worst days because it is believed that emissions reductions from anthropogenic sources that improve visibility during the 20% worst days will also have a positive effect on the visibility during the 20% best days. Based on modeling of baseline emissions and emissions projected for the future, the reasonable progress goals as shown in table 11-11 indicate the projected emissions reductions are having a positive effect on the 20% best days.

Table 12-1 summarizes Idaho's contributions to the total amounts of SO_x and NO_x at Class I areas in surrounding states. Idaho's sulfate contributions range from 1.93% at Eagle Cap Glacier National Park to 9.20% at Bridger Wilderness. Over the first planning period,

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24 For this document the definition of fugitive dust is described as: Fugitive dust sources may be separated into two broad categories: process sources and open dust sources. Process sources of fugitive emissions are those associated with industrial operations such as rock crushing that alter the characteristics of a feed material. Open dust sources are those that generate non-ducted emissions of solid particles by the forces of wind or machinery acting on exposed material. Open dust sources include industrial sources of particulate emissions associated with the open transport, storage, and transfer of raw, intermediate, and waste aggregate materials, and nonindustrial sources such as unpaved roads and parking lots, paved streets and highways, heavy construction activities, and agricultural tilling. For a full description of fugitive dust sources and controls see the Fugitive Dust Hand Book at: http://www.wrapair.org/forums/dejf/fdh/index.html

Idaho's sulfate contributions are All over the board ranging from a 7.81% decrease at Cabinet Mountain Wilderness, 24.44% increase at Eagle Cap Wilderness. Jarbidge, Yellowstone, and Bridger are all down wind of emissions that were once anticipated from an electrical generating unit (EGU) that was included in the PSAT modeling; however, it is unlikely the unit will ever be built. For a complete discussion of the modeled emissions from the EGU project, see section 9.2 of this plan. Most of the expected sulfate emissions reductions are associated with BART controls and changes to the sulfur content of fuels used by on-road diesel sources.

Table 12-1 Idaho's Contribution of SO_x and NO_x in Surrounding Class I Areas

2018 Idaho Percent Contribution and Change 2002/2018										
State	**Class I Area**	**Pollutant**	**Nat. Fires & Bio.**	**Anthro. Fires**	**Mobile**	**Area**	**Point**	**Outside Domain**	**Idaho Total**	**Percent Change 02/018**
Oregon	**Hells Canyon**	SO_x	0.38%	0.00%	0.38%	2.44%	5.25%	0.00%	8.44%	-6.25%
		NO_x	2.63%	0.11%	9.13%	19.75%	4.00%	0.00%	35.62%	-20.00%
	Eagle Cap	SO_x	1.64%	0.00%	0.16%	0.33%	7.06%	0.00%	9.20%	24.44%
		NO_x	1.48%	0.23%	5.25%	11.07%	2.28%	0.00%	20.32%	-21.59%
Nevada	**Jarbidge**	SO_x	5.36%	0.00%	0.20%	0.99%	3.57%	0.00%	10.12%	2.00%
		NO_x	4.64%	0.00%	7.59%	13.92%	4.64%	0.00%	30.80%	-24.74%
Wyoming	**Yellowstone**	SO_x	2.86%	0.00%	0.20%	0.61%	5.11%	0.00%	8.79%	7.50%
		NO_x	6.88%	0.00%	6.42%	7.80%	3.21%	0.00%	24.31%	-26.39%
	Bridger	SO_x	1.64%	0.00%	0.16%	0.33%	7.06%	0.00%	9.20%	24.44%
		NO_x	2.86%	0.00%	1.43%	2.14%	1.43%	0.00%	7.86%	-35.29%
	North Absaroka	SO_x	2.28%	0.19%	0.19%	0.38%	2.85%	0.00%	5.89%	3.33%
		NO_x	3.38%	0.34%	3.38%	4.39%	1.69%	0.00%	13.18%	-29.09%
Montana	**Cabinet**	SO_x	5.58%	0.13%	0.38%	1.02%	0.38%	0.00%	7.49%	-7.81%
		NO_x	1.21%	0.17%	4.48%	6.55%	1.55%	0.00%	13.97%	-26.36%
	Glacier	SO_x	0.12%	0.12%	0.12%	0.72%	0.84%	0.00%	1.93%	-15.79%
		NO_x	3.42%	0.00%	0.16%	0.31%	0.78%	0.00%	4.67%	-3.23%
	Bob Marshall	SO_x	3.42%	0.00%	0.16%	0.31%	0.78%	0.00%	4.67%	-3.23%
		NO_x	1.53%	0.22%	1.97%	2.41%	0.88%	0.00%	7.00%	-27.27%
	Gates	SO_x	2.98%	0.00%	0.14%	0.28%	0.71%	0.00%	4.12%	-6.45%
		NO_x	1.80%	0.00%	1.55%	1.80%	0.77%	0.00%	5.93%	-25.81%

Idaho's contributions to nitrate totals range from 4.67% at Glacier National Park to 35% at Hells Canyon Wilderness. Most of the Class I areas are expected to see a 20% or greater decrease in NO_x emissions from Idaho. Most of the expected decrease in NO_x emissions from Idaho is associated with reductions from mobile sources and BART. Jarbidge Wilderness and Glacier Wilderness are exceptions; for these two Class I areas major reductions in NOx from Idaho are not expected, but that is based on modeled emissions

that included those anticipated from a projected EGU that is now unlikely to be built, as mentioned above.

12.3.2 Idaho Class I Areas Affected by Emissions from Other States

Section 8.2 of this plan reveals that all the WRAP states surrounding Idaho are expecting decreases in their SO_x and NO_x emissions. Tables 8-9 and 8-10 depict these expected reductions.

Table 12-2 shows the percentages of 2018 projected amounts of total SOx and NO_x in Idaho's Class I areas that are expected to come from the WRAP states impacting Idaho. The concentrations shown are based on the PSAT modeling discussed in Chapter 9. It should be noted that change shown from 2002 to 2018 may not include reductions expected from all the BART sources or changes in later versions of the 2018 emissions inventory. This may in part explain the SO_x and NO_x contributions from Wyoming. Wyoming overall NO_x and SO_x emissions are expected to decline by 14 to 15%. Wyoming is expecting some increases from oil and gas productions but through WRAP consultation process Idaho believes Wyoming as well as other surrounding states are diligently working to reduce sulfate and nitrate visibility impacts.

Table 12-2 Other States' 2018 Contributions to Totals at Idaho Class I Areas and Change from 2002

	Craters of the Moon NM			
	SO_x		NO_x	
Source Region	Percent Contribution	Change from 2002 - 2018	Percent Contribution	Change from 2002 - 2018
CA	0.91%	-16.67%	1.12%	-40.00%
MT	0.91%	0.00%	2.61%	-25.00%
NV	1.82%	11.11%	2.61%	-8.70%
OR	5.11%	-6.67%	3.47%	-34.88%
Pacific Offshore marine diesel	2.37%	0.00%	0.99%	0.00%
UT	3.10%	-5.56%	14.52%	-33.90%
WA	3.10%	-22.73%	2.98%	-52.94%
WY	3.47%	35.71%	4.34%	9.38%
Outside of Domain	51.46%	0.00%	25.19%	2.01%
	Sawtooth Wilderness			
	SO_x		NO_x	
Source Region	Percent Contribution	Change from 2002 - 2018	Percent Contribution	Change from 2002 - 2018
CA	2.57%	0.00%	2.68%	-33.33%
MT	0.77%	0.00%	2.01%	-25.00%
NV	2.57%	0.00%	4.03%	0.00%
OR	9.51%	-9.76%	8.72%	-31.58%
Pacific Offshore marine diesel	4.37%	0.00%	0.67%	0.00%
UT	0.51%	-33.33%	1.34%	-50.00%
WA	6.94%	-27.03%	8.05%	-42.86%
WY	2.06%	33.33%	0.00%	0.00%

Source Region	Selway-Bitterroot Wilderness			
Outside of Domain	50.64%	-1.01%	36.91%	7.84%
	SO_x		NO_x	
	Percent Contribution	Change from 2002 - 2018	Percent Contribution	Change from 2002 - 2018
CA	1.82%	0.00%	0.70%	-60.00%
MT	4.13%	0.00%	16.90%	-35.14%
NV	0.83%	0.00%	0.70%	0.00%
OR	6.12%	-5.13%	4.58%	-40.91%
Pacific Offshore marine diesel	3.64%	-4.35%	1.41%	0.00%
UT	0.50%	0.00%	1.06%	-50.00%
WA	7.27%	-26.67%	10.56%	-50.00%
WY	1.98%	33.33%	3.52%	0.00%
Outside of Domain	44.63%	0.00%	33.45%	3.26%

12.3.3 Estimated International Contribution to Idaho Class I Areas

Table 12-3 shows the 2018 projected contributions from outside the United States to concentrations of SO_x and NO_x at Idaho's Class I areas. These projections are based on the PSAT modeling discussed in Chapter 9. In many cases, the contribution from international emissions is more than the total contributions from the surrounding states and Idaho's point sources.

Table12-12-3 International 2018 Contributions to Emissions at Idaho's Class I Areas

	Craters of the Moon NM		Sawtooth Wilderness		Selway-Bitterroot Wilderness	
	SO_x	NO_x	SO_x	NO_x	SO_x	NO_x
Source Region	Percent Contribution	Percent Contribution	Percent Contribution	Percent Contribution	Percent Contribution	Percent Contribution
CAN	7.30%	4.22%	6.68%	6.04%	13.39%	11.62%
MEX	0.18%	0.00%	1.29%	0.00%	1.16%	0.00%
Pacific Offshore marine diesel	2.37%	0.99%	4.37%	0.67%	3.64%	1.41%
Outside of Domain	51.46%	25.19%	50.64%	36.91%	44.63%	33.45%

The PSAT and WEP results in Chapter 9 describe the amount of contribution from Canada, Mexico Pacific Offshore, marine shipping emissions, and global emissions identified as "outside domain" of the modeling boundaries. Since Idaho does not have regulatory authority over any of these emissions, the strategies for reductions from those sources will need to come from organizations like EPA.

This topic was brought up at a WRAP Implementation Work Group in March of 2007. Below is a brief summary of the EPA response regarding their work on international emissions.

The U.S. and Canada have been working on addressing transboundary emissions issues through the bilateral 191 Canada-United States Air Quality Agreement. Information regarding these agreements and reports can be found at: http://www.epa.gov/airmarkets/resurce/usaqa-resources.html. EPA Region 10 has been meeting with their counterparts in the British Columbia Ministry of Environment for the past five years to identify air quality issues in the Georgia Basin-Puget Sound airshed and to develop an International Airshed Strategy to address these issues.

The United States and Mexico, in partnership with border tribal, state, and local governments, have worked to increase the knowledge about air pollutions sources and their impacts on both sides of the border, establish monitoring networks in several key areas, conduct emissions inventories, and build local capacity.

In February 1992, the environmental authorities of both Federal governments released the Integrated Border Environmental Plan for the U.S.-Mexico Area (IBEP). The IBEP, a two-year plan, was the first bi-national Federal initiative created under the assumption that increased liberalization of trade would place additional stress on the environment and human health along the border.

Additionally, the United States and Mexico in partnership with border tribal, state and local governments are working together on projects such as retrofitting diesel trucks and school buses with either diesel oxidation catalysts or diesel particulate filters to operate on ultra-low-sulfur diesel fuel, constructing “lower polluting” or “environmentally friendly” brick kilns, and paving roads to reduce the levels of particulate matter in the border regions.

12.4 Summary of Interstate Consultation

Section 51.308(d)(3)(i) of the Regional Haze Rule requires the state to consult with the other states in order to develop coordinated emissions management strategies. A discussion of the WRAP consultation process is included in Chapter 2. This included consultation with the federal land managers, and the state-to-state consultation through the WRAP committees and work groups.

12.5 Technical Documentation

Section 51.308(d)(3)(iii) of the Regional Haze Rule requires the state to document the technical bases, including modeling, monitoring, and emissions information on which the state has relied to determine its apportionment of emissions reduction obligations necessary to achieve the RPGs. Idaho has relied upon technical information developed by WRAP with input from its member states through the various committees and work groups. Idaho has relied upon the emissions inventory and modeling results available on the WRAP technical support system. A discussion of the emissions inventory is in Chapter 8 and the modeling for source apportionment is in Chapter 9. The monitoring data for this plan came from the IMPROVE monitoring network. Chapter 4 provides an explanation of the IMPROVE monitoring system and the monitoring sites for Class I areas residing in Idaho.

12.6 Required Factors for the Long Term Strategy

Section 58.308(d)(3)(v) of the Regional Haze Rule requires each state to look at the following factors, at a minimum, in developing its LTS:

- Emissions reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment;
- Measures to mitigate the visibility impacts of construction activities;
- Emissions limitations and schedules for compliance to achieve the reasonable progress goals;
- Emissions source retirement and replacement schedules;
- Smoke management techniques for agricultural and forestry management purposes including plans that currently exist with the state for these purposes;
- Enforceability of emissions limitations and control measures; and
- The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategies.

The remainder of this section will discuss these required factors for the LTS.

12.6.1 Emissions Reductions Due to Ongoing Air Pollution Programs

The following summary describes ongoing programs and regulations in Idaho that directly protect visibility, or can be expected to improve visibility in Idaho's Class I areas, by reducing emissions in general. This summary does not attempt to estimate the actual improvements in visibility that will occur, as many of the benefits are secondary to the primary air pollution objective of these programs/rules, and consequently would be extremely difficult to quantify due to the technical complexity and limitations in current assessment techniques.

Prevention of Significant Deterioration/New Source Review (NSR) Rules

Idaho's Prevention of Significant Deterioration (PSD) and NSR Program are the primary tools for future protection of visibility at Idaho's Class I areas. These programs require new major sources and major modifications at existing sources with significant impacts to visibility at Class I areas to install Best Available Control Technology (BACT). Much like BART, PSD requires new or major modifications to model the emissions impacts on Class I areas within 300km to determine if the change in visibility above natural levels is significant. As new National Ambient Air Quality Standards are promulgated these significant levels can change. The PSD NSR permitting program is located at IDAPA 58.01.01.200 through 228 (specifically see 202.01.b.v, 202.01.c.vi, and also see 40 CFR 52.670 and annual updates at IDAPA 58.01.01.107) and establishes the baseline dates and the maximum allowable increases in pollutant concentrations.

State and Federal Mobile Source Regulations

The Federal Motor Vehicle Control Program has already produced large emissions reductions in NO_x, SO_x, VOC and particulate matter. The Federal Tier II vehicle emissions and fuel standards reduced the sulfur content of diesel fuel from 500 to 15 ppm (Ultra Low Sulfur Diesel – ULSD) in 2006. The reduction in sulfur content allowed diesel engines to be fitted with diesel oxidation chambers to reduce particulate. In 2007, non-road diesel was required to meet a maximum sulfur content of 500 ppm and this will be further reduced to 15 ppm in 2010. Additional programs include:

For on-road sources

- Tier 2 vehicle emission standards and Federal low-sulfur gasoline
- National low emission vehicle standards
- Heavy duty diesel standards

Federal non-road measures

- Lawn and garden equipment
- Tier 2 heavy duty diesel equipment
- Locomotive engine standards
- Compression ignition standards for vehicles and equipment
- Recreational marine engine standards

Programs to Meet PM_{10} NAAQS

12.6.1..1 Northern Ada County Carbon Monoxide (CO) Limited Maintenance Plan

Northern Ada County was first designated non-attainment for carbon monoxide (CO) under the provisions of the 1977 Clean Air Act Amendments. The latest Northern Ada County carbon monoxide limited maintenance plan was approved on October 28, 2002, and contained the following control measures:

- Local ordinances that ban residential wood stoves and open burning during inversion conditions;
- Voluntary transit control measures to increase ridership of alternative forms of transportation;
- Ada County vehicle inspection and maintenance plan;
- A voluntary oxygenated fuel with a tax incentive that reduced the tax by 2.5% per gallon if the fuel contained 10% by volume ethanol;
- The City of Boise replaced its diesel commuter buses with compressed natural gas buses.

12.6.1..2 Northern Ada County PM_{10} Maintenance Plan

On October 27, 2003, EPA rescinded the March 12 1999, finding (64 FR 12257) that the PM_{10} standards promulgated on July 1, 1987 (52 FR 24634) and the accompanying designation and classification for PM_{10} no longer applied. This action restored the applicability of the current PM_{10} standards Northern Ada County/Boise, Idaho which reverted the area to moderate non-attainment. Simultaneously, EPA took final action to approve the PM_{10} maintenance plan for the Ada County/ Boise, Idaho area as a SIP revision and redesignated the area to attainment for PM_{10}.

The maintenance plan takes credit for several control measures that are contained in the Northern Ada County carbon monoxide maintenance plan. Because of the woodstove ordinances, vehicle inspection and maintenance program, along with controls from the permitting program, the plan was able to demonstrate attainment and maintenance of the PM_{10} NAAQS.

These two plans reduce both carbon and particulate emissions in the surrounding Class I areas. The closest Class I areas are Sawtooth Wilderness, Craters of the Moon National Monument, Eagle Cap Wilderness, and Hells Canyon Wilderness.

12.6.1..3 Portneuf Valley (Pocatello) PM10 Maintenance Plan

On July 13, 2006, EPA (71 FR 39574) approved a maintenance plan submitted by Idaho and redesignated the area back to attainment of the PM_{10} NAAQS. The plan contains several voluntary and enforceable control measures that include:

- A residential wood stove education program and local ordinances that require all new stoves to be certified;
- A voluntary wood stove buyout program;
- A road-sanding program that reduced sanding materials between 15 and 35%; in addition, all of the communities within the maintenance area use regenerative air street sweepers to clean up sanding material as soon as possible;
- A consent order required RACT controls on the only major industrial source;
- The Sip requires transportation is to adhere to a motor vehicle emissions budget.

Reductions from these control measures affect visibility at Craters of the Moon National Monument, Yellowstone National Park, and other nearby Class I areas.

Sandpoint PM_{10} Non-attainment

Idaho is currently in the process of developing a revised PM_{10} plan for Sandpoint that will be submitted for EPA approval. The Sandpoint PM_{10} plan is very similar to other Idaho SIPs and includes:

- A residential wood stove program that includes both education and local ordinances the only allow the sale of new stoves that are certified by EPA;
- A wood stove program that bought out 150 uncertified wood stoves;
- A voluntary wood stove curtailment program with a message on urgency of the curtailment based upon concentration levels;
- A local ordinance that sets specific standards for the amount of “fines” (dust in the sand) in the anti-skid material applied to roads as a means to reduce fugitive dust;
- A street sweeping program in Sandpoint to remove road-sanding material as soon as possible.

12.6.2 Measures to Mitigate the Impacts of Construction Activities

40 CFR 51.308(d)(3)(v)(B) requires states to consider measures to mitigate the impacts of construction activities. Fugitive and windblown dust are the major source of particulate matter associated with construction activities. Idaho’s rule’s IDAPA 58.01.01.651 and 652 addresses control of fugitive dust from activities like construction by requiring all reasonable precautions be taken to prevent particulate matter from becoming airborne. In determining what is reasonable, the rule specifically identifies activities and “the proximity to mandatory Class I Federal Areas” As a factor to be considered.   The types of precautions listed in the rule include:

- use of water or chemicals,

- application of dust suppressants,
- use of control equipment,
- covering of truck loads,
- paving of roads,
- prompt removal of materials.

12.6.3 Emissions Limitations and Schedules of Compliance

40 CFR 51.308(d)(3)(v)(C) of the Regional Haze Rule requires states to consider emissions limitations and schedules for compliance to achieve the reasonable progress goals. The only emissions limitations and compliance schedules associated with this plan are the BART controls identified in Chapter 10. The control technologies for P4 Production (formerly Monsanto) are already in place and operating. The NO_x and SO_x controls for TASCO Nampa (Amalgamated Sugar) will be installed and operational no later than five-years after EPA approval of this plan.

In Chapter 11 (Reasonable Progress Goals) several source categories were identified as having the potential to cause or contribute to visibility impairment in Class I areas. It was determined it would take 4 to 5 years to determine if these source categories are in fact causing or contribution and develop rules for compliance. In most instances, it would take 1 to 2 years to model the emissions from individual facilities within the source category to determine if they are impacting visibility in Class I areas and another 2 to 3 years to develop rules for implementation, and time for the facilities to secure the necessary capital and install emission controls.

Idaho DEQ is required by the Clean Air Act section 110(a)(2)(A-D) to have a plan to assure compliance with the revised NAAQS for $PM_{2.5}$ and ozone. Since the state will need to implement the New Source Review Program and PSD program for the new $PM_{2.5}$ standard and must assure compliance with the revised standard, it makes sense to simultaneously analyze the source categories identified in the four factor analysis as needing further investigation on visibility impacts.

Idaho is investigating whether to deploy a strategy that would include a sensitivity study using AERMOD (a regulatory dispersion model) with local meteorology to determine the level of $PM_{2.5}$ emissions that may cause a significant concentration at any combination of a range of typical fenceline conditions and a range of typical stack parameters. Based on such an AERMOD sensitivity study, threshold emissions rates (solid and condensable) would be determined for various plume heights.

Secondary pollutants (such as ammonium nitrate and ammonium sulfate) do not contribute near a source (i.e. fenceline); however a large source of secondary pollutants may contribute to an airshed-wide non-attainment problem or impact visibility at Class I areas. A sensitivity study could also be conducted using an airshed photochemical grid model to determine what levels of SO_2 and NO_x emissions may cause a significant impact at any point in the airshed. Since the photochemical precursor environment varies throughout the airshed, the sensitivity study should explore a number of source locations to assure that conservative conditions are captured.

The results of the primary and secondary $PM_{2.5}$ sensitivity study would be a set of emissions thresholds for a specific non-attainment airshed above which a significant contribution may result. The point source emissions inventory containing $PM_{2.5}$, SO_2, and NO_x could then be sorted and compared to determine if facilities' emissions are above these thresholds. Those facilities with emissions above these thresholds could have the potential to cause or contribute to visibility impairment and may require further modeling to see if controls are warranted.

12.6.4 Emissions Source Retirement and Replacement Schedules

Section 51.308(d)(3)(v)(D) of the Regional Haze Rule requires States to consider emissions source retirement and replacement schedules. At this time, DEQ is not aware of any sources expecting to shut down or any scheduled replacements. If shutdowns or replacements do occur, they will be included as part of future projections.

12.6.5 Agricultural and Forestry Smoke Management Techniques

Section 51.308(d)(3)(v)(E) requires States to consider smoke management techniques for the purposes of agricultural and forestry management in developing reasonable progress goals. Idaho's open burning rules (IDAPA 58.01.01.600-623) regulate all open burning in Idaho on lands other than the five Indian reservations. Visibility concerns are addressed in Idaho's open burning rules; "The purpose of Sections 600-623 is to reduce the amount of emissions and minimize the impact of open burning to protect human health and environment from air pollutants resulting from open burning as well as to reduce the visibility impairment in mandatory Class I Federal Areas in accordance with the regional haze long-term strategy referenced at Section 667." (IDAPA 58.01.01.600)

Crop Residue Burning Program

Idaho specifically regulates crop residue burning with a permit by rule process. Crop residue is defined as "any vegetative material remaining in the field after harvest or vegetative material produced on designated conservation reserve program (CRP) lands." This includes entire fields, spots and broken bales within a field, pasture, and food plots. EPA approved Idaho's SIP for the crop residue burning program in August 2008. This SIP demonstrated that the new crop residue burning program meets all the requirements of an enhanced smoke management program, under 40 CFR 309 (d)(6)(i).

Prescribed Burning

Idaho also specifically regulates forestry (prescribed) burning under 58.01.01.614. Idaho regulates prescribed burning in the following two ways.

- When burn permits or prescribed fire plans are required:

DEQ will seek interagency agreements to assure permits or plans issued by agencies provide adequate consideration for controlling smoke from prescribed burning.

- When burn permits or prescribed fire plans are **not** required:

DEQ will develop and put into effect a smoke management plan for prescribed burning that must be followed by all burners.

Most of the major prescribed burners in Idaho voluntarily participate in the Montana/Idaho Airshed Group (Airshed Group). The Airshed group is composed of state, federal, tribal,

and private member organizations who are dedicated to the preservation of air quality in Montana and Idaho. Its members are prescribed burners and the public health and regulatory agencies that regulate this burning work cooperatively to prevent smoke impacts while using fire to accomplish land management objectives.

The Airshed Group is composed of three units: Montana, North Idaho, and South Idaho. The Montana Unit (formerly called the Montana State Airshed Group) was formed in 1978. The North Idaho Unit (formerly called the North Idaho State Airshed Group) was formed in 1990. The South Idaho Unit was formed in September 1998 and formally joined the operations of Montana and North Idaho in the fall of 1999.

Since 1999, Idaho has used the Airshed Group's operating guide as the state smoke management plan for prescribed burning. In 2003, DEQ sent a letter to EPA Region 10 certifying the Montana/Idaho Airshed Group's operating guide as DEQ's smoke management program for prescribed burning.

Idaho is currently in the process of developing a stand-alone smoke management plan that incorporates the MT/ID Airshed Group's operating guide. The smoke management plan will follow the EPA's *Interim Air Quality Policy on Wildland and Prescribed Fires* (1998). This smoke management plan will apply to all prescribed burning in Idaho on lands other than the five Indian reservations. The smoke management plan will address what is needed to protect air quality when a burn permit or prescribed fire burn plan is and is not required. The smoke management plan will be implemented in 3 phases:

1. Address burning by the members of the Airshed Group. Documenting the smoke management techniques used by the Airshed Group.
2. Evaluate and address burning by large prescribed burners that are not currently members of the Airshed Group.
3. Evaluate and address burning by smaller prescribed burners.

12.7 Additional Factors Considered in Developing the Long Term Strategy

Under Idaho's general rules there are several rules that reduce emissions of visibility-impairing pollutants. While these rules are presented here, they are state-only rules and only included here as examples of additional factors Idaho is implementing that have a positive effect on visibility. These rules may change in the future as needed to reduce emissions under the intent of the rule.

Idaho's dairy rule provides for a program that reduces ammonia emissions through best management practices (BMPs). Under this program, feedlot and dairy operations are given a variety of BMPs to choose. Each BMP has a point score based on the effectiveness of that BMP to reduce ammonia.

Idaho's sulfur content rule sets a threshold for sulfur content in distillate fuel and coal. The burning of lower sulfur content fuels contributes less sulfur to the atmosphere which reduces the formation of sulfates.

12.8 Enforceability of Idaho's Measures

Section 51.308(d)(3)(v)(F) of the Regional Haze Rule requires states to assure that emissions limitations relied upon to meet reasonable progress goals are enforceable.

Idaho has assured that all emissions limitations relied upon to meet the RPGs identified in this plan are enforceable. Both subject–to-BART facilities have permit limits based upon the emissions reductions expected from BART controls. The state has also developed and adopted rules to implement BART, set RPGs, and establish LTS. These rules can be found at IDAPA 58.01.01.665-668

12.9 Net Effect on Visibility from the Long Term Strategy

Section 51.308(d)(3)(v)(G) requires states to address the net effect on visibility resulting from projected changes in point, area, and mobile source emissions by 2018. Idaho projects emissions inventory changes to point, area, and mobile source inventories by the end of the first implementation period. These changes are summarized in the tables found in Chapter 8. These changes in the emissions inventory are from the most recent emissions inventory produced by WRAP and include all the BART and LTS known at the time of the inventory development.

12.9.1 Emissions Reductions from Point, Area, and Mobile Sources

A full description of the projected emissions reductions can be found in Chapter 8. Chapter 8 includes a separate analysis for each of the visibility-impairing pollutants and the source categories. The tables in Chapter 8 summarize the data and show the net change in emissions from 2002 to 2018. In Chapter 11, Table 11-11 shows all of the visibility-impairing pollutants and the percentage contribution from each source category.

12.9.2 Projection of 2018 Visibility Conditions from 2002 Base Case (results from WRAP regional modeling work)

Using WRAP's 2002 and 2018 emissions inventories, Chapter 11 shows the modeling results and the Idaho's RPGs. Section 11.5 discusses RPGs for both the 20% best and 20% worst days and also looks at the estimated future concentrations in comparison with the URP and discusses impacts from anthropogenic and natural sources.

Chapter 13. Consultation and Future Commitments

13.1 Federal Land Manager Consultation

Section 51.308(i) of the Regional Haze Rule requires consultation between the state and federal land managers (FLMs) related to development and implementation of regional haze plans. States need to provide FLMs an opportunity to comment at least 60 days prior to holding a public hearing on any proposed plan or plan revisions. This includes the opportunity to comment on the state's assessment of visibility impairment in each Class I area, and providing recommendations on the reasonable progress goals and visibility control strategies the state has proposed. States also need to provide the FLMs an opportunity to comment on the five-year progress reports and other developing programs that may contribute to Class I visibility impairment.

Idaho has provided agency contacts to the FLMs as required. In the development of this plan, the FLMs were consulted in accordance with provisions of 51.308(i)(2). Idaho has provided the FLMs an opportunity for consultation at least 60 days prior to holding any public hearing on the plan. The FLM comment period started on June 3, 2010 and closed on August 5, 2010. The first public hearing on the plan is August 31, 2010. The Idaho Regional Haze State Implementation Plan was made available to the FLMs for review and comment via DEQ's regional haze Web site on June 3, 2010. The FLMs were notified by e-mail and a letter on that date. A copy of the letter can be found in Appendix I.

In accordance with 40 CFR 51.308(i)(3), Idaho has received comments regarding the plan from the FLMs. These comments on the plan were addressed by DEQ and can be found in Appendix I.

Section 51.308(i)(4) requires procedures for continuing consultation between the state and FLMs on the implementation of the visibility protection program. Idaho will consult with the FLMs on the status of the following implementation items:

- Implementation of emissions strategies identified in the plan as contributing to expected improvements in visibility on the 20%worst days visibility.
- Summary of new permits issued for major sources.
- Status of state actions to meet commitments for completing any future assessments or rulemaking on sources identified as likely contributors to visibility impairment.
- Any changes to the monitoring strategy or monitoring station locations that affect tracking of reasonable progress.
- Work underway for preparing the five-year reviews and 10-year revisions.
- Items for FLMs to consider or provide support for in preparation for any visibility plan revisions (based on any five-year review or 10-year revision).

Section 51.308(g) requires States to submit a progress report to EPA every five years evaluating progress towards the reasonable progress goal established for each Class I area. The first progress report is due 5 years from submittal of this plan. In accordance with Section 51.308(h), Idaho will submit a determination of the adequacy of the existing regional haze SIP as part of the five-year progress report. Idaho will continue to consult with the FLMs during the development of future progress reports and revisions.

13.2 State Consultation and Coordination

Section 51.308(d)(3)(i) of the Regional Haze Rule requires states to consult with neighboring states to develop coordinated emissions strategies. This requirement applies both where emissions from a state are reasonably anticipated to contribute to visibility impairment in Class I areas outside the state, and where emissions from other states are reasonably anticipated to contribute to Class I visibility impairment inside the state.

As described in Chapter 12, Idaho reviewed interstate transport of haze (visibility-impairing) pollutants with neighboring states, focusing on source apportionment information to identify visibility impacts at Class I areas in Idaho and neighboring states. The states consulted by Idaho were Washington, Oregon, Nevada, Wyoming and Montana. This section reviews the consultation process with these states. Additional consultation with these states was part of Idaho's participation in WRAP forums and committees as described in Chapter 2.

As part of the WRAP process, the Implementation Work Group (IWG), composed of the 14 Western States, reviewed major strategies associated with state and tribal regional haze plans. These meetings addressed the issues associated with development of strategies for meeting reasonable progress goals and consultation with states and tribes to address impacts of intrastate emissions.

13.2.1 Summary of State Consultation Process

The WRAP IWG process was one of the primary mechanisms for state-to-state consultation. Idaho also consulted directly with IWG members from the following neighboring states:

1. Washington – Doug Schneider, Washington Department of Ecology
2. Oregon – Brian Finneran, Oregon Department of Environmental Quality
3. Nevada – Frank Forsgren, Nevada Division of Environmental Protection
4. Wyoming- Tina Anderson, Wyoming Department of Environmental Quality
5. Montana – Laurel Dygoski, EPA Region 8

Discussions with neighboring states included the review of major contributing sources of air pollution, as documented in numerous WRAP reports and projects, and as described in Chapters 7-12 of this plan. The focus of this review process was interstate transport of emissions, major emissions sources believed to be contributing to visibility impairment, and whether any mitigation measures were needed. All the states relied upon similar emission inventories, results from source apportionment studies and BART modeling, review of IMPROVE monitoring data, existing state smoke management programs, and

other information in assessing the extent to which each state contributes to visibility impairment in other states' Class I areas.

Idaho will continue to coordinate and consult with other states as part of the implementation of the strategies in the Idaho regional haze plan and for future progress reports and revisions.

13.2.2 Consistency with Neighboring State SIPs

Idaho's Regional Haze Plan was developed with emphasis on consistency with other State plans, through consultation directly with neighboring states and in the WRAP, and the technical tools, policy documents, and other products that were used to develop all of the by western states' regional haze plans. The format, layout, and in some instances language from other WRAP states was used in the development of this regional haze SIP. In an effort to improve consistency among SIPs submitted to EPA Region X, this plan follows Oregon's Regional Haze SIP as a template.

13.2.3 Idaho and Other States' Emissions Reduction Obligations

Section 51.308(d)(3)(ii) requires each state to demonstrate that its regional haze plan includes all measures necessary to achieve its fair share of emissions reductions needed to meet reasonable progress goals. Based on the consultation described above, no major contributions were identified that supported developing new interstate strategies, mitigation measures, or emissions reduction obligations. Both Idaho and neighboring states agreed that the implementation of BART and other existing measures in state regional haze plans were sufficient, and that future consultation would address any new strategies or measures needed.

13.3 Public Comment

As required by 40 CFR 51.102 and adopted by reference in the Department of Environmental Quality rules, IDAPA 58-10-10-107.03.a, this Regional Haze Plan was provided to the public for comments. The public comment period started on August 31, 2010 and ended at close of business on September 30, 2010. A public hearing was held on September 15, 2010 at 3:00 pm. A copy of the "Certificate of Hearing" certifying no members of the public attended the hearing and that the notice was published in several news papers can be found in Appendix I.

DEQ received three written comments from Lesilie Weldon (USDA Forest Service), Charles Johnson (Nampa citizen) and Dean DeLorey (Amalgamated Sugar Company – TASCO). The actual comments and response to those comments can be found in Appendix I.

13.4 Tribal Consultation

Although not required by the EPA Regional Haze Rule, DEQ consulted with the tribes during the development of this plan. Like the state consultation process described above, consultation with the tribes involved reviewing major emissions sources and regional haze strategies, both through WRAP activities and direct outreach to tribes in Idaho. Idaho

participated in two “Environmental Summits” put on by the tribes and presented Idaho’s regional haze plans.

A letter was sent on March 13, 2008, to the WRAP Tribal Caucus Coordinator Ken Cronin with the National Tribal Environmental Council (NTEC), describing Idaho’s interest in obtaining participation from the tribes in the development of Idaho’s haze plan, and seeking assistance from NTEC in contacting Tribes on this matter. A copy of the letter can be found in appendix I.

13.5 Commitment to Future Regional Haze Plan Revisions

13.5.1 Comprehensive 10-Year Plan Revisions

Section 51.308(f) of the Regional Haze Rule requires states to revise their regional haze plans and submit a plan revision to EPA by July 31, 2018, and every 10 years thereafter. In accordance with the requirements listed in this section of the federal Regional Haze Rule, Idaho commits to revising and submitting a regional haze implementation plan by July 31, 2018.

These plan revisions must evaluate and reassess elements under 40 CFR 51.308(d), taking into account improvements in monitoring data collection and analysis, and control technologies. Elements of the future plan are summarized below.

1. **Current Visibility Conditions**- Determine current visibility (most recent five-year period preceding the required date of the plan submittal for which data is available) conditions for the most impaired and least impaired days and determine the actual progress made towards natural conditions.
2. **Long Term Strategies –** Determine the effectiveness of the long term strategy for achieving the presumptive goal for the prior SIP period. If the long term strategy or prior goal was insufficient to attain natural conditions by 2064, the State must look at additional or new controls measures that may be adopted considering the cost of compliance, the time necessary to implement, energy and non-air quality environmental impacts, and the affected source’s remaining useful life.
3. **Reasonable Progress Goals –** Affirm or revise the current reasonable progress goal based on assessment of new or updated information, improved technologies, and ongoing programs.
4. **Monitoring Strategy –** Re-evaluate the adequacy of the existing monitoring strategy. Provide updated information and changes to the monitoring strategy, as well as an updated emissions inventory.

13.6 Adequacy Determination of the Plan

As required by Section 51.308(h) of the Regional Haze Rule, depending on the findings of the five-year progress report, Idaho commits to taking one of the following actions at the same time Idaho submits its five-year progress report:

1. If Idaho finds that no substantive SIP revisions are required to meet established visibility goals, Idaho shall provide EPA a negative declaration saying that no plan revision is needed;

2. If Idaho finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from outside the state, Idaho shall notify EPA and the other contributing state(s), and initiate efforts through a regional planning process to develop additional strategies for addressing the SIP deficiency;
3. If Idaho finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from another country, Idaho shall notify EPA and provide the available supporting information; or
4. If Idaho finds that the plan is or may be inadequate to ensure reasonable progress due to emissions from within the State, Idaho will develop additional control strategies to address the plan deficiencies and revise the plan.

Appendix A: Regional Haze Definitions

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Appendix A Chapter 1 Introduction

Regional Haze Definitions

The following definitions apply to this implementation plan, and can be separated into four categories: (A) general definitions from Section 301(40 CFR 51.301) related to visibility, some of which were added or revised upon adoption of the Regional Haze Rule in 1999; (B) specific definitions for the fire. (C) General definitions as taken from the Visibility Information Exchange Web System (VIEWS) at: http://views.cira.colostate.edu/web/Glossary.aspx

A. General Definitions from Section 301 related to Visibility:

BART-eligible source means an existing stationary facility as defined in this section.

Best Available Retrofit Technology (BART) means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant, which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and 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.

Deciview means a measurement of visibility impairment. A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired. The deciview haze index is calculated based on the following equation (for the purposes of calculating deciview, the atmospheric light extinction coefficient must be calculated from aerosol measurements):

$$\text{Deciview haze index} = 10 \quad 1n_e \quad (b_{ext}/10\ Mm^{-1}).$$

Where b_{ext} = the atmospheric light extinction coefficient, expressed in inverse megameters (Mm^{-1}).

Existing stationary facility means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted.

Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input,
Coal cleaning plants (thermal dryers),
Kraft pulp mills,
Portland cement plants,
Primary zinc smelters,
Iron and steel mill plants,
Primary aluminum ore reduction plants,
Primary copper smelters,
Municipal incinerators capable of charging more than 250 tons of refuse per day,
Hydrofluoric, sulfuric, and nitric acid plants,
Petroleum refineries,
Lime plants,
Phosphate rock processing plants,
Coke oven batteries,
Sulfur recovery plants,
Carbon black plants (furnace process),
Primary lead smelters,
Fuel conversion plants,
Sintering plants,
Secondary metal production facilities,
Chemical process plants,
Fossil-fuel boilers of more than 250 million British thermal units per hour heat input,
Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels,
Taconite ore processing facilities,
Glass fiber processing plants, and
Charcoal production facilities.

Federal Class I area means any Federal land that is classified or reclassified Class I.

Federal Land Manager means the Secretary of the department with authority over the Federal Class I area (or the Secretary's designee) or, with respect to Roosevelt-Campobello International Park, the Chairman of the Roosevelt-Campobello International Park Commission.

Federally enforceable means all limitations and conditions which are enforceable by the Administrator under the Clean Air Act including those requirements developed pursuant to 40 CFR Parts 60 and 61, requirements within any applicable State Implementation Plan, and any permit requirements established pursuant to 40 CFR 52.21 of this chapter or under regulations approved pursuant to CFR Parts 51, 52, or 60.

Implementation plan means, for the purposes of this part, any State Implementation Plan, Federal Implementation Plan, or Tribal Implementation Plan.

Indian tribe or tribe means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village, which is federally recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

In existence means that the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or (2) entered into binding agreements or contractual obligations, which cannot be cancelled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed in a reasonable time.

Least impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the lowest amount of visibility impairment.

Major stationary source and major modification mean major stationary source and major modification, respectively, as defined in 40 CFR 51.166.

Mandatory Class I Federal Area means any area identified in 40 CFR Part 81, Subpart D.

Most impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the highest amount of visibility impairment.

Natural conditions includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Potential to emit means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions do not count in determining the potential to emit of a stationary source.

Reasonably attributable means attributable by visual observation or any other technique the state deems appropriate.

Reasonably attributable visibility impairment means visibility impairment that is caused by the emission of air pollutants from one, or a small number of sources.

Regional haze means visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources.

State means ``State'' as defined in section 302(d) of the CAA.

Stationary Source means any building, structure, facility, or installation, which emits or may emit any air pollutant.

Visibility impairment means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

B. Definitions for the Fire

1. ***Fire*** means any wildfire, wildland fire, prescribed fire, and agricultural burning that is conducted on Federal, State, and private wildlands and farmlands. Except where "prescribed fire" is noted, the term "fire" shall apply to the sources identified herein.
2. ***Land Manager*** means any federal, state, local, or private entity that owns, administers, directs, oversees or controls the use of public or private land, including the application of fire to the land.
3. ***Prescribed fire*** or ***prescribed burn*** means any fire ignited by management actions to meet specific objectives, such as achieving resource benefits.
4. ***Wildland Fire Used for Resource Benefits*** means naturally ignited wildland fire that is managed to accomplish specific prestated resource management objectives in predefined geographic areas.

General Definitions:

2000-04 Baseline: Refers to a WRAP emissions or modeling scenario based on the designated planning emissions inventories, including a 5 year average of fire emissions. Also referred to as Plan02 analysis series.

2002 Base Case: Refers to a WRAP emissions or modeling scenario based on 2002 emissions inventories, including actual fire emissions for 2002. Also referred to as Base02 analysis series.

2018 Base Case: Refers to a WRAP emissions or modeling scenario based on 2018 emissions inventories estimated by applying rules on the books in late 2004, generated in early 2006. Also referred to as Base18 analysis series.

2018 Preliminary Reasonable Progress: Refers to a WRAP emissions or modeling scenario based on the preliminary reasonable progress emissions inventories, generated in early 2007. Includes corrections, refinements and additions to the 2018 Base Case, as well as estimates of controlling SO_2 and some NO_x from special coal-fired power plants, called BART sources. Also referred to as PRP18 analysis series.

A

Abrasion mode:A size range of particles, typically larger than about 3 micrometers in diameter, primarily generated by abrasion of solids.
Absorption:A class of processes by which one material is taken up by another.
Absorption coefficient:A measure of the ability of particles or gases to absorb photons; a number that is proportional to the number of photons removed from the sight path by absorption per unit length.
Absorption cross section: The amount of light absorbed by a particle divided by its physical cross section.
Accumulation mode:A size range of particles, from about 0.1 to 3 micrometers, formed largely by accumulation of gases and particles upon smaller particles. They are very effective in scattering light.
Acid deposition: Wet and/or dry deposition of acidic materials to water or land surfaces. The chemicals found in acidic deposition include nitrate, sulfate, and ammonium.
Acid precipitation: Typically is rain with high concentrations of acids produced by the interaction of water with oxygenated compounds of sulfur and nitrogen which are the by-products of fossil fuel combustion.
Acid rain:(or Acid Mist) The deposition of acid chemicals (incorporated into rain, snow, fog, or precipitation) from the atmosphere to water or land surfaces. The pH of rain is considered acid when it is below about 5.2 pH.
Adverse impact:A determination that an air-quality related value is likely to be degraded within a Class I area.
Aerometric Information Retrieval System (AIRS):A computer-based repository of US air pollution information administered by the EPA Office of Air Quality Planning and Standards.
Aerosol: Suspensions of tiny liquid and/or solid particles in the air.
Aerosol extinction: See reconstructed light extinction.
aerosol_bext:VIEWS parameter: Aerosol extinction; Type Code: CALC; Units: Inverse megameters
Aethalometer: An aerosol monitoring instrument that continuously measures particle light absorption (aerosol black carbon) on a quartz fiber filter.
AGf:VIEWS parameter: Silver (Fine); Description: Silver Elemental Concentration FINE Size Fraction; CAS Number: 7440-22-4; AQS Code: 84166; Type Code: PM2.5; Units: UG/CU Meter (LC)
Agglomeration: The process of collisions of particles that stick together to become larger particles.
Air light: Light scattered by air (molecules or particles) toward an observer, reducing the contrast of observed images.
Air parcel:A volume of air that tends to be trans-ported as a single entity.
Air pollutant: An unwanted chemical or other material found in the air.
Air pollution: Degradation of air quality resulting from unwanted chemicals or other materials occurring in the air.
Air quality (In context of the national parks): The properties and degree of purity of air to which people and natural and heritage resources are exposed.
Air Quality Values (AQRVs): Including visibility, flora, fauna, cultural and historical resources, related values odor, soil, water, and virtually all resources that are dependent upon and affected by air quality. "These values include visibility and those scenic,

cultural, biological, and recreation resources of an area that are affected by air quality" (43 Fed. Reg. 15016).
AIRS: Aerometric Information Retrieval System (of USEPA)
AIRWeb: Air Resources Web, an air quality information retrieval system for US parks and wildlife refuges developed by the Air Resources Division of the National Park Service and the Air Quality Branch of the US Fish and Wildlife Service.
Al2O3:VIEWS parameter: Aluminum Oxide; CAS Number: 1344-28-1; Units: UG/CU Meter (LC)
Albedo: The fraction of total light incident on a reflecting surface that is reflected back omnidirectionally.
ALc:VIEWS parameter: Aluminum (Coarse); CAS Number: 7429-90-5; AQS Code: 83101; Type Code: COARSE; Units: UG/CU Meter (LC)
ALf:VIEWS parameter: Aluminum (Fine); CAS Number: 7429-90-5; AQS Code: 88104; Type Code: PM2.5; Units: UG/CU Meter (LC)
Ambient air: Air that is accessible to the public.
ammNO3: Ammonium nitrate.
ammNO3f:VIEWS parameter: Ammonium Nitrate (Fine); CAS Number: 6484-52-2; AQS Code: 88344; Type Code: PM2.5; Units: UG/CU Meter (LC)
ammNO3f_bext:VIEWS parameter: Ammonium Nitrate Extinction (Fine); CAS Number: 6484-52-2; Type Code: CALC; Units: Inverse megameters
ammNO3f_Large:VIEWS parameter: Ammonium Nitrate (Fine), Large Fraction; Type Code: CALC; Units: UG/CU Meter (LC)
ammNO3f_Small:VIEWS parameter: Ammonium Nitrate (Fine), Small Fraction; Type Code: CALC; Units: UG/CU Meter (LC)
ammSO4: Ammonium sulfate.
ammSO4f:VIEWS parameter: Ammonium Sulfate (Fine); Description: If particulate Sulfur (Sf) is non-null, then ammSO4f is calculated as 4.125 * Sulfur. Otherwise, it is calculated as 1.375 * Sulfate (SO4f). If the concentration of the base parameter (Sf or SO4f) is below the minimum detection limit, then 0.5 * MDL is used. (NOTE: The calculation procedure for RHR datasets differs from this. Please see the RHR guidance documents detailed calculation procedures.); CAS Number: 7783-20-2; AQS Code: 88339; Type Code: PM2.5; Units: UG/CU Meter (LC)
ammSO4f_bext:VIEWS parameter: Ammonium Sulfate Extinction (Fine); CAS Number: 7783-20-2; Type Code: CALC; Units: Inverse megameters
ammSO4f_Large:VIEWS parameter: Ammonium Sulfate (Fine), Large Fraction; Type Code: CALC; Units: UG/CU Meter (LC)
ammSO4f_Small:VIEWS parameter: Ammonium Sulfate (Fine), Small Fraction; Type Code: CALC; Units: UG/CU Meter (LC)
Anion:A negative ion, such as sulfate, nitrate, or chloride.
Anthropogenic: Produced by human activities.
Anthropogenic Fire Sources: Combustion emissions from agricultural burning by farmers and ranchers and restoration burning activities of wildland managers. These sources are computed as daily point source events.
Apparent contrast: Contrast at the observer of a target with respect to some background, usually an element of horizon sky directly above the target.

Apparent spectral contrast: Percent difference in radiant energy associated with an object and its background when the object is observed at some distance r.

Apportionment: To distribute or divide and assign proportionately.

Area Sources: Non-point land-based emissions sources that are treated as being spread over a spatial extent (usually a county or air district) and that are not movable (as compared to nonroad mobile and on-road mobile sources). Because it is not possible to collect the emissions at each point of emission, they are estimated over larger regions. These sources are computed as being spread over a spatial extent based on population, economic activity data, or other factors, and estimated with factors developed from special studies. Examples of stationary area sources are residential heating and architectural coatings.

Artifact: Any component of a signal or measurement that is extraneous to the variable represented by the signal or measurement.

Atmospheric clarity: An optical property related to the visual quality of the landscape viewed from a distance.

Atomic absorption spectroscopy:A method of chemical analysis based on the absorption of light of specific wavelengths of light by disassociated atoms in a flame or high temperature furnace. It is sensitive only to elements.

Attainment area:A geographic area in which levels of a criteria air pollutant meet the health-based National Ambient Air Quality Standard for that specific pollutant.

Attenuation: The diminution of quantity. In the case of visibility, attenuation or extinction refers to the loss of image-forming light as it passes from an object to the observer.

Audit: An investigation of the ability of a system of procedures and activities to produce data of a specified quality.

Avg_bp:VIEWS parameter: Average barometric pressure; Description: Average barometric pressure during sampling; Type Code: MET

Avg_Temp:VIEWS parameter: Average temperature; Description: Average temperature during sampling; Type Code: TMP; Units: DEGREES, CENTIGRADE

B

babs:VIEWS parameter: Light absorption coefficient; Description: Light Absorption Coefficient (Non-corrected); Type Code: OPT

Back trajectory: The modeled path of an air parcel as it is projected backward in time.

Background luminance:A measure of light power reflected or emitted from the background of an object within a solid angle of one steradian per unit area projected in a given direction.

BAf:VIEWS parameter: Barium (Fine); Description: Barium Elemental Concentration FINE Size Fraction; CAS Number: 7440-39-3; AQS Code: 84107; Type Code: PM2.5; Units: UG/CU Meter (LC)

BE_EC_PM25:VIEWS parameter: SEARCH Best Estimate EC PM2.5; CAS Number: 7440-44-0; Type Code: PM2.5; Units: UG/CU Meter (LC)

BE_MASS_PM25:VIEWS parameter: SEARCH Best Estimate MASS PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)

BE_MMO_PM25:VIEWS parameter: SEARCH Best Estimate MMO PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)

BE_NH4_PM25:VIEWS parameter: SEARCH Best Estimate NH4 PM2.5; CAS Number: 14798-03-9; Type Code: PM2.5; Units: UG/CU Meter (LC)
BE_NO3_PM25:VIEWS parameter: SEARCH Best Estimate NO3 PM2.5; CAS Number: 12033-49-7; Type Code: PM2.5; Units: UG/CU Meter (LC)
BE_OM_PM25:VIEWS parameter: SEARCH Best Estimate OM PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
BE_OTHER_PM25:VIEWS parameter: SEARCH Best Estimate OTHER PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
BE_SO4_PM25:VIEWS parameter: SEARCH Best Estimate SO4 PM2.5; CAS Number: 14808-79-8; Type Code: PM2.5; Units: UG/CU Meter (LC)
Best Available Control Technology (BACT):A source emission limitation, based on the maximum degree of reduction for each pollutant, that must be applied by sources subject to the Prevention of Significant Deterioration program.
Best Available Retrofit Technology (BART):A source emission limitation, based on the maximum degree of reduction for each pollutant, that must be achieved by sources subject to the Prevention of Significant Deterioration program.
Bext: See extinction.
Bias: An unfair influence, inclination, or partiality of opinion.
Bimodal distribution:A plot of the frequency of occurrence of a variable versus the variable. A bimodal distribution exists if there are two maxima of the frequency of occurrence separated by a mini-mum. See mode.
Biogenic Sources: Carbon and nitrogen emissions from plant and animal activities. These sources are computed by applying meteorological data by land use type over a spatial extent (an emissions model grid cell, cross-referenced to a county or air district).
Biological effects: Ecological studies to determine the nature or extent of air pollution injury to biological systems.
BRc:VIEWS parameter: Bromine (Coarse); CAS Number: 7726-95-6; AQS Code: 83109; Type Code: COARSE; Units: UG/CU Meter (LC)
BRf:VIEWS parameter: Bromine (Fine); CAS Number: 7726-95-6; AQS Code: 88109; Type Code: PM2.5; Units: UG/CU Meter (LC)
Brightness:A measure of the light received from an object, adjusted for the wavelength response of the human eye, so as to correspond to the subjective sensation of brightness. For visually large objects, the brightness does not depend on the distance from the observer.
Brightness contrast: The ratio of the difference in brightness between two objects to the brightness of the brighter of the two. It varies from 0 to -1.
Bscat: Scattering coefficient. Measured directly by a nephelometer, the scattering coefficient includes scattering due to particles and atmospheric gases (Rayleigh scattering). Standard reporting units are inverse megameters (Mm-1).
bsp:VIEWS parameter: Light scattering coefficient; Description: Light Scattering Coefficient (Bsp); Type Code: OPT; Units: Inverse megameters
Budget: See light extinction budget.

C

Ca:VIEWS parameter: Calcium Ion; Description: Calcium Ion; CAS Number: 7440-70-2; Type Code: AQU; Units: MILLIGRAMS/LITER
CAA: Clean Air Act (including all of its amendments)

CAAA: Clean Air Act Amendments (generally refers to Clean Air Act Amendments of 1999)
CAc:VIEWS parameter: Calcium (Coarse); CAS Number: 7440-70-2; AQS Code: 83111; Type Code: COARSE; Units: UG/CU Meter (LC)
CAf:VIEWS parameter: Calcium (Fine); Description: Mass of calcium particles < 2.5 um in diameter; CAS Number: 7440-70-2; AQS Code: 88111; Type Code: PM2.5; Units: UG/CU Meter (LC)
Calibration: The process of submitting samples of known value to an instrument, in order to establish the relationship of value to instrumental output.
Camera: Device for recording visual range on film.
CaO:VIEWS parameter: CaO; Units: UG/CU Meter (LC)
car_car:VIEWS parameter: Carbon Carbonate (Fine); Description: AIRS calculated; CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)
Carbon Monoxide: One of the six criteria pollutants. A colorless, odorless and poisonous gas produced by incomplete burning of carbon in fuels.
Cascade impactor: An instrument that samples particles by impacting on solid surfaces via jets of air. After passing the first surface, the air is accelerated toward the next surface by a higher speed jet, in order to capture smaller particles than could be captured by the previous one.
CAt:VIEWS parameter: Calcium (Tsp); Description: Mass of calcium particles from open inlet (no size cut); CAS Number: 7440-70-2; AQS Code: 12111; Type Code: TSP; Units: UG/CU Meter (LC)
CDf:VIEWS parameter: Cadmium (Fine); CAS Number: 7440-43-9; AQS Code: 84110; Type Code: PM2.5; Units: UG/CU Meter (LC)
CEf:VIEWS parameter: Cerium (Fine); CAS Number: 7440-45-1; Type Code: PM2.5; Units: UG/CU Meter (LC)
CENRAP: Central States Regional Air Partnership, one of five RPOs. Includes the states and tribal areas encompassed by Nebraska, Kansas, Oklahoma, Texas, Minnesota, iowa, Missouri, Arkansas, and Louisiana. Affiliated with CenSARA.
CenSARA: Central States Air Resource Agencies. Represents the states of Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Missouri, Arkansas, and Louisiana.
cf_vcode:VIEWS parameter: cf_vcode; Type Code: FLAG
Charge neutralization:A process of removing static electric charges. This is done to particle- sampling filters in order to prevent electrostatic forces from distorting the apparent weight of the sample.
Chemical Speciation Network (CSN): The CSN was established to meet the regulatory requirements for monitoring speciated PM2.5 to determine the chemical composition of these particles. The purpose of the CSN is to determine, over a period of several years, trends in concentration levels of selected ions, metals, carbon species, and organic compounds in PM2.5.The program began in 1999 with 54 Speciation Trends Network (STN) sites across the nation located primarily in or near larger Metropolitan Statistical Areas (MSAs) and has increased to 200 sites nationwide. In the database and in most of the references on the VIEWS website, this network is currently referred to as the "EPA PM2.5 Speciation - Daily" network.
CHL: Chloride. Primary measurement used to calculate sea salt in the revised IMPROVE algorithm.

CHLf:VIEWS parameter: Chloride (Fine); Description: Chloride Elemental Concentration FINE Size Fraction; CAS Number: 16887-00-6; AQS Code: 88203; Type Code: PM2.5; Units: UG/CU Meter (LC)
CHLt:VIEWS parameter: Chloride (Tsp); Description: Chloride ion concentration from open inlet (no size cut); Type Code: TSP; Units: UG/CU Meter (LC)
Cl:VIEWS parameter: Chlorine Ion; Description: Chlorine Ion; Type Code: AQU; Units: MILLIGRAMS/LITER
Clarity: Relative distinctness or sharpness of perceived scene elements.
Class I Area: As defined by the Clean Air Act, include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks that existed as of August 1977.
Class II Areas: Areas of the country protected under the Clean Air Act, but identified for somewhat less stringent protection from air pollution damage than Class I, except in specified cases.
CLc:VIEWS parameter: Chlorine (Coarse); CAS Number: 7782-50-5; AQS Code: 83115; Type Code: COARSE; Units: UG/CU Meter (LC)
Clean Air Act: Originally passed in 1963, the current national air pollution control program is based on the 1970 version of the law. Substantial revisions were made by the 1990 Clean Air Act Amendments.
Clean fuels: Low-pollution fuels that can replace ordinary gasoline, including gasohol, natural gas, and propane.
CLf:VIEWS parameter: Chlorine (Fine); CAS Number: 7782-50-5; AQS Code: 88115; Type Code: PM2.5; Units: UG/CU Meter (LC)
Cloud condensation nuclei: Particles of liquids or solids upon which condensation of water vapor begins in the atmosphere.
CM_bext:VIEWS parameter: Coarse Mass Extinction; Type Code: CALC; Units: Inverse megameters
CM_calculated:VIEWS parameter: Mass, PM2.5 - PM10 (Coarse); Description: Calculated coarse mass; AQS Code: 81103; Type Code: COARSE; Units: UG/CU Meter (LC)
CM_measured:VIEWS parameter: PM2.5-10: mass (SFU); Description: Gravimetric coarse mass; Type Code: COARSE; Units: UG/CU Meter (LC)
CMAQ: Community Multiscale Air Quality modeling system
CO: Carbon monoxide
Coagulation: The process by which small particles collide with and adhere to one another to form larger particles.
Coarse mode:A size range of particles between 2.5 microns and 10 microns. Coarse particles are mostly composed of soils. The sum of the masses of coarse and fine particles (all particles smaller than 10 microns) is called PM10.
COf:VIEWS parameter: Cobalt (Fine); CAS Number: 7440-48-4; AQS Code: 84113; Type Code: PM2.5; Units: UG/CU Meter (LC)
Color:A qualitative sensation described by hue, brightness, and saturation
Color contrast or difference: Contrast between two adjacent scene element colors. Any difference in color hue, saturation, or brightness, between two perceived objects.
Colorimetric analysis: Chemical analysis based on the colors of dyes formed by the reaction of the analysis with reagents.

Condensation:A process by which molecules in the atmosphere collide and adhere to small particles.
Condensation counternuclei: An instrument that counts nucleation mode particles by causing them to grow in a humid atmosphere, and observing light reflections from the individual enlarged particles.
Condensation nuclei: The small nuclei or particles with which gaseous constituents in the atmosphere (e.g., water vapor) collide and adhere.
Continuous sampling device: An air analyzer that measures air quality components continuously. (See also monitoring, integrated sampling device).
Contrast: Relative difference in light coming from a target compared to the surrounding background, usually the horizon sky. Any difference in the optical quality of two adjacent images.
Contrast change threshold: Minimum change in contrast perceptible to an observer.
Contrast threshold: Minimum apparent contrast at which a target is just perceptible.
Contrast transmittance: Ratio between apparent and inherent spectral contrast. When the object is darker than its background, it has a value between 0 and -1. For objects brighter than their background, the value varies from 0 to infinity. When the contrast transmittance is equal to zero, the object cannot be seen.
CRc:VIEWS parameter: Chromium (Coarse); CAS Number: 7440-47-3; AQS Code: 83112; Type Code: COARSE; Units: UG/CU Meter (LC)
CRf:VIEWS parameter: Chromium (Fine); CAS Number: 7440-47-3; AQS Code: 88112; Type Code: PM2.5; Units: UG/CU Meter (LC)
Criteria Pollutant:EPA uses six "criteria pollutants" as indicators of air quality, and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS). The criteria pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter and lead.
CSf:VIEWS parameter: Cesium (Fine); CAS Number: 7440-46-2; Type Code: PM2.5; Units: UG/CU Meter (LC)
CUc:VIEWS parameter: Copper (Coarse); CAS Number: 7440-50-8; AQS Code: 83114; Type Code: COARSE; Units: UG/CU Meter (LC)
CUf:VIEWS parameter: Copper (Fine); Description: Copper Elemental Concentration FINE Size Fraction; CAS Number: 7440-50-8; AQS Code: 88114; Type Code: PM2.5; Units: UG/CU Meter (LC)
Current conditions: Refers to contemporary, or modern, atmospheric conditions that are affected by human activity.
D
DataBrowser Submit button: The large button in the middle of the Data Browser toolbar that has a green arrow pointing to the word "Submit".
DataBrowser tabs: The series of simulated "folder tabs" that appear along the top of the main Data Browser panel. The first of these tabs is labeled "Select Report".
Datalogger: An electronic device for measuring analog or digital signals and recording the results on a storage media. Many of them can record inputs on a number of separate locations, reporting them as separate "channels."
Deciview: The unit of measurement of haze, as in the haze index (HI) defined below.

Deliquescence: The process that occurs when the vapor pressure of the saturated aqueous solution of a substance is less than the vapor pressure of the water in the ambient air. Water vapor is collected until the substance is dissolved and in equilibrium with its environment.

Dew point: The temperature at which humidity in the air will condense upon a solid surface.

Dichotomous: Any particle sampler that separately collects coarse and fine particles sampler from one atmosphere. Often refers to virtual impactor instruments.

Diffraction: Modification of the behavior of a light wave resulting from limitations of its lateral extent by an obstacle. For example, the bending of light into the “shadow area” behind a particle.

Diffusion:A process by which substances, heat, or other properties of a medium are transferred from regions of higher concentration to regions of lower concentration.

Direct effects: The optical effects of aerosols on climate modification referring to absorption and scattering of solar radiation by airborne particles.

Dirtiest, or haziest, days of the year.:

Discoloration: Any change in the apparent color of an image. Often refers to the loss of blue sky color due to air pollution.

Dose-response: The relationship between the dose of a pollutant and its effect on a biological system.

Dry deposition: Also known as dryfall, includes gases and particles deposited from the atmosphere to water and land surfaces. This dryfall can include acidifying compounds such as nitric acid vapor, nitrate and sulfate particles, and acidic gases.

dv:VIEWS parameter: deciview; Type Code: CALC; Units: Deciview

E

E-GRID: Emissions & Generation Resource Integrated Database

EC: Elemental carbon (see LAC).

EC1f:VIEWS parameter: Carbon, Elemental Fraction 1 (Fine); CAS Number: 7440-44-0; AQS Code: 88329; Type Code: PM2.5; Units: UG/CU Meter (LC)

EC2f:VIEWS parameter: Carbon, Elemental Fraction 2 (Fine); CAS Number: 7440-44-0; AQS Code: 88330; Type Code: PM2.5; Units: UG/CU Meter (LC)

EC3f:VIEWS parameter: Carbon, Elemental Fraction 3 (Fine); CAS Number: 7440-44-0; AQS Code: 88331; Type Code: PM2.5; Units: UG/CU Meter (LC)

ECf:VIEWS parameter: Carbon, Elemental Total (Fine); Description: From TOR carbon fractions (E1+E2+E3-OP); CAS Number: 7440-44-0; AQS Code: 88321; Type Code: PM2.5; Units: UG/CU Meter (LC)

ECf_bext:VIEWS parameter: Carbon, Elemental Extinction (Fine); CAS Number: 7440-44-0; Type Code: CALC; Units: Inverse megameters

ECf_NIOSH:VIEWS parameter: Carbon, Elemental Total (Fine) (NIOSH); Description: Organic Carbon from STN (NIOSH); CAS Number: 7440-44-0; Type Code: PM2.5; Units: UG/CU Meter (LC)

ECHf:VIEWS parameter: Eh IMPROVE Pm2.5 LC; CAS Number: 7440-44-0; AQS Code: 88323; Type Code: PM2.5; Units: UG/CU Meter (LC)

ECOS: Environmental Council of the States

Edge sharpness: Characteristic of landscape features. Landscape features with sharp edges contain scenic features with abrupt changes in brightness.

EFF:VIEWS parameter: Rain Gauge Efficiency Ratio; Description: Rain Gauge Efficiency Ratio (Svol/Ppt); Type Code: AQU
EI: Emission Inventory
Electrical aerosol:A particle sampler that puts electrical charges on particles and sorts analyze them by their different drift rates in an electric field.
Elevated layer:A pollution distribution that is not in contact with the ground.
Emissions: Gaseous or particulate pollutants entering the atmosphere due to a man-made or natural process.
EPA: Environmental Protection Agency
Equilibration:A balancing or counter balancing to create stability, often with a standard measure or constant.
Equivalent contrast: Any scene can be fourier decomposed into light and dark bars of various frequencies and intensities modulated in accordance with a sine wave function. Equivalent contrast is the average contrast of those sine waves within a specified range of spatial frequencies.
EUf:VIEWS parameter: Europium (Fine); CAS Number: 7440-53-1; Type Code: PM2.5; Units: UG/CU Meter (LC)
Externally mixed: Particulate species that co-exist as separate particles without co-mingling or combining.
Extinction: The attenuation of light due to scattering and absorption as it passes through a medium.
Extinction budget: Apportioning the extinction coefficient to atmospheric constituents to analysis estimate the change in visibility caused by a change in constituent concentrations.
Extinction coefficient:A measure of the ability of particles or gases to absorb and scatter photons from a beam of light; a number that is proportional to the number of photons removed from the sight path per unit length. See absorption.
Extinction cross section: The amount of light scattered and absorbed by a particle divided by its physical cross section.

F

f(RH): Light scattering enhancement factor due to the uptake of water by certain aerosol species, based on relative humidity. There are several versions of the f(RH) function used in the original and revised IMPROVE algorithms.
fabs:VIEWS parameter: Filter Absorption Coefficient; Description: Filter Absorption Coefficient (Non-corrected); AQS Code: 63102; Type Code: OPT
Fe2O3:VIEWS parameter: Fe2O3; CAS Number: 1309-37-1; Units: UG/CU Meter (LC)
FEc:VIEWS parameter: Iron (Coarse); CAS Number: 7439-89-6; AQS Code: 83126; Type Code: COARSE; Units: UG/CU Meter (LC)
FEf:VIEWS parameter: Iron (Fine); CAS Number: 7439-89-6; AQS Code: 88126; Type Code: PM2.5; Units: UG/CU Meter (LC)
Field Cond:VIEWS parameter: Field Conductance; Description: Conductance of the precipitation sample as measured in the field laboratory, reported in microsiemens per centimeter.; Type Code: MET; Units: MICROSIEMENS/CENTIMETER
Fine particles: Particulate matter with an aerodynamic diameter of 2.5 microns or less (PM2.5). Fine particles are responsible for most atmospheric particle-induced extinction. Ambient fine particulate matter consists basically of five species

Fine particulate matter: Particulate matter with an aerodynamic diameter less than 2.5 microns(PM2.5).
FIP: Federal Implementation Plan
FLM: Federal Land Manager
flRH:VIEWS parameter: Large particle size fRH; Type Code: CALC; Units: Unspecified
fRH:VIEWS parameter: Relative Humidity Factor; Type Code: MET
fRHgrid:VIEWS parameter: Relative Humidity Factor (Climatological Monthly); Description: Based on climatological monthly average RH from EPA; Type Code: CALC; Units: PERCENT
FRM_EC_PM25:VIEWS parameter: SEARCH FRM Equivalent EC PM2.5; CAS Number: 7440-44-0; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_Mass:VIEWS parameter: FRM Mass; Units: UG/CU Meter (LC)
FRM_Mass_non-Blank:VIEWS parameter: FRM Mass non-Blank; Units: UG/CU Meter (LC)
FRM_MASS_PM25:VIEWS parameter: SEARCH FRM Equivalent MASS PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_MMO_PM25:VIEWS parameter: SEARCH FRM Equivalent MMO PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_NH4:VIEWS parameter: FRM NH4; CAS Number: 14798-03-9; Units: UG/CU Meter (LC)
FRM_NH4_PM25:VIEWS parameter: SEARCH FRM Equivalent NH4 PM2.5; CAS Number: 14798-03-9; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_NO3:VIEWS parameter: FRM NO3; CAS Number: 12033-49-7; Units: UG/CU Meter (LC)
FRM_NO3_PM25:VIEWS parameter: SEARCH FRM Equivalent NO3 PM2.5; CAS Number: 12033-49-7; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_OM_PM25:VIEWS parameter: SEARCH FRM Equivalent OM PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_OTHER_PM25:VIEWS parameter: SEARCH FRM Equivalent OTHER PM2.5; Type Code: PM2.5; Units: UG/CU Meter (LC)
FRM_SO4:VIEWS parameter: FRM SO4; CAS Number: 14808-79-8; Units: UG/CU Meter (LC)
FRM_SO4_PM25:VIEWS parameter: SEARCH FRM Equivalent SO4 PM2.5; CAS Number: 14808-79-8; Type Code: PM2.5; Units: UG/CU Meter (LC)
fsRH:VIEWS parameter: Small particle size fRH; Type Code: CALC; Units: Unspecified
fssRH:VIEWS parameter: Sea salt fRH; Type Code: CALC; Units: Unspecified
Fugitive Dust: Emissions associated with anthropogenic mechanical processes affecting the release of dust and organic carbon from disturbed or undisturbed lands. These sources are computed as being spread over a spatial extent (a county or air district).

G

GAf:VIEWS parameter: Gallium (Fine); Description: Fine (PM2.5) particles of elemental Gallium (GA); CAS Number: 7440-55-3; AQS Code: 84124; Type Code: PM2.5; Units: UG/CU Meter (LC)

GEf:VIEWS parameter: Germanium (Fine); Description: Germanium Elemental Concentration FINE Size Fraction; CAS Number: 7440-56-4; Type Code: PM2.5; Units: UG/CU Meter (LC)

Glide Path: The Regional Haze Rule mathematical curve between baseline (2000-04) conditions and natural (2064) conditions. Also called Glide Slope.

Glide Slope: The Regional Haze Rule mathematical curve between baseline (2000-04) conditions and natural (2064) conditions. Also called Glide Path.

H

H1:VIEWS Status Flag: Historical data that have not been assessed or validated.; Source: NARSTO

Hazardous air pollutants (HAP): Airborne chemicals that cause serious health and environmental effects.

Haze: An atmospheric aerosol of sufficient concentration to be visible. The particles are so small that they cannot be seen individually, but are still effective in scene distortion and visual range restriction. See an example of uniform and Layered Hazes.

Hf:VIEWS parameter: Hydrogen (Fine); Description: Hydrogen Elemental Concentration FINE Size Fraction; CAS Number: 1333-74-0; AQS Code: 88337; Type Code: PM2.5; Units: UG/CU Meter (LC)

HFf:VIEWS parameter: Hafnium (Fine); CAS Number: 7440-58-6; AQS Code: 88127; Type Code: PM2.5; Units: UG/CU Meter (LC)

HgConc:VIEWS parameter: Total Mercury Concentration

HgDep:VIEWS parameter: Total Mercury Deposition

HGf:VIEWS parameter: Mercury (Fine); CAS Number: 7439-97-6; AQS Code: 84142; Type Code: PM2.5; Units: UG/CU Meter (LC)

High volume:A simple particle sampler consisting of a filter holder and a vacuum sampler cleaner blower, in a simple rain shelter. Some units have flow measuring or controlling features.

HNO3:VIEWS parameter: Nitric Acid; CAS Number: 7697-37-2; AQS Code: 42305; Type Code: GAS; Units: UG/CU Meter (LC)

Homogenous nucleation: Process by which gases interact and combine with droplets made up of their own kind. For instance, the collision and subsequent adherence of water vapor to a water droplet is homogenous nucleation. See nucleation.

Hue: Attribute of color that determines whether it is red, yellow, green, blue, or other color. It is most strongly related to wavelength of light.

Humidity: Water in air, as a gas. Often measured as a percentage, compared to the maximum amount of water vapor the air can contain at that temperature.

Hydrocarbons: Compounds containing only hydrogen and carbon. Examples

Hydrophobic: Lacking affinity for water, or failing to adsorb or absorb water.

Hygroscopic: Readily absorbing moisture, as from the atmosphere.

I

I0:VIEWS Status Flag: Invalid value - unknown reason; Source: VIEWS

I1:VIEWS Status Flag: Invalid value - known reason; Source: VIEWS

I2:VIEWS Status Flag: Invalid value (-999), though sample-level flag seems valid (SEM); Source: VIEWS

Illumination: Application of visible radiation to an object.

Impairment: The degree to which a scenic view or distance of clear visibility is degraded by man-made pollutants.

IMPROVE: Interagency Monitoring of PROtected Visual Environments; a collaborative monitoring program established in the mid-1980s as past of the Federal Implementation Plans. IMPROVE objectives are to provide data needed to assess the impacts of new emission sources, identify existing man-made visibility impairment, and assess progress toward the national visibility goals that define protection of the 156 Class I areas.

IMPROVE algorithm, original: Algorithm used to calculate light extinction from IMPROVE monitoring data, developed in the 1980s.

IMPROVE algorithm, revised: Algorithm used to calculate light extinction from IMPROVE monitoring data, developed in 2005. The revised algorithm includes: variable scattering efficiencies for sulfates, nitrates, and organic matter; a larger multiplier to calculate organic mass from organic carbon; inclusion of site-specific Rayleigh scattering; inclusion of extinction from sea salt; and inclusion of extinction from NO2 (optional).

Indirect effects: Non-optical atmospheric effects of aerosols on cloud albedo and formation, e. g., as condensation nuclei for cloud droplets.

INf:VIEWS parameter: Indium (Fine); Description: Indium Elemental Concentration FINE Size Fraction; CAS Number: 7440-74-6; AQS Code: 84131; Type Code: PM2.5; Units: UG/CU Meter (LC)

Inhalable particulate matter: Particles smaller than about 12 micrometers in diameter, capable of being drawn into the human bronchial system. Larger particles tend to be filtered out in the upper respiratory tract.

Inherent spectral contrast: Percent difference in radiant energy associated with an object and its background at an observer distance equal to zero.

Integral vistas: Scenic views which extend beyond Class I boundaries, that are critical to the enjoyment of the area.

Integrated Database: The primary VIEWS relational database where data from individual programs are normalized and integrated into a common schema. This integration enables the management, analysis, and visualization of disparate source data formats by a common set of tools.

Integrated Planning Model (IPM): An electric utility planning model that EPA uses to estimate air emission changes, incremental electric power system costs, changes in fuel use and prices, and other impacts of various approaches to air pollution control.

Integrated sampling: An air sampling device that allows estimation of air quality components device over a period of time (e.g., 24 hours to two weeks) through laboratory analysis of the sampler's medium.

Integrating nephelometer: An instrument that measures the amount of light scattered (scattering coefficient).

Internally mixed: Refers to the situation where individual particles contain one or more species. For example, water is internally mixed with its hygroscopic hosts.

invalcode:VIEWS parameter: Sample Invalidation Code; Description: A series of codes assigned to samples which are considered invalid by NADP/NTN for the purposes of computing weighted-mean concentrations, depositions, and data completeness estimates. The codes indicate the reasons for invalidation. b = bulk sample (Collector was open continuously.); u = undefined sample (Collector was open for > 6 hours and less than the

entire sampling interval when no precipitation was occurring; f = field protocol departure; c = contaminated sample; v = inadequate volume for analysis; e = extended sampling interval (> 8 days); l = lab error; i = incomplete chemical analyses; n = no sample collected; p = precipitation amount unknown; x = reasons other than described above.; Type Code: FLAG

Inversion: See temperature inversion.

Ion:A charged molecular group or atom.

Ion chromatography:A method of separating ions by their different speeds of passage through an ion-exchange resin. The ions are usually detected by their conductivity.

IRf:VIEWS parameter: Iridium (Fine); CAS Number: 7439-88-5; Type Code: PM2.5; Units: UG/CU Meter (LC)

Isopleth:A line drawn on a map through all points having the same numerical value.

Isotropic:A situation where a quantity (or its spatial derivatives) are independent of position or direction.

Isotropic scattering: The process of scattering light equally in all directions.

J

Just noticeable change:A variation of just noticeable difference that relates directly to human visual perception. A JNC corresponds to the amount of optical change in the atmosphere required to evoke human recognition of a change in a given landscape (scenic) appearance. The change in atmospheric optical properties may be expressed as the number of JNC's between views of a given scene at different intervals of time.

Just noticeable difference: Measure of change in image appearance that affects image sharpness. Counting the number of JND's (detectable changes) in scene appearance is regarded as an alternative method of quantifying visibility reduction (light extinction).

K

K:VIEWS parameter: Potassium Ion; Description: Potassium Ion; CAS Number: 7440-09-7; Type Code: AQU; Units: MILLIGRAMS/LITER

K2O:VIEWS parameter: K2O; CAS Number: 12136-45-7; Units: UG/CU Meter (LC)

Kc:VIEWS parameter: Potassium (Coarse); CAS Number: 7440-09-7; AQS Code: 83180; Type Code: COARSE; Units: UG/CU Meter (LC)

Kf:VIEWS parameter: Potassium (Fine); Description: Mass of potassium particles < 2.5 um in diameter; CAS Number: 7440-09-7; AQS Code: 88180; Type Code: PM2.5; Units: UG/CU Meter (LC)

Kf_ion:VIEWS parameter: Potassium ion (Fine); Description: Mass of potassium particles < 2.5 um in diameter, EPA Speciation ions; CAS Number: 7440-09-7; Type Code: PM2.5; Units: UG/CU Meter (LC)

Koschmeider constant: The constant in the reciprocal relationship between standard visual range and the extinction coefficient.

Kt:VIEWS parameter: Potassium (Tsp); Description: Mass of potassium particles from open inlet (no size cut); CAS Number: 7440-09-7; AQS Code: 12180; Type Code: TSP; Units: UG/CU Meter (LC)

L

Lab Cond:VIEWS parameter: Lab Conductance; Description: Conductance of the precipitation sample as measured at the CAL, reported in microsiemens per centimeter.; Type Code: MET; Units: MICROSIEMENS/CENTIMETER

Lab Type:VIEWS parameter: Lab Type; Description: A code indicating the condition of the sample upon arrival at the CAL.; Type Code: FLAG

LAC: Light absorbing carbon (see EC).

LADCO: Lake Michigan Air Directors Consortium. Represents states of Illinois, Indiana, Michigan, and Wisconsin.

LAf:VIEWS parameter: Lanthanum (Fine); Description: Lanthanum Elemental concentration FINE Size Fraction ; CAS Number: 7439-91-0; AQS Code: 84146; Type Code: PM2.5; Units: UG/CU Meter (LC)

Large Fraction: Pertains to the revised IMPROVE algorithm. Measured sulfate, nitrate, and organic matter are assumed to be the combination of large and small size distributions, each with separate extinction efficiencies and f(RH) functions.

Layered haze: Haze that obscures a horizontal layer of a vista.

Light: Radiant energy that is capable of exciting the retina and producing a visual sensation. This definition is the one most meaningful for display professionals, although it differs from the definition frequently used by physicists. Our definition excludes ultraviolet (UV) and infrared (IR) wavelengths. UV is shorter in wavelength than light as we've defined it, and IR is longer. The visible wavelengths of the electromagnetic spectrum extend from about 380 to 770 nm. The unit of light energy is the lumen second.

Light energy: Electromagnetic energy in the visibility spectrum, i.e. wave lengths between 0.4 and 0.7 micrometers.

Light extinction budget: The percent of total atmospheric extinction attributed to each aerosol and gaseous component of the atmosphere.

Liquid water: The water present within a cloud expressed as a percent of total cloud constitutents, or liquid phase water in an aerosol.

Long path measurement: An atmospheric measurement process that is made over distances in excess of a few hundred meters.

Luminance:A measure of light power refected or emitted from an object within a solid angle of one steradian per unit area area projected in a given direction. The SI unit is the candela per square meter, which is sometimes called a nit. See Brightness, Luminance, and Confusion from Information Display, March 1993 by Charles P. Halsted at http

Luminous flux: Visible power, or light energy per unit of time. It is measured in lumens. One watt of radiant power at 555 nm--the wavelength at which the typical human eye is most sensitive--is equivalent to a luminous flux of 680 lumens. See brightness, luminance, and confusion from Information Display, March 1993 by Charles P. Halsted at http

Luminous intensity: The luminous flux per solid angle emitted or reflected from a point. The unit of measure is the lumen per steradian, or candela (cd). (The steradian is the unit of measurement of a solid angle.

M

M1:VIEWS Status Flag: Missing value because no value is available; Source: NARSTO

M2:VIEWS Status Flag: Missing value because invalidated by data originator; Source: NARSTO

M3:VIEWS Status Flag: Missing value due to clogged filter; Source: NARSTO

Major source:A stationary facility that emits a regulated pollutant in an amount exceeding the threshold level (100 or 250 tons per year, depending on the type of facility).

MARAMA: Mid-Atlantic Regional Air Management Association. Represents the states of Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia, the city of Philadelphia and the District of Columbia.

Matrix filter:A filter that is formed of a mat or matrix of fibers. It is physically thick, and particles are trapped deep in its structure.

Max_bp:VIEWS parameter: Maximum barometric pressure; Description: Maximum barometric pressure during sampling; Type Code: MET

Max_Temp:VIEWS parameter: Maximum temperature; Description: Maximum temperature during sampling; Type Code: TMP; Units: DEGREES, CENTIGRADE

Membrane filter:A thin filter, usually made of a synthetic polymer, with microscopic holes in it. Particles are collected only on the surface facing the air flow.

Metadata: Data about data. In data processing, meta-data is definitional data that provides information about or documentation of other data managed within an application or environment.

MF:VIEWS parameter: Mass, PM2.5 (Fine); Description: Gravimetric fine mass; AQS Code: 88502; Type Code: PM2.5; Units: UG/CU Meter (LC)

Mg:VIEWS parameter: Magnesium Ion; Description: Magnesium Ion; CAS Number: 7439-95-4; Type Code: AQU; Units: MILLIGRAMS/LITER

MGc:VIEWS parameter: Magnesium (Coarse); Description: Magnesium Elemental Concentration FINE Size Fraction; CAS Number: 7439-95-4; AQS Code: 83140; Type Code: COARSE; Units: UG/CU Meter (LC)

MGf:VIEWS parameter: Magnesium (Fine); Description: Mass of magnesium particles < 2.5 um in diameter; CAS Number: 7439-95-4; AQS Code: 88140; Type Code: PM2.5; Units: UG/CU Meter (LC)

MGt:VIEWS parameter: Magnesium (Tsp); Description: Mass of magnesium particles from open inlet (no size cut); CAS Number: 7439-95-4; AQS Code: 12140; Type Code: TSP; Units: UG/CU Meter (LC)

Micron:A unit of length equal to one millionth of a meter; the unit of measure for wavelength.

Midwest RPO: One of the five RPOs. Affiliated with LADCO. Includes the states and tribal areas encompassed by Illinois, Indiana, Michigan, Ohio, and Wisconsin.

Mie scattering: The attenuation of light in the atmosphere by scattering due to particles of a size comparable to the wavelength of the incident light. This is the phenomenon largely responsible for the reduction of atmospheric visibility. Visible solar radiation falls into the range from 0.4 to 0.8 µm, roughly with a maximum intensity around 0.52 µm.

Min_bp:VIEWS parameter: Minimum barometric pressure; Description: Minimum barometric pressure during sampling; Type Code: MET

Min_Temp:VIEWS parameter: Minimum temperature; Description: Minimum temperature during sampling; Type Code: TMP; Units: DEGREES, CENTIGRADE

Mixing layer: An unstable layer of air that has turbulent mixing, usually due to solar heating of the ground. It is often capped by a stable layer of air.

MM5: Mesoscale Meteorological Model. A numerical model for weather prediction on scales from continental to one km.

MNc:VIEWS parameter: Manganese (Coarse); CAS Number: 7439-96-5; AQS Code: 83132; Type Code: COARSE; Units: UG/CU Meter (LC)

MNf:VIEWS parameter: Manganese (Fine); CAS Number: 7439-96-5; AQS Code: 88132; Type Code: PM2.5; Units: UG/CU Meter (LC)

Mobile sources: Moving objects that release regulated air pollutants, (e.g., cars, trucks, buses, airplanes, trains, motorcycles, and gas-powered lawn mowers). See also source; stationary source.

Mode: The maximum point in a plot of the frequency of occurrence of a variable versus the variable.

Models-3/CMAQ: Community Multiscale Air Quality model is a unique numerical grid model capable of operating as part of the Models-3 framework for the purpose of estimating pollutant concentrations for multiple pollutants (including ozone, particulate matter, precursor and component species, regional haze, air toxins, etc.) in "one-atmosphere" model applications.

Modulation transfer function (MTF): Mathematical function which describes contrast transmittance in spatial-frequency space. It is the ratio between scene equivalent contrast at the observer and equivalent contrast at the object. When the object of interest is small compared to its surroundings, the modulation transfer function and contrast transmittance reduce to the same value.

MOf:VIEWS parameter: Molybdenum (Fine); CAS Number: 7439-98-7; Type Code: PM2.5; Units: UG/CU Meter (LC)

Monitoring: Measurement of air pollution and related atmospheric parameters. See also continuous sampling device, integrated sampling device.

Most impaired days: Data representing a subset of the annual measurements that correspond to the

Most Recent Data: Any new data we receive is imported into our integrated database. Though much of our data is also available in static ASCII text files, those files are regenerated periodically and may not include the most recent data updates as a result.

MOU: Memorandum of Understanding.

MT:VIEWS parameter: Mass, PM10 (Total); Description: Gravimetric mass < 10 um in diameter; AQS Code: 85101; Type Code: PM10; Units: UG/CU Meter (LC)

N

N2f:VIEWS parameter: Nitrite (Fine); CAS Number: 14797-65-0; AQS Code: 88338; Type Code: PM2.5; Units: UG/CU Meter (LC)

Na:VIEWS parameter: Sodium Ion; Description: Sodium Ion; CAS Number: 7440-23-5; Type Code: AQU; Units: MILLIGRAMS/LITER

NA:VIEWS Status Flag: Not available from source data; Source: VIEWS

NAc:VIEWS parameter: Sodium (Coarse); Description: Sodium Elemental Concentration FINE Size Fraction; CAS Number: 7440-23-5; AQS Code: 83184; Type Code: COARSE; Units: UG/CU Meter (LC)

NAf:VIEWS parameter: Sodium (Fine); Description: Mass of sodium particles < 2.5 um in diameter; CAS Number: 7440-23-5; AQS Code: 88184; Type Code: PM2.5; Units: UG/CU Meter (LC)

NAf_ion:VIEWS parameter: Sodium ion (Fine); Description: Mass of sodium particles < 2.5 um in diameter, EPA Speciation ions; CAS Number: 7440-23-5; Type Code: PM2.5; Units: UG/CU Meter (LC)

NAS: National Academy of Sciences

NAt:VIEWS parameter: Sodium (Tsp); Description: Mass of sodium particles from open inlet (no size cut); CAS Number: 7440-23-5; AQS Code: 12184; Type Code: TSP; Units: UG/CU Meter (LC)

National Acid Precipitation Assessment (NAPAP): The 10-year (1980-1990) interagency research program designed to investigate acid deposition and its effects nationwide. The products of this program are the series of State of the Science and Technology Program documents that summarize what we know about the severity of acid deposition and the resources it affects.

National Ambient Air Quality Standards: Permissible levels of criteria air pollutants established to protect public health and welfare. Established and maintained by EPA under authority of the Clean Air Act.

National Atmospheric Program:A national network of about 200 sites where wet deposition is collected weekly and sent to the Central Analytical Laboratory in Illinois for Deposition chemical analysis. This network has operated since 1977 and is funded (NADP) by seven federal agencies, and numerous cooperators in agencies, universities, and industry. This network of predominately rural sites is designed to represent broad, regional patterns of deposition.

Natural conditions: Prehistoric and pristine atmospheric states, i. e., atmospheric conditions that are not affected by human activities.

Natural Conditions II: Alternate method for calculating natural conditions. Used in conjunction with the revised IMPROVE algorithm.

Natural Fire Sources: Combustion emissions from wildfire, wildland fire use, non-federal rangeland burning, and maintenance burning activities of wildland managers. These sources are computed as daily point source events.

NBf:VIEWS parameter: Niobium (Fine); CAS Number: 7440-03-1; Type Code: PM2.5; Units: UG/CU Meter (LC)

NC II: Natural conditions II. Alternate method for calculating natural conditions. Used in conjunction with the revised IMPROVE algorithm.

Nephelometer: An instrument used to measure the light scattering component of light extinction.

Network:A collection of environmental monitoring locations operated according to a common set of protocols and objectives. Often synonymous with "Program".

Neutron activation:A method of chemical analysis in which the sample is bombarded with analysis neutrons in a nuclear reactor. The nuclei of various elements in the sample are modified to radioactive forms, and the concentrations of the elements are then determined by the intensities and wavelengths of the radiation emitted.

NGM: Nested Grid Model, a regional atmospheric model.

NH3:VIEWS parameter: Ammonia (vapor phase only); CAS Number: 7664-41-7; Type Code: GAS; Units: UG/CU Meter (LC)

NH4:VIEWS parameter: Ammonium Ion; Description: Ammonium Ion; CAS Number: 14798-03-9; Type Code: AQU; Units: MILLIGRAMS/LITER

NH4f:VIEWS parameter: Ammonium Ion (Fine); Description: Mass of ammonium particles < 2.5 um in diameter; CAS Number: 14798-03-9; Type Code: PM2.5; Units: UG/CU Meter (LC)

NH4t:VIEWS parameter: Ammonium Ion (Tsp); Description: Mass of ammonium particles from open inlet (no size cut); CAS Number: 14798-03-9; Type Code: TSP; Units: UG/CU Meter (LC)
NIc:VIEWS parameter: Nickel (Coarse); CAS Number: 7440-02-0; AQS Code: 83136; Type Code: COARSE; Units: UG/CU Meter (LC)
NIf:VIEWS parameter: Nickel (Fine); CAS Number: 7440-02-0; AQS Code: 88136; Type Code: PM2.5; Units: UG/CU Meter (LC)
Nitrogen dioxide:A gas (NO2) consisting of one nitrogen and two oxygen atoms. It absorbs blue light and therefore has a reddish-brown color associated with it.
NO: Nitrous oxide
NO2: Nitrogen dioxide
NO3:VIEWS parameter: Nitrate Ion; Description: Nitrate Ion; CAS Number: 12033-49-7; Type Code: AQU; Units: MILLIGRAMS/LITER
NO3_whatman:VIEWS parameter: Nitrate from whatman; Description: Nitrate from CASTNet filter pack whatman; CAS Number: 12033-49-7; Type Code: UNS; Units: UG/CU Meter (LC)
NO3f:VIEWS parameter: Nitrate (Fine); Description: Mass of nitrate particles < 2.5 um in diameter; CAS Number: 12033-49-7; AQS Code: 88306; Type Code: PM2.5; Units: UG/CU Meter (LC)
NO3sum:VIEWS parameter: Nitrate (total tsp & vapor); Description: Sum of HNO3 and particle NO3-; CAS Number: 12033-49-7; Type Code: CALC; Units: UG/CU Meter (LC)
NO3t:VIEWS parameter: Nitrate (Tsp); Description: Mass of nitrate particles from open inlet (no size cut); CAS Number: 12033-49-7; AQS Code: 12306; Type Code: TSP; Units: UG/CU Meter (LC)
Nonattainment area:A geographic area in which the level of a criteria air pollutant is higher than the level allowed by the federal standards. For NAAQS, where the pattern of "violations of standard" is sufficient to require remedial action; a boundary is determined around the location of the violations. The area within that boundary is designated to be in non-attainment of the particular NAAQS standard and an enforceable plan is developed to prevent additional violations.
NOx: Oxides of nitrogen (NO + NO2). One of the six criteria pollutants. The term used to describe the sum of nitric oxide (NO), nitric dioxide (NO2), and other oxides of nitrogen, which plays a major role in the formation of ozone. The major sources of man-made NOx emissions are high temperature combustion processes, such as those occurring in automobiles and power plants.
NSPS: New Source Performance Standard. A standard for emissions from new stationary sources. These sources are divided into several categories.
NSR: New Source Review. Federal air program that establishes control technologies and emission limits for new major sources and for major modifications at existing sources.
Nucleation: Process by which a gas interacts and combines with droplets. See homogenous nucleation.
Nuclei mode:A size range of particles below about 0.1 micrometer in diameter. These particles are the nuclei around which larger particles grow.
nv_nitrate:VIEWS parameter: Non-Volatile Nitrate (Fine); Description: AIRS calculated; CAS Number: 12033-49-7; Type Code: CALC; Units: UG/CU Meter (LC)

O

O3:VIEWS parameter: Ozone; CAS Number: 10028-15-6; AQS Code: 44201; Type Code: GAS; Units: PARTS PER BILLION

OAQPS: Office of Air Quality Planning and Standards (of USEPA)

OAR: Office of Air and Radiation

Object luminance:A measure of light power reflected or emitted from an object itself within a solid angle of one steradian per unit area projected in a given direction.

OC: Organic carbon.

OC1f:VIEWS parameter: Carbon, Organic Fraction 1 (Fine); CAS Number: 7440-44-0; AQS Code: 88332; Type Code: PM2.5; Units: UG/CU Meter (LC)

OC2f:VIEWS parameter: Carbon, Organic Fraction 2 (Fine); CAS Number: 7440-44-0; AQS Code: 88333; Type Code: PM2.5; Units: UG/CU Meter (LC)

OC3f:VIEWS parameter: Carbon, Organic Fraction 3 (Fine); CAS Number: 7440-44-0; AQS Code: 88334; Type Code: PM2.5; Units: UG/CU Meter (LC)

OC4f:VIEWS parameter: Carbon, Organic Fraction 4 (Fine); CAS Number: 7440-44-0; AQS Code: 88335; Type Code: PM2.5; Units: UG/CU Meter (LC)

OCf:VIEWS parameter: Carbon, Organic Total (Fine); Description: From TOR carbon fractions (OC1+OC2+OC3+OC4+OP); CAS Number: 7440-44-0; AQS Code: 88320; Type Code: PM2.5; Units: UG/CU Meter (LC)

OCf_NIOSH:VIEWS parameter: Carbon, Organic Total (Fine) (NIOSH); Description: Organic Carbon from STN (NIOSH); CAS Number: 7440-44-0; Type Code: PM2.5; Units: UG/CU Meter (LC)

OCf_NIOSHadj:VIEWS parameter: Carbon, Organic Total (Fine) (NIOSH Adjusted); Description: Organic Carbon from STN (NIOSH Adjusted for blank correction); CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)

OCHf:VIEWS parameter: Oh IMPROVE Pm2.5 LC; CAS Number: 7440-44-0; AQS Code: 88322; Type Code: PM2.5; Units: UG/CU Meter (LC)

OCMf_NIOSH:VIEWS parameter: Carbon, Organic Mass (Fine) (NIOSH Adjusted); Description: 1.4 * OCf_NIOSHadj; CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)

OCX2f:VIEWS parameter: Carbon, Organic Fraction 2 (Fine) (NIOSH); Description: EPA PM 2.5 Chemical Speciation Network, NIOSH 5040; CAS Number: 7440-44-0; Type Code: PM2.5; Units: UG/CU Meter (LC)

Off-Road Mobile Sources: Emissions sources from vehicular and otherwise movable sources not traveling on roadways. These sources are computed as being spread over a spatial extent (a county or air district). Off-road mobile source emissions are estimated as the products of emissions factors and activity estimates. Examples of nonroad mobile sources include locomotives, lawn and garden equipment, construction vehicles, and boat emissions.

Off-Shore Sources: Emissions sources occurring in the open ocean distinctly separated from land-based activities. These sources are computed by applying activity location data by emissions activity type over a spatial extent (marine shipping in an emissions model grid cell) or emissions sources that are identified by point locations (oil drilling and production platforms). The emissions from off-shore marine shipping are in the international portions of the open ocean, not associated with port activities; the emissions from ships, tugboats, and cruise vessels in and around ports and harbors are included in

the nonroad mobile sources category and are regulated by states, counties, and/or air districts.

OMC: Organic mass estimated from the IMPROVE organic carbon measurement (see POM).

OMCf:VIEWS parameter: Carbon, Organic Mass (Fine) (1.8*OC); Description: 1.8 * OC; CAS Number: 7440-44-0; AQS Code: 88350; Type Code: PM2.5; Units: UG/CU Meter (LC)

OMCf_1.4:VIEWS parameter: Carbon, Organic Mass (Fine) (1.4*OC); Description: 1.4 * OC; CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)

OMCf_bext:VIEWS parameter: Carbon, Organic Extinction (Fine); CAS Number: 7440-44-0; Type Code: CALC; Units: Inverse megameters

OMCf_Large:VIEWS parameter: Organic Carbon Mass (Fine), Large Fraction; CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)

OMCf_Small:VIEWS parameter: Organic Carbon Mass (Fine), Small Fraction; CAS Number: 7440-44-0; Type Code: CALC; Units: UG/CU Meter (LC)

On-Road Mobile Sources: Emissions sources from vehicles certified for highway use. Sources can be computed either as being spread over a spatial extent or as being assigned to a line location, and on-road inventories can be reflected as either emissions or activity data. On-road mobile source emissions are estimated as the products of emissions factors and activity estimates. Samples of on-road mobile sources include light-duty gasoline vehicles and heavy-duty diesel vehicles

OPf:VIEWS parameter: Carbon, Organic Pyrolized (Fine); CAS Number: 7440-44-0; AQS Code: 88328; Type Code: PM2.5; Units: UG/CU Meter (LC)

Optical depth: The degree to which a cloud or haze prevents light from passing through it. It is a function of physical composition, size distribution, and particle concentration. Often used interchangeably with "turbidity."

Optical monitoring: Optical monitoring refers to directly measuring the behavior of light in the ambient atmosphere.

Optical particle: An instrument which measures the size of individual particles by the counter amount of reflected light from a microscopic illuminated volume.

Organic compounds: Chemicals that contain the element carbon.

Orifice audit device:A device which measures air flow based on the known relationship of air flow through and orifice to the pressure drop across it.

Origins: Particle origins can be anthropogenic (man-made) or natural. Another origin classification is primary (particles that are emitted into the atmosphere as particles, such as organic and soot particles in smoke plumes or soil dust particles), and secondary (those formed from gas-to-particle conversion in the atmosphere, such as sulfates, nitrates, and secondary organics).

OTC: Ozone Transport Commission. One of the five RPOs, affiliated with the Northeast States for Coordinated Air Use Management Association (NESCAUM) and the Mid-Atlantic Regional Air Management Association (MARAMA). Includes the states and tribal areas encompassed by Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Northern Virginia, the District of Columbia, and suburbs of Washington, D.C.

Ozone: One of the six criteria pollutants. Ozone (O3) is a photochemical oxidant and the major component of smog.

P

Parameter:A substance or variable that is measured, calculated, or modeled. Examples are "Sulfate, PM2.5", "Aerosol Optical Depth", "Relative Humidity", etc.

Particle sampler: An instrument to measure particulate matter in ambient air.

Particle scattering coefficient: Proportion of incident light scattered by particles per unit distance (Mm-1).

Path radiance: Or "airlight," a radiometric property of the air resulting from light scattering processes along the sight line, or path, between a viewer and the object (target).

PBc:VIEWS parameter: Lead (Coarse); CAS Number: 7439-92-1; AQS Code: 83128; Type Code: COARSE; Units: UG/CU Meter (LC)

PBf:VIEWS parameter: Lead (Fine); CAS Number: 7439-92-1; AQS Code: 88128; Type Code: PM2.5; Units: UG/CU Meter (LC)

Pc:VIEWS parameter: Phosphorus (Coarse); CAS Number: 7723-14-0; AQS Code: 83152; Type Code: COARSE; Units: UG/CU Meter (LC)

PCM1_Mass:VIEWS parameter: PCM1 Mass; Units: UG/CU Meter (LC)

PCM1_NH4:VIEWS parameter: PCM1 NH4; CAS Number: 14798-03-9; Units: UG/CU Meter (LC)

PCM1_NO3:VIEWS parameter: PCM1 NO3; CAS Number: 12033-49-7; Units: UG/CU Meter (LC)

PCM1_SO4:VIEWS parameter: PCM1 SO4; CAS Number: 14808-79-8; Units: UG/CU Meter (LC)

PCM1_TEF_NH4:VIEWS parameter: PCM1 Teflon NH4; Units: UG/CU Meter (LC)

PCM1_TEF_NO3:VIEWS parameter: PCM1 Teflon NO3; Units: UG/CU Meter (LC)

PCM1_VOL_NH4:VIEWS parameter: PCM1 Vol NH4; Units: UG/CU Meter (LC)

PCM1_VOL_NO3:VIEWS parameter: PCM1 Vol NO3; Units: UG/CU Meter (LC)

PCM2_CL:VIEWS parameter: PCM2 CL; CAS Number: 16887-00-6; Units: UG/CU Meter (LC)

PCM2_NH4:VIEWS parameter: PCM2 NH4; CAS Number: 14798-03-9; Units: UG/CU Meter (LC)

PCM2_NO3:VIEWS parameter: PCM2 NO3; CAS Number: 12033-49-7; Units: UG/CU Meter (LC)

PCM2_SO4:VIEWS parameter: PCM2 SO4; CAS Number: 14808-79-8; Units: UG/CU Meter (LC)

PCM3_EC:VIEWS parameter: PCM3 EC; CAS Number: 7440-44-0; Units: UG/CU Meter (LC)

PCM3_OC:VIEWS parameter: PCM3 OC; CAS Number: 7440-44-0; Units: UG/CU Meter (LC)

PDf:VIEWS parameter: Palladium (Fine); Description: Palladium Elemental Concentration FINE Size Fraction; CAS Number: 7440-05-3; AQS Code: 84151; Type Code: PM2.5; Units: UG/CU Meter (LC)

PEC: Primary elemental carbon

Perceived Visual Air Quality (PVAQ): An index that relates directly to how human observers perceive changes in visual air quality.

Perceptible: Capable of being seen.

Pf:VIEWS parameter: Phosphorus (Fine); CAS Number: 7723-14-0; AQS Code: 88152; Type Code: PM2.5; Units: UG/CU Meter (LC)

pH Field:VIEWS parameter: Field pH; Description: The pH of the sample as measured in the field laboratory, reported as the negative log of hydrogen ion concentration.; Type Code: MET; Units: PH UNITS

pH Lab:VIEWS parameter: Lab pH; Description: Negative log of the hydrogen ion concentration as measured at the CAL, in pH units.; Type Code: MET; Units: PH UNITS

Phase function: Relationship of scattered to incident light as a function of scattering angle; volume scattering function.

Phase shift:A change in the periodicity of a wave-form such as light.

phf_vcode:VIEWS parameter: Field pH Validity Code; Description: p = the field measurement passes all of the screening criteria; f = the field measurement fails to pass all of the screening criteria; i = incomplete information. Some of the information required to complete the screening is unavailable, and none of the information that IS available would warrant the assignment of a field validity code of "f".; Type Code: FLAG

Photochemical: Any chemical reaction which is initiated by light. Such processes are process important in the production of ozone and sulfates in smog.

Photometer: Instrument for measuring photometric quantities such as luminance, illuminance, luminous intensity, and luminous flux. An instrument for measuring the brightness of an object. It has been suggested that this name be reserved for those instruments which have been adjusted to match the wavelength response of the human eye, but established usage is not yet this consistent, and radiometers are sometimes called photometers.

Photometry: Instrumental methods, including analytical methods, employing measurement of light intensity. See telephotometer.

Photon:A bundle of electromagnetic energy that exhibits both wave-like and particle-like characteristics.

Photopic: Vision or wavelength response of the cones of a normal eye when exposed to a luminance of at least 3.4 candelas per square meter.

Plume: Airborne emissions from a specified source and the path through the atmosphere of these emissions.

Plume blight: Visual impairment of air quality that manifests itself as a coherent plume. See an example of plume bight.

PM10: Measure of particulate matter (pollutants from combustion and natural sources); denotes particles with a nominal size less than 10 micrometers in diameter.

PM2.5: Measure of particulate matter (pollutants from combustion and natural sources); denotes particles smaller than 2.5 micrometers in diameter.

PM25_MajorMetalOxides:VIEWS parameter: PM25 MajorMetalOxides; Units: UG/CU Meter (LC)

PMC: Coarse particulate matter (PM10 - PM2.5)

PMFINE: Fine particulate matter (PM2.5)

PNO3: Particulate nitrate

PO4:VIEWS parameter: Phosphate Ion; Description: Phosphate Ion; CAS Number: 14265-44-2; Type Code: AQU; Units: MILLIGRAMS/LITER

POA: Primary organic aerosol

Point source:A source of pollution that is point-like in nature. An example is the smoke stack of a coal-fired power plant or smelter. See source.

Point Sources: Emissions sources that are identified by point locations, typically because they are regulated and their locations are available in regulatory reports. The characteristics of these sources are generally very well understood, with detailed information available about stack height, emissions rates, chemical composition, and operating schedules. Point sources can be further subdivided into electric generating unit (EGU) sources and non-EGU sources, particularly in criteria inventories in which EGUs are a primary source of NOx and SO2. Examples of non-EGU major point sources include chemical manufacturers, refineries, smelters, and pulp and paper mills.

Polar nephelometer: An instrument that measures the amount of light scattered in a specific direction. See integrating nephelometer.

Polarization:A property of light. Light can be linearly polarized in any direction perpendicular to the direction of travel, circularly polarized (clockwise or counterclockwise), unpolarized, or mixtures of the above.

POM: Particulate organic matter (see OMC).

Ppb: Parts per billion (1 in 10^9).

Ppm: Parts per million (1 in 10^6).

Ppt: Parts per trillion (1 in 10^12).

Ppt Nws:VIEWS parameter: NWS Stick Gauge Reading; Description: Precipitation amount as measured by the NWS stick rain gage, in mm. Trace amounts are indicated by -7.; Type Code: MET; Units: MILLIMETERS (RAINFALL)

Ppt Rec:VIEWS parameter: Rain Gauge Reading; Description: Precipitation amount as measured by the recording rain gage, in mm. Trace amounts are indicated by -7.; Type Code: MET; Units: MILLIMETERS (RAINFALL)

Precursor:A substance or condition whose presence generally precedes the formation of another, more notable, condition or substance.

Precursor emissions: Emissions from point or regional sources that transform into pollutants with varied chemical properties.

Prescribed burn:A wildland fire whose progress has been controlled by a combination of strategies, including

Prevention of Significant Deterioration:A program established by the Clean Air Act that limits the amount of additional air pollution that is allowed in Class I and Class II areas.

Primary particles: Primary particles are suspended in the atmosphere as particles from the time of emission, e. g., dust and soot.

Program: An organized effort to obtain related environmental data on a regular or periodic basis, usually by means of the routine operation of a monitoring network or special study. Often synonymous with "Network".

PSAT:PM Source Apportionment Technology (PSAT) is a modeling tool which performs source apportionment based on user-defined source groups. A source group is the combination of a geographic source region and an emissions source category. Examples of source regions include states, nonattainment areas, and counties. Examples of source categories include mobile sources, biogenic sources, and elevated point sources.

PSD: Prevention of Significant Deterioration; a program established by the Clean Air Act that limits the amount of additional air pollution that is allowed in Class I and Class II areas.

PSO4: Particulate sulfate

Psychophysical: The branch of psychology that deals with the relationships between physical stimuli and resulting sensations and mental states.
Psychrometer: An instrument for measuring humidity based on the temperature drop of a thermometer with a wet wick on the bulb.
PVAQ: See Perceived Visual Air Quality.
Pyranometer: Instrument that measures directly the loss of total solar radiance under clear sky conditions.
Q
QR Code:VIEWS parameter: Quality Rating Code; Description: A code indicating the relative quality of the sample.; Type Code: FLAG
QTAG: Ozone transport Assessment Group. A national workgroup that addressed the problem of ground level ozone (smog) and the long-range transport of air pollution across the Eastern United States.
QTAQ: Office of Transportation and Air Quality (of USEPA)
Quadratic detection model: Model used to predict the amount of change in equivalent contrast or perceived landscape structure required to evoke a single noticeable change in landscape appearance.
Quality assurance: An overall plan undertaken to quantify, control, and perhaps improve the quality of data acquired by a system.
Quality control: Actions routinely taken to maintain a specified level of quality of acquired data.
R
RACT: Reasonably Available Control Technology
Radiometer:A name for light-measuring instruments which do not match the wavelength response of the human eye.
RAVI: Reasonably Attributable Visibility Impairment; visibility impairment caused by a single or small number of sources.
RBEXT:VIEWS parameter: RBext
RBf:VIEWS parameter: Rubidium (Fine); CAS Number: 7440-17-7; AQS Code: 88176; Type Code: PM2.5; Units: UG/CU Meter (LC)
RCFM:VIEWS parameter: Mass, PM2.5 Reconstructed (Fine); Type Code: PM2.5; Units: UG/CU Meter (LC)
RCTM:VIEWS parameter: Reconstructed Total Mass; Type Code: CALC; Units: UG/CU Meter (LC)
Receptor Modeling: The application of multivariate statistical methods to the identification and quantitative apportionment of air pollutants to their sources.
Reconstructed light extinction: The relationship between atmospheric aerosols and the light extinction coefficient. Can usually be approximated as the sum of the products of the concentrations of individual species and their respective light extinction efficiencies.
Reflectance: Ratio of reflected to incident light.
Reflection: Return of radiation by a surface without a change of frequency.
Refraction: The change of direction of a ray of light in passing obliquely from one medium into another in which the speed of propagation differs.
Regional haze:A cloud of aerosols extending up to hundreds of miles across a region and promoting noticeably hazy conditions. Condition of the atmosphere in which uniformly

distributed aerosol obscures the entire vista irrespective of direction or point of observation. Is not easily traced visually to a single source.

Regional Haze Rule:A rule enacted in 1999 by the EPA that calls for state and federal agencies to work together to improve visibility in 156 national parks and wilderness areas such as the Grand Canyon, Yosemite, the Great Smokies and Shenandoah. The rule requires the states, in coordination with the Environmental Protection Agency, the National Park Service, U.S. Fish and Wildlife Service, the U.S. Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The first State plans for regional haze are due in the 2003-2008 timeframe. Five multi-state regional planning organizations are working together now to develop the technical basis for these plans.

Relative Response Factor: Estimated or expected change in aerosol species monitoring concentration between 2 different years, based on model results from both years. WRAP used 3 methods to develop relative response factors (RRFs): Specific Days (designated by EPA); Quarterly Weighted; and Monthly Weighted. These methods are described in more detail under the TSS Methods page.

REMSAD: Regulatory Modeling System for Aerosols and Deposition; a numerical grid model for rapid scoping and strategy assessments for particulate matter, regional haze, PM species, and deposition of air toxins.

Report: Organized and formatted data, often displayed as a web page or data file.

Residence Time: The fraction of time an air parcel spends in a defined region (model grid cell). Residence time maps are generated by summarizing back trajectories over a period of time of interest.

RFP: Request for Proposal

RH:VIEWS parameter: Relative Humidity (Station Hourly); Description: Hourly RH measured at Nephelometer Station; AQS Code: 68110; Type Code: MET; Units: PERCENT

RHgrid:VIEWS parameter: Relative Humidity (Climatological Monthly); Description: Climatological monthly average RH from EPA; Type Code: CALC; Units: PERCENT

Road Dust: Emissions associated with mechanical re-entrainment of dust materials from paved and unpaved road surfaces by vehicular traffic. These sources are computed as being spread over a spatial extent (a county or air district).

RPO: Regional Planning Organization

RRF: See Relative Response Factor.

S

S_Rayleigh:VIEWS parameter: Site Rayleigh; Type Code: CALC; Units: Inverse megameters

Saturation: One part of the description of color, it qualitatively corresponds to the purity of color

SBf:VIEWS parameter: Antimony (Fine); CAS Number: 7440-36-0; AQS Code: 84102; Type Code: PM2.5; Units: UG/CU Meter (LC)

Sc:VIEWS parameter: Sulfur (Coarse); CAS Number: 7704-34-9; AQS Code: 83169; Type Code: COARSE; Units: UG/CU Meter (LC)

Scattering (light): An interaction of a light wave with an object that causes the light to be redirected in its path. In elastic scattering, no energy is lost to the object.

Scattering angle: The angle between the direction of propagation of the scattered and incident light (or transmitted light)

Scattering coefficient:A measure of the ability of particles or gases to scatter photons out of a beam of light; a number that is proportional to the amount of photons scattered per unit length.

Scattering cross section: The amount of light scattered by a particle divided by its physical cross section.

Scattering efficiency: The relative ability of aerosols and gases to scatter light. A higher scattering efficiency means more light scattering per unit mass or number of particles, this in turn means poorer visibility. In general, fine particles (diameter less than 2.5 microns) are efficient scatterers of visible light.

Scene element: Discrete segment of a landscape scene.

Scene monitoring: Scene monitoring is the monitoring of a specific vista or target. Optical and aerosol monitoring measure an abstract, but easily quantifiable parameter of the atmosphere. Scene monitoring captures the effects of all atmospheric parameters simultaneously, but in an inherently difficult manner to quantify. It is, for example, difficult to determine quantitatively which of two photographs represent "better" visibility conditions. Scene monitoring is generally done to help relate quantitative data in a "user-friendly" format.

SCf:VIEWS parameter: Scandium (Fine); CAS Number: 7440-20-2; Type Code: PM2.5; Units: UG/CU Meter (LC)

Sea Salt: Particulate matter generated by wind on the ocean, approximated from measurements of chloride or chlorine in an aerosol sampler.

SeaSaltf:VIEWS parameter: Sea Salt (Fine); Description: 1.8 x [Chloride], or 1.8 x [Chlorine] if the chloride measurement is below detection limits, missing or invalid.; CAS Number: 7647-14-5; Type Code: PM2.5

SeaSaltf_bext:VIEWS parameter: Sea Salt (Fine), Light Extinction; Description: Light Extinction due to Fine (PM2.5) Sea Salt; Type Code: CALC

Secondary aerosols: Aerosol formed by the interaction of two or more gas molecules and/or primary aerosols.

Secondary particles: Form in the atmosphere by a gas-to-particle conversion process.

SEf:VIEWS parameter: Selenium (Fine); CAS Number: 7782-49-2; AQS Code: 88154; Type Code: PM2.5; Units: UG/CU Meter (LC)

SESARM: Southeast States Air Resource Managers. Affiliated with Southern Appalachian Mountain Initiative (SAMI). Represents the states of Alabama, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee.

Sf:VIEWS parameter: Sulfur (Fine); CAS Number: 7704-34-9; AQS Code: 88169; Type Code: PM2.5; Units: UG/CU Meter (LC)

SGA: Southern Governors Association.

SIc:VIEWS parameter: Silicon (Coarse); CAS Number: 7440-21-3; AQS Code: 83165; Type Code: COARSE; Units: UG/CU Meter (LC)

SIf:VIEWS parameter: Silicon (Fine); CAS Number: 7440-21-3; AQS Code: 88165; Type Code: PM2.5; Units: UG/CU Meter (LC)

Sight path: The straight line between the observation point and the target.

SiO2:VIEWS parameter: Sand; CAS Number: 14808-60-7; Units: UG/CU Meter (LC)

SIP: State Implementation Plan; a detailed description of the measures a state will use to carry out its responsibilities under the Clean Air Act.
Skinny Format:A report format in which parameter concentrations are displayed as a single column of data next to a Parameter Code column. This format is normalized for relational databases and results in a longer file.
SL:VIEWS parameter: Sample Level Code; Description: A code indicating departures from field or laboratory standard operating procedures.; Type Code: FLAG
Small Fraction: Pertains to the revised IMPROVE algorithm. Measured sulfate, nitrate, and organic matter are assumed to be the combination of large and small size distributions, each with separate extinction efficiencies and f(RH) functions.
SMf:VIEWS parameter: Samarium (Fine); CAS Number: 7440-19-9; Type Code: PM2.5; Units: UG/CU Meter (LC)
Smog:A mixture of air pollutants, principally ground-level ozone, produced by chemical reactions involving smog-forming chemicals. See also haze.
SMOKE: Sparse Matrix Object Kernel Emission-EPA processor for preparation of emission data.
SNf:VIEWS parameter: Tin (Fine); CAS Number: 7440-31-5; AQS Code: 84160; Type Code: PM2.5; Units: UG/CU Meter (LC)
SO2:VIEWS parameter: Sulfur Dioxide; CAS Number: 7446-09-5; AQS Code: 42401; Type Code: GAS; Units: UG/CU Meter (LC)
SO2_whatman:VIEWS parameter: Sulfur dioxide from whatman; Description: Sulfur dioxide from CASTNet filter pack, whatman filter (used with SO4_nylon to calculate SO2); CAS Number: 7446-09-5; Type Code: UNS; Units: UG/CU Meter (LC)
SO4:VIEWS parameter: Sulfate Ion; Description: Sulfate Ion; CAS Number: 14808-79-8; Type Code: AQU; Units: MILLIGRAMS/LITER
SO4_nylon:VIEWS parameter: Sulfate from nylon; Description: Sulfate from CASTNet filter pack, nylon filter (used with SO2_whatman to calculate SO2); CAS Number: 14808-79-8; Type Code: UNS; Units: UG/CU Meter (LC)
SO4f:VIEWS parameter: Sulfate (Fine); Description: Mass of sulfate particles < 2.5 um in diameter; CAS Number: 14808-79-8; AQS Code: 88403; Type Code: PM2.5; Units: UG/CU Meter (LC)
SO4t:VIEWS parameter: Sulfate (Tsp); Description: Mass of sulfate particles from open inlet (no size cut); CAS Number: 14808-79-8; AQS Code: 12403; Type Code: TSP; Units: UG/CU Meter (LC)
SOILf:VIEWS parameter: Soil (Fine); AQS Code: 88348; Type Code: PM2.5; Units: UG/CU Meter (LC)
SOILf_bext:VIEWS parameter: Soil Extinction (Fine); Type Code: CALC; Units: Inverse megameters
SOILPART:VIEWS parameter: Particles: Soil composition; Description: Derived from information on the NAtChem website.; Units: NG/Cu Meter (LC)
Soot: Black particles with high concentrations of carbon in graphitic and amorphous elemental forms. It is a product of incomplete combustion of organic compounds.
SOP: Standard Operating Procedure
Source: In atmospheric chemistry, the place, places, group of sites, or areas where a substance is injected into the atmosphere. Can include point sources, elevated sources, area sources, regional sources, multiple sources, etc.

Southern Appalachian Mountain Initiative (SAMI):A consortium of government agencies, industry, and environmental groups, formed to investigate the status of air quality and its effects in the highland regions of the southeastern United States. The objective of this regional cooperative is to determine the current and future impacts of regional air pollutants, such as ozone and acid deposition, and to recommend regional air management strategies to control the formation of these pollutants.
SP:VIEWS parameter: Sample Protocol Code; Description: A code indicating departures from standard sample collection procedures that may have compromised sample integrity.; Type Code: FLAG
Spatial frequency: The reciprocal of the distance between sine wave crests (or troughs) measured in degrees of angular subtense of a sine wave grating. Spatial frequency is a general term for the frequencies associated with the image radiance in a scene along the path of radiance (path of sight). Landscape features contain multiple landscape scenic elements. Each element generates its own image radiance with its own frequency and intensity.
Spectral: An adjective implying a separation of wavelengths of light or other waves into a spectrum or separated series of wavelengths.
SRf:VIEWS parameter: Strontium (Fine); CAS Number: 7440-24-6; AQS Code: 88168; Type Code: PM2.5; Units: UG/CU Meter (LC)
Stable air mass: An air mass which has little vertical mixing. See temperature inversion.
Stagnant: Referring to meteorological conditions that are not conducive to atmospheric mixing.
Stagnation episodes: See stagnation periods.
Stagnation periods: Lengths of time during which little atmospheric mixing occurs over a geographical area, making the presence of layered hazes more likely. See temperature inversion.
Standard visual range: Reciprocal of the extinction coefficient. The distance under daylight and uniform lighting conditions at which the apparent contrast between a specified target and its background becomes just equal to the threshold contrast of an observer, assumed to be 0.02.
STAPPA/ALAPCO: State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officers. The two national associations representing air pollution control agencies in the 54 states and territories and over 150 major metropolitan areas across the United States.
State Implementation Plan:A collection of regulations used by the state to carry out its Implementation responsibilities under the Clean Air Act.
Stationary source:A fixed source of regulated air pollutants (e.g., industrial facility). See also source; mobile sources.
Std2local_cf:VIEWS parameter: STP to Loc conversion factor; Description: Numeric factor for converting from Standard Temperature and Pressure (STP) to Local Temperature and Pressure
Stratification: The process of separating a database into different groups according to (of data) some detail of their origin, for the purposes of improving statistical sensitivity.
Strip chart recorder:A device for making a time record of some signal, usually an applied voltage. The signal drives a pen in one direction, while paper is moved under the pen in the perpendicular direction at a uniform rate.

SubPpt:VIEWS parameter: Substituted Precipitation; Description: Precipitation amount used by NADP in calculating weighted-mean concentrations, depositions and precipitation totals, in mm. In most cases sub_ppt equals the recording rain gauge reading. Where rain gauge reading is a trace amount, a value of 0.127mm is assigned; in cases where the recording rain gauge reading is missing or invalid, the NWS stick rain gauge amount is used; in cases where both rain gauge readings are missing or invalid, the equivalent depth of the sample volume is used (for this conversion, the area of the sample bucket is 678.9 square centimeters).; Type Code: MET; Units: MILLIMETERS (RAINFALL)
Substitute Data: Some IMPROVE monitoring sites did not meet EPA Regional Haze Rule data completeness requirements for the baseline period (2000-04). For these sites data were substituted for missing samples based on a methodology developed by WRAP. For more information see http://matar.cira.colostate.edu/views/web/documents/substitutedata.aspx
SULF: Sulfuric acid
Sulfur dioxide:A gas (SO2) consisting of one sulfur and two oxygen atoms. Of interest because sulfur dioxide converts to an aerosol that is a very efficient light scatterer. Also, it can convert into acid droplets consisting primarily of sulfuric acid.
Sun angle: Refers to the angle of the sun above the horizon of the earth.
Sun radiometer:A device for measuring the intensity of sunlight falling on the ground. If the sky is cloudless and the angle of the sun is known, then a measure of the clarity of the air can be had by this measurement.
Super-VHS:A high definition video format which is capable of achieving horizontal resolution of over 400 lines. A tape recorded in S-VHS format cannot be played on a recorder which is designed to accommodate only the VHS format. See also VHS.
Surface layer:A concentration of air pollution that extends from the ground to an elevation where the top edge of a pollution layer is visible.
Svol:VIEWS parameter: Sample Volume; Description: Volume of sample captured in the sample bucket, in ml.; Type Code: MET; Units: MILLILITERS
SVR:VIEWS parameter: Standard Visual Range; Type Code: CALC; Units: KILOMETERS (VISIBILITY)

T

TAf:VIEWS parameter: Tantalum (Fine); CAS Number: 7440-25-7; Type Code: PM2.5; Units: UG/CU Meter (LC)
Target: Object in the distance observed by a person or instrument for visibility measurements.
TBf:VIEWS parameter: Terbium (Fine); CAS Number: 7440-27-9; Type Code: PM2.5; Units: UG/CU Meter (LC)
TCMf:VIEWS parameter: Carbon, Total Mass (Fine); Description: OMCf + ECf; Type Code: PM2.5
TCMf_NIOSH:VIEWS parameter: Carbon, Total Mass (Fine) (NIOSH Adjusted); Description: OMCf_NIOSH + ECf_NIOSH; Type Code: CALC; Units: UG/CU Meter (LC)
Telephotometer: An instrument that measures the brightness of a specific point in either the sky or vista.

Temperature: Weather condition in which warm air sits atop cooler air, promoting inversion stagnation and increased concentrations of air pollutants. A condition of a layer of atmosphere in which temperature increases with altitude. Such a layer is stable, and pollutants migrate through it very slowly. Also known as an inversion layer.
Temperature inversion: In meteorology, a departure from the normal decrease of temperature with increasing altitude such that the temperature is higher at a given height in the inversion layer than would be expected from the temperature below the layer. This warmer layer leads to increased stability and limited vertical mixing of air.
Texture: Roughness of the landscape.
Threshold contrast:A measure of human eye sensitivity to contrast. It is the smallest increment of contrast perceptible by the human eye.
TIc:VIEWS parameter: Titanium (Coarse); CAS Number: 7440-32-6; AQS Code: 83161; Type Code: COARSE; Units: UG/CU Meter (LC)
TIf:VIEWS parameter: Titanium (Fine); CAS Number: 7440-32-6; AQS Code: 88161; Type Code: PM2.5; Units: UG/CU Meter (LC)
TiO2:VIEWS parameter: Titanium Dioxide; CAS Number: 13463-67-7; Units: UG/CU Meter (LC)
TIP: Tribal Implementation Plan; a detailed description of the measures a tribe will use to carry out its responsibilities under the Clean Air Act.
Total carbon: Sum of the light absorbing carbon and organic carbon.
Total light extinction: The sum of scattering (including Rayleigh scattering) and absorption coefficients. See also extinction coefficient.
Total suspended particulates: Total particulate matter in a sample of ambient air.
total_bext:VIEWS parameter: Total extinction, aerosol + rayleigh; Type Code: CALC; Units: Inverse megameters
Toxic air pollutants: See hazardous air pollutants.
TPINT:VIEWS parameter: Internal instrument temperature; Description: Internal temperature as recorded inside instrument; Type Code: TMP; Units: DEGREES, CENTIGRADE
Tracer elements: An element which is emitted most strongly by a specific source or class of sources, and can therefore be used as evidence for an impact by such a source when the element is detected in an air pollution sample.
Transmission gauge:A device for determining the amount of particles collected on a filter by the attenuation of light passing through the filter. Beta rays are sometimes used in place of visible light, and the resulting instrument is called a beta gauge.
Transmissometer: An instrument that measures the amount of light attenuation over a specified path length.
Transmittance: The fraction of initial light from a light source that is transmitted through the atmosphere. Light is attenuated by scattering and absorption from gases and particles.
Tribal Implementation Plan (TIP):A collection of regulations used by the Indian tribes to carry out its responsibilities under the Clean Air Act.
Turbidity:A condition that reduces atmospheric transparency to radiation, especially light. The degree of cloudiness, or haziness, caused by the presence of aerosols, gases, and dust.
U

Uniform haze: Pollutants that are uniformly distributed both horizontally and vertically from the ground to a height well above the highest terrain.
Unstable air mass: An air mass that is vertically well mixed. See also stable air mass, temperature inversion.
USEPA: United States Environmental Protection Agency.

V

v_nitrate:VIEWS parameter: Volatile Nitrate (Fine); Description: 12033-49-7; Type Code: CALC; Units: UG/CU Meter (LC)
V0:VIEWS Status Flag: Valid value; Source: NARSTO
V1:VIEWS Status Flag: Valid value but comprised wholly or partially of below detection limit data; Source: NARSTO
V2:VIEWS Status Flag: Valid estimated value; Source: NARSTO
V3:VIEWS Status Flag: Valid interpolated value; Source: NARSTO
V4:VIEWS Status Flag: Valid value despite failing to meet some QC or statistical criteria; Source: NARSTO
V5:VIEWS Status Flag: Valid value but qualified because of possible contamination; Source: NARSTO
V6:VIEWS Status Flag: Valid value but qualified due to non-standard sampling conditions; Source: NARSTO
V7:VIEWS Status Flag: Valid value set equal to the detection limit (DL) since the value was below the DL; Source: NARSTO
valcode:VIEWS parameter: Sample Validity Code; Description: A code which indicates whether a sample is considered valid according to NADP/NTN data validation rules. In the case of a valid sample, the code indicates how the sample is used in calculations of weighted-mean concentrations, depositions and data completeness estimates. (= invalid sample; t = valid trace sample; d = valid dry collection period; w, wa, wd = valid sample of lab type w, wa, or wd) Only samples with valcodes of w, wa and wd are used by NADP/NTN in calculating weighted-mean concentrations and depositions.; Type Code: FLAG
Vc:VIEWS parameter: Vanadium (Coarse); CAS Number: 7440-62-2; AQS Code: 83164; Type Code: COARSE; Units: UG/CU Meter (LC)
Vf:VIEWS parameter: Vanadium (Fine); CAS Number: 7440-62-2; AQS Code: 88164; Type Code: PM2.5; Units: UG/CU Meter (LC)
VIEW: Visibility Intensive Experiment in the West, a project of the US EPA, with cooperation of the National Park Service, to measure visibility at many stations throughout the western United States to document current visibility and examine trends.
Violation of standard:A regulatory situation, (i.e., NAAQS), where the pattern of "exceedences of standard" is greater than the frequency allowable under that standard.
Virtual impactor:A type of dichotomous sampler which separates large particles from an air stream by impacting them on the "virtual surface" of a slowly moving column of air.
Visibility: Refers to the visual quality of the view, or scene, in daylight with respect to color rendition and contrast definition. The ability to perceive form, color, and texture.
Visibility indexes: Have been formalized for aerosol, optical, and scenic attributes. Aerosol indexes include mass concentrations, particle concentrations, physical characteristics, and size distributions. The optical indexes include coefficients for

scattering, extinction, and absorption. Scenic indexes comprise visual range, contrast, radiance, color, and just noticeable changes.

Visibility Metric:A statistical summary of a set of visibility data including the median (or mean) of the cleanest 20% of the samples, the median (or mean) of all samples, and the median (or mean) or the dirtiest 20% of the samples.

Vista contrast: See Contrast.

VISTAS: Visibility Improvement States and Tribal Association of the Southeast, one of the five RPOs. Includes the states and tribal areas encompassed by Alabama, Tennessee, Virginia, West Virginia, Georgia, Kentucky, Florida, Mississippi, North Carolina, and South Carolina. Affiliated with SASARM.

Visual air quality: Air quality evaluated in terms of pollutant particles and gases that affect how well one can see through the atmosphere.

Visual image processing: The digitizing, calibration, modeling, and display of the effects of atmospheric optical parameters on a scene. The process starts with a photograph of landscape features viewed in clean atmospheric conditions and models the effects of changes in atmospheric composition.

Visual range: The distance at which a large black object just disappears from view.

Visual reduction: Is the impairment or degradation of atmospheric clarity. Becomes significant when the color and contrast values of a scene to the horizon are altered or distorted by airborne impurities.

VM:VIEWS Status Flag: Valid modeled value; Source: VIEWS

VOC: Volatile organic carbons

W

Washout: The process by which particles are removed from air by capture by raindrops.

Wavelength: The distance, measured in the direction of propagation of a wave, between two successive points in the wave that are characterized by the same phase of oscillation.

Weighted Emissions: Specific to the Weighted Emissions Potential (WEP) analysis on the TSS. Gridded emissions were weighted by gridded residence times and distance from a class I area, and normalized.

Weighted Emissions Potential: Specific to the Weighted Emissions Potential (WEP) analysis on the TSS. Gridded emissions were weighted by gridded residence times and distance from a class I area, and normalized. The results of this analysis are interpreted as the potential for sources within specific grid cells to impact visibility at a class I area, and thus provide a screening tool for planners. The results are not scientifically rigorous as it contains no method for accounting for chemistry and deposition.

WESTAR: Western States Air Resources Council. Represents the states of Alaska, California, Oregon, Washington, Hawaii, Arizona, New Mexico, Montana, Nevada, Colorado, Idaho, North Dakota, Oregon, South Dakota, Utah, and Wyoming.

Wet deposition: The deposit of atmospheric gases and particles (incorporated into rain, snow, fog, or mist) to water or land surfaces.

Wide Format:A report format in which parameter concentrations are displayed as multiple columns across the page. This results in a wider file.

Wildfire: Any wildland fire that requires a suppression response. A controlled burn may be declared a wildfire if part of it escapes from the control line or if weather conditions deteriorate and become unacceptable, as described in the burning plan.

Windblown Dust: Emissions associated with aeolian re-entrainment affecting the release of dust and organic carbon from disturbed or undisturbed lands by land use type. These sources are computed by applying meteorological data by land use type over a spatial extent (an emissions model grid cell, cross-referenced to a county or air district).
wolf:VIEWS parameter: WOLF; Description: AQS STN Calculated; Type Code: CALC
WRAP: Western Regional Air Partnership, one of five RPOs. Includes the states and tribal areas encompassed by Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. Affiliated with WESTAR.
WRAP Area Oil and Gas Sources: Non-point land-based emissions sources that are uniquely associated with the drilling, maintenance, production, and distribution of oil and gas. These sources are computed as being spread over a spatial extent (the production basin portion of a county or air district). In a given state, there are also point sources of emissions that are uniquely associated with the drilling, maintenance, production, and distribution of oil and gas - each state has a different definition of oil and gas sources that are counted or regulated as area or point sources.
Yf:VIEWS parameter: Yttrium (Fine); CAS Number: 7440-65-5; AQS Code: 84183; Type Code: PM2.5; Units: UG/CU Meter (LC)
ZNc:VIEWS parameter: Zinc (Coarse); CAS Number: 7440-66-6; AQS Code: 83167; Type Code: COARSE; Units: UG/CU Meter (LC)
ZNf:VIEWS parameter: Zinc (Fine); CAS Number: 7440-66-6; AQS Code: 88167; Type Code: PM2.5; Units: UG/CU Meter (LC)
ZRf:VIEWS parameter: Zirconium (Fine); CAS Number: 7440-67-7; AQS Code: 88185; Type Code: PM2.5; Units: UG/CU Meter (LC)

Abbreviations and Acronyms

BACT - Best Available Control Technology

BART - Best Available Retrofit Technology

Btu - British thermal unit

CAA - Clean Air Act

CAMx – Comprehensive Air Model with extensions

CERR – Consolidated Emission Reporting Rule

CMAQ – Community Multi-Scale Air Quality Model

dv - Deciview

EC – Elemental Carbon

EDMS – Emissions Data Management System

ENVIRON – Environmental Consulting Firm

EPA - Environmental Protection Agency

FETS – Fire Emission Tracking System

FLM – Federal Land Manager

FR - Federal Register

GCVTC - Grand Canyon Visibility Transport Commission

HI – Haze Index

IMPROVE – Interagency Monitoring of Protected Visual Environments

IOA – International Origin Anthropogenic

IOC – Initiatives Oversight Committee

IWG – Implementation Work Group

kWh - Kilowatt_hour

LAC – Light Absorbing Carbon

LAER - Lowest Achievable Emission Rate

LEV – Low Emission Vehicle

LTS - Long Term Strategy **RPG**s - Reasonable Progress Goals

NH_3 - Ammonia

NOx - A mixture of NO_2 (nitrogen dioxide), nitric oxide (NO), and other nitrogen oxide gases

NSPS - New Source Performance Standards

NTEC – National Tribal Environmental Council

OC – Organic Carbon

$PM_{2.5}$ – Particulate of 2.5 microns or less

PM_{10} – Particulate of 10 microns or less

RH – Regional Haze

PSAT – Particulate-matter Source Apportionment Technology

RHR - Regional Haze Rule

RMC – Regional Modeling Center

RPG – Reasonable Progress Goal

RPO - Regional Planning Organization

RRF – Relative Reduction Factor

SCR - Selective Catalytic Reduction

SIP - State Implementation Plan

SOA – State Origin Anthropogenic

SO_2 – Sulfur dioxide

TOC – Technical Oversight Committee

TSS – Technical Support System

TSSA - Tagged Species Source Apportionment

URP – Uniform Rate of Progress

VOC – Volatile Organic Compound

WEP – Weighted Emission Potential

WGA – Western Governors Association

WRAP – Western Regional Air Partnership

Appendix B: SIP Development and Consultation

Appendix to Chapter 2 Development and Consultation

WRAP Work Groups and Committees

WRAP Consultation process

This list compiles meetings recorded and posted on the WRAP webpage. Although there have been many more meetings and conference calls than are documented here, this list demonstrates the extent of consultation among the WRAP partners and stakeholders for the last eight years.

Organizational Description:

The WRAP membership, reflected in the Board of Directors is organized to maximize decision making through consensus and consultation. This appendix is organized by the various committees and the meetings and conference calls held by the individual committees. Links to the documents are included on all items that appear underlined. Should the links not work, the information can be obtained from the WRAPAIR.org website and clicking on the pull down for the various committees.

- Overview of Committees, Forums and Work Groups

Download/View WRAP Organizational Chart

POSTED FACE-TO-FACE MEETINGS AND CONFERENCE CALLS BY COMMITTEE, FORUM AND WORKGROUP

Committees:

- **309 Coordinating Committee**

2004 Meetings

05/24/04 Call to Coordinate Pre-Trigger SO_2 Reporting and Milestone Comparisons PDF or DOC

02/05/04 309 Conference Call Notes PDF or DOC

- **Air Managers Committee**

(Implementation Work Group)

2007 Events

08/29/07 IWG Meeting, Denver, CO

08/28/07 AMC Meeting, Denver, CO

05/15/07 IWG Conference Call

04/17/07 IWG Meeting, San Diego, CA

04/13/07 TSS Demonstrating Reasonable Progress Training Call

03/15/07 IWG Conference Call

02/15/07 IWG Conference Call, Notes PDF or DOC

02/15/07 TSS Training for SIP Planners Call

01/25/07 IWG Conference Call

2006 Events

12/21/06 IWG Conference Call Notes PDF or DOC

12/06/06 IWG Meeting, Santa Fe, NM

11/16/06 IWG Conference Call

10/26/06 IWG Conference Call

09/21/06 IWG Conference Call

08/29/06 IWG Meeting, Portland, OR

08/21/06 IWG Conference Call

08/02/06 IWG Special Conference Call

07/20/06 IWG Conference Call

06/15/06 IWG Conference Call

05/24/06 IWG Meeting, Sacramento CA

05/18/06 IWG Conference Call

05/08/06 AMC Conference Call Notes PDF or DOC

04/20/06 IWG Conference Call

03/16/06 IWG Conference Call

- Draft IWG 5/24-25 Agenda PDF or DOC
- Call Notes PDF or DOC
- Western Regional Haze State Implementation Plans, State & Federal Protocol PDF or DOC

02/16/06 IWG Conference Call

01/19/06 IWG Conference Call

2005 Events

12/15/05 IWG Conference Call

10/13/05 IWG Conference Call

09/29/05 IWG Conference Call

- Agenda: PDF or DOC

08/29/05 IWG Meeting, Portland, OR

- Agenda: PDF or DOC
- Meeting Notes: PDF or DOC

08/18/05 IWG Conference Call

07/21/05 IWG Conference Call

06/16/05 IWG Conference Call

05/19/05 IWG Conference Call

- Agenda: PDF or DOC
- Call Notes: PDF or DOC

04/21/05 IWG Conference Call

03/17/05 IWG Conference Call

- Agenda PDF or DOC
- Meeting Notes PDF or DOC

03/08/05 IWG Meeting, San Francisco, CA

- Agenda PDF or DOC
- Meeting Notes PDF or DOC
- Presentation of Draft Phase I Attribution of Haze Report PDF or PPT
- Update on the CO SIP Process and Outcomes PDF or PPT
    - Process Timeline PDF or DOC
- Attribution of Haze: What Are the Pieces and How Do They Fit? PDF or PPT
- Nevada Attribution of Haze Case Study PDF or PPT
  Use of Attribution of Haze Report for preliminary analysis of Jarbidge Wilderness Area in Nevada
- Presentation: Glacier NP Attribution of Haze Case Study PDF or PPT
  Use of Attribution of Haze Report for preliminary analysis of Glacier National Park in Montana
- 308 Template Table of Contents PDF or DOC
  Working draft Table of Contents for prototype 308 SIP/TIP-Writers of first drafts identified

02/18/05 Air Managers Committee Conference Call

- Call Notes PDF or DOC
- Proposed AMC 2006 Workplan Narrative PDF or DOC

02/17/05 IWG Conference Call

- Call Notes PDF or DOC

01/20/05 IWG Conference Call

2004 Events

12/14/04 IWG Meeting, Tempe, AZ

- Agenda PDF or DOC
- DRAFT 308 Regional Haze SIP/TIP Relationship Table Work Products to Road Map, Sorted by Road Map PDF or DOC
- DRAFT 308 Regional Haze SIP/TIP Relationship Table Work Products to Road Map, Alpha Sorted by Work Product Code PDF or DOC
- 308 SIP Development – A Resource Matrix for SIP Preparers PDF or DOC
- DRAFT Road Map (as of 4/22/04) Regional Haze State Implementation Plan Under Section 309(g) of the Regional Haze Rule PDF or DOC
- DRAFT Master Key for Road Map, Relationship Table, and Matrix PDF or DOC
- DRAFT 308 Regional Haze SIP/TIP Development Road Map PDF or PPT
- Roadmap/Resource Matrix Guide PDF or PPT

10/28/04 IWG Conference Call

09/16/04 IWG Conference Call

- Call Notes PDF or DOC
- 2005 Workplan SIP Schedule PDF or XLS
- 2004 Closeout and 2005 Deliverables Table PDF or DOC
- 308 Regional Haze SIP Development Road Map (Draft) PDF or PPT

07/07/04 IWG Conference Call

07/06/04 AMC State Caucus Call

05/27/04 IWG Conference Call (Notes: PDF or DOC)

04/29/04 IWG Conference Call (Notes: PDF or DOC)

04/14/04 AMC Call

03/23/04 308/309(g) IWG Meeting, Santa Fe, NM

01/12/04 AMC Call

2003 Events

11/19/03 308 Planning Group Meeting, Phoenix, AZ

- Agenda PDF or DOC

06/25/03 AMC Call (Notes: PDF)

03/19/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

- AMC Meeting Notes DOC
- AMC Meeting Agenda PDF

2002 Events

11/26/02 AMC Call Notes DOC

09/04/02 Air Managers Committee Meeting, Santa Fe, NM

05/23/02 Air Managers Committee Meeting, Salt Lake City, UT

04/15/02 Air Managers Committee/WESTAR Meeting Minutes, Incline Village, NV PDF

2001 Events

09/27/01 Northern Air Managers Committee Meeting Minutes, Portland, OR PDF

07/10/01 Northern Air Managers Conference Call Document DOC

2000 Events

05/09/00 Northern Air Managers Committee Meeting Presentation, Phoenix, AZ PDF

05/03/00 Northern Air Managers Conference Call Minutes

02/14/00 Northern Air Managers Conference Call Minutes

- **Communications Committee**

2006 Meetings

06/30/06 Committee Call Minutes PDF or DOC

04/03/06 Committee Meeting, Salt Lake City, UT

- Agenda PDF or DOC
- Website Statistics Update PDF or DOC
- Green Tag Presentation PDF or DOC

2005 Meetings

09/27/05 Committee Meeting, Missoula, MT

- Meeting Notes PDF or DOC
- Agenda PDF or DOC
- Draft Strategic Plan PDF or DOC
- WRAP Web Site Statistics Update (09/15/05) PDF or DOC

05/16/05 Committee Meeting, Phoenix, AZ

- Meeting Notes PDF or DOC
- Agenda PDF or DOC
- Attendees PDF or DOC
- 2003-05 WRAP Web Statistics PDF or DOC

2004 Meetings

12/06/04 Committee Meeting, San Francisco, CA

04/07/04 Committee Meeting, Tempe, AZ

- Agenda PDF or DOC
- Meeting Notes PDF or DOC

2003 Meetings

10/13/03 Committee Meeting, Salt Lake City, UT

- Agenda PDF or DOC
- Meeting Notes PDF or DOC

04/01/03 Committee Meeting, Portland, OR PDF or DOC

2002 Meetings

12/12/02 Committee Meeting, San Francisco, CA

07/22/02 Committee Meeting, Denver, CO

07/05/02 Subcommittee on Outreach Call Minutes PDF

04/04/02 Committee Conference Call Miutes DOC

2001 Meetings

11/13/01 Committee Meeting, DOC Salt Lake City, UT

07/24/01 TOC Team Call Minutes DOC

06/22/01 TOC Team Call Minutes DOC

05/22/01 Committee Meeting Minutes, DOC Albuquerque, NM

02/06/01 Committee Conference Call Minutes

2000 Meetings

09/26/00 Committee Meeting Minutes, Sacramento, CA

09/14/00 Speaker's Bureau Conference Call Minutes

09/07/00 Committee Conference Call Minutes

08/10/00 Committee Meeting Minutes, Seattle Washington

07/26/00 Committee Conference Call Minutes

07/18/00 Committee Conference Call Minutes

06/14/00 Committee Conference Call Minutes

06/06/00 Committee Conference Call Minutes

05/30/00 Committee Conference Call Minutes

05/24/00 Committee Conference Call Minutes

05/17/00 Committee Conference Call Minutes

05/08/00 Committee Meeting Minutes, Tempe, AZ

01/06/00 Committee Conference Call Minutes

1999 Meetings

09/17/99 Committee Meeting Minutes, Salt Lake City, UT

08/12/99 Committee Conference Call Minutes

06/17/99 Committee Meeting Minutes, Seattle, WA

05/06/99 Committee Meeting Minutes, Denver, CO

- **Planning Team**

2006 Meetings

02/22/06 Planning Team Meeting, Salt Lake City, UT

2005 Meetings

03/09/05 Planning Team Meeting, San Francisco, CA

2004 Meetings

07/20/04 Planning Team Meeting, Denver, CO

- Agenda PDF or DOC
- Individual Work Plans Available as of July 13 PDF or DOC
- 2004 Financial Status and 2005 Proposed Projects XLS or PDF
- 2004 Work Plan PDF
- Strategic Plan PDF

2003 Meetings

08/13/03 Planning Team Meeting, Denver, CO

03/18/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

2002 Meetings

10/07/02 Planning Team Meeting, Tempe, AZ

07/25/02 Planning Team Meeting, Denver, CO

2001 Meetings

09/05/01 Planning Team Meeting, Seattle, WA

2000 Meetings

07/17/00 Coordinating Group Meeting Minutes, Denver, CO

06/05/00 Group Conference Call Minutes

03/29/00 Coordinating Group Meeting Minutes, Salt Lake City, UT

1999 Meetings

11/01/99 Coordinating Group Meeting Minutes, Salt Lake City, UT

10/27/99 Group Conference Call Minutes

10/20/99 Group Conference Call Minutes

10/07/99 Group Conference Call Minutes

09/29/99 Group Conference Call Minutes

09/22/99 Group Conference Call Minutes

09/16/99 Coordinating Group Meeting Minutes, Salt Lake City, UT

09/08/99 Group Conference Call Minutes

09/01/99 Group Conference Call Minutes

07/20/99 Coordinating Group Meeting Minutes, Salt Lake City, UT

06/16/99 Coordinating Group Meeting Minutes, Seattle, WA

05/14/99 Coordinating Group Meeting Minutes, Phoenix, AZ

04/22/99 Group Conference Call Minutes

- **Initiatives Oversight Committee**

2006 Meetings

05/23/06 WRAP Workshop on Carbon, Fire and Dust, Sacramento, CA

01/10/06 WRAP Workshop on Sulfate, Nitrate, and Reasonable Progress, Tucson, AZ

2003 Meetings

07/28/03 NOx Issues in the West, Denver, CO

03/18/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

2002 Meetings

10/09/02 IOC Meeting, Tempe, AZ

10/07/02 Planning Team Meeting, Tempe, AZ

07/25/02 Planning Team Meeting, Denver, CO

07/11/02 IOC Meeting, Denver, CO

03/20/02 IOC Meeting Minutes and Documents, Tempe, AZ

2001 Meetings

12/13/01 IOC Meeting Minutes, San Diego, CA PDF

09/05/01 Planning Team Meeting, Seattle, WA

07/23/01 IOC Conference Call Minutes DOC

06/18/01 IOC Meeting Minutes, Portland, OR DOC

04/30/01 IOC Conference Call Minutes DOC

2000 Meetings

11/09/00 IOC Meeting Agenda

09/15/00 IOC Conference Call Minutes

08/23/00 IOC Conference Call Minutes

03/28/00 IOC Meeting Minutes

01/31/00 IOC Conference Call Minutes

01/10/00 IOC Meeting Minutes

- **Technical Oversight Committee**

2007 Meetings

09/25/07 Regional Haze Emissions Inventories Meeting, Salt Lake City, UT

06/19/07 TSS Orientation & Review Workshop, Denver, CO

06/01/07 TOC/Co-Chairs Conference Call

05/04/07 TOC/Co-Chairs Conference Call

04/06/07 TOC/Co-Chairs Conference Call

03/02/07 TOC/Co-Chairs Conference Call

02/02/07 TOC/Co-Chairs Conference Call

01/05/07 TOC/Co-Chairs Conference Call

2006 Meetings

12/01/06 TOC Conference Call (Notes: PDF or DOC)

11/06/06 TOC Conference Call (Notes: PDF or DOC)

10/06/06 TOC Conference Call (Notes: PDF or DOC)

09/01/06 TOC Conference Call - Cancelled

08/04/06 TOC Conference Call

07/07/06 TOC Conference Call (Notes: PDF or DOC)

06/02/06 TOC Conference Call (Notes: PDF or DOC)

05/05/06 TOC Conference Call

04/07/06 TOC Conference Call (Notes: PDF or DOC)

03/03/06 TOC Conference Call (Notes: PDF or DOC)

02/13/06 TOC Conference Call

- February 13, 2006 Draft: EPA PM NAAQS Proposal of January 17, 2006 - Technical Comments by WRAP PDF or DOC

02/03/06 TOC Conference Call (Notes: PDF or DOC)

01/06/06 TOC Conference Call (Notes: PDF or DOC)

- Forums Update PDF or DOC

2005 Meetings

12/02/05 TOC Conference Call

11/04/05 TOC Conference Call

10/07/05 TOC Conference Call

09/02/05 TOC Conference Call

08/05/05 TOC Conference Call

07/08/05 TOC Conference Call

04/08/05 TOC Conference Call

02/11/05 TOC Conference Call

01/13/05 TOC Conference Call

2004 Meetings

12/06/04 TOC Conference Call

11/08/04 TOC Conference Call

10/14/04 TOC Conference Call

09/17/04 TOC Conference Call

08/12/04 TOC Conference Call

07/13/04 TOC WIGIMS Call

07/08/04 TOC Co-Chairs Call

07/07/04 TOC WIGIMS Call

06/17/04 TOC Conference Call

05/13/04 TOC Co-Chairs Meeting, San Francisco, CA

04/15/04 TOC Conference Call

03/12/04 TOC Conference Call

02/12/04 TOC Conference Call

01/26/04 TOC Technical Summit, Tempe, AZ

01/08/04 TOC Conference Call

2003 Meetings

12/04/03 TOC Conference Call

11/13/03 TOC Conference Call

09/11/03 TOC Conference Call Documents

- Meeting Notes PDF, DOC or WPD
- Agenda PDF or DOC
- 2004 Workplan and Budget Requests (08/18/03) XLS
- WIGIMS Scope of Work (07/17/03) PDF or DOC
- Attribution of Haze Workgroup Mission Statement (09/11/03) PDF, DOC or WPD

- Technical Forum's Status Report PDF or DOC

07/11/03 TOC Conference Call

- Meeting Notes PDF or WPD
- Agenda PDF or DOC
- July 2003 Technical Forums Update PDF or DOC

06/13/03 TOC Conference Call Notes PDF, DOC or WPD

05/05/03 Technical Oversight Committee Meeting, Denver, CO

03/18/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

03/07/03 TOC Conference Call

- Agenda DOC
- Status of Technical Forums Summary DOC
- Notes PDF

02/10/03 Technical Oversight Co-Chairs Meeting, Scottsdale, AZ

- Meeting Minutes PDF

01/17/03 TOC Conference Call Notes PDF

2002 Meetings

12/13/02 TOC Conference Call Summary DOC

10/09/02 TOC & Technical Co-Chairs Meeting, Tempe, AZ

10/07/02 Planning Team Meeting, Tempe, AZ

07/25/02 Planning Team Meeting, Denver, CO

07/09/02 WRAP Technical Conference & Presentations, Denver, CO

06/12/02 TOC Technical Oversight Committee Meeting, Seattle, WA

04/19/02 TOC Conference Call Summary DOC

03/07/02 Technical Oversight Committee Meeting, Scottsdale, AZ

- Meeting Notes DOC

01/10/02 TOC & Technical Co-Chairs Conference Call

2001 Meetings

12/17/01 TOC & Technical Co-Chairs Conference Call

11/29/01 TOC & Technical Co-Chairs Conference Call

10/25/01 TOC Conference Call Summary

09/05/01 Planning Team Meeting, Seattle, WA

06/21/01 TOC & Technical Co-Chairs Conference Call Summary PDF

03/29/01 TOC & Technical Co-Chairs Meeting Summary PDF

07/16/01 TOC Meeting Agenda, Denver CO PDF

Forums:

- **Air Pollution Prevention Forum**

2003

05/20/03 Pollution Prevention Workshop for Preparation of 309 Plans, Portland, OR

2002

06/06/02 Forum Meeting, Portland, OR

02/19/02 Forum & SIP Guidebook Meetings

2001

03/15/01 Forum Meeting Summary, Sacramento, CA DOC

2000

12/05/00 Forum Meeting Summary, Portland, OR
Agenda for the AP2 Meeting

05/31/00 Forum Meeting Summary, San Francisco, CA

05/09/00 Presentation at Meeting, Phoenix, AZ

03/13-14/00 Meeting, Portland, OR

01/31 - 02/01/00 Meeting San Diego, CA

- **Dust Emissions Joint Forum**

2006 Events

12/12/06 DEJF Conference Call

10/24/06 DEJF Conference Call

09/26/06 DEJF Conference Call Notes: PDF or DOC

05/23/06 WRAP Workshop on Fire, Carbon and Dust, Sacramento, CA

02/28/06 DEJF Conference Call PDF or DOC

2005 Events

11/15/05 DEJF Meeting, Tempe, AZ

10/24/05 DEJF Conference Call PDF or DOC

08/23/05 DEJF Conference Call PDF or DOC

05/12/05 DEJF Meeting, Palm Springs, CA

05/10/05 Fugitive Dust Control Conference, Palm Springs, CA

04/26/05 DEJF Conference Call PDF or DOC

03/22/05 DEJF Conference Call PDF or DOC

02/22/05 DEJF Conference Call PDF, WPD or DOC

01/25/05 DEJF Conference Call PDF or DOC

01/04/05 DEJF Conference Call PDF, DOC or WPD

2004 Events

11/30/04 DEJF Conference Call PDF or DOC

11/15/04 DEJF & AoH Work Group Meeting, Las Vegas, NV

- DEJF & AoH Work Group Meeting Agenda PDF or DOC
- DEJF Meeting Minutes by Lee Gribovicz PDF or DOC or WPD
- DEJF Meeting Attendee List PDF or DOC
- Fugitive Dust Handbook and Website PDF or PPT
  Richard Countess, Countess Environmental (1/15, 1:15p)
- Dust Emission Research in the Northern Chihuahuan Desert of NM PDF (3.8 MB)
  Dale Gillette, NOAA (1/15, 2:15p)
- Projection of 2018 Dust Emission Inventory PDF or DOC
  Lee Alter and Tom Moore, WGA (1/15, 3:30p)
- Dust Watch Proposal PDF or PPT
  Lee Alter, WGA (1/15, 3:30p)
- Overview of AoH Report - Process & Status PDF or PPT
  Joe Adlhoch, Air Resource Specialists (11/16, 9:30a)
- DEJF Windblown Dust Model – Results & Status PDF or PPT
  Gerard Mansell, ENVIRON (11/16, 10:30a)

10/22/04 DEJF Conference Call Minutes PDF or DOC

09/28/04 DEJF Conference Call Minutes PDF or DOC

08/24/04 DEJF Conference Call Minutes PDF, WPD or DOC

08/13/04 DEJF Conference Call Minutes PDF or WPD

07/27/04 Dust Emissions Joint Forum Meeting, Reno, NV

- Agenda PDF or DOC
- Minutes PDF or WPD
- Forum Overview and Timeframes, Lee Alter PDF or PPT

- Update on Dust Handbook, Richard Countess PDF or PPT
- Update on Windblown Dust Inventory, Gerry Mansell, PDF or PPT
- Update on Ambient Analysis of 20% Worst Days, Jin Xu, PDF or PPT
- Dust Monitoring and Modeling at Owens Lake, Duane Ono, PDF or PPT
- Recent CA Legislation and Control Measures, Mel Zeldin, PDF or PPT
- Using Satellite Imagery to Improve Dust Emission Inventories, Chat Cowherd, PDF or PPT
- Using Satellite Imagery to Identiry Dust Emission Areas and Compliance, David Groeneveld (forthcoming)
- Fugitive Dust Research at DRI, Hampden Kuhns, PDF or PPT

05/25/04 Dust Emissions Joint Forum Conference Call Minutes PDF or DOC

04/27/04 Dust Emissions Joint Forum Conference Call

- Call Minutes PDF or WPD
- Agenda PDF or DOC
- Draft Work Plan for Development of a Fugitive Dust Handbook and Website PDF or DOC

03/23/04 Dust Emissions Joint Forum Conference Call Minutes PDF or WPD

02/24/04 Dust Emissions Joint Forum Meeting, Las Vegas, NV

- Agenda PDF or DOC
- Minutes PDF
- Rd. dust measurement techniques (Rodney Langston) PDF or PPT
- Transportation conformity and haze issues (Susan Hardy) PDF or PPT
- Notes on the definition and categorization of dust (Lee Alter) PDF or DOC
- Dust impacts on the 20% worst visibility days (Vic Etyemezian) PDF or PPT
- Notes on dust impacts on the 20% worst days (Lee Alter) PDF or DOC
- Summary/recs for a wind-blown dust inventory (Gerry Mansell) PDF or PPT
- Additional recs for a wind-blown dust inventory (Michael Uhl) PDF or PPT
- Next steps for a wind-blown dust inventory (Tom Moore) PDF or PPT
- Comparison of the Fugitive Dust Model to Emission at Keeler Dunes (Duane Ono) PDF or PPT

02/10/04 Dust Emissions Joint Forum Conference Call Minutes PDF or DOC

01/13/04 Dust Emissions Joint Forum Conference Call Minutes PDF or DOC

2003 Events

12/16/03 Dust Emissions Joint Forum Conference Call Minutes PDF or DOC

11/14/03 Dust Emissions Joint Forum Conference Call Minutes PDF or DOC

10/29/03 Emissions Joint Forum & Dust Emissions Joint Forum Meeting, Las Vegas, NV

03/19/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

2002 Events

11/06/02 Dust Emissions Joint Forum Meeting, Las Vegas, NV

2001 Events

05/07/01 Teleconference on WRAP Dust Issue DOC

The Emissions Forum coordinated a conference call on fugitive dust issues in the WRAP 1996 Base Year Emission Inventory, and on potential cooperative efforts between the WRAP/EPA/WESTAR to address these concerns.

2000 Events

12/14/00 Research and Development Forum Fugitive Dust Workshop, Las Vegas, NV

- **Economic Analysis Forum**

2003 Meetings

03/18/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

- Economic Analysis Forum Meeting Agenda PDF

2002 Meetings

12/13/02 Economic Analysis Framework Workshop, Denver, CO

- **Emissions Forum**

2007 Events

06/27/07 EDMS Status Call

05/30/07 EDMS Status Call

05/01/07 EDMS Status Call

03/29/07 EDMS Status Call

02/28/07 EDMS Status Call

01/17/07 EDMS Status Call

2006 Events

11/30/06 Emissions Forum Call, Call Notes: PDF or DOC

10/18/06 Emissions Forum Meeting, Spokane, WA

08/14/06 Emissions Forum Call

08/02/06 EDMS Steering Committee Call

07/12/06 Emissions Forum Meeting, Portland, OR

05/31/06 Emissions Forum Call

04/18/06 Emissions Forum Meeting, Tempe, AZ

02/07/06 Emissions Forum Meeting, Santa Fe, NM

01/18/06 Emissions Forum Call

2005 Events

12/05/05 Emissions Data Management System Web Training Call

12/02/05 Emissions Forum Call (Notes: PDF)

10/05/05 Emissions Forum Call (Notes: PDF or DOC)

09/27/05 Emissions Forum Meeting, Missoula, MT

06/21/05 Emissions Forum Call

05/24/05 Emissions Forum Call (Notes: PDF or DOC)

04/26/05 Alaska Regional Haze Technical Analysis Meeting

02/10/05 Emissions Forum Call (Notes: PDF or DOC)

01/26/05 Emissions Forum Meeting, San Diego, CA

2004 Events

12/10/04 Emissions Forum Call (Notes: PDF or DOC)

11/08/04 Emissions Forum Call

10/19/04 Emissions Forum Meeting & EDMS Training, Boise, ID

08/05/04 Emissions Forum Call

07/14/04 Emissions Forum Meeting, Reno, NV

06/18/04 Emissions Forum Call

05/11/04 EDMS Project Workshop

04/09/04 Emissions Forum Call

03/24/04 Emissions Forum Meeting, Santa Fe, NM

02/03/04 Emissions Forum Call

2003 Events

10/28/03 Emissions Forum & Dust Emissions Forum Joint Meeting, Las Vegas, NV

10/14/03 NARSTO Workshop on Innovative Emission Inventory Methods, Austin, TX

09/05/03 Emissions Forum Call

07/01/03 Emissions Forum Meeting, Portland, OR

05/07/03 Emissions Data Management System Needs Assessment Workshop, Denver, CO

03/19/03 WRAP Forums and Planning Team Meeting, Santa Fe, NM

2002 Events

11/14/02 Emissions Forum Meeting, Tempe, AZ

05/23/02 Emissions Forum Workplan & Budget Meeting, Salt Lake City, UT

04/03/02 Emissions Forum/EI Work Group Conference Call Minutes DOC or WPD

01/29/02 Emissions Forum Meeting, Phoenix, AZ

2001 Events

09/27/01 Emissions Forum & Emissions Work Group Meeting, UC Riverside

05/14/01 Emissions Forum Meeting, Spokane, WA

05/07/01 Teleconference on WRAP Dust Issue DOC

02/01/01 Emissions Forum Final Meeting Minutes PDF or WPD

2000 Events

07/11/00 Emissions Forum Final Meeting Minutes WPD

08/30/00 Emissions Forum Final Meeting Minutes WPD

- **Fire Emissions Joint Forum**

2007 Events

09/26/07 FEJF Meeting, Salt Lake City, UT

06/25/07 FEJF Coference Call

05/29/07 FEJF Conference Call

04/24/07 FEJF Conference Call

02/22/07 Fire Emissions Joint Forum Meeting, San Diego, CA

01/30/07 FEJF Conference Call

2006 Events

11/28/06 FEJF Conference Call

10/17/06 Fire Emissions Joint Forum Meeting, Spokane, WA

07/11/06 Fire Emissions Joint Forum Meeting, Portland, OR

05/23/06 WRAP Workshop on Fire, Carbon and Dust, Sacramento, CA

04/25/06 FEJF Conference Call

03/28/06 FEJF Conference Call

03/07/06 FEJF Meeting, Albuquerque, NM

01/24/06 FEJF Conference Call

2005 Events

12/20/05 FEJF Conference Call Notes PDF or DOC

11/30/05 FEJF Meeting, Seattle, WA

10/25/05 FEJF Conference Call Notes PDF or DOC

09/28/05 FEJF Meeting, Missoula, MT

08/23/05 FEJF Conference Call Notes PDF or DOC

07/26/05 FEJF Conference Call Notes PDF or DOC

06/07/05 FEJF Meeting, Denver, CO

02/23/05 FEJF Meeting, Salt Lake City, UT

02/09/05 Inter-RPO Fire and Smoke Technical and Policy Coordination Meeting, Round Rock, TX

2004 Events

12/08/04 FEJF Meeting, Las Vegas, NV

09/08/04 FEJF Meeting, Worley, ID

06/16/04 308/309 Smoke Management Planning Workshop, Portland, OR

06/15/04 FEJF Meeting, Portland, OR

05/04/04 National Fire Emissions Technical Work Shop, New Orleans, LA

03/10/04 FEJF Meeting, San Diego, CA

2003 Events

12/10/03 FEJF Meeting, Tucson, AZ

- Agenda PDF or DOC
- Attendee List PDF or DOC
- Presentation: Plans for Fire Emissions Inventories (Moore) PPT
- Presentation: Fire Emissions from 30,000' - Regional Haze Planning Needs and Level(s) of Effort (Moore/Alter) PPT
- Issue Paper: FEJF De Minimis Task Team PDF or DOC

09/24/03 FEJF Meeting, Portland, OR

- Agenda PDF or DOC
- Draft Minutes PDF or DOC
- Attendee List PDF or DOC
- Emission Reduction Techniques for Agricultural Burning and Wildland Fire PDF or PPT
  (Draft Annotated Bibliography, Indices, and Summary Table—Kenneth Meardon, MACTEC)
- Lee Alter's WRAP Update Power Point Presentation PDF or PPT
- FEJF Draft 04 Workplan PDF or DOC
- Dave Randall's Model Sensitivity Runs Presentation PDF
- De-minimus outline PDF or DOC

06/03/03 FEJF Meeting, San Francisco, CA

03/18/03 FEJF Meeting, Santa Fe, NM

2002 Events

12/10/02 FEJF Meeting, Jackson, WY

Includes Meeting Documents and Presentations from the meeting.

(Updated 12/24/02)

09/18/02 FEJF Meeting, Phoenix, AZ

05/15/02 FEJF Meeting, Coeur d'Alene, ID

04/26/02 FEJF Conference Call PDF

02/06/02 FEJF Meeting, Tucson, AZ PDF

ARCHIVE - 2001 and earlier

- **Mobile Sources Forum**

2007 Events

06/07/07 Workshop for Developing And Implementing A State Funded Retrofit Program

05/03/07 Mobile Sources Forum Call

03/22/07 Mobile Sources Forum Call

01/30/07 Mobile Sources Forum Call

2006 Events

10/03/06 WRAP Diesel Retrofit Boot Camp, Las Vegas, NV

2005 Events

01/27/05 WRAP Member Offroad Retrofit Program Workshop, San Diego, CA

2003 Events

07/16/03 Workshop on EPA's Nonroad Proposal, Denver, CO

2002 Events

10/30/02 Mobile Sources Forum Meeting, Denver, CO

10/09/02 MSF/IOC Conference Call

- The Forum was invited participate in the IOC Meeting via speakerphone for the following mobile source agenda item: Discussion of ***Preliminary Mobile Source Significance Test Modeling Results*** PPT (Revised IOC Mobile Source Power Point presentation)

04/15/02 Mobile Sources Forum Meeting, Denver, CO

2001 Events

07/25/01 Mobile Sources Forum Meeting Agenda DOC

2000 Events

06/07/00 Mobile Sources Forum Meeting Minutes PDF

- **Sources In and Near Class I Areas Forum**

(12/10/02) Sources In and Near Class I Areas Forum Meeting, Novato, CA
The Forum will review and finalize the workplan that its contractor (ENVIRON) will follow in characterizing emissions near Class I areas throughout the WRAP region. The meeting will be held from 12-3 at ENVIRON's offices in Novato, CA. (Posted 11/21/02)

Sources In and Near Class I Areas Forum
1999 Meeting Minutes (zip file)

- **Stationary Sources Joint Forum**

2006 Events

11/14/06 SSJF Meeting, Tempe, AZ

08/16/06 SSJF Meeting, Salt Lake City, UT

05/30/06 SSJF/309 Workgroup Call on SO2 PDF or DOC

05/10/06 Oil and Gas Workgroup Call PDF or DOC

05/05/06 AMC Conference Call Notes PDF or DOC

02/01/06 SSJF Meeting, Denver, CO

2005 Events

09/07/05 SSJF Meeting, Denver, CO

05/10/05 SSJF Meeting, Palm Springs, CA

02/23/05 SSJF Meeting, Salt Lake City, UT

2004 Events

12/13/04 SSJF Meeting, Tempe, AZ

- Update on Identifying BART-eligible sources PDF ZIP
- Tribal Point Source Project PDF or PPT
- 2003 SO2 Emissions and Milestone Report PDF or PPT
- Attribution of Haze Project Update PDF or PPT

06/02/04 SSJF Meeting, Denver, CO

- Agenda PDF or DOC
- Minutes PDF or WPD
- Summary of Action Items and Future Work (Pat Cummins) PDF or DOC
- Identification of BART-eligible sources (project update) PDF or PPT
- EPA's summary of BART reproposal PDF or PPT
- Status of WRAP comments on BART reproposal (update) PDF or PPT
- EPA's analysis of EGU NOx controls in the West PDF or PPT and XLS
- EPA's analysis of the CAIR's impact on SO2 emissions in the 309 states PDF or PPT
- Lee Alter's summary of EGU NOx emissions XLS
- Overview of oil and gas development emissions and haze issues PDF or PPT
- Attribution of haze (project update) PDF or PPT

04/13/04 SSJF Conference Call Notes PDF or DOC

02/18/04 Stationary Sources Joint Forum Meeting, Denver, CO

- Agenda PDF or DOC
- Minutes PDF or WPD
- BART Overview PDF or PPT
- WRAP Technical Approach PDF or PPT
- EPA Update on BART, IAQR, and Hg PDF or PPT
- Issues related to expanding EPA’s proposed Interstate Air Quality Rule (IAQR) to cover regional haze in the West PDF or DOC

- **Technical Analysis Forum**

Work Groups:

- **Implementation Work Group**

See Air Manager's Committee

- **Tribal Data Development Work Group**

Also Tribal Caucus

2007 Events

08/28/07 Tribal Caucus Meeting, Denver, CO

07/17/07 TDDWG Meeting, Worley, ID

04/16/07 TDDWG Meeting, San Diego, CA

01/23/07 TDDWG Meeting, Palm Springs, CA

2006 Events

11/28/06 WRAP Tribal Technical & Policy Workshop, Albuquerque, NM

10/12/06 TDDWG Meeting, Scottsdale/Fountain Hills, AZ (Fort McDowell Yavapai Nation)

09/11/06 Tribal Caucus Meeting, Whitefish, MT

07/26/06 TDDWG Meeting, Lewiston, ID

05/01/06 NTEC Conference, Temecula, CA

04/10/06 Advanced EI/TEISS Technical Assistance Training, Seattle, WA

03/28/06 TEISS Training, Las Vegas, NV

03/14/06 TDDWG & Inter-RPO Tribal WG Joint Meeting Albuquerque, NM

02/21/06 TEISS Training, Las Vegas, NV

2005 Events

12/12/05 Tribal Caucus Meeting, Palm Springs, CA

12/07/06 TDDWG Meeting, Santa Fe, NM

11/01/05 Advanced EI/TEISS Technical Assistance Training, Phoenix, AZ

08/17/05 TDDWG Meeting, Polson, MT

05/16/05 Tribal Caucus Meeting, Phoenix, AZ

05/03/05 NTEC Conference, Greenbay, WI

01/19/05 TDDWG Meeting, Lake Tahoe, NV

2004 Events

11/09/04 Tribal Caucus Meeting Salt Lake City, UT

10/19/04 TDDWG Meeting, Boise, ID

10/12/04 Tribal Caucus Call

10/05/04 National Tribal Air Association's 3rd Annual Conference

09/07/04 TDDWG Conference Call

08/10/04 Tribal Caucus Call

06/29/04 TDDWG Meeting, Tempe, AZ

04/05/04 Tribal Caucus Meeting, Tempe, AZ

03/02/04 National Tribal Forum Series on Air Quality, San Diego, CA

02/09/04 TDDWG Meeting, Las Vegas, NV

2003 Events

11/13/03 TDDWG Meeting, Las Vegas, NV

10/13/03 Alaska Tribal Conference on Environmental Management, Anchorage, AK

10/13/03 Tribal Caucus Meeting, Salt Lake City, UT

09/16/03 WRAP Tribal Policy and Technical Workshop, Albuquerque, NM

08/06/03 TDDWG Meeting, Seattle, WA

04/28/03 TDDWG Meeting, Sacaton, AZ

04/01/03 Tribal Air Caucus Meeting, Portland, OR

2002 Events

05/22/02 Tribal Caucus Meeting, Salt Lake City, UT

04/08-09/02 TDDWG Meeting, RMC, Riverside, CA

01/08-09/02 TDDWG Meeting, Phoenix, AZ

2001 Events

09/26/01 Meeting Minutes

01/24/01 Meeting Minutes

05/31/01 Meeting Minutes

09/13/01 TDDWG Meeting, Albuquerque, NM

01/24/01 TDDWG Meeting, Las Vegas, NV, PDF or DOC

2000 Events

01/13/00 TDDWG Meeting, Phoenix, AZ

1999 Events

06/17/99 TDDWG Meeting

Additional TDDWG Meeting Minutes for 1999 (zip file)

Archived

- Air Monitoring and Reporting Forum (Archive Status as of 12/06)
- Air Quality Modeling Forum (Archive Status as of 12/06)
- Attribution of Haze Work Group (Archive Status as of 12/06)
- Market Trading Forum (Archive Status as of 1/04)

Appendix C: Pollutants Causing Visibility Impairment

Appendix to Chapter 7 of the

State Implementation Plan

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State Implementation Plan 1
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Statewide Base Year Aerosol Light Extinction 3
Craters of the Moon Data 3
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Overview of data sources

The data relied upon for Chapter 7 came from the WRAP TSS website and is available at: http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx
By selecting a location from the map, views are given the option of viewing monitoring, emission inventory or modeling data. For this Chapter monitoring data for the individual Class I areas. The TSS website allows users to view information in a stack bar or line graph for the 20% best or worst days, by pollutant in either dv or concentration levels.

The "The Class I Summary Table" option was used to develop information for the statewide and individual Class I "Aerosol Light Extinction" 3-D bar graphs as in Figure 7-1 data.

Information for the pie charts in Chapter 7 utilized the TSS monitoring data from the base year 2002 worst 20% days. The data is available by selecting the Class I are of interest from the TSS website map, then select "Monitoring" from the box below. Select "Total Light Extinction Time Series" and the pollutant and years of interest from the pull down table. If the data isn't displayed below the graph, click on "+Show Data."

Statewide Base Year Aerosol Light Extinction

Figure 7-1 Data

Idaho Class I Area Base Year Aerosol Light Extinction					
	2000-04 Baseline Conditions Craters of the Moon	2000-04 Baseline Conditions Hells Canyon	2000-04 Baseline Conditions Sawtooth Wilderness	2000-04 Baseline Conditions Selway Wilderness	2000-04 Baseline Conditions Yellowstone
	(Mm-1)	(Mm-1)	(Mm-1)	(Mm-1)	(Mm-1)
Amm. Sulfate	5.69	8.37	3.06	4.83	4.26
Amm. Nitrate	11.35	28.47	0.63	1.46	1.77
Organic Carbon	9.06	15.6	22.24	20.01	13.48
Elemental Carbon	1.92	3.06	4.2	2.52	2.48
Fine Soil	1.04	0.66	0.77	0.94	0.95
Coarse Material[3]	2.95	1.93	1.74	2.49	2.58
Sea Salt[3]	0.03	0.05	0.12	0.26	0.02
Total Light Extinction	42.05	56.21	42.77	42.52	34.55
Deciview	14	18.55	13.78	13.41	11.76

Craters of the Moon Data

Data Figure 7-2

Craters of the Moon NM 2002 20% Worst Days										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
CRMO1	NIA	2001	21	7.99	16.02	4.3	1.4	1.36	2.76	0
CRMO1	NIA	2002	23	4.49	13.84	10.68	2.06	1.05	2.68	0.01
CRMO1	NIA	2003	21	4.23	6.92	14.77	2.53	0.86	3.46	0
CRMO1	NIA	2004	23	6.07	8.61	6.49	1.69	0.9	2.89	0.12

Data Figure 7-10

	Class I Area Visibility Summary: Craters of the Moon NM, ID							
	Visibility Conditions: Worst 20% Days							
	RRF Calculation Method: Specific Days (EPA)							
	Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)							
	Monitored		**Estimated**		**Projected**			
	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Uniform Rate of Progress Target	2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions[2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)[1]	(Mm-1)	(tons / %)	(%)	(%)
Amm. Sulfate	5.69	4.39	0.83	4.39	5.35	-13,272 -34%	-25%	-30%
Amm. Nitrate	11.35	8.31	1.05	8.31	8.3	-32,418 -19%	-27%	-34%
Organic Carbon	9.06	7.73	3.98	7.73	8.73	-4,416 -8%	-5%	-25%
Elemental Carbon	1.92	1.54	0.36	1.54	1.51	-2,084 -15%	-17%	-50%
Fine Soil	1.04	1.08	1.2	1.08	1.23	2,350 16%	9%	15%
Coarse Material[3]	2.95	3.2	4.05	3.2	Not Applicable	13,507 20%	12%	27%
Sea Salt[3]	0.03	0.04	0.06	0.04		Not Applicable		
Total Light Extinction	32.04	26.29	11.53	35.96	38.11			
Deciview	14	12.49	7.53	12.49	13.06			
Reduction Needed		5.75	20.51					
Base year and reduction in dv	14	1.51	6.47					

Hells Canyon Wilderness Data

Data Figure 7-11

Hells Canyon Wilderness Area 20% Worst Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
HECA1	NIA	2001	23	9.95	32.88	11.36	2.94	0.68	1.35	0
HECA1	NIA	2002	22	6.58	20.03	20.75	3.69	0.75	1.96	0.01
HECA1	NIA	2004	25	8.59	32.5	14.71	2.55	0.56	2.48	0.13

Data Figure 7-17

Hells Canyon Wilderness Area 20% Best Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
HECA1	NIA	2001	22	2.21	1.03	1.61	0.55	0.24	0.7	0.11
HECA1	NIA	2002	21	1.91	0.79	2.29	0.74	0.32	0.9	0.04
HECA1	NIA	2004	24	1.68	0.53	2.14	0.46	0.19	0.81	0.08

Data Figure7-19

	Class I Area Visibility Summary: Hells Canyon W, ID						
	Visibility Conditions: Worst 20% Days						
	RRF Calculation Method: Specific Days (EPA)						
	Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored		**Estimated**	**Projected**			
	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions[2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	(tons / %)	(%)	(%)
Amm. Sulfate	8.37	6.35	1.14	7.49	-20,912 -40%	-29%	-38%
Amm. Nitrate	28.47	19.69	2.67	19.91	-96,079 -37%	-22%	-30%
Organic Carbon	15.6	12.12	3.69	11.54	-3,120 -3%	-12%	-31%
Elemental Carbon	3.06	2.37	0.37	2.65	-3,043 -11%	-21%	-44%
Fine Soil	0.66	0.72	0.92	0.74	-909 -3%	10%	15%
Coarse Material[3]	1.93	2.26	3.4	Not Applicable	31,039 47%	12%	27%
Sea Salt[3]	0.05	0.05	0.05				
Needed Improvement	0	14.58	45.9				
Sea Salt[3]	0.05	0.05	0.05		Not Applicable		
Total Light Extinction	58.14	43.56	12.24	55.31			
Deciview	18.55	16.17	8.32	16.49			
Dv needed	0	2.38	10.23				

Sawtooth Wilderness Data

Data Figure 7-20

Sawtooth Wilderness Area 20% Worst Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
SAWT1	NIA	2001	22	3.47	0.79	23.94	5.63	1.07	2.33	0.28
SAWT1	NIA	2002	22	2.13	0.57	22.51	4.95	0.76	1.55	0
SAWT1	NIA	2003	23	2.6	0.54	21.59	2.85	0.45	1.57	0.21
SAWT1	NIA	2004	24	4.05	0.62	20.92	3.38	0.8	1.52	0.01

Data Figure 7-28

Sawtooth Wilderness Area 20% Best Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
SAWT1	NIA	2001	22	1.74	0.36	2.81	0.88	0.14	0.33	0.04
SAWT1	NIA	2002	21	1.12	0.32	2.13	0.58	0.16	0.31	0
SAWT1	NIA	2003	22	0.83	0.22	1.92	0.46	0.09	0.31	0
SAWT1	NIA	2004	23	1.12	0.28	2.63	0.56	0.17	0.33	0.02

Figure 7-30

	Class I Area Visibility Summary: Sawtooth W, ID **Visibility Conditions:** Worst 20% Days							
	RRF Calculation Method: Specific Days (EPA)							
	Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)							
	Monitored		**Estimated**		**Projected**			
	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions		2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions [2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm-1)	(Mm-1)[1]	(Mm-1)		(Mm-1)	(tons / %)	(%)	(%)
Amm. Sulfate	3.06	2.5	0.81		2.59	-13,272 -34%	-27%	-35%
Amm. Nitrate	0.63	0.65	0.7		0.54	-32,418 -19%	-25%	-32%
Organic Carbon	22.24	16.51	3.94		20.81	-4,416 -8%	-7%	-26%
Elemental Carbon	4.2	3.2	0.38		3.73	-2,084 -15%	-16%	-44%
Fine Soil	0.77	0.81	0.94		0.79	2,350 16%	12%	18%
Coarse Material[3]	1.74	1.89	2.39		Not Applicable	13,507 20%	15%	31%
Sea Salt[3]	0.12	0.12	0.13			Not Applicable		
Total Light Extinction	32.76	25.68	9.29		40.32			
Deciview	13.78	12.06	6.42		13.22			
Reduction Needed	0	7.08	23.47					
Reduction Needed dv		1.72	7.36					

Selway-Bitterroot Data

Data Figure 7-31

Selway-Bitterroot Wilderness Area 20% Worst Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
SULA1	NIA	2001	24	4.78	1.26	11.47	1.95	1.56	3.7	1.01
SULA1	NIA	2002	24	4.63	1.58	12.59	2.05	0.91	2.45	0
SULA1	NIA	2003	23	4.78	1.57	43.26	4.34	0.59	1.75	0
SULA1	NIA	2004	24	5.14	1.45	12.73	1.75	0.69	2.08	0.01

Data Figure 7-39

Selway-Bitterroot Wilderness Area 20% Best Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
SULA1	NIA	2001	23	1.32	0.43	0.96	0.29	0.21	0.3	0.1
SULA1	NIA	2002	23	1.14	0.39	1.02	0.32	0.07	0.21	0
SULA1	NIA	2003	22	0.69	0.18	0.77	0.16	0.04	0.13	0.01
SULA1	NIA	2004	23	1.23	0.36	0.99	0.33	0.06	0.21	0.01

Data Figure 7-41

	Class I Area Visibility Summary: Anaconda-Pintler W, MT: Selway-Bitterroot W, MT						
	Visibility Conditions: Worst 20% Days						
	RRF Calculation Method: Specific Days (EPA)						
	Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored		**Estimated**	**Projected**			
	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions[2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	(tons / %)	(%)	(%)
Amm. Sulfate	4.83	3.86	1.1	4.32	-6,128 -12%	-15%	-29%
Amm. Nitrate	1.46	1.38	1.12	0.96	-63,099 -26%	-21%	-37%
Organic Carbon	20.01	15.46	4.84	19.09	-1,587 -3%	-2%	-20%
Elemental Carbon	2.52	2	0.43	2.4	-1,971 -17%	-6%	-39%
Fine Soil	0.94	0.93	0.91	1.02	5,807 14%	10%	17%
Coarse Material[3]	2.49	2.54	2.7	Not Applicable	54,709 19%	13%	33%
Sea Salt[3]	0.26	0.26	0.27		Not Applicable		
Reduction Needed	0	6.08	21.14				
Total Light Extinction	32.51	26.43	11.37	40.54			
Deciview	13.41	12.02	7.43	12.94			
Dv needed	0	1.39	5.98				

Yellowstone National Park

Data Figure 7-42

Yellowstone National Park Area 20% Worst Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
YELL2	NIA	2000	20	4.16	1.97	18.45	3.65	0.8	2.84	0
YELL2	NIA	2001	22	4.71	2.36	16.11	2.61	1.39	2.69	0
YELL2	NIA	2002	22	3.8	1.63	11.16	1.87	1.21	3.12	0.03
YELL2	NIA	2003	21	4.07	1.43	12.8	2.33	0.44	1.3	0
YELL2	NIA	2004	23	4.57	1.46	8.89	1.94	0.92	2.94	0.07

Data Figure 7-50

Yellowstone National Park Area 20% Best Days Light Extinction										
Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	SeaSalt Extinction
YELL2	NIA	2000	19	1.68	0.88	1.13	0.15	0.09	0.25	0.05
YELL2	NIA	2001	21	1.92	0.76	1.16	0.4	0.12	0.19	0
YELL2	NIA	2002	21	1.32	0.82	1.14	0.31	0.13	0.27	0
YELL2	NIA	2003	20	1.12	0.53	0.92	0.24	0.09	0.24	0
YELL2	NIA	2004	22	1.33	0.62	1.27	0.46	0.08	0.26	0.02

Data Figure 7-51

	Class I Area Visibility Summary: Grand Teton NP, WY: Red Rock Lakes NWRW, MT: Teton W, WY: Yellowstone NP, WY						
	Visibility Conditions: Worst 20% Days						
	RRF Calculation Method: Specific Days (EPA)						
	Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored		**Estimated**	**Projected**			
	2000-04 Baseline Conditions	2018 Uniform Rate of Progress Target	2064 Natural Conditions	2018 Projected Visibility Conditions	Baseline to 2018 Change In Statewide Emissions	Baseline to 2018 Change In Upwind Weighted Emissions[2]	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2]
	(Mm-1)	(Mm-1)[1]	(Mm-1)	(Mm-1)	(tons / %)	(%)	(%)
Amm. Sulfate	4.26	3.35	0.76	3.71	-22,794 -15%	-26%	-32%
Amm. Nitrate	1.77	1.5	0.63	1.36	-39,861 -14%	-26%	-34%
Organic Carbon	13.48	11.02	4.61	12.87	-730 -3%	-4%	-29%
Elemental Carbon	2.48	1.97	0.43	2.2	-1,217 -15%	-11%	-50%
Fine Soil	0.95	0.97	1.02	1.04	5,223 31%	14%	25%
Coarse Material[3]	2.58	2.67	2.99	Not Applicable	13,394 27%	19%	42%
Sea Salt[3]	0.02	0.02	0.03		Not Applicable		
Reductions Needed	0	4.04	15.07				
Total Light Extinction	25.54	21.5	10.47	32.77			
Deciview	11.76	10.52	6.44	11.23			
Deciview needed	0	1.24	5.32				

Appendix D: Emission Inventory

Appendix to Chapter 8 of the State Implementation Plan

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Emission Inventory Development

Documentation and Description of Emission Inventory Development for WRAP 2002-2018 Emission Inventories

Information is available at the WRAP Technical Support System

http://vista.cira.colostate.edu/TSS/Results/Emissions.aspx

Stationary Point-Source Emissions

1.1

The stationary point source emission category includes those sources that are identified by point locations, typically because they are regulated and their locations are available in regulatory reports. In addition, elevated point sources will have their emissions allocated vertically through the model layers, as opposed to being emitted into only the first model layer. Point sources are often further subdivided into electric generating unit (EGU) sources and non-EGU sources, particularly in criteria inventories in which EGUs are a primary source of NO_x and SO_2. Examples of non-EGU point sources include chemical manufacturers and furniture refinishers. Point sources are included in both criteria and toxics inventories

Stationary point source emissions data for SMOKE consist of (1) Inventory Data Analyzer (IDA)-formatted inventory files; (2) ancillary data for allocating the inventories in space, time, and to the Carbon Bond-IV chemistry mechanism used in CMAQ and CAMx; and (3) meteorology data for calculating plume rise from the elevated point sources.

The development of the stationary point source emission inventories for WRAP regional modeling is described in this section. The discussion focuses on the development of the 2002 Base inventory; emissions modeling for the 2002 Planning inventory and the 2018 base year inventory use the same processing approach. Variations to the modeling approach and specific revisions and enhancements incorporated into the final modeling versions of the inventories have been described previously (refer to the Emission Overview Documentation). Specific revisions are noted with respect to data sources and source categories for the Plan02 and Base18 emissions inventories.

Data Sources

Non-Oil and Gas Sources

For the Base02 stationary point source inventories, actual 2002 data were used. Data sources include emissions developed by the RPOs for the U.S., version 2 of the year 2000 Canadian inventory, and the BRAVO 1999 Mexican inventory. Entirely new inventories for the six northern states of Mexico for stationary area, as well as stationary point, on-road mobile, and off-road mobile sources, were incorporated into the 2002 Planning inventories.   These data were provided by ERG, Inc., who completed an updated 1999 emissions inventory for northern Mexico (Fields et al., 2006) and delivered these data in early 2006.

The WRAP stationary point inventory consisted of annual county-level and tribal data provided by ERG, Inc. (2005). The CENRAP (E.H. Pechan et al., 2005a) and VISTAS (Stella, 2005) stationary point inventories consisted of an annual data set and monthly CEM data for selected EGUs. CENRAP and Alpine Geophysics provided these data directly to the RMC. The MANE-VU and MRPO 2002 stationary point inventories were

obtained from the MANE-VU and LADCO web sites, respectively. For the Base02 inventory, the RMC opted to use the summer season inventory to model the entire year for the MANE-VU states (E.H. Pechan et al., 2005b). The MRPO Base I stationary point inventory was used in the Base02 inventory.

ERG, Inc. provided SMOKE-ready temporal profiles and cross-reference files for representing baseline EGU activities in the WRAP states. The RMC worked closely with ERG to refine the cross-references that associate the profiles with actual inventory sources. For additional information on the development and application of these profiles, refer to Fields et al. (2005). Alpine Geophysics, LLC, provided SMOKE-ready temporal profiles and cross-reference files for representing baseline EGU activities for non-WRAP EGUs

The WRAP RMC entered into a nondisclosure agreement with Environment Canada to obtain version 2 of the 2000 Canadian point-source inventory. This inventory represented a major improvement over the version of the data used in the preliminary 2002 modeling. For Mexico, the same BRAVO 1999 inventory used in the preliminary 2002 modeling (Tonnesen et al., 2005) was used for the current Base02 inventory modeling. New inventory data for Mexico developed by ERG for the six northern Mexican states were used for the Plan02 inventories.

The 2018 point area source emission inventories for WRAP, MANE-VU, and VISTAS were developed from county-level input data processed outside SMOKE. For the MRPO and CENRAP regions, 2018 projection factors (growth and control) were applied to the Plan02 inventories. For all non-WRAP EGU sources, updated temporal profiles, as developed from the IPM for 2018 emissions were used

The Base02 inventory used updated meteorology data and improved the temporal allocation information relative to the preliminary 2002 modeling; the rest of the ancillary data for modeling stationary point sources remained the same (Tonnesen et al., 2005). The meteorology data that used to calculate plume rise for the elevated sources was version 2 of the 2002 MM5 data preprocessed for SMOKE and CMAQ with MCIP version 2.3 (Kemball-Cook et al., 2005). One major improvement to the temporal allocation data based on information provided by the VISTAS RPO was incorporated. For the VISTAS sources, we added EGU-based CEM profiles developed by Alpine Geophysics were included in the SMOKE modeling. These additions included new monthly profiles and month-specific weekly and diurnal profiles.

Oil and Gas Production Operations

The 2002 Base year emission inventory included a number of emissions sectors that WRAP had never modeled before, including oil and gas production operations. Emissions from oil and gas production operations have been sporadically reported by some states in their stationary area source inventories, but for the most part were missing from the modeling inventories. In the Base02 inventories, oil and gas production emissions were represented explicitly as both area and point sources in a handful of states across the WRAP region.

The oil and gas production emissions inventories for the WRAP states and for tribal lands in the WRAP region were provided as stationary area source and stationary point source IDA-formatted inventories. ERG, Inc. provided the point-source inventories with the rest of the stationary-point data (ERG, 2005a). ENVIRON provided the area source oil and gas inventories for non-CA WRAP states and for tribal lands in the WRAP region, along with spatial surrogates for allocating these data to the model grid (Russell and Pollack, 2005). For California, oil and gas inventories were extracted from the stationary area source data used in the preliminary 2002 modeling. Oil and gas production emissions data for outside of the WRAP region, if they exist, are contained in the stationary area inventories received from the other RPOs.

For 2018, ENVIRON and ERG provided projected inventory data for oil and gas operations for the WRAP states. Projection factors were used for all other RPOs.

Emissions Modeling

Non-Oil and Gas Sources

For Base02 emission inventory, SMOKE was configured to process the annual inventories for the U.S., Canada, and Mexico and process hourly CEM data for the VISTAS and CENRAP states. SMOKE was configured to allocate these emissions up to model layer 15, which roughly corresponds to the maximum planetary boundary layer (PBL) heights across the entire domain throughout the year. As coarse particulate matter (PMc) is not an inventory pollutant but is required by the air quality models as input species, SMOKE was set to calculate PMc during the processing as (PM_{10} - $PM_{2.5}$). Also, the SMOKE option WKDAY_NORMALIZE set to "No," to treat the annual inventories based on the assumption that they represent average-day data based on a seven-day week, rather than average weekday data. It was also assumed that all of the volatile organic compound (VOC) emissions in the inventories are reactive organic gas (ROG), and thus used SMOKE to convert the VOC to total organic gas (TOG) before converting the emissions into CB-IV speciation for the air quality models. To capture the differences in diurnal patterns that are contained in the CEM temporal profiles for the VISTAS and CENRAP states, SMOKE was configured to generate daily temporal matrices, as opposed to using a Monday-weekday-Saturday-Sunday (MWSS) temporal allocation approach.

The quality assurance of the stationary point emissions followed the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily time-series plots, annual time-series plots, and daily vertical profiles. These QA graphics are available at
http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/pt/plots/

As part of the QA process for new emissions scenarios, qualitative and quantitative comparisons are made between sequential cases to confirm that the results show the

expected changes based on the incremental updates that are made between cases. The comparison of the Plan02 emissions results with Base02 results was consistent with the revisions, as expected, except for the non-WRAP stationary point sources. Observed differences in these emissions were much larger than expected, considering that only the temporal profiles were updated for these sources. It was discovered that the IPM-derived temporal profiles used in Plan02 for the non-WRAP stationary point sources were intended for use only with IPM-projected 2018 inventories, not with the 2002 inventories. The use of these profiles caused the 2002 emissions for non-WRAP EGUs to increase dramatically in case Plan02. The IPM-derived temporal profiles were therefore replaced with baseline CEM temporal profiles calculated as 2000-2003 activity averages for the VISTAS states and with actual 2002 CEM-derived temporal profiles for the CENRAP, MANE-VU, and MRPO states.

Oil and Gas Emissions

The oil and gas production industry includes a large number of processes and equipment types that stretch from the wellhead to fuel distribution networks. Many of these processes emit significant quantities of nitrous oxides (NOx), volatile organic compounds (VOC) and other pollutants. Past emission inventories have estimated emissions from specific pieces of equipment, for limited geographic areas and for other segments of the industry. The largest oil and gas production facilities, gas plants and major compressor stations, have been previously inventoried as stationary sources. All states in the western region had previously compiled emission inventories for the year 2002 that included the major “point” emission sources in the oil and gas production industry. However, what was included in these emission inventories varied from state to state, depending on the permitting and/or reporting thresholds.

Oil and gas production facilities that are geographically distributed and have lesser emissions than the point source threshold are considered area sources. Previously, there had not been a comprehensive emission inventory of oil and gas production operations in the western region that covered both point and area sources. Nor had there been a methodology developed to produce an inventory of this scope. The current WRAP inventory of oil and gas emissions was developed by ENVIRON as part of a WRAP-funded study to develop and implement a uniform procedure for estimating area source emissions from oil and gas production operations across the western region (Russell and Pollack, 2005). The emphasis of this study was placed on estimating emissions of pollutants with the potential to impair visibility near Class I areas in the west, in particular NOx emissions. In developing the emission estimation methodology, considerable resources were devoted to incorporating the insights and guidance of a variety of stakeholders, as well as integrating the point source emissions estimates developed in previous inventory efforts.

The 2002 oil and gas point source emissions have been adopted from the state inventories (ERG, 2005a). The level of coverage in those inventories was evaluated and the point source emissions have been reconciled with emissions estimated using the newly developed area source inventory methodology.

Oil and gas point source emission inventories include location parameters. For the current oil and gas area source emissions, a new spatial allocation scheme was developed to facilitate the integration of these emissions sources into the WRAP regional haze modeling. New spatial surrogates were developed for each of the non-point oil and gas emission sources addressed by this inventory. These surrogates, which are based on the geographic locations of oil and gas production, will enable the appropriate spatial distribution of emissions from oil and gas production operations in the air quality modeling.

Finally, a procedure was formulated and implemented to project the emissions from oil and gas production operations to future year 2018. For the WRAP 2018 base case modeling, only those emission control strategies that have already been adopted are considered. Oil and gas production forecasts were drawn from several sources and combined with the emissions estimates produced for the 2002 inventory and information on future controls to arrive at the 2018 inventory. Oil and gas point source projections are described in a separate report (ERG, 2005b).

Inventoried Sources

The WRAP Oil and Gas inventory was developed for a number of specific processes and equipment not previously inventoried. Emissions were estimated and modeled as both stationary point and distributed area sources. Major sources of NOx and VOC emission were the focus of the inventory.

Major sources of NOx emissions include the following processes and equipment types:

- Compressor engines
- Drill rigs
- Wellheads
- CBM pump engines

Major sources of VOC emissions include the following processes and equipment types:

- Oil well tanks
- Oil well pneumatic devices
- Gas well pneumatic devices
- Gas well dehydrators
- Gas well flaring and venting
- Condensate tanks

For each of these equipment types and processes, new and/or revised estimation methodologies were developed and applied. A detailed discussion of these methodologies can be found in Russell and Pollack, 2005.

Spatial Allocation

For air quality modeling, the EPA default spatial allocation surrogates were not appropriate for the area source oil and gas production emissions. ENVIRON therefore developed a new set of spatial allocation surrogates to be used in SMOKE to allocate the county-level area source emissions to the appropriate oil and gas fields. Oil and gas operation emissions estimated as stationary point sources are allocated based on geographic coordinates.

A total of four different surrogate categories were designed to allocate emissions from the twelve oil and gas emission source categories listed in Table 1. The oil, gas and water production surrogates were based on production data at known well locations, while the drill rig surrogate was based solely on the number and location of wells drilled.

Table 1. Emission sources and surrogate categories.

Source	SCC	Allocation Surrogate	Surrogate Code
Drill rigs	2310000220	Drill Rigs	688
Oil well - heaters	2310010100	Oil Production	686
Oil well - tanks	2310010200	Oil Production	686
Oil well - pneumatic devices	2310010300	Oil Production	686
Compressor engines	2310020600	Gas Production	685
Gas well - heaters	2310021100	Gas Production	685
Gas well - pneumatic devices	2310021300	Gas Production	685
Gas well - dehydration	2310021400	Gas Production	685
Gas well - completion	2310021500	Gas Production	685
CBM pump engines	2310023000	Water production at CBM wells	687
Gas well - tanks, uncontrolled	2310030210	Gas Production	685
Gas well - tanks, controlled	2310030220	Gas Production	685

Once the well locations were known, creation of the surrogates took place in several steps, and relied on the use of ArcINFO GIS software.

1. All wells and drill rigs were labeled with the appropriate grid cell IJ values for the 36-km domain.
2. For each individual well, the oil, gas and water production values were divided by the total oil, gas and water production values corresponding to the county in which the well was located. This division resulted in determination of the fraction of a county's total production taking place at each well. In the case of drill rigs, the number of drills, rather than the production values, were used.
3. For each unique grid cell / county combination with wells, each well's production fractions were summed to create the surrogate value.

The surrogate values for each grid cell / county combination were reformatted to comply with the SMOKE emissions processor AGPRO file format and an accompanying SMOKE AGREF file was created. The purpose of the AGREF file, presented in Table 2, is to define the relationship between the 3-digit codes chosen to represent each of the four surrogate categories in the AGPRO file and the SCC codes for the twelve oil and gas

emission categories to be allocated with these surrogates. This file also specifies which county/state/county (COSTCY) should use the given cross-reference. In this case, COSTCY is set to 000000 to indicate that all states and counties can use these cross-references.

Table 2. SMOKE gridding surrogate cross-reference (AGREF) file.

COSTCY	SCC	CODE
000000	2310000220	686
000000	2310010100	688
000000	2310010200	686
000000	2310010300	686
000000	2310020600	686
000000	2310021100	685
000000	2310021300	685
000000	2310021400	685
000000	2310021500	685
000000	2310023000	687
000000	2310030210	685
000000	2310030220	685

2018 Projection Methodology

The 2018 emission estimates from oil and gas production operations reflect the anticipated 2018 emission levels with the future controls currently defined by state and federal regulation. The 2018 oil and gas point source emissions inventory was prepared and reported separately by Eastern Research Group (ERG, 2005b). A detailed discussion of the development of the 2018 oil and gas inventory, including those sources modeled as area sources can be found in Russell and Pollack, 2005.

There were two primary basic methods used to estimate 2018 county-level oil and gas emissions. The first and by far the dominant method was to develop growth factors that were then used to project from the 2002 oil and gas emissions. A second method was necessary to estimate emissions in the handful of counties that had no 2002 oil and gas emissions but are anticipated to see oil and gas development by 2018. The decision of which method was used to estimate 2018 emissions was based on the existence of oil and gas emissions in 2002. Detailed discussions of each of the projection methods, data sources and methodologies for both cases are presented in Russell and Pollack, 2005.

To QA the oil and gas production emissions, we used the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Comparisons of the spatial plots produced from SMOKE output with spatial plots provided by ENVIRON were reviewed to ensure these data were modeled correctly. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily

spatial plots, daily time-series plots, and annual time-series plots are available at http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/wog/plots/.

Gridded Stationary Point Source Emission Inventory Summaries

Summaries of the gridded point source emissions for the Base02b, Plan02c and Base18b inventories by state and county, annual and seasonal periods, can be found on the TSS at: http://vista.cira.colostate.edu/tss/Results/Emissions.aspx.

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1.2 Area Source Emissions

The stationary area source emission category includes those sources that are treated as being spread over a spatial extent (usually a county or air district) and that are not movable (as compared to off-road mobile and on-road mobile sources). Because it is not possible to collect the emissions at each point of emission, they are estimated over larger regions. Examples of stationary area sources are residential heating and architectural coatings. Numerous sources, such as dry cleaning facilities and oil and gas production facilities, may be treated either as stationary area sources or as point sources, or a combination of both.

Stationary area source emissions data for SMOKE modeling consist of IDA-formatted inventory files and ancillary data for allocating the inventories in space, time, and to the Carbon Bond-IV chemistry mechanism used in CMAQ and CAMx. The development of the area source emission inventory is described in this section.

1.2.1 Source Categories

In addition to the typical area source emission categories, the WRAP RMC included the following emission source categories in the development of the inventories for this sector:

- Stationary area sources
- Agricultural and natural ammonia emission sources
- Oil and gas production operations
- Biogenic emissions

The development of each of these sectors is described below. The discussion focuses on the development of the 2002 Base inventory; emissions modeling for the 2002 Planning inventory and the 2018 base year inventory use the same processing approach. Variations to the modeling approach and specific revisions and enhancements incorporated into the final modeling versions of the inventories have been described previously (refer to the Emission Overview Documentation). Specific revisions are noted with respect to data sources and source categories for the Plan02 and Base18 emissions inventories.

Data sources

The data sources used in the development of the area sources emissions inventory for the WRAP modeling efforts are documented below.

Stationary Area Sources

The Base02 stationary area source inventories used actual 2002 data developed by the RPOs for the U.S., version 2 of the year 2000 Canadian inventory, and the BRAVO 1999 Mexican inventory. The WRAP stationary area inventory consists of annual county-level and tribal data provided by ERG, Inc. (2005), however, due to the small contribution of

the WRAP tribal inventories to the total domain emissions and the lack of readily available spatial allocation data for these parts of the domain, the WRAP tribal data was not incorporated into the final modeling inventories. The CENRAP (E.H. Pechan et al., 2005) and VISTAS Phase II (Stella, 2005) stationary area inventories also consisted of an annual data set and were provided by these RPOs. The MANE-VU and MRPO 2002 stationary area inventories were obtained from the MANE-VU and LADCO websites, respectively.

For Mexico, the same BRAVO 1999 inventory that was used in the preliminary 2002 modeling (Tonnesen et al., 2005), was used in the development of the Base02 inventories. Entirely new inventories for the six northern states of Mexico for stationary area, as well as stationary point, on-road mobile, and off-road mobile sources, were incorporated into the 2002 Planning inventories. These data were provided by ERG, Inc., who completed an updated 1999 emissions inventory for northern Mexico (Fields et al., 2006) and delivered these data in early 2006 For Canada, the Canadian 2000 inventory version 2, obtained from the U.S. EPA EFIG (U.S. EPA, 2005) was used.

The 2018 area source emission inventories for WRAP, MANE-VU, and VISTAS were developed from county-level input data processed outside SMOKE. For the MRPO and CENRAP regions, 2018 projection factors (growth and control) were applied to the Plan02 inventories; Mexico and Canada data were held constant at 2002 levels.

Agricultural and Natural Ammonia Emissions

Ammonia emissions from agricultural sources (livestock operations and fertilizer application) and natural sources (soil ammonia emissions), were derived from 2002 data and used in the WRAP RMC GIS-based NH3 emissions model. The development of emission inventories from this source sector, and specific data sources used, is described in more detail below and also in Mansell (2005)

CENRAP and MRPO provided monthly IDA-formatted inventories produced from process-based models of their own, along with temporal profiles and spatial cross-reference information for these sources. The rest of the U.S., Canada, and Mexico had agricultural NH_3 emissions contained within their annual stationary area source inventories

The 2018 ammonia source emission inventories for WRAP, MANE-VU, and VISTAS were held constant at 2002 levels. For the MRPO and CENRAP regions, 2018 projection factors (growth and control) applied to the Plan02 inventories. Mexican and Canadian data were held constant at 2002 levels.

Oil and Gas Production Operations

The 2002 Base year emission inventory included a number of emissions sectors that WRAP had never modeled before, including oil and gas production operations.

Emissions from oil and gas production operations have been sporadically reported by some states in their stationary area source inventories, but for the most part were missing from the modeling inventories. In the Base02 inventories, oil and gas production emissions were represented explicitly as both area and point sources in a handful of states across the WRAP region.

The oil and gas production emissions inventories for the WRAP states and for tribal lands in the WRAP region were provided as stationary area source and stationary point source IDA-formatted inventories. ERG, Inc. provided the point-source inventories with the rest of the stationary-point data (ERG, 2005a). ENVIRON provided the area source oil and gas inventories for non-CA WRAP states and for tribal lands in the WRAP region, along with spatial surrogates for allocating these data to the model grid (Russell and Pollack, 2005). For California, oil and gas inventories were extracted from the stationary area source data used in the preliminary 2002 modeling. Oil and gas production emissions data for outside of the WRAP region, if they exist, are contained in the stationary area inventories received from the other RPOs.

For 2018, ENVIRON and ERG provided projected inventory data for oil and gas operations for the WRAP states. Projection factors were used for all other RPOs.

Biogenic Emissions

For Base02 biogenic emissions inventories, the BELD3 land use data and biogenic emissions factors collected during the WRAP preliminary 2002 modeling (Tonnesen et al., 2005) were used. These data included BELD3 1-km resolution land use estimates and version 0.98 of the BELD emissions factors. The Base02 biogenic emissions modeling differed from the preliminary 2002 modeling in the use of improved 2002 meteorology data we developed in 2005 (Kemball-Cook et al., 2005). Biogenic emissions are held constant for the 2018 future year modeling inventories.

Emissions Modeling

To prepare the stationary area inventories for modeling, several modifications to the inventory files were made by removing selected sources either to model them as separate source categories or to omit them from the Base02 inventories completely. Using guidance provided by EPA (U.S. EPA, 2004b) fugitive and road dust sources were extracted from all stationary area source inventories for adjustment by transport factors and modeling as separate source categories (seethe Fugitive Dust Emissions documentation). The stage II refueling sources were also extracted and discarded from the non-WRAP U.S. inventories; these sources were modeled with MOBILE6 as part of the on-road mobile-source emissions. The stage II refueling emissions in the WRAP stationary area inventory were retained because the on-road mobile inventory for this region did not contain these emissions.

Additional steps performed to prepare the area source inventories included moving oil and gas sources from the California inventory to a separate file for explicit treatment, confirming that there is no overlap between the anthropogenic NH_3 inventory and

stationary area sources, moving several off-road mobile SCCs from the Mexico inventory to the off-road mobile sector, and moving area source fires in each regional inventory to separate files. In addition to these inventory modifications, a few changes to the ancillary data files for the Base02 inventories were made.

Base02 used improved temporal and spatial allocation information relative to the preliminary 2002 modeling; the rest of the ancillary data for modeling stationary area sources remained unchanged from the preliminary 2002 modeling (Tonnesen et al., 2005). Enhanced spatial allocation data with additional area-based surrogates were incorporated for Canada, and additional surrogates for Broomfield County in Colorado were used.

Improvements to the temporal allocation data for the Base02 inventories included the addition of several FIPS-specific profiles provided by VISTAS and CENRAP. These temporal profiles targeted mainly fire and agricultural NH_3 sources in these regions, such as open burning and livestock operations, respectively.

The quality assurance of the area source emissions followed the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily time-series plots, annual time-series plots, and daily vertical profiles. These QA graphics are available on the RMC web site at http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/ar/plots/.

Ammonia Emission Sources

Ammonia (NH_3) emissions from agricultural activities are a major source of ammonia and are dependent on many different environmental parameters, such as meteorology, crop and soil types, and land use. Traditionally these emissions have been represented in the stationary-area-source inventory as annual, county-level estimates. These estimates did not consider meteorology, and may have used different land use assumptions than were used in the air quality model simulations to which they were input. The WRAP funded development of a process-based agricultural NH_3 emissions model to estimate NH_3 emissions from several different agricultural sources (such as soils, livestock, and fertilizer application) that uses the same meteorology and land use assumptions that are used in CMAQ and CAMx.

The WRAP NH_3 emissions were prepared outside of SMOKE using the WRAP NH_3 model; details of this modeling are available in Mansell (2005). Due to an incorrect assumption in the soil emission factor used in the model, however, we had to discard the emissions from this sector. The WRAP NH_3 model emissions estimates were combined with data provided by the other RPOs to represent agricultural NH_3 emissions in Base02 modeling inventories. CENRAP and MRPO provided monthly IDA-formatted, county-level NH_3 inventories that they developed with their own process-based models. These emissions were modeled as area sources with SMOKE, applying the temporal profiles and the spatial cross-referencing received from these RPOs. The agricultural NH_3

emissions for the rest of the RPOs, Canada, and Mexico are contained within their stationary area inventories. The SMOKE default temporal profiles and spatial surrogates were applied to all non-process-based NH_3 emissions.

The quality assurance of the ammonia emissions followed the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily time-series plots, annual time-series plots, and daily vertical profiles. These QA graphics are available at http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/nh3/plots/.

Oil and Gas Emissions

The oil and gas production industry includes a large number of processes and equipment types that stretch from the wellhead to fuel distribution networks. Many of these processes emit significant quantities of nitrous oxides (NOx), volatile organic compounds (VOC) and other pollutants. Past emission inventories have estimated emissions from specific pieces of equipment, for limited geographic areas and for other segments of the industry. The largest oil and gas production facilities, gas plants and major compressor stations, have been previously inventoried as stationary sources. All states in the western region had previously compiled emission inventories for the year 2002 that included the major "point" emission sources in the oil and gas production industry. However, what was included in these emission inventories varied from state to state, depending on the permitting and/or reporting thresholds.

Oil and gas production facilities that are geographically distributed and have lesser emissions than the point source threshold are considered area sources. Previously, there had not been a comprehensive emission inventory of oil and gas production operations in the western region that covered both point and area sources. Nor had there been a methodology developed to produce an inventory of this scope. The current WRAP inventory of oil and gas emissions was developed by ENVIRON as part of a WRAP-funded study to develop and implement a uniform procedure for estimating area source emissions from oil and gas production operations across the western region (Russell and Pollack, 2005). The emphasis of this study was placed on estimating emissions of pollutants with the potential to impair visibility near Class I areas in the west, in particular NOx emissions. In developing the emission estimation methodology, considerable resources were devoted to incorporating the insights and guidance of a variety of stakeholders, as well as integrating the point source emissions estimates developed in previous inventory efforts.

The 2002 oil and gas point source emissions have been adopted from the state inventories (ERG, 2005a). The level of coverage in those inventories was evaluated and the point source emissions have been reconciled with emissions estimated using the newly developed area source inventory methodology.

Oil and gas point source emission inventories include location parameters. For the current oil and gas area source emissions, a new spatial allocation scheme was developed to facilitate the integration of these emissions sources into the WRAP regional haze modeling. New spatial surrogates were developed for each of the non-point oil and gas emission sources addressed by this inventory. These surrogates, which are based on the geographic locations of oil and gas production, will enable the appropriate spatial distribution of emissions from oil and gas production operations in the air quality modeling.

Finally, a procedure was formulated and implemented to project the emissions from oil and gas production operations to future year 2018. For the WRAP 2018 base case modeling, only those emission control strategies that have already been adopted are considered. Oil and gas production forecasts were drawn from several sources and combined with the emissions estimates produced for the 2002 inventory and information on future controls to arrive at the 2018 inventory. Oil and gas point source projections are described in a separate report (ERG, 2005b).

Inventoried Sources

The WRAP Oil and Gas inventory was developed for a number of specific processes and equipment not previously inventoried. Emissions were estimated and modeled as both stationary point and distributed area sources. Major sources of NOx and VOC emission were the focus of the inventory.

Major sources of NOx emissions include the following processes and equipment types:

- Compressor engines
- Drill rigs
- Wellheads
- CBM pump engines

Major sources of VOC emissions include the following processes and equipment types:

- Oil well tanks
- Oil well pneumatic devices
- Gas well pneumatic devices
- Gas well dehydrators
- Gas well flaring and venting
- Condensate tanks

For each of these equipment types and processes, new and/or revised estimation methodologies were developed and applied. A detailed discussion of these methodologies can be found in Russell and Pollack, 2005.

Spatial Allocation

For air quality modeling, the EPA default spatial allocation surrogates were not appropriate for the area source oil and gas production emissions. ENVIRON therefore developed a new set of spatial allocation surrogates to be used in SMOKE to allocate the county-level area source emissions to the appropriate oil and gas fields. Oil and gas operation emissions estimated as stationary point sources are allocated based on geographic coordinates.

A total of four different surrogate categories were designed to allocate emissions from the twelve oil and gas emission source categories listed in Table 1. The oil, gas and water production surrogates were based on production data at known well locations, while the drill rig surrogate was based solely on the number and location of wells drilled.

Table 1. Emission sources and surrogate categories.

Source	**SCC**	**Allocation Surrogate**	**Surrogate Code**
Drill rigs	2310000220	Drill Rigs	688
Oil well - heaters	2310010100	Oil Production	686
Oil well - tanks	2310010200	Oil Production	686
Oil well - pneumatic devices	2310010300	Oil Production	686
Compressor engines	2310020600	Gas Production	685
Gas well - heaters	2310021100	Gas Production	685
Gas well - pneumatic devices	2310021300	Gas Production	685
Gas well - dehydration	2310021400	Gas Production	685
Gas well - completion	2310021500	Gas Production	685
CBM pump engines	2310023000	Water production at CBM wells	687
Gas well - tanks, uncontrolled	2310030210	Gas Production	685
Gas well - tanks, controlled	2310030220	Gas Production	685

Once the well locations were known, creation of the surrogates took place in several steps, and relied on the use of ArcINFO GIS software.

4. All wells and drill rigs were labeled with the appropriate grid cell IJ values for the 36-km domain.
5. For each individual well, the oil, gas and water production values were divided by the total oil, gas and water production values corresponding to the county in which the well was located. This division resulted in determination of the fraction of a county's total production taking place at each well. In the case of drill rigs, the number of drills, rather than the production values, were used.
6. For each unique grid cell / county combination with wells, each well's production fractions were summed to create the surrogate value.

The surrogate values for each grid cell / county combination were reformatted to comply with the SMOKE emissions processor AGPRO file format and an accompanying SMOKE AGREF file was created. The purpose of the AGREF file, presented in Table 2, is to define the relationship between the 3-digit codes chosen to represent each of the four surrogate categories in the AGPRO file and the SCC codes for the twelve oil and gas

emission categories to be allocated with these surrogates. This file also specifies which county/state/county (COSTCY) should use the given cross-reference. In this case, COSTCY is set to 000000 to indicate that all states and counties can use these cross-references.

Table 2. SMOKE gridding surrogate cross-reference (AGREF) file.

COSTCY	SCC	CODE
000000	2310000220	686
000000	2310010100	688
000000	2310010200	686
000000	2310010300	686
000000	2310020600	686
000000	2310021100	685
000000	2310021300	685
000000	2310021400	685
000000	2310021500	685
000000	2310023000	687
000000	2310030210	685
000000	2310030220	685

2018 Projection Methodology

The 2018 emission estimates from oil and gas production operations reflect the anticipated 2018 emission levels with the future controls currently defined by state and federal regulation. The 2018 oil and gas point source emissions inventory was prepared and reported separately by Eastern Research Group (ERG, 2005b). A detailed discussion of the development of the 2018 oil and gas inventory, including those sources modeled as area sources can be found in Russell and Pollack, 2005.

There were two primary basic methods used to estimate 2018 county-level oil and gas emissions. The first and by far the dominant method was to develop growth factors that were then used to project from the 2002 oil and gas emissions. A second method was necessary to estimate emissions in the handful of counties that had no 2002 oil and gas emissions but are anticipated to see oil and gas development by 2018. The decision of which method was used to estimate 2018 emissions was based on the existence of oil and gas emissions in 2002. Detailed discussions of each of the projection methods, data sources and methodologies for both cases are presented in Russell and Pollack, 2005.

To QA the oil and gas production emissions, we used the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Comparisons of the spatial plots produced from SMOKE output with spatial plots provided by ENVIRON were reviewed to ensure these data were modeled correctly. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily

spatial plots, daily time-series plots, and annual time-series plots are available at http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/wog/plots/.

Biogenic Emissions

The BEIS3.12 model, integrated in SMOKE, was used to prepare biogenic emissions for the Base02 modeling inventories. 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. The results of BEIS3 modeling are hourly, gridded emissions fluxes formatted for input to CMAQ or CAMx.

Most of the preparation for the biogenic emissions processing was completed during the preliminary 2002 modeling. As the modeling domains did not change from the preliminary 2002 to the Base02 modeling, the gridded land use data and vegetation emissions factors prepared for the preliminary simulations were used. The major difference in the emissions processing between the preliminary 2002 and Base02 modeling was in the integration of improved meteorology in the Base02 inventories.

The quality assurance of the biogenic emissions followed the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily time-series plots, annual time-series plots, and daily vertical profiles. These QA graphics are available at
http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/b3/plots/.

Gridded Area Source Emission Inventory Summaries

Summaries of the gridded area source emissions for the Base02b, Plan02c and Base18b inventories by state and county, annual and seasonal periods, can be found on the TSS at: http://vista.cira.colostate.edu/tss/Results/Emissions.aspx.

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1.3 Mobile Source Emissions

Introduction

Mobile sources include on-road and off-road vehicles and engines. On-road mobile sources include vehicles certified for highway use – cars, trucks, and motorcycles. For reporting on-road mobile source emissions, vehicles are divided into two major classes – light-duty and heavy-duty. Light-duty vehicles include passenger cars, light-duty trucks (up to 8500 lbs gross vehicle weight [GVW]), and motorcycles. Heavy-duty vehicles are trucks of more than 8500 lbs GVW.

Off-road mobile equipment encompasses a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. Off-road mobile equipment sources are defined as those that move or are moved within a 12-month period and are covered under the EPA's emissions regulations for nonroad mobile sources. Off-road mobile sources are vehicles and engines in the following categories:

- Agricultural equipment, such as tractors, combines, and balers;
- Aircraft, jet and piston engines;
- Airport ground support equipment, such as terminal tractors;
- Commercial marine vessels, such as ocean-going deep draft vessels;
- Commercial and industrial equipment, such as fork lifts and sweepers;
- Construction and mining equipment, such as graders and back hoes;
- Lawn and garden equipment, such as leaf and snow blowers;
- Locomotives, switching and line-haul trains;
- Logging equipment, such as shredders and large chain saws;
- Pleasure craft, such as power boats and personal watercraft;
- Railway maintenance equipment, such as rail straighteners;
- Recreational equipment, such as all-terrain vehicles and off-road motorcycles; and
- Underground mining and oil field equipment, such as mechanical drilling engines.

Road dust emissions estimates are also included in the mobile source emissions category, and are discussed separately with the fugitive dust emissions inventory summary.

Mobile Source Inventory Scope

The scope of the WRAP mobile sources emission inventories is as follows:

> Geographic domain: Emissions were estimated by county for all counties in 14 states: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.
>
> Temporal resolution: Emissions were estimated for an average day in each of the four seasons, and for an average annual weekday. Seasons are defined as three-month periods: spring is March through May; summer is June through August; fall is September through November; and winter is December through February.

Emissions were estimated for the 2002 base year and for three future years – 2008, 2013, and 2018.

Pollutants: Emissions were estimated for primary particulate matter (PM_{10} and $PM_{2.5}$), nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOCs), carbon monoxide (CO), ammonia (NH_3), elemental and organic carbon (EC/OC), and sulfate (SO4).

Sources: For all pollutants, emissions were estimated separately by vehicle class for on-road sources and by equipment type/engine type for off-road sources. Emissions were summarized for gasoline and diesel-fueled engines.

Approach For Estimating Mobile Source Emissions

As with most emissions sources, on-road and off-road mobile source emissions are estimated as the products of emission factors and activity estimates. Except for California, the on-road mobile sources emission factors were derived from EPA's MOBILE6 model, available at http://www.epa.gov/OMSWWW/m6.htm. Activity for on-road mobile sources is vehicle miles traveled (VMT). State and local agencies were provided default modeling inputs and VMT levels for base and future years for review and update; all states and several agencies provided updated. The California Air Resources Board (CARB) provided on-road emissions estimates by county and vehicle class directly; these were based on CARB's in-house version of their EMFAC model.

For all states except California, EPA's draft NONROAD2004 model was used to estimate so-called traditional off-road sources[1], all sources listed above except aircraft, commercial marine, and locomotives. The NONROAD model includes estimates of emission factors, activity levels, and growth factors for all traditional off-road sources. The default activity levels were provided to state agencies for input and update; however, no state provided updated off-road activity data. Emissions estimation methods for aircraft, commercial marine, and locomotives were similar to approaches EPA has recently used in developing national emission inventories. For California, CARB provided off-road emissions estimates by source category and county directly.

Emissions Models Used and Additional Calculations for Air Quality Modeling

On-road and off-road mobile source emissions are estimated as the products of emission factors and activity estimates. Except for California, the on-road mobile sources emission factors were derived from the EPA MOBILE6 model. Activity for on-road mobile sources is vehicle miles traveled (VMT). EPA's NONROAD2004 model was used to estimate emissions from off-road mobile sources except for aircraft, commercial marine, and locomotives.

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[1] The final version of NONROAD (NONROAD2005, available at http://www.epa.gov/otaq/nonrdmdl.htm) was released after the work in this project was completed.

EPA MOBILE6 Model

The MOBILE model is EPA's regulatory model for estimating on-road mobile source gram per mile emission factors for VOC (exhaust and evaporative), NO_X, CO, PM, NH_3, and SO_2. The current regulatory version of the model is MOBILE6, released in 2002. The model and supporting documentation may be found on EPA's web site at http://www.epa.gov/OMSWWW/m6.htm.

The MOBILE6 model includes the effects of all of the following "on the books" Federal regulations for on-road motor vehicles:

- Tier 1 light-duty vehicle standards, beginning with, beginning MY 1996;
- National Low Emission Vehicle (NLEV) standards, beginning MY 2001;
- Tier 2 light-duty vehicle standards beginning MY 2005, with low sulfur gasoline beginning summer 2004;
- Heavy-duty vehicle standards beginning MY 2004; and
- Heavy-duty vehicle standards beginning MY 2007, with low sulfur diesel beginning summer 2006.

MOBILE6 estimates emissions by vehicle class, for 28 vehicle classes. For the WRAP modeling, the emissions were estimated for eight vehicle classes, which are combined from these 28. The eight vehicle classes are those that were modeled in the prior generation of the mode, MOBILE5, as shown in Table 1.

Table 1. MOBILE5 vehicle classes for which emissions were estimated.

Vehicle Class	MOBILE Code	Weight Description
Light-duty gasoline vehicles (passenger cars)	LDGV	Up to 6000 lb gross vehicle weight (GVW)
Light-duty gasoline trucks[1] (pick-ups, minivans, passenger vans, and sport-utility vehicles)	LDGT1	Up to 6000 lb GVW
	LDGT2	6001-8500 lb GVW
Heavy-duty gasoline vehicles	HDGV	8501 lb and higher GVW equipped with heavy-duty gasoline engines
Light-duty diesel vehicles (passenger cars)	LDDV	Up to 6000 lb GVW
Light-duty diesel trucks	LDDT	Up to 8500 lb GVW
Heavy-duty diesel vehicles	HDDV	8501 lb and higher GVW
Motorcycles[2]	MC	

[1] Emissions for light-duty trucks are modeled separately for two weight classes with different emissions standards in the Clean Air Act

[2] Highway-certified motorcycles only are included in the model. Off-road motorcycles, such as dirt bikes, are modeled as a no-road mobile source in EPA's NONROAD model.

The particulate matter emission factors in MOBILE6 are from an earlier EPA particulates emission factor model called PART5. The tire and brake wear estimates from PART5 used in MOBILE6 are dated, and newer brake wear estimates were available (Garg et al,) and were used to develop revised brake wear emission factors, the same as used in the previous WRAP mobile sources emission inventory (Pollack et al., 2004).

EPA NONROAD Model

Off-road mobile equipment encompasses a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. Off-road mobile equipment sources are defined as those that move or are moved within a 12-month period and are covered under the EPA's emissions regulations for nonroad mobile sources. Emissions for so-called traditional nonroad sources are estimated by EPA in their NONROAD emissions model, available on the NONROAD web page at http://www.epa.gov/otaq/nonrdmdl.htm.

At the time that the off-road emissions were estimated for this project, the latest version of the model was draft NONROAD2004. In December of 2005 final NONROAD2005 was released. The web page above provides now only the NONROAD2005 final model.

The NONROAD model includes both emission factors and default county-level population and activity data. The model therefore estimates not just emission factors but also emissions. Technical documentation of all aspects of the model can be found on the EPA NONROAD web page.

The NONROAD model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating and fuel type, in the following categories:

- airport ground support, such as terminal tractors;
- agricultural equipment, such as tractors, combines, and balers;
- construction equipment, such as graders and back hoes;
- industrial and commercial equipment, such as fork lifts and sweepers;
- recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- residential and commercial lawn and garden equipment, such as leaf and snowblowers;
- logging equipment, such as shredders and large chain saws;
- recreational marine vessels, such as power boats;
- underground mining equipment; and
- oil field equipment.

The NONROAD model does not include commercial marine, locomotive, and aircraft emissions. Emissions for these three source categories are estimated using other EPA methods and guidance documents (described in Sections 5-7). However, support equipment for aircraft, locomotive, and commercial marine operations and facilities are included in the NONROAD model.

The NONROAD model estimates emissions for six exhaust pollutants: hydrocarbons (HC), NO_X, carbon monoxide (CO), carbon dioxide (CO_2), sulfur oxides (SO_X), and PM. The model also estimates emissions of non-exhaust HC for six modes — hot soak, diurnal, refueling, resting loss, running loss, and crankcase emissions.

The NONROAD model used in this study incorporates the effects of all of the following "on the books" Federal nonroad equipment regulations:

$ Emission standards for new nonroad spark-ignition engines below 25 hp;
$ Phase 2 emission standards for new spark-ignition hand-held engines below 25 hp;
$ Phase 2 emission standards for new spark-ignition nonhandheld engines below 25 hp;
$ Emission standards for new gasoline spark-ignition marine engines;
$ Tier 1 emission standards for new nonroad compression-ignition engines above 50 hp;
$ Tier 1 and Tier 2 emission standards for new nonroad compression-ignition engines below 50 hp including recreational marine engines;

- $ Tier 2 and Tier 3 standards for new nonroad compression-ignition engines of 50 hp and greater not including recreational marine engines greater than 50 hp; and
- $ Tier 4 emissions standards for new nonroad compression-ignition engines above 50 hp, and reduced nonroad diesel fuel sulfur levels.

The NONROAD model provides emission estimates at the national, state, and county level. The basic equation for estimating emissions in the NONROAD model is as follows:

$$Emissions = (Pop)(Power)(LF)(A)(EF)$$

where

Pop = Engine Population
Power = Average Power (hp)
LF = Load Factor (fraction of available power)
A = Activity (hrs/yr)
EF = Emission Factor (g/hp-hr)

The national or state engine population is estimated and multiplied by the average power, activity, and emission factors. Equipment population by county is estimated in the model by geographically allocating national engine population through the use of econometric indicators, such as construction valuation. The manner in which the geographic allocation is performed is as follows:

$$(County\ Population)_i /(National\ Population)_I = (County\ Indicator)_i /(National\ Indicator)_i$$

where

i is an equipment application like construction or agriculture.

Activity is temporally allocated through the use of monthly, and day of week fractions of yearly activity.

The NONROAD model has default estimates for all variables and factors used in the calculations. All of these estimates are in model input files, and can be changed by the user if data more appropriate to the local area are available.

California Models

The California Air Resources Board (CARB) provided on-road and off-road emissions data for base and future years for use in this project. CARB has developed their own models for on-road and off-road emissions estimation. CARB's on-road model is referred to as EMFAC. The version of the model that was used to generate the CARB on-road emissions was EMFAC2002 (available at http://www.arb.ca.gov/msei/on-road/latest_version.htm), with internal updates for some of the activity data that were not publicly available.

For many years, CARB has been developing its own off-road emissions model, called OFFROAD. Although CARB has developed most of the model inputs as part of their analyses in support of their off-road equipment regulations, the model has never been publicly released.

For all California emissions, CARB provided their emissions estimates for the base and future years. Emissions data only were provided, not activity data and emission factors.

Pollutants Added for Air Quality Modeling

For CMAQ modeling, additional model species are required beyond what is estimated in MOBILE, NONROAD, EMFAC, and OFFROAD. Specifically, particulate matter needed to be split into elemental carbon (EC), organic carbon (OC), and sulfate (SO_4); and NO_X needed to be split into NO and NO_2.

EC and OC were estimated by applying EC/OC fractions to the PM_{10} and $PM_{2.5}$ emissions estimates. The EC/OC splits used for these calculations are summarized in Table 2. These are the same EC/OC fractions used in the previous WRAP mobile sources emissions estimates; their derivation is described in Pollack et al., 2004. Sulfate was then estimated as PM – EC – OC, for both PM10 and PM2.5. Coarse PM is calculated as PM10 – PM2.5

Table 2. Elemental carbon/organic carbon fractions.

Process/Pollutant	EC	OC	Source
Gasoline Exhaust	23.9%	51.8%	Gillies and Gertler, 2000
Light-Duty Diesel Exhaust	61.3%	30.3%	Gillies and Gertler, 2000
Heavy-Duty Diesel Exhaust	75.0%	18.9%	Gillies and Gertler, 2000
Tire Wear	60.9%	21.75%	Radian, 1988
Brake Wear	2.8%	97.2%	Garg et al, 2000

While there have been several studies and reviews of particulate composition (e.g. EPA, 2001 and Turpin and Lim, 2000) since the time of the work referenced in Table 2, there has not been a comparable comprehensive evaluation of particulate composition. Many particulate source/receptor statistical modeling efforts have been attempted, but all used source profiles that predate those listed in Table 2. A comprehensive evaluation of source profiles needs to include the effect of the proper age distribution and maintenance history of in-use vehicles. No recent studies have investigated the source profiles using such an evaluation, and so could not be used for this work. In addition, the default EPA

resource for compositional estimates of emissions, SPECIATE, has not provided any revised profiles since October 1999.

The ratio of NO to NO2 for NOx emissions from mobile sources is a result of the chemical equilibrium formed during internal combustion with NO the primary constituent of NOx. Aftertreatment devices may begin to perturb the ratio of NO and NO2 as NOx and particulate control are applied to diesel engines (Tonkyn, 2001, Herndon, 2002, and Chatterjee, 2004). However, these systems have not yet been widely employed, so it is not possible to judge what the proportion of NOx that NO and NO2 will be in the future. For this work the EPA default proportions of NO and NO2 (90/10) were used to apportion the NOx emission estimates.

Temporal Profiles

The on-road and off-road emissions are estimated as average day, per season. For use in air quality modeling, these average day emissions must be temporally allocated to the 24 hours of the day for each day of the week. This temporal allocation is done in the SMOKE emissions processing system. The EPA temporal profiles for on-road and off-road emissions were reviewed and found to be deficient for on-road sources. The EPA defaults for on-road temporal profiles vary only by weekday vs. weekend; for both weekdays and weekends the 24-hour profiles do not vary by vehicle class. And there are only two day of week profiles – one for light-duty gasoline vehicles and one for all vehicle classes.

ENVIRON has analyzed an extremely large database of detailed traffic counter data by vehicle class, roadway type, and state under contract to EPA (Lindhjem, 2004). From this work using national databases of vehicle activity maintained by the Federal Highway Administration (FHWA), revised temporal profiles for on-road sources were developed. The databases used were the FHWA Traffic Volume Trends (http://www.fhwa.dot.gov/policy/ohpi/travel/index.htm) for temporal activity of vehicles, and the FHWA Vehicle Travel Information System (VTRIS) (http://www.fhwa.dot.gov/ohim/ohimvtis.htm) that identifies individual vehicle classes to estimate temporal variation in the vehicle mix. Three sets of profiles were developed: day of week profiles by vehicle class (Figure 1); hour of day profiles for weekdays, by vehicle class (Figure 2); and hour of day profiles for weekends, by vehicle class (Figure 3). These temporal profiles show important differences in vehicle activity by vehicle class across the days of the week and the hours of the day.

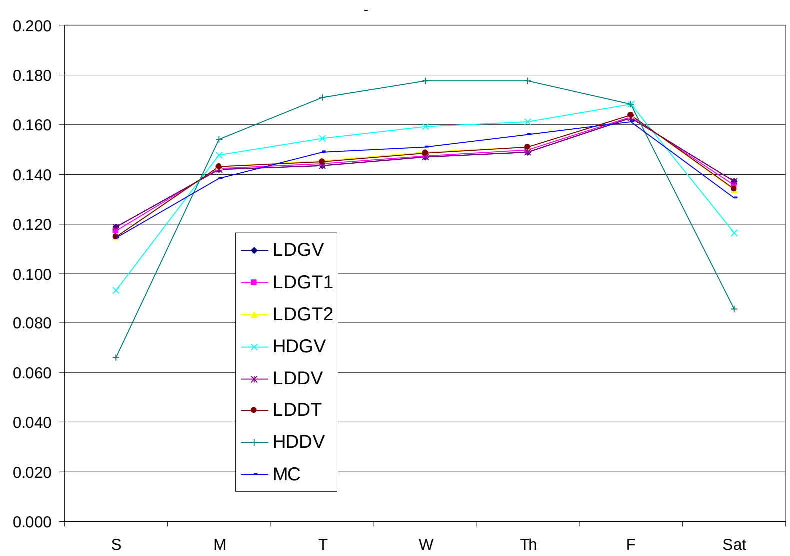

Figure 1. Day of week profiles by vehicle class.

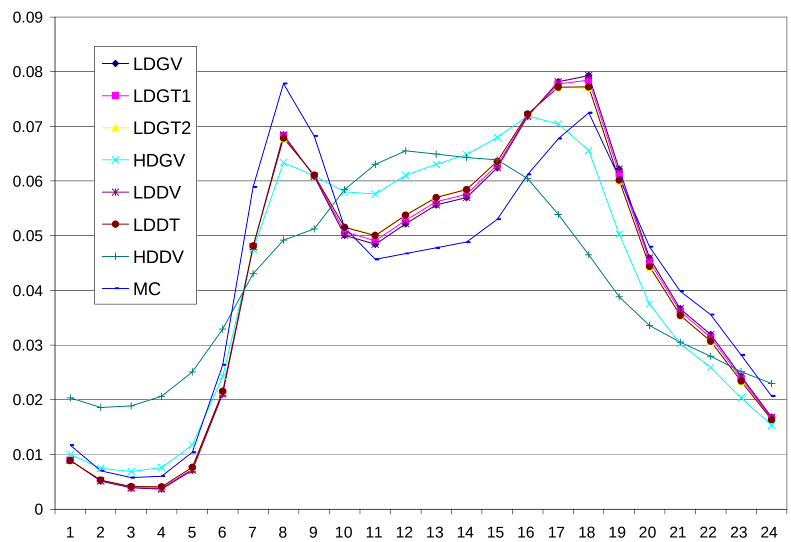

Figure 2. Weekday hour of day profiles by vehicle class.

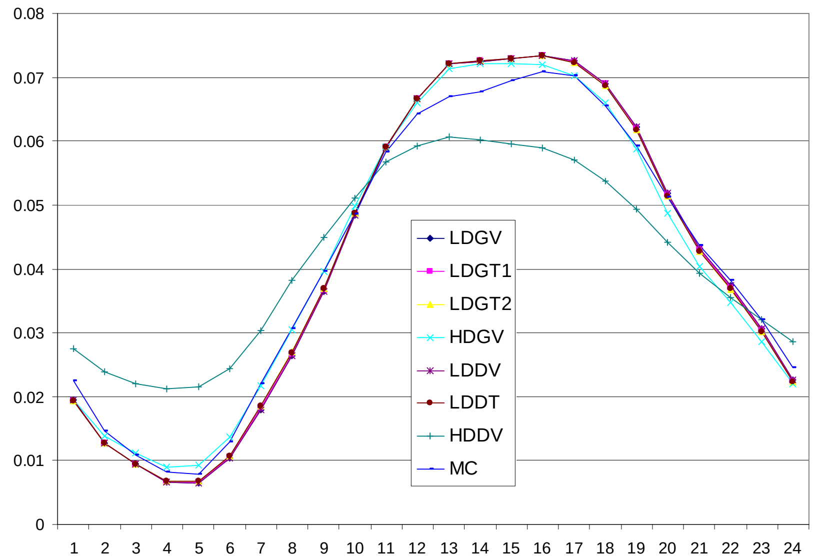

Figure 3. Day of week profiles by vehicle class.

Locomotive Emissions Estimation Methodology

County level locomotive emissions estimates were estimated as the product of locomotive fuel consumption and average locomotive emission factors. Previous WRAP locomotive emissions estimates (Pollack et al., 2004) allocated national fuel consumption estimates to counties using emissions data offered by the National Emissions Inventory. A detailed revision to that allocation method was developed for allocating 2002 national fuel consumption estimates. Emission factors were also revised to combine line-haul and switching engines because only national total fuel consumption was available. Additional emission factors for ammonia and fuel sulfur provided by EPA were also incorporated and form the basis from which sulfur dioxide was estimated.

2002 Locomotive Emissions

Development of the 2002 locomotive emissions involved spatially allocated 2002 national locomotive activity, in the form of fuel consumption, using historic data of freight movements. The 2002 Class I railroad activity data were derived from national fuel consumption data reported by the Association of American Railroads (AAR, 2003), and the activity data for Class II/III railroads from data reported by the American Short Line & Regional Railroad Association (ASLRRA, 1999 and Benson, 2004). To allocate this national fuel consumption to the county level, ENVIRON used the most recent county level rail activity estimates available. These activity estimates were ton-miles of freight movement estimated by the Bureau of Transportation Statistics (2002), using data from 1995. The 2002 national activity data were allocated to each county in the WRAP states using the fraction of the 1995 national rail activity that occurred in each county and

then multiplying that fraction by the 2002 national rail activity, as demonstrated in equation (1).

$$CA02 = NA02 * (CA95/NA95) \qquad (1)$$

where

CA02 = 2002 county locomotive fuel consumption
NA02 = 2002 national locomotive fuel consumption
CA95 = 1995 county million gross ton miles (MGTM)
NA95 = 1995 national total MGTM

The spatial allocation of the national emissions in this work followed the methods of the EPA National Emission Inventory (NEI, 1999 and unchanged for 2002) of allocating locomotive activity. The 1995 activity data were obtained as GIS shapefiles containing track segments and an associated database of rail density per mile (MGTM/mi) corresponding to those segments. The segment-specific rail density estimates were provided as ranges. For each segment, the midpoint of the density range was assumed to represent the average track loading on that segment. Table 3 shows a list of the ranges and the midpoint values used in this study. The top end density was reported as an open-ended range, greater than 100 MGTM/mi, which was estimated as 120 MGTM/mi. This differs from the allocation method used in the NEI 2002, which represented the top end traffic density as 100 MGTM/mi. The use of 120 MGTM/mi is expected to more accurately reflect the relative importance of those main line track segments than using the minimum value of 100 MGTM/mi.

Table 3. Track segment density ranges used for allocation to counties (MGTM/mi).

Density ID	Segment Density Range	Assumed Segment Density
0	unknown, abandoned, or dummy	0
1	0.1 to 4.9	2.5
2	5.0 to 9.9	7.45
3	10.0 to 19.9	14.95
4	20.0 to 39.9	29.95
5	40.0 to 59.9	49.95
6	60.0 to 99.9	79.95
7	100.0 and greater	120

To obtain county level rail density from track segment density, a shapefile was first created that contained all US counties. Next, the two shapefiles were projected to the same map projection so that the counties were overlaid by the BTS track segments. Then, track segments were intersected by the county borders so that county-specific track segments were created. For each county it was then possible to sum the products of segment densities and county-specific segment lengths to obtain the total county activity as 1995 ton-miles. The county fraction of 1995 national rail activity was then the sum of activity in that county over the sum of activity in all counties. The relative county locomotive activity for the western States is shown in Figure 4.

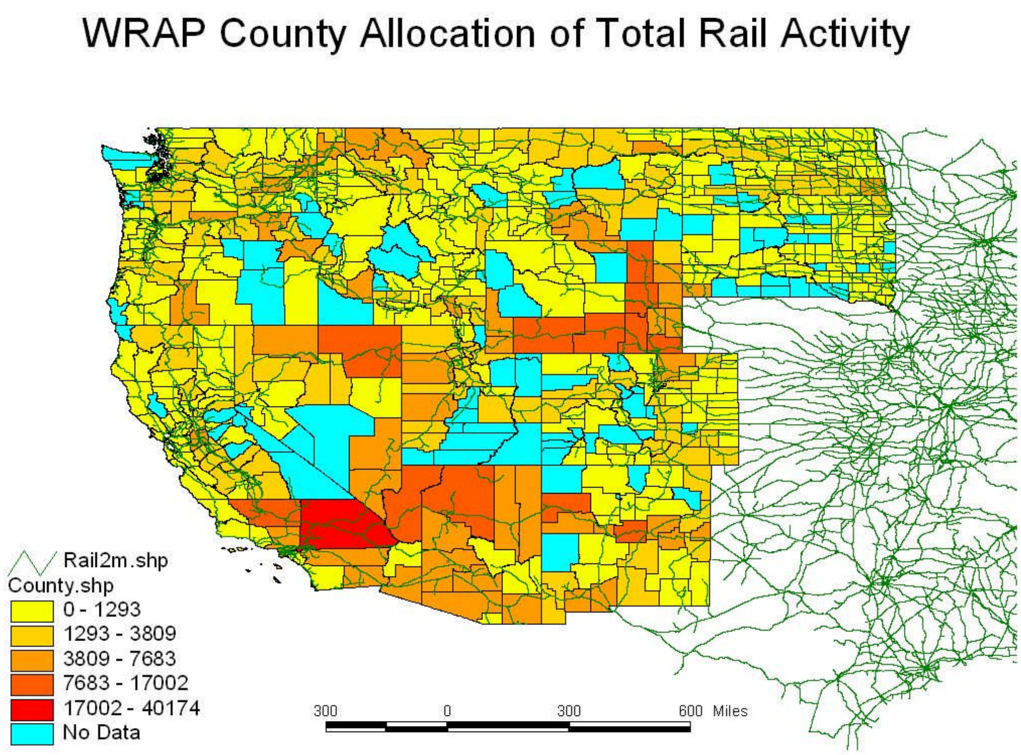

Figure 4. County level rail activity in the WRAP states.

Year 2002 county rail fuel consumption was estimated using the 1995 county fraction of national rail activity as demonstrated in equation (1). National locomotive fleet average emissions factors with units of grams per gallon of fuel were obtained from the EPA (1997). The emission factors for 2002 are summarized in Table 4. County level emissions of hydrocarbons (HC), NOx and particulate matter (PM10) were calculated by multiplying 2002 county level fuel consumption by these emission factors.

Table 4. National fleet average emission factors (gram per gallon) from EPA (1997).

Engine Type	HC	CO	NOx	PM	SO2[1]	NH3[2]
2002 Fleet Average	10.7	27.4	248.8	6.8	16.4	0.116

[1] Reported as SO_2 and derived from an average sulfur level of 2600 ppm. (EPA, 2004b)
[2] EPA (2004a)

One issue was to determine the fraction of the total PM emissions that is sulfate. Equation (2) was derived from test data from an EPA study that measured the PM weight change that resulted from a change in the fuel sulfur level. The percentage of sulfate PM was estimated to be 19.4%. The remaining PM was split between EC and OC using the historic National Emission Trends report estimate of 80% as elemental carbon and 20% as organic carbon.

$$\text{Sulfate PM (BSFC units)} = \text{BSFC} * 7.0 * 0.02247 * 0.01 * (SOx_{fuel} - SOx_{bas}) \quad (2)$$

where

SOx_{bas} = 0% sulfur for entirely elemental and organic carbon PM
SOx_{fuel} = % sulfur in fuel used (0.26%)

Sulfate PM = 0.0004 (g/gram fuel) or 1.32 (g/gallon) or 19.4% of the PM rate in Table 4.

Equation (2) was derived by estimating that the fuel sulfur partially (2.247%) converts to SO_3 (with the remainder emitted as SO_2), which rapidly hydrolyzes in the humid exhaust to hydrated sulfuric acid [H_2SO_4*(7)H_2O] and condenses on other PM. From this assumption arises the molecular weight adjustment of 7.0 (ratio of hydrated sulfuric acid to elemental sulfur). The figure 0.01 in the equation is to adjust values in percent (%) to fractional values.

County level locomotive emissions were estimated for all WRAP counties based on the procedure described above, except for those areas for which emissions data were supplied by local or state agencies. Four states - Alaska, Arizona, Wyoming, and Idaho - and one county - Clark County, NV - supplied more detailed locomotive emissions estimates from local surveys and other information derived from specific activity in those states. In the case of Arizona and Wyoming, ENVIRON performed surveys of all railroad activity (Pollack et al, 2004a; Pollack et al, 2004b). The Alaska Department of Environmental Conservation (Edwards, 2005) and the Idaho Department of Environmental Quality

(Reinbold, 2005) supplied their own estimates, as did the Clark County Department of Air Quality Management (Li, 2005).

The spatial allocation of annual locomotive NOx emissions is shown in Figure 5. Seasonal emissions were estimated based on an assumption of uniform year-round activity. Figure 5 shows the effect of the major east-west corridors from Los Angeles through Arizona and New Mexico, Northern California through Nevada, Utah and Wyoming, and Washington, Northern Montana and North Dakota; the north-south corridor through California, Oregon, and Washington; and the coal mining region of eastern Wyoming. Other major and minor routes are also evident though the size of the county affects the emission totals estimated, so a major line that runs through a small or narrow county may not appear significant, and, likewise, a large county may appear over-weighted compared with a neighboring county with less through mileage.

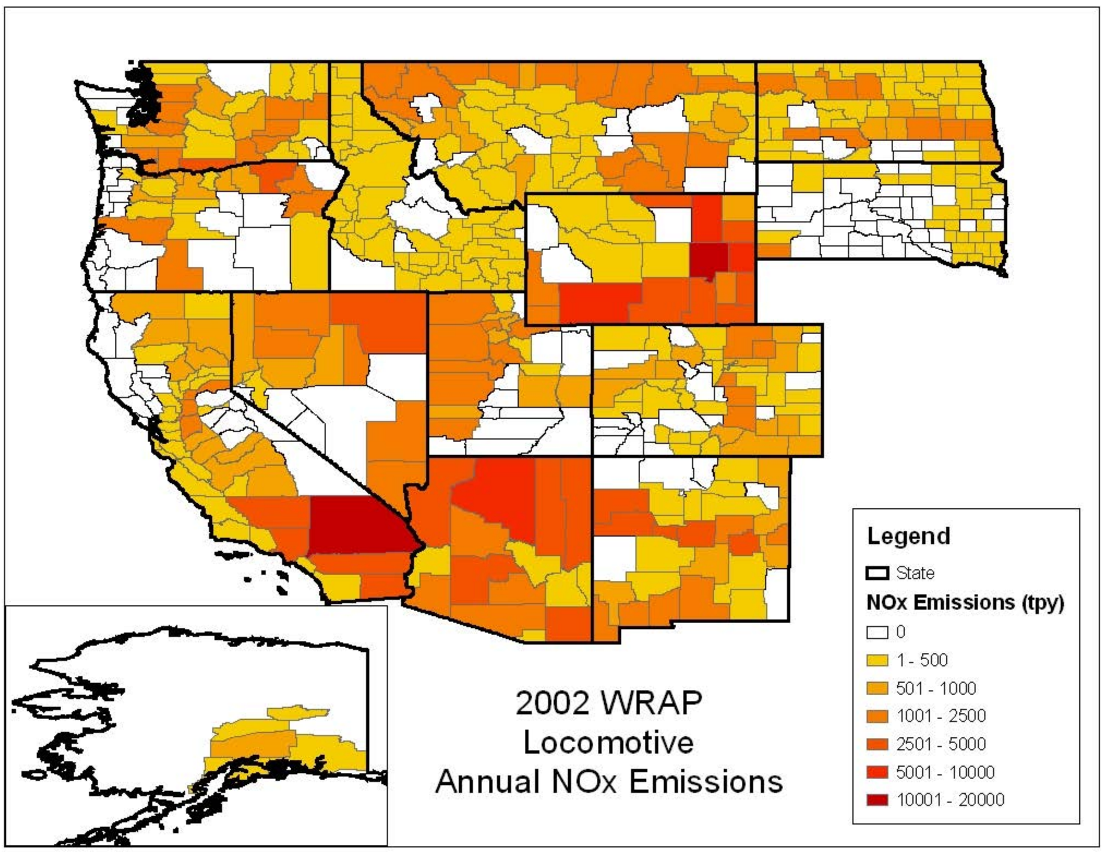

Figure 5. County level rail NOx emissions (tons per year) in the WRAP states.

2018 Locomotive Emissions

To estimate future year activity, a trend analysis was performed on the historical fuel consumption of the activity of the two predominant (in the West, Union Pacific and BNSF) railroads' activity. Figure 6 shows the company-wide fuel consumption

calculated from historic revenue ton-mile and fuel consumption per revenue ton-mile. National freight transfers and the regression of fuel efficiency were used to determine the fuel consumption trend over as long a period as possible. Freight transfers (ton-mile) are not a sufficient activity indicator alone because the efficiency (ton-miles per gallon of fuel consumed) of railroads has been improving over time. AAR (2005) provided historical efficiency (gallons per ton-mile) for Burlington Northern (predating the merger with the Atchison Topeka and Santa Fe [ATSF] railroad) and Union Pacific (predating the merger with Southern Pacific and others). The historic trend in fuel efficiency for each company (Union Pacific and Burlington Northern) was combined with the revenue ton-mile for Union Pacific and Southern Pacific, and BN and ATSF. A trend in fuel consumption for the combined companies was thus estimated from 1990 through 2002 as shown in Figure 5-3 despite the merger activity that occurred during this period. The future year projected activity was then determined from a linear regression of the fuel consumption for the combined company operations of the predominant railroads in their current configuration as Union Pacific and BNSF.

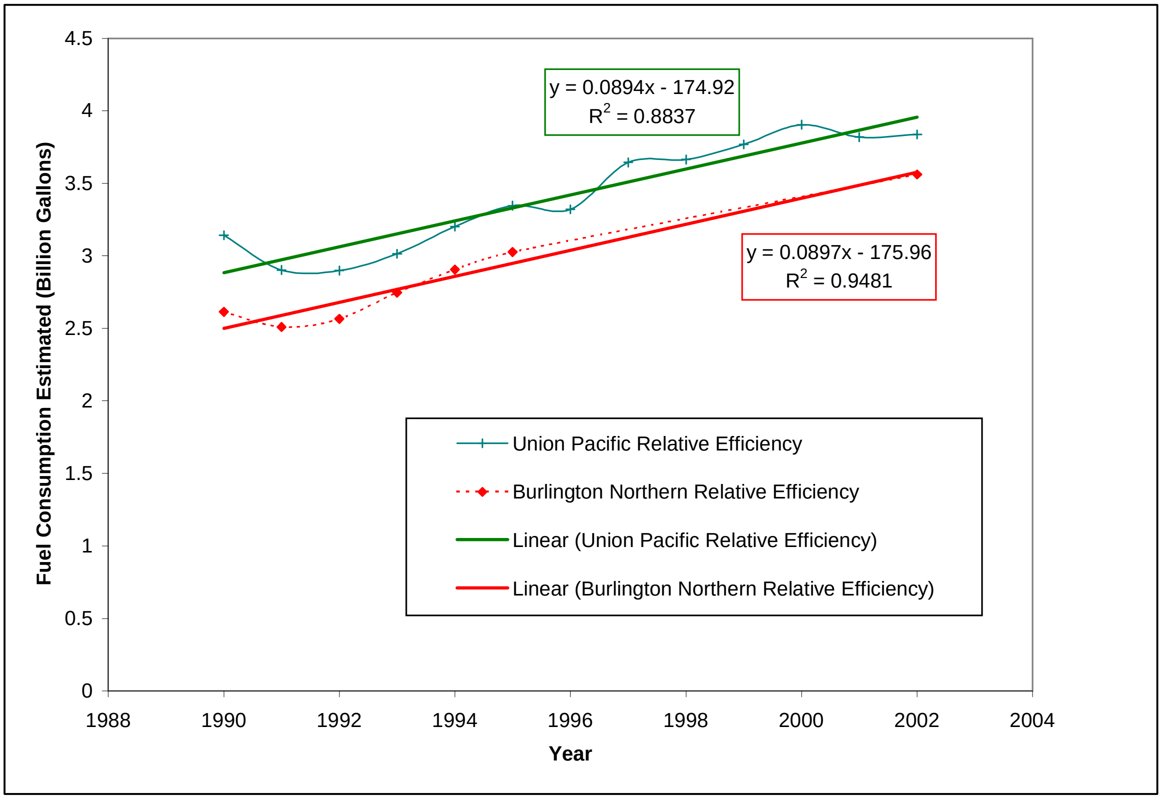

Figure 6. Trends in historical rail fuel consumption by railroad.

The resulting future year projection factors are listed in Table 5 for the two major railroads and the combined projection. The trends for the two railroads are very similar.

Table 5. Locomotive activity growth projection for this work.

Comparison Years	Union Pacific	BNSF	Combined

2008 / 2002	1.13	1.15	1.14
2013 / 2002	1.24	1.27	1.26
2018 / 2002	1.35	1.40	1.37

In addition to projected railroad activity, the emission rates were projected using EPA future year emission rates (1997, Regulatory Support Document), as shown in Table 6.

Table 6. Locomotive emission rate projections.

Comparison Years	HC	CO	NOx	PM	SO2*	NH3
2008/2002	0.892	1.000	0.693	0.882	0.192	1
2013/2002	0.819	1.000	0.627	0.802	0.006	1
2018/2002	0.763	1.000	0.580	0.740	0.006	1

* Fuel sulfur averaged 2600 ppm in 2002, assumed to average 500 ppm in 2008 and 15 ppm in 2013 and 2018. (EPA, Clean Air Nonroad Diesel Rule Fact Sheet, May, 2004) PM emission rates were not adjusted for fuel sulfur level though a reduction should be realized with low sulfur fuel.

The overall emissions from locomotives for future years were then determined by combining the activity growth in Table 5 and the emission rate projections in Table 6.

California Locomotive Emissions

CARB provided locomotive emissions for the base and three future years from their internal emissions data bases. CARB's emission estimates assumed 2500 ppm sulfur in the fuel for all years, and so adjustments were made to the SO2 and PM emissions to reflect the lower mandated levels in future years. Federal requirements are for sulfur levels to be 500 ppm in 2008 and 15 ppm in 2013 and 2018. However, ARB expects fuel sulfur levels to be 129 in 2008. SO2 emissions were adjusted using a direct scalar of the fuel sulfur levels assumed in the emissions estimated by ARB and the regulated levels. The PM emissions were adjusted to reflect the lower sulfur levels using a PM adjustment derived by ARB staff, as provided to ENVIRON.

The CARB emissions did not include NH3; NH3 was estimated by developing a scaling factor based on SO_X emissions. Yearly fuel consumption estimates were derived based on SO_X emissions and the CARB assumed 2500ppm fuel sulfur content. A per-volume NH3 emission factor was applied to the estimated fuel consumption to estimate NH3 emissions for each year at the county level. Lastly, PM was split among sulfate, EC, and OC using the same methods as for the other states described above.

Aircraft Emissions Estimation Methodology

County-level aircraft emissions for 2002 for the WRAP states were obtained from work performed for EPA's 2002 National Emissions Inventory (NEI2002). Activity data for aircraft emissions are takeoff cycles (LTOs), and emission factors are primarily from the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System

(EDMS). The 2002 emissions were projected to future years using forecast LTOs available from the FAA. More detailed estimates were provided for some states.

The FAA EDMS model combines specified aircraft and activity levels with default emissions factors in order to estimate annual inventories for a specific airport. Aircraft activity levels in EDMS are expressed in terms of LTOs, which consist of the four aircraft operating modes: taxi and queue, take-off, climb-out, and landing. Default values for the amount of time a specific aircraft spends in each mode, or the time-in-modes (TIMs), are coded into EDMS.

Aircraft emissions are estimated for four aircraft categories:

- Air carriers, which are larger turbine-powered commercial aircraft with at least 60 seats or 18,000 lbs payload capacity;
- Air taxis, which are commercial turbine or piston-powered aircraft with less than 60 seats or 18,000 lbs payload capacity;
- General aviation aircraft, which are small piston-powered, non-commercial aircraft; and
- Military aircraft.

2002 Aircraft Emissions

For the 2002 aircraft emissions, annual emissions files prepared for the NEI2002 formed the basis of the work. These files were sent to ENVIRON by EPA's contractor, Eastern Research Group (Billings, 2005). For this work, ERG ran the EDMS model for about 1100 towered airports across the U.S. using detailed 2002 aircraft/LTO activity data. Additional calculations were performed to estimate the additional pollutants needed for WRAP modeling. Key elements of those calculations are described by aircraft type below.

Air Carriers – The NEI2002 inventory data for VOC, CO, NOx, and SO_2 for Air Carriers were used directly. Additional calculations were made to estimate the emissions of the additional pollutants in the WRAP inventory:

- The NOx inventory speciation values for NO and NO_2 were assumed to be 90% and 10%, respectively, which are the default EPA speciations.
- It was assumed that no NH_3 is emitted from air carrier turbine engines, which normally run lean.
- All of the fuel-bound sulfur was assumed to form SO_2 in the engine exhaust.
- Due to the lack of other, more recent sources for aircraft particulate emission factors, the total suspended particulate (TSP) emissions from the air carriers were estimated using a commercial fleet-average emission factor from EPA's 1985 National Acid Precipitation Assessment Program (NAPAP). To calculate PM2.5, according to the NEI2002, 97.6% of the particulate matter emitted from

Commercial Aircraft was assumed to be $PM_{2.5}$, as is assumed in the NEI2002.

Air Taxi, General Aviation and Military Aircraft – The NEI2002 inventory data for VOC, CO, NOx, SO_2, PM10, and PM2.5 for these Aircraft types were used directly. Additional calculations were made to estimate the emissions of the additional pollutants in the inventory:

- As for the air carriers, 90% of the NOx emissions were assumed to be NO and 10% were assumed to be NO_2.
- For ammonia, air taxi and military aircraft were assumed to be dominated by turbine-powered aircraft running lean, thus producing a negligible amount of ammonia. For general aviation, ammonia was estimated using a fleet-average fuel consumption rate from the EDMS data for piston engines, operational mode-specific fuel flow rates weighted by the typical time spent in each mode, average hours of operation estimated from FAA data, and a g/gallon emission factor for non-catalyst light-duty gasoline engines.
- As for air carriers, all of the fuel-bound sulfur was assumed to form SO_2 in the engine exhaust.

State Updates

The NEI2002-based inventory estimates were updated with additional information provided for six areas:

For Alaska, Sierra Research, under contract to the WRAP Emissions Forum, developed seasonal aircraft emissions estimates for all aircraft types for Alaska in 2002. These data were used instead of the NEI2002 data described above. A number of minor modifications needed to be made to the data to make them consistent with the rest of the aircraft data. The most significant difference was that air carriers and air taxis were lumped into one category. These were then coded as the air carriers SCC, and WRAP Alaska air taxi emissions were set to zero.

For Arizona, the NEI2002-based inventory was updated with emissions estimates from the Arizona 2002 inventory work previously done by ENVIRON (Pollack et al., 2004). This work included detailed EDMS modeling based on activity data obtained from both the FAA and local sources. Further updates were made for specific airports with emissions data provided by Pima and Maricopa Counties.

The Idaho DEQ provided 2002 aircraft emissions for all counties for general aviation and military aircraft.

Clark County (Nevada) provided 2002 emissions estimates for three airports in the county, based on a recent airport emissions study (Ricondo, 2004).

For Wyoming, the NEI2002-based inventory was updated emissions estimates from Wyoming 2002 inventory work previously done by ENVIRON (Pollack et al., 2004a). This work included detailed EDMS modeling based on activity data obtained from both the FAA and local sources.

The California Air Resources Board (CARB) provided both base and future year aircraft emissions estimates, discussed below.

Seasonal Emissions Estimates

The NEI2002 aircraft emissions are annual estimates, as were most of the updates provided by state and local agencies. To estimate seasonal county-level emission inventories, the monthly distribution of activity for airports in the WRAP region was obtained from the FAA's Air Traffic Activity Data System (ATADS) (**http://www.apo.data.faa.gov/main/atads.asp**). The ATADS is the official source for historical monthly or annual air traffic statistics for airports with FAA-operated or FAA-contracted traffic control towers. The average seasonal distribution was calculated by state and aircraft type from the ATADS dataset. These state-level seasonal distributions were then applied to the annual county-level emissions in each state to derive the seasonal county-level emissions for each state.

2018 Aircraft Emissions

For all states except California, aircraft emissions were projected to the three future years from the 2002 emissions, by county and aircraft type, using FAA LTO forecasts as the activity data. Emission factors were assumed to be unchanged over time. The International Civil Aviation Organization (ICAO) has promulgated NO_x and CO emission standards for commercial aircraft, exempting general aviation and military engines from the rule (ICAO, 1998), and the majority of engines are already meeting this standard. EPA officially promulgated the ICAO standards for air carriers in a final rule in November 0f 2005.

The historic and projected LTO data by airport are available online from the Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) database (http://www.apo.data.faa.gov/main/taf.asp) for all aircraft categories for which emissions were estimated. Projected LTO data for years 2008, 2013 and 2018, and historic data for 2002 were used to develop future year growth factors for all aircraft types. Growth factors were calculated as the ratio of the sum of LTOs by county and aircraft type in each future year to the sum of LTOs by county and aircraft type in 2002. These future year growth factors were then applied to 2002 emission estimates by county and aircraft to develop future year emission inventories.

A small number of counties had no aircraft LTOs in 2002 and a significant number of LTOs in future years. For these counties, emissions were calculated using projected future year LTOs and Emission Factors by aircraft type.

California Aircraft Emissions

CARB provided annual, winter, and summer aircraft emissions estimates by county and aircraft type for the 2002 base year and the three future years. A number of processing steps were required to generate off-road emissions for California that are similar in content and format to the emissions for the remaining WRAP states:

- The CARB aircraft emissions for commercial aircraft and air taxis were combined. The SCC for commercial aircraft was assigned to the combined emissions, and zero emissions were assigned to the SCC for air taxis.
- Spring and call emissions were calculated at the county and SCC level as
  Spring or fall emissions = (4 * annual emissions – winter emissions – summer emissions) / 2
- Ammonia emissions were calculated using NH3/SOX scaling factors at the county and SCC level.
- The additional pollutants needed for WRAP modeling were calculated using speciation factors and appropriate formulas.

Detailed discussions of the development of the mobile source emissions inventories can be found n Pollack, et al., 2006.

Generation of SMOKE and NIF Files

All mobile source emissions files were generated in the format needed for SMOKE emissions processing. Annual average day county-level locomotive emissions SMOKE files were generated, for all WRAP states combined, only for years 2002 and 2018, the years for which the WRAP air quality modeling is performed. The pollutants included in the SMOKE files are VOC, NO_X, CO, NH3, SO_2, PM10, EC10, OC10, SO4(10), PM2.5, EC2.5, OC2.5, SO4(2.5), coarse PM (PMC), NO, and NO2. Separate files were prepared for each year.

Emissions Summaries

Summaries of the gridded mobile source emissions for the Base02b, Plan02c and Base18b inventories by state and county, annual and seasonal periods, can be found on the TSS at: http://vista.cira.colostate.edu/tss/Results/Emissions.aspx.

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1.4 Fugitive dust emissions, as represented in the WRAP modeling inventories, include the following general source categories:

- Agricultural Operations
- Construction and Mining Operations
- Road Dust
- Windblown Dust from Vacant lands

In general, each of these emissions source categories includes more specific sub-categories, as described below. For each, a brief description characterizing the source and the general methodology used to estimate emission rates are provided. For the most part, the estimation methodologies are based on AP-42 guidance. In the case of the WRAP inventory development, specific modifications and/or deviations from these general methodologies are noted.

Agricultural Operations

Dust emissions from agricultural operations result from the disturbance of soil inherent in the preparation of agricultural lands for planting and after harvest activities. These include discing, leveling, and other mechanical operations. Dust emissions from this category exhibit a seasonal pattern as planting and harvesting generally occur in the spring and fall, respectively. In addition, agricultural practices and planting and harvesting calendars are crop-specific in many cases. In addition to operations associated with agricultural land preparation and harvesting, this emission source category includes dust emissions arising from the transport of agricultural crops as well as dust from agricultural feedlots or confined animal feeding operations (CAFOs).

While the current version of AP-42 guidance (5^{th} Edition) does not include estimation methodologies for this dust emission category, guidance was provided in previous versions. However, the California Air Resource Board has developed procedures for estimating PM10 dust emissions from agricultural activities, and these procedures were adopted for development of the WRAP modeling inventories, as describe below.

Particulate dust emissions from agricultural operations are estimated as the product of crop-specific emission factors and appropriate activity data. Emission factors vary as a function of the specific soil preparation operation used for a particular crop, while the activity data is based on harvested acreage, modified by factors to account for the typical number of passes per acre required to prepare a field for planting. The activity data used for estimating land preparation emissions are based on state summaries of crop acreage harvested, further spatially allocated by county and crop type for the each state.

Acre-passes (the total number of passes typically performed to prepare land for planting during a year) are used to compute crop specific emission factors for land preparation. These land preparation operations may occur following harvest or closer to planting, and can include discing, tilling, land leveling, and other operations. Each crop is different in the type of soil operations performed and when they occur; crop profiles from similar

crops are used for cases where specific crop data has not been updated. For updating acre-pass data, specific information on when agricultural operations occur is used to create detailed temporal profiles for PM emissions from agricultural land preparations.

Operation specific PM10 emission factors used to estimate the crop specific emissions for agricultural land preparations are based on data developed by the University of California Davis. Five emission factors were developed using 1995 to 1998 test data measured in cotton and wheat fields in California. Operations tested included root cutting, discing, ripping and subsoiling, land planing and floating, and weeding. The PM2.5/PM10 ratio for agricultural tilling dust used by CARB is 0.222.

PM dust emissions from agricultural activities were developed for the WRAP by Eastern Research Group (ERG). A detailed discussion of the development and data sources used by ERG can be found in ERG, 2006.

<u>Construction Operations</u>

Construction operations are significant source of dust emissions that may have a substantial temporary impact on local air quality. This emission source category includes both residential and non-residential construction as well as road construction. Dust emissions during the construction of buildings or roads are associated with land clearing, drilling and blasting, ground excavation, and cut and fill operations (i.e., earth moving). Dust emissions can vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A significant amount of the dust emissions result from construction vehicle traffic over temporary roads at construction sites.

Residential Construction

PM dust emissions from residential construction are a function of the total acres of land disturbed and the volume of soil excavated. The volume of soil excavated also varies by type of structure under construction. County-level housing starts by structure type are used to estimate the disturbed acreage for construction. These data can be obtained from the US Census Bureau and the Department of Commerce. Volume of soil excavated is estimated based on assumed characteristics of single-family homes and whether the structures include basements.

Emission factors are estimated based on structure type and duration of construction. For single family houses, construction duration is assumed to be 6 months; for apartment buildings, 12-month construction duration is assumed. The emissions factors vary from approximately 0.011 tons PM10/acre-month to 0.11 tons PM10/acre-month. Additional adjustments are applied based on soil moisture, silt content and control efficiency. The ratio of PM2.5 to PM10, as documented in AP-42, is assumed to be 0.20.

Non-residential/Commercial Construction

Dust emissions from non-residential and commercial construction are a function of the total acres of land disturbed. Activity data is based on the total value of the construction in $MM. Data for construction values are typically obtained on a national basis from the Department of Commerce. County-level data is allocated from national estimates using employment statistics. County-level valuation data is then used to estimate total acreages disturbed during construction. An assumed value of 1.55 acres/$MM is applied to the county-level valuation data, as specified in AP-42.

An emission factor of 0.19 tons PM10/acre-month is used for the initial emissions estimate. The assumed construction duration is typically 11 months. As with residential construction, emission factors are adjusted to reflect variations in silt content, soil moisture and control efficiency. The ratio of PM2.5 to PM10, as documented in AP-42, is assumed to be 0.20.

Road Construction

PM dust emissions from road construction activities are a function of acres disturbed during construction. Activity data is based on data obtained from the4 Federal Highway Administration (FHWA) as a function of road type. State-level new miles of road constructed are estimated from 2002 FHWA state expenditures for capital outlay data, in thousands of dollars. These data are then converted to new miles of road constructed using 4/mile conversions from the North Carolina Department of Transportation (NCDOT) data. These data also vary by type of road. The new miles of road constructed is then used to estimate total acres disturbed using conversion factors for acres disturbed/mile of road constructed, as a function of road type. State-level acre disturbed are allocated top the county-level based on residential housing starts data.

An emission factor of 0.42 tons PM10/acre-month is used to estimate PM10 dust emission from road construction activities. A construction duration of 12 months is typically assumed. Adjustments are applied for variations in silt content, soil moisture and control efficiency

PM dust emissions from construction activities were developed for the WRAP by Eastern Research Group (ERG). A detailed discussion of the development and data sources used by ERG can be found in ERG, 2006.

Paved Road Dust

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions, and resuspension of loose material on the road surface. In general terms, resuspended particulate emissions from paved roads originate from, and result in the depletion of the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously

replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas.

Dust emissions from paved roads have been found to vary with the "silt loading" present on the road surface as well as the average weight of vehicles traveling the road. The term silt loading (sL) refers to the mass of silt-size material (equal to or less than 75 micrometers [µm] in physical diameter) per unit area of the travel surface. The total road surface dust loading consists of loose material that can be collected by broom sweeping and vacuuming of the traveled portion of the paved road. The silt fraction is determined by measuring the proportion of the loose dry surface dust that passes through a 200-mesh screen using the ASTM-C-136 method. Silt loading is the product of the silt fraction and the total loading, and is abbreviated "sL."

The surface silt loading (sL) provides a means of characterizing seasonal variability in a paved road emission inventory. In many areas of the country, road surface silt loadings are heaviest during the late winter and early spring months when the residual loading from snow/ice controls is greatest. Once replenishment of fresh material is eliminated, the road surface silt loading can be expected to reach an equilibrium value, which is substantially lower than the late winter/early spring values.

Particulate emissions from road surfaces due to vehicle travel on a dry paved road may be estimated using the following empirical expression:

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$$

where,

- E = particulate emission factor (having units matching the units of k),
- k = particle size multiplier for particle size range,
- sL = road surface silt loading (grams per square meter, g/m^2),
- W = average weight (tons) of the vehicles traveling the road, and
- C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Unpaved Road Dust

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Dust emissions also depend on source parameters that characterize the condition of a particular road and the associated vehicle traffic. Characterization of these source parameters allow for "correction" of emission estimates to specific road and traffic conditions present on public and industrial roadways.

Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75 micrometers [μm] in physical diameter) in the road surface materials. As the silt content of a rural dirt road will vary with geographic location, it should be measured for use in projecting emissions. For a conservative approximation, the silt content of the parent soil is often used. Tests, however, show that road silt content is normally lower than in the surrounding parent soil, because the fines are continually removed by the vehicle traffic, leaving a higher percentage of coarse particles.

Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight. On the other hand, there is far less variability in the weights of cars and pickup trucks that commonly travel publicly accessible unpaved roads throughout the United States. For those roads, the moisture content of the road surface material may be more important in determining differences in emission levels between a hot desert environment and a cool moist location.

The PM10 emission factors presented below are based on stepwise linear regressions of field emission test results of vehicles traveling over unpaved surfaces. Due to a limited amount of information available for PM2.5, the expression for that particle size range has been scaled against the PM10 results. The following empirical expressions may be used to estimate the quantity of size-specific particulate emissions from an unpaved road in pounds (lb) per vehicle mile traveled (VMT). For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation:

$$E = k\,(s/12)^{a}(W/3)^{b}$$

and, for vehicles traveling on publicly accessible roads, dominated by light duty vehicles, emissions may be estimated from the following equation:

$$E = \frac{k\,(s/12)^{a}\,(S/30)^{d}}{(M/0.5)^{c}} - C$$

where k, a, b, c and d are empirical constants, and

- E = size-specific emission factor (lb/VMT)
- s = surface material silt content (%)
- W = mean vehicle weight (tons)
- M = surface material moisture content (%)
- S = mean vehicle speed (mph)
- *C* = emission factor for 1980’s vehicle fleet exhaust, brake wear and tire wear.

The source characteristics s, W and M are referred to as correction parameters for adjusting the emission estimates to local conditions.

For the WRAP, paved and unpaved road dust emissions were estimated using updated VMT for the base and future years provided by state and local contacts as part of the base and future year survey work. Any updated road dust controls provided were also incorporated into the estimates. It is important to note that since the previous WRAP road dust emissions estimates were prepared, EPA's guidance on estimating paved and unpaved road dust emissions was updated; see http://www.epa.gov/ttn/chief/ap42/ch13/index.html. The WRAP Emissions Forum opted to update the road dust emissions only to reflect updated VMT and controls, and not to reflect the updated EPA guidance methodology.

A more detailed discussion of the development of paved and unpaved road dust emissions can be found in Pollack, et al., 2006

Windblown Dust from Vacant lands

Fugitive dust from wind erosion of agricultural and vacant lands represents a significant source of particulate matter emissions, particularly throughout the Western US. For agricultural windblown dust, emission factors may be estimated using the USDA wind erosion equation (WEQ) (ARB, 1997) which relates the PM10 emission factors to various parameters characterizing the specific crops, soil erodibility, surface roughness, vegetative cover and climatic factors. PM10 emissions are obtained by multiplying the resulting emission factor by the total crop acreage in units of tons/acre/yr. For non-agricultural vacant lands, numerous wind tunnel studies have been conducted to estimate appropriate emission factors based on soil types, surface conditions and threshold friction velocities.

Windblown fugitive dust emissions have not been estimated by EPA in previous national emission inventories. ENVIRON has recently completed the development of a windblown dust model for use in WRAP regional haze modeling efforts (Mansell, et. al, 2006). A description of the model development and the most recent results for the WRAP states can be found at http://www.wrapair.org/forums/dejf/fderosion.html. The model estimates fugitive PM dust emissions from vacant lands given wind speed data. All vacant land types are considered; mechanically disturbed lands, e.g., agricultural tilling, are not included. The current version of the model is set up to use the regional-scale land use databases for characterizing vacant lands, and also requires specification of soil characteristics, specifically soil texture. The model provides hourly gridded emission estimates that can be easily summarized on a county level. A complete detailed description of the model development and requisite input databases is included in the project Final Report and related documentation (Mansell, et al., 2006)

Emissions Modeling for Fugitive Dust Sources

For regional air quality modeling, the county-level, annual (or seasonal/monthly) PM dust emissions are spatially allocated to the modeling grid and temporally allocated hourly. In addition, fugitive dust transport fractions are applied to the PM dust emissions estimates prior to their use in the air quality model. The WRAP RMC utilized the

SMOKE emissions processing system to develop the necessary air quality model-ready dust emissions data.

Similar to emissions modeling for other source sectors, the fugitive dust emissions were extracted from the point, area and mobile source inventory data files and processed separately through SMOKE. Dust emissions were extracted from the inventory files based on SCCs. Processing the dust emissions separately allows for more efficient quality assurance of the data and the direct application of the fugitive dust transport fractions. The application of transport fractions is discussed in more detail below. With the exception of the windblown dust emissions, transport fractions are applied using the growth and control modules of SMOKE. The windblown dust emission models incorporate the transport fractions directly in the estimation methodologies used. Note that, except for the gridded emissions summaries, the data presented in the summaries below do not reflect the application of transport fractions.

The final step in preparation of PM dust emissions for air quality modeling involves the spatial and temporal allocation of annual, county-level emissions estimates. The PM10 emissions estimates are also speciated as PMC (=PM10–PM2.5) and PMFINE (=PM2.5). Speciation and spatial and temporal allocation is performed based on detailed SCCs. The revised PM2.5/PM10 ratios, developed by MRI (MRI, 2005), were applied the final versions of the gridded dust emission inventories presented below.

Fugitive Dust SCCs and PM2.5/PM10 Ratios

The development of the WRAP Base02b fugitive dust emissions inventory were based on the specific SCCs extracted from the area and point source inventory data used in the SMOKE emissions processing. As noted in Mansell (2006), several detailed source category codes that were either not included in the initial list of SCCs for fugitive dust processing, or were found to be reported using the most general SCC descriptions. For example, in some counties in Arizona, construction dust emissions were reported in terms of the general “all processes” SCC and were not included extracted from the area source inventory files. Likewise, agricultural dust emissions in California were provided separately from other fugitive dust source categories and were therefore initially not processed as fugitive dust within the SMOKE emissions modeling.

The ratio of PM2.5 to PM10, as reported in the inventory data were evaluated for the Base02b fugitive dust emission inventory (Mansell, 2006). The PM2.5/PM10 ratios are generally consistent with AP-42 guidance documents, although some exceptions were found in the Base02b inventory. Table 1 summarizes these ratios based on AP-42 and also presents the revised factors as recommended by MRI. In 2005, the DEJF initiated a project to evaluate the fine fraction of particulate matter in fugitive dust. The result of this study indicated that the analysis procedures and findings on which the EPA's AP-42 Guidance is based may be biased by as much as a factor of 2. The completed DEJF study (MRI, 2005) provided recommended revisions, by dust emission source category, and are included in Table 1.

Table 2 presents the complete listing of fugitive dust emission source category codes used by the RMC for extracting data from area and point source inventory data files. Also included in Table 2 are the original and revised PM2.5/PM10 ratios used in the SMOKE processing. Note that several SCCs listed were not included in the development of the Base02b modeling inventories. Based on the initial review of emissions data for the Base02b inventory, these SCCs have subsequently been included in the current SMOKE processing procedures and are reflected in the Plan02b and Base18a fugitive dust emissions inventory summaries described below.

Table 1. AP-42 PM2.5/PM10 ratios and recommended ratios from MRI, 2005.

Source Category	AP-42 Section	PM2.5/PM10 Ratio	
		Current	Proposed
Paved Roads	13.2.1	0.25	0.15
Unpaved Roads	13.2.2	0.15	0.10
Construction & Demolition	--	0.208	0.10
Aggregate Handling/Storage Piles	13.2.4	0.314	0.10 (traffic) 0.15 (transfer)
Industrial Wind Erosion	13.2.5	0.40	0.15
Agricultural Tilling	--	0.222	0.20

Table 2. Fugitive dust emission SCCs extracted from area and point source emissions inventory data files.

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2801000001	Agriculture Production - Crops;Agriculture - Crops;Land Breaking	0.222	0.2
2801000002	Agriculture Production - Crops;Agriculture - Crops;Planting	0.222	0.2
2801000003	Agriculture Production - Crops;Agriculture - Crops;Tilling	0.222	0.2
2801000004	Agriculture Production - Crops;Agriculture - Crops;Defoliation	0.222	0.2
2801000005	Agriculture Production - Crops;Agriculture - Crops;Harvesting	0.222	0.2
2801000006	Agriculture Production - Crops;Agriculture - Crops;Drying	0.222	0.2
2801000007	Agriculture Production - Crops;Agriculture - Crops;Loading	0.222	0.2
2801000008	Agriculture Production - Crops;Agriculture - Crops;Transport	0.222	0.2
2805000000	Agriculture Production - Livestock;Agriculture - Livestock;Total	0.222	0.2
2805001000	Agriculture Production - Livestock;Beef Cattle Feedlots;Dust Kicked-up by Hooves	0.222	0.2
2805001001	Agriculture Production - Livestock;Beef Cattle Feedlots;Feed Preparation	0.222	0.2
2805005000	Agriculture Production - Livestock;Poultry Operations;Total (use 2805030000)	0.222	0.2

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2805005001	Agriculture Production - Livestock;Poultry Operations;Feed Preparation	0.222	0.2
2805010000	Agriculture Production - Livestock;Dairy Operations;Total (use 2805020000 and subsets)	0.222	0.2
2805010001	Agriculture Production - Livestock;Dairy Operations;Feed Preparation	0.222	0.2
2805015000	Agriculture Production - Livestock;Hog Operations;Total (use 2805025000)	0.222	0.2
2805015001	Agriculture Production - Livestock;Hog Operations;Feed Preparation	0.222	0.2
2805020000	Agriculture Production - Livestock;Cattle and Calves Waste Emissions;Total	0.222	0.2
2805025000	Agriculture Production - Livestock;Hogs and Pigs Waste Emissions;Total	0.222	0.2
2805030000	Agriculture Production - Livestock;Poultry Waste Emissions;Total	0.222	0.2
2805035000	Agriculture Production - Livestock;Horses and Ponies Waste Emissions;Total	0.222	0.2
2805040000	Agriculture Production - Livestock;Sheep and Lambs Waste Emissions;Total	0.222	0.2
2805045001	Agriculture Production - Livestock;Goats Waste Emissions;Total	0.222	0.2
2275085000	Aircraft;Unpaved Airstrips;Unpaved Airstrips	n/a	0.1
2311000000	Construction: SIC 15 - 17;All Processes;Total	0.208	0.1
2311000010	Construction: SIC 15 - 17;All Processes;Land Clearing	0.208	0.1
2311000040	Construction: SIC 15 - 17;All Processes;Ground Excavations	0.208	0.1
2311000050	Construction: SIC 15 - 17;All Processes;Cut and Fill Operations	0.208	0.1
2311000060	Construction: SIC 15 - 17;All Processes;Construction	0.208	0.1
2311000070	Construction: SIC 15 - 17;All Processes;Vehicle Traffic	0.208	0.1
2311010000	Construction: SIC 15 - 17;General Building Construction;Total	0.208	0.1
2311010010	Construction: SIC 15 - 17;General Building Construction;Land Clearing	0.208	0.1
2311010040	Construction: SIC 15 - 17;General Building Construction;Ground Excavations	0.208	0.1
2311010050	Construction: SIC 15 - 17;General Building Construction;Cut and Fill Operations	0.208	0.1
2311010060	Construction: SIC 15 - 17;General Building Construction;Construction	0.208	0.1
2311010070	Construction: SIC 15 - 17;General Building Construction;Vehicle Traffic	0.208	0.1
2311020000	Construction: SIC 15 - 17;Heavy Construction;Total	0.208	0.1
2311020010	Construction: SIC 15 - 17;Heavy Construction;Land Clearing	0.208	0.1
2311020040	Construction: SIC 15 - 17;Heavy Construction;Ground Excavations	0.208	0.1
2311020050	Construction: SIC 15 - 17;Heavy Construction;Cut and Fill Operations	0.208	0.1
2311020060	Construction: SIC 15 - 17;Heavy Construction;Construction	0.208	0.1
2311020070	Construction: SIC 15 - 17;Heavy Construction;Vehicle Traffic	0.208	0.1
2311030000	Construction: SIC 15 - 17;Road Construction;Total	0.208	0.1
2311030010	Construction: SIC 15 - 17;Road Construction;Land Clearing	0.208	0.1
2311030040	Construction: SIC 15 - 17;Road Construction;Ground Excavations	0.208	0.1
2311030050	Construction: SIC 15 - 17;Road Construction;Cut and Fill Operations	0.208	0.1
2311030060	Construction: SIC 15 - 17;Road Construction;Construction	0.208	0.1
2311030070	Construction: SIC 15 - 17;Road Construction;Vehicle Traffic	0.208	0.1
2311040000	Construction: SIC 15 - 17;Special Trade Construction;Total	0.208	0.1
2305000000	Industrial Processes;Mineral Processes: SIC 32;All Processes;Total	n/a	0.1
2305070000	Industrial Processes;Mineral Processes: SIC 32;Concrete, Gypsum, Plaster Products;Total	n/a	0.1
2305080000	Industrial Processes;Mineral Processes: SIC 32;Cut Stone and Stone Products;Total	n/a	0.1
2325020000	Industrial Processes;Mining and Quarrying: SIC 14;Crushed and Broken Stone;Total	n/a	0.1
2325030000	Industrial Processes;Mining and Quarrying: SIC 14;Sand and Gravel;Total	n/a	0.1
2325040000	Industrial Processes;Mining and Quarrying: SIC 14;Clay, Ceramic, and Refractory;Total	n/a	0.1
2530000020	Storage and Transport;Bulk Materials Storage;All Storage Types;Cement	n/a	0.1
2530000100	Storage and Transport;Bulk Materials Storage;All Storage Types;Limestone	n/a	0.1

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2530000120	Storage and Transport;Bulk Materials Storage;All Storage Types;Sand	n/a	0.1
2325000000	Mining and Quarrying: SIC 14;All Processes;Total	n/a	0.1
2294000000	Paved Roads;All Paved Roads;Total: Fugitives	0.25	0.12
2294000001	Paved Roads;All Paved Roads;Total: Average Conditions - Fugitives	0.25	0.12
2294000002	Paved Roads;All Paved Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2294005000	Paved Roads;Interstate/Arterial;Total: Fugitives	0.25	0.12
2294005001	Paved Roads;Interstate/Arterial;Total: Average Conditions - Fugitives	0.25	0.12
2294005002	Paved Roads;Interstate/Arterial;Total: Sanding/Salting - Fugitives	0.25	0.12
2294010000	Paved Roads;All Other Public Paved Roads;Total: Fugitives	0.25	0.12
2294010001	Paved Roads;All Other Public Paved Roads;Total: Average Conditions - Fugitives	0.25	0.12
2294010002	Paved Roads;All Other Public Paved Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2294015000	Paved Roads;Industrial Roads;Total: Fugitives	0.25	0.12
2294015001	Paved Roads;Industrial Roads;Total: Average Conditions - Fugitives	0.25	0.12
2294015002	Paved Roads;Industrial Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2296000000	Unpaved Roads;All Unpaved Roads;Total: Fugitives	0.15	0.1
2296005000	Unpaved Roads;Public Unpaved Roads;Total: Fugitives	0.15	0.1
2296010000	Unpaved Roads;Industrial Unpaved Roads;Total: Fugitives	0.15	0.1

Fugitive Dust Transport Fractions

The concept of fugitive dust transport fractions has been considered and refined in recent years. It has been recognized that, due to various mechanisms, dust particles are subject to near source removal. These mechanisms include gravitational settling, particle deposition to the ground and impaction and removal due to particle capture by the surrounding vegetation canopy and other physical structures. The EPA for many years had promoted the “divide by four” approach for reducing the emission from fugitive dust sources to account for these processes. The idea is that only a limited amount of the dust emitted by a particular source is transported significantly to affect the total available emissions in the atmosphere for air quality grid modeling.

Recent research has shown that the amount of fugitive dust captured in the surround canopy or on physical structures can be related to the physical characteristics of the land surface, i.e., land use/land cover. The EPA recently developed county-level transport fractions for use in emissions inventory development for air quality modeling (Pace, 2003; 2005). The county-level transport fractions were based on the percentage of land use in each county. The transport fractions were calculated as a weighted sum of landuse-specific fractions for each landuse type. Previously, landuse percentages were derived from the BELD3 LULC database. In the WRAP fugitive dust emission inventory, transport fractions were revised to reflect a more current LULC database. The current gridded dust emissions for the WRAP are based on the 2000 North American Land Cover (2000 NALC) database. A description of the 2000 NALC database can be found in Mansell and Hoats, 2005.

For the windblown dust emissions, transport fractions were developed and applied within the wind blown dust model based on the gridded landuse data used in the estimation methodology. A discussion of the application of the transport fraction for windblown dust emissions can be found in Mansell, et al., 2006. The original and revised transport fractions for each of the relevant land use types are presented in Table 3.

Table 3. Fugitive dust transport fractions as a function of landuse.

Fugitive Dust Transport Fractions		
LULC Category	**Original**	**Revised**
Urban	0.30	0.00
Agriculture	0.85	0.75
Grassland	0.70	0.75
Shrubland	0.60	0.75
Forest	0.30	0.00
Barren/Water	0.97	1.00

Gridded Fugitive Dust Emission Inventory Summaries

Summaries of the gridded fugitive dust source emissions for the Base02b, Plan02c and Base18b inventories by state and county, annual and seasonal periods, can be found on the TSS at: http://vista.cira.colostate.edu/tss/Results/Emissions.aspx.

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1.5 Fire Emissions

Fire emissions data for SMOKE have traditionally been represented as county-level area-source inventories that were placed in only the first vertical model layer. The representation of fire emissions for air quality modeling was enhanced by preparing the inventory data as point sources with specific latitude-longitude coordinates for each fire centroid and pre-computed plume rise parameters that were derived from individual fire characteristics. These new inventories consist of annual, daily, and hourly IDA-formatted emissions inventory files and ancillary data for allocating the inventories in space, time, and to the Carbon Bond-IV chemistry mechanism used in CMAQ and CAMx. The development of the fire emissions inventory is described in this section.

Source Categories

The fire emission inventories developed for the WRAP modeling efforts were organized into the following individual categories:

- Wildfires
- Agricultural fires
- Wildland fire use
- Natural prescribed
- Anthropogenic prescribed
- Non-Federal rangeland fires
- non-WRAP fires

For the non-WRAP fire emissions inventory, most of the data were modeled as area sources, with the exception of fire emissions for Canada, which were treated as elevated point sources.

The development of the fire emission inventory is described below. The discussion focuses on the development of the 2002 Base inventory; emissions modeling for the 2002 Planning inventory and the 2018 base year inventory use the same processing approach. Variations to the modeling approach and specific revisions and enhancements incorporated into the final modeling versions of the inventories have been described previously (refer to the Emission Overview Documentation). Specific revisions are noted with respect to data sources and source categories for the Plan02 and Base18 emissions inventories.

1.5.1 Data sources

For the fire inventories in Base02 inventory, actual 2002 data were used as developed by the RPOs for the U.S., version 2 of the year 2000 Canadian inventory, and actual 2002 data for Ontario, Canada. There were no fire emissions in the BRAVO 1999 Mexico inventories, so Mexican fires were not included in the Base02 inventories. The inventories used consisted of both area- and point-source data for the U.S. and Canada. Air Sciences provided the WRAP inventories divided among six different fire categories:

wildfires, agricultural fires, wildland fire use, natural prescribed, anthropogenic prescribed, and non-Federal rangeland fires (Air Sciences, Inc., 2005). These inventories consisted of annual, daily, and hourly IDA-formatted files with information on daily emissions totals and hourly plume characteristics for each fire. Similar point source fire inventories for the VISTAS states were received from Alpine Geophysics (Stella, 2005). In addition, county-level fire inventories represented as area sources for the VISTAS and CENRAP states were also included. Monthly temporal profiles received from Alpine Geophysics were used to distribute these annual inventories throughout the year. The area source inventories for the rest of the RPOs and Canada also contained fire emissions that were not distributed separately. These sources were modeled with the rest of the stationary-area-source sector. Finally, a 2002 fire inventory for Ontario, Canada was received from MANE-VU and formatted to take advantage of the SMOKE fire plume rise algorithm (Pouliot et al., 2005).

For the development of the Plan02 inventories, the RMC received corrected U.S. data for only the updated portions of the Base02 inventories. The previous inventory data for the affected states were removed from the files used in the Base02 modeling and combined the remaining data with the updated information to build revised Base02 inventories. The resulting dataset was used to develop the Plan02 inventory. This substitution of only the revised portions of the inventories was a general approach applied to several emissions sectors. More specific approaches were also developed for preparing the Plan02 fire inventories as described below.

Air Sciences, Inc., provided annual Baseline Phase III fire inventories for each of the five fire categories (wildfires, agricultural fires, prescribed fires, non-Federal rangeland prescribed fires, and wildland fire use) as three-file sets for each category. Consistent with the fire inventories for Phases I and II, each fire category consisted of an annual IDA file with physical fire event information, a daily IDA file with daily emissions by criteria pollutant, and an hourly IDA file with hourly pre-computed plume rise values. Upon receiving these data, the annual inventories are split into monthly files to avoid computer memory problems related to processing very large inventories with SMOKE. Additional information on the development of these fire inventories is available in WRAP-FEJF (2006).

Baseline fire emission inventories for 2018 (Base18a) for WRAP, CENRAP, and VISTAS were held constant at Plan02 emission levels. For the 2018b inventory, a number of revisions were incorporated as follows:

- The WRAP inventories for prescribed and agricultural fires were updated and errors corrected in the application of temporal and speciation profiles for non-Federal rangeland prescribed fires.
- Air Sciences, Inc. provided revisions to the Phase III prescribed and agricultural fire inventories to estimate the emissions reductions from applying fire emissions reduction techniques (ERTs) to controllable fire emissions (Randall, 2006). They based the revised emissions on the same data that the RMC used in case Plan02b to illustrate the changes that resulted from controlling prescribed and agricultural fires between the Plan02b and Base18b emission scenarios.

- The temporal and speciation profiles applied to the non-Federal rangeland prescribed fires were corrected. By not adding the SCC for this source to the input cross-reference files in the Plan02 and Base18a inventories, default temporal and speciation profiles were mistakenly applied to these emissions. The appropriate cross-reference for this source were added to the SMOKE input files in case Base18b.

1.5.2 Emissions processing

SMOKE is instrumented to distribute point-source-formatted fire inventories to the vertical model layers either by using a pre-computed plume rise approach or by computing the plume rise dynamically using actual 2002 meteorology. Both approaches for modeling point source fire emissions were applied for the Base02 inventories. For the pre-computed plume rise approach, SMOKE reads an annual inventory file with information on fire locations, a daily inventory file with daily emission totals for each fire, and an hourly inventory file with hourly plume bottom, plume top, and layer 1 fractions for each fire. SMOKE uses this information to locate the fires on the horizontal model grid and to distribute the plume of each fire vertically to the model layers. Because some of these fires have plumes that reach the model top, the number of emissions layers for processing these inventories are set to the full 19 layers of the meteorology. This approach was applied to the point-source fires for the WRAP and VISTAS regions.

The alternative plume rise approach uses information on fuel loading and the heat flux of the fires to distribute the fires vertically to the model layers. The data are provided to SMOKE in the form of an annual inventory with information on fire locations and a daily inventory with daily emission totals for each fire, daily heat flux, and daily fuel loading. This approach to the point source fires was applied for Ontario, Canada.

All of the point-source fires used diurnal temporal profiles and speciation profiles for VOC and $PM_{2.5}$ developed by Air Sciences during the preliminary 2002 modeling (Tonnesen et al., 2005).

For the area source fires outside of the WRAP region, including Canada, monthly temporal profiles developed by VISTAS were applied.. While these profiles appear to be an improvement over the EPA defaults, they are specific to the VISTAS region and will misrepresent the seasonality of the fires in other regions of the modeling domain. Flat weekly temporal profiles, and the diurnal profiles developed by Air Sciences were also used in the fire emissions modeling. In addition, the forestland spatial surrogates were used to distribute these county level (province level for Canada) data to the model grid. Using spatial surrogates to locate fires is a crude approach that results in the artificial smearing of the emissions over too large an area. Both of these issues can be remedied by moving to a point source approach for representing these fires, similar to the approach used by Air Sciences for preparing the WRAP fire inventories.

The RMC discovered several errors with the WRAP Phase II inventories. Some of these errors were fixed with corrections made by the RMC with guidance from Air Sciences,

and others will be addressed by Air Sciences in Phase III of the 2002 WRAP fire inventories. The errors identified, with corrections, were as follows:

- Missing or malformed dates in several agricultural burning events in CA. These events were intended to be dropped and were ultimately deleted from the inventories by the RMC.
- Missing dates in several prescribed burning events in AZ. These records were corrected by Air Sciences and redistributed to the RMC.
- Inconsistencies between the records in the hourly and annual inventory files for several agricultural burning events in CA. These records were corrected by Air Sciences and redistributed to the RMC.

The quality assurance of the fire emissions followed the WRAP emissions modeling QA protocol (Adelman, 2004) and a suite of graphical summaries. Tabulated summaries of the input data and SMOKE script settings were used to document the data and configuration of SMOKE. The graphical QA summaries include, for all emissions output species, daily time-series plots, annual time-series plots, and daily vertical profiles. These QA graphics for the 2002 inventories are available at http://pah.cert.ucr.edu/aqm/308/QA_base02a36.plots/allf/plots/.

Gridded Fire Emission Inventory Summaries

Summaries of the gridded fire source emissions for the Base02b, Plan02c and Base18b inventories by state and county, annual and seasonal periods, can be found on the TSS at: http://vista.cira.colostate.edu/tss/Results/Emissions.aspx.

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Appendix E: Source Apportionment

Appendix to Chapter 9 of the State Implementation Plan

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AIR QUALITY MODELING

Overview

Visibility impairment occurs when fine particulate matter ($PM_{2.5}$) in the atmosphere scatters and absorbs light, thereby creating haze. $PM_{2.5}$ can be emitted into the atmosphere directly as primary particulates, or it can be produced in the atmosphere from photochemical reactions of gas-phase precursors and subsequent condensation to form secondary particulates. Examples of primary $PM_{2.5}$ include crustal materials and elemental carbon; examples of secondary PM include ammonium nitrate, ammonium sulfates, and secondary organic aerosols (SOA). Secondary $PM_{2.5}$ is generally smaller than primary $PM_{2.5}$, and because the ability of $PM_{2.5}$ to scatter light depends on particle size, with light scattering for fine particles being greater than for coarse particles, secondary $PM_{2.5}$ plays an especially important role in visibility impairment. Moreover, the smaller secondary $PM_{2.5}$ can remain suspended in the atmosphere for longer periods and is transported long distances, thereby contributing to regional-scale impacts of pollutant emissions on visibility.

The sources of $PM_{2.5}$ are difficult to quantify because of the complex nature of their formation, transport, and removal from the atmosphere. This makes it difficult to simply use emissions data to determine which pollutants should be controlled to most effectively improve visibility. Photochemical air quality models offer opportunity to better understand the sources of $PM_{2.5}$ by simulating the emissions of pollutants and the formation, transport, and deposition of $PM_{2.5}$. If an air quality model performs well for a historical episode, the model may then be useful for identifying the sources of $PM_{2.5}$ and helping to select the most effective emissions reduction strategies for attaining visibility goals. Although several types of air quality modeling systems are available, the gridded, three-dimensional, Eulerian models provide the most complete spatial representation and the most comprehensive representation of processes affecting $PM_{2.5}$, especially for situations in which multiple pollutant sources interact to form $PM_{2.5}$. For less complex situations in which a few large point sources of emissions are the dominant source of $PM_{2.5}$, trajectory models (such as the California Puff Model [CALPUFF]) may also be useful for simulating $PM_{2.5}$.

Air Quality Models

The WRAP RMC utilized two regulatory air quality modeling systems to conduct all regional haze modeling. A brief discussion of each of these models is provided below.

Community Multi-Scale Air Quality Model

EPA initially developed the Community Multi-Scale Air Quality (CMAQ) modeling system in the late 1990s. The model source code and supporting data can be downloaded from the Community Modeling and Analysis System (CMAS) Center (http://www.cmascenter.org/), which is funded by EPA to distribute and provide limited support for CMAQ users. CMAQ was designed as a “one atmosphere” modeling system to encompass modeling of multiple pollutants and issues, including ozone, PM, visibility, and air toxics. This is in contrast to many earlier air quality models that focused on single-pollutant issues (e.g., ozone modeling by the Urban Airshed Model). CMAQ is an Eulerian model—that is, it is a grid-based model

in which the frame of reference is a fixed, three-dimensional (3-D) grid with uniformly sized horizontal grid cells and variable vertical layer thicknesses. The number and size of grid cells and the number and thicknesses of layers are defined by the user, based in part on the size of the modeling domain to be used for each modeling project. The key science processes included in CMAQ are emissions, advection and dispersion, photochemical transformation, aerosol thermodynamics and phase transfer, aqueous chemistry, and wet and dry deposition of trace species. CMAQ offers a variety of choices in the numerical algorithms for treating many of these processes, and it is designed so that new algorithms can be included in the model. CMAQ offers a choice of three photochemical mechanisms for solving gas-phase chemistry: the Regional Acid Deposition Mechanism version 2 (RADM2), a fixed coefficient version of the SAPRC90 mechanism, and the Carbon Bond IV mechanism (CB-IV).

Comprehensive Air Quality Model with Extensions

The Comprehensive Air Quality Model with extensions (CAMx) model was initially developed by ENVIRON in the late 1990s as a nested-grid, gas-phase, Eulerian photochemical grid model. ENVIRON later revised CAMx to treat PM, visibility, and air toxics. While there are many similarities between the CMAQ and CAMx systems, there are also some significant differences in their treatment of advection, dispersion, aerosol formation, and dry and wet deposition.

Model Versions

Both EPA and ENVIRON periodically update and revise their models as new science or other improvements to the models are developed. For CMAQ, EPA typically provides a new release about once per year. The initial 2002 MPE for WRAP used CMAQ version 4.4, which was released in October 2004. In October 2005 EPA released CMAQ version 4.5, which includes the following updates and improvements to the modeling system:

- A new vertical advection algorithm with improved mass conservation
- Changes in deposition velocities for some PM species
- A new sea-salt emissions model and inclusion of sea salt in the aerosol thermodynamics
- An option to make vertical mixing parameters vary as a function of land use type

The RMC completed the initial CMAQ MPE using CMAQ v.4.4. When version 4.5 was released in October, the modeling was revised and a comparison of the model performance using the two versions was compared. Note that some of the new features in CMAQ v4.5 (e.g., sea salt in the AE4 aerosol dynamics module, and percent urban minimum vertical diffusivity) require the reprocessing of the MM5 data using the new version of MCIP (MCIP v3.0). However, because such reprocessing could potentially jeopardize the WRAP modeling schedule, WRAP elected to operate CMAQ v4.5 using the MM5 data processed using a previous MCIP version, MCIP v2.3, and the AE3 aerosol module that does not include active sea salt chemistry.

ENVIRON releases updated versions of CAMx approximately every two years, or as new features become available. The version used for the comparison of CMAQ and CAMx was CAMx v4.3. There are many similarities between CMAQ and CAMx regarding the science

algorithms and chemical mechanisms used, including the CB-IV gas-phase and RADM aqueous-phase chemistries, ISORROPIA aerosol thermodynamics, and PPM horizontal advection scheme. In the past, the treatment of vertical advection was a major difference between the two models; however, the incorporation of the new mass conservation scheme in CMAQ v4.5 makes its vertical advection algorithm much more similar to that of CAMx.

Major differences between the two models that still exist are in the basic model code, in the treatment of horizontal diffusion SOA formation mechanisms, and in grid nesting (CAMx supports one-way and two-way nesting, whereas CMAQ supports just one-way grid nesting). Both models include process analysis for the gas-phase portions of the model. The publicly released version of CAMx supports ozone and PM source apportionment through its Ozone and PM Source Apportionment Technology (OSAT/PSAT) probing tools, while for CMAQ there are research versions of the model that include Tagged Species Source Apportionment (TSSA) for some PM species (e.g., sulfate and nitrate). There are also research versions of CMAQ and CAMx that support the Decoupled Direct Method (DDM) sensitivity tool for PM and ozone.

The CAMx model is computationally more efficient than CMAQ. However, CAMx is currently supported for use on only a single central processing unit (CPU) and can perform multiprocessing using Open Multi-Processing (OMP) parallelization (i.e., shared memory multiprocessors). CMAQ parallelization, on the other hand, is implemented using Message Passing Interface (MPI) multiprocessing and therefore can be run using any number of CPUs. Depending on the number of model simulations to be performed and the manner in which they are set up, there can be a slight advantage either to CAMx or to CMAQ in regard to computational efficiency.

Model Simulations

In support of the WRAP Regional Haze air quality modeling efforts, the RMC developed air quality modeling inputs including annual meteorology and emissions inventories for a 2002 actual emissions base case, a planning case to represent the 2000-04 regional haze baseline period using averages for key emissions categories, and a 2018 base case of projected emissions determined using factors known at the end of 2005. All emission inventories were developed using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Each of these inventories has undergone a number of revisions throughout the development process to arrive at the final versions used in CMAQ and CAMx air quality modeling. The development of each of these emission scenarios is documented under the emissions inventory sections of the TSS. In addition to various sensitivities scenarios, the WRAP performed air quality model simulations for each of the emissions scenarios as follows:

- The 2002 base case emissions scenario, referred to as “2002 Base Case” or “Base02”. The purpose of the Base02 inventory is to represent the actual conditions in calendar year 2002 with respect to ambient air quality and the associated sources of criteria and particulate matter air pollutants. The Base02 emissions inventories are used to validate the air quality model and associated databases and to demonstrate acceptable model performance with respect to replicating observed particulate matter air quality.

- The 2000-04 baseline period planning case emissions scenario is referred to as "Plan02". The purpose of the Plan02 inventory is to represent baseline emission patterns based on average, or "typical", conditions. This inventory provides a basis for comparison with the future year 2018 projected emissions, as well as to gauge reasonable progress with respect to future year visibility.
- The 2018 future-year base case emissions scenario, referred to as "2018 Base Case" or "Base18". These emissions are used to represent conditions in future year 2018 with respect to sources of criteria and particulate matter air pollutants, taking into consideration growth and controls. Modeling results based on this emission inventory are used to define the future year ambient air quality and visibility metrics.

Data Sources

The CMAQ model requires inputs of three-dimensional gridded wind, temperature, humidity, cloud/precipitation, and boundary layer parameters. The current version of CMAQ can only utilize output fields from the PSU/NCAR MM5 meteorological model. MM5 is a state-of-the-science atmosphere model that has proven useful for air quality applications and has been used extensively in past local, state, regional, and national modeling efforts. MM5 has undergone extensive peer-review, with all of its components continually undergoing development and scrutiny by the modeling community. In-depth descriptions of MM5 can be found in Dudhia (1993) and Grell et al. (1994), and at http://www.mmm.ucar.edu/mm5. All meteorological data used for the WRAP air quality modeling efforts are derived from MM5 model simulations. The development of these data is documented in (Kemball-Cook, S. et al., 2005)

Emission inventories for all WRAP air quality simulations were developed using the Matrix Operator Kernel Emissions (SMOKE) modeling system. The development of these data has been discussed and documented elsewhere (Tonnesen, G. et al., 2006)

Initial conditions (ICs) are specified by the user for the first day of a model simulation. For continental-scale modeling using the RPO Unified 36-km domain, the ICs can affect model results for as many as 15 days, although the effect typically becomes very small after about 7 days. A model spin-up period is included in each simulation to eliminate any effects from the ICs. For the WRAP modeling, the annual simulation is divided into four quarters, and included a 15-day spin-up period for the quarters beginning in April, July, and October. For the quarter beginning in January 2002, a spin-up period covering December 16-31, 2001, using meteorology and emissions data developed for CENRAP were used..

Boundary conditions (BCs) specify the concentrations of gas and PM species at the four lateral boundaries of the model domain. BCs determine the amounts of gas and PM species that are transported into the model domain when winds flow is into the domain. Boundary conditions have a much larger effect on model simulations than do ICs. For some areas in the WRAP region and for clean conditions, the BCs can be a substantial contributor to visibility impairment.

For this study BC data generated in an annual simulation of the global-scale GEOS-Chem model that was completed by Jacob et al. (http://www-as.harvard.edu/chemistry/trop/geos/)

for calendar year 2002 were applied. Additional data processing of the GEOS-Chem data was required before using them in CMAQ and CAMx. The data first had to be mapped to the boundaries of the WRAP domain, and the gas and PM species had to be remapped to a set of species used in the CMAQ and CAMx models. This work was completed by Byun and coworkers (http://www-as.harvard.edu/chemistry/trop/geos/meetings/2005/ppt/Expanding_Model_Capabilities/GEOS-CMAQ_april_4_Byun.ppt

The CMAQ model options and configuration used for the WRAP 36-km model simulations are described in Tonnesen, G. et al., 2006.

Model Run Specification Sheets

In order to provide documentation for each of the CMAQ and CAMx air quality model simulations conducted by the WRAP RMC during Calendar year 2006, a series of Model Run Specification Sheets were developed. These "Spec Sheets" provide a description of each simulation, the various air quality model options and configurations used and detailed listing and description of the meteorological data and emission inventories for each scenario. These Spec Sheets also provide a means for the RMC to track the development of each of the input data sets and defined the modeling schedule. The purpose of each simulation, and expected results, including their implications, are also included. A link to each of the individual Specification Sheets for the model simulations can be found on the RMC web site at: http://pah.cert.ucr.edu/aqm/308/cmaq.shtml.

2002 Base Case Modeling

Base02 Sensitivity Simulations

The purpose of the 2002 Base Case modeling efforts was to evaluate air quality/visibility modeling systems for a historical episode—in this case, for calendar year 2002—to demonstrate the suitability of the modeling systems for subsequent planning, sensitivity, and emissions control strategy modeling. Model performance evaluation is performed by comparing output from model simulations with ambient air quality data for the same time period. After creating emissions and meteorology inputs for the two air quality models, CMAQ and CAMx, the next step was to perform the visibility modeling and the model performance evaluations, which are described below. A detailed discussion of the results of the CMAQ and CAMx model simulations can be found in Tonnesen, G. et al., 2006. Also documented in Tonnesen, G. et al., 2006 are the results of the model performance evaluation, a model inter-comparison and discussion of various sensitivity simulations. This information was used as the basis for recommending the selection of CMAQ and/or CAMx to complete the remaining modeling efforts in RMC's support of WRAP.

Model Performance Evaluation

The objective of a model performance evaluation (MPE) is to compare model-simulated concentrations with observed data to determine whether the model's performance is sufficiently accurate to justify using the model for simulating future conditions. There are a number of challenges in completing an annual MPE for regional haze. The model must be compared to ambient data from several different monitoring networks for both PM and gaseous species, for an annual time period, and for a large number of sites. The model must be evaluated for both the worst visibility conditions and for very clean conditions. Finally, final guidance on how to perform an MPE for fine-particulate models is not yet available from EPA. Therefore, the RMC experimented with many different approaches for showing model performance results. The plot types that were found to be the most useful are the following:

- Time-series plots comparing the measured and model-predicted species concentrations
- Scatter plots showing model predictions on the *y*-axis and ambient data on the *x*-axis
- Spatial analysis plots with ambient data overlaid on model predictions
- Bar plots comparing the mean fractional bias (MFB) or mean fractional error (MFE) performance metrics
- "Bugle plots" showing how model performance varies as a function of the PM species concentration
- Stacked-bar plots of contributions to light extinction for the average of the best-20% visibility days or the worst-20% visibility days at each site; the higher the light extinction, the lower the visibility

Examples of each of these MPE metrics and analysis products can be found in Tonnesen, G. et al., 2006. The results of the MPE are available from the WRAP RMC website (http://pah.cert.ucr.edu/aqm/308/eval.shtml)

2002 Planning Scenario

The 2000-04 baseline period planning case scenario is referred to as "Plan02". The purpose of the Plan02 scenario is to simulation the air quality representative of baseline emission patterns based on average, or "typical", conditions. This scenario provides a basis for comparison with the future year 2018 scenario based on projected emissions, as well as to gauge reasonable progress with respect to future year visibility.

<u>Plan02 Simulations Input Data</u>

Input data used for the 2002 Planning model simulations consisted of the same meteorology as for the 2002 Base Case and the Plan02 emission inventories described under the Emissions Modeling section of the TSS.

The setup of the CMAQ model (including science options, run scripts, simulation periods, and ancillary data) for the Plan02 cases was identical to that used in the Base02 modeling, as

described in the 2002 MPE report (Tonnesen et al., 2006). In summary, CMAQ v4.5 (released by EPA in October 2005) was used on the RPO Unified 36-km domain. The Carbon Bond Mechanism version 4 (CB4) with RADM aqueous chemistry, the SORGAM organic aerosol algorithm, and all other science algorithms detailed in Tonnesen et al., 2006 were used. Initial condition (IC) data for January 1, 2002, were developed using a 15-day spin-up period (December 16-31, 2001). Boundary condition (BC) data were generated in an annual simulation of the global-scale GEOS-Chem model that was completed by Jacob et al. (http://www-as.harvard.edu/chemistry/trop/geos/) for calendar year 2002.

Comparison With Base02 Simulations

For each of the three Plan02 emissions datasets, annual visibility modeling was performed using the CMAQ model. This was a key aspect of the QA procedure, since errors in the emissions inventories that might not be apparent during the emissions QA steps might be more readily detected in the results from the CMAQ modeling.

In our initial analysis of the Plan02 scenario, plots were prepared for QA purposes that compared the Plan02a CMAQ results with the Base02a CMAQ results for daily and monthly averages. After revising Plan02a to create Plan02b and Plan02c, additional QA plots were prepared to compare the CMAQ results of each revised Plan02 case to the previous iteration. These were prepared as Program for the Analysis and Visualization of Environmental data (PAVE) spatial plots showing the change in individual $PM_{2.5}$ species concentrations as daily, monthly, and annual averages. The final set of analysis products, available on the RMC web site, include PAVE difference plots comparing the CMAQ-predicted annual average species concentrations from the Plan02c case with those from the Base02b case. Note that these plots are not useful for visibility planning purposes, but are being provided to show the magnitudes of changes when moving from the 2002 Base Case to the 2002 Planning Case—in other words, from the actual emissions for the year 2002 to the "typical-year" emissions created for the final Plan02 scenario. The primary analysis "product" from the Plan02 CMAQ modeling is the use of its output in combination with the CMAQ output from the 2018 modeling to develop the visibility progress calculations and glide path plots, described below.

2018 Model Simulations

The 2018 future-year base case scenario is referred to as "2018 Base Case" or "Base18". The purpose of the Base18 scenario is to simulation the air quality representative of conditions in future year 2018 with respect to sources of criteria and particulate matter air pollutants, taking into consideration growth and controls. Modeling results based on this emission inventory are used to define the future year ambient air quality and visibility metrics.

Base18 Simulation Input Data

Input data used for the 2018 Base Case model simulations consisted of the same meteorology as for the 2002 Base Case and the Base18 emission inventories described under the Emissions Modeling section of the TSS.

The setup of the CMAQ model (including science options, run scripts, simulation periods, and ancillary data) for the Base18 cases was identical to that used in the Base02 modeling, as described in the 2002 MPE report (Tonnesen et al., 2006). In summary, CMAQ v4.5 (released by EPA in October 2005) was used on the RPO Unified 36-km domain. The Carbon Bond Mechanism version 4 (CB4) with RADM aqueous chemistry, the SORGAM organic aerosol algorithm, and all other science algorithms detailed in Tonnesen et al., 2006 were used. Initial condition (IC) data for January 1, 2002, were developed using a 15-day spin-up period (December 16-31, 2001). Boundary condition (BC) data were generated in an annual simulation of the global-scale GEOS-Chem model that was completed by Jacob et al. (http://www-as.harvard.edu/chemistry/trop/geos/) for calendar year 2002.

Base18 Simulation Results

The purpose of modeling 2018 visibility is to compare the 2018 visibility predictions to the 2002 typical-year visibility modeling results, as discussed below. Some improvements in visibility by 2018 are expected because of reductions in emissions due to currently planned regulations and technology improvements. A brief summary is provided here of the comparison between the 2018 and 2002 results using annual average PAVE spatial plots. The goal of this summary is to convey the scale and spatial extent of changes in key $PM_{2.5}$ species from 2002 to 2018. For planning purposes, on the other hand, states and tribes should focus on the visibility projections and glide path calculations at individual Class I Areas.

Figures 1 through 4 show the annual average concentrations for sulfate, nitrate, $PM_{2.5}$ and model-reconstructed visibility (in deciviews), respectively. In each figure, the bottom two plots show the modeled concentration or deciviews for the Plan02b and Base18b cases, while the top plot shows the change in visibility calculated as Base18b minus Plan02b. The Plan02b results are presented here instead of Plan02c results because these plots had previously been prepared with version B. As the differences between Plan02b and Plan02c are extremely small, new plots prepared using Plan02c would be essentially identical to the results in Figure 1 through 4.

In each of the top plots in the four figures, cool colors indicate areas in which model-predicted visibility improved from 2002 to 2018, while warm colors indicate areas where modeled visibility became worse over that period. Figure 1 shows that reductions in sulfate were largest in the southwest corner of the WRAP region and in Texas and Oklahoma. This results from planned SO_x emissions reductions in the CENRAP region. There were smaller reductions in sulfate in the Los Angeles area, western Washington state, and southern Nevada. There were small increases of sulfate, mostly in Wyoming, due to growth in SO_x emissions. Most regions of the WRAP domain had low concentrations of sulfate in 2002 and little change in sulfate by 2018.

Figure 2 shows the results for nitrate. In the both 2002 and 2018, the modeled nitrate was greatest in California, and there were reduction in nitrate in that state in 2018 because of

reductions in mobile-source NO_x emissions. There were small reductions in the Phoenix area as well, also from reductions in mobile-source NO_x emissions.

Figure 3 shows the comparison of $PM_{2.5}$ for 2002 and 2018. In most areas of the WRAP region, changes in $PM_{2.5}$ were less than 1 $\mu g/m^3$. Locations with increases in $PM_{2.5}$ correspond to areas of increased sulfate (see Figure 3-1). Areas with the largest reductions in $PM_{2.5}$ were the areas in California that had large reductions in modeled nitrate in 2018 (see Figure 3-2). Results for other species that contribute to $PM_{2.5}$ are available on the RMC web site at http://pah.cert.ucr.edu/aqm/308/cmaq.shtml#base18bvsplan02b.

Figure 4 compares model-reconstructed visibility for 2002 and 2018. Note that these results are calculated using the modeled relative humidity (RH), so they differ from the results that use site-specific monthly average RH. Nonetheless, the results in Figure 4 are indicative of the direction and magnitude of visibility changes in from 2002 to 2018. Although the largest improvements are in California and the Pacific Northwest, there were improvements throughout the WRAP region. The change in deciviews is more dramatic than the change in $PM_{2.5}$ mass (Figure 3) because the visibility in deciviews is a relative metric, so small mass changes in $PM_{2.5}$ in good visibility areas can result in large relative improvements in visibility.

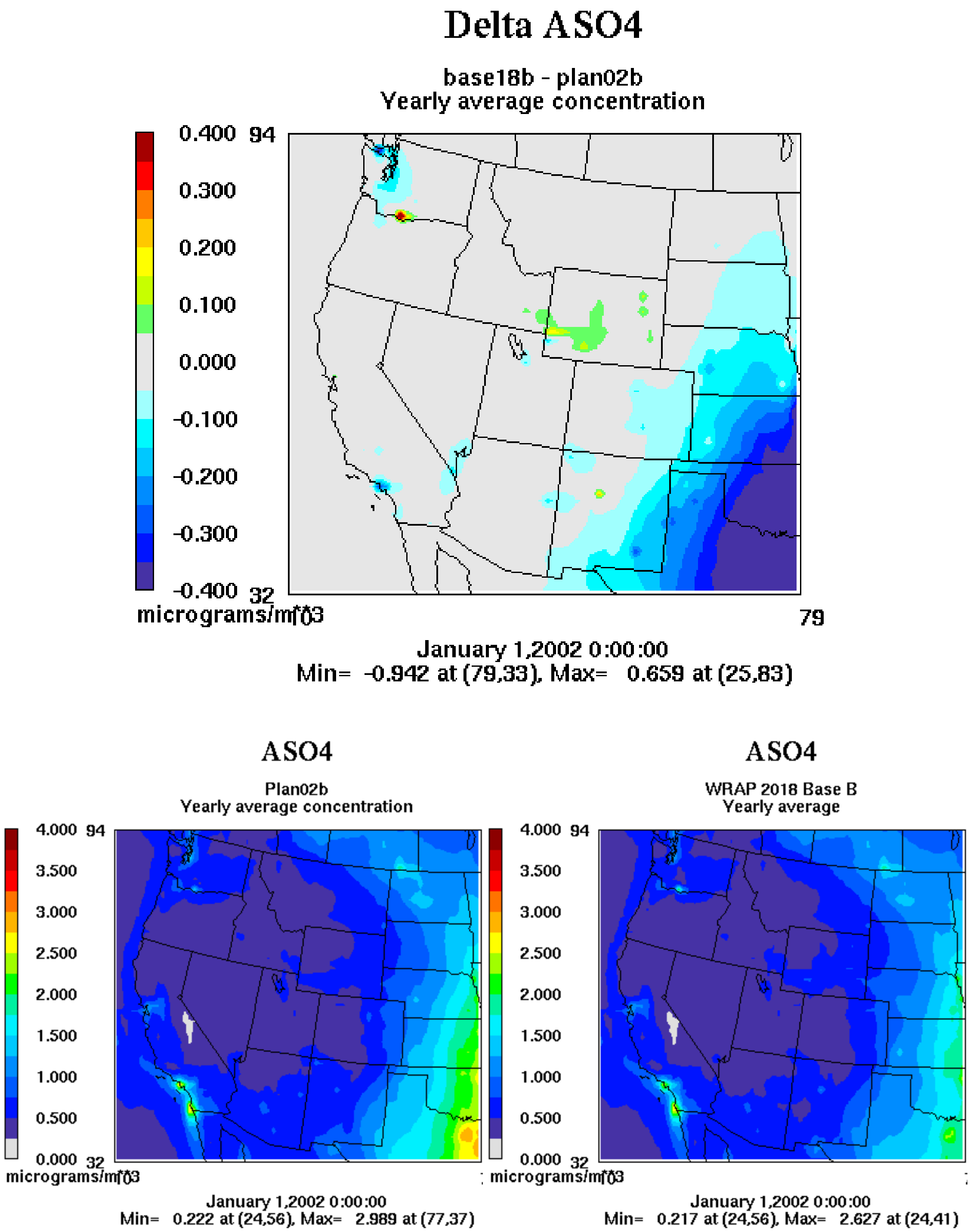


Figure 1. Annual average aerosol sulfate (ASO4) concentration comparisons between Base18b and Plan02b. Top plot: difference between the two (Base18b – Plan02b); bottom left plot: Plan02b results; bottom right plot: Base18b results.

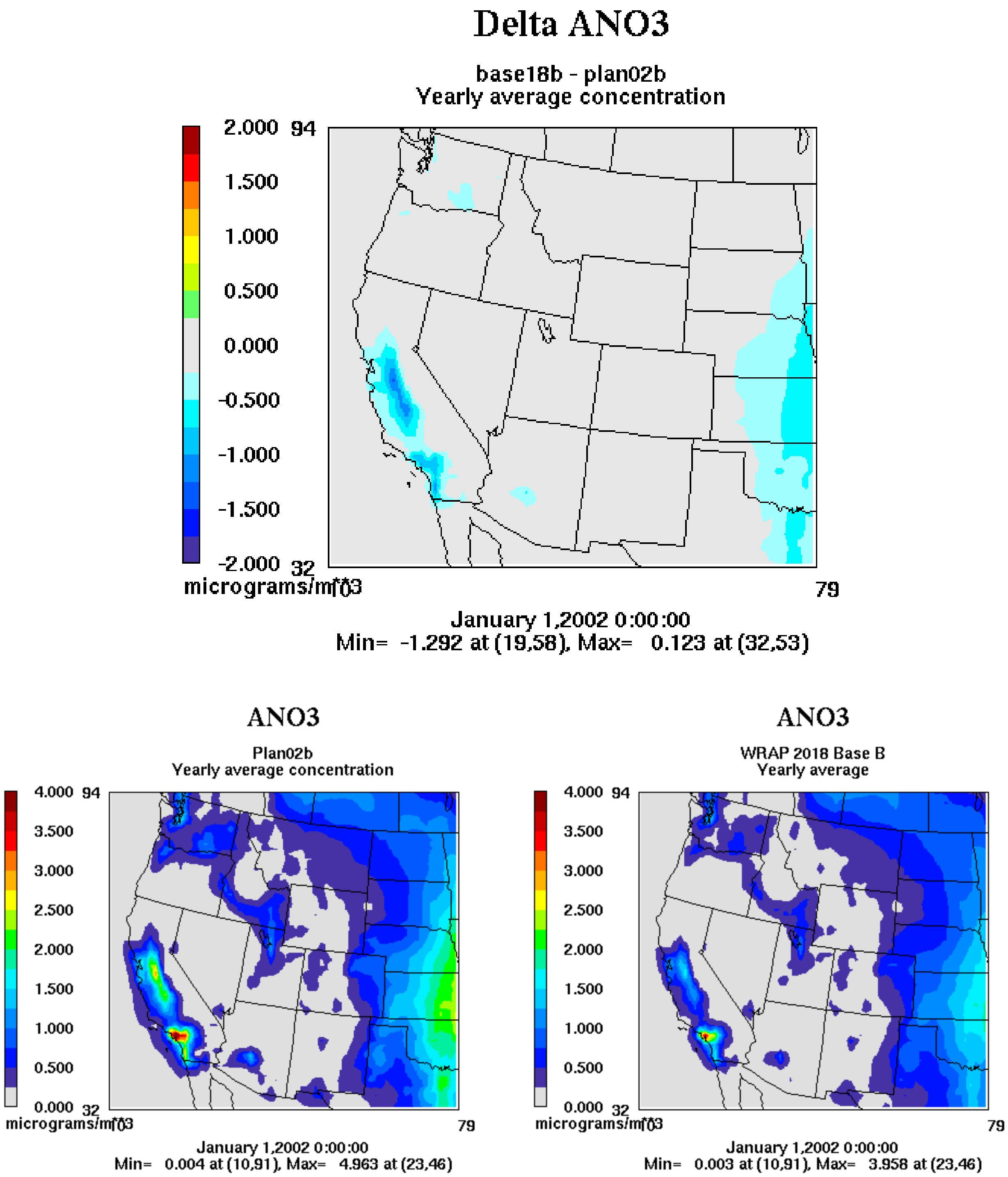


Figure 2. Annual average aerosol nitrate (ANO3) concentration comparisons between Base18b and Plan02b. Top plot: difference between the two (Base18b – Plan02b); bottom left plot: Plan02b results; bottom right plot: Base18b results.

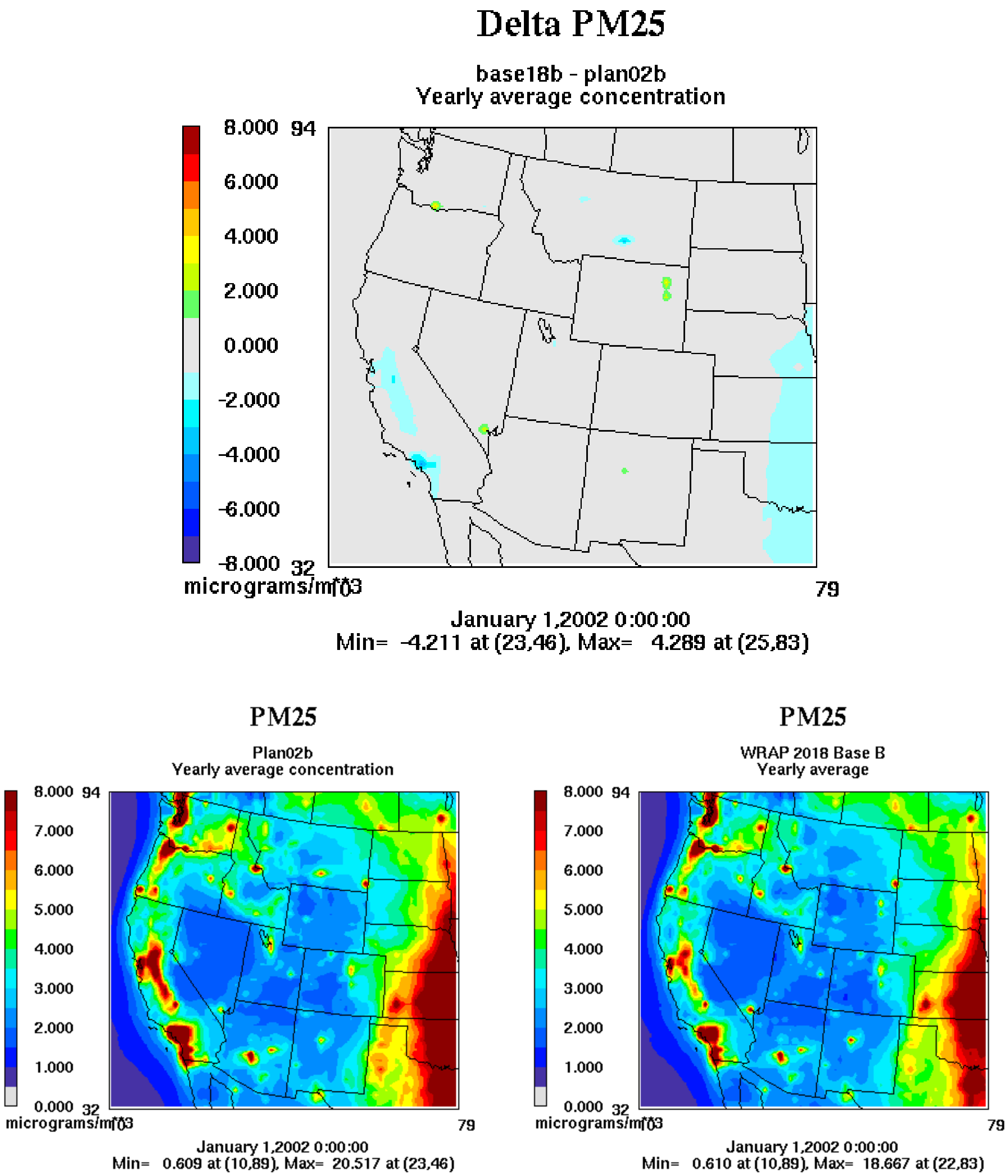


Figure 3. Annual average $PM_{2.5}$ concentration comparisons between Base18b and Plan02b. Top plot: difference between the two (Base18b – Plan02b); bottom left plot: Plan02b results; bottom right plot: Base18b results.

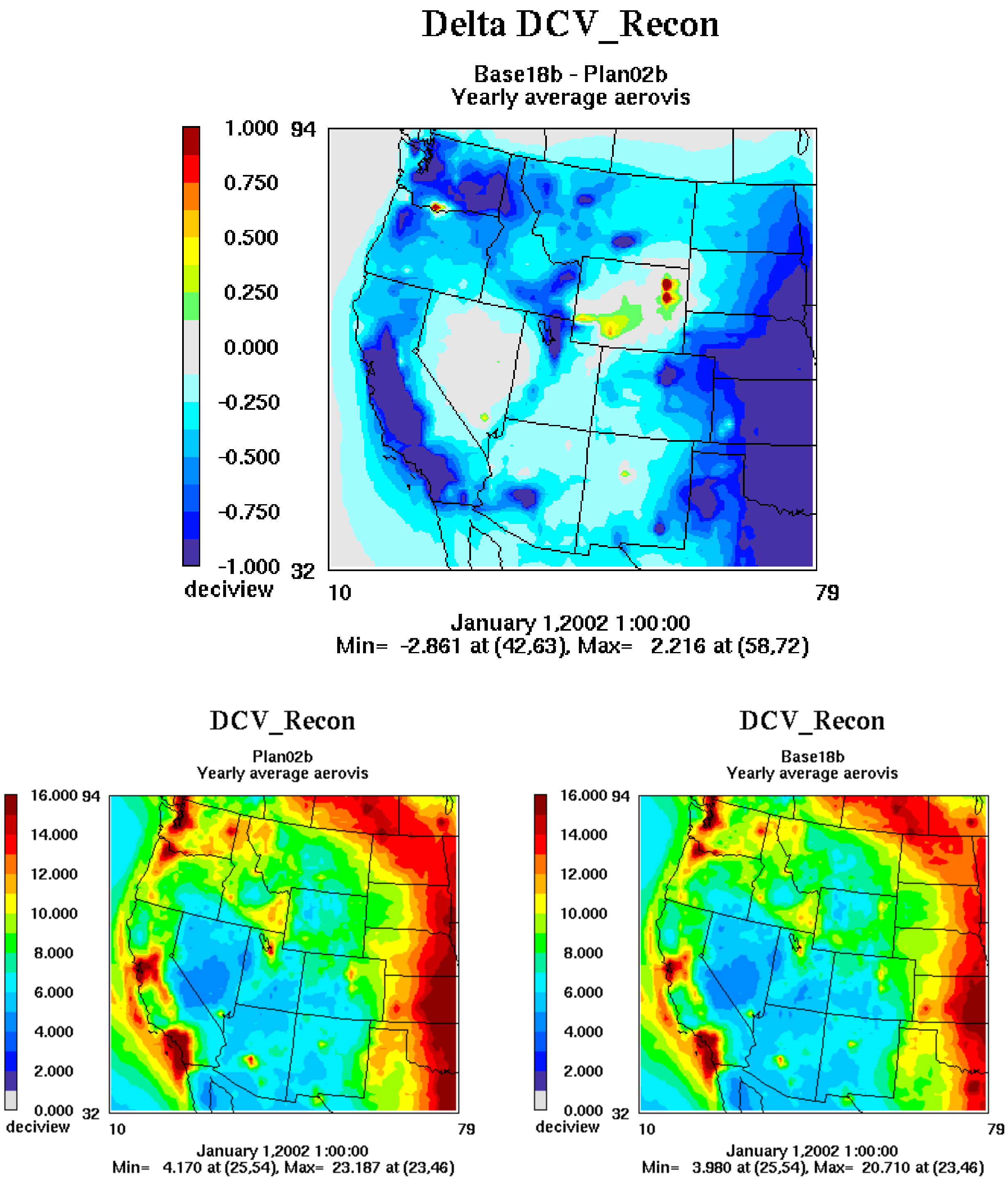


Figure 4. Annual average deciview comparisons between Base18b and Plan02b. Top plot: difference between the two (Base18b – Plan02b); bottom left plot: Plan02b results; bottom right plot: Base18b results.

Visibility Projections

The Regional Haze Rule (RHR) goals include achieving natural visibility conditions at 156 Federally mandated Class I areas by 2064. In more specific terms, that RHR goal is defined as (1) visibility improvement toward natural conditions for the 20% of days that have the worst visibility (termed "20% worst," or W20%, visibility days) and (2) no worsening in visibility for the 20% of days that have the best visibility ("20% best," or B20%, visibility days). One component of the states' demonstration to EPA that they are making reasonable progress toward this 2064 goal is the comparison of modeled visibility projections for the first milestone year of 2018 with what is termed a uniform rate of progress (URP) goal. As explained in detail below, the 2018 URP goal is obtained by constructing a "linear glide path" (in deciviews) that has at one end the observed visibility conditions during the mandated five-year (2000-2004) baseline period and at the other end natural visibility conditions in 2064; the visibility value that occurs on the glide path at year 2018 is the URP goal.

Preliminary WRAP 2018 visibility projections have been made using the Plan02c and Base18b CMAQ 36-km modeling results, following EPA guidance that recommends applying the modeling results in a relative sense to project future-year visibility conditions (U.S. EPA, 2001, 2003a, 2006**).** Projections are made using relative response factors (RRFs), which are defined as the ratio of the future-year modeling results to the current-year modeling results. The calculated RRFs are applied to the baseline observed visibility conditions to project future-year observed visibility. These projections can then be used to assess the effectiveness of the simulated emission control strategies that were included in the future-year modeling. The major features of EPA's recommended visibility projections are as follows (U.S. EPA, 2003a,b, 2006):

- Monitoring data should be used to define current air quality.
- Monitored concentrations of PM_{10} are divided into six major components; the first five are assumed to be $PM_{2.5}$ and the sixth is $PM_{2.5-10}$.
  - SO_4 (sulfate)
  - NO_3 (particulate nitrate)
  - OC (organic carbon)
  - EC (elemental carbon)
  - OF (other fine particulate or soil)
  - CM (coarse matter).
- Models are used in a relative sense to develop RRFs between future and current predicted concentrations of each component.
- Component-specific RRFs are multiplied by current monitored values to estimate future component concentrations.
- Estimates of future component concentrations are consolidated to provide an estimate of future air quality.

- Future estimated air quality is compared with the goal for regional haze to see whether the simulated control strategy would result in the goal being met.
- It is acceptable to assume that all measured sulfate is in the form of ammonium sulfate [$(NH_4)_2SO_4$] and all particulate nitrate is in the form of ammonium nitrate [NH_4NO_3].

To facilitate tracking the progress toward visibility goals, two important visibility parameters are required for each Class I area:

- *Baseline Conditions:* "Baseline Conditions" represent visibility for the B20% and W20% days for the initial five-year baseline period of the regional haze program. Baseline Conditions are calculated using monitoring data collected during the 2000-2004 five-year period and are the starting point in 2004 for the uniform rate of progress (URP) glide path to Natural Conditions in 2064 (U.S. EPA, 2003a).
- *Natural Conditions:* "Natural Conditions," the RHR goal for 2064 for the Federally mandated Class I areas, represent estimates of natural visibility conditions for the B20% and W20% days at a given Class I area.

<u>Baseline Conditions</u>

Baseline Conditions for Class I areas are calculated using fine and coarse PM concentrations measured at Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors (Malm et al., 2000). Each Class I area in the WRAP domain has an associated IMPROVE PM monitor. The IMPROVE monitors do not measure visibility directly, but instead measure speciated fine particulate ($PM_{2.5}$) and total $PM_{2.5}$ and PM_{10} mass concentrations from which visibility is calculated using the IMPROVE aerosol extinction equation, discussed later.

Visibility conditions are estimated starting with the IMPROVE 24-h average PM mass measurements related to six PM components of light extinction:

- Sulfate [$(NH_4)_2SO_4$]
- Particulate nitrate [(NH_4NO_3]
- Organic matter [OMC]
- Light-absorbing carbon [LAC] or elemental carbon [EC]
- Soil
- Coarse matter [CM]

The IMPROVE monitors do not directly measure some of these species, so assumptions are made as to how the IMPROVE measurements can be adjusted and combined to obtain these six components. For example, sulfate and particulate nitrate are assumed to be completely neutralized by ammonium and only the fine mode ($PM_{2.5}$) is speciated to obtain sulfate and nitrate measurements (that is, any coarse-mode sulfate and nitrate in the real atmosphere may

be present in the IMPROVE CM measurement). Concentrations for the above six components of light extinction in the IMPROVE aerosol extinction equation are obtained from the IMPROVE measured species using the formulas shown in Table 1.

Table 1. Definition of IMPROVE components from measured species.

IMPROVE Component	Calculation of Component from IMPROVE Measured Species
Sulfate	1.375 x (3 x S)
Nitrate	1.29 x NO_3^-
OMC	1.4 x OC
LAC	EC
Soil	(2.2 x Al) + (2.49 x Si) + (1.63 x Ca) + (2.42 x Fe) + (1.94 x Ti)
CM	MT – MF

where

- S is elemental sulfur as determined from proton-induced x-ray emissions (PIXE) analysis of the IMPROVE Module A. To estimate the mass of the sulfate ion ($SO_4^=$), S is multiplied by 3 to account for the presence of oxygen. If S is missing then the sulfate (SO_4) measured by ion chromatography analysis of Module B is used to replace (3 x S). For the IMPROVE aerosol extinction calculation, sulfate is assumed to be completely neutralized by ammonium (1.375 x SO_4).

- NO_3^- is the particulate nitrate measured by ion chromatography analysis of Module B. For the IMPROVE aerosol extinction calculation, it is assumed to be completely neutralized by ammonium (1.29 x NO_3).

- The IMPROVE organic carbon (OC) measurements are multiplied by 1.4 to obtain organic matter (OMC), which adjusts the OC mass for other elements assumed to be associated with OC.

- Elemental carbon (EC) is also referred to as light-absorbing carbon (LAC).

- Soil is determined as a sum of the masses of those elements (measured by PIXE) predominantly associated with soil (Al, Si, Ca, Fe, K, and Ti), adjusted to account for oxygen associated with the common oxide forms. Because K is also a product of the combustion of vegetation, it is represented in the formula by 0.6 x Fe and is not shown explicitly.

- MT and MF are total PM_{10} and $PM_{2.5}$ mass, respectively.

Associated with each PM species is an extinction efficiency that converts concentrations (in $\mu g/m^3$) to light extinction (in inverse megameters, Mm^{-1}), as listed below. Sulfate and nitrate are hygroscopic, so relative humidity (RH) adjustment factors, f(RH), are used to increase the

particles' extinction efficiency with increasing RH; this accounts for the particles' taking on water and having greater light scattering. Note that some organic matter (OMC) compounds may also have hygroscopic properties, but the IMPROVE aerosol extinction equation assumes OMC is nonhygroscopic.

$\beta_{Sulfate}$ = 3 x f(RH) x [sulfate]

$\beta_{Nitrate}$ = 3 x f(RH) x [nitrate]

β_{OM} = 4 x [OMC]

β_{EC} = 10 x [EC]

β_{Soil} = 1 x [soil]

β_{CM} = 0.6 x [CM]

The total light extinction (β_{ext}) is assumed to be the sum of the light extinctions due to the six PM species listed above plus Rayleigh (blue sky) background extinction (β_{Ray}), which is assumed to be 10 Mm^{-1}. This is reflected in the IMPROVE extinction equation:

$$\beta_{ext} = \beta_{Ray} + b_{Sulfate} + \beta_{Nitrate} + \beta_{EC} + \beta_{OMC} + \beta_{Soil} + \beta_{CM}$$

The total light extinction (β_{ext}) in Mm^{-1} is related to visual range (VR) in kilometers using the following relationship:

$$VR = 3912 / \beta_{ext}$$

The RHR requires that visibility be expressed in terms of a haze index (HI) in units of deciview (dv), which is calculated as follows:

$$HI = 10 \ln(\beta_{ext}/10)$$

The equations above, with measurements from the associated IMPROVE monitor, are used to estimate the daily average visibility at each Class I area for each IMPROVE monitored day. For each year from the 2000-2004 baseline period, these daily average visibility values are then ranked from highest to lowest. The "worst days" visibility for each of the five years in the baseline period is defined as the average visibility across the 20% worst-visibility days (highest deciview values); similarly, the "best days" visibility is defined as the average visibility across the 20% best-visibility days (lowest deciview values) for each year. The Baseline Conditions for the best and worst days are defined as the five-year average of the B20% visibility days and of the W20% visibility days, respectively, across the five-year baseline period.

The set of equations given above for relating measured PM species to visibility (light extinction) are referred to as the "Old IMPROVE" equation. The IMPROVE Steering Committee has developed a "New IMPROVE" equation that they believe better represents the fit between measured PM species concentrations and visibility impairment. Although conceptually similar to the Old IMPROVE equation, the New IMPROVE equation includes updates to many of the parameters and the addition of extinctions due to NO_2 absorption and sea salt. 2018 visibility projections and comparisons with the URP glide path goals were

performed using both the New and Old IMPROVE equations. The reader is referred elsewhere for details on the New IMPROVE extinction equation (e.g., EPA, 2006a,b).

Mapping Model Results to IMPROVE Measurements

As noted above, future-year visibility at Class I areas is projected by using modeling results in a relative sense to scale current observed visibility for the B20% and W20% visibility days. This scaling is done using RRFs, the ratios of future-year modeling results to current-year results. Each of the six components of light extinction in the IMPROVE reconstructed mass extinction equation is scaled separately. Because the modeled species do not exactly match up with the IMPROVE measured PM species, assumptions must be made to map the modeled PM species to the IMPROVE measured species for the purpose of projecting visibility improvements. For example, in the model's chemistry (which explicitly simulates ammonium), sulfate may or may not be fully neutralized; the IMPROVE extinction equation, on the other hand, assumes that observed sulfate is fully neutralized by ammonium. For the CMAQ v4.5 model (September 2005 release) used in the WRAP RMC modeling, the mapping of modeled species to IMPROVE measured PM species is listed in Table 2.

Table 2. Mapping of CMAQ v4.5 modeled species concentrations to IMPROVE measured components.

IMPROVE Component	CMAQ V4.3 Species
Sulfate	1.375 x (ASO4J + ASO4I)
Nitrate	1.29 x (ANO3J + ANO3I)
OMC	AORGAJ + AORGAI + AORGPAJ + AORGPAI + AORGBJ + AORGBI
LAC	AECJ + AECI
Soil	A25J + A25I
CM	ACORS + ASEAS + ASOIL

Projecting Visibility Changes Using Modeling Results

RRFs calculated from modeling results can be used to project future-year visibility. For the urrent modeling efforts, RRFs are the ratio of the 2018 modeling results to the 2002 modeling results, and are specific to each Class I area and each PM species. RRFs are applied to the Baseline Condition observed PM species levels to project future-year PM levels, which are then used with the IMPROVE extinction equation listed above to assess visibility. The following six steps are used to project future-year visibility for the B20% and W20% visibility days (the discussion below is for W20% days but also applies to B20% days):

1. For each Class I area and each monitored day, daily visibility is ranked using IMPROVE data and IMPROVE extinction equation for each year from the five-year baseline period (2000-2004) to identify the W20% visibility days for each year.

2. Use an air quality model to simulate a base-year period (ideally 2000-2004, but in reality just 2002) and a future year (e.g., 2018), then apply the resulting information to develop Class-I-area-specific RRFs for each of the six components of light extinction in the IMPROVE aerosol extinction equation.

3. Multiply the RRFs by the measured 24-h PM data for each day from the W20% days for each year from the five-year baseline period to obtain projected future-year (2018) 24-h PM concentrations for the W20% days.

4. Compute the future-year daily extinction using the IMPROVE aerosol extinction equation and the projected PM concentrations for each of the W20% days in the five-year baseline from Step 3.

5. For each of the W20% days within each year of the five-year baseline, convert the future-year daily extinction to units of deciview and average the daily deciview values within each of the five years separately to obtain five years of average deciview visibility for the W20% days.

6. Average the five years of average deciview visibility to obtain the future-year visibility Haze Index estimate that is compared with the 2018 progress goal.

In calculating the RRFs, EPA draft guidance (U.S. EPA, 2001, 2006a) recommends selecting modeled PM species concentrations "near" the monitor by taking a spatial average of PM concentrations across a grid-cell-resolution–dependent NX by NY array of cells centered on the grid containing the monitor. For the WRAP 36-km CMAQ modeling, the model estimates for just the grid cell containing the monitor are used (i.e., NX=NY=1).

For the preliminary 2018 visibility projections, results are presented only for "Method 1," which is the recommended approach in EPA's draft modeling guidance documents (U.S. EPA, 2001, 2006a). In the Method 1 Average RRF Approach, an average RRF for the W20% days from 2002 (Modeled Worst Days) is obtained for the Plan02c and the Base18b CMAQ simulations by averaging the PM concentration components across the Modeled Worst Days and then calculating the (future year):(base year) ratio of the average PM concentrations. For example, if $SO4_{i,j}$ is the measured sulfate concentrations at Class I area *j* for the *i*=1,…,*N* 20% worst visibility days in 2002, then the RRF for sulfate on the W20% days would be obtained as:

$$RRF_j(SO4) = \frac{\frac{1}{N}\sum_{i=1}^{N} SO4_{ij}(2018)}{\frac{1}{N}\sum_{i=1}^{N} SO4_{ij}(2002)} = \frac{\sum_{i=1}^{N} SO4_{ij}(2018)}{\sum_{i=1}^{N} SO4_{ij}(2002)}$$

For each Class I area and each of the W20% days, the average RRF for each PM component would be applied to concentrations for the W20% days from the 2000-2004 baseline period to estimate future-year PM concentrations for each of the W20% days. Extinction and HI would then be calculated to obtain the projected future-year visibility conditions using the procedures given previously.

<u>Glide Path to Natural Conditions</u>

The presumptive visibility target for 2018 is the URP goal that is obtained by constructing a linear glide path from the current Baseline Conditions to Natural Conditions in 2064 (both expressed in deciviews). For instance, Figure 5 displays an example visibility glide path for the Grand Canyon National Park (GRCA) Class I area. EPA's default Natural Conditions value for the W20% days (U.S. EPA, 2003b), shown as the green line, is the 2064 visibility goal at GRCA of 6.95 dv. The blue diamonds at the left of the plot are the annual average current conditions, based on IMPROVE observations for the W20% days as obtained from the Visibility Information Exchange Web System (VIEWS) web site (http://vista.cira.colostate.edu/views/). These annual average visibility values for the 20% worst days allow an assessment of trends and the year-to-year variation in visibility. The Baseline Conditions are the average of the W20% visibility from 2000-2004, which is the starting point for the glide path in 2004 (12.04 dv for GRCA). A linear URP from the Baseline Conditions in 2004 to Natural Conditions in 2064 (sloping pink line with triangles) is assumed, and the value on the glide path at 2018 is the presumptive URP visibility target that the modeled 2018 projections are compared against to judge progress. In this example, the visibility progress goal in 2018 would be 10.85 dv. Meeting this would require a 1.19 dv reduction in visibility by 2018 to meet that milestone year's visibility progress target at the Grand Canyon National Park.

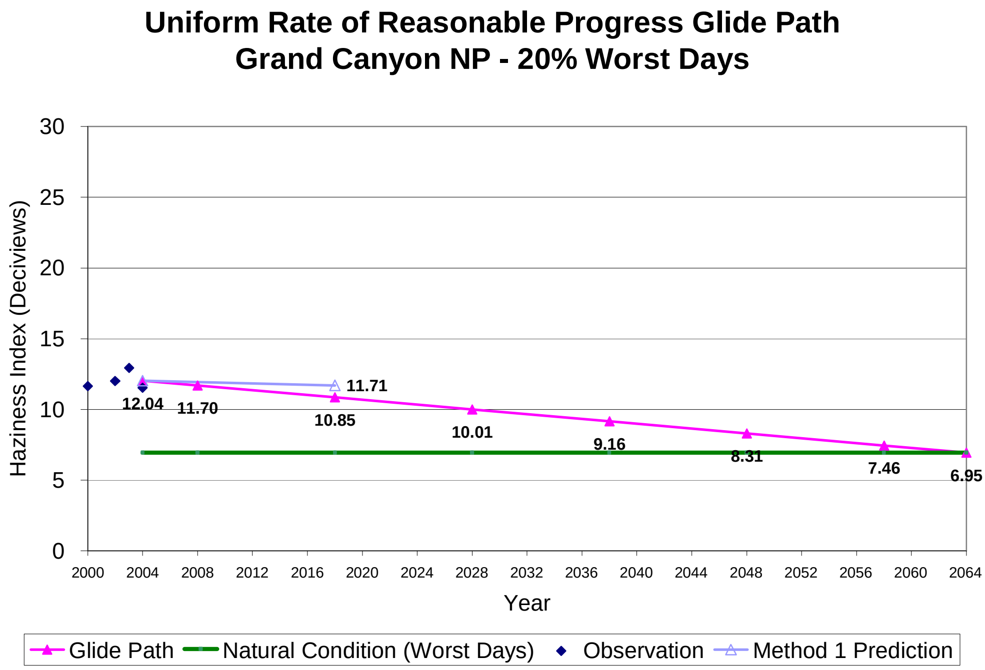
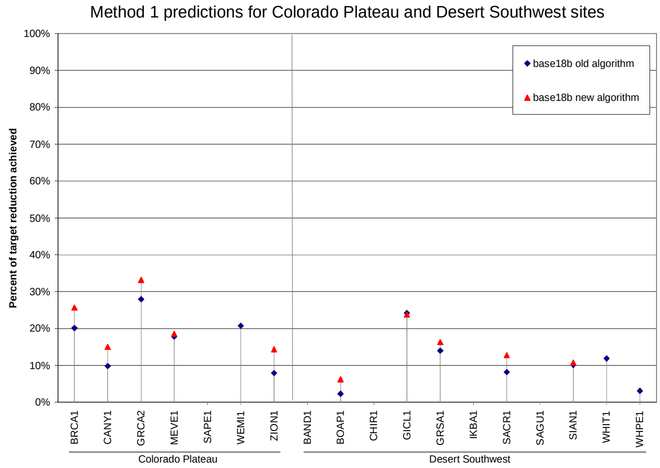
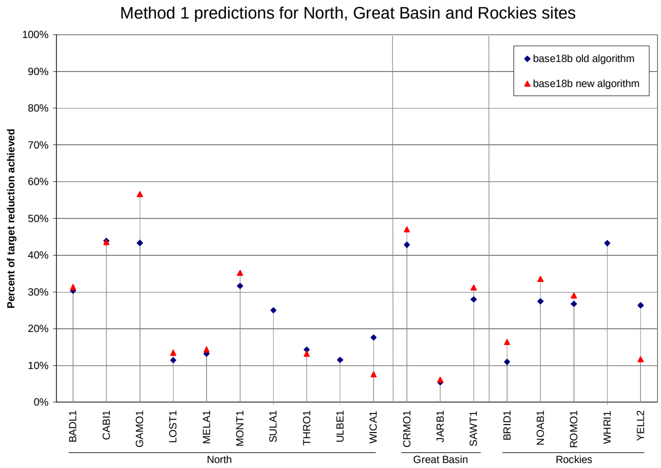


Figure 5. Example of URP glide path using IMPROVE data from the Grand Canyon National Park for the W20% days and comparison with Base18b visibility projections.

Preliminary Visibility Projection Results

For all of the WRAP Class I areas, the RMC performed preliminary 2018 visibility projections and compared them to the 2018 URP goals using the Plan02c and Base18b CMAQ modeling results and the Old and New IMPROVE equations. As an example, Figure 5 above compares the Base18b visibility projections with the URP goal based on the glide path for GRCA and the Old IMPROVE equation. To achieve the 2018 URP goal, the modeled 2018 visibility projection would have to show a 1.19 dv (=12.04-10.85) reduction. However, the modeled 2018 visibility projection shows only a 0.33 dv (=12.04-11.71) reduction by 2018, which indicates that the emission controls simulated in case Base18b would not achieve the modeled URP goal; the 2018 visibility projection achieves only 28% of the goal (28% = 100 x 0.33/1.19). Figure 6 displays the 2018 visibility projections for all WRAP Class I areas, using both the Old and New IMPROVE equations, expressed as a percentage of achieving the URP goal, with values of 100% or greater achieving the goal. Using the procedures outlined above, none of the WRAP Class I areas are projected to achieve their URP goals. There are various reasons for this, such as the presence of W20% days that are dominated by emissions from sources that are not controllable, such as wildfires, dust, and/or international transport. Additional analysis of these results and alternative projection techniques are currently under study.





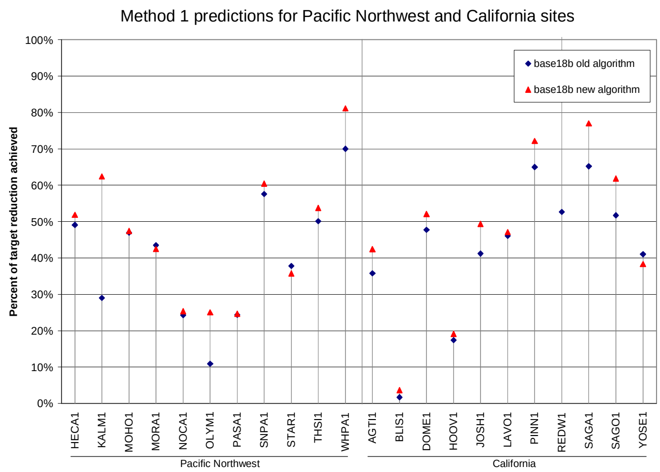


Figure 6. 2018 visibility projections at WRAP Class I areas expressed as a percent of achieving the 2018 URP goal using the Old and New IMPROVE equation and the WRAP Base18c CMAQ 36-km modeling results.

PM Source Apportionment

Impairment of visibility in Class I areas is caused by a combination of local air pollutants and regional pollutants that are transported long distances. To develop effective visibility improvement strategies, the WRAP member states and tribes need to know the relative contributions of local and transported pollutants, and which emissions sources are significant contributors to visibility impairment at a given Class I area.

A variety of modeling and data analysis methods can be used to perform source apportionment of the PM observed at a given receptor site. Model sensitivity simulations have been used in which a "base case" model simulation is performed and then a particular source is "zeroed out" of the emissions. The importance of that source is assessed by evaluating the change in pollutants at the receptor site, calculated as pollutant concentration in the sensitivity case minus that in the base case. This approach is known as a "brute force" sensitivity because a separate model run is required for each sensitivity.

An alternative approach is to implement a mass-tracking algorithm in the air quality model to explicitly track for a given emissions source the chemical transformations, transport, and removal of the PM that was formed from that source. Mass tracking methods have been implemented in both the CMAQ and CAMx air quality models. Initial work completed by the RMC during 2004 used the CMAQ Tagged Species Source Apportionment (TSSA) method. Unfortunately, there were problems with mass conservation in the version of CMAQ used in that study, and these affected the TSSA results. A similar algorithm has been implemented in CAMx, the PM Source Apportionment Technology (PSAT). Comparisons of TSSA and PSAT showed that the results were qualitatively similar, that is, the relative ranking of the most significant source contributors were similar for the two methods. However, the total mass contributions differed. With separate funding from EPA, UCR has implemented a version of TSSA in the new CMAQ release (v4.5) that corrects the mass conservation error, but given the uncertainty of the availability of this update, the CAMx/PSAT source apportionment method was used for the WRAP modeling analysis.

The main objective of applying CAMx/PSAT is to evaluate the regional haze air quality for typical 2002 (Plan02c) and future-year 2018 (Base18b) conditions. These results are used

- to assess the contributions of different geographic source regions (e.g., states) and source categories to current (2002) and future (2018) visibility impairment at Class I areas, to obtain improved understanding of (1) the causes of the impairment and (2) which states are included in the area of influence (AOI) of a given Class I area; and

- to identify the source regions and emissions categories that, if controlled, would produce the greatest visibility improvements at a Class I area.

<u>CAMx/PSAT</u>

The PM Source Apportionment Technology performs source apportionment based on user-defined source groups. A source group is the combination of a geographic source region and an emissions source category. Examples of source regions include states, nonattainment areas, and counties. Examples of source categories include mobile sources, biogenic sources,

and elevated point sources; PSAT can even focus on individual sources. The user defines a geographic source region map to specify the source regions of interest. He or she then inputs each source category as separate, gridded low-level emissions and/or elevated-point-source emissions. The model then determines each source group by overlaying the source categories on the source region map. For further information, please refer to the white paper on the features and capabilities of PSAT (http://pah.cert.ucr.edu/aqm/308/reports/PSAT_White_Paper_111405_final_draft1.pdf), with additional details available in the CAMx user's guide (ENVIRON, 2005; http://www.camx.com).

PM source apportionment modeling was performed for aerosol sulfate (SO_4) and aerosol nitrate (NO_3) and their related species (e.g., SO_2, NO, NO_2, HNO_3, NH_3, and NH_4). The PSAT simulations include 9 tracers, 18 source regions, and 6 source groups. The computational cost for each of these species differs because additional tracers must be used to track chemical conversions of precursors to the secondary PM species SO_4, NO_3, NH_4, and secondary organic aerosols (SOA). Table 3 summarizes the computer run time required for each species. The practical implication of this table for WRAP is that it is much more expensive to perform PSAT simulations for NO_3 and especially for SOA than it is to perform simulations for other species.

Table 3. Benchmarks for PSAT computational costs for each PM species. Run time is for one day (01/02/2002) on the WRAP 36-km domain.

Species	No. of Species Tracers	RAM Memory	Disk Storage per Day	Run Time with 1 CPU
SO_4	2	1.6 GB	1.1 GB	4.7 h/day
NO_3	7	1.7 GB	2.6 GB	13.2 h/day
SO_4 and NO_3 combined	9	1.9 GB	3.3 GB	16.8 h/day
SOA	14	6.8 GB	Not tested	Not tested
Primary PM species	6	1.5 GB	3.0 GB	10.8 h/day

Two annual 36-km CAMx/PSAT model simulations were performed: one with the Plan02c typical-year baseline case and the other with the Base18b future-year case. It is expected that the states and tribes will use these results to assess the sources that contribute to visibility impairment at each Class I Area, and to guide the choice of emission control strategies. The RMC web site includes a full set of source apportionment spatial plots and receptor bar plots for both Plan02b and Base18b. These graphical displays of the PSAT results, as well as additional analyses of these results are available on the TSS under http://vista.cira.colostate.edu/tss/Tools/ResultsSA.aspx

CAMx/PSAT 2002 and 2018 Setup

PSAT source apportionment simulations for 2002 and 2018 were performed using CAMx v4.30. Table 4 lists overall specifications for the 2002 PSAT simulations. The domain setup was identical to the standard WRAP CMAQ modeling domain. The CAMx/PSAT run-time options are shown in Table 5. The CAMx/PSAT computational cost for one simulation day with source tracking for sulfate (SO_4) and nitrate (NO_3) is approximately 14.5 CPU hours with an AMD Opteron CPU. The source regions used in the PSAT simulations are shown in Figure 7 and Table 4. The six emissions source groups are described in Table 6. The development of these emissions data are described in more detail below.

The annual PSAT run was divided into four seasons for modeling. The initial conditions for the first season (January 1 to March 31, 2002) came from a CENRAP annual simulation. For the other three seasons, we allowed 15 model spin-up days prior to the beginning of each season. Based on the chosen set of source regions and groups, with nine tracers, and with a minimum requirement of 87,000 point sources and a horizontal domain of 148 by 112 grid cells with 19 vertical layers, the run-time memory requirement is 1.9 GB. Total disk storage per day is approximately 3.3 GB. Although the RMC's computation nodes are equipped with dual Opteron CPUs with 2 GB of RAM and 1 GB of swap space, the high run-time memory requirements prevented running PSAT simulations using the OpenMP shared memory multiprocessing capability implemented in CAMx.

Table 4. WRAP 2002 CAMx/PSAT specifications.

WRAP PSAT Specs	Description
Model	CAMx v4.30
OS/compiler	Linux, pgf90 v.6.0-5
CPU type	AMD Opteron with 2 GB of RAM
Source region	18 source regions; see Figure 4.1 and Table 4.4
Emissions source groups	Plan02b, 6 source groups; see Table 4.5
Initial conditions	From CENRAP (camx.v4.30.cenrap36.omp.2001365.inst.2)
Boundary conditions	3-h BC from GEOS-Chem v2

Table 5. WRAP CAMx/PSAT run-time options.

WRAP PSAT specs	Description
Advection solver	PPM
Chemistry parameters	CAMx4.3.chemparam.4_CF
Chemistry solver	CMC
Plume-in-grid	Not used

WRAP PSAT specs	Description
Probing tool	PSAT
Dry/wet deposition	TRUE (turned on)
Staggered winds	TRUE (turned on)

Table 6. WRAP CAMx/PSAT source regions cross-reference table.

Source Region ID	Source Region Description[1]	Source Region ID	Source Region Description[1]
1	Arizona (AZ)	10	South Dakota (SD)
2	California (CA)	11	Utah (UT)
3	Colorado (CO)	12	Washington (WA)
4	Idaho (ID)	13	Wyoming (WY)
5	Montana (MT)	14	Pacific off-shore & Sea of Cortez (OF)
6	Nevada (NV)	15	CENRAP states (CE)
7	New Mexico (NM)	16	Eastern U.S., Gulf of Mexico, & Atlantic Ocean (EA)
8	North Dakota (ND)	17	Mexico (MX)
9	Oregon (OR)	18	Canada (CN)

[1]The abbreviations in parentheses are used to identify source regions in PSAT receptor bar plots.

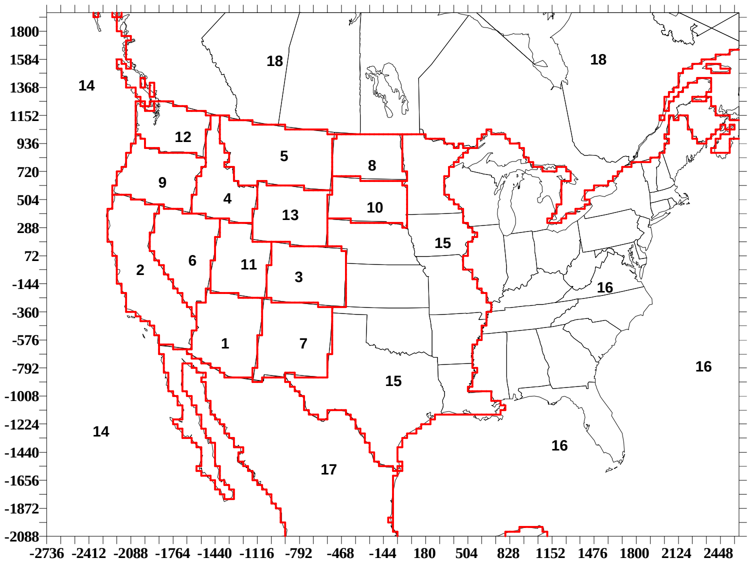


Figure 7. WRAP CAMx/PSAT source region map. Table 6 defines the source region IDs.

Table 7. WRAP CAMx/PSAT emissions source groups.

Emissions Source Groups	Low-level Sources	Elevated Sources
1	Low-level point sources (including stationary off-shore)	Elevated point sources (including stationary off-shore)
2	Anthropogenic wildfires (WRAP only)	Anthropogenic wild fires (WRAP only)
3	Total mobile (on-road, off-road, including planes, trains, ships in/near port, off-shore shipping)	
4	Natural emissions (natural fire, WRAP only, biogenics)	Natural emissions (natural fire, WRAP only, biogenics)
5	Non-WRAP wildfires (elevated fire sources in other RPOs)	Non-WRAP wild fires (elevated fire sources in other RPOs)
6	Everything else (area sources, all dust, fugitive ammonia, non-elevated fire sources in other RPOs)	

PSAT Results

The source apportionment algorithms implemented in CAMx generate output files in the same format as the standard modeled species concentrations files. This typically consists of a two-dimensional, gridded dataset of hourly-average surface concentrations for each source group tracer that gives the contribution of the tracer to all the surface grid cells in the model domain for each hour of the simulation. Three-dimensional instantaneous concentrations are also output for the last two hours of the simulation, which are used to restart the model. Although there are options to output hourly 3-D average tracer concentrations, the model is usually configures to output only the model's surface layer concentrations because of the vast disk storage space needed for the 3-D file output for all the source group contributions.

The source apportionment model results are typically presented in two ways :

- *Spatial plots* showing the area of influence of a source group's PM species contributions throughout the model domain, either at a given hourly-average point in time or averaged over some time interval (e.g., monthly average).
- *Receptor bar plots* showing the rank order of source groupings that contribute to PM species at any given receptor site. These plots also can be at a particular point in time or averaged over selected time intervals—for example, the average source contributions for the 20% worst visibility days.

If the 3-D tracer output files are saved, it is also possible to prepare animations of PM species plumes from each of the source groups. However, these plots are less useful than the others for quantitative analysis, are expensive to produce, and require saving 3-D hourly output, which is disk-space intensive. The primary products of the WRAP PSAT modeling were receptor bar plots showing the emission source groups that contribute the most to the model grid cells containing each IMPROVE monitoring site and other receptor sites identified by WRAP.

Model Sensitivity Simulations

A variety of sensitivity simulations were conducted by the RMC as part of their modeling efforts to support the WRAP in addressing the Regional Haze Rule requirements. These sensitivity simulations are described below.

2002 Clean Case

There are many natural sources of ambient $PM_{2.5}$, both direct emissions of primary $PM_{2.5}$ (such as windblown dust) and emissions of gaseous species that undergo photochemical transformation or condensation to form secondary $PM_{2.5}$. Natural sources of $PM_{2.5}$ are of concern because they represent sources that cannot be controlled. Estimates of natural haze levels have been developed by EPA for visibility planning purposes and are described in *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (U.S. EPA, 2003a). These are the natural haze levels to be used in glide path calculations, such as those we performed as part of the visibility projections for 2018. However, the natural haze levels developed by EPA for glide path calculations were based on ambient data analysis, not on visibility modeling. This question thus arises: Would modeled levels of natural haze be consistent with the values estimated by EPA for visibility planning? If the natural haze levels calculated by the model were substantially higher than the levels used for planning purposes, this would make it more difficult for modeling studies to demonstrate progress in attaining visibility goals, because the model would predict haze levels that exceeded EPA's natural haze levels even if all anthropogenic sources of $PM_{2.5}$ were removed from the modeling. The RMC explored this issue by conducting a CMAQ sensitivity "clean conditions" simulation

There are many uncertainties and unknowns regarding natural emissions. There have been only limited studies of natural emissions conditions. It is known that there are very large uncertainties in the categories of natural emissions included in the WRAP emissions inventories, and that some categories of natural emissions are not included at all. Also, it is difficult to know what truly natural emissions would have been like in the absence of human modifications of the environment. For example, wildfire emissions are a large source of natural emissions in our modeling, but how much larger might that source be in the absence of fire suppression efforts? For all of these reasons, it was decided to describe this sensitivity simulation as a "clean conditions" scenario rather than a "natural conditions" scenario. In this simulation, all anthropogenic emissions were removed from the inventory and only those emissions that were defined as biogenic in the 2002 base case (Base02) were included. Thus, this model simulation does not represent true natural conditions. It indicates instead the lowest haze levels that could be achieved in the model if all anthropogenic emissions were zeroed out.

Emission Inventories

The emissions for the clean 2002 sensitivity case were derived from case Base02a. Because it was a sensitivity analysis to test the impacts of natural emissions sources on visibility, it is referred to it as scenario Base02nt, where "nt" refers to natural. The following emissions categories in Base02nt were included:

- *Biogenics:* Generated in case Base02a by BEIS3.12 using SMOKE.

- *WRAP Ammonia:* The Base02a ammonia emissions for the WRAP region were developed with a GIS by ENVIRON. The five emissions category modeled included three anthropogenic sources (domestic animals, livestock, and fertilizer application) and two natural sources (soils and wildlife). Only the two natural sources in scenario Base02nt were used.

- *CENRAP and MRPO Ammonia:* To create ammonia inventory files for only natural sources, we used a list of SCCs representing natural sources to extract the emissions records of these sources from the monthly inventory files that were used in Base02a. it was found that there were no natural ammonia sources in the MRPO monthly inventory files.

- *Natural Area Sources:* The Base02a area-source inventory files included natural sources, such as wildfires and wild animals. These records were extracted from the stationary-area-source inventories. Note that the WRAP area-source files did not include any natural sources.

- *Natural Fires:* Of the five fire categories modeled in Base02a (wildfires, wildland fire use, non-Federal rangeland prescribed fires, prescribed fires [which were split into natural and anthropogenic prescribed for this purpose of this sensitivity], and agricultural fires), only the categories that represent natural fires (wildfires, wildland fire use, and natural prescribed fires) were included.

- *Windblown Dust:* We used the windblown dust inventory that ENVIRON and the RMC developed for use in case Base02a. Additional details on this dust inventory are available at http://www.cert.ucr.edu/aqm/308/wb_dust2002/wb_dust_ii_36k.shtml.

The biogenic and windblown dust emissions from the Base02a SMOKE outputs that are stored at the RMC were used directly. For the fire (including both point and area fires), natural area, and ammonia emissions, these data were reprocessed specifically for scenario Base02nt using the same ancillary data (temporal, chemical, and spatial allocation data) used in case Base02a. QA plots and documentation for scenario Base02nt are posted on the RMC web site at http://pah.cert.ucr.edu/aqm/308/qa_Base02nt36.shtml.

Modeling Results

Figure 8 shows the model-reconstructed light extinction in the clean emissions model simulation. Because the natural fire emissions in the WRAP states were a major component of the clean emissions, the largest visibility impairment is in the regions with natural fire emissions. Contributions to light extinction from natural sources were small in regions without large fire emissions, as evidenced in the eastern U.S., where the extinction was only slightly larger (about 2 Mm^{-1}) than perfectly clean Rayleigh conditions of 10 Mm^{-1}.

Although there are large uncertainties in the natural emissions, and it is known that there are missing types of natural emissions, the components of the natural inventory used in this sensitivity simulation did contribute to relatively large visibility impairment in regions where there were large wildfires. Extinction coefficients as large as 90 Mm^{-1} were simulated in the southern Oregon and northern California regions; this was most likely a result of the large Biscuit fire in Oregon, plus contributions from smaller fires and other natural emissions.

These visibility impairment levels exceed the natural visibility levels specified in the EPA regional haze natural visibility guidance document. It will thus be more difficult for the modeling to demonstrate attainment of progress goals in areas of the country subject to wildfires because of their large contribution to visibility impairment that is not controllable. In other regions of the country for which the inventories lacked large natural fire emissions, the modeled clean visibility was only slightly greater than clean Rayleigh conditions. Note the model results may be overly optimistic in these regions because we lack a complete, accurate natural emissions inventory.

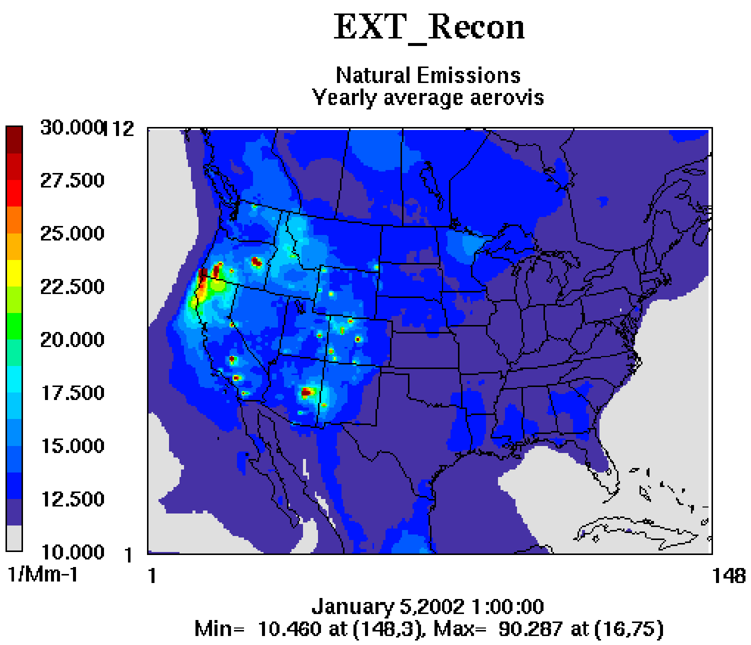


Figure 8. Annual average model-reconstructed "clean conditions" visibility as extinction coefficient.

These results are all very tentative because of the large uncertainties in natural emissions. Considerable effort would be needed to more fully investigate natural conditions in future modeling studies. It will always be difficult to determine and quantify "clean conditions" based on observations because of the pervasive influence of anthropogenic emissions.

Also as part of this sensitivity analysis, the contributors to organic carbon aerosols (OC) for the clean conditions scenario wer4e evaluated. The CMAQ model represents explicitly three classes of organic carbon aerosols:

- *AORGPA:* Primary anthropogenic OC resulting from direct organic mass emissions, such as primary organic aerosol (POA).
- *AORGA:* Secondary anthropogenic OC resulting from aromatic VOCs, such as xylene, toluene, and cresols.

- *AORGB:* Secondary biogenic OC resulting from biogenic VOCs, such as terpenes.

Because it was not cost effective to carry out CAMx/PSAT simulations with OC, the explicit OC results for the clean conditions case were analyzed, and then compared those results to the Base02b case in an attempt to infer the relative contributions of biogenic and anthropogenic VOCs to OC. These results are difficult to interpret for at least two reasons:

- Because of the simplified approach used by CMAQ and the Carbon Bond Mechanism version 4 (CB4) to represent these species, it is not possible to accurately classify all emissions into the CMAQ model as either biogenic or anthropogenic based simply on the species name. Thus, some biogenic OC might be included with AORGA, and some anthropogenic OC might be included in AORB.

- Some fire emissions are classified as anthropogenic, but these emissions might include species such as terpenes that are typically considered biogenic. Using the analysis approach in which all terpenes are assumed biogenic then incorrectly causes some anthropogenic emissions to be labeled biogenic when we use the simplified approach of analyzing OC in terms of AORGPA, AORGA and AORGB.

In spite of these difficulties, however, the results should classify the majority of the emissions correctly as either biogenic or anthropogenic.

For each of the above three components of OC, plots of the annual average mass in the Base02b case were prepared, and then the controllable mass was estimated as the difference between the Base02b case the Base02nt clean emissions scenario. Figure 9 shows the annual average mass of OC contributed from AORGPA in case Base02b (top) and the portion of that mass attributed to controllable emissions (bottom). Comparing these two plots indicates that in the western U.S. there is considerable AORGPA mass that is not controllable. It is likely that much of this mass is from fires, since uncontrollable AORGPA mass is present at the site of large fires in southern Oregon and north of Tucson, AZ.

Figure 10 shows the annual average mass of secondary OC contributed from AORGA in the Base02b case (top) and the portion of that mass attributed to controllable emissions (bottom). These plots indicate that virtually all of the AORGA mass is controllable, since the bottom plot is almost identical to the top plot.

Figure 11 shows the annual average mass of OC contributed from AORGPA in the Base02b case (top) and the portion of that mass attributed to controllable emissions (bottom). These plots indicate that although most of the AORGB mass is not controllable, a significant amount of mass is controllable. It is likely that the controllable AORGB mass results from VOC oxidation chemistry and the larger amount of biogenic mass that is oxidized and subsequently condenses to form OC in the Base02b case. These results indicate that controlling O_3 precursor emissions is effective at reducing a small but significant fraction of the biogenic OC.

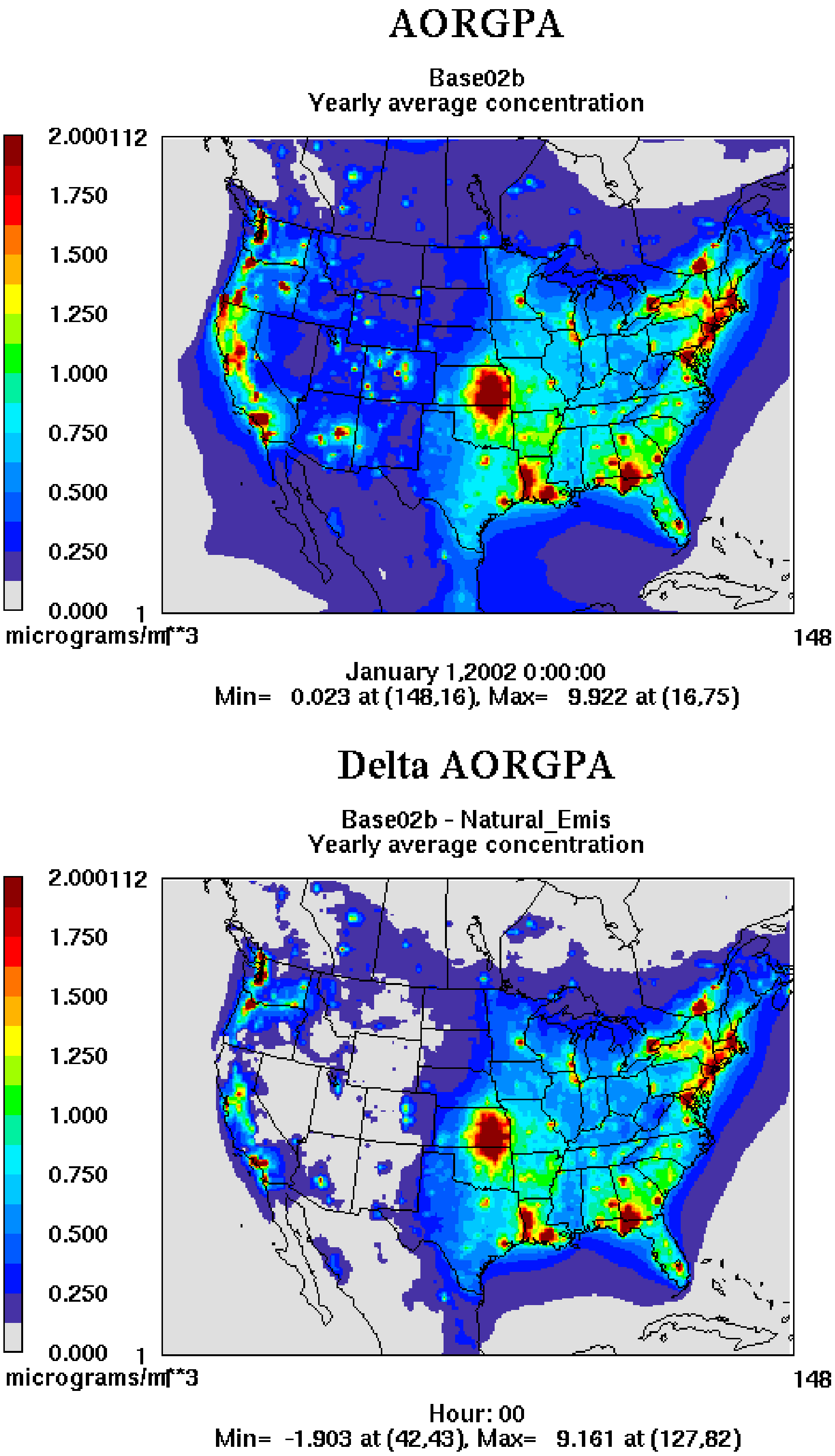
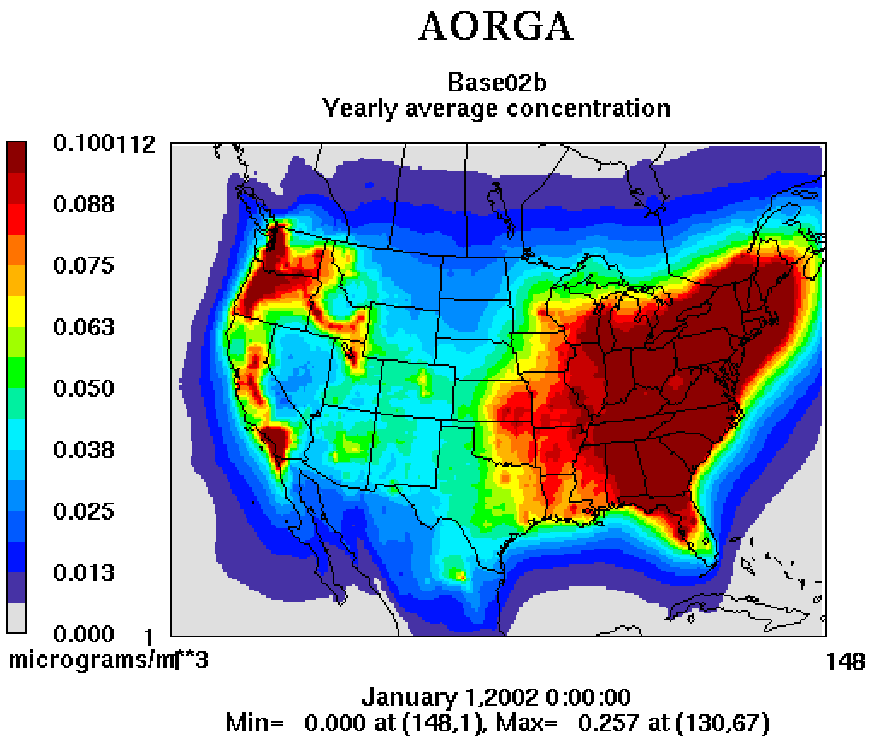


Figure 9. Annual average modeled primary anthropogenic OC (AORGPA) in Base02b (top) and the portion that is "controllable" primary anthropogenic OC (bottom).



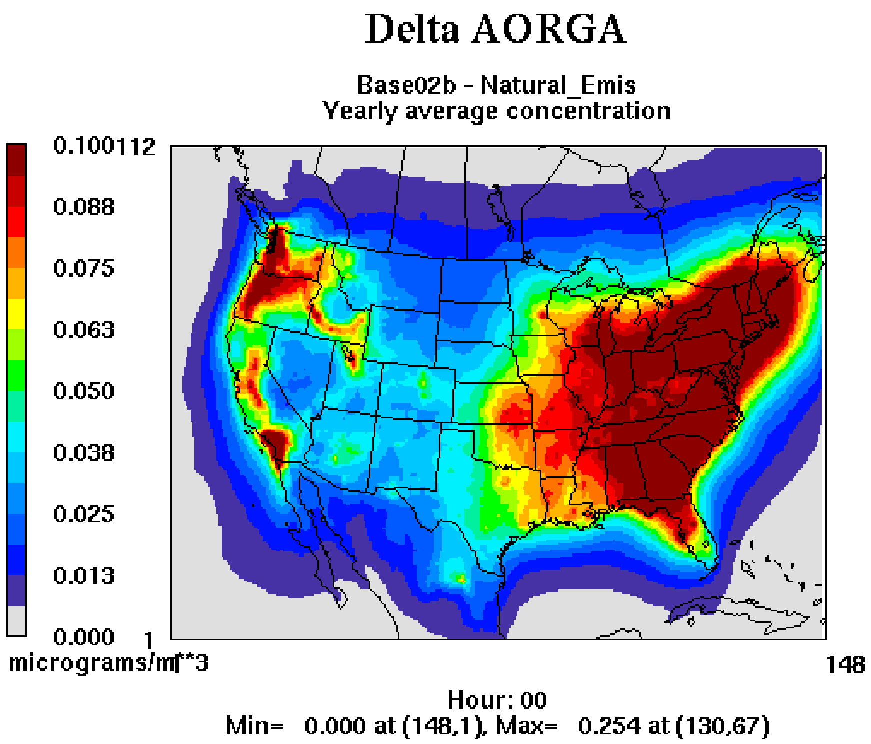


Figure 10. Annual average modeled secondary anthropogenic OC (AORGA) in Base02b (top) and the portion that is "controllable" secondary anthropogenic OC (bottom).

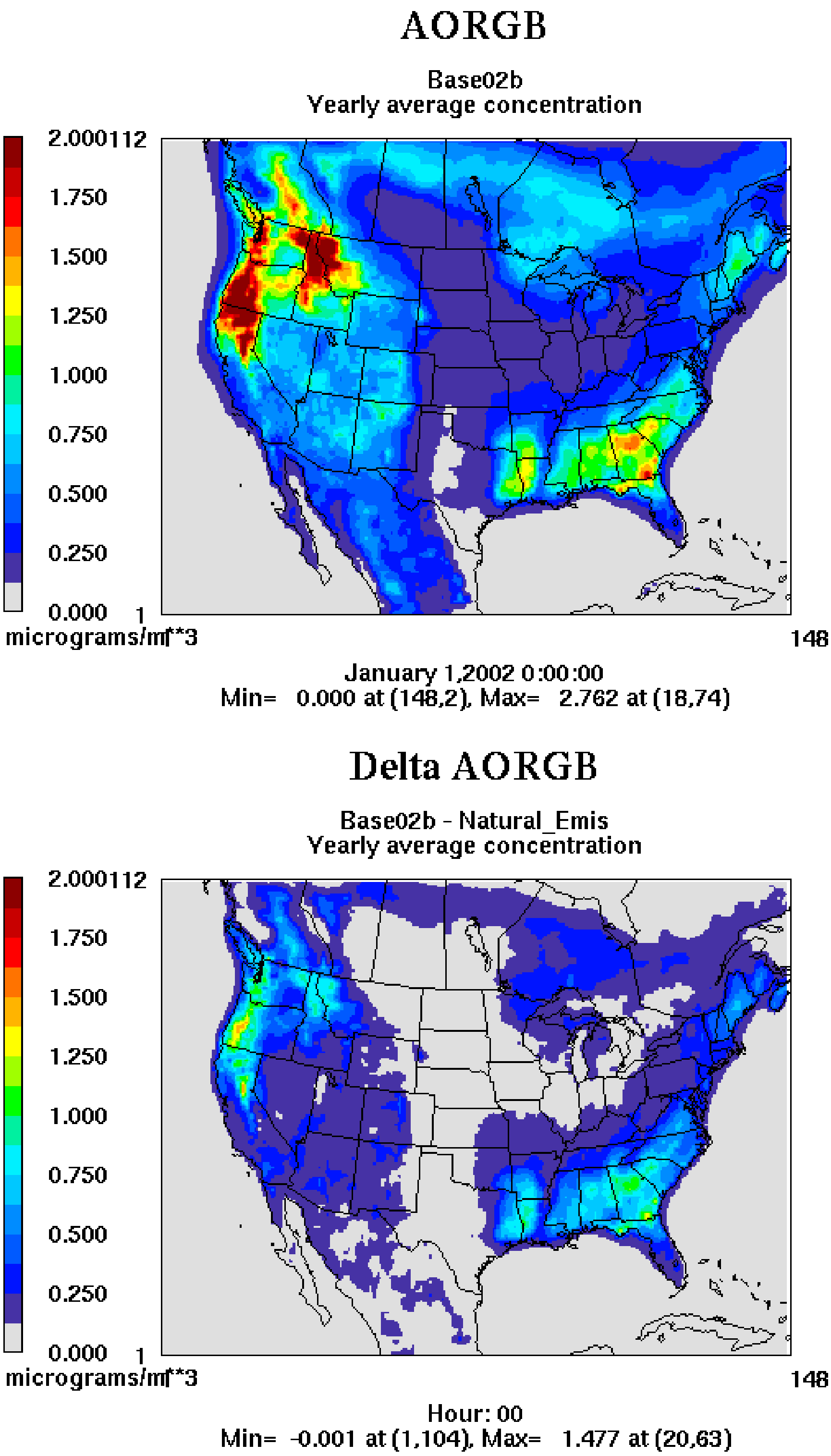


Figure 11. Annual average modeled primary biogenic OC (AORGB) in Base02b (top) and the portion that is "controllable" primary biogenic OC (bottom).

It might be difficult for the WRAP states and tribes to use these results quantitatively in developing emissions control strategies for visibility SIPs and TIPs. However, the results do provide some insight into the relative contributions of biogenic and anthropogenic OC as well as the amount of each that is controllable in the model simulations.

Finally, it is noted that there are uncertainties in the modeled emissions of anthropogenic VOCs, and larger uncertainties in the modeled emissions of biogenic VOCs. It is not possible to evaluate the model performance individually for biogenic and anthropogenic OC because the OC measurements do not distinguish between those two forms. Instead, only comparisons of total modeled OC to total measured OC can be made. Therefore, even when the model achieves good performance for total OC, it is possible that the model may be overpredicting one component of total OC and underpredicting the other. The inability to evaluate model performance for each component of OC increases the uncertainty of the results described here and illustrated in Figures 9 through 11, so caution should be used when drawing conclusions about the sources of OC based on these results.

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WEIGHTED EMISSIONS POTENTIAL ANALYSIS

Introduction

The Weighted Emissions Potential analysis (WEP) was developed as a screening tool for states to decide which source regions have the potential to contribute to haze formation at specific Class I areas, based on both the 2002 and 2018 emissions inventories. This method does not produce highly accurate results because, unlike the air quality model and associated PSAT analysis, it does not account for chemistry and removal processes. Instead, it relies on an integration of gridded emissions data, back trajectory residence time data, a one-over-distance factor to approximate deposition, and a normalization of the final results. Residence time over an area is indicative of general flow patterns, but does not necessarily imply the area contributed significantly to haze at a given receptor. Therefore, users are cautioned to view the WEP as one piece of a larger, more comprehensive weight of evidence analysis.

Emissions Data Inputs

The emissions data used were the annual, 36km grid SMOKE-processed, model-ready emissions inventories provided by the WRAP Regional Modeling Center (RMC). The analysis was performed for nine (9) pollutants (maps were generated for all but the last three):

- Sulfur oxides
- Nitrogen oxides
- Organic carbon
- Elemental carbon
- Fine particulate matter
- Coarse particulate matter
- Ammonia
- Volatile organic carbon
- Carbon monoxide.

The following source categories for each pollutant were identified and preserved through the analysis:

- Biogenic
- Natural fire
- Point
- Area
- WRAP oil and gas
- Off-shore
- On-road mobile
- Off-road mobile
- Road dust
- Fugitive dust
- Windblown dust

- Anthropogenic fires

Residence Time Inputs

The back trajectory residence times were provided by the WRAP Causes of Haze Assessment (COHA). The COHA project used NOAA's HYSPLIT model to generate eight (8) back trajectories daily for each WRAP Class I area for the entire five-year baseline period (2000-04). The major model parameters selected for this analysis are presented in Table 1. From these individual trajectories, residence time fields were generated for one-degree latitude by one-degree longitude grid cells. Residence time analysis computes the amount of time (e.g., number of hours) or percent of time an air parcel is in a horizontal grid cell. Plotted on a map, residence time is shown as percent of total hours in each grid cell across the domain, thus allowing an interpretation of general air flow patterns for a given Class I area. The residence time fields for the 20% worst and best IMPROVE-monitored extinction days were selected for the WEP analysis to highlight the potential emissions sources during those specific periods.

Table 1
Back Trajectory Model Parameters Selected for WEP Analysis

Model Parameter	Value
Trajectory duration	192 hours (8 days) backward in time
Top of model domain	14,000 meters
Vertical motion option	used model data
Receptor height	500 meters
Meteorological Field	EDAS and FNL (location dependent)

Integration of Emissions and Residence Time Data

The WEP analysis consisted of weighting the annual gridded emissions (by pollutant and source category) by the worst and best extinction days residence times for the five-year baseline period. To account for deposition along the trajectories, the result was further weighted by a one-over-distance factor, measured as the distance in km between the centroid of each emissions grid cell and the centroid of the grid cell containing the Class I area monitoring site under investigation. (The "home" grid cell of the monitoring site was weighted by one fourth of the 36km grid cell distance, or one-over-9km, to avoid a large response in that grid cell.) The resulting weighted emissions field was normalized by the highest grid cell to ease interpretation.

An example series of maps illustrating the WEP analysis is presented in Figure 1. This example shows the annual emissions for NOx across the domain, the specific residence time pattern for the 20% worst monitored days at a Class I area, and the resulting weighted emissions map. Both the 2002 and 2018 cases are presented. Interpretation of the results should focus on which grid cells (or larger regions) have significant potential to affect the Class I area, and on changes between 2002 and 2018.

An example of associated bar charts showing the estimated contribution by source category and region is presented in Figure 2. It is important to note that these charts show normalized values with no direct connection to original emissions values. Interpretation of the results should focus on the relative contributions by each source category and region, and the changes between 2002 and 2018.

Caveats

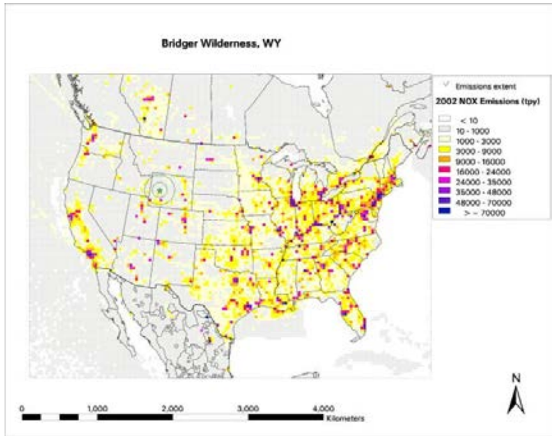
The WEP is not a rigorous, stand-alone analysis, but a simple, straightforward use of existing data. As such, there are several caveats to keep in mind when using WEP results as part of a comprehensive weight of evidence analysis:

- This analysis does not take into account any emissions chemistry.

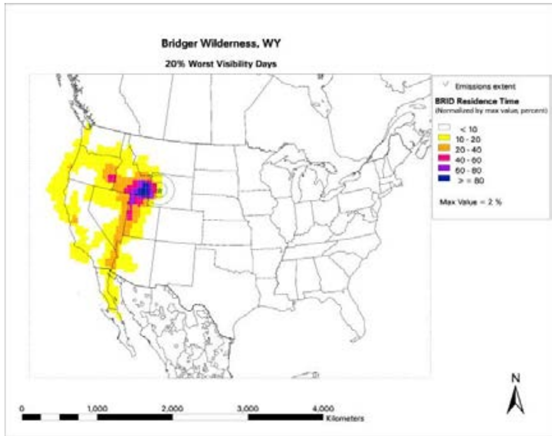
- While actual emissions may vary considerably throughout the year, this analysis pairs up annual emissions data with 20% worst/best extinction days residence times – this is likely most problematic for carbon and dust emissions, which can be highly episodic.

- Coarse particle and some fine particle dust emissions tend not to be transported long distances due to their large mass.

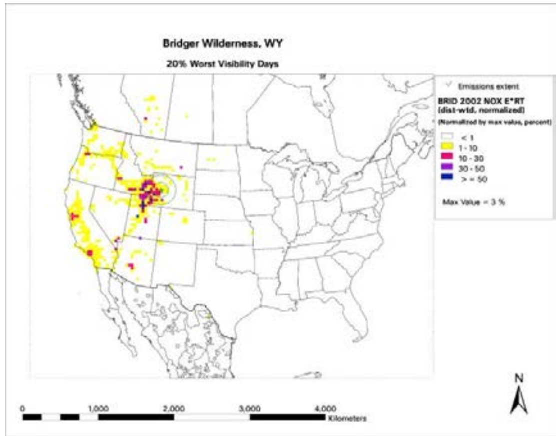
- The WEP results are unitless numbers, normalized to the largest-valued grid cell. Effective use of these results requires an understanding of actual emissions values and their relative contribution to haze at a given Class I area.



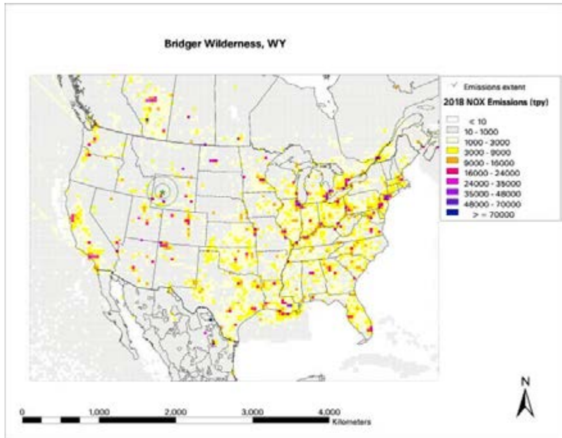
2002 NOx Emissions (TPY)



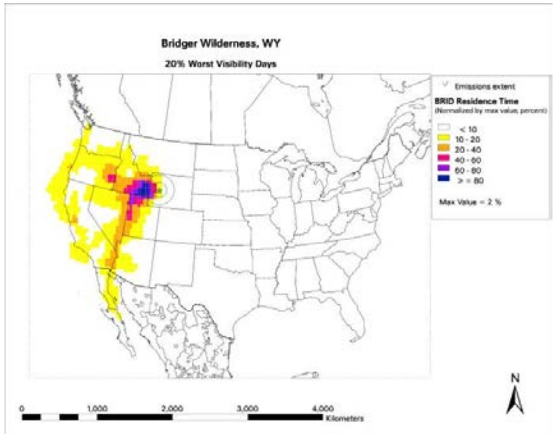
Residence Time Field, Worst 20% Monitored Days (2000-2005)



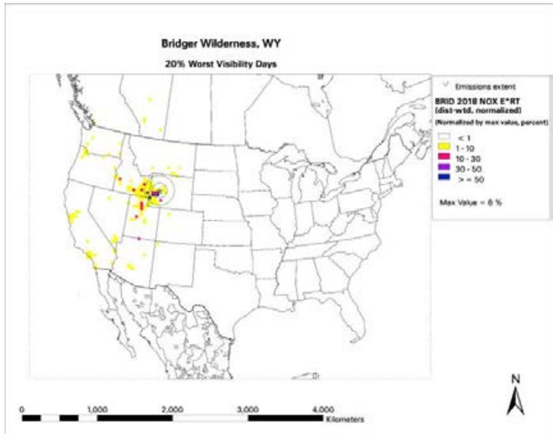
2002 NOx Emissions Weighted by Residence Time and One-Over-Distance



2018 NOx Emissions (TPY)



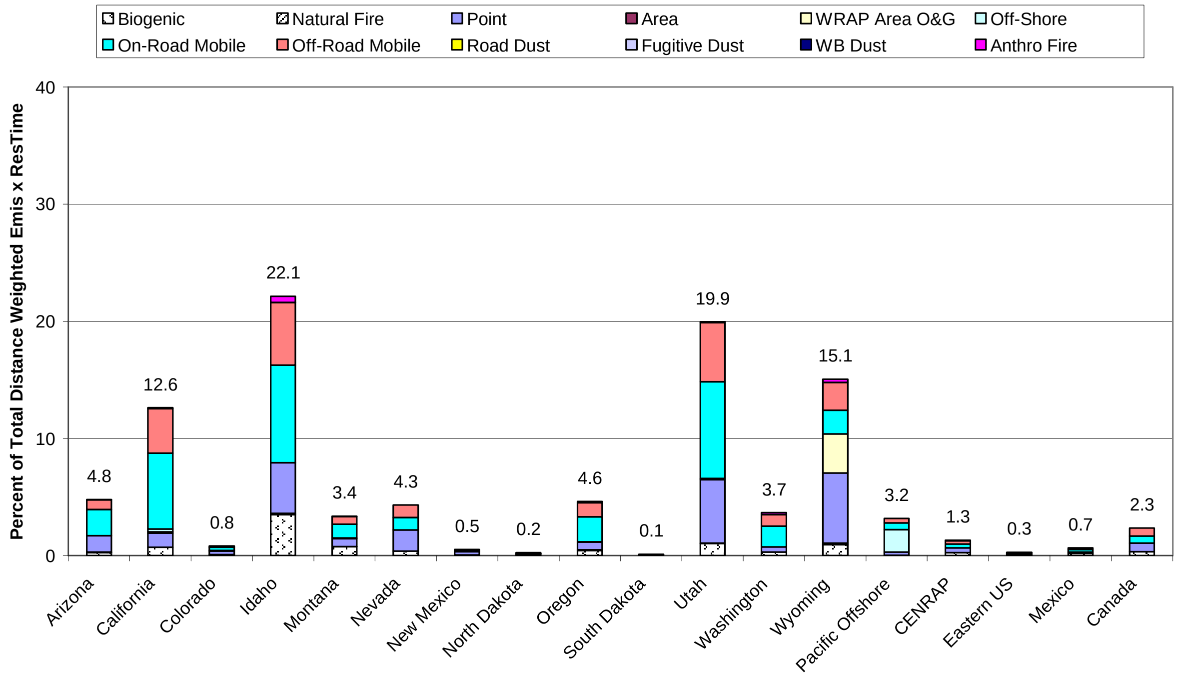
Residence Time Field, Worst 20% Monitored Days (2000-2005)



2018 NOx Emissions Weighted by Residence Time and One-Over-Distance

Figure 1. Example series of maps for WEP analysis at Bridger Wilderness, WY. From left to right: single-year annual emissions density map; five-year residence time map; emissions weighted by residence time, by one-over-distance, and normalized to the highest grid cell. Top row presents 2002 results, bottom row presents 2018 results.

Sources and Areas of Potential Nitrogen Oxide Emissions Influence
2000-2004 Baseline for Bridger Wilderness, WY
20% Worst Visibility Days



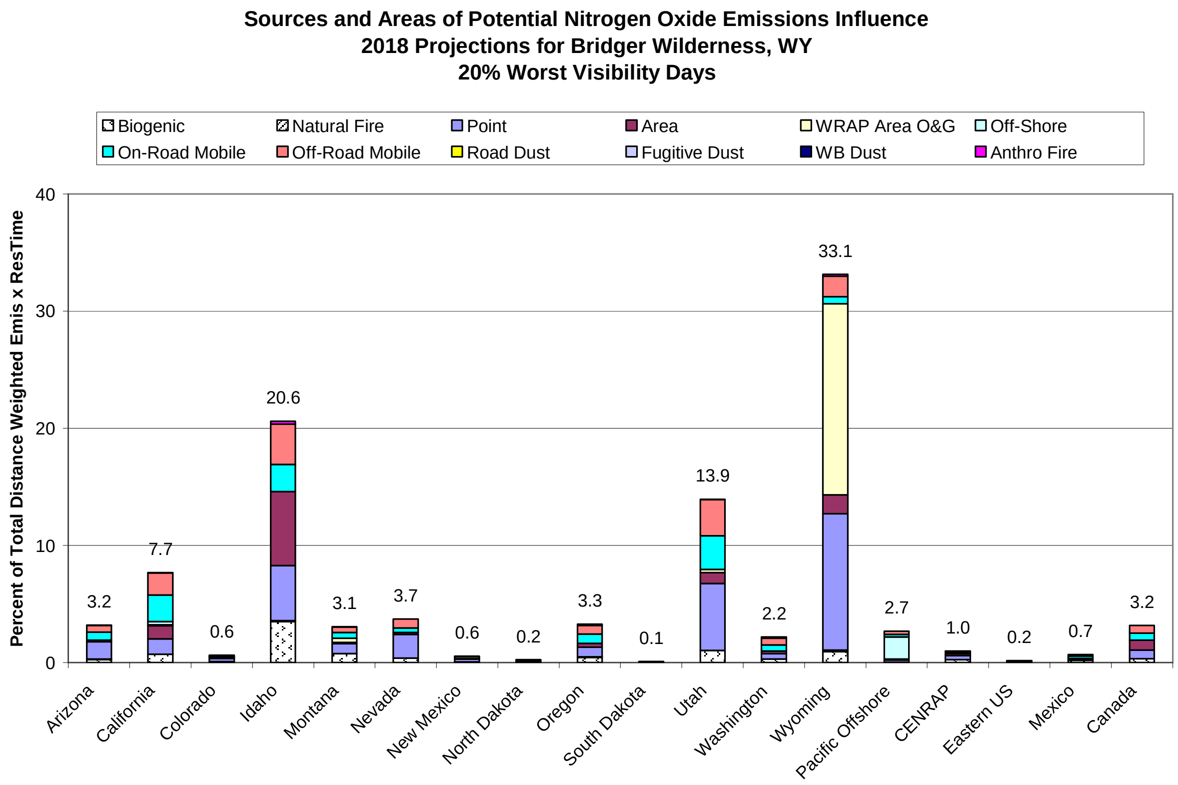


Figure 2. Example source category bar charts based on WEP analysis at Bridger Wilderness, WY. Top chart presents 2002 results, bottom chart presents 2018 results.

Source Attribution data

The WRAP and member states relied upon gridded three dimensional photochemical Eulerian models to track emissions from sources to Class I areas. The model Comprehensive Air Quality Model with Extensions (CAMx) - PSAT (PM Source Apportionment Technology) was used for mass-tracking algorithms to explicitly track for a given emissions source, the chemical transformations, transport and removal of the particulate that was formed from that source. Additional information on this model is available in the preceding modeling discussion.

Idaho used the WRAP CAMx PSAT information to determine Idaho's contribution to Class I areas in and outside of Idaho. As part of the analysis, each state's percent contribution was calculated for both the base year of 2002 and 2018. In addition the percentage change in contribution from 2002 to 2018 was also calculated to identify reasonable progress. The following tables used the plan 02 C base year emission inventory and the 2018 base case 18b which was an earlier version of the 2018 emission inventory.

Craters of the Moon NM

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
CRMO1	2002	plan02c36k	PS4	23	AZ	0	0	0	0	0.001		0.001	**0.19%**
CRMO1	2002	plan02c36k	PS4	23	CA	0.001	0	0.001	0.001	0.003		0.006	**1.11%**
CRMO1	2002	plan02c36k	PS4	23	CAN	0	0	0.001	0.008	0.031		0.04	**7.41%**
CRMO1	2002	plan02c36k	PS4	23	CEN	0	0	0	0	0.002		0.002	**0.37%**
CRMO1	2002	plan02c36k	PS4	23	CO	0	0	0	0	0.001		0.001	**0.19%**
CRMO1	2002	plan02c36k	PS4	23	EUS	0	0	0	0	0.001		0.001	**0.19%**
CRMO1	2002	plan02c36k	PS4	23	ID	0.012	0.003	0.014	0.009	0.05		0.088	**16.30%**
CRMO1	2002	plan02c36k	PS4	23	MEX	0	0	0	0	0.001		0.001	**0.19%**
CRMO1	2002	plan02c36k	PS4	23	MT	0	0	0.001	0.001	0.003		0.005	**0.93%**
CRMO1	2002	plan02c36k	PS4	23	ND	0	0	0	0	0.006		0.006	**1.11%**
CRMO1	2002	plan02c36k	PS4	23	NM	0	0	0	0	0.001		0.001	**0.19%**
CRMO1	2002	plan02c36k	PS4	23	NV	0	0	0.001	0.001	0.007		0.009	**1.67%**
CRMO1	2002	plan02c36k	PS4	23	OR	0.011	0.001	0.004	0.003	0.011		0.03	**5.56%**
CRMO1	2002	plan02c36k	PS4	23	PO	0	0	0.001	0.011	0.001		0.013	**2.41%**
CRMO1	2002	plan02c36k	PS4	23	SD	0	0	0	0	0		0	**0.00%**
CRMO1	2002	plan02c36k	PS4	23	UT	0	0	0.004	0.001	0.013		0.018	**3.33%**
CRMO1	2002	plan02c36k	PS4	23	WA	0.001	0	0.005	0.002	0.014		0.022	**4.07%**
CRMO1	2002	plan02c36k	PS4	23	WY	0	0	0.001	0.002	0.011		0.014	**2.59%**
CRMO1	2002	plan02c36k	PS4	23	OD						0.282	0.282	**52.22%**
Total						**0.025**	**0.004**	**0.033**	**0.039**	**0.157**	**0.282**	**0.540**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
CRMO1	2018	base18b36k	PS4	23	AZ	0	0	0	0	0.001		0.001	**0.18%**
CRMO1	2018	base18b36k	PS4	23	CA	0.001	0	0	0.001	0.003		0.005	**0.91%**
CRMO1	2018	base18b36k	PS4	23	CAN	0	0	0.001	0.008	0.031		0.04	**7.30%**
CRMO1	2018	base18b36k	PS4	23	CEN	0	0	0	0	0.002		0.002	**0.36%**
CRMO1	2018	base18b36k	PS4	23	CO	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PS4	23	EUS	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PS4	23	ID	0.012	0.001	0.004	0.01	0.074		0.101	**18.43%**
CRMO1	2018	base18b36k	PS4	23	MEX	0	0	0	0	0.001		0.001	**0.18%**
CRMO1	2018	base18b36k	PS4	23	MT	0	0	0	0.001	0.004		0.005	**0.91%**
CRMO1	2018	base18b36k	PS4	23	ND	0	0	0	0	0.006		0.006	**1.09%**
CRMO1	2018	base18b36k	PS4	23	NM	0	0	0	0	0.001		0.001	**0.18%**
CRMO1	2018	base18b36k	PS4	23	NV	0	0	0	0.001	0.009		0.01	**1.82%**
CRMO1	2018	base18b36k	PS4	23	OR	0.011	0.001	0.001	0.002	0.013		0.028	**5.11%**
CRMO1	2018	base18b36k	PS4	23	PO	0	0	0.001	0.011	0.001		0.013	**2.37%**
CRMO1	2018	base18b36k	PS4	23	SD	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PS4	23	UT	0	0	0.001	0.001	0.015		0.017	**3.10%**
CRMO1	2018	base18b36k	PS4	23	WA	0.001	0	0.001	0.003	0.012		0.017	**3.10%**
CRMO1	2018	base18b36k	PS4	23	WY	0	0	0	0.003	0.016		0.019	**3.47%**
CRMO1	2018	base18b36k	PS4	23	OD						0.282	0.282	**51.46%**
Total						0.025	0.002	0.009	0.041	0.189	0.282	0.548	**100.00%**
Percent by Source Type						**4.56%**	**0.36%**	**1.64%**	**7.48%**	**34.49%**	**51.46%**	**100.00%**	
Idaho Percent Total Contribution						**2.19%**	**0.18%**	**0.73%**	**1.82%**	**13.50%**	**0.00%**	**18.43%**	

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	**Total**	**Percent Contribution**
CRMO1	2002	plan02c36k	PN3	23	AZ	0	0	0.001	0	0		0.001	**0.10%**
CRMO1	2002	plan02c36k	PN3	23	CA	0.001	0	0.011	0.002	0.001		0.015	**1.45%**
CRMO1	2002	plan02c36k	PN3	23	CAN	0.002	0	0.016	0.008	0.008		0.034	**3.28%**
CRMO1	2002	plan02c36k	PN3	23	CEN	0	0	0.003	0	0.001		0.004	**0.39%**
CRMO1	2002	plan02c36k	PN3	23	CO	0	0	0.001	0	0.001		0.002	**0.19%**
CRMO1	2002	plan02c36k	PN3	23	EUS	0	0	0	0	0		0	**0.00%**
CRMO1	2002	plan02c36k	PN3	23	ID	0.043	0.007	0.229	0.091	0.044		0.414	**39.92%**
CRMO1	2002	plan02c36k	PN3	23	MEX	0	0	0	0	0		0	**0.00%**
CRMO1	2002	plan02c36k	PN3	23	MT	0.003	0.001	0.016	0.001	0.007		0.028	**2.70%**
CRMO1	2002	plan02c36k	PN3	23	ND	0.001	0	0.001	0	0.002		0.004	**0.39%**
CRMO1	2002	plan02c36k	PN3	23	NM	0	0	0	0	0.001		0.001	**0.10%**
CRMO1	2002	plan02c36k	PN3	23	NV	0.002	0	0.012	0	0.009		0.023	**2.22%**
CRMO1	2002	plan02c36k	PN3	23	OR	0.003	0.003	0.028	0.002	0.007		0.043	**4.15%**
CRMO1	2002	plan02c36k	PN3	23	PO	0	0	0.002	0.006	0		0.008	**0.77%**
CRMO1	2002	plan02c36k	PN3	23	SD	0	0	0.001	0	0		0.001	**0.10%**
CRMO1	2002	plan02c36k	PN3	23	UT	0.005	0	0.12	0.006	0.046		0.177	**17.07%**
CRMO1	2002	plan02c36k	PN3	23	WA	0.003	0.001	0.039	0.003	0.005		0.051	**4.92%**
CRMO1	2002	plan02c36k	PN3	23	WY	0.001	0	0.011	0.005	0.015		0.032	**3.09%**
CRMO1	2002	plan02c36k	PN3	23	OD						0.199	0.199	**19.19%**
Total						**0.064**	**0.012**	**0.491**	**0.124**	**0.147**	**0.199**	**1.037**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
CRMO1	2018	base18b36k	PN3	23	AZ	0	0	0	0	0.001		0.001	**0.12%**
CRMO1	2018	base18b36k	PN3	23	CA	0.001	0	0.005	0.002	0.001		0.009	**1.12%**
CRMO1	2018	base18b36k	PN3	23	CAN	0.002	0	0.016	0.008	0.008		0.034	**4.22%**
CRMO1	2018	base18b36k	PN3	23	CEN	0	0	0.001	0	0.001		0.002	**0.25%**
CRMO1	2018	base18b36k	PN3	23	CO	0	0	0	0	0.001		0.001	**0.12%**
CRMO1	2018	base18b36k	PN3	23	EUS	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PN3	23	ID	0.042	0.003	0.085	0.12	0.048		0.298	**36.97%**
CRMO1	2018	base18b36k	PN3	23	MEX	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PN3	23	MT	0.002	0	0.008	0.003	0.008		0.021	**2.61%**
CRMO1	2018	base18b36k	PN3	23	ND	0	0	0.001	0	0.002		0.003	**0.37%**
CRMO1	2018	base18b36k	PN3	23	NM	0	0	0	0	0.001		0.001	**0.12%**
CRMO1	2018	base18b36k	PN3	23	NV	0.002	0	0.007	0	0.012		0.021	**2.61%**
CRMO1	2018	base18b36k	PN3	23	OR	0.003	0.002	0.012	0.002	0.009		0.028	**3.47%**
CRMO1	2018	base18b36k	PN3	23	PO	0	0	0.002	0.006	0		0.008	**0.99%**
CRMO1	2018	base18b36k	PN3	23	SD	0	0	0	0	0		0	**0.00%**
CRMO1	2018	base18b36k	PN3	23	UT	0.005	0	0.054	0.01	0.048		0.117	**14.52%**
CRMO1	2018	base18b36k	PN3	23	WA	0.003	0	0.013	0.003	0.005		0.024	**2.98%**
CRMO1	2018	base18b36k	PN3	23	WY	0	0	0.005	0.013	0.017		0.035	**4.34%**
CRMO1	2018	base18b36k	PN3	23	OD						0.203	0.203	**25.19%**
Total						0.06	0.005	0.209	0.167	0.162	0.203	0.806	**100.00%**
Percent by Source Type						**7.44%**	**0.62%**	**25.93%**	**20.72%**	**20.10%**	**25.19%**	**100.00%**	
Idaho % Total Contribution						**5.21%**	**0.37%**	**10.55%**	**14.89%**	**5.96%**	**0.00%**	**36.97%**	

Hells Canyon Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	**Total**	**Percent Contribution**
HECA1	2002	plan02c36k	PS4	22	AZ	0	0	0	0	0.001		0.001	**0.18%**
HECA1	2002	plan02c36k	PS4	22	CA	0.001	0	0.002	0.003	0.009		0.015	**2.74%**
HECA1	2002	plan02c36k	PS4	22	CAN	0	0	0.001	0.01	0.04		0.051	**9.31%**
HECA1	2002	plan02c36k	PS4	22	CEN	0	0	0	0	0.003		0.003	**0.55%**
HECA1	2002	plan02c36k	PS4	22	CO	0	0	0	0	0.001		0.001	**0.18%**
HECA1	2002	plan02c36k	PS4	22	EUS	0	0	0	0	0.003		0.003	**0.55%**
HECA1	2002	plan02c36k	PS4	22	ID	0.002	0.001	0.01	0.012	0.023		0.048	**8.76%**
HECA1	2002	plan02c36k	PS4	22	MEX	0	0	0	0.001	0.002		0.003	**0.55%**
HECA1	2002	plan02c36k	PS4	22	MT	0	0	0.001	0	0.003		0.004	**0.73%**
HECA1	2002	plan02c36k	PS4	22	ND	0	0	0	0	0.007		0.007	**1.28%**
HECA1	2002	plan02c36k	PS4	22	NM	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PS4	22	NV	0.001	0	0.001	0.003	0.013		0.018	**3.28%**
HECA1	2002	plan02c36k	PS4	22	OR	0.006	0.003	0.01	0.005	0.019		0.043	**7.85%**
HECA1	2002	plan02c36k	PS4	22	PO	0	0	0.001	0.015	0.001		0.017	**3.10%**
HECA1	2002	plan02c36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PS4	22	UT	0	0	0.001	0	0.003		0.004	**0.73%**
HECA1	2002	plan02c36k	PS4	22	WA	0.001	0.001	0.008	0.003	0.019		0.032	**5.84%**
HECA1	2002	plan02c36k	PS4	22	WY	0.001	0	0	0.001	0.006		0.008	**1.46%**
HECA1	2002	plan02c36k	PS4	22	OD						0.29	0.29	**52.92%**
Total						**0.012**	**0.005**	**0.035**	**0.053**	**0.153**	**0.290**	**0.548**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
HECA1	2018	base18b36k	PS4	22	AZ	0	0	0	0	0.001		0.001	**0.19%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	CA	0.001	0	0.001	0.003	0.01		0.015	**2.81%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	CAN	0	0	0.001	0.01	0.039		0.05	**9.38%**	**-1.96%**
HECA1	2018	base18b36k	PS4	22	CEN	0	0	0	0	0.002		0.002	**0.38%**	**-33.33%**
HECA1	2018	base18b36k	PS4	22	CO	0	0	0	0	0		0	**0.00%**	**-100.00%**
HECA1	2018	base18b36k	PS4	22	EUS	0	0	0	0	0.002		0.002	**0.38%**	**-33.33%**
HECA1	2018	base18b36k	PS4	22	ID	0.002	0	0.002	0.013	0.028		0.045	**8.44%**	**-6.25%**
HECA1	2018	base18b36k	PS4	22	MEX	0	0	0	0.001	0.002		0.003	**0.56%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	MT	0	0	0	0	0.004		0.004	**0.75%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	ND	0	0	0	0	0.007		0.007	**1.31%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	NM	0	0	0	0	0		0	**0.00%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	NV	0.001	0	0	0.004	0.017		0.022	**4.13%**	**22.22%**
HECA1	2018	base18b36k	PS4	22	OR	0.006	0.002	0.002	0.005	0.021		0.036	**6.75%**	**-16.28%**
HECA1	2018	base18b36k	PS4	22	PO	0	0	0.001	0.015	0.002		0.018	**3.38%**	**5.88%**
HECA1	2018	base18b36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	UT	0	0	0	0	0.004		0.004	**0.75%**	**0.00%**
HECA1	2018	base18b36k	PS4	22	WA	0.001	0	0.001	0.004	0.018		0.024	**4.50%**	**-25.00%**
HECA1	2018	base18b36k	PS4	22	WY	0.001	0	0	0.001	0.007		0.009	**1.69%**	**12.50%**
HECA1	2018	base18b36k	PS4	22	OD						0.291	0.291	**54.60%**	**0.34%**
Total						0.012	0.002	0.008	0.056	0.164	0.291	0.533	**100.00%**	**-2.74%**
% by Source Type						**2.25%**	**0.38%**	**1.50%**	**10.51%**	**30.77%**	**54.60%**	**100.00%**		
Idaho % Total Contribution						**0.38%**	**0.00%**	**0.38%**	**2.44%**	**5.25%**	**0.00%**	**8.44%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
HECA1	2002	plan02c36k	PN3	22	AZ	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	CA	0.005	0.001	0.08	0.013	0.009		0.108	**9.78%**
HECA1	2002	plan02c36k	PN3	22	CAN	0.003	0	0.018	0.008	0.009		0.038	**3.44%**
HECA1	2002	plan02c36k	PN3	22	CEN	0	0	0.002	0	0.001		0.003	**0.27%**
HECA1	2002	plan02c36k	PN3	22	CO	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	ID	0.024	0.002	0.207	0.126	0.031		0.39	**35.33%**
HECA1	2002	plan02c36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	MT	0.001	0.001	0.009	0.001	0.004		0.016	**1.45%**
HECA1	2002	plan02c36k	PN3	22	ND	0	0	0.001	0	0.002		0.003	**0.27%**
HECA1	2002	plan02c36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	NV	0.003	0	0.026	0.001	0.023		0.053	**4.80%**
HECA1	2002	plan02c36k	PN3	22	OR	0.016	0.005	0.081	0.005	0.029		0.136	**12.32%**
HECA1	2002	plan02c36k	PN3	22	PO	0	0	0.005	0.011	0.001		0.017	**1.54%**
HECA1	2002	plan02c36k	PN3	22	SD	0	0	0	0	0		0	**0.00%**
HECA1	2002	plan02c36k	PN3	22	UT	0.001	0	0.025	0.001	0.009		0.036	**3.26%**
HECA1	2002	plan02c36k	PN3	22	WA	0.006	0.007	0.061	0.004	0.006		0.084	**7.61%**
HECA1	2002	plan02c36k	PN3	22	WY	0	0	0.003	0.001	0.005		0.009	**0.82%**
HECA1	2002	plan02c36k	PN3	22	OD						0.211	0.211	**19.11%**
Total						**0.059**	**0.016**	**0.518**	**0.171**	**0.129**	**0.211**	**1.104**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
HECA1	2018	base18b36k	PN3	22	AZ	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	CA	0.005	0	0.03	0.012	0.009		0.056	6.39%	-48.15%
HECA1	2018	base18b36k	PN3	22	CAN	0.003	0	0.018	0.008	0.008		0.037	4.22%	-2.63%
HECA1	2018	base18b36k	PN3	22	CEN	0	0	0.001	0	0		0.001	0.11%	-66.67%
HECA1	2018	base18b36k	PN3	22	CO	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	EUS	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	ID	0.023	0.001	0.08	0.173	0.035		0.312	35.62%	-20.00%
HECA1	2018	base18b36k	PN3	22	MEX	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	MT	0.001	0	0.005	0.002	0.005		0.013	1.48%	-18.75%
HECA1	2018	base18b36k	PN3	22	ND	0	0	0.001	0	0.002		0.003	0.34%	0.00%
HECA1	2018	base18b36k	PN3	22	NM	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	NV	0.003	0	0.015	0.002	0.028		0.048	5.48%	-9.43%
HECA1	2018	base18b36k	PN3	22	OR	0.016	0.003	0.042	0.006	0.035		0.102	11.64%	-25.00%
HECA1	2018	base18b36k	PN3	22	PO	0	0	0.003	0.011	0.001		0.015	1.71%	-11.76%
HECA1	2018	base18b36k	PN3	22	SD	0	0	0	0	0		0	0.00%	0.00%
HECA1	2018	base18b36k	PN3	22	UT	0.001	0	0.011	0.002	0.009		0.023	2.63%	-36.11%
HECA1	2018	base18b36k	PN3	22	WA	0.006	0.002	0.022	0.004	0.007		0.041	4.68%	-51.19%
HECA1	2018	base18b36k	PN3	22	WY	0	0	0.002	0.004	0.005		0.011	1.26%	22.22%
HECA1	2018	base18b36k	PN3	22	OD						0.214	0.214	24.43%	1.42%
Total						0.058	0.006	0.23	0.224	0.144	0.214	0.876	100.00%	-20.65%
Percent by Source Type						**6.62%**	**0.68%**	**26.26%**	**25.57%**	**16.44%**	**24.43%**	**100.00%**		
Idaho Percent Total Contribution						**2.63%**	**0.11%**	**9.13%**	**19.75%**	**4.00%**	**0.00%**	**35.62%**		

Sawtooth Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
SAWT1	2002	plan02c36k	PS4	22	**AZ**	0	0	0	0	0.001		0.001	**0.24%**
SAWT1	2002	plan02c36k	PS4	22	**CA**	0.003	0	0.001	0.001	0.005		0.01	**2.40%**
SAWT1	2002	plan02c36k	PS4	22	**CAN**	0	0	0.001	0.009	0.017		0.027	**6.47%**
SAWT1	2002	plan02c36k	PS4	22	**CEN**	0	0	0	0.001	0.004		0.005	**1.20%**
SAWT1	2002	plan02c36k	PS4	22	**CO**	0	0	0	0	0.001		0.001	**0.24%**
SAWT1	2002	plan02c36k	PS4	22	**EUS**	0	0	0	0	0.008		0.008	**1.92%**
SAWT1	2002	plan02c36k	PS4	22	**ID**	0.014	0.003	0.008	0.006	0.008		0.039	**9.35%**
SAWT1	2002	plan02c36k	PS4	22	**MEX**	0	0	0	0.001	0.004		0.005	**1.20%**
SAWT1	2002	plan02c36k	PS4	22	**MT**	0	0	0.001	0.001	0.001		0.003	**0.72%**
SAWT1	2002	plan02c36k	PS4	22	**ND**	0	0	0	0	0.004		0.004	**0.96%**
SAWT1	2002	plan02c36k	PS4	22	**NM**	0	0	0	0	0.001		0.001	**0.24%**
SAWT1	2002	plan02c36k	PS4	22	**NV**	0.003	0	0	0.002	0.005		0.01	**2.40%**
SAWT1	2002	plan02c36k	PS4	22	**OR**	0.015	0.002	0.006	0.004	0.014		0.041	**9.83%**
SAWT1	2002	plan02c36k	PS4	22	**PO**	0	0	0.001	0.015	0.001		0.017	**4.08%**
SAWT1	2002	plan02c36k	PS4	22	**SD**	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PS4	22	**UT**	0	0	0.001	0	0.002		0.003	**0.72%**
SAWT1	2002	plan02c36k	PS4	22	**WA**	0.002	0.001	0.009	0.004	0.021		0.037	**8.87%**
SAWT1	2002	plan02c36k	PS4	22	**WY**	0.002	0	0	0	0.004		0.006	**1.44%**
SAWT1	2002	plan02c36k	PS4	22	**OD**						0.199	0.199	**47.72%**
Total						**0.039**	**0.006**	**0.028**	**0.044**	**0.101**	**0.199**	**0.417**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
SAWT1	2018	base18b36k	PS4	22	**AZ**	0	0	0	0	0.001		0.001	**0.26%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**CA**	0.003	0	0.001	0.001	0.005		0.01	**2.57%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**CAN**	0	0	0.001	0.009	0.016		0.026	**6.68%**	**-3.70%**
SAWT1	2018	base18b36k	PS4	22	**CEN**	0	0	0	0.001	0.003		0.004	**1.03%**	**-20.00%**
SAWT1	2018	base18b36k	PS4	22	**CO**	0	0	0	0	0.001		0.001	**0.26%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**EUS**	0	0	0	0	0.003		0.003	**0.77%**	**-62.50%**
SAWT1	2018	base18b36k	PS4	22	**ID**	0.014	0.001	0.002	0.007	0.009		0.033	**8.48%**	**-15.38%**
SAWT1	2018	base18b36k	PS4	22	**MEX**	0	0	0	0.001	0.004		0.005	**1.29%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**MT**	0	0	0	0.001	0.002		0.003	**0.77%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**ND**	0	0	0	0	0.004		0.004	**1.03%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**NM**	0	0	0	0	0.001		0.001	**0.26%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**NV**	0.003	0	0	0.002	0.005		0.01	**2.57%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**OR**	0.015	0.002	0.001	0.003	0.016		0.037	**9.51%**	**-9.76%**
SAWT1	2018	base18b36k	PS4	22	**PO**	0	0	0.001	0.015	0.001		0.017	**4.37%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**SD**	0	0	0	0	0		0	**0.00%**	**0.00%**
SAWT1	2018	base18b36k	PS4	22	**UT**	0	0	0	0	0.002		0.002	**0.51%**	**-33.33%**
SAWT1	2018	base18b36k	PS4	22	**WA**	0.002	0.001	0.001	0.004	0.019		0.027	**6.94%**	**-27.03%**
SAWT1	2018	base18b36k	PS4	22	**WY**	0.002	0	0	0.001	0.005		0.008	**2.06%**	**33.33%**
SAWT1	2018	base18b36k	PS4	22	**OD**						0.197	0.197	**50.64%**	**-1.01%**
Total						0.039	0.004	0.007	0.045	0.097	0.197	0.389	**100.00%**	**-6.71%**
Percent by Source Type						**10.03%**	**1.03%**	**1.80%**	**11.57%**	**24.94%**	**50.64%**	**100.00%**		
Idaho Percent Total						**3.60%**	**0.26%**	**0.51%**	**1.80%**	**2.31%**	**0.00%**	**8.48%**		

Contribution														

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
SAWT1	2002	plan02c36k	PN3	22	AZ	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	CA	0	0	0.004	0.001	0.001		0.006	**3.49%**
SAWT1	2002	plan02c36k	PN3	22	CAN	0.001	0	0.003	0.002	0.002		0.008	**4.65%**
SAWT1	2002	plan02c36k	PN3	22	CEN	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	CO	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	ID	0.008	0.002	0.024	0.015	0.003		0.052	**30.23%**
SAWT1	2002	plan02c36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	MT	0.001	0	0.002	0	0.001		0.004	**2.33%**
SAWT1	2002	plan02c36k	PN3	22	ND	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	NV	0.001	0	0.003	0	0.002		0.006	**3.49%**
SAWT1	2002	plan02c36k	PN3	22	OR	0.002	0.003	0.011	0.001	0.002		0.019	**11.05%**
SAWT1	2002	plan02c36k	PN3	22	PO	0	0	0	0.001	0		0.001	**0.58%**
SAWT1	2002	plan02c36k	PN3	22	SD	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	UT	0	0	0.003	0	0.001		0.004	**2.33%**
SAWT1	2002	plan02c36k	PN3	22	WA	0.003	0.002	0.014	0.001	0.001		0.021	**12.21%**
SAWT1	2002	plan02c36k	PN3	22	WY	0	0	0	0	0		0	**0.00%**
SAWT1	2002	plan02c36k	PN3	22	OD						0.051	0.051	**29.65%**
Total						**0.016**	**0.007**	**0.064**	**0.021**	**0.013**	**0.051**	**0.172**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
SAWT1	2018	base18b36k	PN3	22	AZ	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	CA	0	0	0.002	0.001	0.001		0.004	2.68%	-33.33%
SAWT1	2018	base18b36k	PN3	22	CAN	0.001	0	0.004	0.002	0.002		0.009	6.04%	12.50%
SAWT1	2018	base18b36k	PN3	22	CEN	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	CO	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	EUS	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	ID	0.007	0.001	0.01	0.022	0.003		0.043	28.86%	-17.31%
SAWT1	2018	base18b36k	PN3	22	MEX	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	MT	0.001	0	0.001	0	0.001		0.003	2.01%	-25.00%
SAWT1	2018	base18b36k	PN3	22	ND	0	0	0	0	0.001		0.001	0.67%	0.00%
SAWT1	2018	base18b36k	PN3	22	NM	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	NV	0.001	0	0.002	0	0.003		0.006	4.03%	0.00%
SAWT1	2018	base18b36k	PN3	22	OR	0.002	0.002	0.005	0.001	0.003		0.013	8.72%	-31.58%
SAWT1	2018	base18b36k	PN3	22	PO	0	0	0	0.001	0		0.001	0.67%	0.00%
SAWT1	2018	base18b36k	PN3	22	SD	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	UT	0	0	0.001	0	0.001		0.002	1.34%	-50.00%
SAWT1	2018	base18b36k	PN3	22	WA	0.003	0.001	0.005	0.001	0.002		0.012	8.05%	-42.86%
SAWT1	2018	base18b36k	PN3	22	WY	0	0	0	0	0		0	0.00%	0.00%
SAWT1	2018	base18b36k	PN3	22	OD						0.055	0.055	36.91%	7.84%
Total						0.015	0.004	0.03	0.028	0.017	0.055	0.149	100.00%	-13.37%
Percent by Source Type						**10.07%**	**2.68%**	**20.13%**	**18.79%**	**11.41%**	**36.91%**	**100.00%**		
Idaho Percent Total Contribution						**4.70%**	**0.67%**	**6.71%**	**14.77%**	**2.01%**	**0.00%**	**28.86%**		

Selway-Bitterroot Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	**Total**	**Percent Contribution**
SULA1	2002	plan02c36k	PS4	24	AZ	0	0	0	0	0.001		0.001	**0.16%**
SULA1	2002	plan02c36k	PS4	24	CA	0.002	0	0.001	0.002	0.006		0.011	**1.76%**
SULA1	2002	plan02c36k	PS4	24	CAN	0	0	0.002	0.021	0.058		0.081	**12.94%**
SULA1	2002	plan02c36k	PS4	24	CEN	0	0	0	0.001	0.004		0.005	**0.80%**
SULA1	2002	plan02c36k	PS4	24	CO	0	0	0	0	0.001		0.001	**0.16%**
SULA1	2002	plan02c36k	PS4	24	EUS	0	0	0	0	0.003		0.003	**0.48%**
SULA1	2002	plan02c36k	PS4	24	ID	0.063	0.001	0.005	0.003	0.004		0.076	**12.14%**
SULA1	2002	plan02c36k	PS4	24	MEX	0	0	0	0.001	0.006		0.007	**1.12%**
SULA1	2002	plan02c36k	PS4	24	MT	0.001	0	0.007	0.006	0.011		0.025	**3.99%**
SULA1	2002	plan02c36k	PS4	24	ND	0	0	0	0	0.007		0.007	**1.12%**
SULA1	2002	plan02c36k	PS4	24	NM	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PS4	24	NV	0.001	0	0	0.001	0.003		0.005	**0.80%**
SULA1	2002	plan02c36k	PS4	24	OR	0.01	0.001	0.007	0.004	0.017		0.039	**6.23%**
SULA1	2002	plan02c36k	PS4	24	PO	0	0	0.002	0.019	0.002		0.023	**3.67%**
SULA1	2002	plan02c36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PS4	24	UT	0	0	0.001	0	0.002		0.003	**0.48%**
SULA1	2002	plan02c36k	PS4	24	WA	0.003	0.002	0.017	0.006	0.032		0.06	**9.58%**
SULA1	2002	plan02c36k	PS4	24	WY	0.001	0	0	0.001	0.007		0.009	**1.44%**
SULA1	2002	plan02c36k	PS4	24	OD						0.27	0.27	**43.13%**
Total						**0.081**	**0.004**	**0.042**	**0.065**	**0.164**	**0.270**	**0.626**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
SULA1	2018	base18b36k	PS4	24	AZ	0	0	0	0	0.001		0.001	**0.17%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	CA	0.002	0	0.001	0.002	0.006		0.011	**1.82%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	CAN	0	0	0.002	0.02	0.059		0.081	**13.39%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	CEN	0	0	0	0.001	0.003		0.004	**0.66%**	**-20.00%**
SULA1	2018	base18b36k	PS4	24	CO	0	0	0	0	0.001		0.001	**0.17%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	EUS	0	0	0	0	0.002		0.002	**0.33%**	**-33.33%**
SULA1	2018	base18b36k	PS4	24	ID	0.063	0.001	0.001	0.003	0.005		0.073	**12.07%**	**-3.95%**
SULA1	2018	base18b36k	PS4	24	MEX	0	0	0	0.001	0.006		0.007	**1.16%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	MT	0.001	0	0.002	0.006	0.016		0.025	**4.13%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	ND	0	0	0	0	0.007		0.007	**1.16%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	NM	0	0	0	0	0		0	**0.00%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	NV	0.001	0	0	0.001	0.003		0.005	**0.83%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	OR	0.01	0.001	0.001	0.004	0.021		0.037	**6.12%**	**-5.13%**
SULA1	2018	base18b36k	PS4	24	PO	0	0	0.001	0.019	0.002		0.022	**3.64%**	**-4.35%**
SULA1	2018	base18b36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	UT	0	0	0	0	0.003		0.003	**0.50%**	**0.00%**
SULA1	2018	base18b36k	PS4	24	WA	0.003	0.001	0.002	0.007	0.031		0.044	**7.27%**	**-26.67%**
SULA1	2018	base18b36k	PS4	24	WY	0.001	0	0	0.001	0.01		0.012	**1.98%**	**33.33%**
SULA1	2018	base18b36k	PS4	24	OD						0.27	0.27	**44.63%**	**0.00%**
Total						0.081	0.003	0.01	0.065	0.176	0.27	0.605	**100.00%**	**-3.35%**
Percent by Source Type						**13.39%**	**0.50%**	**1.65%**	**10.74%**	**29.09%**	**44.63%**	**100.00%**		
Idaho Percent Total Contribution						**10.41%**	**0.17%**	**0.17%**	**0.50%**	**0.83%**	**0.00%**	**12.07%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	**Total**	**Percent Contribution**
SULA1	2002	plan02c36k	PN3	24	AZ	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PN3	24	CA	0	0	0.004	0.001	0		0.005	**1.35%**
SULA1	2002	plan02c36k	PN3	24	CAN	0.002	0	0.015	0.008	0.009		0.034	**9.19%**
SULA1	2002	plan02c36k	PN3	24	CEN	0	0	0.002	0	0.001		0.003	**0.81%**
SULA1	2002	plan02c36k	PN3	24	CO	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PN3	24	ID	0.018	0.003	0.023	0.007	0.003		0.054	**14.59%**
SULA1	2002	plan02c36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PN3	24	MT	0.006	0	0.051	0.004	0.013		0.074	**20.00%**
SULA1	2002	plan02c36k	PN3	24	ND	0	0	0.001	0	0.002		0.003	**0.81%**
SULA1	2002	plan02c36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**
SULA1	2002	plan02c36k	PN3	24	NV	0	0	0.001	0	0.001		0.002	**0.54%**
SULA1	2002	plan02c36k	PN3	24	OR	0.003	0.002	0.012	0.001	0.004		0.022	**5.95%**
SULA1	2002	plan02c36k	PN3	24	PO	0	0	0.001	0.003	0		0.004	**1.08%**
SULA1	2002	plan02c36k	PN3	24	SD	0	0	0.001	0	0		0.001	**0.27%**
SULA1	2002	plan02c36k	PN3	24	UT	0	0	0.004	0	0.002		0.006	**1.62%**
SULA1	2002	plan02c36k	PN3	24	WA	0.007	0.007	0.041	0.002	0.003		0.06	**16.22%**
SULA1	2002	plan02c36k	PN3	24	WY	0	0	0.003	0.001	0.006		0.01	**2.70%**
SULA1	2002	plan02c36k	PN3	24	OD						0.092	0.092	**24.86%**
Total						**0.036**	**0.012**	**0.159**	**0.027**	**0.044**	**0.092**	**0.370**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
SULA1	2018	base18b36k	PN3	24	AZ	0	0	0	0	0		0	0.00%	0.00%
SULA1	2018	base18b36k	PN3	24	CA	0	0	0.001	0.001	0		0.002	0.70%	-60.00%
SULA1	2018	base18b36k	PN3	24	CAN	0.002	0	0.015	0.008	0.008		0.033	11.62%	-2.94%
SULA1	2018	base18b36k	PN3	24	CEN	0	0	0.001	0	0.001		0.002	0.70%	-33.33%
SULA1	2018	base18b36k	PN3	24	CO	0	0	0	0	0		0	0.00%	0.00%
SULA1	2018	base18b36k	PN3	24	EUS	0	0	0	0	0		0	0.00%	0.00%
SULA1	2018	base18b36k	PN3	24	ID	0.017	0.001	0.008	0.009	0.004		0.039	13.73%	-27.78%
SULA1	2018	base18b36k	PN3	24	MEX	0	0	0	0	0		0	0.00%	0.00%
SULA1	2018	base18b36k	PN3	24	MT	0.005	0	0.022	0.006	0.015		0.048	16.90%	-35.14%
SULA1	2018	base18b36k	PN3	24	ND	0	0	0.001	0	0.002		0.003	1.06%	0.00%
SULA1	2018	base18b36k	PN3	24	NM	0	0	0	0	0		0	0.00%	0.00%
SULA1	2018	base18b36k	PN3	24	NV	0	0	0.001	0	0.001		0.002	0.70%	0.00%
SULA1	2018	base18b36k	PN3	24	OR	0.002	0.001	0.005	0.001	0.004		0.013	4.58%	-40.91%
SULA1	2018	base18b36k	PN3	24	PO	0	0	0.001	0.003	0		0.004	1.41%	0.00%
SULA1	2018	base18b36k	PN3	24	SD	0	0	0	0	0		0	0.00%	-100.00%
SULA1	2018	base18b36k	PN3	24	UT	0	0	0.002	0	0.001		0.003	1.06%	-50.00%
SULA1	2018	base18b36k	PN3	24	WA	0.007	0.004	0.014	0.002	0.003		0.03	10.56%	-50.00%
SULA1	2018	base18b36k	PN3	24	WY	0	0	0.002	0.004	0.004		0.01	3.52%	0.00%
SULA1	2018	base18b36k	PN3	24	OD						0.095	0.095	33.45%	3.26%
Total						0.033	0.006	0.073	0.034	0.043	0.095	0.284	100.00%	-23.24%
Percent by Source Type						**11.62%**	**2.11%**	**25.70%**	**11.97%**	**15.14%**	**33.45%**	**100.00%**		
Idaho Percent Total Contribution						**5.99%**	**0.35%**	**2.82%**	**3.17%**	**1.41%**	**0.00%**	**13.73%**		

Yellowstone National Park

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
YELL2	2002	plan02c36k	PS4	22	AZ	0.001	0	0.001	0	0.005		0.007	**1.42%**
YELL2	2002	plan02c36k	PS4	22	CA	0.004	0	0.002	0.002	0.008		0.016	**3.24%**
YELL2	2002	plan02c36k	PS4	22	CAN	0	0	0.001	0.006	0.02		0.027	**5.47%**
YELL2	2002	plan02c36k	PS4	22	CEN	0	0	0.001	0.001	0.01		0.012	**2.43%**
YELL2	2002	plan02c36k	PS4	22	CO	0	0	0	0	0.003		0.003	**0.61%**
YELL2	2002	plan02c36k	PS4	22	EUS	0	0	0	0.001	0.009		0.01	**2.02%**
YELL2	2002	plan02c36k	PS4	22	ID	0.014	0.001	0.006	0.003	0.016		0.04	**8.10%**
YELL2	2002	plan02c36k	PS4	22	MEX	0	0	0.001	0.003	0.016		0.02	**4.05%**
YELL2	2002	plan02c36k	PS4	22	MT	0.001	0	0.001	0.001	0.004		0.007	**1.42%**
YELL2	2002	plan02c36k	PS4	22	ND	0	0	0	0	0.001		0.001	**0.20%**
YELL2	2002	plan02c36k	PS4	22	NM	0	0	0	0	0.003		0.003	**0.61%**
YELL2	2002	plan02c36k	PS4	22	NV	0.003	0	0.001	0.002	0.007		0.013	**2.63%**
YELL2	2002	plan02c36k	PS4	22	OR	0.01	0.001	0.003	0.002	0.007		0.023	**4.66%**
YELL2	2002	plan02c36k	PS4	22	PO	0	0	0.001	0.016	0.003		0.02	**4.05%**
YELL2	2002	plan02c36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PS4	22	UT	0.001	0	0.003	0.001	0.007		0.012	**2.43%**
YELL2	2002	plan02c36k	PS4	22	WA	0.002	0.001	0.005	0.002	0.011		0.021	**4.25%**
YELL2	2002	plan02c36k	PS4	22	WY	0.008	0	0.002	0.003	0.016		0.029	**5.87%**
YELL2	2002	plan02c36k	PS4	22	OD						0.23	0.23	**46.56%**
Total						**0.044**	**0.003**	**0.028**	**0.043**	**0.146**	**0.230**	**0.494**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
YELL2	2018	base18b36k	PS4	22	AZ	0.001	0	0	0	0.006		0.007	**1.43%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	CA	0.004	0	0.001	0.002	0.008		0.015	**3.07%**	**-6.25%**
YELL2	2018	base18b36k	PS4	22	CAN	0	0	0.001	0.006	0.021		0.028	**5.73%**	**3.70%**
YELL2	2018	base18b36k	PS4	22	CEN	0	0	0	0.002	0.007		0.009	**1.84%**	**-25.00%**
YELL2	2018	base18b36k	PS4	22	CO	0	0	0	0	0.003		0.003	**0.61%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	EUS	0	0	0	0.001	0.004		0.005	**1.02%**	**-50.00%**
YELL2	2018	base18b36k	PS4	22	ID	0.014	0	0.001	0.003	0.025		0.043	**8.79%**	**7.50%**
YELL2	2018	base18b36k	PS4	22	MEX	0	0	0.001	0.003	0.017		0.021	**4.29%**	**5.00%**
YELL2	2018	base18b36k	PS4	22	MT	0.001	0	0	0.001	0.005		0.007	**1.43%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	ND	0	0	0	0	0.001		0.001	**0.20%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	NM	0	0	0	0	0.002		0.002	**0.41%**	**-33.33%**
YELL2	2018	base18b36k	PS4	22	NV	0.003	0	0	0.002	0.006		0.011	**2.25%**	**-15.38%**
YELL2	2018	base18b36k	PS4	22	OR	0.01	0	0	0.002	0.008		0.02	**4.09%**	**-13.04%**
YELL2	2018	base18b36k	PS4	22	PO	0	0	0.001	0.016	0.004		0.021	**4.29%**	**5.00%**
YELL2	2018	base18b36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	UT	0.001	0	0	0.001	0.01		0.012	**2.45%**	**0.00%**
YELL2	2018	base18b36k	PS4	22	WA	0.002	0	0.001	0.002	0.009		0.014	**2.86%**	**-33.33%**
YELL2	2018	base18b36k	PS4	22	WY	0.008	0	0.001	0.003	0.027		0.039	**7.98%**	**34.48%**
YELL2	2018	base18b36k	PS4	22	OD						0.231	0.231	**47.24%**	**0.43%**
Total						0.044	0	0.007	0.044	0.163	0.231	0.489	**100.00%**	**-1.01%**
Percent by Source Type						**9.00%**	**0.00%**	**1.43%**	**9.00%**	**33.33%**	**47.24%**	**100.00%**		
Idaho Percent Total Contribution						**2.86%**	**0.00%**	**0.20%**	**0.61%**	**5.11%**	**0.00%**	**8.79%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
YELL2	2002	plan02c36k	PN3	22	AZ	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	CA	0.001	0	0.008	0.001	0.001		0.011	**4.31%**
YELL2	2002	plan02c36k	PN3	22	CAN	0	0	0.002	0.001	0.001		0.004	**1.57%**
YELL2	2002	plan02c36k	PN3	22	CEN	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	CO	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	ID	0.015	0.001	0.036	0.013	0.007		0.072	**28.24%**
YELL2	2002	plan02c36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	MT	0.001	0	0.004	0	0.001		0.006	**2.35%**
YELL2	2002	plan02c36k	PN3	22	ND	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	NV	0.001	0	0.002	0	0.002		0.005	**1.96%**
YELL2	2002	plan02c36k	PN3	22	OR	0.002	0.001	0.011	0.001	0.003		0.018	**7.06%**
YELL2	2002	plan02c36k	PN3	22	PO	0	0	0.001	0.003	0		0.004	**1.57%**
YELL2	2002	plan02c36k	PN3	22	SD	0	0	0	0	0		0	**0.00%**
YELL2	2002	plan02c36k	PN3	22	UT	0.001	0	0.013	0.001	0.004		0.019	**7.45%**
YELL2	2002	plan02c36k	PN3	22	WA	0.002	0.001	0.018	0.001	0.002		0.024	**9.41%**
YELL2	2002	plan02c36k	PN3	22	WY	0.001	0	0.005	0.002	0.004		0.012	**4.71%**
YELL2	2002	plan02c36k	PN3	22	OD						0.08	0.08	**31.37%**
Total						**0.024**	**0.003**	**0.100**	**0.023**	**0.025**	**0.080**	**0.255**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
YELL2	2018	base18b36k	PN3	22	AZ	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	CA	0.001	0	0.003	0.001	0.001		0.006	**2.75%**	**-45.45%**
YELL2	2018	base18b36k	PN3	22	CAN	0	0	0.002	0.001	0.001		0.004	**1.83%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	CEN	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	CO	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	ID	0.015	0	0.014	0.017	0.007		0.053	**24.31%**	**-26.39%**
YELL2	2018	base18b36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	MT	0.001	0	0.002	0	0.001		0.004	**1.83%**	**-33.33%**
YELL2	2018	base18b36k	PN3	22	ND	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	NV	0.001	0	0.001	0	0.003		0.005	**2.29%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	OR	0.002	0.001	0.005	0.001	0.003		0.012	**5.50%**	**-33.33%**
YELL2	2018	base18b36k	PN3	22	PO	0	0	0.001	0.004	0		0.005	**2.29%**	**25.00%**
YELL2	2018	base18b36k	PN3	22	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
YELL2	2018	base18b36k	PN3	22	UT	0.001	0	0.006	0.001	0.005		0.013	**5.96%**	**-31.58%**
YELL2	2018	base18b36k	PN3	22	WA	0.002	0.001	0.006	0.001	0.003		0.013	**5.96%**	**-45.83%**
YELL2	2018	base18b36k	PN3	22	WY	0.001	0	0.002	0.007	0.006		0.016	**7.34%**	**33.33%**
YELL2	2018	base18b36k	PN3	22	OD						0.087	0.087	**39.91%**	**8.75%**
Total						0.024	0.002	0.042	0.033	0.03	0.087	0.218	**100.00%**	**-14.51%**
Percent by Source Type						**11.01%**	**0.92%**	**19.27%**	**15.14%**	**13.76%**	**39.91%**	**100.00%**		
Idaho Percent Total Contribution						**6.88%**	**0.00%**	**6.42%**	**7.80%**	**3.21%**	**0.00%**	**24.31%**		

Cabinet Mountain Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
CABI1	2002	plan02c36k	PS4	24	AZ	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PS4	24	CA	0.001	0	0.001	0.001	0.002		0.005	**0.61%**
CABI1	2002	plan02c36k	PS4	24	CAN	0	0	0.003	0.041	0.095		0.139	**17.01%**
CABI1	2002	plan02c36k	PS4	24	CEN	0	0	0	0	0.002		0.002	**0.24%**
CABI1	2002	plan02c36k	PS4	24	CO	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PS4	24	EUS	0	0	0	0	0.002		0.002	**0.24%**
CABI1	2002	plan02c36k	PS4	24	ID	0.044	0.003	0.008	0.007	0.002		0.064	**7.83%**
CABI1	2002	plan02c36k	PS4	24	MEX	0	0	0	0	0.001		0.001	**0.12%**
CABI1	2002	plan02c36k	PS4	24	MT	0.001	0.003	0.009	0.004	0.007		0.024	**2.94%**
CABI1	2002	plan02c36k	PS4	24	ND	0	0	0	0	0.011		0.011	**1.35%**
CABI1	2002	plan02c36k	PS4	24	NM	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PS4	24	NV	0	0	0	0.001	0.002		0.003	**0.37%**
CABI1	2002	plan02c36k	PS4	24	OR	0.003	0.001	0.007	0.005	0.026		0.042	**5.14%**
CABI1	2002	plan02c36k	PS4	24	PO	0	0	0.003	0.02	0.002		0.025	**3.06%**
CABI1	2002	plan02c36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PS4	24	UT	0	0	0	0	0.001		0.001	**0.12%**
CABI1	2002	plan02c36k	PS4	24	WA	0.004	0.004	0.033	0.013	0.059		0.113	**13.83%**
CABI1	2002	plan02c36k	PS4	24	WY	0	0	0	0.001	0.004		0.005	**0.61%**
CABI1	2002	plan02c36k	PS4	24	OD						0.38	0.38	**46.51%**
Total						**0.053**	**0.011**	**0.064**	**0.093**	**0.216**	**0.380**	**0.817**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
CABI1	2018	base18b36k	PS4	24	AZ	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PS4	24	CA	0.001	0	0	0.001	0.002		0.004	0.51%	-20.00%
CABI1	2018	base18b36k	PS4	24	CAN	0	0	0.003	0.043	0.101		0.147	18.65%	5.76%
CABI1	2018	base18b36k	PS4	24	CEN	0	0	0	0	0.001		0.001	0.13%	-50.00%
CABI1	2018	base18b36k	PS4	24	CO	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PS4	24	EUS	0	0	0	0	0.001		0.001	0.13%	-50.00%
CABI1	2018	base18b36k	PS4	24	ID	0.044	0.001	0.003	0.008	0.003		0.059	7.49%	-7.81%
CABI1	2018	base18b36k	PS4	24	MEX	0	0	0	0	0.001		0.001	0.13%	0.00%
CABI1	2018	base18b36k	PS4	24	MT	0.001	0.002	0.004	0.005	0.012		0.024	3.05%	0.00%
CABI1	2018	base18b36k	PS4	24	ND	0	0	0	0	0.012		0.012	1.52%	9.09%
CABI1	2018	base18b36k	PS4	24	NM	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PS4	24	NV	0	0	0	0.001	0.002		0.003	0.38%	0.00%
CABI1	2018	base18b36k	PS4	24	OR	0.003	0.001	0.001	0.004	0.033		0.042	5.33%	0.00%
CABI1	2018	base18b36k	PS4	24	PO	0	0	0.001	0.019	0.002		0.022	2.79%	-12.00%
CABI1	2018	base18b36k	PS4	24	SD	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PS4	24	UT	0	0	0	0	0.001		0.001	0.13%	0.00%
CABI1	2018	base18b36k	PS4	24	WA	0.004	0.002	0.005	0.015	0.058		0.084	10.66%	-25.66%
CABI1	2018	base18b36k	PS4	24	WY	0	0	0	0.001	0.005		0.006	0.76%	20.00%
CABI1	2018	base18b36k	PS4	24	OD						0.381	0.381	48.35%	0.26%
Total						0.053	0.006	0.017	0.097	0.234	0.381	0.788	100.00%	-3.55%
Percent by Source Type						**6.73%**	**0.76%**	**2.16%**	**12.31%**	**29.70%**	**48.35%**	**100.00%**		
Idaho Percent Total Contribution						**5.58%**	**0.13%**	**0.38%**	**1.02%**	**0.38%**	**0.00%**	**7.49%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
CABI1	2002	plan02c36k	PN3	24	AZ	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	CA	0.001	0	0.01	0.002	0.001		0.014	**1.82%**
CABI1	2002	plan02c36k	PN3	24	CAN	0.003	0	0.04	0.016	0.014		0.073	**9.48%**
CABI1	2002	plan02c36k	PN3	24	CEN	0	0	0.001	0	0		0.001	**0.13%**
CABI1	2002	plan02c36k	PN3	24	CO	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	ID	0.007	0.003	0.067	0.027	0.006		0.11	**14.29%**
CABI1	2002	plan02c36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	MT	0.007	0.005	0.084	0.006	0.012		0.114	**14.81%**
CABI1	2002	plan02c36k	PN3	24	ND	0	0	0.001	0	0.001		0.002	**0.26%**
CABI1	2002	plan02c36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	NV	0	0	0.002	0	0.002		0.004	**0.52%**
CABI1	2002	plan02c36k	PN3	24	OD						0.11	0.11	**14.29%**
CABI1	2002	plan02c36k	PN3	24	OR	0.004	0.002	0.038	0.003	0.012		0.059	**7.66%**
CABI1	2002	plan02c36k	PN3	24	PO	0	0	0.004	0.008	0.001		0.013	**1.69%**
CABI1	2002	plan02c36k	PN3	24	SD	0	0	0	0	0		0	**0.00%**
CABI1	2002	plan02c36k	PN3	24	UT	0	0	0.005	0	0.002		0.007	**0.91%**
CABI1	2002	plan02c36k	PN3	24	WA	0.021	0.011	0.196	0.012	0.017		0.257	**33.38%**
CABI1	2002	plan02c36k	PN3	24	WY	0	0	0.002	0.001	0.003		0.006	**0.78%**
Total						**0.043**	**0.021**	**0.450**	**0.075**	**0.071**	**0.110**	**0.770**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
CABI1	2018	base18b36k	PN3	24	AZ	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	CA	0.001	0	0.004	0.002	0.001		0.008	1.38%	-42.86%
CABI1	2018	base18b36k	PN3	24	CAN	0.003	0	0.041	0.016	0.015		0.075	12.93%	2.74%
CABI1	2018	base18b36k	PN3	24	CEN	0	0	0	0	0		0	0.00%	-100.00%
CABI1	2018	base18b36k	PN3	24	CO	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	EUS	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	ID	0.007	0.001	0.026	0.038	0.009		0.081	13.97%	-26.36%
CABI1	2018	base18b36k	PN3	24	MEX	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	MT	0.006	0.003	0.047	0.009	0.014		0.079	13.62%	-30.70%
CABI1	2018	base18b36k	PN3	24	ND	0	0	0	0	0.001		0.001	0.17%	-50.00%
CABI1	2018	base18b36k	PN3	24	NM	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	NV	0	0	0.001	0	0.003		0.004	0.69%	0.00%
CABI1	2018	base18b36k	PN3	24	OD						0.119	0.119	20.52%	8.18%
CABI1	2018	base18b36k	PN3	24	OR	0.004	0.002	0.019	0.004	0.015		0.044	7.59%	-25.42%
CABI1	2018	base18b36k	PN3	24	PO	0	0	0.004	0.009	0.001		0.014	2.41%	7.69%
CABI1	2018	base18b36k	PN3	24	SD	0	0	0	0	0		0	0.00%	0.00%
CABI1	2018	base18b36k	PN3	24	UT	0	0	0.002	0	0.002		0.004	0.69%	-42.86%
CABI1	2018	base18b36k	PN3	24	WA	0.022	0.005	0.082	0.015	0.021		0.145	25.00%	-43.58%
CABI1	2018	base18b36k	PN3	24	WY	0	0	0.001	0.002	0.003		0.006	1.03%	0.00%
Total						0.043	0.011	0.227	0.095	0.085	0.119	0.58	100.00%	-24.68%
Percent by Source Type						**7.41%**	**1.90%**	**39.14%**	**16.38%**	**14.66%**	**20.52%**	**100.00%**		
Idaho Percent Total Contribution						**1.21%**	**0.17%**	**4.48%**	**6.55%**	**1.55%**	**0.00%**	**13.97%**		

Eagle Cap Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
STAR1	2002	plan02c36k	PS4	23	AZ	0	0	0	0	0.001		0.001	**0.14%**
STAR1	2002	plan02c36k	PS4	23	CA	0.001	0	0.001	0.001	0.003		0.006	**0.86%**
STAR1	2002	plan02c36k	PS4	23	CAN	0	0	0.002	0.024	0.079		0.105	**15.09%**
STAR1	2002	plan02c36k	PS4	23	CEN	0	0	0	0	0.002		0.002	**0.29%**
STAR1	2002	plan02c36k	PS4	23	CO	0	0	0	0	0		0	**0.00%**
STAR1	2002	plan02c36k	PS4	23	EUS	0	0	0	0	0.002		0.002	**0.29%**
STAR1	2002	plan02c36k	PS4	23	ID	0.001	0.001	0.006	0.006	0.01		0.024	**3.45%**
STAR1	2002	plan02c36k	PS4	23	MEX	0	0	0	0	0.002		0.002	**0.29%**
STAR1	2002	plan02c36k	PS4	23	MT	0	0	0.001	0.001	0.003		0.005	**0.72%**
STAR1	2002	plan02c36k	PS4	23	ND	0	0	0	0	0.01		0.01	**1.44%**
STAR1	2002	plan02c36k	PS4	23	NM	0	0	0	0	0		0	**0.00%**
STAR1	2002	plan02c36k	PS4	23	NV	0	0	0.001	0.002	0.009		0.012	**1.72%**
STAR1	2002	plan02c36k	PS4	23	OR	0.004	0.004	0.017	0.009	0.036		0.07	**10.06%**
STAR1	2002	plan02c36k	PS4	23	PO	0	0	0.002	0.02	0.001		0.023	**3.30%**
STAR1	2002	plan02c36k	PS4	23	SD	0	0	0	0	0		0	**0.00%**
STAR1	2002	plan02c36k	PS4	23	UT	0	0	0	0	0.001		0.001	**0.14%**
STAR1	2002	plan02c36k	PS4	23	WA	0.003	0.002	0.024	0.01	0.061		0.1	**14.37%**
STAR1	2002	plan02c36k	PS4	23	WY	0	0	0	0	0.004		0.004	**0.57%**
STAR1	2002	plan02c36k	PS4	23	OD						0.329	0.329	**47.27%**
Total						**0.009**	**0.007**	**0.054**	**0.073**	**0.224**	**0.329**	**0.696**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
STAR1	2018	base18b36k	PS4	23	AZ	0	0	0	0	0.001		0.001	0.15%	0.00%
STAR1	2018	base18b36k	PS4	23	CA	0.001	0	0.001	0.001	0.003		0.006	0.89%	0.00%
STAR1	2018	base18b36k	PS4	23	CAN	0	0	0.002	0.023	0.078		0.103	15.33%	-1.90%
STAR1	2018	base18b36k	PS4	23	CEN	0	0	0	0	0.001		0.001	0.15%	-50.00%
STAR1	2018	base18b36k	PS4	23	CO	0	0	0	0	0		0	0.00%	#DIV/0!
STAR1	2018	base18b36k	PS4	23	EUS	0	0	0	0	0.001		0.001	0.15%	-50.00%
STAR1	2018	base18b36k	PS4	23	ID	0.001	0.001	0.001	0.007	0.012		0.022	3.27%	-8.33%
STAR1	2018	base18b36k	PS4	23	MEX	0	0	0	0	0.002		0.002	0.30%	0.00%
STAR1	2018	base18b36k	PS4	23	MT	0	0	0	0.001	0.004		0.005	0.74%	0.00%
STAR1	2018	base18b36k	PS4	23	ND	0	0	0	0	0.011		0.011	1.64%	10.00%
STAR1	2018	base18b36k	PS4	23	NM	0	0	0	0	0		0	0.00%	#DIV/0!
STAR1	2018	base18b36k	PS4	23	NV	0	0	0	0.002	0.011		0.013	1.93%	8.33%
STAR1	2018	base18b36k	PS4	23	OR	0.004	0.003	0.005	0.009	0.043		0.064	9.52%	-8.57%
STAR1	2018	base18b36k	PS4	23	PO	0	0	0.001	0.019	0.001		0.021	3.13%	-8.70%
STAR1	2018	base18b36k	PS4	23	SD	0	0	0	0	0		0	0.00%	0.00%
STAR1	2018	base18b36k	PS4	23	UT	0	0	0	0	0.001		0.001	0.15%	0.00%
STAR1	2018	base18b36k	PS4	23	WA	0.003	0.001	0.003	0.011	0.069		0.087	12.95%	-13.00%
STAR1	2018	base18b36k	PS4	23	WY	0	0	0	0.001	0.005		0.006	0.89%	50.00%
STAR1	2018	base18b36k	PS4	23	OD						0.328	0.328	48.81%	-0.30%
Total						0.009	0.005	0.013	0.074	0.243	0.328	0.672	100.00%	-3.45%
Percent by Source Type						**1.34%**	**0.74%**	**1.93%**	**11.01%**	**36.16%**	**48.81%**	**100.00%**		
Idaho Percent Total Contribution						**0.15%**	**0.15%**	**0.15%**	**1.04%**	**1.79%**	**0.00%**	**3.27%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
STAR1	2002	plan02c36k	PN3	23	AZ	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	CA	0.003	0.001	0.033	0.005	0.003		0.045	3.93%
STAR1	2002	plan02c36k	PN3	23	CAN	0.006	0	0.029	0.015	0.016		0.066	5.77%
STAR1	2002	plan02c36k	PN3	23	CEN	0	0	0.001	0	0		0.001	0.09%
STAR1	2002	plan02c36k	PN3	23	CO	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	EUS	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	ID	0.014	0.004	0.12	0.071	0.018		0.227	19.84%
STAR1	2002	plan02c36k	PN3	23	MEX	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	MT	0.002	0.001	0.013	0.001	0.004		0.021	1.84%
STAR1	2002	plan02c36k	PN3	23	ND	0	0	0.001	0	0.002		0.003	0.26%
STAR1	2002	plan02c36k	PN3	23	NM	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	NV	0.003	0	0.02	0.001	0.018		0.042	3.67%
STAR1	2002	plan02c36k	PN3	23	OR	0.033	0.013	0.197	0.011	0.045		0.299	26.14%
STAR1	2002	plan02c36k	PN3	23	PO	0	0	0.003	0.008	0.001		0.012	1.05%
STAR1	2002	plan02c36k	PN3	23	SD	0	0	0	0	0		0	0.00%
STAR1	2002	plan02c36k	PN3	23	UT	0	0	0.009	0	0.003		0.012	1.05%
STAR1	2002	plan02c36k	PN3	23	WA	0.018	0.017	0.163	0.008	0.016		0.222	19.41%
STAR1	2002	plan02c36k	PN3	23	WY	0	0	0.002	0.001	0.003		0.006	0.52%
STAR1	2002	plan02c36k	PN3	23	OD						0.188	0.188	16.43%
Total						**0.079**	**0.036**	**0.591**	**0.121**	**0.129**	**0.188**	**1.144**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
STAR1	2018	base18b36k	PN3	23	AZ	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	CA	0.003	0	0.014	0.005	0.004		0.026	**2.97%**	**-42.22%**
STAR1	2018	base18b36k	PN3	23	CAN	0.005	0	0.028	0.015	0.016		0.064	**7.31%**	**-3.03%**
STAR1	2018	base18b36k	PN3	23	CEN	0	0	0	0	0		0	**0.00%**	**-100.00%**
STAR1	2018	base18b36k	PN3	23	CO	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	EUS	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	ID	0.013	0.002	0.046	0.097	0.02		0.178	**20.32%**	**-21.59%**
STAR1	2018	base18b36k	PN3	23	MEX	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	MT	0.002	0	0.007	0.002	0.004		0.015	**1.71%**	**-28.57%**
STAR1	2018	base18b36k	PN3	23	ND	0	0	0.001	0	0.002		0.003	**0.34%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	NM	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	NV	0.003	0	0.012	0.001	0.022		0.038	**4.34%**	**-9.52%**
STAR1	2018	base18b36k	PN3	23	OR	0.032	0.01	0.102	0.012	0.056		0.212	**24.20%**	**-29.10%**
STAR1	2018	base18b36k	PN3	23	PO	0	0	0.002	0.008	0.001		0.011	**1.26%**	**-8.33%**
STAR1	2018	base18b36k	PN3	23	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	UT	0	0	0.004	0.001	0.003		0.008	**0.91%**	**-33.33%**
STAR1	2018	base18b36k	PN3	23	WA	0.017	0.007	0.068	0.009	0.019		0.12	**13.70%**	**-45.95%**
STAR1	2018	base18b36k	PN3	23	WY	0	0	0.001	0.002	0.003		0.006	**0.68%**	**0.00%**
STAR1	2018	base18b36k	PN3	23	OD						0.195	0.195	**22.26%**	**3.72%**
Total						0.075	0.019	0.285	0.152	0.15	0.195	0.876	**100.00%**	**-23.43%**
Percent by Source Type						**8.56%**	**2.17%**	**32.53%**	**17.35%**	**17.12%**	**22.26%**	**100.00%**		
Idaho Percent Total Contribution						**1.48%**	**0.23%**	**5.25%**	**11.07%**	**2.28%**	**0.00%**	**20.32%**		

Jarbidge Wilderness

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
JARB1	2002	plan02c36k	PS4	21	AZ	0	0	0	0	0.003		0.003	**0.57%**
JARB1	2002	plan02c36k	PS4	21	CA	0.007	0	0.003	0.003	0.011		0.024	**4.59%**
JARB1	2002	plan02c36k	PS4	21	CAN	0	0	0.001	0.01	0.012		0.023	**4.40%**
JARB1	2002	plan02c36k	PS4	21	CEN	0	0	0.001	0.001	0.008		0.01	**1.91%**
JARB1	2002	plan02c36k	PS4	21	CO	0	0	0	0	0.002		0.002	**0.38%**
JARB1	2002	plan02c36k	PS4	21	EUS	0	0	0	0.001	0.014		0.015	**2.87%**
JARB1	2002	plan02c36k	PS4	21	ID	0.027	0	0.006	0.005	0.012		0.05	**9.56%**
JARB1	2002	plan02c36k	PS4	21	MEX	0	0	0	0.002	0.011		0.013	**2.49%**
JARB1	2002	plan02c36k	PS4	21	MT	0	0	0	0	0.001		0.001	**0.19%**
JARB1	2002	plan02c36k	PS4	21	ND	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PS4	21	NM	0	0	0	0	0.002		0.002	**0.38%**
JARB1	2002	plan02c36k	PS4	21	NV	0.005	0	0.002	0.003	0.014		0.024	**4.59%**
JARB1	2002	plan02c36k	PS4	21	OR	0.011	0.001	0.008	0.005	0.015		0.04	**7.65%**
JARB1	2002	plan02c36k	PS4	21	PO	0	0	0.002	0.028	0.004		0.034	**6.50%**
JARB1	2002	plan02c36k	PS4	21	SD	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PS4	21	UT	0	0	0.002	0	0.006		0.008	**1.53%**
JARB1	2002	plan02c36k	PS4	21	WA	0.001	0.001	0.011	0.004	0.028		0.045	**8.60%**
JARB1	2002	plan02c36k	PS4	21	WY	0.002	0	0	0.001	0.005		0.008	**1.53%**
JARB1	2002	plan02c36k	PS4	21	OD						0.221	0.221	**42.26%**
Total						**0.053**	**0.002**	**0.036**	**0.063**	**0.148**	**0.221**	**0.523**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
JARB1	2018	base18b36k	PS4	21	AZ	0	0	0	0	0.003		0.003	**0.60%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	CA	0.007	0	0.002	0.003	0.013		0.025	**4.96%**	**4.17%**
JARB1	2018	base18b36k	PS4	21	CAN	0	0	0.001	0.01	0.012		0.023	**4.56%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	CEN	0	0	0	0.001	0.006		0.007	**1.39%**	**-30.00%**
JARB1	2018	base18b36k	PS4	21	CO	0	0	0	0	0.001		0.001	**0.20%**	**-50.00%**
JARB1	2018	base18b36k	PS4	21	EUS	0	0	0	0.001	0.006		0.007	**1.39%**	**-53.33%**
JARB1	2018	base18b36k	PS4	21	ID	0.027	0	0.001	0.005	0.018		0.051	**10.12%**	**2.00%**
JARB1	2018	base18b36k	PS4	21	MEX	0	0	0	0.003	0.011		0.014	**2.78%**	**7.69%**
JARB1	2018	base18b36k	PS4	21	MT	0	0	0	0	0.001		0.001	**0.20%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	ND	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	NM	0	0	0	0	0.002		0.002	**0.40%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	NV	0.005	0	0.001	0.004	0.018		0.028	**5.56%**	**16.67%**
JARB1	2018	base18b36k	PS4	21	OR	0.011	0.001	0.001	0.004	0.019		0.036	**7.14%**	**-10.00%**
JARB1	2018	base18b36k	PS4	21	PO	0	0	0.001	0.028	0.005		0.034	**6.75%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PS4	21	UT	0	0	0.001	0.001	0.008		0.01	**1.98%**	**25.00%**
JARB1	2018	base18b36k	PS4	21	WA	0.001	0	0.001	0.005	0.023		0.03	**5.95%**	**-33.33%**
JARB1	2018	base18b36k	PS4	21	WY	0.002	0	0	0.001	0.008		0.011	**2.18%**	**37.50%**
JARB1	2018	base18b36k	PS4	21	OD						0.221	0.221	**43.85%**	**0.00%**
Total						0.053	0.001	0.009	0.066	0.154	0.221	0.504	**100.00%**	**-3.63%**
Percent by Source Type						**10.52%**	**0.20%**	**1.79%**	**13.10%**	**30.56%**	**43.85%**	**100.00%**		
Idaho Percent Total Contribution						**5.36%**	**0.00%**	**0.20%**	**0.99%**	**3.57%**	**0.00%**	**10.12%**		

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
JARB1	2002	plan02c36k	PN3	21	AZ	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	CA	0.002	0	0.016	0.003	0.002		0.023	**7.59%**
JARB1	2002	plan02c36k	PN3	21	CAN	0	0	0.003	0.001	0.001		0.005	**1.65%**
JARB1	2002	plan02c36k	PN3	21	CEN	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	CO	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	EUS	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	ID	0.012	0.001	0.049	0.025	0.01		0.097	**32.01%**
JARB1	2002	plan02c36k	PN3	21	MEX	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	MT	0	0	0.001	0	0		0.001	**0.33%**
JARB1	2002	plan02c36k	PN3	21	ND	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	NM	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	NV	0.005	0	0.018	0.001	0.012		0.036	**11.88%**
JARB1	2002	plan02c36k	PN3	21	OR	0.002	0.001	0.009	0.001	0.002		0.015	**4.95%**
JARB1	2002	plan02c36k	PN3	21	PO	0	0	0.001	0.002	0		0.003	**0.99%**
JARB1	2002	plan02c36k	PN3	21	SD	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	UT	0.002	0	0.024	0.001	0.012		0.039	**12.87%**
JARB1	2002	plan02c36k	PN3	21	WA	0.002	0.002	0.014	0.001	0.001		0.02	**6.60%**
JARB1	2002	plan02c36k	PN3	21	WY	0	0	0	0	0		0	**0.00%**
JARB1	2002	plan02c36k	PN3	21	OD						0.064	0.064	**21.12%**
Total						**0.025**	**0.004**	**0.135**	**0.035**	**0.040**	**0.064**	**0.303**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
JARB1	2018	base18b36k	PN3	21	AZ	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	CA	0.001	0	0.006	0.003	0.002		0.012	**5.06%**	**-47.83%**
JARB1	2018	base18b36k	PN3	21	CAN	0	0	0.003	0.001	0.001		0.005	**2.11%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	CEN	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	CO	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	EUS	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	ID	0.011	0	0.018	0.033	0.011		0.073	**30.80%**	**-24.74%**
JARB1	2018	base18b36k	PN3	21	MEX	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	MT	0	0	0	0	0		0	**0.00%**	**-100.00%**
JARB1	2018	base18b36k	PN3	21	ND	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	NM	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	NV	0.005	0	0.011	0.001	0.015		0.032	**13.50%**	**-11.11%**
JARB1	2018	base18b36k	PN3	21	OR	0.002	0.001	0.004	0.001	0.003		0.011	**4.64%**	**-26.67%**
JARB1	2018	base18b36k	PN3	21	PO	0	0	0	0.002	0		0.002	**0.84%**	**-33.33%**
JARB1	2018	base18b36k	PN3	21	SD	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	UT	0.002	0	0.01	0.001	0.012		0.025	**10.55%**	**-35.90%**
JARB1	2018	base18b36k	PN3	21	WA	0.002	0.001	0.005	0.001	0.002		0.011	**4.64%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	WY	0	0	0	0	0		0	**0.00%**	**0.00%**
JARB1	2018	base18b36k	PN3	21	OD						0.066	0.066	**27.85%**	**3.13%**
Total						0.023	0.002	0.057	0.043	0.046	0.066	0.237	**100.00%**	**-21.78%**
Percent by Source Type						**9.70%**	**0.84%**	**24.05%**	**18.14%**	**19.41%**	**27.85%**	**100.00%**		
Idaho Percent Total Contribution						**4.64%**	**0.00%**	**7.59%**	**13.92%**	**4.64%**	**0.00%**	**30.80%**		

Glacier National Park

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
GLAC1	2002	plan02c36k	PN3	24	AZ	0	0	0.001	0	0		0.001	**0.09%**
GLAC1	2002	plan02c36k	PN3	24	CA	0.001	0	0.017	0.003	0.002		0.023	**2.06%**
GLAC1	2002	plan02c36k	PN3	24	CAN	0.01	0	0.108	0.064	0.061		0.243	**21.72%**
GLAC1	2002	plan02c36k	PN3	24	CEN	0	0	0.001	0	0		0.001	**0.09%**
GLAC1	2002	plan02c36k	PN3	24	CO	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PN3	24	ID	0.006	0.003	0.06	0.024	0.008		0.101	**9.03%**
GLAC1	2002	plan02c36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PN3	24	MT	0.016	0.011	0.178	0.017	0.034		0.256	**22.88%**
GLAC1	2002	plan02c36k	PN3	24	ND	0	0	0.001	0	0.001		0.002	**0.18%**
GLAC1	2002	plan02c36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PN3	24	NV	0.001	0	0.003	0	0.003		0.007	**0.63%**
GLAC1	2002	plan02c36k	PN3	24	OR	0.004	0.006	0.039	0.003	0.011		0.063	**5.63%**
GLAC1	2002	plan02c36k	PN3	24	PO	0	0	0.002	0.006	0.001		0.009	**0.80%**
GLAC1	2002	plan02c36k	PN3	24	SD	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PN3	24	UT	0	0	0.005	0	0.002		0.007	**0.63%**
GLAC1	2002	plan02c36k	PN3	24	WA	0.012	0.006	0.114	0.007	0.009		0.148	**13.23%**
GLAC1	2002	plan02c36k	PN3	24	WY	0	0	0.003	0.001	0.005		0.009	**0.80%**
GLAC1	2002	plan02c36k	PN3	24	OD						0.249	0.249	**22.25%**
Total						**0.249**	**1.119**	**1.000**	**0.000**	**0.000**	**0.000**	**1.119**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
GLAC1	2018	base18b36k	PN3	24	AZ	0	0	0	0	0		0	**0.00%**	**-100.00%**
GLAC1	2018	base18b36k	PN3	24	CA	0.001	0	0.007	0.003	0.002		0.013	**1.38%**	**-43.48%**
GLAC1	2018	base18b36k	PN3	24	CAN	0.011	0	0.109	0.065	0.062		0.247	**26.14%**	**1.65%**
GLAC1	2018	base18b36k	PN3	24	CEN	0	0	0	0	0		0	**0.00%**	**-100.00%**
GLAC1	2018	base18b36k	PN3	24	CO	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PN3	24	ID	0.006	0.001	0.024	0.034	0.01		0.075	**7.94%**	**-25.74%**
GLAC1	2018	base18b36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PN3	24	MT	0.016	0.007	0.105	0.023	0.039		0.19	**20.11%**	**-25.78%**
GLAC1	2018	base18b36k	PN3	24	ND	0	0	0.001	0	0.002		0.003	**0.32%**	**50.00%**
GLAC1	2018	base18b36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PN3	24	NV	0.001	0	0.002	0	0.004		0.007	**0.74%**	**0.00%**
GLAC1	2018	base18b36k	PN3	24	OR	0.004	0.006	0.019	0.003	0.014		0.046	**4.87%**	**-26.98%**
GLAC1	2018	base18b36k	PN3	24	PO	0	0	0.002	0.006	0.001		0.009	**0.95%**	**0.00%**
GLAC1	2018	base18b36k	PN3	24	SD	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PN3	24	UT	0	0	0.002	0	0.002		0.004	**0.42%**	**-42.86%**
GLAC1	2018	base18b36k	PN3	24	WA	0.012	0.005	0.048	0.008	0.011		0.084	**8.89%**	**-43.24%**
GLAC1	2018	base18b36k	PN3	24	WY	0	0	0.002	0.003	0.004		0.009	**0.95%**	**0.00%**
GLAC1	2018	base18b36k	PN3	24	OD						0.258	0.258	**27.30%**	**3.61%**
Total						0.051	0.019	0.321	0.145	0.151	0.258	0.945	**100.00%**	**-15.55%**
Percent by Source Type						**5.40%**	**2.01%**	**33.97%**	**15.34%**	**15.98%**	**27.30%**	**100.00%**		
Idaho Percent Total Contribution						**0.63%**	**0.11%**	**2.54%**	**3.60%**	**1.06%**	**0.00%**	**7.94%**		

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	**Total**	**Percent Contribution**
GLAC1	2002	plan02c36k	PS4	24	AZ	0	0	0	0	0.001		0.001	**0.12%**
GLAC1	2002	plan02c36k	PS4	24	CA	0.001	0	0.001	0.001	0.003		0.006	**0.72%**
GLAC1	2002	plan02c36k	PS4	24	CAN	0	0	0.004	0.044	0.14		0.188	**22.60%**
GLAC1	2002	plan02c36k	PS4	24	CEN	0	0	0	0	0.002		0.002	**0.24%**
GLAC1	2002	plan02c36k	PS4	24	CO	0	0	0	0	0.001		0.001	**0.12%**
GLAC1	2002	plan02c36k	PS4	24	EUS	0	0	0	0	0.003		0.003	**0.36%**
GLAC1	2002	plan02c36k	PS4	24	ID	0.001	0.002	0.006	0.005	0.005		0.019	**2.28%**
GLAC1	2002	plan02c36k	PS4	24	MEX	0	0	0	0	0.002		0.002	**0.24%**
GLAC1	2002	plan02c36k	PS4	24	MT	0.004	0.008	0.021	0.017	0.027		0.077	**9.25%**
GLAC1	2002	plan02c36k	PS4	24	ND	0	0	0	0	0.009		0.009	**1.08%**
GLAC1	2002	plan02c36k	PS4	24	NM	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PS4	24	NV	0.001	0	0	0.001	0.004		0.006	**0.72%**
GLAC1	2002	plan02c36k	PS4	24	OR	0.005	0.003	0.006	0.004	0.021		0.039	**4.69%**
GLAC1	2002	plan02c36k	PS4	24	PO	0	0	0.001	0.011	0.001		0.013	**1.56%**
GLAC1	2002	plan02c36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**
GLAC1	2002	plan02c36k	PS4	24	UT	0	0	0	0	0.002		0.002	**0.24%**
GLAC1	2002	plan02c36k	PS4	24	WA	0.002	0.002	0.015	0.006	0.025		0.05	**6.01%**
GLAC1	2002	plan02c36k	PS4	24	WY	0	0	0	0.001	0.007		0.008	**0.96%**
GLAC1	2002	plan02c36k	PS4	24	OD						0.406	0.406	**48.80%**
Total						**0.406**	**0.832**	**1.000**	**0.000**	**0.000**	**0.000**	**0.832**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
GLAC1	2018	base18b36k	PS4	24	AZ	0	0	0	0	0.001		0.001	**0.12%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	CA	0.001	0	0	0.001	0.003		0.005	**0.60%**	**-16.67%**
GLAC1	2018	base18b36k	PS4	24	CAN	0	0	0.004	0.045	0.145		0.194	**23.35%**	**3.19%**
GLAC1	2018	base18b36k	PS4	24	CEN	0	0	0	0	0.002		0.002	**0.24%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	CO	0	0	0	0	0		0	**0.00%**	**-100.00%**
GLAC1	2018	base18b36k	PS4	24	EUS	0	0	0	0	0.001		0.001	**0.12%**	**-66.67%**
GLAC1	2018	base18b36k	PS4	24	ID	0.001	0.001	0.001	0.006	0.007		0.016	**1.93%**	**-15.79%**
GLAC1	2018	base18b36k	PS4	24	MEX	0	0	0	0	0.002		0.002	**0.24%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	MT	0.004	0.005	0.007	0.02	0.048		0.084	**10.11%**	**9.09%**
GLAC1	2018	base18b36k	PS4	24	ND	0	0	0	0	0.009		0.009	**1.08%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	NM	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PS4	24	NV	0	0	0	0.001	0.004		0.005	**0.60%**	**-16.67%**
GLAC1	2018	base18b36k	PS4	24	OR	0.005	0.003	0.001	0.004	0.027		0.04	**4.81%**	**2.56%**
GLAC1	2018	base18b36k	PS4	24	PO	0	0	0.001	0.011	0.001		0.013	**1.56%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
GLAC1	2018	base18b36k	PS4	24	UT	0	0	0	0	0.002		0.002	**0.24%**	**0.00%**
GLAC1	2018	base18b36k	PS4	24	WA	0.002	0.002	0.002	0.007	0.027		0.04	**4.81%**	**-20.00%**
GLAC1	2018	base18b36k	PS4	24	WY	0	0	0	0.001	0.008		0.009	**1.08%**	**12.50%**
GLAC1	2018	base18b36k	PS4	24	OD						0.408	0.408	**49.10%**	**0.49%**
Total						0.013	0.011	0.016	0.096	0.287	0.408	0.831	**100.00%**	**-0.12%**
Percent by Source Type						**1.56%**	**1.32%**	**1.93%**	**11.55%**	**34.54%**	**49.10%**	**100.00%**		
Idaho % Total Contribution						**0.12%**	**0.12%**	**0.12%**	**0.72%**	**0.84%**	**0.00%**	**1.93%**		

Bob Marshall Wilderness

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
MONT1	2002	plan02c36k	PN3	24	AZ	0	0	0.001	0	0		0.001	**0.18%**
MONT1	2002	plan02c36k	PN3	24	CA	0	0	0.003	0	0		0.003	**0.54%**
MONT1	2002	plan02c36k	PN3	24	CAN	0.004	0	0.029	0.016	0.016		0.065	**11.63%**
MONT1	2002	plan02c36k	PN3	24	CEN	0	0	0.002	0	0.001		0.003	**0.54%**
MONT1	2002	plan02c36k	PN3	24	CO	0	0	0.001	0	0.001		0.002	**0.36%**
MONT1	2002	plan02c36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**
MONT1	2002	plan02c36k	PN3	24	ID	0.007	0.002	0.024	0.008	0.003		0.044	**7.87%**
MONT1	2002	plan02c36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**
MONT1	2002	plan02c36k	PN3	24	MT	0.017	0.007	0.122	0.01	0.029		0.185	**33.09%**
MONT1	2002	plan02c36k	PN3	24	ND	0.001	0	0.001	0	0.002		0.004	**0.72%**
MONT1	2002	plan02c36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**
MONT1	2002	plan02c36k	PN3	24	NV	0	0	0.001	0	0.001		0.002	**0.36%**
MONT1	2002	plan02c36k	PN3	24	OR	0.002	0.002	0.011	0.001	0.004		0.02	**3.58%**
MONT1	2002	plan02c36k	PN3	24	PO	0	0	0.001	0.001	0		0.002	**0.36%**
MONT1	2002	plan02c36k	PN3	24	SD	0	0	0.001	0	0		0.001	**0.18%**
MONT1	2002	plan02c36k	PN3	24	UT	0	0	0.005	0	0.002		0.007	**1.25%**
MONT1	2002	plan02c36k	PN3	24	WA	0.006	0.005	0.04	0.002	0.003		0.056	**10.02%**
MONT1	2002	plan02c36k	PN3	24	WY	0	0	0.006	0.002	0.009		0.017	**3.04%**
MONT1	2002	plan02c36k	PN3	24	OD						0.147	0.147	**26.30%**
Total						**0.147**	**0.559**	**1.000**	**0.000**	**0.000**	**0.000**	**0.559**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
MONT1	2018	base18b36k	PN3	24	AZ	0	0	0	0	0		0	**0.00%**	**-100.00%**
MONT1	2018	base18b36k	PN3	24	CA	0	0	0.001	0	0		0.001	**0.22%**	**-66.67%**
MONT1	2018	base18b36k	PN3	24	CAN	0.004	0	0.029	0.017	0.017		0.067	**14.66%**	**3.08%**
MONT1	2018	base18b36k	PN3	24	CEN	0	0	0.001	0	0.001		0.002	**0.44%**	**-33.33%**
MONT1	2018	base18b36k	PN3	24	CO	0	0	0	0	0.001		0.001	**0.22%**	**-50.00%**
MONT1	2018	base18b36k	PN3	24	EUS	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
MONT1	2018	base18b36k	PN3	24	ID	0.007	0.001	0.009	0.011	0.004		0.032	**7.00%**	**-27.27%**
MONT1	2018	base18b36k	PN3	24	MEX	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
MONT1	2018	base18b36k	PN3	24	MT	0.016	0.003	0.057	0.015	0.035		0.126	**27.57%**	**-31.89%**
MONT1	2018	base18b36k	PN3	24	ND	0.001	0	0.001	0.001	0.002		0.005	**1.09%**	**25.00%**
MONT1	2018	base18b36k	PN3	24	NM	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
MONT1	2018	base18b36k	PN3	24	NV	0	0	0	0	0.001		0.001	**0.22%**	**-50.00%**
MONT1	2018	base18b36k	PN3	24	OR	0.002	0.001	0.006	0.001	0.005		0.015	**3.28%**	**-25.00%**
MONT1	2018	base18b36k	PN3	24	PO	0	0	0.001	0.001	0		0.002	**0.44%**	**0.00%**
MONT1	2018	base18b36k	PN3	24	SD	0	0	0	0	0		0	**0.00%**	**-100.00%**
MONT1	2018	base18b36k	PN3	24	UT	0	0	0.002	0	0.002		0.004	**0.88%**	**-42.86%**
MONT1	2018	base18b36k	PN3	24	WA	0.006	0.003	0.017	0.003	0.004		0.033	**7.22%**	**-41.07%**
MONT1	2018	base18b36k	PN3	24	WY	0	0	0.003	0.005	0.007		0.015	**3.28%**	**-11.76%**
MONT1	2018	base18b36k	PN3	24	OD						0.153	0.153	**33.48%**	**4.08%**
Total						0.036	0.008	0.127	0.054	0.079	0.153	0.457	**100.00%**	**-18.25%**
Percent by Source Type						**7.88%**	**1.75%**	**27.79%**	**11.82%**	**17.29%**	**33.48%**	**100.00%**		
Idaho Percent Total Contribution						**1.53%**	**0.22%**	**1.97%**	**2.41%**	**0.88%**	**0.00%**	**7.00%**		

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
MONT1	2002	plan02c36k	PS4	24	AZ	0	0	0	0	0.001		0.001	**0.15%**
MONT1	2002	plan02c36k	PS4	24	CA	0.001	0	0.001	0.001	0.004		0.007	**1.07%**
MONT1	2002	plan02c36k	PS4	24	CAN	0	0	0.002	0.021	0.075		0.098	**15.03%**
MONT1	2002	plan02c36k	PS4	24	CEN	0	0	0.001	0.001	0.007		0.009	**1.38%**
MONT1	2002	plan02c36k	PS4	24	CO	0	0	0	0	0.003		0.003	**0.46%**
MONT1	2002	plan02c36k	PS4	24	EUS	0	0	0	0	0.003		0.003	**0.46%**
MONT1	2002	plan02c36k	PS4	24	ID	0.022	0.001	0.003	0.002	0.003		0.031	**4.75%**
MONT1	2002	plan02c36k	PS4	24	MEX	0	0	0	0.001	0.005		0.006	**0.92%**
MONT1	2002	plan02c36k	PS4	24	MT	0.002	0.005	0.011	0.007	0.02		0.045	**6.90%**
MONT1	2002	plan02c36k	PS4	24	ND	0	0	0	0	0.008		0.008	**1.23%**
MONT1	2002	plan02c36k	PS4	24	NM	0	0	0	0	0.001		0.001	**0.15%**
MONT1	2002	plan02c36k	PS4	24	NV	0.001	0	0	0.001	0.003		0.005	**0.77%**
MONT1	2002	plan02c36k	PS4	24	OR	0.007	0.001	0.004	0.003	0.011		0.026	**3.99%**
MONT1	2002	plan02c36k	PS4	24	PO	0	0	0.001	0.012	0.001		0.014	**2.15%**
MONT1	2002	plan02c36k	PS4	24	SD	0	0	0	0	0		0	**0.00%**
MONT1	2002	plan02c36k	PS4	24	UT	0	0	0.001	0	0.003		0.004	**0.61%**
MONT1	2002	plan02c36k	PS4	24	WA	0.003	0.002	0.012	0.005	0.023		0.045	**6.90%**
MONT1	2002	plan02c36k	PS4	24	WY	0	0	0.001	0.002	0.016		0.019	**2.91%**
MONT1	2002	plan02c36k	PS4	24	OD						0.327	0.327	**50.15%**
Total						**0.327**	**0.652**	**1.000**	**0.000**	**0.000**	**0.000**	**0.652**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
MONT1	2018	base18b36k	PS4	24	AZ	0	0	0	0	0.002		0.002	0.31%	100.00%
MONT1	2018	base18b36k	PS4	24	CA	0.001	0	0.001	0.001	0.005		0.008	1.24%	14.29%
MONT1	2018	base18b36k	PS4	24	CAN	0	0	0.002	0.022	0.08		0.104	16.17%	6.12%
MONT1	2018	base18b36k	PS4	24	CEN	0	0	0	0.001	0.005		0.006	0.93%	-33.33%
MONT1	2018	base18b36k	PS4	24	CO	0	0	0	0	0.003		0.003	0.47%	0.00%
MONT1	2018	base18b36k	PS4	24	EUS	0	0	0	0	0.001		0.001	0.16%	-66.67%
MONT1	2018	base18b36k	PS4	24	ID	0.022	0	0.001	0.002	0.005		0.03	4.67%	-3.23%
MONT1	2018	base18b36k	PS4	24	MEX	0	0	0	0.001	0.005		0.006	0.93%	0.00%
MONT1	2018	base18b36k	PS4	24	MT	0.002	0.002	0.003	0.007	0.032		0.046	7.15%	2.22%
MONT1	2018	base18b36k	PS4	24	ND	0	0	0	0	0.009		0.009	1.40%	12.50%
MONT1	2018	base18b36k	PS4	24	NM	0	0	0	0	0.001		0.001	0.16%	0.00%
MONT1	2018	base18b36k	PS4	24	NV	0.001	0	0	0.001	0.002		0.004	0.62%	-20.00%
MONT1	2018	base18b36k	PS4	24	OR	0.007	0.001	0	0.002	0.013		0.023	3.58%	-11.54%
MONT1	2018	base18b36k	PS4	24	PO	0	0	0.001	0.012	0.002		0.015	2.33%	7.14%
MONT1	2018	base18b36k	PS4	24	SD	0	0	0	0	0		0	0.00%	#DIV/0!
MONT1	2018	base18b36k	PS4	24	UT	0	0	0	0	0.004		0.004	0.62%	0.00%
MONT1	2018	base18b36k	PS4	24	WA	0.003	0.001	0.001	0.005	0.021		0.031	4.82%	-31.11%
MONT1	2018	base18b36k	PS4	24	WY	0	0	0	0.003	0.02		0.023	3.58%	21.05%
MONT1	2018	base18b36k	PS4	24	OD						0.327	0.327	50.86%	0.00%
Total						0.036	0.004	0.009	0.057	0.21	0.327	0.643	100.00%	-1.38%
Percent by Source Type						**5.60%**	**0.62%**	**1.40%**	**8.86%**	**32.66%**	**50.86%**	**100.00%**		
Idaho Percent Total Contribution						**3.42%**	**0.00%**	**0.16%**	**0.31%**	**0.78%**	**0.00%**	**4.67%**		

Gates of the Mountain Wilderness

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
GAMO1	2002	plan02c36k	PN3	23	AZ	0	0	0.001	0	0		0.001	**0.22%**
GAMO1	2002	plan02c36k	PN3	23	CA	0	0	0.002	0	0		0.002	**0.43%**
GAMO1	2002	plan02c36k	PN3	23	CAN	0.003	0	0.026	0.02	0.019		0.068	**14.69%**
GAMO1	2002	plan02c36k	PN3	23	CEN	0	0	0.001	0	0		0.001	**0.22%**
GAMO1	2002	plan02c36k	PN3	23	CO	0	0	0.001	0	0		0.001	**0.22%**
GAMO1	2002	plan02c36k	PN3	23	EUS	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PN3	23	ID	0.007	0.001	0.016	0.005	0.002		0.031	**6.70%**
GAMO1	2002	plan02c36k	PN3	23	MEX	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PN3	23	MT	0.019	0.001	0.09	0.008	0.029		0.147	**31.75%**
GAMO1	2002	plan02c36k	PN3	23	ND	0	0	0.001	0	0.001		0.002	**0.43%**
GAMO1	2002	plan02c36k	PN3	23	NM	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PN3	23	NV	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PN3	23	OR	0.001	0.001	0.007	0	0.003		0.012	**2.59%**
GAMO1	2002	plan02c36k	PN3	23	PO	0	0	0.001	0.001	0		0.002	**0.43%**
GAMO1	2002	plan02c36k	PN3	23	SD	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PN3	23	UT	0	0	0.003	0	0.002		0.005	**1.08%**
GAMO1	2002	plan02c36k	PN3	23	WA	0.005	0.005	0.032	0.002	0.003		0.047	**10.15%**
GAMO1	2002	plan02c36k	PN3	23	WY	0	0	0.004	0.002	0.007		0.013	**2.81%**
GAMO1	2002	plan02c36k	PN3	23	OD						0.131	0.131	**28.29%**
Total						**0.131**	**0.463**	**1.000**	**0.000**	**0.000**	**0.000**	**0.463**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
GAMO1	2018	base18b36k	PN3	23	AZ	0	0	0	0	0		0	0.00%	-100.00%
GAMO1	2018	base18b36k	PN3	23	CA	0	0	0.001	0	0		0.001	0.26%	-50.00%
GAMO1	2018	base18b36k	PN3	23	CAN	0.003	0	0.026	0.02	0.019		0.068	17.53%	0.00%
GAMO1	2018	base18b36k	PN3	23	CEN	0	0	0	0	0		0	0.00%	-100.00%
GAMO1	2018	base18b36k	PN3	23	CO	0	0	0	0	0		0	0.00%	-100.00%
GAMO1	2018	base18b36k	PN3	23	EUS	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PN3	23	ID	0.007	0	0.006	0.007	0.003		0.023	5.93%	-25.81%
GAMO1	2018	base18b36k	PN3	23	MEX	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PN3	23	MT	0.017	0.001	0.042	0.013	0.038		0.111	28.61%	-24.49%
GAMO1	2018	base18b36k	PN3	23	ND	0	0	0	0	0.001		0.001	0.26%	-50.00%
GAMO1	2018	base18b36k	PN3	23	NM	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PN3	23	NV	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PN3	23	OR	0.001	0	0.004	0.001	0.003		0.009	2.32%	-25.00%
GAMO1	2018	base18b36k	PN3	23	PO	0	0	0.001	0.001	0		0.002	0.52%	0.00%
GAMO1	2018	base18b36k	PN3	23	SD	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PN3	23	UT	0	0	0.001	0	0.001		0.002	0.52%	-60.00%
GAMO1	2018	base18b36k	PN3	23	WA	0.005	0.002	0.013	0.002	0.003		0.025	6.44%	-46.81%
GAMO1	2018	base18b36k	PN3	23	WY	0	0	0.003	0.003	0.005		0.011	2.84%	-15.38%
GAMO1	2018	base18b36k	PN3	23	OD						0.135	0.135	34.79%	3.05%
Total						0.033	0.003	0.097	0.047	0.073	0.135	0.388	100.00%	-16.20%
Percent by Source Type						**8.51%**	**0.77%**	**25.00%**	**12.11%**	**18.81%**	**34.79%**	**100.00%**		
Idaho Percent Total Contribution						**1.80%**	**0.00%**	**1.55%**	**1.80%**	**0.77%**	**0.00%**	**5.93%**		

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
GAMO1	2002	plan02c36k	PS4	23	AZ	0	0	0	0	0.002		0.002	**0.28%**
GAMO1	2002	plan02c36k	PS4	23	CA	0.002	0	0.001	0.001	0.004		0.008	**1.12%**
GAMO1	2002	plan02c36k	PS4	23	CAN	0	0	0.003	0.034	0.115		0.152	**21.32%**
GAMO1	2002	plan02c36k	PS4	23	CEN	0	0	0	0.001	0.005		0.006	**0.84%**
GAMO1	2002	plan02c36k	PS4	23	CO	0	0	0	0	0.002		0.002	**0.28%**
GAMO1	2002	plan02c36k	PS4	23	EUS	0	0	0	0	0.006		0.006	**0.84%**
GAMO1	2002	plan02c36k	PS4	23	ID	0.021	0.001	0.003	0.002	0.004		0.031	**4.35%**
GAMO1	2002	plan02c36k	PS4	23	MEX	0	0	0	0.001	0.005		0.006	**0.84%**
GAMO1	2002	plan02c36k	PS4	23	MT	0.001	0.001	0.016	0.009	0.026		0.053	**7.43%**
GAMO1	2002	plan02c36k	PS4	23	ND	0	0	0	0	0.009		0.009	**1.26%**
GAMO1	2002	plan02c36k	PS4	23	NM	0	0	0	0	0.001		0.001	**0.14%**
GAMO1	2002	plan02c36k	PS4	23	NV	0.001	0	0	0.001	0.003		0.005	**0.70%**
GAMO1	2002	plan02c36k	PS4	23	OR	0.007	0.001	0.004	0.002	0.01		0.024	**3.37%**
GAMO1	2002	plan02c36k	PS4	23	PO	0	0	0.001	0.012	0.002		0.015	**2.10%**
GAMO1	2002	plan02c36k	PS4	23	SD	0	0	0	0	0		0	**0.00%**
GAMO1	2002	plan02c36k	PS4	23	UT	0	0	0.001	0	0.003		0.004	**0.56%**
GAMO1	2002	plan02c36k	PS4	23	WA	0.004	0.002	0.011	0.004	0.02		0.041	**5.75%**
GAMO1	2002	plan02c36k	PS4	23	WY	0.001	0	0.001	0.002	0.011		0.015	**2.10%**
GAMO1	2002	plan02c36k	PS4	23	OD						0.333	0.333	**46.70%**
Total						**0.333**	**0.713**	**1.000**	**0.000**	**0.000**	**0.000**	**0.713**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
GAMO1	2018	base18b36k	PS4	23	AZ	0	0	0	0	0.002		0.002	0.28%	0.00%
GAMO1	2018	base18b36k	PS4	23	CA	0.002	0	0.001	0.001	0.005		0.009	1.28%	12.50%
GAMO1	2018	base18b36k	PS4	23	CAN	0	0	0.003	0.035	0.12		0.158	22.44%	3.95%
GAMO1	2018	base18b36k	PS4	23	CEN	0	0	0	0.001	0.003		0.004	0.57%	-33.33%
GAMO1	2018	base18b36k	PS4	23	CO	0	0	0	0	0.001		0.001	0.14%	-50.00%
GAMO1	2018	base18b36k	PS4	23	EUS	0	0	0	0	0.003		0.003	0.43%	-50.00%
GAMO1	2018	base18b36k	PS4	23	ID	0.021	0	0.001	0.002	0.005		0.029	4.12%	-6.45%
GAMO1	2018	base18b36k	PS4	23	MEX	0	0	0	0.001	0.005		0.006	0.85%	0.00%
GAMO1	2018	base18b36k	PS4	23	MT	0.001	0	0.005	0.009	0.044		0.059	8.38%	11.32%
GAMO1	2018	base18b36k	PS4	23	ND	0	0	0	0	0.009		0.009	1.28%	0.00%
GAMO1	2018	base18b36k	PS4	23	NM	0	0	0	0	0.001		0.001	0.14%	0.00%
GAMO1	2018	base18b36k	PS4	23	NV	0.001	0	0	0.001	0.002		0.004	0.57%	-20.00%
GAMO1	2018	base18b36k	PS4	23	OR	0.007	0	0	0.002	0.011		0.02	2.84%	-16.67%
GAMO1	2018	base18b36k	PS4	23	PO	0	0	0.001	0.012	0.002		0.015	2.13%	0.00%
GAMO1	2018	base18b36k	PS4	23	SD	0	0	0	0	0		0	0.00%	#DIV/0!
GAMO1	2018	base18b36k	PS4	23	UT	0	0	0	0	0.003		0.003	0.43%	-25.00%
GAMO1	2018	base18b36k	PS4	23	WA	0.004	0.001	0.001	0.005	0.02		0.031	4.40%	-24.39%
GAMO1	2018	base18b36k	PS4	23	WY	0.001	0	0	0.002	0.014		0.017	2.41%	13.33%
GAMO1	2018	base18b36k	PS4	23	OD						0.333	0.333	47.30%	0.00%
Total						0.037	0.001	0.012	0.071	0.25	0.333	0.704	100.00%	-1.26%
Percent by Source Type						**5.26%**	**0.14%**	**1.70%**	**10.09%**	**35.51%**	**47.30%**	**100.00%**		
Idaho Percent Total Contribution						**2.98%**	**0.00%**	**0.14%**	**0.28%**	**0.71%**	**0.00%**	**4.12%**		

North Absaroka Wilderness

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
NOAB1	2002	plan02c36k	PN3	22	AZ	0	0	0.001	0	0		0.001	**0.30%**
NOAB1	2002	plan02c36k	PN3	22	CA	0	0	0.004	0.001	0.001		0.006	**1.82%**
NOAB1	2002	plan02c36k	PN3	22	CAN	0.001	0	0.013	0.011	0.013		0.038	**11.55%**
NOAB1	2002	plan02c36k	PN3	22	CEN	0	0	0.001	0	0		0.001	**0.30%**
NOAB1	2002	plan02c36k	PN3	22	CO	0	0	0.001	0	0.001		0.002	**0.61%**
NOAB1	2002	plan02c36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**
NOAB1	2002	plan02c36k	PN3	22	ID	0.01	0.001	0.029	0.01	0.005		0.055	**16.72%**
NOAB1	2002	plan02c36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**
NOAB1	2002	plan02c36k	PN3	22	MT	0.005	0	0.022	0.002	0.02		0.049	**14.89%**
NOAB1	2002	plan02c36k	PN3	22	ND	0	0	0.001	0	0.001		0.002	**0.61%**
NOAB1	2002	plan02c36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**
NOAB1	2002	plan02c36k	PN3	22	NV	0	0	0.001	0	0.001		0.002	**0.61%**
NOAB1	2002	plan02c36k	PN3	22	OR	0.001	0.001	0.006	0.001	0.002		0.011	**3.34%**
NOAB1	2002	plan02c36k	PN3	22	PO	0	0	0.001	0.002	0		0.003	**0.91%**
NOAB1	2002	plan02c36k	PN3	22	SD	0	0	0.001	0	0		0.001	**0.30%**
NOAB1	2002	plan02c36k	PN3	22	UT	0	0	0.01	0.001	0.004		0.015	**4.56%**
NOAB1	2002	plan02c36k	PN3	22	WA	0.001	0.001	0.011	0.001	0.001		0.015	**4.56%**
NOAB1	2002	plan02c36k	PN3	22	WY	0.001	0	0.01	0.004	0.012		0.027	**8.21%**
NOAB1	2002	plan02c36k	PN3	22	OD						0.101	0.101	**30.70%**
Total						**0.101**	**0.329**	**1.000**	**0.000**	**0.000**	**0.000**	**0.329**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
NOAB1	2018	base18b36k	PN3	22	AZ	0	0	0.001	0	0.001		0.002	**0.68%**	**100.00%**
NOAB1	2018	base18b36k	PN3	22	CA	0	0	0.002	0.001	0.001		0.004	**1.35%**	**-33.33%**
NOAB1	2018	base18b36k	PN3	22	CAN	0.001	0	0.014	0.011	0.013		0.039	**13.18%**	**2.63%**
NOAB1	2018	base18b36k	PN3	22	CEN	0	0	0	0	0		0	**0.00%**	**-100.00%**
NOAB1	2018	base18b36k	PN3	22	CO	0	0	0	0	0.001		0.001	**0.34%**	**-50.00%**
NOAB1	2018	base18b36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
NOAB1	2018	base18b36k	PN3	22	ID	0.01	0.001	0.01	0.013	0.005		0.039	**13.18%**	**-29.09%**
NOAB1	2018	base18b36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
NOAB1	2018	base18b36k	PN3	22	MT	0.005	0	0.012	0.009	0.024		0.05	**16.89%**	**2.04%**
NOAB1	2018	base18b36k	PN3	22	ND	0	0	0	0.001	0.001		0.002	**0.68%**	**0.00%**
NOAB1	2018	base18b36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**	**#DIV/0!**
NOAB1	2018	base18b36k	PN3	22	NV	0	0	0	0	0.001		0.001	**0.34%**	**-50.00%**
NOAB1	2018	base18b36k	PN3	22	OR	0.001	0.001	0.003	0.001	0.002		0.008	**2.70%**	**-27.27%**
NOAB1	2018	base18b36k	PN3	22	PO	0	0	0.001	0.002	0		0.003	**1.01%**	**0.00%**
NOAB1	2018	base18b36k	PN3	22	SD	0	0	0	0	0		0	**0.00%**	**-100.00%**
NOAB1	2018	base18b36k	PN3	22	UT	0	0	0.004	0.001	0.003		0.008	**2.70%**	**-46.67%**
NOAB1	2018	base18b36k	PN3	22	WA	0.001	0.001	0.004	0.001	0.002		0.009	**3.04%**	**-40.00%**
NOAB1	2018	base18b36k	PN3	22	WY	0.001	0	0.006	0.009	0.01		0.026	**8.78%**	**-3.70%**
NOAB1	2018	base18b36k	PN3	22	OD						0.104	0.104	**35.14%**	**2.97%**
Total						0.019	0.003	0.057	0.049	0.064	0.104	0.296	**100.00%**	**-10.03%**
Percent by Source Type						**6.42%**	**1.01%**	**19.26%**	**16.55%**	**21.62%**	**35.14%**	**100.00%**		
Idaho Percent Total Contribution						**3.38%**	**0.34%**	**3.38%**	**4.39%**	**1.69%**	**0.00%**	**13.18%**		

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
NOAB1	2002	plan02c36k	PS4	22	AZ	0	0	0	0	0.003		0.003	**0.58%**
NOAB1	2002	plan02c36k	PS4	22	CA	0.003	0	0.001	0.001	0.004		0.009	**1.73%**
NOAB1	2002	plan02c36k	PS4	22	CAN	0	0	0.001	0.012	0.052		0.065	**12.52%**
NOAB1	2002	plan02c36k	PS4	22	CEN	0	0	0.001	0.001	0.008		0.01	**1.93%**
NOAB1	2002	plan02c36k	PS4	22	CO	0	0	0	0	0.003		0.003	**0.58%**
NOAB1	2002	plan02c36k	PS4	22	EUS	0	0	0	0	0.001		0.001	**0.19%**
NOAB1	2002	plan02c36k	PS4	22	ID	0.012	0.001	0.004	0.002	0.011		0.03	**5.78%**
NOAB1	2002	plan02c36k	PS4	22	MEX	0	0	0	0.001	0.008		0.009	**1.73%**
NOAB1	2002	plan02c36k	PS4	22	MT	0.001	0	0.003	0.002	0.028		0.034	**6.55%**
NOAB1	2002	plan02c36k	PS4	22	ND	0	0	0	0	0.004		0.004	**0.77%**
NOAB1	2002	plan02c36k	PS4	22	NM	0	0	0	0	0.002		0.002	**0.39%**
NOAB1	2002	plan02c36k	PS4	22	NV	0.001	0	0	0.001	0.004		0.006	**1.16%**
NOAB1	2002	plan02c36k	PS4	22	OR	0.006	0.001	0.003	0.002	0.005		0.017	**3.28%**
NOAB1	2002	plan02c36k	PS4	22	PO	0	0	0.001	0.01	0.002		0.013	**2.50%**
NOAB1	2002	plan02c36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**
NOAB1	2002	plan02c36k	PS4	22	UT	0	0	0.001	0	0.006		0.007	**1.35%**
NOAB1	2002	plan02c36k	PS4	22	WA	0.001	0.001	0.004	0.002	0.009		0.017	**3.28%**
NOAB1	2002	plan02c36k	PS4	22	WY	0.001	0	0.002	0.004	0.022		0.029	**5.59%**
NOAB1	2002	plan02c36k	PS4	22	OD						0.26	0.26	**50.10%**
Total						**0.260**	**0.519**	**1.000**	**0.000**	**0.000**	**0.000**	**0.519**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
NOAB1	2018	base18b36k	PS4	22	AZ	0	0	0	0	0.004		0.004	0.76%	33.33%
NOAB1	2018	base18b36k	PS4	22	CA	0.003	0	0.001	0.001	0.005		0.01	1.90%	11.11%
NOAB1	2018	base18b36k	PS4	22	CAN	0	0	0.001	0.012	0.053		0.066	12.55%	1.54%
NOAB1	2018	base18b36k	PS4	22	CEN	0	0	0	0.001	0.005		0.006	1.14%	-40.00%
NOAB1	2018	base18b36k	PS4	22	CO	0	0	0	0	0.003		0.003	0.57%	0.00%
NOAB1	2018	base18b36k	PS4	22	EUS	0	0	0	0	0.001		0.001	0.19%	0.00%
NOAB1	2018	base18b36k	PS4	22	ID	0.012	0.001	0.001	0.002	0.015		0.031	5.89%	3.33%
NOAB1	2018	base18b36k	PS4	22	MEX	0	0	0	0.002	0.009		0.011	2.09%	22.22%
NOAB1	2018	base18b36k	PS4	22	MT	0.001	0	0.001	0.002	0.033		0.037	7.03%	8.82%
NOAB1	2018	base18b36k	PS4	22	ND	0	0	0	0	0.004		0.004	0.76%	0.00%
NOAB1	2018	base18b36k	PS4	22	NM	0	0	0	0	0.002		0.002	0.38%	0.00%
NOAB1	2018	base18b36k	PS4	22	NV	0.001	0	0	0.001	0.003		0.005	0.95%	-16.67%
NOAB1	2018	base18b36k	PS4	22	OR	0.006	0.001	0	0.002	0.007		0.016	3.04%	-5.88%
NOAB1	2018	base18b36k	PS4	22	PO	0	0	0	0.01	0.002		0.012	2.28%	-7.69%
NOAB1	2018	base18b36k	PS4	22	SD	0	0	0	0	0		0	0.00%	#DIV/0!
NOAB1	2018	base18b36k	PS4	22	UT	0	0	0	0.001	0.008		0.009	1.71%	28.57%
NOAB1	2018	base18b36k	PS4	22	WA	0.001	0	0	0.002	0.008		0.011	2.09%	-35.29%
NOAB1	2018	base18b36k	PS4	22	WY	0.001	0	0.001	0.005	0.03		0.037	7.03%	27.59%
NOAB1	2018	base18b36k	PS4	22	OD						0.261	0.261	49.62%	0.38%
Total						0.025	0.002	0.005	0.041	0.192	0.261	0.526	100.00%	1.35%
Percent by Source Type						**4.75%**	**0.38%**	**0.95%**	**7.79%**	**36.50%**	**49.62%**	**100.00%**		
Idaho Percent Total Contribution						**2.28%**	**0.19%**	**0.19%**	**0.38%**	**2.85%**	**0.00%**	**5.89%**		

Bridger Wilderness

Nitrate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
BRID1	2002	plan02c36k	PN3	22	AZ	0	0	0.001	0	0		0.001	**0.63%**
BRID1	2002	plan02c36k	PN3	22	CA	0.001	0	0.008	0.001	0.001		0.011	**6.88%**
BRID1	2002	plan02c36k	PN3	22	CAN	0.001	0	0.004	0.002	0.002		0.009	**5.63%**
BRID1	2002	plan02c36k	PN3	22	CEN	0	0	0.001	0	0		0.001	**0.63%**
BRID1	2002	plan02c36k	PN3	22	CO	0	0	0	0	0.001		0.001	**0.63%**
BRID1	2002	plan02c36k	PN3	22	EUS	0	0	0	0	0		0	**0.00%**
BRID1	2002	plan02c36k	PN3	22	ID	0.005	0	0.007	0.003	0.002		0.017	**10.63%**
BRID1	2002	plan02c36k	PN3	22	MEX	0	0	0	0	0		0	**0.00%**
BRID1	2002	plan02c36k	PN3	22	MT	0.001	0	0.002	0	0.003		0.006	**3.75%**
BRID1	2002	plan02c36k	PN3	22	ND	0	0	0.002	0	0.003		0.005	**3.13%**
BRID1	2002	plan02c36k	PN3	22	NM	0	0	0	0	0		0	**0.00%**
BRID1	2002	plan02c36k	PN3	22	NV	0	0	0.002	0	0.002		0.004	**2.50%**
BRID1	2002	plan02c36k	PN3	22	OR	0.001	0	0.003	0	0.001		0.005	**3.13%**
BRID1	2002	plan02c36k	PN3	22	PO	0	0	0.001	0.001	0		0.002	**1.25%**
BRID1	2002	plan02c36k	PN3	22	SD	0.001	0	0.001	0	0		0.002	**1.25%**
BRID1	2002	plan02c36k	PN3	22	UT	0.001	0	0.016	0.001	0.007		0.025	**15.63%**
BRID1	2002	plan02c36k	PN3	22	WA	0.001	0	0.004	0	0		0.005	**3.13%**
BRID1	2002	plan02c36k	PN3	22	WY	0.001	0	0.009	0.007	0.014		0.031	**19.38%**
BRID1	2002	plan02c36k	PN3	22	OD						0.035	0.035	**21.88%**
Total						**0.035**	**0.160**	**1.000**	**0.000**	**0.000**	**0.000**	**0.160**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
BRID1	2018	base18b36k	PN3	22	AZ	0	0	0	0	0.001		0.001	0.71%	0.00%
BRID1	2018	base18b36k	PN3	22	CA	0.001	0	0.003	0.001	0.001		0.006	4.29%	-45.45%
BRID1	2018	base18b36k	PN3	22	CAN	0.001	0	0.004	0.002	0.002		0.009	6.43%	0.00%
BRID1	2018	base18b36k	PN3	22	CEN	0	0	0	0	0		0	0.00%	-100.00%
BRID1	2018	base18b36k	PN3	22	CO	0	0	0	0	0		0	0.00%	-100.00%
BRID1	2018	base18b36k	PN3	22	EUS	0	0	0	0	0		0	0.00%	#DIV/0!
BRID1	2018	base18b36k	PN3	22	ID	0.004	0	0.002	0.003	0.002		0.011	7.86%	-35.29%
BRID1	2018	base18b36k	PN3	22	MEX	0	0	0	0	0		0	0.00%	#DIV/0!
BRID1	2018	base18b36k	PN3	22	MT	0.001	0	0.001	0.002	0.003		0.007	5.00%	16.67%
BRID1	2018	base18b36k	PN3	22	ND	0	0	0.001	0	0.003		0.004	2.86%	-20.00%
BRID1	2018	base18b36k	PN3	22	NM	0	0	0	0	0		0	0.00%	#DIV/0!
BRID1	2018	base18b36k	PN3	22	NV	0	0	0.001	0	0.002		0.003	2.14%	-25.00%
BRID1	2018	base18b36k	PN3	22	OR	0.001	0	0.001	0	0.001		0.003	2.14%	-40.00%
BRID1	2018	base18b36k	PN3	22	PO	0	0	0	0.001	0		0.001	0.71%	-50.00%
BRID1	2018	base18b36k	PN3	22	SD	0.001	0	0.001	0	0		0.002	1.43%	0.00%
BRID1	2018	base18b36k	PN3	22	UT	0.001	0	0.006	0.002	0.006		0.015	10.71%	-40.00%
BRID1	2018	base18b36k	PN3	22	WA	0.001	0	0.002	0	0.001		0.004	2.86%	-20.00%
BRID1	2018	base18b36k	PN3	22	WY	0.001	0	0.005	0.021	0.011		0.038	27.14%	22.58%
BRID1	2018	base18b36k	PN3	22	OD						0.036	0.036	25.71%	2.86%
Total						0.012	0	0.027	0.032	0.033	0.036	0.14	100.00%	-12.50%
Percent by Source Type						8.57%	0.00%	19.29%	22.86%	23.57%	25.71%	100.00%		
Idaho Percent Total Contribution						2.86%	0.00%	1.43%	2.14%	1.43%	0.00%	7.86%		

Sulfate

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution
BRID1	2002	plan02c36k	PS4	22	AZ	0.001	0	0.001	0	0.008		0.01	**1.71%**
BRID1	2002	plan02c36k	PS4	22	CA	0.007	0	0.003	0.003	0.01		0.023	**3.93%**
BRID1	2002	plan02c36k	PS4	22	CAN	0	0	0.001	0.006	0.023		0.03	**5.13%**
BRID1	2002	plan02c36k	PS4	22	CEN	0	0	0.001	0.001	0.009		0.011	**1.88%**
BRID1	2002	plan02c36k	PS4	22	CO	0	0	0	0	0.004		0.004	**0.68%**
BRID1	2002	plan02c36k	PS4	22	EUS	0	0	0	0.001	0.009		0.01	**1.71%**
BRID1	2002	plan02c36k	PS4	22	ID	0.01	0	0.004	0.002	0.029		0.045	**7.69%**
BRID1	2002	plan02c36k	PS4	22	MEX	0	0	0.001	0.005	0.023		0.029	**4.96%**
BRID1	2002	plan02c36k	PS4	22	MT	0.001	0	0.001	0.001	0.01		0.013	**2.22%**
BRID1	2002	plan02c36k	PS4	22	ND	0	0	0	0	0.013		0.013	**2.22%**
BRID1	2002	plan02c36k	PS4	22	NM	0	0	0	0	0.005		0.005	**0.85%**
BRID1	2002	plan02c36k	PS4	22	NV	0.004	0	0.001	0.004	0.017		0.026	**4.44%**
BRID1	2002	plan02c36k	PS4	22	OR	0.011	0	0.003	0.002	0.005		0.021	**3.59%**
BRID1	2002	plan02c36k	PS4	22	PO	0	0	0.001	0.019	0.007		0.027	**4.62%**
BRID1	2002	plan02c36k	PS4	22	SD	0	0	0	0	0		0	**0.00%**
BRID1	2002	plan02c36k	PS4	22	UT	0.003	0	0.006	0.002	0.024		0.035	**5.98%**
BRID1	2002	plan02c36k	PS4	22	WA	0	0	0.003	0.001	0.007		0.011	**1.88%**
BRID1	2002	plan02c36k	PS4	22	WY	0.01	0	0.004	0.011	0.065		0.09	**15.38%**
BRID1	2002	plan02c36k	PS4	22	OD						0.182	0.182	**31.11%**
BRID1	2002	plan02c36k	PS4	22	OD						0.182	**0.585**	**100.00%**

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domain	Total	Percent Contribution	Change from 02 - 18
BRID1	2018	base18b36k	PS4	22	AZ	0.002	0	0	0	0.011		0.013	2.13%	30.00%
BRID1	2018	base18b36k	PS4	22	CA	0.007	0	0.002	0.003	0.011		0.023	3.78%	0.00%
BRID1	2018	base18b36k	PS4	22	CAN	0	0	0.001	0.006	0.023		0.03	4.93%	0.00%
BRID1	2018	base18b36k	PS4	22	CEN	0	0	0	0.002	0.007		0.009	1.48%	-18.18%
BRID1	2018	base18b36k	PS4	22	CO	0	0	0	0	0.003		0.003	0.49%	-25.00%
BRID1	2018	base18b36k	PS4	22	EUS	0	0	0	0.001	0.004		0.005	0.82%	-50.00%
BRID1	2018	base18b36k	PS4	22	ID	0.01	0	0.001	0.002	0.043		0.056	9.20%	24.44%
BRID1	2018	base18b36k	PS4	22	MEX	0	0	0.001	0.005	0.025		0.031	5.09%	6.90%
BRID1	2018	base18b36k	PS4	22	MT	0.001	0	0	0.001	0.012		0.014	2.30%	7.69%
BRID1	2018	base18b36k	PS4	22	ND	0	0	0	0	0.013		0.013	2.13%	0.00%
BRID1	2018	base18b36k	PS4	22	NM	0	0	0	0.001	0.005		0.006	0.99%	20.00%
BRID1	2018	base18b36k	PS4	22	NV	0.004	0	0	0.004	0.009		0.017	2.79%	-34.62%
BRID1	2018	base18b36k	PS4	22	OR	0.011	0	0	0.001	0.006		0.018	2.96%	-14.29%
BRID1	2018	base18b36k	PS4	22	PO	0	0	0.001	0.019	0.007		0.027	4.43%	0.00%
BRID1	2018	base18b36k	PS4	22	SD	0	0	0	0	0		0	0.00%	#DIV/0!
BRID1	2018	base18b36k	PS4	22	UT	0.003	0	0.001	0.002	0.029		0.035	5.75%	0.00%
BRID1	2018	base18b36k	PS4	22	WA	0	0	0	0.001	0.006		0.007	1.15%	-36.36%
BRID1	2018	base18b36k	PS4	22	WY	0.01	0	0.001	0.013	0.094		0.118	19.38%	31.11%
BRID1	2018	base18b36k	PS4	22	OD						0.184	0.184	30.21%	1.10%
Total						0.048	0	0.008	0.061	0.308	0.184	0.609	100.00%	4.10%
Percent by Source Type						**7.88%**	**0.00%**	**1.31%**	**10.02%**	**50.57%**	**30.21%**	**100.00%**		
Idaho Percent Total Contribution						**1.64%**	**0.00%**	**0.16%**	**0.33%**	**7.06%**	**0.00%**	**9.20%**		

Appendix F: Best Available Retrofit Technology

Appendix to Section Chapter 10 of the State Implementation Plan

Regional Haze Rules and Negotiated Rule Making Summary **1**

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Regional Haze Rules and Negotiated Rule Making Summary

Negotiated Regional Haze Rule

IDAPA 58 - DEPARTMENT OF ENVIRONMENTAL QUALITY

58.01.01 - RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO

DOCKET NO. 58-0101-0601

NOTICE OF RULEMAKING - PROPOSED RULEMAKING

AUTHORITY: In compliance with Section 67-5221(1), Idaho Code, notice is hereby given that this agency has proposed rulemaking. The action is authorized by Sections 39-105 and 39-107, Idaho Code.

PUBLIC HEARING SCHEDULE: A public hearing concerning this proposed rulemaking will be held as follows:

September 6, 2006 at 4:00 p.m.
Department of Environmental Quality Conference Center
1410 N. Hilton, Boise, Idaho

The hearing site(s) will be accessible to persons with disabilities. Requests for accommodation must be made no later than five (5) days prior to the hearing. For arrangements, contact the undersigned at (208) 373-0418.

DESCRIPTIVE SUMMARY: The Department of Environmental Quality (DEQ) is tasked with developing a plan to address Regional Haze in Class I Wilderness Areas within Idaho and other Class I areas impacted by Idaho by December 17, 2007 as required by the Federal Clean Air Act, Regional Haze Rule, 40 CFR 51.308. The intent of the Regional Haze Rule is to reduce the impacts of man-made visibility impairing pollutants on Class I areas by 2064. The first implementation plan will cover the time period from 2008 through 2018. The plan will set "Reasonable Progress Goals" and develop control strategies to attain the progress goals.

Through the negotiated rule process, rules were drafted that provide DEQ with the authority to develop "Long-Term Strategies" for making reasonable progress toward improving visibility in mandatory Class I Federal Areas. The proposed rule also provides DEQ with the authority to establish "Reasonable Progress Goals," based on emission reduction control strategies identified through the "Long-Term Strategies" and the implementation of Best Available Retrofit Technologies, in order to obtain the goals and satisfy other requirements under 40 CFR 51.308 and Subpart P -- Protection of Visibility requirements.

The text of this rule was developed by DEQ in conjunction with a negotiating committee made up of persons having an interest in the development of this rule including industry representatives, federal land managers, and public officials. BART-eligible and other sources of air pollution may be affected by this rulemaking and may wish to submit comment. Representatives of the industrial community, special interest groups, public officials, federal land managers, metropolitan planning organizations, or members of the public who have an interest in the air quality in Idaho may also wish to comment on this proposed rule. The proposed rule text is in legislative format. Language the agency proposes to add is underlined. Language the agency proposes to delete is struck out. It is these additions and deletions to which public comment should be addressed.

After consideration of public comments, DEQ intends to present the final proposal to the Board of Environmental Quality in October 2006 for adoption of a pending rule. The rule is expected to be final and effective upon the adjournment of the 2007 legislative session if adopted by the Board and approved by the Legislature.

IDAHO CODE 39-107D STATEMENT: This proposed rule does not regulate an activity not regulated by the federal government, nor is it broader in scope or more stringent than federal regulations.

FISCAL IMPACT: The following is a specific description, if applicable, of any negative fiscal impact on the state general fund greater than ten thousand dollars ($10,000) during the fiscal year: N/A

NEGOTIATED RULEMAKING: The text of the rule has been drafted based on discussions held and concerns raised during negotiations conducted pursuant to Idaho Code Section 67-5220 and IDAPA 04.11.01.812-815. The Notice of Negotiated Rulemaking was published in the Idaho Administrative Bulletin, January 4, 2006, Vol. 06-1, page 296.

GENERAL INFORMATION: For more information about DEQ's programs and activities, visit DEQ's web site at www.deq.idaho.gov.

ASSISTANCE ON TECHNICAL QUESTIONS AND SUBMISSION OF WRITTEN COMMENTS: For assistance on technical questions concerning this rulemaking, contact Mike Edwards at (208) 373-0438, mike.edwards@deq.idaho.gov.

Anyone may submit written comments by mail, fax or e-mail at the address below regarding this proposed rule. DEQ will consider all written comments received by the undersigned on or before September 6, 2006.

DATED this 30th day of June, 2006.

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THE FOLLOWING IS THE TEXT OF DOCKET NO. 58-0101-0601

006. GENERAL DEFINITIONS.

01. Accountable. Any SIP emission trading program must account for the aggregate effect of the emissions trades in the demonstration of reasonable further progress, attainment, or maintenance. (4-5-00)

02. Act. The Environmental Protection and Health Act of 1972 as amended (Sections 39-101 through 39-130, Idaho Code). (5-1-94)

03. Actual Emissions. The actual rate of emissions of a pollutant from an emissions unit as determined in accordance with the following: (4-5-00)

a. In general, actual emissions as of a particular date shall equal the average rate, in tons per year, at which the unit actually emitted the pollutant during a two-year period which precedes the particular date and which is representative of normal source operation. The Department shall allow the use of a different time period upon a determination that it is more representative of normal source operation. Actual emissions shall be calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period. (4-5-00)

b. The Department may presume that the source-specific allowable emissions for the unit are equivalent to actual emissions of the unit. (4-5-00)

c. For any emissions unit (other than an electric utility steam generating unit as specified below) which has not yet begun normal operations on the particular date, actual emissions shall equal the potential to emit of the unit on that date. (4-5-00)

d. For an electric utility steam generating unit (other than a new unit or the replacement of an existing unit) actual emissions of the unit following the physical or operational change shall equal the representative actual annual emissions of the unit, provided the source owner or operator maintains and submits to the Department, on an annual basis for a period of five (5) years from the date the unit resumes regular operation, information demonstrating

that the physical or operational change did not result in an emissions increase. A longer period, not to exceed ten (10) years may be required by the Department if it determines such a period to be more representative of normal source post-change operations. (4-5-00)

04. **Adverse Impact on Visibility**. Visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal Class I Area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency, and time of visibility impairments, and how these factors correlate with: ( )

a. Times of visitor use of the Federal Class I Area; and ( )

b. The frequency and timing of natural conditions that reduce visibility. ( )

c. This term does not include affects on integral vistas when applied to 40 CFR 51.307. ( )

0~~4~~5. **Air Pollutant/Air Contaminant**. Any substance, including but not limited to, dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon or particulate matter or any combination thereof. (4-5-00)

0~~5~~6. **Air Pollution**. The presence in the outdoor atmosphere of any air pollutant or combination thereof in such quantity of such nature and duration and under such conditions as would be injurious to human health or welfare, to animal or plant life, or to property, or to interfere unreasonably with the enjoyment of life or property. (4-5-00)

0~~6~~7. **Air Quality**. The specific measurement in the ambient air of a particular air pollutant at any given time. (5-1-94)

0~~7~~8. **Air Quality Criterion**. The information used as guidelines for decisions when establishing air quality goals and air quality standards. (5-1-94)

0~~8~~9. **Allowable Emissions**. The allowable emissions rate of a stationary source or facility calculated using the maximum rated capacity of the source or facility (unless the source or facility is subject to federally enforceable limits which restrict the operating rate, or hours of operation, or both) and the most stringent of the following: (4-5-00)

a. The applicable standards set forth in 40 CFR part 60 and 61; (4-5-00)

b. Any applicable State Implementation Plan emissions limitation including those with a future compliance date; or (4-5-00)

c. The emissions rate specified as a federally enforceable permit condition, including those with a future compliance date. (4-5-00)

~~09~~10. **Ambient Air**. That portion of the atmosphere, external to buildings, to which the general public has access. (5-1-94)

1~~0~~1. **Ambient Air Quality Violation**. Any ambient concentration that causes or contributes to an exceedance of a national ambient air quality standard as determined by 40 CFR Part 50. (4-11-06)

1~~1~~2. **Atmospheric Stagnation Advisory**. An air pollution alert declared by the Department when air pollutant impacts have been observed and/or meteorological conditions are conducive to additional air pollutant buildup. (4-11-06)

1~~2~~3. **Attainment Area**. Any area which is designated, pursuant to 42 U.S.C. Section 7407(d), as having ambient concentrations equal to or less than national primary or secondary ambient air quality standards for a particular air pollutant or air pollutants. (4-11-06)

14. **BART-Eligible Source**. Any of the following stationary sources of air pollutants, including any

reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit two hundred fifty (250) tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted. ( )

a. Fossil-fuel fired steam electric plants of more than two hundred fifty (250) million BTU's per hour heat input; ( )

b. Coal cleaning plants (thermal dryers); ( )

c. Kraft pulp mills; ( )

d. Portland cement plants; ( )

e. Primary zinc smelters; ( )

f. Iron and steel mill plants; ( )

g. Primary aluminum ore reduction plants; ( )

h. Primary copper smelters; ( )

i. Municipal incinerators capable of charging more than two hundred fifty (250) tons of refuse per day; ( )

j. Hydrofluoric, sulfuric, and nitric acid plants; ( )

k. Petroleum refineries; ( )

l. Lime plants; ( )

m. Phosphate rock processing plants; ( )

n. Coke oven batteries; ( )

o. Sulfur recovery plants; ( )

p. Carbon black plants (furnace process); ( )

q. Primary lead smelters; ( )

r. Fuel conversion plants; ( )

s. Sintering plants; ( )

t. Secondary metal production facilities; ( )

u. Chemical process plants; ( )

v. Fossil-fuel boilers of more than two hundred fifty (250) million BTU's per hour heat input; ( )

w. Petroleum storage and transfer facilities with a capacity exceeding three hundred thousand (300,000) barrels; ( )

x. Taconite ore processing facilities; ( )

y. Glass fiber processing plants; and ( )

z. Charcoal production facilities. ( )

1~~3~~5. **Baseline (Area, Concentration, Date)**. See Section 579. (5-1-94)

16. **Best Available Retrofit Technology (BART)**. Means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and 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. ( )

1~~4~~7. **Board**. Idaho Board of Environmental Quality. (5-1-94)

1~~5~~8. **Breakdown**. An unplanned failure of any equipment or emissions unit which may cause excess emissions. (4-5-00)

1~~6~~9. **BTU**. British thermal unit. (5-1-94)

~~17~~20. **Clean Air Act**. The federal Clean Air Act, 42 U.S.C. Sections 7401 through 7671q. (5-1-94)

~~18~~21. **Collection Efficiency**. The overall performance of the air cleaning device in terms of ratio of materials collected to total input to the collector unless specific size fractions of the contaminant are stated or required. (5-1-94)

~~19~~22. **Commence Construction or Modification**. In general, this means initiation of physical on-site construction activities on an emissions unit which are of a permanent nature. Such activities include, but are not limited to, installation of building supports and foundations, laying of underground pipework, and construction of permanent storage structures. With respect to a change in method of operation, this term refers to those on-site activities, other than preparatory activities, which mark the initiation of the change. (4-5-00)

2~~0~~3. **Complete**. A determination made by the Department that all information needed to process a permit application has been submitted for review. (5-1-94)

2~~1~~4. **Construction**. Fabrication, erection, installation, or modification of a stationary source or facility. (5-1-94)

2~~2~~5. **Control Equipment**. Any method, process or equipment which removes, reduces or renders less noxious, air pollutants discharged into the atmosphere. (5-1-94)

2~~3~~6. **Controlled Emission**. An emission which has been treated by control equipment to remove all or part of an air pollutant before release to the atmosphere. (5-1-94)

2~~4~~7. **Criteria Air Pollutant**. Any of the following: PM-10; sulfur oxides; ozone, nitrogen dioxide; carbon monoxide; lead. (4-5-00)

28. **Deciview**. A measurement of visibility impairment. A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired. The deciview haze index is calculated based on the following equation (for the purposes of calculating deciview, the atmospheric light extinction coefficient must be calculated from aerosol measurements): Deciview Haze Index = $10 \ln_e (b_{ext}/10Mm^{-1})$ where b_{ext} = the atmospheric light extinction coefficient, expressed in inverse megameters (Mm^{-1}). ( )

2~~5~~9. **Department**. The Department of Environmental Quality. (5-1-94)

~~26~~30. **Designated Facility**. Any of the following facilities: (5-1-94)

a. Fossil-fuel fired steam electric plants of more than two hundred fifty (250) million BTU's per hour heat input; (5-1-94)

b. Coal cleaning plants (thermal dryers); (5-1-94)

c. Kraft pulp mills; (5-1-94)

d. Portland cement plants; (5-1-94)

e. Primary zinc smelters; (5-1-94)

f. Iron and steel mill plants; (5-1-94)

g. Primary aluminum ore reduction plants; (5-1-94)

h. Primary copper smelters; (5-1-94)

i. Municipal incinerators capable of charging more than two hundred and fifty (250) tons of refuse per day; (5-1-94)

j. Hydrofluoric, sulfuric, and nitric acid plants; (5-1-94)

k. Petroleum refineries; (5-1-94)

l. Lime plants; (5-1-94)

m. Phosphate rock processing plants; (5-1-94)

n. Coke oven batteries; (5-1-94)

o. Sulfur recovery plants; (5-1-94)

p. Carbon black plants (furnace process); (5-1-94)

q. Primary lead smelters; (5-1-94)

r. Fuel conversion plants; (5-1-94)

s. Sintering plants; (5-1-94)

t. Secondary metal production facilities; (5-1-94)

u. Chemical process plants; (5-1-94)

v. Fossil-fuel boilers (or combination thereof) of more than two hundred and fifty (250) million BTU's per hour heat input; (5-1-94)

w. Petroleum storage and transfer facilities with a capacity exceeding three hundred thousand (300,000) barrels; (5-1-94)

x. Taconite ore processing facilities; (5-1-94)

y. Glass fiber processing plants; and (5-1-94)

z. Charcoal production facilities. (5-1-94)

~~27~~31. **Director**. The Director of the Department of Environmental Quality or his designee. (5-1-94)

~~28~~32. **Effective Dose Equivalent**. The sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body of reference man. The unit of the effective dose equivalent is the rem. It is generally calculated as an annual dose. (5-1-94)

~~29~~33. **Emission**. Any controlled or uncontrolled release or discharge into the outdoor atmosphere of any air pollutants or combination thereof. Emission also includes any release or discharge of any air pollutant from a stack, vent, or other means into the outdoor atmosphere that originates from an emission unit. (5-1-94)

3~~0~~4. **Emission Standard**. A permit or regulatory requirement established by the Department or EPA which limits the quantity, rate, or concentration of emissions of air pollutants on a continuous basis, including any requirements which limit the level of opacity, prescribe equipment, set fuel specifications, or prescribe operation or maintenance procedures for a source to assure continuous emission reduction. (4-5-00)

3~~1~~5. **Emissions Unit**. An identifiable piece of process equipment or other part of a facility which emits or may emit any air pollutant. This definition does not alter or affect the term "unit" for the purposes of 42 U.S.C. Sections 7651 through 7651o. (5-1-94)

3~~2~~6. **EPA**. The United States Environmental Protection Agency and its Administrator or designee. (5-1-94)

3~~3~~7. **Environmental Remediation Source**. A stationary source that functions to remediate or recover any release, spill, leak, discharge or disposal of any petroleum product or petroleum substance, any hazardous waste or hazardous substance from any soil, ground water or surface water, and shall have an operational life no greater than five (5) years from the inception of any operations to the cessation of actual operations. Nothing in this definition shall be construed so as to actually limit remediation projects to five (5) years or less of total operation. (5-1-95)

3~~4~~8. **Excess Emissions**. Emissions that exceed an applicable emissions standard established for any facility, source or emissions unit by statute, regulation, rule, permit, or order. (4-11-06)

3~~5~~9. **Existing Stationary Source or Facility**. Any stationary source or facility that exists, is installed, or is under construction on the original effective date of any applicable provision of this chapter. (5-1-94)

~~36~~40. **Facility**. All of the pollutant-emitting activities which belong to the same industrial grouping, are located on one (1) or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities shall be considered as part of the same industrial grouping if they belong to the same Major Group (i.e. which have the same two-digit code) as described in the Standard Industrial Classification Manual. The fugitive emissions shall not be considered in determining whether a permit is required unless required by federal law. (4-11-06)

~~37~~41. **Federal Class I Area**. Any federal land that is classified or reclassified "Class I" ~~pursuant to Section 580~~. ~~(5-1-94)~~( )

~~38~~42. **Federal Land Manager**. The Secretary of the ~~federal~~ department with authority over ~~any federal lands in the United States~~ the Federal Class I Area (or the Secretary's designee). ~~(5-1-94)~~( )

43. **Federally Enforceable**. All limitations and conditions which are enforceable by the Department under the Clean Air Act, including those requirements developed pursuant to 40 CFR Parts 60 and 61 requirements within any applicable State Implementation Plan, and any permit requirements established pursuant to 40 CFR 51.21 or under regulations approved pursuant to 40 CFR Parts 51, 52, or 60. ( )

~~39~~44. **Fire Hazard**. The presence or accumulation of combustible material of such nature and in sufficient quantity that its continued existence constitutes an imminent and substantial danger to life, property, public welfare or adjacent lands. (5-1-94)

~~40~~5. **Fuel-Burning Equipment**. Any furnace, boiler, apparatus, stack and all appurtenances thereto, used in the process of burning fuel for the primary purpose of producing heat or power by indirect heat transfer. (5-1-94)

4~~1~~6. **Fugitive Dust**. Fugitive emissions composed of particulate matter. (5-1-94)

4~~2~~7. **Fugitive Emissions**. Those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. (5-1-94)

4~~3~~8. **Garbage**. Any waste consisting of putrescible animal and vegetable materials resulting from the handling, preparation, cooking and consumption of food including, but not limited to, waste materials from households, markets, storage facilities, handling and sale of produce and other food products. (5-1-94)

<u>49. **Geographic Enhancement for the Purpose of 40 CFR 51.308**. A method, procedure, or process to allow a broad regional strategy, such as an emissions trading program designed to achieve greater reasonable progress than BART for regional haze, to accommodate BART for reasonable attributable impairment. ( )</u>

~~44~~50. **Grain Elevator**. Any plant or installation at which grain is unloaded, handled, cleaned, dried, stored, or loaded. (5-1-94)

~~4~~51. **Grain Storage Elevator**. Any grain elevator located at any wheat flour mill, wet corn mill, dry corn mill (human consumption), rice mill, or soybean extraction plant which has a permanent grain storage capacity of thirty five thousand two hundred (35,200) cubic meters (ca. 1 million bushels). (5-1-94)

~~46~~52. **Grain Terminal Elevator**. Any grain elevator which has a permanent storage capacity of more than eighty-eight thousand one hundred (88,100) cubic meters (ca. 2.5 million bushels), except those located at animal food manufacturers, pet food manufacturers, cereal manufacturers, breweries, and livestock feedlots. (5-1-94)

~~47~~53. **Hazardous Air Pollutant (HAP)**. Any air pollutant listed pursuant to Section 112(b) of the Clean Air Act. Hazardous Air Pollutants are regulated air pollutants. (4-11-06)

~~48~~54. **Hazardous Waste**. Any waste or combination of wastes of a solid, liquid, semisolid, or contained gaseous form which, because of its quantity, concentration or characteristics (physical, chemical or biological) may: (5-1-94)

a. Cause or significantly contribute to an increase in deaths or an increase in serious, irreversible, or incapacitating reversible illnesses; or (5-1-94)

b. Pose a substantial threat to human health or to the environment if improperly treated, stored, disposed of, or managed. Such wastes include, but are not limited to, materials which are toxic, corrosive, ignitable, or reactive, or materials which may have mutagenic, teratogenic, or carcinogenic properties; provided that such wastes do not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are allowed under a national pollution discharge elimination system permit, or source, special nuclear, or by-product material as defined by 42 U.S.C. Sections 2014(e),(z) or (aa). (5-1-94)

~~49~~55. **Hot-Mix Asphalt Plant**. Those facilities conveying proportioned quantities or batch loading of cold aggregate to a drier, and heating, drying, screening, classifying, measuring and mixing the aggregate and asphalt for the purpose of paving, construction, industrial, residential or commercial use. (5-1-94)

5~~0~~6. **Incinerator**. Any source consisting of a furnace and all appurtenances thereto designed for the destruction of refuse by burning. "Open Burning" is not considered incineration. For purposes of these rules, the destruction of any combustible liquid or gaseous material by burning in a flare stack shall be considered incineration. (5-1-94)

5~~1~~7. **Indian Governing Body**. The governing body of any tribe, band, or group of Indians subject to the jurisdiction of the United States and recognized by the United States as possessing power of self-government.

(5-1-94)

58. **Integral Vista**. A view perceived from within the mandatory Class I Federal Area of a specific landmark or panorama located outside the boundary of the mandatory Class I Federal Area. ( )

5~~2~~9. **Kraft Pulping**. Any pulping process which uses, for a cooking liquor, an alkaline sulfide solution containing sodium hydroxide and sodium sulfide. (5-1-94)

60. **Least Impaired Days**. The average visibility impairment (measured in deciviews) for the twenty percent (20%) of monitored days in a calendar year with the lowest amount of visibility impairment. ( )

~~53~~**61**. **Lowest Achievable Emission Rate (LAER)**. For any source, the more stringent rate of emissions based on the following: (4-5-00)

a. The most stringent emissions limitation which is contained in any State Implementation Plan for such class or category of facility, unless the owner or operator of the proposed facility demonstrates that such limitations are not achievable; or (4-5-00)

b. The most stringent emissions limitation which is achieved in practice by such class or category of facilities. This limitation, when applied to a modification, means the lowest achievable emissions rate for the new or modified emissions units within the facility. In no event shall the application of the term permit a proposed new or modified facility to emit any pollutant in excess of the amount allowable under an applicable new source standard of performance. (4-5-00)

62. **Mandatory Class I Federal Area.** Any area identified in 40 CFR 81.400 through 81.437. ( )

~~54~~**63**. **Member of the Public**. For purposes of Subsection 006.~~89~~103.a.xvi., a person located at any off-site point where there is a residence, school, business or office. ~~*(4-11-06)*~~( )

~~55~~**64**. **Modification**. (4-11-06)

a. Any physical change in, or change in the method of operation of, a stationary source or facility which results in an emission increase as defined in Section 007 or which results in the emission of any regulated air pollutant not previously emitted. (4-11-06)

b. Any physical change in, or change in the method of operation of, a stationary source or facility which results in an increase in the emissions rate of any state only toxic air pollutant, or emissions of any state only toxic air pollutant not previously emitted. (4-11-06)

c. Fugitive emissions shall not be considered in determining whether a permit is required for a modification unless required by federal law. (4-11-06)

d. For purposes of ~~*Subsections 006.55.a. and 006.55.b.*~~ this definition of modification, routine maintenance, repair and replacement shall not be considered physical changes and the following shall not be considered a change in the method of operation: ~~*(4-11-06)*~~( )

i. An increase in the production rate if such increase does not exceed the operating design capacity of the affected stationary source, and if a more restrictive production rate is not specified in a permit; (5-1-94)

ii. An increase in hours of operation if more restrictive hours of operation are not specified in a permit; and (5-1-94)

iii. Use of an alternative fuel or raw material if the stationary source is specifically designed to accommodate such fuel or raw material and use of such fuel or raw material is not specifically prohibited in a permit. (4-5-00)

~~56~~**5**. **Monitoring**. Sampling and analysis, in a continuous or noncontinuous sequence, using techniques

which will adequately measure emission levels and/or ambient air concentrations of air pollutants. (5-1-94)

66. **Most Impaired Days**. The average visibility impairment (measured in deciviews) for the twenty percent (20%) of monitored days in a calendar year with the highest amount of visibility impairment. ( )

~~56~~7. **Multiple Chamber Incinerator**. Any article, machine, equipment, contrivance, structure or part of a structure used to dispose of combustible refuse by burning, consisting of three (3) or more refractory lined combustion furnaces in series physically separated by refractory walls, interconnected by gas passage ports or ducts and employing adequate parameters necessary for maximum combustion of the material to be burned. (5-1-94)

68. **Natural Conditions**. Includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration. ( )

~~58~~69. **New Stationary Source or Facility**. (5-1-94)

a. Any stationary source or facility, the construction or modification of which is commenced after the original effective date of any applicable provision of this chapter; or (5-1-94)

b. The restart of a nonoperating facility shall be considered a new stationary source or facility if: (5-1-94)

i. The restart involves a modification to the facility; or (5-1-94)

ii. After the facility has been in a nonoperating status for a period of two (2) years, and the Department receives an application for a Permit to Construct in the area affected by the existing nonoperating facility, the Department will, within five (5) working days of receipt of the application notify the nonoperating facility of receipt of the application for a Permit to Construct. Upon receipt of this Departmental notification, the nonoperating facility will comply with the following restart schedule or be considered a new stationary source or facility when it does restart: Within thirty (30) working days after receipt of the Department's notification of the application for a Permit to Construct, the nonoperating facility shall provide the Department with a schedule detailing the restart of the facility. The restart must begin within sixty (60) days of the date the Department receives the restart schedule. (5-1-94)

~~59~~70. **Nonattainment Area**. Any area which is designated, pursuant to 42 U.S.C. Section 7407(d), as not meeting (or contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. (5-1-94)

~~60~~71. **Noncondensibles**. Gases and vapors from processes that are not condensed at standard temperature and pressure unless otherwise specified. (5-1-94)

~~61~~72. **Odor**. The sensation resulting from stimulation of the human sense of smell. (5-1-94)

~~62~~73. **Opacity**. A state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view, expressed as percent. (5-1-94)

~~63~~74. **Open Burning**. The burning of any matter in such a manner that the products of combustion resulting from the burning are emitted directly into the ambient air without passing through a stack, duct or chimney. (5-1-94)

~~64~~75. **Operating Permit**. A permit issued by the Director pursuant to Sections 300 through 386 and/or 400 through 461. (4-5-00)

~~65~~76. **Particulate Matter**. Any material, except water in uncombined form, that exists as a liquid or a solid at standard conditions. (5-1-94)

~~66~~77. **Particulate Matter Emissions**. All particulate matter emitted to the ambient air as measured by an applicable reference method, or any equivalent or alternative method in accordance with Section 157. (4-5-00)

~~67~~8. **Permit to Construct**. A permit issued by the Director pursuant to Sections 200 through 228. (7-1-02)

~~68~~79. **Person**. Any individual, association, corporation, firm, partnership or any federal, state or local governmental entity. (5-1-94)

~~69~~80. **PM-10**. All particulate matter in the ambient air with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers as measured by a reference method based on Appendix J of 40 CFR Part 50 and designated in accordance with 40 CFR Part 53 or by an equivalent method designated in accordance with 40 CFR Part 53. (5-1-94)

~~70~~81. **PM-10 Emissions**. All particulate matter, including condensible particulates, with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers emitted to the ambient air as measured by an applicable reference method, or an equivalent or alternative method in accordance with Section 157. (4-5-00)

~~71~~82. **Potential to Emit/Potential Emissions**. The maximum capacity of a facility or stationary source to emit an air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or source to emit an air pollutant, ~~provided the limitation or its effect on emissions is state or federally enforceable, shall be treated as part of its design. Limitations may include, but are not limited to,~~ including air pollution control equipment~~,~~ and restrictions on hours of operation ~~and restrictions~~ or on the type or amount of material combusted, stored or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is state or federally enforceable. ~~This definition does not alter or affect the term "capacity factor" as defined in 42 U.S.C. Sections 7651 through 7651o.~~ Secondary emissions do not count in determining the potential to emit of a facility or stationary source. ~~(4-5-00)~~(   )

~~72~~83. **Portable Equipment**. Equipment which is designed to be dismantled and transported from one (1) job site to another job site. (5-1-94)

~~73~~84. **PPM (parts per million)**. Parts of a gaseous contaminant per million parts of gas by volume. (5-1-94)

~~74~~85. **Prescribed Fire Management Burning**. The controlled application of fire to wildland fuels in either their natural or modified state under such conditions of weather, fuel moisture, soil moisture, etc., as will allow the fire to be confined to a predetermined area and at the same time produce the intensity of heat and rate of spread required to accomplish planned objectives, including: (5-1-94)

a. Fire hazard reduction; (5-1-94)

b. The control of pests, insects, or diseases; (5-1-94)

c. The promotion of range forage improvements; (5-1-94)

d. The perpetuation of natural ecosystems; (5-1-94)

e. The disposal of woody debris resulting from a logging operation, the clearing of rights of way, a land clearing operation, or a driftwood collection system; (5-1-94)

f. The preparation of planting and seeding sites for forest regeneration; and (5-1-94)

g. Other accepted natural resource management purposes. (5-1-94)

~~75~~86. **Primary Ambient Air Quality Standard**. That ambient air quality which, allowing an adequate margin of safety, is requisite to protect the public health. (5-1-94)

~~76~~87. **Process or Process Equipment**. Any equipment, device or contrivance for changing any materials whatever or for storage or handling of any materials, and all appurtenances thereto, including ducts, stack, etc., the

use of which may cause any discharge of an air pollutant into the ambient air but not including that equipment specifically defined as fuel-burning equipment or refuse-burning equipment. (5-1-94)

~~77~~**88**. **Process Weight**. The total weight of all materials introduced into any source operation which may cause any emissions of particulate matter. Process weight includes solid fuels charged, but does not include liquid and gaseous fuels charged or combustion air. Water which occurs naturally in the feed material shall be considered part of the process weight. (5-1-94)

~~7~~8~~8~~9. **Process Weight Rate**. The rate established as follows: (5-1-94)

a. For continuous or long-run steady-state source operations, the total process weight for the entire period of continuous operation or for a typical portion thereof, divided by the number of hours of such period or portion thereof; (4-5-00)

b. For cyclical or batch source operations, the total process weight for a period that covers a complete cycle of operation or an integral number of cycles, divided by the hours of actual process operation during such a period. Where the nature of any process or operation or the design of any equipment is such as to permit more than one (1) interpretation of this definition, the interpretation that results in the minimum value for allowable emission shall apply. (4-5-00)

~~7~~9~~9~~0. **Quantifiable**. The Department must be able to determine the emissions impact of any SIP trading programs requirement(s) or emission limit(s). (4-5-00)

~~80~~**91**. **Radionuclide**. A type of atom which spontaneously undergoes radioactive decay. (5-1-94)

92. **Reasonably Attributable**. Attributable by visual observation or any other technique the state deems appropriate. ( )

93. **Regional Haze**. Visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. ( )

~~81~~**94**. **Regulated Air Pollutant**. (4-11-06)

a. For purposes of determining applicability of major source permit to operate requirements, issuing, and modifying permits pursuant to Sections 300 through 397, and in accordance with Title V of the federal Clean Air Act amendments of 1990, 42 U.S.C. Section 7661 et seq., "regulated air pollutant" shall have the same meaning as in Title V of the federal Clean Air Act amendments of 1990, and any applicable federal regulations promulgated pursuant to Title V of the federal Clean Air Act amendments of 1990, 40 CFR Part 70; (4-11-06)

b. For purposes of determining applicability of any other operating permit requirements, issuing, and modifying permits pursuant to Sections 400 through 410, the federal definition of "regulated air pollutant" as defined in Subsection 006.~~81~~94.a. shall also apply; ~~(4-11-06)~~( )

c. For purposes of determining applicability of permit to construct requirements, issuing, and modifying permits pursuant to Sections 200 through 228, except Section 214, and in accordance with Part D of Subchapter I of the federal Clean Air Act, 42 U.S.C. Section 7501 et seq., "regulated air pollutant" shall mean those air contaminants that are regulated in non-attainment areas pursuant to Part D of Subchapter I of the federal Clean Air Act and applicable federal regulations promulgated pursuant to Part D of Subchapter I of the federal Clean Air Act, 40 CFR 51.165; and (4-11-06)

d. For purposes of determining applicability of any other major or minor permit to construct requirements, issuing, and modifying permits pursuant to 200 through 228, except Section 214, "regulated air pollutant" shall mean those air contaminants that are regulated in attainment and unclassifiable areas pursuant to Part C of Subchapter I of the federal Clean Air Act, 40 CFR 52.21, and any applicable federal regulations promulgated pursuant to Part C of Subchapter I of the federal Clean Air Act, 42 U.S.C. Section 7470 et seq. (4-11-06)

~~82~~95. **Replicable.** Any SIP procedures for applying emission trading shall be structured so that two (2) independent entities would obtain the same result when determining compliance with the emission trading provisions. (4-5-00)

~~83~~96. **Responsible Official**. One (1) of the following: (5-1-94)

a. For a corporation: a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one (1) or more manufacturing, production, or operating facilities applying for or subject to a permit and either: (5-1-94)

i. The facilities employ more than two hundred fifty (250) persons or have gross annual sales or expenditures exceeding twenty-five million dollars ($25,000,000) (in second quarter 1980 dollars); or (4-5-00)

ii. The delegation of authority to such representative is approved in advance by the Department. (5-1-94)

b. For a partnership or sole proprietorship: a general partner or the proprietor, respectively. (5-1-94)

c. For a municipality, State, Federal, or other public agency: either a principal executive officer or ranking elected official. For the purposes of Section 123, a principal executive officer of a Federal agency includes the chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., a Regional Administrator of EPA). (4-5-00)

d. For Phase II sources: (5-1-94)

i. The designated representative in so far as actions, standards, requirements, or prohibitions under 42 U.S.C. Sections 7651 through 7651o or the regulations promulgated thereunder are concerned; and (5-1-94)

ii. The designated representative for any other purposes under 40 CFR Part 70. (5-1-94)

~~84~~97. **Safety Measure**. Any shutdown (and related startup) or bypass of equipment or processes undertaken to prevent imminent injury or death or severe damage to equipment or property which may cause excess emissions. (4-5-00)

~~85~~98. **Salvage Operation**. Any source consisting of any business, trade or industry engaged in whole or in part in salvaging or reclaiming any product or material, such as, but not limited to, reprocessing of used motor oils, metals, chemicals, shipping containers, or drums, and specifically including automobile graveyards and junkyards. (5-1-94)

~~86~~99. **Scheduled Maintenance**. Planned upkeep, repair activities and preventative maintenance on any air pollution control equipment or emissions unit, including process equipment, and including shutdown and startup of such equipment. (3-20-97)

~~87~~100. **Secondary Ambient Air Quality Standard**. That ambient air quality which is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air. (5-1-94)

101. **Secondary Emissions**. Emissions which would occur as a result of the construction, modification, or operation of a stationary source or facility, but do not come from the stationary source or facility itself. Secondary emissions must be specific, well defined, quantifiable, and affect the same general area as the stationary source, facility, or modification which causes the secondary emissions. Secondary emissions include emissions from any offsite support facility which would not be constructed or increase its emissions except as a result of the construction or operation of the primary stationary source, facility or modification. Secondary emissions do not include any emissions which come directly from a mobile source regulated under 42 U.S.C. Sections 7521 through 7590. (   )

~~88~~102. **Shutdown**. The normal and customary time period required to cease operations of air pollution control equipment or an emissions unit beginning with the initiation of procedures to terminate normal operation and continuing until the termination is completed. (5-1-94)

~~89~~103. **Significant**. In reference to a net emissions increase or the potential of a source to emit any of the following pollutants, a rate of emissions that would equal or exceed any of the following: (4-11-06)

a. Pollutant and emissions rate: (4-11-06)

i. Carbon monoxide, one hundred (100) tons per year; (5-1-94)

ii. Nitrogen oxides, forty (40) tons per year; (5-1-94)

iii. Sulfur dioxide, forty (40) tons per year; (5-1-94)

iv. Particulate matter, twenty-five (25) tons per year of particulate matter emissions; fifteen (15) tons per year of PM_{10} emissions; (4-11-06)

v. Ozone, forty (40) tons per year of volatile organic compounds; (4-11-06)

vi. Lead, six-tenths (0.6) of a ton per year; (5-1-94)

vii. Fluorides, three (3) tons per year; (5-1-94)

viii. Sulfuric acid mist, seven (7) tons per year; (5-1-94)

ix. Hydrogen sulfide (H2S), ten (10) tons per year; (5-1-94)

x. Total reduced sulfur (including H2S), ten (10) tons per year; (5-1-94)

xi. Reduced sulfur compounds (including H2S), ten (10) tons per year; (5-1-94)

xii. Municipal waste combustor organics (measured as total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans), thirty-five ten-millionths (0.0000035) tons per year; (5-1-94)

xiii. Municipal waste combustor metals (measured as particulate matter), fifteen (15) tons per year; (5-1-94)

xiv. Municipal waste combustor acid gases (measured as sulfur dioxide and hydrogen chloride), forty (40) tons per year; (5-1-94)

xv. Municipal solid waste landfill emissions (measured as nonmethane organic compounds), fifty (50) tons per year; or (4-11-06)

xvi. Radionuclides, a quantity of emissions, from source categories regulated by 40 CFR Part 61, Subpart H, that have been determined in accordance with 40 CFR Part 61, Appendix D and by Department approved methods, that would cause any member of the public to receive an annual effective dose equivalent of at least one tenth (0.1) mrem per year, if total facility-wide emissions contribute an effective dose equivalent of less than three (3) mrem per year; or any radionuclide emission rate, if total facility-wide radionuclide emissions contribute an effective dose equivalent of greater than or equal to three (3) mrem per year. (5-1-95)

b. In reference to a net emissions increase or the potential of a source or facility to emit a regulated air pollutant not listed in Subsection 006.~~89~~103.a. above and not a toxic air pollutant, any emission rate; or ~~(4-11-06)~~(____)

c. For a major facility or major modification which would be constructed within ten (10) kilometers of a Class I area, the emissions rate which would increase the ambient concentration of an emitted regulated air

pollutant in the Class I area by one (1) microgram per cubic meter, twenty-four (24) hour average, or more. (4-5-00)

~~90~~104. **Significant Contribution**. Any increase in ambient concentrations which would exceed the following: (5-1-94)

a. Sulfur dioxide: (5-1-94)

i. One (1.0) microgram per cubic meter, annual average; (5-1-94)

ii. Five (5) micrograms per cubic meter, twenty-four (24) hour average; (5-1-94)

iii. Twenty-five (25) micrograms per cubic meter, three (3) hour average; (5-1-94)

b. Nitrogen dioxide, one (1.0) microgram per cubic meter, annual average; (5-1-94)

c. Carbon monoxide: (5-1-94)

i. One-half (0.5) milligrams per cubic meter, eight (8) hour average; (5-1-94)

ii. Two (2) milligrams per cubic meter, one (1) hour average; (5-1-94)

d. PM-10: (5-1-94)

i. One (1.0) microgram per cubic meter, annual average; (5-1-94)

ii. Five (5.0) micrograms per cubic meter, twenty-four (24) hour average. (5-1-94)

~~91~~105. **Small Fire.** A fire in which the material to be burned is not more than four (4) feet in diameter nor more than three (3) feet high. (5-1-94)

~~92~~106. **Smoke**. Small gas-borne particles resulting from incomplete combustion, consisting predominantly, but not exclusively, of carbon and other combustible material. (5-1-94)

~~93~~107. **Smoke Management Plan**. A document issued by the Director to implement Sections 606 through 616, Categories of Allowable Burning. (5-1-94)

~~94~~108. **Smoke Management Program**. A program whereby meteorological information, fuel conditions, fire behavior, smoke movement and atmospheric dispersal conditions are used as a basis for scheduling the location, amount and timing of open burning operations so as to minimize the impact of such burning on identified smoke sensitive areas. (5-1-94)

~~95~~109. **Source**. A stationary source. (5-1-94)

~~96~~110. **Source Operation**. The last operation preceding the emission of air pollutants, when this operation: (5-1-94)

a. Results in the separation of the air pollutants from the process materials or in the conversion of the process materials into air pollutants, as in the case of fuel combustion; and (5-1-94)

b. Is not an air cleaning device. (5-1-94)

~~97~~111. **Stack.** Any point in a source arranged to conduct emissions to the ambient air, including a chimney, flue, conduit, or duct but not including flares. (5-1-94)

~~98~~112. **Standard Conditions.** Except as specified in Subsection 576.02 for ambient air quality standards, a dry gas temperature of twenty degrees Celsius (20C) sixty-eight degrees Fahrenheit (68F) and a gas pressure of seven hundred sixty (760) millimeters of mercury (14.7 pounds per square inch) absolute. (4-5-00)

~~99~~113. Startup. The normal and customary time period required to bring air pollution control equipment or an emissions unit, including process equipment, from a nonoperational status into normal operation. (5-1-94)

1~~00~~14. Stationary Source. Any building, structure, facility, emissions unit, or installation which emits or may emit any air pollutant. The fugitive emissions shall not be considered in determining whether a permit is required unless required by federal law. (4-11-06)

1~~0~~15. Tier I Source. Any of the following: (5-1-94)

a. Any source located at any major facility as defined in Section 008; (4-5-00)

b. Any source, including an area source, subject to a standard, limitation, or other requirement under 42 U.S.C. Section 7411 or 40 CFR Part 60, and required by EPA to obtain a Part 70 permit; (4-11-06)

c. Any source, including an area source, subject to a standard or other requirement under 42 U.S.C. Section 7412, 40 CFR Part 61 or 40 CFR Part 63, and required by EPA to obtain a Part 70 permit, except that a source is not required to obtain a permit solely because it is subject to requirements under 42 U.S.C. Section 7412(r); (4-11-06)

d. Any Phase II source; and (5-1-94)

e. Any source in a source category designated by the Department. (5-1-94)

1~~02~~16. Total Suspended Particulates. Particulate matter as measured by the method described in 40 CFR 50 Appendix B. (4-5-00)

1~~03~~17. Toxic Air Pollutant. An air pollutant that has been determined by the Department to be by its nature, toxic to human or animal life or vegetation and listed in Section 585 or 586. (5-1-94)

1~~04~~18. Toxic Air Pollutant Carcinogenic Increments. Those ambient air quality increments based on the probability of developing excess cancers over a seventy (70) year lifetime exposure to one (1) microgram per cubic meter (1 ug/m3) of a given carcinogen and expressed in terms of a screening emission level or an acceptable ambient concentration for a carcinogenic toxic air pollutant. They are listed in Section 586. (5-1-94)

1~~05~~19. Toxic Air Pollutant Non-carcinogenic Increments. Those ambient air quality increments based on occupational exposure limits for airborne toxic chemicals expressed in terms of a screening emission level or an acceptable ambient concentration for a non-carcinogenic toxic air pollutant. They are listed in Section 585. (5-1-94)

1~~06~~20. Toxic Substance. Any air pollutant that is determined by the Department to be by its nature, toxic to human or animal life or vegetation. (5-1-94)

1~~07~~21. Trade Waste. Any solid, liquid or gaseous material resulting from the construction or demolition of any structure, or the operation of any business, trade or industry including, but not limited to, wood product industry waste such as sawdust, bark, peelings, chips, shavings and cull wood. (5-1-94)

1~~08~~22. TRS (Total Reduced Sulfur). Hydrogen sulfide, mercaptans, dimethyl sulfide, dimethyl disulfide and any other organic sulfide present. (5-1-94)

1~~09~~23. Unclassifiable Area. An area which, because of a lack of adequate data, is unable to be classified pursuant to 42 U.S.C. Section 7407(d) as either an attainment or a nonattainment area. (5-1-94)

1~~10~~24. Uncontrolled Emission. An emission which has not been treated by control equipment. (5-1-94)

1~~11~~25. Upset. An unplanned disruption in the normal operations of any equipment or emissions unit which may cause excess emissions. (4-5-00)

126. Visibility Impairment. Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions. ( )

127. Visibility in Any Mandatory Class I Federal Area. Includes any integral vista associated with that area. ( )

1~~1~~28. Wigwam Burner. Wood waste burning devices commonly called teepee burners, silos, truncated cones, and other such burners commonly used by the wood product industry for the disposal by burning of wood wastes. (5-1-94)

1~~13~~29. Wood Stove Curtailment Advisory. An air pollution alert issued through local authorities and/or the Department to limit wood stove emissions during air pollution episodes. (5-1-94)

007. DEFINITIONS FOR THE PURPOSES OF SECTIONS 200 THROUGH 228 AND 400 THROUGH 461.

~~***01. Adverse Impact on Visibility**. Visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal Class I area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency, and time of visibility impairments, and how these factors correlate with: (4-5-00)*~~

~~***a.** Times of visitor use of the Federal Class I area; and (4-5-00)*~~

~~***b.** The frequency and timing of natural conditions that reduce visibility. (4-5-00)*~~

~~***c.** This term does not include affects on integral vistas. (4-5-00)*~~

0~~2~~1. Agricultural Activities and Services. For the purposes of Subsection 222.02.f., the usual and customary activities of cultivating the soil, producing crops and raising livestock for use and consumption. Agricultural activities and services do not include manufacturing, bulk storage, handling for resale or the formulation of any agricultural chemical listed in Sections 585 or 586. (5-1-94)

0~~3~~2. Baseline Actual Emissions. The rate of emissions, in tons per year, of a regulated air pollutant as determined by the following provisions: (4-11-06)

a. For any existing electric utility steam generating unit, baseline actual emissions means the average rate, in tons per year, at which the unit actually emitted the regulated air pollutant during any consecutive twenty-four (24) month period selected by the owner or operator within the five (5) year period immediately preceding when the owner or operator begins actual construction of the project. The Director shall allow the use of a different time period upon a determination that it is more representative of normal source operation. (4-11-06)

i. The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions. (4-11-06)

ii. The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above any emission limitation that was legally enforceable during the consecutive twenty-four (24) month period. (4-11-06)

iii. For a regulated air pollutant, when a project involves multiple emissions units, only one (1) consecutive twenty-four (24) month period must be used to determine the baseline actual emissions for all the emissions units being changed. A different consecutive twenty-four (24) month period can be used for each regulated air pollutant. (4-11-06)

iv. The average rate shall not be based on any consecutive twenty-four (24) month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by Subsection 007.0~~3~~2.a.ii. ~~*(4-11-06)*~~( )

b. For an existing emissions unit (other than an electric utility steam generating unit), baseline actual emissions means the average rate, in tons per year, at which the emissions unit actually emitted the regulated air pollutant during any consecutive twenty-four (24) month period selected by the owner or operator within the ten (10) year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Director for a permit required under these rules, whichever is earlier, except that the ten (10) year period shall not include any period earlier than November 15, 1990. (4-11-06)

i. The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions. (4-11-06)

ii. The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above an emission limitation that was legally enforceable during the consecutive twenty-four (24) month period. (4-11-06)

iii. The average rate shall be adjusted downward to exclude any emission limitation with which the source must currently comply, had such source been required to comply with such limitations during the consecutive twenty-four (24) month period; however, if an emission limitation is part of a standard or other requirement under 40 CFR Part 63, the baseline actual emissions need only be adjusted if the Department has taken credit for such emissions reductions in an attainment demonstration or maintenance plan. (4-11-06)

iv. For a regulated air pollutant, when a project involves multiple emissions units, only one (1) consecutive twenty-four (24) month period must be used to determine the baseline actual emissions for all the emissions units being changed. A different consecutive twenty-four (24) month period can be used for each regulated air pollutant. (4-11-06)

v. The average rate shall not be based on any consecutive twenty-four (24) month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by Subsections 006.03.b.ii. and 006.03.b.iii. (4-11-06)

c. For a new emissions unit, the baseline actual emissions for purposes of determining the emissions increase that will result from the initial construction and operation of such unit shall equal zero (0); and, thereafter, for all other purposes, shall equal the unit's potential to emit. (4-11-06)

d. For a plantwide applicability limit (PAL) for a stationary source, the baseline actual emissions shall be calculated for existing electric utility steam generating units in accordance with the procedures contained in Subsection 007.0~~3~~2.a, for other existing emissions units in accordance with the procedures contained in Subsection 007.0~~3~~2.b, and for a new emissions unit in accordance with the procedures contained in Subsection 007.0~~3~~2.c. ~~(4-11-06)~~(   )

0~~4~~3. Begin Actual Construction. Commence construction. (4-11-06)

0~~5~~4. Emissions Increase. The amount by which projected actual emissions exceed baseline actual emissions of an emissions unit. (4-11-06)

0~~6~~5. Innovative Control Technology. Any system of air pollution control that has not been adequately demonstrated in practice, but would have a substantial likelihood of achieving greater continuous emissions reduction than any control system in current practice, or of achieving at least comparable reductions at lower cost in terms of energy, economics, or non-air quality environmental effects. (5-1-94)

~~**07. Integral Vista**. *A view perceived from within the mandatory federal Class I area of a specific landmark or panorama located outside the boundary of the mandatory federal Class I area. Integral vistas are identified by the responsible federal land manager in accordance with criteria adopted pursuant to 40 CFR Part 51.304(a). (5-1-94)*~~

~~**08. Mandatory Federal Class I Area**. *Any area designated under 42 U.S.C. Section 7472(a) as Class I and never to be redesignated. (5-1-94)*~~

0~~9~~6. **Net Emissions Increase**. For purposes of Sections 204 and 205, a net emissions increase shall be defined by the federal regulations incorporated by reference. For purposes of Section 210, a net emissions increase shall be an emissions increase from a particular modification plus any other increases and decreases in actual emissions at the facility that are creditable and contemporaneous with the particular modification, where: (4-11-06)

a. A creditable increase or decrease in actual emissions is contemporaneous with a particular modification if it occurs between the date five (5) years before the commencement of construction or modification on the particular change and the date that the increase from the particular modification occurs. Any replacement unit that requires shakedown becomes operational only after a reasonable shakedown period, not to exceed one hundred and eighty (180) days; (4-5-00)

b. A decrease in actual emissions is creditable only if it satisfies the requirements for emission reduction credits (Section 460) and has approximately the same qualitative significance for public health and welfare as that attributed to the increase from the particular modification, and is federally enforceable at and after the time that construction of the modification commences. (4-5-00)

c. The increase in toxic air pollutant emissions from an already operating or permitted source is not included in the calculation of the net emissions increase for a proposed new source or modification if: (5-1-95)

i. The already operating or permitted source commenced construction or modification prior to July 1, 1995; or (5-1-95)

ii. The uncontrolled emission rate from the already operating or permitted source is ten per cent (10%) or less of the applicable screening emissions level listed in Section 585 or 586; or (6-30-95)

iii. The already operating or permitted source is an environmental remediation source subject to or regulated by the Resource Conservation and Recovery Act (42 U.S.C. Sections 6901-6992k) and "Idaho Rules and Standards for Hazardous Waste," (IDAPA 58.01.05.000 et seq.) or the Comprehensive Environmental Response, Compensation and Liability Act (42 U.S.C. 6901-6992k) or a consent order. (6-30-95)

~~10~~7. **Pilot Plant**. A stationary source located at least one quarter (1/4) mile from any sensitive receptor that functions to test processing, mechanical, or pollution control equipment to determine full-scale feasibility and which does not produce products that are offered for sale except in developmental quantities. (5-1-94)

~~11~~08. **Projected Actual Emissions.** (4-11-06)

a. The maximum annual rate, in tons per year, at which an existing emissions unit is projected to emit a regulated air pollutant in any one (1) of the five (5) years (twelve (12) month period) following the date the unit resumes regular operation after the project, or in any one (1) of the ten (10) years following that date, if the project involves increasing the emissions unit's design capacity or its potential to emit that regulated air pollutant and full utilization of the unit would result in a significant emissions increase or a significant net emissions increase at an existing major stationary source. (4-11-06)

b. In determining the projected actual emissions, the owner or operator of the stationary source: (4-11-06)

i. Shall consider all relevant information including, but not limited to, historical operational data, the company's own representations, the company's expected business activity and the company's highest projections of business activity, the company's filings with state or federal regulatory authorities, and compliance plans under the approved state implementation plan; and (4-11-06)

ii. Shall include fugitive emissions to the extent quantifiable and emissions associated with startups, shutdowns, and malfunctions; and (4-11-06)

iii. Shall exclude, in calculating any increase in emissions that results from the particular project, that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive twenty-four (24) month period used to establish the baseline actual emissions and that are also unrelated

to the particular project, including any increased utilization due to product demand growth; or (4-11-06)

iv. In lieu of using the method set out in Subsections 007.11.b.i. through 007.11.b.iii., may elect to use the emissions unit's potential to emit, in tons per year. (4-11-06)

~~*12*~~09. **Reasonable Further Progress (RFP)**. Annual incremental reductions in emissions of the applicable air pollutant as identified in the SIP which are sufficient to provide for attainment of the applicable ambient air quality standard by the required date. (4-11-06)

~~***13. Secondary Emissions**. Emissions which would occur as a result of the construction, modification, or operation of a stationary source or facility, but do not come from the stationary source or facility itself. Secondary emissions must be specific, well defined, quantifiable, and affect the same general area as the stationary source, facility, or modification which causes the secondary emissions. Secondary emissions include emissions from any offsite support facility which would not be constructed or increase its emissions except as a result of the construction or operation of the primary stationary source, facility or modification. Secondary emissions do not include any emissions which come directly from a mobile source regulated under 42 U.S.C. Sections 7521 through 7590. (4-5-00)*~~

1~~*4*~~0. **Sensitive Receptor**. Any residence, building or location occupied or frequented by persons who, due to age, infirmity or other health based criteria, may be more susceptible to the deleterious effects of a toxic air pollutant than the general population including, but not limited to, elementary and secondary schools, day care centers, playgrounds and parks, hospitals, clinics and nursing homes. (5-1-94)

1~~*5*~~1. **Short Term Source**. Any new stationary source or modification to an existing source, with an operational life no greater than five (5) years from the inception of any operations to the cessation of actual operations. (5-1-94)

1~~*6*~~2. **Toxic Air Pollutant Reasonably Available Control Technology (T-RACT)**. An emission standard based on the lowest emission of toxic air pollutants that a particular source is capable of meeting by the application of control technology that is reasonably available, as determined by the Department, considering technological and economic feasibility. If control technology is not feasible, the emission standard may be based on the application of a design, equipment, work practice or operational requirement, or combination thereof. (5-1-94)

~~***17. Visibility Impairment**. Any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions. (4-5-00)*~~

(BREAK IN CONTINUITY OF SECTIONS)

107. INCORPORATIONS BY REFERENCE.

01. General. Unless expressly provided otherwise, any reference in these rules to any document identified in Subsection 107.03 shall constitute the full incorporation into these rules of that document for the purposes of the reference, including any notes and appendices therein. The term "documents" includes codes, standards or rules which have been adopted by an agency of the state or of the United States or by any nationally recognized organization or association. (5-1-94)

02. Availability of Referenced Material. Copies of the documents incorporated by reference into these rules are available at the following locations: (5-1-94)

a. All federal publications: U.S. Government Printing Office, http://www.gpoaccess.gov/index.html; and (3-20-04)

b. All documents herein incorporated by reference: (7-1-97)

i. Department of Environmental Quality, 1410 N. Hilton, Boise, Idaho 83706-1255 at (208) 373-0502. (7-1-97)

ii. State Law Library, 451 W. State Street, P.O. Box 83720, Boise, Idaho 83720-0051, (208) 334-3316. (7-1-97)

03. Documents Incorporated by Reference. The following documents are incorporated by reference into these rules: (5-1-94)

a. Requirements for Preparation, Adoption, and Submittal of Implementation Plans; Appendix W to Part 51--Guideline on Air Quality Models. 40 CFR Parts 51 and 52 revised as of July 1, 2005. (4-11-06)

b. Implementation Plan for the Control of Air Pollution in the State of Idaho (SIP), Department of Environmental Quality, November 1996. (3-19-99)

c. National Primary and Secondary Ambient Air Quality Standards, 40 CFR Part 50, revised as of July 1, 2005. (4-11-06)

d. Requirements for Preparation, Adoption, and Submittal of Implementation Plans, Protection of Visibility, ~~Identification of Integral Vistas, Subsection a,~~ 40 CFR ~~Part~~ 51.301, 51.304(a), 51.307, and 51.308, revised as of July 1, 2005. ~~(4-11-06)~~( )

e. Approval and Promulgation of Implementation Plans, 40 CFR Part 52, revised as of July 1, 2005. (4-11-06)

f. Ambient Air Monitoring Reference and Equivalent Methods, 40 CFR Part 53, revised as of July 1, 2005. (4-11-06)

g. Ambient Air Quality Surveillance, Quality Assurance Requirements for Prevention of Significant Deterioration (PSD Air Monitoring), 40 CFR Part 58, Appendix B, revised as of July 1, 2005. (4-11-06)

h. Standards of Performance for New Stationary Sources, 40 CFR Part 60, revised as of July 1, 2005. (4-11-06)

i. National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, revised as of July 1, 2005. (4-11-06)

j. National Emission Standards for Hazardous Air Pollutants for Source Categories, 40 CFR Part 63, revised as of July 1, 2005. (4-11-06)

k. Compliance Assurance Monitoring, 40 CFR Part 64, revised as of July 1, 2005. (4-11-06)

l. Permits, 40 CFR Part 72, revised as of July 1, 2005. (4-11-06)

m. Sulfur Dioxide Allowance System, 40 CFR Part 73, revised as of July 1, 2005. (4-11-06)

n. Protection of Stratospheric Ozone, 40 CFR Part 82, revised as of July 1, 2005. (4-11-06)

o. Clean Air Act, 42 U.S.C. Sections 7401 through 7671g (1997). (3-19-99)

p. Determining Conformity of Federal Actions to State or Federal Implementation Plans: Conformity to State or Federal Implementation Plans of Transportation Plans, Programs and Projects Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Laws, 40 CFR Part 93, Subpart A, Sections 93.100 through 93.129, revised as of July 1, 2005, except that Sections 93.102(c), 93.104(d), 93.104(e)(2), 93.105, 93.109(c)-(f), 93.118(e), 93.119(f)(3), 93.120(a)(2), 93.121(a)(1), and 93.124(b) are expressly omitted from the incorporation by reference. (4-11-06)

q. The final rule for Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 70 Fed. Reg. 28,606 (May 18, 2005), corrected at 70 Fed. Reg. 51,267, is expressly excluded from any incorporation by reference into these rules. (4-11-06)

(BREAK IN CONTINUITY OF SECTIONS)

204. PERMIT REQUIREMENTS FOR NEW MAJOR FACILITIES OR MAJOR MODIFICATIONS IN NONATTAINMENT AREAS.

New major facilities or major modifications proposed for location in a nonattainment area and which would be major for the nonattainment regulated air pollutant are considered nonattainment new source review (NSR) actions and are subject to the requirements in Section 204. Section 202 contains application requirements and Section 209 contains processing requirements for nonattainment NSR permitting actions. The intent of Section 204 is to incorporate the federal nonattainment NSR rule requirements. (4-6-05)

01. Incorporated Federal Program Requirements. Requirements contained in the following subparts of 40 CFR 51.165, revised as of July 1, 2005, are hereby incorporated by reference. Requirements contained in the following subparts of 40 CFR 52.21, revised as of July 1, 2005, are hereby incorporated by reference. These CFR sections have been codified in the electronic CFR which is available at www.gpoaccess.gov/ecfr.

40 CFR Reference	40 CFR Reference Title
40 CFR 51.165(a)(1)	Definitions
40 CFR 51.165(a)(2)(ii)(A) - (J)	Applicability Provisions
40 CFR 51.165(a)(6)(i) - (v)	Applicability Provisions
40 CFR 51.165(c)	Clean Unit Test for Emission Units that are Subject to LAER
40 CFR 51.165(d)	Clean Unit Provisions for Emission Units that Achieve an Emission Limitation Comparable to LAER
40 CFR 52.21(z)(1) - (3) and (6)	PCP Exclusion Procedural Requirements
40 CFR 52.21(aa)	Actual PALs

(4-11-06)

02. Additional Requirements. The applicant must demonstrate to the satisfaction of the Department the following: (4-6-05)

a. LAER. Except as otherwise provided in Section 204, the new major facility or major modification would be operated at the lowest achievable emission rate (LAER) for the nonattainment regulated air pollutant, specifically: (4-6-05)

i. A new major facility would meet the lowest achievable emission rate at each new emissions unit which emits the nonattainment regulated air pollutant; and (4-5-00)

ii. A major modification would meet the lowest achievable emission rate at each new or modified emissions unit which has a net emissions increase of the nonattainment regulated air pollutant. (4-5-00)

b. Required offsets. Allowable emissions from the new major facility or major modification are offset by reductions in actual emissions from stationary sources, facilities, and/or mobile sources in the nonattainment area so as to represent reasonable further progress. All offsetting emission reductions must satisfy the requirements for emission reduction credits (Section 460) and provide for a net air quality benefit which satisfies the requirements of Section 208. If the offsets are provided by other stationary sources or facilities, a permit to construct shall not be issued for the new major facility or major modification until the offsetting reductions are made enforceable through

the issuance of operating permits. The new major facility or major modification may not commence operation, and an operating permit for the new major facility or major modification shall not be effective before the date the offsetting reductions are achieved. (4-5-00)

c. Compliance status. All other sources in the State owned or operated by the applicant, or by any entity controlling, controlled by or under common control with such person, are in compliance with all applicable emission limitations and standards or subject to an enforceable compliance schedule. (5-1-94)

d. Effect on visibility. The effect on visibility of any federal Class I area, Class I area designated by the Department, or integral vista of a mandatory ~~*federal*~~ Class I Federal ~~*a*~~Area, by the new major facility or major modification, is consistent with making reasonable progress toward ~~*remedying existing and preventing future visibility impairment*~~ the national visibility goal referred to in 40 CFR 51.300(a). The Department may take into account the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance and the useful life of the source. Any integral vista which the Federal Land Manager has not identified at least six (6) months prior to the submittal of a complete application, or which the Department determines was not identified in accordance with the criteria adopted pursuant to 40 CFR ~~*Part*~~ 51.304(a), may be exempted from Section 204 by the Department. ~~*(4-6-05)*~~(____)

03. Nonmajor Requirements. If the proposed action meets the requirements of an exemption or exclusion under the provisions of 40 CFR 51.165 or 40 CFR 52.21 incorporated in Section 204, the nonmajor facility or stationary source permitting requirements of Sections 200 through 228 apply, including the exemptions in Sections 220 through 223. (4-6-05)

205. PERMIT REQUIREMENTS FOR NEW MAJOR FACILITIES OR MAJOR MODIFICATIONS IN ATTAINMENT OR UNCLASSIFIABLE AREAS.

The prevention of significant deterioration (PSD) program is a construction permitting program for new major facilities and major modifications to existing major facilities located in areas in attainment or in areas that are unclassifiable for any criteria air pollutant. Section 202 contains application requirements and Section 209 contains processing requirements for PSD permit actions. The intent of Section 205 is to incorporate the federal PSD rule requirements. (4-6-05)

01. Incorporated Federal Program Requirements. Requirements contained in the following subparts of 40 CFR 52.21, revised as of July 1, 2005, are hereby incorporated by reference. These CFR sections have been codified in the electronic CFR which is available at www.gpoaccess.gov/ecfr.

40 CFR Reference	40 CFR Reference Title
40 CFR 52.21(a)(2)	Applicability Procedures
40 CFR 52.21(b)	Definitions
40 CFR 52.21(i)	Review of Major Stationary Sources and Major Modifications - Source Applicability and Exempting
40 CFR 52.21(j)	Control Technology Review
40 CFR 52.21(k)	Source Impact Analysis
40 CFR 52.21(r)	Source Obligation
40 CFR 52.21(v)	Innovative Control Technology
40 CFR 52.21(w)	Permit Rescission
40 CFR 52.21(x)	Clean Unit Test
40 CFR 52.21(y)	Clean Unit Provisions for Emissions Units that Achieve an Emission Limit Comparable to BACT
40 CFR 52.21(z)(1) - (3) and (6)	PCP Exclusion Procedural Requirements

40 CFR Reference	40 CFR Reference Title
40 CFR 52.21(aa)	Actual PALS

(4-11-06)

02. Effect on Visibility. The applicant must demonstrate that the effect on visibility of any federal Class I area, Class I area designated by the Department, or integral vista of a mandatory Class I Federal Area, by the new major facility or major modification, is consistent with making reasonable progress toward the national visibility goal referred to in 40 CFR 51.300(a). The Department may take into account the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance and the useful life of the source. Any integral vista which the Federal Land Manager has not identified at least six (6) months prior to the submittal of a complete application, or which the Department determines was not identified in accordance with the criteria adopted pursuant to 40 CFR 51.304(a), may be exempted from this requirement by the Department. (   )

0~~2~~3. Exception to Incorporation by Reference of 40 CFR 52.21. Every use of the word Administrator in 40 CFR 52.21 means the Department except for the following: (4-6-05)

a. In 40 CFR 52.21(b)(17), the definition of federally enforceable, Administrator means the EPA Administrator. (4-6-05)

b. In 40 CFR 52.21(l)(2), air quality models, Administrator means the EPA Administrator. (4-6-05)

c. In 40 CFR 52.21(b)(43), permit program approved by the Administrator, Administrator means the EPA Administrator. (4-6-05)

d. In 40 CFR 52.21(b)(48)(ii)(c), MACT standard that is proposed or promulgated by the Administrator, Administrator means the EPA Administrator. (4-6-05)

e. In 40 CFR 52.21(b)(50)(i), regulated NSR pollutant as defined by Administrator, Administrator means the EPA Administrator. (4-6-05)

f. In 40 CFR 52.21(y)(4)(i), Administrator for BACT, LAER and RACT clearinghouse, Administrator means the EPA Administrator. (4-6-05)

0~~3~~4. Nonmajor Requirements. If the proposed action meets the requirements of an exemption or exclusion under the provisions of 40 CFR 52.21 incorporated in Section 205, the nonmajor facility or stationary source permitting requirements of Sections 200 through 228 apply, including the exemptions in Sections 220 through 223. (4-6-05)

(BREAK IN CONTINUITY OF SECTIONS)

600. RULES FOR CONTROL OF OPEN BURNING.

The purpose of Sections 600 through 617 is to reduce the amount of emissions and minimize the impact of open burning to protect human health and the environment from air pollutants resulting from open burning as well as to reduce the visibility impairment in mandatory Class I Federal Areas in accordance with the regional haze long-term strategy referenced at Section 667. ~~(3-21-03)~~(   )

(BREAK IN CONTINUITY OF SECTIONS)

651. GENERAL RULES.
All reasonable precautions shall be taken to prevent particulate matter from becoming airborne. In determining what is reasonable, consideration will be given to factors such as the proximity of dust emitting operations to human habitations and/or activities, the proximity to mandatory Class I Federal Areas and atmospheric conditions which might affect the movement of particulate matter. Some of the reasonable precautions may include, but are not limited to, the following: ~~(5-1-94)~~( )

01. Use of Water or Chemicals. Use, where practical, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land. (5-1-94)

02. Application of Dust Suppressants. Application, where practical, of asphalt, oil, water or suitable chemicals to, or covering of dirt roads, material stockpiles, and other surfaces which can create dust. (5-1-94)

03. Use of Control Equipment. Installation and use, where practical, of hoods, fans and fabric filters or equivalent systems to enclose and vent the handling of dusty materials. Adequate containment methods should be employed during sandblasting or other operations. (5-1-94)

04. Covering of Trucks. Covering, when practical, open bodied trucks transporting materials likely to give rise to airborne dusts. (5-1-94)

05. Paving. Paving of roadways and their maintenance in a clean condition, where practical. (5-1-94)

06. Removal of Materials. Prompt removal of earth or other stored material from streets, where practical. (5-1-94)

652. -- 6~~7~~64. (RESERVED).

665. REGIONAL HAZE RULES.
The purpose of Sections 665 through 668 is to address regional haze visibility impairment in mandatory Class I Federal Areas. The intent of Sections 665 through 668 is to incorporate the federal protection of visibility definitions and regional haze program requirements. ( )

666. REASONABLE PROGRESS GOALS.
The Department will establish reasonable progress goals, expressed in deciviews for each mandatory Class I Federal Area located within Idaho. These goals will provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period. The reasonable progress goals are not directly enforceable, but will be implemented through enforceable strategies in the long-term strategy. ( )

01. Process for Setting Reasonable Progress Goals. In establishing a reasonable progress goal for any mandatory Class I Federal Area within Idaho, the Department shall: ( )

a. Consider 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 any potentially affected sources, and include a demonstration showing how these factors were taken into consideration in selecting the goal. ( )

b. Analyze and determine the rate of progress needed to attain natural visibility conditions by the year 2064. To calculate this rate of progress, the Department will compare baseline visibility conditions to natural visibility conditions in the mandatory Class 1 Federal Area and determine the uniform rate of visibility improvement (measured in deciviews) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. In establishing the reasonable progress, the Department will consider the uniform rate of improvement in visibility and the emission reduction measures needed to achieve it for the period covered by the implementation plan. ( )

c. Consult with those states which may reasonably be anticipated to cause or contribute to visibility

impairment in the mandatory Class I Federal Area. ( )

02. Justification for Reasonable Progress Goals. If the Department establishes a reasonable progress goal that provides for a slower rate of improvement in visibility than the rate that would be needed to attain natural conditions by 2064, the Department will demonstrate, based on the factors in Subsection 666.01.a., that the rate of progress for the implementation plan to attain natural conditions by 2064 is not reasonable; and that the progress goal adopted by the Department is reasonable. The Department will provide to the public for review, as part of its implementation plan, an assessment of the number of years it would take to attain natural conditions if visibility improvement continues at the rate of progress selected by the Department as reasonable. ( )

667. LONG-TERM STRATEGY FOR REGIONAL HAZE.

The purpose of Section 667 is to develop a long-term strategy for making reasonable progress toward the national goal of preventing any future and remedying any existing impairment of visibility in mandatory Class I Federal Areas in which impairment results from man-made air pollution. ( )

01. Submittal of Long-Term Strategy. The Department will submit a long-term strategy that addresses regional haze visibility impairment for each mandatory Class I Federal Area within the state and for each mandatory Class I Federal Area located outside the state which may be affected by emissions from the state. ( )

02. Enforceable Emission Limitations. The long-term strategy must include enforceable emissions limitations, compliance schedules, and other measures as necessary to achieve the reasonable progress goals established by the Department. ( )

03. Requirements for Long-Term Strategy. In establishing long-term strategy for regional haze, the Department will meet the following requirements: ( )

a. The Department will document the technical basis, including modeling, monitoring and emissions information, on which the state is relying to determine its apportionment of emission reduction obligations necessary for achieving reasonable progress in each mandatory Class I Federal Area it affects. The Department may meet this requirement by relying on technical analyses developed by the regional planning organization and approved by all state participants. The Department will identify the baseline emission inventory on which its strategies are based. The baseline emissions inventory year is presumed to be the most recent year of the consolidated periodic emissions inventory. ( )

b. The Department will identify all anthropogenic sources of visibility impairment considered by the Department in developing its long-term strategy. The Department should consider major and minor stationary sources, mobile sources, and area sources. ( )

c. The Department will consider, at a minimum, the following factors in developing its long-term strategy: ( )

i. Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment; ( )

ii. Measures to mitigate the impacts of construction activities; ( )

iii. Emissions limitations and schedules for compliance to achieve the reasonable progress goal; ( )

iv. Source retirement replacement schedules; ( )

v. Smoke management techniques for agricultural and forestry management purposes including plans as currently exist with the state for these purposes; ( )

vi. Enforceability of emissions limitations and control measures; and ( )

vii. The anticipated net effect on visibility due to projected changes in point, area, and mobile source

emissions over the period addressed by the long-term strategy. ( )

04. **Interstate Consultation**. The Department will undertake the following process in developing the long-term strategy where interstate consultation is required. ( )

a. Where Idaho has emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal Area located in another state or states, the Department will consult with the other state(s) in order to develop coordinated emission management strategies. ( )

b. The Department will consult with any other state having emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal Area within Idaho. ( )

c. Where other states cause or contribute to impairment in a mandatory Class I Federal Area, the Department must demonstrate that the state has included in its implementation plan all measures necessary to obtain its share of the emission reductions needed to meet the progress goal for the area. If the state of Idaho has participated in a regional planning process, the Department must ensure the state has included all measures needed to achieve its apportionment of emission reduction obligations agreed upon through that process. ( )

668. BART REQUIREMENT FOR REGIONAL HAZE.

The purpose of Section 668 is to implement the BART requirements in 40 CFR 51.308(e). The following analysis and documentation is required for each BART-eligible source: ( )

01. **BART-Eligible Sources**. The Department shall identify a list of all BART-eligible sources within the state. ( )

02. **BART Determination**. The Department shall complete a determination of BART for each BART-eligible source in the state that emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class 1 Federal Area. All such sources are subject to BART. ( )

a. A single source that is responsible for a one (1.0) deciview change or more in any mandatory Class I Federal Area is considered to "cause" visibility impairment. ( )

b. A single source that is responsible for a one-half (0.5) deciview change or more in any mandatory Class I Federal Area is considered to "contribute" to visibility impairment. ( )

c. The determination of BART must be based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable for each BART-eligible source that is subject to BART within the state. In this analysis, the following must be taken into consideration: ( )

i. Costs of compliance; ( )

ii. Energy and non-air quality environmental impacts of compliance; ( )

iii. Any pollution control equipment in use at the source; ( )

iv. The remaining useful life of the source; and ( )

v. The degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. ( )

d. The Department may determine that a BART determination is not required: ( )

i. For sulfur dioxide (SO_2) or for nitrogen oxides (NO_x) if a BART-eligible source has the potential to emit less than forty (40) tons per year of such pollutant(s); or ( )

ii. For PM10 if a BART-eligible source emits less than fifteen (15) tons per year of such pollutant. ( )

03. Alternative to Infeasible Emission Standards. If the Department determines in establishing BART that technological or economic limitations on the applicability of measurement methodology to a particular source would make the imposition of an emission standard infeasible, it may instead prescribe a design, equipment, work practice, or other operational standard, or combination thereof, to require the application of BART. Such standard, to the degree possible, is to set forth the emission reduction to be achieved by implementation of such design, equipment, work practice, or operation and must provide for compliance by means which achieve equivalent results. (   )

04. BART Installation and Operation Due Date. Each source subject to BART is required to install and operate BART as expeditiously as practicable, but in no event later than five (5) years after approval of the implementation plan. (   )

05. Maintenance of BART Equipment. Each source subject to BART is required to maintain the control equipment required by the Department and establish procedures to ensure such equipment is properly operated and maintained. (   )

06. BART Alternative. As an alternative to the installation of BART for a source or sources, the Department may approve a BART alternative. If the Department approves source grouping as a BART alternative, only sources (including BART-eligible and non-BART eligible sources) causing or contributing to visibility impairment to the same mandatory Class I Federal Area may be grouped together. (   )

a. If a source(s) proposes a BART alternative, the resultant emissions reduction and visibility impacts must be compared with those that would result from the BART options evaluated for the source(s). (   )

b. Source(s) proposing a BART alternative must demonstrate that this BART alternative will achieve greater reasonable progress than would be achieved through the installation and operation of BART. (   )

c. Source(s) proposing a BART alternative shall include in the BART analysis an analysis and justification of the averaging period and method of evaluating compliance with the proposed emission limitation. (   )

07. Reasonable Progress Goal Requirements for BART-Eligible Sources. Once the Department has met the requirements for BART or BART alternative, as identified in Subsection 668.06, BART-eligible sources will be subject to the requirements of reasonable progress goals, as defined in 40 CFR 51.308(d), in the same manner as other sources. (   )

669. -- 674. (RESERVED).

BART Modeling

BART Modeling Protocol

Modeling Protocol for
Washington, Oregon, and Idaho:
Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation

1. Introduction and Protocol Objective

1.1 Background

Under the Regional Haze Regulations, the U.S. Environmental Protection Agency (EPA) issued the final Guidelines for Best Available Retrofit Technology (BART) Determinations (July 6, 2005) (BART Guideline). According to the Regional Haze Rule, States are required to use these guidelines for establishing BART emission limitations for fossil fuel fired power plants having a capacity in excess of 750 megawatts. The use of these guidelines is optional for states establishing BART emission limitations for other BART-eligible sources. However, according to EPA, the BART Guideline was designed to help states and others do the following: (1) identify those sources that must comply with the BART requirement, and (2) determine the level of control technology that represents BART for each source.

This modeling protocol is a cooperative effort among Idaho Department of Environmental Quality (IDEQ), Oregon Department of Environmental Quality (ODEQ), and Washington Department of Ecology (WDOE) to develop an analysis that will be applied consistently to Idaho, Washington, and Oregon BART-eligible sources. The U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, and U.S. EPA Region 10 were consulted during the development of this protocol (EPA 2006a, b, c). This protocol adopts the BART Guideline and addresses both the BART exemption modeling as well as the BART determination modeling. The three agencies are also collaborating on the development of a consistent three-year meteorological data set. Collaboration on the protocol and meteorological data set helps ensure modeling consistency and the sharing of resources and workload.

1.2 Objectives

The protocol describes the modeling methodology that will be used for the following purposes:

- **BART Exemption modeling –** Evaluating whether a BART-eligible source is

exempt from BART controls because it is not reasonably anticipated to cause or contribute to impairment of visibility in Class I areas
- **BART Determination modeling –** Quantifying the visibility improvements of BART control options

The objectives of this protocol are to provide the following:

- A streamlined and consistent approach in determining which BART-eligible sources are subject to BART
- A clearly delineated modeling methodology
- A common CALMET/CALPUFF/POSTUTIL/CALPOST modeling configuration

2. Modeling Approach

2.1 Bart-Eligible Source List

BART-eligible source refers to the entire facility that has BART-eligible emission units.

Oregon, Washington, and Idaho are in the process of finalizing lists of BART-eligible sources. Table 1 presents the BART-eligible lists, as of July 21, 2006. Sources may be added/removed as additional information is reviewed.

Table 1. BART-eligible sources.

Washington	Oregon	Idaho
Intalco Aluminum	Amalgamated Sugar	Amalgamated Sugar – Nampa
Conoco-Phillips	PGE Boardman	Amalgamated Sugar – Paul
Centralia Powerplant (TransAlta)	Boise Cascade	Amalgamated Sugar – Twin Falls
Longview Fibre	Fort James	J.R. Simplot Don Siding Plant
Weyerhaeuser – Longview	Pope & Talbot	Potlatch Pulp and Paper
BP Cherry Point	Weyerhaeuser	Monsanto
Tesoro NW	PGE Beaver	NuWest (Agrium)
Lafarge	Georgia Pacific	
Georgia Pacific (Fort James) Camas	Smurfit	
Port Townsend Paper		
Simpson Tacoma Kraft		
Shell (Puget Sound Refining Co)		
Graymont Western		
Alcoa-Wenatchee		
Columbia		

2.2 Class I Areas

The mandatory Class I federal areas in Idaho, Oregon, and Washington, as well as neighboring states that could be impacted by BART-eligible sources, are presented in Appendix A. Figure A-1 graphically presents the BART-eligible source locations with respect to the Class I areas.

All federally mandatory Class I areas within 300 kilometers (km) of a BART-eligible source will be included in the BART exemption modeling analysis. Section 6.1(c) of the Guideline on Air Quality Models states, "It was concluded from these case studies that the CALPUFF dispersion model had performed in a reasonable manner, and had no apparent bias toward over or under prediction, so long as the transport distance was limited to less than 300km" (40 CFR 51, Appendix W). If the 300km extends into a neighboring state, visibility impairment shall also be quantified at those Class I areas. Furthermore, if it lies within the 300km radius, visibility impairment at the Columbia River Gorge Scenic Area will also be quantified for information purposes only.

2.3 Pollutants to Consider

The BART Guideline specifies that sulfur dioxide (SO_2), oxides of nitrogen (NO_x) and direct particulate matter (PM) emissions, including both PM_{10} and $PM_{2.5}$ should be included for both the BART exemption and BART determination modeling analyses.

The BART Guideline also discusses the inclusion of volatile organic compound (VOC), ammonia and ammonia compounds as visibility impairing pollutants. These pollutants will be included in the BART analysis if it is determined that they are reasonably anticipated to cause or contribute to visibility impairment. For sources that are selected to evaluate VOC emissions, the first criterion is the emission level. The VOC emissions will be included in the BART exemption analysis if the greater-than-six-carbon VOC gases exceed 250 tons-per-year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms. Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds which require a full BART exemption analysis.

2.4 Emissions and Stack Data

The BART Guideline states, "*the emission estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization.*" These emissions should not generally include start-up, shutdown, or malfunction emissions. The BART Guideline recommends that states use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled. The meteorological period is 2003 – 2005.

Depending on the availability of emissions data, the following emissions information (listed in order of priority) should be used with CALPUFF for BART exemption modeling:

- 24-hour average actual emission rate from the highest emitting day within the modeling period (2003 – 2005) (preferred). Actual emissions may be calculated using emission factors specified in Title V permits or representative stack test; or
- Allowable emissions (maximum 24-hour allowable).

States will work with the BART-eligible sources to develop an appropriate emission inventory.

If plant-wide emissions from all BART eligible units for SO_2, NO_x, and PM_{10} are less than the significant emission rate (SER) used for Prevention of Significant Deterioration, emissions of that pollutant will not be included in the BART exemption modeling. However, if plant-wide emissions from all BART eligible units exceed the SERs for these pollutants, then all emissions of that pollutant from individual emission units will be evaluated even if emissions are below the SER for an individual emission unit.

The states have the option of determining how to include small emission units in the BART exemption analysis. Fugitive dust sources at a distance greater than 10km from any Class I area are exempt from the analysis. Emission units with emissions less than the SER will be quantified, if possible, and added to the stack emissions from an emission unit that is already being evaluated. Thus, the emissions from these small units will be included in the total from the plant, but will not have to be modeled separately.

2.5 Natural Background

The natural visibility background is defined as the 20% best days. This definition of natural background is consistent with the intent of the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125). The natural background values for Class I areas used in this protocol are based on EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule" (EPA 2003). The natural background for the Columbia River Gorge Scenic Area is based on IMPROVE monitoring data, and was supplied by Scott Copeland of CIRA (Cooperative Institute for Research in the Atmosphere). These background data for Class I areas and the Columbia River Gorge are presented in Appendix B. The option presented in EPA's guidance for refining the default visibility background is not to be used in this protocol.

2.6 Visibility Calculation

The CALPUFF modeling techniques presented in this protocol will provide ground level concentrations of visibility impairing pollutants. The concentration estimates from CALPUFF are used with the current FLAG equation to calculate the extinction coefficient, as shown below.

$b_{ext} = 3\ f(RH)\ [(NH_4)_2SO_4] + 3\ f(RH)\ [NH_4NO_3] + 4[OC] + 1[Soil] + 0.6[Coarse\ Mass] + 10[EC] + b_{Ray}$

As described in the IWAQM Phase 2 Report, the change in visibility for the BART exemption analysis is compared against background conditions. The delta-deciview, Δdv, value is calculated from the source's contribution to extinction, $b_{ext\,(source)}$, and background extinction, $b_{ext(bkg)}$, as follows:

$$\Delta dv = 10\ ln\ [\ (\ b_{ext(bkg)} + b_{ext\,(source)}\ )\ /\ (\ b_{ext(bkg)}\ )\ ]$$

2.7 Model Execution

2.7.1 BART Exemption Analysis

The BART exemption modeling determines which BART-eligible sources are reasonably anticipated to cause or contribute to visibility impairment at any Class I area. This protocol adopts Option 1 in Section III of the BART Guideline. This option is the Individual Source Attribution Approach. With this approach, each BART-eligible source is modeled separately and the impact on visibility impairment in any Class I area is determined. However, this protocol also allows the state or other authority to include all BART-eligible sources in a single analysis and determine whether or not all sources together are exempt from BART if the total impact on visibility impairment at any Class I area is below the "contribute" threshold.

Sources, or in some cases groups of sources, that exceed the threshold will be considered subject to BART. Sources or groups of sources with modeled impairment below the threshold will be exempt and excused from further analyses.

For determining the visibility threshold, the recommendations in the BART Guideline are followed to assess whether a BART-eligible source is reasonably anticipated to cause or contribute to any visibility impairment in a Class I area. According to the BART Guideline:

"A single source that is responsible for a 1.0 deciview change or more should be considered to "cause" visibility impairment; a source that causes less than a 1.0 deciview change may still contribute to visibility impairment and thus be subject to BART… As a general matter, any threshold that you used for determining whether a source "contributes" to visibility impairment should not be higher than 0.5 deciviews.

In setting a threshold for "contribution," you should consider the number of emissions sources affecting the Class I areas at issue and the magnitude of the individual sources' impacts. In general, a larger number of sources causing impacts in a Class I area may warrant a lower contribution threshold. States remain free to use a threshold lower than 0.5 deciviews if they conclude that the location of a large number of BART-eligible sources within the State and in proximity to a Class I area justify this approach."

As a result, this protocol has determined that if a single source causes a 0.5 deciview or greater change from natural background, then that source is determined to be reasonably anticipated to contribute to any visibility impairment in a Class I area and will be subject to BART. For this single source analysis, the BART exemption modeling will not consider the frequency, magnitude, and duration of impairment.

In addition, as suggested by the BART Guideline, if multiple BART-eligible sources impact a given Class I area on the same day, then a lower, individual, contribution threshold may be considered. For BART-eligible sources in Oregon and Washington, the following steps will be used to address this condition: 1) after all BART-eligible sources have completed their individual BART exemption modeling, the modeled visibility impairment from all sources will be aggregated for each Class I area receptor for each day; 2) if the total for any receptor exceeds 0.5 deciview, all sources responsible for visibility impairment at that receptor for that day will be considered for further evaluation. This evaluation will include an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each of the sources in the multi-source group. The inclusion of these qualifying factors in the multi-source analysis follows the direction given in the BART Guideline for interpreting the refined modeling results in the determination phase of the BART process and recommendations for sources subject to PSD analyses given in the FLAG Phase I Final Report (FLAG 2000). There is no set individual source visibility threshold for these multi-source assessments. After the multi-source evaluation, a determination will be made as to which sources, if any, from a multi-source group will be considered to have contributed to visibility impairment and be subject to BART.

2.7.2 BART Determination Analysis

The BART Determination analysis determines the degree of visibility improvement for each control option. The BART Guideline states:

"Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. You have the flexibility to assess visibility improvement due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment."

In order to quantify the degree of visibility improvement due to BART controls, the modeling system is executed in a similar manner as for the BART exemption analysis. Model execution and results are needed for both pre-BART control and post-BART control scenarios to allow for comparison of CALPOST delta-deciview predictions for both scenarios. The only difference between the modeling runs will be modifications to the CALPUFF inputs associated with control devices (emissions, stack parameters). In contrast to the BART exemption analysis that predicts pre-control impacts from all BART-eligible units at a source together, BART determination analyses evaluates each emission unit independently of each other after control options are in place. As explained in the BART Guideline, the states may consider the frequency, magnitude, and duration of impairment for the determination analysis.

2.7.3 Implementing BART Modeling Analysis

Each state will implement the BART analysis separately, as follows:

- Idaho – DEQ will perform both the BART exemption and BART determination modeling, working closely with the facilities and providing the facilities with the modeling analysis if they too want to perform the analysis.

- Oregon – DEQ will perform the BART exemption analysis and the individual BART-subject facilities will perform the BART determination analysis. Oregon DEQ will perform any cumulative analysis required.

- Washington – The Washington BART-eligible sources will conduct the BART exemption modeling and the BART determination analysis. Ecology and EPA will conduct any cumulative analysis required.

3. Visibility Modeling System

In general, the BART exemption modeling using the CALPUFF suite of programs will follow the procedures and recommendations outlined in two documents: the IWAQM (Interagency Workgroup on Air Quality Models) and the FLAG (Federal Land Managers Air Quality Related Values Workgroup) reports (EPA 1998, FLAG 2000). Exceptions to these procedures are explicitly described in the appropriate sections below. Tables listing the modeling parameters for each CALPUFF module are located in the Appendices.

The specific CALPUFF programs and their version numbers that will be used in both the exemption modeling and determination modeling (control evaluation) are presented in Table 2.

The CALMET meteorological domain, as described below, covers the full three-state area. The computational domains, which will be unique for each source or group of sources undergoing modeling, will be a subset of the meteorological domain. As a result, a consistent meteorological data set will be used in all analyses, but the computational domains will be tailored to suit the modeling requirements for each individual source and the Class I areas within a radius of 300km.

Table 2. CALPUFF Modeling System

Program	Version	Level
CALMET	6.211	060414
CALPUFF	6.112	060412
CALPOST	6.131	060410
POSTUTIL	1.52	060412

3.1 CALMET

The dispersion modeling will use CALMET windfields for the three-year period 2003-2005. These windfields cover the three-state area of Washington, Oregon, and Idaho, and also extend into adjacent states sufficiently to encompass all Class I areas within 300km of any BART-eligible facility included in this analysis (Figure 1). As part of the three-state collaboration on a BART protocol, it was decided to support the development of a consistent meteorological data set for use in both the BART exemption and determination analyses. Therefore, the states contracted with a consulting firm, Geomatrix, to provide this set of meteorological data for use in CALPUFF for determining whether a BART-eligible source is reasonably anticipated to cause or contribute to haze in a Federal Class I area.

One of the deliverables of that contract is a final CALMET modeling protocol that provides details on the methodology used to develop the data sets. Therefore, this BART modeling protocol only summarizes the development of the CALMET data set. For additional detail, the reader is referred to the "*Modeling Protocol for BART CALMET Datasets"* in Attachment 1.

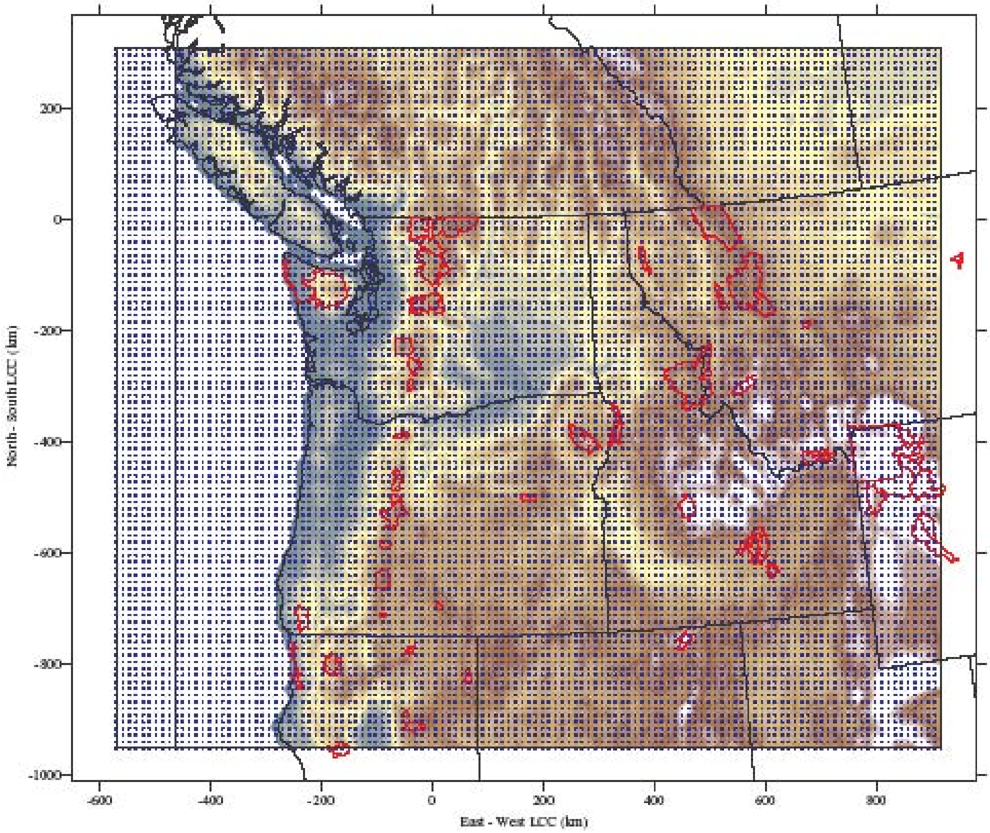

Figure 1. CALMET Meteorological Domain.

3.2 Meteorological Data

3.2.1 Mesoscale Model Data

It was the judgment of Idaho, Oregon, Washington, and EPA Region 10 that the use of three years of MM5 data developed by Western Regional Air Partnership (WRAP) would not adequately capture the meteorology in the Pacific Northwest. WRAP had run MM5 using 36-km and 12-km grids. The states and EPA Region 10 preferred a 4-km grid as it would more adequately capture the meteorology and the influences of complex terrain that characterizes the Region 10 area. Furthermore, WRAP had selected some physics options that are more appropriate for the dry southwest and not the wet northwest.

As a result, the three states contracted a consulting firm (Geomatrix) to process calendar year 2003 to 2005 forecast 12-km MM5 output files archived at the University of Washington (UW). The 12-km MM5 domain includes all of Idaho, Oregon and Washington. Portions of Montana, Wyoming, Utah, Nevada and California are also included in the domain so that BART-eligible sources near these state borders that could impact Class I areas outside of Region 10 are considered in the analysis.

The MM5 data was evaluated for model performance using the statistical evaluation tool METSTAT. CALMET Version 6.211, including a new over-water algorithm, was used to interpolate the 12-km data down to 4-km for the entire domain. The CALMET outputs were also evaluated to determine the model performance of the CALMET wind fields. At this time, METSTAT is unable to evaluate CALMET files. The statistical benchmarks listed in the WRAP Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States (ENVIRON and UCR, 2005) served as a guide for the acceptability of the MM5 data and CALMET output.

CALMET allows the user to adjust the MM5 wind fields in varying degree by the introduction of observational data, including surface, over-water, and upper air data (using the so-called NOOBS parameter). Idaho, Oregon, and Washington have determined that the observed cloud cover should be used, but that observed surface and upper air winds should not be included in CALMET as they locally distort the MM5 wind fields and have no significant effect on long range transport. As a result, the three states have judged that the MM5 simulations more than adequately characterize the regional wind patterns. It should also be noted that CALMET uses the finer scale land use and digital elevation model (DEM) data to interpolate the MM5 winds down to 4km, which improve the wind flow patterns in complex terrain within the modeling domain.

3.2.2 CALMET Control File Settings

These CALMET wind fields will be used by all BART-eligible sources within the three states for both BART exemption and BART determination modeling. The wind fields have been computed by Geomatrix using CALMET Version 6.211. Details of the

parameter settings in CALMET are provided in Appendix C; however, the major assumptions are summarized below.

1) The initial-guess fields used the 12-km MM5 outputs, forecast hours 13 – 24 from every 00Z and 12Z initialization, taken from UW archives, for the three years, January 2003 – December, 2005.

2) Both the BART exemption and determination modeling will utilize the wind fields at 4km resolution.

3) The meteorological data was evaluated in two stages using the extensive database of surface observations maintained by UW. First, the MM5 12-km data was evaluated prior to running CALMM5 using the METSTAT software program and secondly, the wind fields generated by CALMET was evaluated using standard statistical evaluation techniques.

4) There are 10 vertical layers with face heights of 0, 20, 40, 65, 120, 200, 400, 700, 1200, 2200, and 4000 meters.

5) CALMET was run using NOOBS = 1. Upper air, precipitation, and relative humidity data were taken from MM5.

6) The surface wind observations were ignored by setting the relative weight of surface winds to essentially zero (R1 = 1.0E-06). The only surface observation data that was effectively used in CALMET is cloud cover. This is essentially a no-observation approach. This method is specified in this protocol because previous modeling in the Pacific Northwest shows that the radius of influence of a typical surface wind observation must be set at a small number because of the presence of local topographic features. As a result, the adjustment to or distortion of wind fields by surface observations is extremely localized, on the order of 10-15km, and has no effect on long range transport to Class I areas.

7) Precipitation data was obtained from MM5, so MM5NPSTA = -1

8) No weighting of surface and upper air observations, and BIAS = 0, and ICALM = 0

9) The terrain scale factor TERRAD = 12

10) Land use and terrain data were developed using the North American 30-arc-second data

3.3 CALPUFF

The CALPUFF modeling will use Version 6.112. This protocol generally follows the recommendation of the IWAQM and FLAG guidance documents. Details of the parameter

settings in CALPUFF are provided in Appendix D; however, the major features are summarized below:

1) The three-year CALMET input files will be developed by Geomatrix and be provided as input-ready to CALPUFF.

2) The BART exemption modeling will examine the visibility impairment on Class I areas within 300km of each single source. Where BART-eligible sources are grouped or where their emissions could collectively impair visibility in a Class I area, the exemption modeling will also group these sources in order to examine their cumulative impact. The computational modeling domain will be sufficient to include all Class I areas within a 300km radius of a source or sources.

3) Pasquill-Gifford Dispersion coefficients will be used.

4) MESOPUFF-II chemistry algorithm will be used.

5) Building downwash will be ignored for cases with source-to-receptor distances greater than 50km, as recommended by the Federal Land Managers (FLMs) (US Fish and Wildlife, National Park Service, and U.S. Forest Service) who were consulted for this protocol.

6) Puff splitting will not be used, following the recommendations of the FLMs.

7) Source elevations that will be entered in CALPUFF will not use actual elevations but will be based on the modeled terrain surface used in CALMET for developing wind fields. The same algorithm in CALMET that determines the elevations of the observational stations will be used to make this calculation. These modified source elevations will be provided to the BART eligible sources.

3.3.1 Emissions

Section 2.4 above presents the emissions and stack data that is required from the facilities. This section only discusses the emissions estimates needed in CALPUFF.

Primary emission, species will include the input species PM, SO_2, SO_4, and NO_x; and the additional modeled species HNO_3 and NO_3. Emissions of H_2SO_4 will be included, if known, and used for estimation of SO_4 emissions. SO_2 emissions will be reviewed to ensure “double-counting” is avoided.

The primary PM species will be treated as follows:

- BART-eligible sources are required to include both filterable and condensable fractions of PM.

  Filterable:
  - Elemental Carbon (EC) (<2.5 µm)
  - PM Fine (PMF) (<2.5 µm)
  - PM Coarse (PMC) (2.5 – 10 µm)

  Condensable:
  - Organic Carbon (SOA)
  - Inorganic Aerosol (SO_4)
  - Non-SO_4 inorganic aerosol

- The condensable fraction will be treated as primary emissions in the CALPUFF input file and assumed to be 100% in the $PM_{2.5}$ fraction (see NPS Web site listed below).

The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions. The following information sources may be used in the development of the speciation and fractions:

- U.S. National Park Service (NPS) – the NPS has developed both PM speciation and size fractions for several source categories. The information is located at http://www2.nature.nps.gov/air/Permits/ect/index.cfm

- U.S. EPA – the EPA has developed generic PM speciation for all source categories located at http://www.epa.gov/ttn/chief/emch/speciation/.

- If size fraction is not known, the following default values, based on information in the CALPUFF User's Guide, CALPUFF GUI, and AP-42 will be used:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.50 microns	1.5
PMC	5.00 microns	1.5

3.3.2 Ozone Background

Due to the number of BART-eligible sources and Class I areas being analyzed, a single value of 60ppb (parts per billion) is used for all months and all three states. This value was determined based on a review of available ozone data for Idaho, Oregon, and Washington.

3.3.3 Ammonia Background

As with the ozone background, a single value of 17ppb is used for the ammonia background. This value is supported by measurements made in 1996 – 1997 at Abbotsford in the Frazier River Valley of British Columbia. This value has also been commonly used as background for Prevention of Significant Deterioration modeling in the Pacific Northwest and will ensure that for BART exemption modeling, conditions are not ammonia limited. It is recognized that ammonia values may be lower in Class I areas; however, the BART analysis must account for transport through ammonia-rich areas.

3.3.4 Receptor Locations

Visibility impacts will be computed at all Class I areas and the Columbia River Gorge Scenic Area if they lie within a 300-km radius of the BART eligible source. The geolocations of the receptor points and their elevations for the Class I areas that will be used in the modeling are available for download from the National Park Service Web site at http://www2.nature.nps.gov/air/Maps/Receptors/index.cfm>.

Receptor points and elevations for the Columbia River Gorge Scenic Area will be provided by Oregon and Washington.

3.4 CALPOST and VISIBILITY POST-PROCESSING

The following assumptions will be used in CALPOST and POSTUTIL to calculate the visibility impairment:

1) For the visibility calculation, Method 6 will be employed. This method uses monthly average relative humidity and f(RH) values for each Class I area as provided in Appendix B, which are based on the EPA Guidance for Regional Haze analysis (EPA 2003).

2) Particulate species for the visibility analysis will include SO_4, NO_3, EC, OC, PMF, and PMC, as reported in the CALPOST output files.

3) POSTUTIL will not be used to speciate modeled PM_{10} concentrations, as PM_{10} will be speciated into its components (PMF, PMC, SOA, EC, SO_4) and entered as primary emissions in CALPUFF. In addition, HNO_3/NO_3 partition option in POSTUTIL will not be used for ammonia limiting.

4) Natural background extinction calculations will use the 20% best days for each Class I area in the three-state region. The natural background for the 20% best days has been refined from that which is in "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule" (EPA 2003). The extinction

coefficients for the 20% best days have been calculated following the approach taken in the Draft Montana BART modeling protocol. This procedure uses the haze index (HI) in deciviews at the 10th percentile (median of the 20% best days) and an activity factor that is calculated for each Class I area. Tables providing the monthly f(RH) and 20% best days coefficients are provided in Appendix B, and are based on data from EPA (2003). For the exemption modeling, the Rayleigh scattering value will be 10 Mm-1 for all Class I areas.

- The 98th percentile value will be calculated for all BART-eligible sources at each mandatory Class I area.

5) The CALPOST "LST" output files will be used to determine the 98th percentile of visibility impairment for each receptor in CLASS I areas.

6) The contribution threshold has the implied level of precision equal to the level of precision reported by CALPOST. Therefore, the 98th percentile value will be reported to three decimal places.

4. Interpretation of Results

The change in visibility impairment for the BART exemption modeling is based on the increase in HI from a BART-eligible source or sources relative to natural background, defined as the <u>20% best visibility days</u> for each Class I area. This definition of natural background is consistent with the intent of the BART guideline (Federal Register Vol. 70, No. 128, pf 39125).

The U.S. EPA recommends using the 98th percentile value from the distribution of values containing the highest modeled delta-deciview (Δdv) value for each day of the simulation from all modeled receptors at a given Class I area. The 98th percentile Δdv value will be determined in the following ways:

- The 8th highest value for each year modeled
- The 22nd highest value for the 3-year modeling period

Both methods will be used and the highest value of the two will be compared to the contribution threshold ($\Delta dv \geq 0.5$ dv). If there are more than 7 days with values greater than the contribution threshold in any single meteorological year for any Class I area, or more than 21 days in three years, then the source is considered Subject-to-BART.

5. References

40 CFR Part 51, Appendix W. *Guidelines on Air Quality Models*

ENVIRON and UCR 2005. Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States. Available at http://pah.cert.ucr.edu/aqm/308/reports/mm5/DrftFnl_2002MM5_FinalWRAP_Eval.pdf. ENVIRON International Corporation and University of California Riverside). March, 2005.

EPA (U.S. Environmental Protection Agency) 1998. *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*, EPA-454/R-98-019, December 1998.

EPA 2003. *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*, EPA-454/B-03-005, September, 2003.

EPA 2006a. Conference call with Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 17, 2006.

EPA 2006b. Conference call with the Fish and Wildlife and U.S. EPA Region 10, National Park Service, and the states of ID, OR and WA. January 18, 2006.

EPA 2006c. Conference call with the Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 20, 2006.

Federal Land Managers' Air Quality Related Values Workgroup (FLAG) 2000. *Phase I Report*. December 2000.

Federal Register, Vol. 70, No. 128. *Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations*. pp. 39104 – 30172, July 6, 2005.

Appendix A

Mandatory Class I Federal Areas

and

Columbia River Gorge Scenic Area

Figure A-1

Map of BART-Eligible Sources and Class I Areas

Posted on Idaho DEQ's Regional Haze BART Website

http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_bart.cfm.

Appendix A: Mandatory Class I Federal Areas and Columbia River Gorge Scenic Area

Table 1. Federal Mandatory Class I Areas.	
Class I Area	**Federal Land Manager**
Idaho	
Craters of the Moon National Monument	Park Service
Hells Canyon Wilderness	Forest Service
Sawtooth Wilderness	Forest Service
Selway-Bitterroot Wilderness	Forest Service
Yellowstone National Park	Park Service
Oregon	
Crater Lake National Park	Park Service
Diamond Peak Wilderness	Forest Service
Eagle Cap Wilderness	Forest Service
Gearhart Mountain Wilderness	Forest Service
Hells Canyon Wilderness	Forest Service
Kalmiopsis Wilderness	Forest Service
Three Sisters Wilderness	Forest Service
Mount Hood Wilderness	Forest Service
Mount Jefferson Wilderness	Forest Service
Mount Washington Wilderness	Forest Service
Mountain Lakes Wilderness	Forest Service
Strawberry Mountain Wilderness	Forest Service
Washington	
Alpine Lakes Wilderness	Forest Service
Goat Rocks Wilderness	Forest Service
Glacier Peak Wilderness	Forest Service
Mount Adams Wilderness	Forest Service
Mount Ranier National Park	Park Service
North Cascades National Park	Park Service
Olympic National Park	Park Service
Pasayten Wilderness	Forest Service
Neighboring States	
Anaconda-Pintler Wilderness (MT)	Forest Service
Bob Marshall Wilderness (MT)	Forest Service
Cabinet Mountains Wilderness (MT)	Forest Service
Gates of the Mountain Wilderness (MT)	Forest Service
Glacier National Park (MT)	Park Service
Missions Mountain Wilderness (MT)	Forest Service
Scapegoat Wilderness (MT)	Forest Service
Red Rock Lakes Refuge (MT)	Fish & Wildlife Service
Bridger Wilderness (WY)	Forest Service
Fitzpatrick Wilderness (WY)	Forest Service
Grand Teton National Park (WY)	Park Service
North Absaroka Wilderness (WY)	Forest Service
Teton Wilderness (WY)	Forest Service
Washakie Wilderness (WY)	Forest Service
Caribous Wilderness (CA)	Forest Service
Lassen Volcanic National Park (CA)	Park Service

Table 1. Federal Mandatory Class I Areas.	
Class I Area	**Federal Land Manager**
Lava Beds National Monument (CA)	Park Service
Marble Mountain Wilderness (CA)	Forest Service
Redwood National Park (CA)	Park Service
South Warner Wilderness (CA)	Forest Service
Thousand Lakes Wilderness (CA)	Forest Service
Yolla Bolly-Middle Eel Wilderness (CA)	Forest Service
Jarbridge Wilderness (NV)	Forest Service

Hells Canyon is located in Idaho and Oregon.
Yellowstone is located in Idaho, Montana and Wyoming.

Appendix B

Natural Visibility Background

and

Monthly Relative Humidity f(RH)

Appendix B: Natural Visibility Background and Monthly Relative Humidity f(RH)

Adjustment to speciated particulate (Western States) to reflect 20% Best Visibility Days conditions

Monthly f(RH) are from *Appendix A of Draft Guidance for Estimating Natural Visibility Conditions under the RHR (Sept. 2003* ***).***

Background extinction coefficients (20% Best Days) have been calculated using Annual Avg bext, Best 20% bext, and activity factors.

		CALPOST Input Group 2 Monthly extinction coefficients for hygroscopic species (RHFAC)												CALPOST Input Group 2 Background extinction coefficients (20% Best Days)					
Class I Area	State	Jan. f(RH)	Feb. f(RH)	Mar. f(RH)	Apr. f(RH)	May f(RH)	June f(RH)	July f(RH)	Aug. f(RH)	Sep. f(RH)	Oct. f(RH)	Nov. f(RH)	Dec. f(RH)	BKSO4 ug/m3	BKNO3 ug/m3	BKPMC ug/m3	BKOC ug/m3	SOIL ug/m3	BKEC ug/m3
CaribouWilderness	CA	3.69	3.13	2.83	2.45	2.37	2.17	2.07	2.13	2.20	2.38	3.01	3.41	0.048	0.040	1.20	0.188	0.200	0.008
LassenVolcanic	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.189	0.201	0.008
Lava Beds NP	CA	3.98	3.36	3.07	2.70	2.62	2.43	2.31	2.34	2.42	2.72	3.52	3.81	0.050	0.042	1.26	0.197	0.210	0.008
MarbleMountain	CA	4.44	3.79	3.74	3.33	3.37	3.24	3.18	3.19	3.24	3.37	4.12	4.15	0.052	0.043	1.30	0.204	0.217	0.009
RedwoodNP	CA	4.42	3.91	4.56	3.91	4.50	4.70	4.86	4.72	4.31	3.66	3.81	3.40	0.054	0.045	1.34	0.210	0.224	0.009
SouthWarner	CA	3.62	3.08	2.72	2.35	2.29	2.12	1.90	1.92	1.97	2.30	3.05	3.44	0.048	0.040	1.21	0.190	0.202	0.008
ThousandLakes	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.190	0.202	0.008
Yolla Bolly Middle Eel Wilderr	CA	3.95	3.35	3.14	2.76	2.68	2.47	2.44	2.50	2.56	2.70	3.31	3.62	0.049	0.041	1.24	0.194	0.206	0.008
Craters of the Moon	ID	3.13	2.74	2.28	2.02	2.01	1.81	1.43	1.42	1.57	1.97	2.77	3.04	0.046	0.038	1.15	0.180	0.192	0.008
HellsCanyon	ID	3.70	3.12	2.51	2.17	2.12	2.00	1.63	1.58	1.79	2.41	3.45	3.87	0.048	0.040	1.21	0.190	0.202	0.008
SawtoothWilderness	ID	3.34	2.87	2.32	2.01	2.00	1.84	1.43	1.40	1.50	1.96	2.94	3.31	0.046	0.039	1.16	0.182	0.193	0.008
Selway-BitterrootWilderness	ID	3.50	3.02	2.59	2.34	2.36	2.31	1.93	1.86	2.09	2.55	3.30	3.50	0.048	0.040	1.21	0.190	0.202	0.008
Anaconda-PintlerWilderness	MT	3.32	2.88	2.54	2.35	2.36	2.31	1.96	1.88	2.10	2.52	3.15	3.29	0.048	0.040	1.20	0.188	0.200	0.008
BobMarshall	MT	3.57	3.10	2.77	2.59	2.66	2.70	2.34	2.23	2.58	2.92	3.47	3.54	0.049	0.041	1.22	0.191	0.203	0.008
CabinetMountains	MT	3.81	3.27	2.85	2.61	2.66	2.68	2.30	2.18	2.56	2.98	3.70	3.86	0.050	0.041	1.24	0.195	0.207	0.008
Gates of the Mountain	MT	2.89	2.57	2.42	2.30	2.30	2.27	2.03	1.94	2.12	2.41	2.75	2.81	0.047	0.039	1.18	0.185	0.197	0.008
GlacierNP	MT	4.01	3.47	3.18	3.06	3.24	3.39	2.76	2.60	3.19	3.45	3.82	3.89	0.051	0.043	1.28	0.200	0.213	0.009
MissionMountain	MT	3.60	3.13	2.73	2.52	2.60	2.62	2.27	2.19	2.50	2.87	3.51	3.59	0.049	0.041	1.23	0.193	0.205	0.008
RedRock Lakes	MT	2.73	2.46	2.28	2.12	2.10	1.91	1.67	1.58	1.77	2.07	2.56	2.68	0.046	0.039	1.16	0.181	0.193	0.008
ScapegoatWilderness	MT	3.19	2.81	2.57	2.43	2.45	2.44	2.14	2.04	2.28	2.61	3.08	3.14	0.048	0.040	1.20	0.188	0.200	0.008
Crater Lake NP	OR	4.57	3.92	3.68	3.36	3.22	2.99	2.84	2.87	3.05	3.59	4.57	4.56	0.053	0.044	1.32	0.206	0.219	0.009
DiamondPeak	OR	4.52	3.96	3.64	3.66	3.16	3.12	2.90	2.93	3.05	3.67	4.55	4.57	0.053	0.044	1.33	0.208	0.222	0.009
Eagle Cap	OR	3.77	3.16	2.47	2.10	2.04	1.87	1.61	1.56	1.61	2.25	3.44	3.97	0.049	0.041	1.22	0.191	0.203	0.008
Gearhart Mountain	OR	3.96	3.38	3.06	2.75	2.65	2.48	2.28	2.30	2.38	2.84	3.65	3.84	0.050	0.042	1.25	0.196	0.208	0.008
Kalmiopsis Wilderness	OR	4.54	3.90	3.83	3.45	3.46	3.32	3.20	3.20	3.29	3.56	4.39	4.32	0.053	0.044	1.32	0.206	0.219	0.009
Mount Hood	OR	4.29	3.81	3.46	3.87	2.95	3.15	2.85	3.00	3.10	3.86	4.53	4.55	0.053	0.044	1.33	0.209	0.222	0.009
Mount Jefferson	OR	4.41	3.90	3.56	3.74	3.07	3.11	2.89	2.91	3.03	3.78	4.55	4.54	0.054	0.045	1.34	0.210	0.223	0.009
Mountain Lakes	OR	4.29	3.62	3.32	2.98	2.86	2.64	2.49	2.50	2.64	3.10	4.12	4.26	0.051	0.043	1.28	0.201	0.214	0.009
MountWashington	OR	4.44	3.93	3.58	3.73	3.09	3.11	2.98	2.91	3.02	3.76	4.56	4.56	0.054	0.045	1.36	0.213	0.227	0.009
StrawberryMountain	OR	3.89	3.33	2.75	2.93	2.27	2.39	1.98	1.97	1.87	2.63	3.69	4.07	0.050	0.042	1.26	0.197	0.210	0.008
ThreeSisters	OR	4.47	3.95	3.61	3.72	3.11	3.11	3.00	2.91	3.03	3.79	4.60	4.57	0.054	0.045	1.35	0.212	0.226	0.009
AlpineLakes	WA	4.25	3.79	3.47	3.90	2.93	3.22	2.92	3.12	3.25	3.91	4.47	4.51	0.054	0.045	1.35	0.212	0.225	0.009
GlacierPeak	WA	4.16	3.72	3.42	3.75	2.91	3.16	2.88	3.14	3.33	3.90	4.42	4.43	0.054	0.045	1.34	0.210	0.223	0.009
GoatRocks	WA	4.25	3.75	3.36	4.24	2.83	3.38	3.03	3.19	3.07	3.77	4.42	4.55	0.054	0.045	1.34	0.210	0.224	0.009
Mount Adams	WA	4.29	3.80	3.44	4.40	2.92	3.49	3.12	3.27	3.13	3.86	4.49	4.56	0.053	0.044	1.33	0.209	0.222	0.009
MountRainier	WA	4.42	3.96	3.64	4.65	3.06	3.69	3.30	3.50	3.40	4.11	4.66	4.66	0.055	0.045	1.36	0.214	0.227	0.009
NorthCascades NP	WA	4.10	3.69	3.43	3.74	2.93	3.20	2.93	3.23	3.45	3.93	4.39	4.38	0.053	0.044	1.33	0.209	0.222	0.009
OlympicNP	WA	4.51	4.08	3.82	4.08	3.17	3.46	3.12	3.48	3.71	4.38	4.83	4.75	0.054	0.045	1.36	0.213	0.226	0.009
PasaytenWilderness	WA	4.17	3.72	3.41	3.72	2.89	3.16	2.88	3.15	3.32	3.86	4.42	4.46	0.053	0.044	1.33	0.208	0.222	0.009
BridgerWilderness	WY	2.52	2.35	2.34	2.19	2.10	1.80	1.50	1.49	1.74	2.00	2.44	2.42	0.046	0.038	1.14	0.178	0.190	0.008
FitzpatrickWilderness	WY	2.51	2.33	2.24	2.13	2.09	1.80	1.51	1.46	1.73	1.98	2.39	2.44	0.046	0.038	1.14	0.179	0.190	0.008
Grand Teton NP	WY	2.62	2.39	2.24	2.10	2.06	1.79	1.52	1.47	1.72	2.00	2.43	2.55	0.046	0.038	1.14	0.178	0.190	0.008
NorthAbsaroka	WY	2.43	2.27	2.24	2.17	2.14	1.93	1.69	1.56	1.76	2.04	2.35	2.40	0.046	0.038	1.14	0.178	0.190	0.008
TetonWilderness	WY	2.53	2.35	2.24	2.12	2.10	1.85	1.59	1.51	1.74	2.02	2.40	2.48	0.046	0.038	1.14	0.178	0.190	0.008
WashakieWilderness	WY	2.50	2.34	2.23	2.12	2.11	1.84	1.56	1.49	1.75	2.00	2.38	2.46	0.046	0.038	1.14	0.179	0.190	0.008
YellowstoneNP	WY	2.54	2.36	2.27	2.16	2.15	1.94	1.69	1.59	1.79	2.08	2.45	2.51	0.046	0.038	1.15	0.180	0.192	0.008
JarbridgeWilderness	NV	2.95	2.60	2.08	2.12	2.21	2.17	1.58	1.40	1.35	1.63	2.44	2.80	0.046	0.038	1.14	0.179	0.190	0.008
Columbia River Gorge	OR-WA	5.03	5.03	2.59	2.59	2.59	2.11	2.11	2.11	3.51	3.51	3.51	5.03	0.569	0.231	4.85	1.05	0.217	0.205

Appendix C

CALMET Parameter Values

Appendix C: CALMET Parameter Values

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
0	DIADAT	Input file: preprocessed surface temperature data (DIAG.DAT)	User Defined	
0	GEODAT	Input file: Geophysical data (GEO.DAT)	User Defined	User Define
0	LCFILES	Convert file name to lower case	User Defined	
0	METDAT	Output file (CALMET.DAT)	User Defined	
0	METLST	Output file (CALMET.LST)	User Defined	
0	MM4DAT	Input file: MM4 data (MM4.DAT)	User Defined	
0	NOWSTA	Input files: Names of NOWSTA overwater stations	User Defined	0
0	NUSTA	Number of upper air data sites	User Defined	0
0	PACDAT	Output file: in Mesopuff II format (PACOUT.DAT)	User Defined	
0	PRCDAT	Input file: Precipitation data (PRECIP.DAT)	User Defined	
0	PRGDAT	Input file: CSUMM prognostic wind data (PROG.DAT)	User Defined	
0	SEADAT	Input files: Names of NOWSTA overwater stations (SEAn.DAT)	User Defined	
0	SRFDAT	Input file: Surface data (SURF.DAT)	User Defined	
0	TSTFRD	Output file (TEST.FRD)	User Defined	
0	TSTKIN	Output file (TEST.KIN)	User Defined	
0	TSTOUT	Output file (TEST.OUT)	User Defined	
0	TSTPRT	Output file (TEST.PRT)	User Defined	
0	TSTSLP	Output file (TEST.SLP)	User Defined	
0	UPDAT	Input files: Names of NUSTA upper air data files (UPn.DAT)	UPn.DAT	
0	WTDAT	Input file: Terrain weighting factors (WT.DAT)	User Defined	
1	CLDDAT	Input file: Cloud data (CLOUD.DAT)	User Defined	Not used
1	IBDY	Beginning day	User Defined	
1	IBHR	Beginning hour	User Defined	
1	IBMO	Beginning month	User Defined	
1	IBTZ	Base time zone	User Defined	8
1	IBYR	Beginning year	User Defined	
1	IRLG	Number of hours to simulate	User Defined	User Define
1	IRTYPE	Output file type to create (must be 1 for CALPUFF)	1	1
1	ITEST	Flag to stop run after Setup Phase	2	2
1	LCALGRD	Are w-components and temperature needed?	T	T
2	DATUM	WGS-G, NWS-27, NWS-84, ESR-S,…		NWS84
2	DGRIDKM	Grid spacing	User Defined	4
2	IUTMZN	UTM Zone	User Defined	User Define
2	LLCONF	When using Lambert Conformal map coordinates - rotate winds from true north to map north?	F	F
2	NX	Number of east-west grid cells	User Defined	373
2	NY	Number of north-south grid cells	User Defined	316
2	NZ	Number of vertical layers	User Defined	10
2	RLAT0	Latitude used if LLCONF = T	User Defined	49.0N
2	RLON0	Longitude used if LLCONF = T	User Defined	121.0W
2	XLAT0	Southwest grid cell latitude	User Defined	User Define
2	XLAT1	Latitude of 1st standard parallel	User Defined	30
2	XLAT2	Latitude of 2nd standard parallel	User Defined	60
2	XORIGKM	Southwest grid cell X coordinate	User Defined	-572
2	YLON0	Southwest grid cell longitude	User Defined	-956
2	YORIGKM	Southwest grid cell Y coordinate	User Defined	User Define
2	ZFACE	Vertical cell face heights (NZ+1 values)	User Defined	0,20,40,65,120,200,400, 700,1200,2200,4000
3	IFORMO	Format of unformatted file (1 for CALPUFF)	1	1
3	LSAVE	Save met. data fields in an unformatted file?	T	T
4	ICLOUD	Is cloud data to be input as gridded fields? (0 = No)	0	0
4	IFORMC	Format of cloud data (2 = formatted)	2	2
4	IFORMP	Format of precipitation data (2 = formatted)	2	2
4	IFORMS	Format of surface data (2 = formatted)	2	2
4	NOOBS	Use or non-use of surface, overwater, upper observations		1

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
4	NPSTA	Number of stations in PRECIP.DAT	User Defined	-1
4	NSSTA	Number of stations in SURF.DAT file	User Defined	115
5	ALPHA	Empirical factor triggering kinematic effects	0.1	0.1
5	BIAS	Surface/upper-air weighting factors (NZ values)	NZ*0	NZ*0
5	CRITFN	Critical Froude number	1	1
5	DIVLIM	Maximum acceptable divergence	5.00E-06	5.00E-06
5	FEXTR2	Multiplicative scaling factor for extrap surface obs to uppr layrs	NZ*0.0	
5	ICALM	Extrapolate surface calms to upper layers? (0 = No)	0	0
5	IDIOPT1	Compute temperatures from observations (0 = True)	0	0
5	IDIOPT2	Compute domain-average lapse rates? (0 = True)	0	0
5	IDIOPT3	Compute internally inital guess winds? (0 = True)	0	0
5	IDIOPT4	Read surface winds from SURF.DAT? (0 = True)	0	0
5	IDIOPT5	Read aloft winds from UPn.DAT? (0 = True)	0	0
5	IEXTRP	Extrapolate surface winds to upper layers? (-4 = use similarity theory and ignore layer 1 of upper air station data)	-4	-1
5	IFRADJ	Adjust winds using Froude number effects? (1 = Yes)	1	1
5	IKINE	Adjust winds using kinematic effects? (1 = Yes)	0	0
5	IOBR	Use O'Brien procedure for vertical winds? (0 = No)	0	0
5	IPROG	Using prognostic or MM-FDDA data? (0 = No)	0	14
5	ISLOPE	Compute slope flows? (1 = Yes)	1	1
5	ISTEPPG	Timestep (hours) of the prognostic model input data	1	1
5	ISURFT	Surface station to use for surface temperature (between 1 and NSSTA)	User Defined	98
5	IUPT	Station for lapse rates (between 1 and NUSTA)	User Defined	1
5	IUPWND	Upper air station for domain winds (-1 = 1/r**2 interpolation of all stations)	-1	-1
5	IWFCOD	Generate winds by diagnostic wind module? (1 = Yes)	1	1
5	KBAR	Level (1 to NZ) up to which barriers apply	NZ	10
5	LLBREZE	Use Lake Breeze module	F	F
5	LVARY	Use varying radius to develop surface winds?	F	F
5	METBXID	Station IDs in the region	User Defined	
5	NBAR	Number of Barriers to interpolation	User Defined	0
5	NBOX	Number of Lake Breeze regions	User Defined	0
5	NINTR2	Max number of stations for interpolations (NA values)	99	99
5	NITER	Max number of passes in divergence minimization	50	50
5	NLB	Number of stations in region	User Defined	0
5	NSMTH	Number of passes in smoothing (NZ values)	2, 4*(NZ-1)	1,2,2,3,3,4,4,4,4,4
5	R1	Relative weight at surface of Step 1 field and obs	User Defined	1.00E-06
5	R2	Relative weight aloft of Step 1 field and obs	User Defined	1.00E-06
5	RMAX1	Max surface over-land extrapolation radius (km)	User Defined	200
5	RMAX2	Max aloft over-land extrapolation radius (km)	User Defined	200
5	RMAX3	Maximum over-water extrapolation radius (km)	User Defined	200
5	RMIN	Minimum extrapolation radius (km)	0.1	0.1
5	RMIN2	Distance (km) around an upper air site where vertical extrapolation is excluded (Set to -1 if IEXTRP = ±4)	4	-1
5	RPROG	Weighting factor for CSUMM prognostic wind data	User Defined	0
5	TERRAD	Radius of influence of terrain features (km)	User Defined	12
5	XBBAR	X coordinate of Beginning of each barrier	User Defined	0
5	XBCST	X Point defining the coastline (straight line)	User Defined	0
5	XEBAR	X coordinate of Ending of each barrier	User Defined	0
5	XECST	X Point	User Defined	0
5	XG1	X Grid line 1 defining region of interest	User Defined	0
5	XG2	X Grid line 2	User Defined	0
5	YBBAR	Y coordinate of Beginning of each barrier	User Defined	0
5	YBCST	Y Point	User Defined	0
5	YEBAR	Y coordinate of Ending of each barrier	User Defined	0
5	YECST	Y Point	User Defined	0
5	YG1	Y Grid line 1	User Defined	0

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
5	YG2	Y Grid Line 2	User Defined	0
5	ZUPT	Depth of domain-average lapse rate (m)	200	200
5	ZUPWND	Bottom and top of layer for 1st guess winds (m)	1, 1000	1.,1000.
6	CONSTB	Neutral mixing height B constant	1.41	1.41
6	CONSTE	Convective mixing height E constant	0.15	0.15
6	CONSTN	Stable mixing height N constant	2400	2400
6	CONSTW	Over-water mixing height W constant	0.16	0.16
6	CUTP	Minimum cut off precip rate (mm/hr)	0.01	0.01
6	DPTMIN	Minimum capping potential temperature lapse rate	0.001	0.001
6	DSHELF	Coastal/shallow water length scale	0	0
6	DZZI	Depth for computing capping lapse rate (m)	200	200
6	FCORIOL	Absolute value of Coriolis parameter	1.00E-04	1.00E-04
6	HAFANG	Half-angle for looking upwind (degrees)	30	30
6	IAVET	Conduct spatial averaging of temperature? (1 = True)	1	1
6	IAVEZI	Spatial averaging of mixing heights? (1 = True)	1	1
6	ICOARE	Overwater surface fluxes method and parameters	10	10
6	ICOOL	COARE cool skin layer computation	0	0
6	ILEVZI	Layer to use in upwind averaging (between 1 and NZ)	1	1
6	ILUOC3D	Land use category ocean in 3D.DAT datasets	16	16
6	IMIXH	Method to compute the convective mixing height	1	1
6	IRAD	Form of temperature interpolation (1 = 1/r)	1	1
6	IRHPROG	3D relative humidity from observations or from prognostic data	0	1
6	ITPROG	3D temps from obs or from prognostic data?	0	2
6	ITWPROG	Option for overwater lapse rates used in convective mixing height growth	0	2
6	IWARM	COARE warm layer computation	0	0
6	JWAT1	Beginning landuse type defining water	999	55
6	JWAT2	Ending landuse type defining water	999	55
6	MNMDAV	Max averaging radius (number of grid cells)	1	1
6	NFLAGP	Method for precipitation interpolation (2 = 1/r**2)	2	2
6	NUMTS	Max number of stations in temperature interpolations	5	10
6	SIGMAP	Precip radius for interpolations (km)	100	12
6	TGDEFA	Default over-water capping lapse rate (K/m)	-0.0045	-0.0045
6	TGDEFB	Default over-water mixed layer lapse rate (K/m)	-0.0098	-0.0098
6	THRESHL	Threshold buoyancy flux required to sustain convective mixing height growth overland	0.05	0.05
6	THRESHW	Threshold buoyancy flux required to sustain convective mixing height growth overwater	0.05	0.05
6	TRADKM	Radius of temperature interpolation (km)	500	500
6	ZIMAX	Maximum over-land mixing height (m)	3000	3000
6	ZIMAXW	Maximum over-water mixing height (m)	3000	3000
6	ZIMIN	Minimum over-land mixing height (m)	50	50
6	ZIMINW	Minimum over-water mixing height (m)	50	50

Appendix D

CALPUFF Parameter Values

Appendix D: CALPUFF Parameter Values

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.

Input Group	Group Description	Sequence	Variable	Description	Default Value[a]	Recommended Value
1	Run Control	1	METRUN	Do we run all periods (1) or a subset (0)?	0	
1		2	IBYR	Beginning year	User Defined	
1		3	IBMO	Beginning month	User Defined	
1		4	IBDY	Beginning day	User Defined	
1		5	IBHR	Beginning hour	User Defined	
1		5	IRLG	Length of run (hours)	User Defined	
1		5	NSECDT	Length of modeling time step (seconds)	3600	3600
1		6	NSPEC	Number of species modeled (for MESOPUFF II chemistry)	5	
1		7	NSE	Number of species emitted	3	
1		8	ITEST	Flag to stop run after Setup Phase	2	
1		9	MRESTART	Restart options (0 = no restart) allows splitting runs into smaller segments	0	
1		10	NRESPD	Number of periods in Restart	0	
1		11	METFM	Format of input meteorology (1 = CALMET, 2 = ISC)	1	
1		12	AVET	Averaging time lateral dispersion parameters (minutes)	60	60
1		13	PGTIME	PG Averaging time	60	60
2	Tech Options	1	MGAUSS	Near-field vertical distribution (1 = Gaussian)	1	1
2		2	MCTADJ	Terrain adjustments to plume path (3 = Plume path)	3	3
2		3	MCTSG	Do we have subgrid hills? (0 = No) allows CTDM-like treatment for subgrid scale hills	0	0
2		4	MSLUG	Near-field puff treatment (0 = No slugs)	0	0
2		5	MTRANS	Model transitional plume rise? (1 = Yes)	1	1
2		6	MTIP	Treat stack tip downwash? (1 = Yes)	1	1
2		7	MBDW	Method to simulate downwash (1=ISC,2=PRIME)		not used
2		8	MSHEAR	Treat vertical wind shear? (0 = No)	0	0
2		9	MSPLIT	Allow puffs to split? (0 = No)	0	0
2		10	MCHEM	MESOPUFF-II Chemistry? (1 = Yes)	1	1
2		11	MAQCHEM	Aqueous phase transformation	0	0
2		12	MWET	Model wet deposition? (1 = Yes)	1	1
2		13	MDRY	Model dry deposition? (1 = Yes)	1	1
2		13	MTILT	Plume Tilt (gravitational settling)	0	0
2		14	MDISP	Method for dispersion coefficients (2=micromet,3 = PG)	3	3
2		15	MTURBVW	Turbulence characterization? (Only if MDISP = 1 or 5)	3	3
2		16	MDISP2	Backup coefficients (Only if MDISP = 1 or 5)	3	3
2		16	MTAULY	Method for Sigma y Lagrangian timescale	0	0
2		16	MTAUADV	Method for Advective-Decay timescale for Turbulence	0	0
2		16	MCTURB	Method to compute sigma v,w using micromet variables	1	1
2		17	MROUGH	Adjust PG for surface roughness? (0 = No)	0	0
2		18	MPARTL	Model partial plume penetration? (0 = No)	1	1
2		19	MTINV	Elevated inversion strength (0 = compute from data)	0	0
2		20	MPDF	Use PDF for convective dispersion? (0 = No)	0	0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
2		21	MSGTIBL	Use TIBL module? (0 = No) allows treatment of subgrid scale coastal areas	0	0
2		22	MBCON	Boundary conditions modeled	0	0
2		23	MFOG	Configure for FOG model output	0	0
2		24	MREG	Regulatory default checks? (1 = Yes)	1	1
3	Species List	1	CSPECn	Names of species modeled (for MESOPUFF II must be SO2-SO4-NOX-HNO3-NO3)	User Defined	
3		2	Specie Names	Manner species will be modeled	User Defined	
3		3	Specie Groups	Grouping of species if any	User Defined	
3		4	CGRUP			
3		5	CGRUP			
4	MapProjection		XLAT1	Latitude of 1st standard parallel		
4			XLAT2	Latitude of 2nd standard parallel		
4			DATUM			NWS84
4		1	NX	Number of east-west grids of input meteorology	User Defined	
4		2	NY	Number of north-south grids of input meteorology	User Defined	
4		3	NZ	Number of vertical layers of input meteorology	User Defined	
4		4	DGRIDKM	Meteorology grid spacing (km)	User Defined	
4		5	ZFACE	Vertical cell face heights of input meteorology	User Defined	
4		6	XORIGKM	Southwest corner (east-west) of input User	Defined meteorology	
4		7	YORIGIM	Southwest corner (north-south) of input User	Defined meteorology	
4		8	IUTMZN	UTM zone	User Defined	
4		9	XLAT	Latitude of center of meteorology domain	User Defined	
4		10	XLONG	Longitude of center of meteorology domain	User Defined	
4		11	XTZ	Base time zone of input meteorology	User Defined	
4		12	IBCOMP	Southwest X-index of computational domain	User Defined	
4		13	JBCOMP	Southwest Y-index of computational domain	User Defined	
4		14	IECOMP	Northeast X-index of computational domain	User Defined	
4		15	JECOMP	Northeast Y-index of computational domain	User Defined	
4		16	LSAMP	Use gridded receptors? (T = Yes)	F	F
4		17	IBSAMP	Southwest X-index of receptor grid	User Defined	
4		18	JBSAMP	Southwest Y-index of receptor grid	User Defined	
4		19	IESAMP	Northeast X-index of receptor grid	User Defined	
4		20	JESAMP	Northeast Y-index of receptor grid	User Defined	
4		21	MESHDN	Gridded recpetor spacing = DGRIDKM/MESHDN	1	
5	Output Options	1	ICON	Output concentrations? (1 = Yes)	1	1
5		2	IDRY	Output dry deposition flux? (1 = Yes)	1	1
5		3	IWET	Output west deposition flux? (1 = Yes)	1	1
5		4	IT2D	2D Temperature	0	0
5		5	IRHO	2D Density	0	0
5		6	IVIS	Output RH for visibility calculations (1 = Yes)	1	1
5		7	LCOMPRS	Use compression option in output? (T = Yes)	T	T
5		8	ICPRT	Print concentrations? (0 = No)	0	0
5		9	IDPRT	Print dry deposition fluxes (0 = No)	0	0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
5		10	IWPRT	Print wet deposition fluxes (0 = No)	0	0
5		11	ICFRQ	Concentration print interval (1 = hourly)	1	24
5		12	IDFRQ	Dry deposition flux print interval (1 = hourly)	1	24
5		13	IWFRQ	West deposition flux print interval (1 = hourly)	1	24
5		14	IPRTU	Print output units (1 = g/m**3; g/m**2/s; 3 = ug/m3, ug/m2/s)	1	3
5		15	IMESG	Status messages to screen? (1 = Yes)	1	2
5		16	LDEBUG	Turn on debug tracking? (F = No)	F	F
5		16	IPFDEB	First puff to track	1	1
5		17	NPFDEB	(Number of puffs to track)	(1)	1
5		18	NN1	(Met. Period to start output)	(1)	1
5		19	NN2	(Met. Period to end output)	(10)	10
7	Dry Dep Chem		Dry Gas Dep	Chemical parameters of gaseous deposition species	User Defined	defaults
8	Dry Dep Size		Dry Part. Dep	Chemical parameters of particulate deposition species	User Defined	defaults
9	Dry Dep Misc	1	RCUTR	Reference cuticle resistance (s/cm)	30	30
9		2	RGR	Reference ground resistance (s/cm)	10	10
9		3	REACTR	Reference reactivity	8	8
9		4	NINT	Number of particle-size intervals	9	9
9		5	IVEG	Vegetative state (1 = active and unstressed; 2=active and stressed)	1	1
10	Wet Dep		Wet Dep	Wet deposition parameters	User Defined	defaults
11	Chemistry	1	MOZ	Ozone background? (0 = constant background value; 1 = read from ozone.dat)	0	0
11		2	BCKO3	Ozone default (ppb) (Use only for missing data)	80	60
11		3	BCKNH3	Ammonia background (ppb)	10	17
11		4	RNITE1	Nighttime SO2 loss rate (%/hr)	0.2	0.2
11		5	RNITE2	Nighttime NOx loss rate (%/hr)	2	2
11		6	RNITE3	Nighttime HNO3 loss rate (%/hr)	2	2
11		7	MH2O2	H2O2 data input option	1	1
11		8	BCKH2O2	Monthly H2O2 concentrations	1	12*1
			BKPMF	Fine particulate concentration	12 * 1.00	not used
			OFRAC	Organic fraction of Fine Particulate	2*0.15, 9*0.20, 1*0.15	not used
			VCNX	VOC / NOX ratio	12 * 50.00	not used
12	Dispersion	1	SYTDEP	Horizontal size (m) to switch to time dependence	550	550
12		2	MHFTSZ	Use Heffter for vertical dispersion? (0 = No)	0	0
12		3	JSUP	PG Stability class above mixed layer	5	5
12		4	CONK1	Stable dispersion constant (Eq 2.7-3)	0.01	0.01
12		5	CONK2	Neutral dispersion constant (Eq 2.7-4)	0.1	0.1
12		6	TBD	Transition for downwash algorithms (0.5 = ISC)	0.5	0.5
12		7	IURB1	Beginning urban landuse type	10	10
12		8	IURB2	Ending urban landuse type	19	19
12		9	ILANDUIN	Land use type (20 = Unirrigated agricultural land)	20	20
12		10	ZOIN	Roughness length (m)	0.25	0.25
12		11	XLAIIN	Leaf area index	3.0	3.0
12		12	ELEVIN	Met. Station elevation (m above MSL)	0.0	0.0
12		13	XLATIN	Met. Station North latitude (degrees)	-999.0	-999.0
12		14	XLONIN	Met. Station West longitude (degrees)	-999.0	-999.0

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
12		15	ANEMHT	Anemometer height of ISC meteorological data (m)	10.0	10.0
12		16	ISIGMAV	Lateral turbulence (Not used with ISC meteorology)	1	1
12		17	IMIXCTDM	Mixing heights (Not used with ISC meteorology)	0	0
12		18	XMXLEN	Maximum slug length in units of DGRIDKM	1.0	1
12		19	XSAMLEN	Maximum puff travel distance per sampling step (units of DGRIDKM)	1.0	1
12		20	MXNEW	Maximum number of puffs per hour	99	99
12		21	MXSAM	Maximum sampling steps per hour	99	99
12		22	NCOUNT	Iterations when computing Transport Wind (Calmet & Profile Winds)	2	2
12		23	SYMIN	Minimum lateral dispersion of new puff (m)	1.0	1
12		24	SZMIN	Minimum vertical dispersion of new puff (m)	1.0	1
12		25	SVMIN	Array of minimum lateral turbulence (m/s)	6 * 0.50	6 * 0.50
12		26	SWMIN	Array of minimum vertical turbulence (m/s)	0.20,0.12,0.08, 0.06,0.03,0.01 6	
12		27	CDIV (1), (2)	Divergence criterion for dw/dz (1/s)	0.01 (0.0,0.0)	0.0,0.0
12		28	WSCALM	Minimum non-calm wind speed (m/s)	0.5	0.5
12		29	XMAXZI	Maximum mixing height (m)	3000	3000
12		30	XMINZI	Minimum mixing height (m)	50	50
12		31	WSCAT	Upper bounds 1st 5 wind speed classes (m/s)	1.54,3.09,5.14, 8. 23,10.8	1.54,3.09,5.14,8. 23,10.8
12		32	PLX0	Wind speed power-law exponents	0.07,0.07,0.10, 0.15,0.35,0.55	0.07,0.07,0.10,0. 15,0.35,0.55
12		33	PTGO	Potential temperature gradients PG E and F (deg/km)	0.020,0.035	0.020,0.035
12		34	PPC	Plume path coefficients (only if MCTADJ = 3)	0.5,0.5,0.5,0.5, 0.35,0.35	0.5,0.5,0.5,0.5,0. 35,0.35
12		35	SL2PF	Maximum Sy/puff length	10.0	10.0
12		36	NSPLIT	Number of puffs when puffs split	3	3
12		37	IRESPLIT	Hours when puff are eligible to split	User Defined	
12		38	ZISPLIT	Previous hour's mixing height(minimum)(m)	100.0	100.0
12		39	ROLDMAX	Previous Max mix ht/current mix ht ratio must be less then this value for puff to split	0.25	0.25
12		40	NSPLITH	Number of puffs when puffs split horizontally	5	5
12		41	SYSPLITH	Min sigma-y (grid cell units) of puff before horiz split	1.0	1.0
12	12	42	SHSPLITH	Min puff elongation rate per hr from wind shear before horiz split	2.0	2.0
12		43	CNSPLITH	Min conc g/m3 before puff may split horizontally	1.0E-07	1.0E-07
12		44	EPSSLUG	Convergence criterion for slug sampling integration	1.00E-04	1.00E-04
12		45	EPSAREA	Convergence criterion for area source integration	1.00E-06	1.00E-06
12		46	DSRISE	Step length for rise integration	1.0	1.0
12		47	HTMINBC		500.0	500.0
12		48	RSAMPBC		10.0	10.0
12		49	MDEPBC		1	1
13	Point Source	1	NPT1	Number of point sources	User Defined	
13		2	IPTU	Units of emission rates (1 = g/s)	1	
13		3	NSPT1	Number of point source-species combinations	0	

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
13		4	NPT2	Number of point sources with fully variable emission rates	0	
13			Point Sources	Point sources characteristics	User Defined	
14	Area Source		Area Sources	Area sources characteristics	User Defined	
15	Volume Source		Volume	Volume sources characteristics	User Defined Sources	
16	Line Source		Line Sources	Buoyant lines source characteristics	User Defined	
17	Receptors		NREC	Number of user defined receptors	User Defined	
17			Receptor Data	Location and elevation (MSL) of receptors	User Defined	

Appendix E

CALPOST Parameter Value

Appendix E: CALPOST Parameter Values

Table F-1. Recommended CALPOST parameter values chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
1	ASPEC	Species to process	VISIB	VISIB
1	ILAYER	Layer/deposition code (1 = CALPUFF concentrations; -3 = wet+dry deposition fluxes)	1	1
1	LBACK	Add Hourly Background Concentrations/Fluxes?	F	F
1	MFRH	Particle growth curve for hygroscopic species	2	2
2	RHMAX	Maximum relative humidity (%) used in particle growth curve	98	95
2	LDRING	Report results by Discrete receptor Ring, if Discrete Receptors used. (T = true)	T	
		Modeled species to be included in computing the light extinction		
2	LVSO4	Include SO4?	T	T
2	LVNO3	Include NO3?	T	T
2	LVOC	Include Organic Carbon?	T	T
2	LVPMC	Include Coarse Particles?	T	T
2	LVPMF	Include Fine Particles?	T	T
2	LVEC	Include Elemental Carbon?	T	T
2	LVBK	when ranking for TOP-N, TOP-50, and Exceedance tables Include BACKGROUND?	T	T
2	SPECPMC	Species name used for particulates in MODEL.DAT file: COARSE =	PMC	PMC
2	SPECPMF	Species name used for particulates in MODEL.DAT file: FINE =	PMF	PMF
		Extinction Efficiencies (1/Mm per ug/m**3)		
2	EEPMC	PM COARSE =	0.6	0.6
2	EEPMF	PM FINE =	1.0	1.0
2	EEPMCBK	Background PM COARSE	0.6	0.6
2	EESO4	SO4 =	3.0	3.0
2	EENO3	NO3 =	3.0	3.0
2	EEOC	Organic Carbon =	4.0	4.0
2	EESOIL	Soil =	1.0	1.0
2	EEEC	Elemental Carbon =	10.0	10.0
2	LAVER	Method used for 24-hr avg % change light extinction	F	F
2	MVISBK	Method used for background light extinction (2 = Hourly RH adjustment; 6 = FLAG seasonal f(RH))	2 or 6	6
2	RHFAC	Monthly RH adjustment factors from FLAG (unique for each Class I area)	Yes if 6	EPA
		Background monthly extinction coefficients (FLAG) unique for each Class I area		
2	BKSO4	Assume all hygroscopic species as SO4 (raw extinction value without scattering efficiency adjustment)		*see table*
2	BKNO3			*see table*
2	BKPMC			*see table*
2	BKOC			*see table*
2	BKSOIL	Assume all non-hygroscopic species as Soil		*see table*
2	BKEC			*see table*
2	BEXTRAY	Extinction due to Rayleigh scattering	10.0	10.0
		Averaging time(s) reported		
3	L1PD	Averaging period of model output	F	F
3	L1HR	1-hr averages	F	F
3	L3HR	3-hr averages	F	F
3	L24HR	24-hr averages	T	T
3	LRUNL	Run lengtyh (annual)	F	F
3	LT50	Top 50 table for each averaging time selected	T	F
3	LTOPN			1
3	NTOP			1
3	ITOP			

Modeling Protocol Response to Comments

ID-OR-WA BART Modeling Protocol: Summary of Comments and Responses

The BART modeling protocol developed by Washington, Oregon, and Idaho was distributed to BART-eligible sources in the three-state region, the Federal Land Managers (FLMs), and EPA Region 10 in early June 2006. Comments were received in the period up to June 30, 2006. Many comments have been addressed by clarifications or modifications to the protocol, and the protocol is greatly improved with these changes. Significant comments relating to modeling and technical issues are summarized below, together with responses.

Comments Grouped by Topic

General Comments 1: Class I areas and Columbia River Gorge National Scenic Area (CRGNSA).

Comments: The CRGNSA and all Class I areas beyond 200 km should not be included in the analysis.

Response: Inclusion of CRGNSA in the analysis is for information purposes only. The inclusion of all Class I areas within 300 km is based on EPA "Guidelines on Air Quality Modeling" (Section 6.1 of Appendix W).

General Comments 2: Ozone and ammonia backgrounds.

Comments: 1) Provide justification for backgrounds; 2) Use an OZONE.DAT file to allow CALPUFF to choose the ozone concentration at each computational grid point based on the nearest monitoring value; 3) Use monthly or seasonally varying O_3 background; 4) Vary ammonia background by Class I area; 5) Use the ammonia limiting method in POSTUTIL; 6) Use ammonia data from WRAP.

Response: Ozone data in Washington, Oregon and Idaho were analyzed, and an annual background concentration of 60 ppb for domain was determined to be representative. Using varying ozone concentrations for each grid point, including the use of an OZONE.DATA file, is not considered suitable for conditions in the modeling domain. An ammonia background concentration of 17 ppb was determined to be appropriate based on the presence of high ammonia-emitting areas in the three-state region that are not adequately represented in the WRAP modeling. It is recognized that ammonia values may be lower in Class I areas, but the analysis must account for plume transport through ammonia-rich areas. Clarification was added to Section 3.6.3.

General Comments 3: Natural Background and Class I areas.

Comments: 1) Clarify the basis for determining natural background (20% best days or annual average); 2) Provide basis for the 20% best-days natural background numbers that are given in Appendix B; 3) Clarify the use of the alternative method in the EPA Guidance on Developing Natural Background to refine the background values used in the modeling; 4) The natural background is too low (conservative), and should be adjusted to include the contribution of natural carbon and sea salt; 5) Use the new IMPROVE Rayleigh scattering estimates developed in November 2005, instead of the default value of 10; 6) Add the Jarbidge Wilderness area in Nevada to the list of Class I areas in the modeling.

Response: 1) The 20% best days natural background will be used and is consistent with the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125). The protocol was clarified to reflect these comments. The use of the new IMPROVE formula for calculating visibility extinction, including the addition of sea salt, has not been approved by the FLMs for the BART analysis. The new Rayleigh scattering formula will also not be used, which is consistent with FLM recommendations. The Jarbidge Wilderness was added to the Class I area list.

General Comments 4: BART Exemption thresholds.

Comments: 1) Multiple or grouped sources should be compared to the 1.0 dv ("cause" threshold) not to the 0.5 dv ("contribute" threshold); 2) Provide information on how the multi-source analysis will be managed, including data sharing among states; 3) Clarify the use of the 98th percentile dv change versus the highest dv change, and how this metric is linked to the method for estimating natural background; 4) Calculate the change in visibility on a receptor-by-receptor basis, not on the Class I area.

Response: Following the BART modeling guidance, the contribution threshold is 0.5 dv and will be applied to individual sources. In the multi-source assessment, the 0.5 dv value is used only as a marker to indicate that a further analysis of these sources will be carried out; it is not considered a contribution threshold. The additional analysis of these multiple sources will look at the frequency, magnitude, duration, and other factors to determine if these sources, if any, will be considered significant and Subject to BART. Section 2.7.1 has been clarified regarding these multi-source assessments. Emissions and modeled concentration data will be shared among the three states. The 98th percentile change in dv will be used in conjunction with the 20% best days natural background and is based on the EPA BART guidelines and comments of the FLMs. The assessment of visibility change will be based on a receptor-by-receptor basis.

General Comments 5: Multi-source modeling and assessment methodology.

Comments: 1) The reference to FLAG and the use of "magnitude, frequency, duration" in Exemption modeling should be removed as these factors only apply in the Determination phase of the modeling; 2) Clarify the difference between the BART Exemption modeling and Determination modeling; (for

example, if a source is determined to be Subject to BART based on the multi-source analysis, should not the BART Determination also be based on group analysis?).

Response: Consistent with the EPA BART Guidelines, the FLAG and IWAQM reports will be used as general guidance for the visibility assessment. The single-source BART Exemption analyses will be based on the 0.5 dv contribution threshold and will not consider the frequency, magnitude, and duration of impairment (consistent with BART Guideline). For the evaluation of multi-source impacts, the BART Exemption analyses will consider an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each sources in the multi-source group. Section 2.7.2 has been clarified for the Determination phase.

<u>General Comments 6: Inclusion of VOC and ammonia-emitting sources in the BART modeling.</u>

Comments: 1) Remove VOCs and ammonia from the visibility analysis; 2) If VOCs are modeled, justify basis for VOC speciation.

Response: Section 2.3 in the protocol has been modified to read, "Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds that require a full BART exemption analysis." For Washington, "VOC emissions will be included in the BART exemption analysis if the greater-than-six carbon VOC gases exceed 250 tons/year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms."

<u>General Comments 7: Definition of Bart-eligible sources.</u>

Comments: Confusion on definition of BART-eligible source.

Response: Section 2.1 in protocol has been clarified to show that a "BART-eligible source" refers to the entire facility that has BART-eligible emission units."
<u>General Comments 8: Characterization of facility emissions</u>.

Comment: 1) Clarify under what conditions emission units and pollutants can be excluded in the BART Exemption modeling; 2) Do not include fugitive emissions; 3) Describe how different operating scenarios might be included; 4) Clarify the modeling of HNO_3.

Response: Section 2.4 was clarified on the exemption of pollutants and individual emission units and specifically the exemption of fugitive emissions for sources that are greater than 10km from a Class I area. Different operating scenarios are not addressed in the protocol; if this is a significant issue for an individual source, it will be addressed on a case-by-case basis. HNO_3.modeling is addressed in Section 3.6.1.

General Comments 9: PM speciation.

Comments: 1) Clarify how PM will be speciated, especially the inclusion of the condensable fraction of emissions and scavenging coefficients for PM species; 2) Address the possible double-counting of SO_4 in PM_{10} condensables with gaseous SO_2; 3) Correct the problem with the speciation references in the appendices; 4) Add additional sources of speciation data than those listed in the appendices; 5) Make reference to the NPS Web site for speciation information.

Response: Section 3.6.1 was modified to give a better description of PM speciation, size fractionation, treatment of condensables, and the modeling of SO_2 and $H2SO_4$ to ensure no double-counting. The statement "The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions" was added. Appendix G was removed and three information sources were included in Section 3.6.1. A chart showing the default PM size fractions to be used in CALPUFF was included in the protocol:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.48	2
PMC	2.5	5

General Comments 10: CALMET modeling.

Comments: 1) The CALMET modeling protocol was not available for public review, yet the work is already under way; 2) Make clear that states, not Geomatrix, is responsible for the protocol for developing the CALMET data set; 3) Correct the years of CALMET data that is shown in section 3.1.2; 4) Clarify how the 12-km CALMET data will be used; 5) Describe how the CALMET data will be provided; 6) Describe how the MM5 will be evaluated.
Response: Clarification was added to Section 3.5. Due to time and resource constraints, an initial CALMET protocol and the development of the data set was started prior to the finalizing of the protocol. The FLMs and EPA were consulted throughout this process, and the initial draft of the CALMET protocol was reviewed and approved before the work began. The years of CALMET data given in the protocol have been corrected. Only the 4-km CALMET data will be used for BART modeling, but both the 4 km and 12 km met data will be available for other air quality analyses. Individual facilities will contact the appropriate state agency to discuss options for obtaining the CALMET data. The MM5 data was evaluated using METSTAT, a publicly available statistical program.

General Comments 11: CALPUFF model versions.

Comments: 1) Clarify reasons for using Version 6 as this is not consistent with other RPO protocols; 2) Correct the listing of versions in the protocol; 3) Update the protocol and the appendices to reflect the use of Version 6.

Response: Version 6 is the most recent version of CALPUFF and was made available after other protocols in other regions were completed. It was felt important that the most recent version be used, in part because of the improved over-water algorithm. The protocol was corrected to show Version 6 of the CALPUFF modeling system. Appendices were updated to include the new parameters in Version 6.

General Comments 12: CALPUFF modeling parameters.

Comments: Comments on CALPUFF: 1) Clarify the meaning of the phrase "protocol will generally follow FLAG and IWAQM;" 2) Use puff-splitting; 3) Use building downwash; 4) Base source elevations on the same terrain files as the receptor elevations.

Response: The FLAG and IWAQM reports were used as guidance documents during the development of the protocol, and are specifically referenced in the EPA BART guidelines. Puff-splitting and building downwash will not be used in CALPUFF based on the recommendations from FLMs. Clarification was added to Section 3.6.4 to state that source and receptor elevations will be the actual elevations, and will not be based on the DEM data used for the development of the windfields in CALMET.

General Comments 13: CALPOST

Comments: 1) Describe how OC (SOA) is treated in CALPUFF, POSTUTIL, and CALPOST.

Response: Clarification was added to Sections 3.6 and 3.7.

General Comments 14: BART modeling implementation.

Comments: 1) Clarify if the protocol is required for all BART-eligible sources, or can the use of higher resolution met data, or other refined model options, be used to address local conditions; 2) Show the BART schedule, including the estimated time and resources required by IDEQ and WRAP; 3) Describe the process for determining and prioritizing BART control measures, including the sensitivity of the visibility modeling to PM, SO_2, and NO_x emissions; 4) Comment on the observation that control technologies that do not produce visibility improvements will not be determined to be BART.

Response: These local or state-specific issues are not addressed in the protocol, and should be discussed separately with each state agency. In addition, this response to comments is intended only to address the modeling and technical analysis issues of the BART process and not to respond to questions or comments of a legal nature.

Specific Comments

<u>Specific Comment 1: Terminology</u>.

Comment: The term "BART exemption modeling" is not used in the BART Guidelines (40 CFR part 51, Appendix Y). It is suggested that a term that is more directly tied to Appendix Y be used.

Response: The terms in the BART Guidelines are not clear; therefore, the modeling protocol distinguishes between "BART Exemption modeling" (a process to exempt sources from being Subject to BART) and "BART Determination modeling" (a process to determine the level of controls, together with other factors, necessary to meet BART).

<u>Specific Comment 2: Typo</u>

Comment: Put "or" between two bullets in Section 2.4.

Response: The change was incorporated in the protocol.

<u>Specific Comment 3: BART-eligible emission units</u>

Comment: Include a list of all BART-eligible units.

Response: A listing of all BART-eligible units was not included in the protocol as there are potentially a large number of individual emission units, and there may be changes in the actual units included in the modeling as the analysis proceeds. Only a list of BART-eligible sources is included in the protocol.

<u>Specific Comment 4: Model performance evaluation</u>.

Comment: 1) In the protocol, include a section on performance evaluation that addresses the accuracy of the estimated visibility compared to monitored visibility impairment; 2) In the modeling reports, include a summary of a model performance evaluation using the PM_{10} SIP evaluation as guidance; 3) Describe why the protocol and analysis will not result in an overly conservative result, even as a screening approach.

Response: A section on model performance evaluation was not included in the protocol because it is not appropriate for the type of modeling analysis. In order to complete a model evaluation, several data sets are required covering the same time period: meteorological data, actual emissions data from all source types, and monitoring data. The purpose of the BART analysis is to determine the impact on a Class I area of an individual source or a group of sources. All other emissions that are present in the modeling domain that would contribute to impairment at a monitor are not included in the analysis. As

a result, the BART modeled visibility impairment can not be compared to monitoring data. Also, the metrological data and emissions data must be in the same time period as the monitoring data.

The mesoscale meteorological data (MM5) is being evaluated against actual meteorological observation data as well as the CALMET output files.

The protocol is based on recommendations in the BART Guideline, FLAG report, and IWAQM report. In addition, the BART Exemption modeling approach that is described in this protocol is virtually identical to visibility analyses that have been a part of NSR for sources in the Pacific NW for over five years, and is not considered overly protective of visibility.

Modeling Protocol for BART CALMET datasets, Idaho Oregon and Washington

Modeling Protocol for BART CALMET datasets

Idaho, Oregon and Washington

Prepared for:

Idaho Department of Environmental Quality
1410 North Hilton
Boise ID 83706

July 12, 2006

Project No. 012173.000.0

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FIGURES

Figure 1 Modeling Domain, with 12km CALMET Terrain and Class I Areas
Figure 2 Meteorological Stations Included

APPENDIXES

Appendix A Sample CALMM5 Output "3D.DAT" File
Appendix B Sample CALMET Input File

MODELING PROTOCOL
BART CALMET Datasets
Idaho, Oregon and Washington

1. INTRODUCTION

EPA published the Best Available Retrofit Technology (BART) standards under the Regional Haze Rule on July 6, 2005. Appendix Y, "Guideline for Best available Retrofit Technology Determination" (the *BART Guideline*) details EPA's recommendations to states for conducting BART analyses. According to the *BART Guideline*, each state may determine which BART-eligible sources are actually subject to BART using the CALPUFF dispersion model. The CALPUFF model is run using a meteorological data set developed with the CALMET program.

The Idaho Department of Environmental Quality (IDEQ), in cooperation with the Washington Department of Ecology (DOE) and Oregon Department of Environmental Quality (ODEQ) issued a contract to Geomatrix Consultants (Geomatrix) for the development of CALMET meteorological datasets. These datasets will provide consistent meteorology for the dispersion modeling that will be conducted by each state to determine which sources are subject to BART.

The CALMET dataset will be based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at the University of Washington (UW). Two 3-year CALMET datasets will be produced, one using a 12 km mesh size and another using a 4 km mesh size.

Statistical analyses will be performed, assessing both the performance of the UW MM5 runs themselves, and the two CALMET datasets. CALMET adjusts the MM5 data using empirical algorithms and the statistical analyses will assess both the validity of the initial MM5 predictions and the CALMET objective procedures.

2. MODEL SELECTION

The air quality related value (AQRV) of concern for BART modeling assessments is regional haze in Class I areas and modeling needs to estimate the potential contributions of individual industrial sources to regional haze. The *BART Guideline* recommends the use of CALPUFF to establish whether a stationary source is reasonably anticipated to cause or contribute to haze in a Federal Class I area. Features of the CALPUFF modeling system include the ability to consider: secondary aerosol formation; gaseous and particle deposition; wet and dry deposition

processes; complex three-dimensional wind regimes; and the effects of humidity on regional visibility. The CALPUFF modeling system is also currently recommended for evaluating impacts to *all* AQRVs in Class I areas affected by long-range transport from a source. In the case of BART, potential impacts are characterized based on predicted changes to light extinction.

3. MODELING DOMAIN

Geomatrix will use the modeling domain shown in Figure 1 for the CALMET datasets. The 1488 km-by-1260 km domain is essentially the entire usable 12 km MM5 domain, except for a portion that extends out over the Pacific Ocean. The 12 km UW MM5 domain is a nested domain, with feedback between the 36 km domain and the 12 km domain. This requires a smoothing or blending of the fields (both terrain and predicted quantities) along the boundary of the nested (inner) domain. The first few points near the edge of a nested domain should therefore be discarded.

We will extract UW MM5 grid points (X,Y) = (24,4) to (148,109), of a possible maximum (151,112). Here X is the "east-west" direction, not the X of internal MM5 nomenclature (which is the north-south direction). This domain discards 23 points on the western edge, and 3 points along the northern, eastern and southern edges of the UW MM5 12 km grid.

A Lambert Conformal Conic (LCC) coordinate system will be used, with parameters selected to match the coordinate system used by the UW for their MM5 simulations (centered at 49°N, 121°W). The proposed domain, given in terms of the centers of each CALMET grid cell, extends from LCC coordinates (-570,-954) to (918,306) km.

Land use and terrain data will be prepared from the North American 30 second data sets that accompany the CALPUFF modeling system using the tools included in the system, resulting in 12 km and 4 km mesh size fields, depending on the product.

4. METEOROLOGICAL DATA

Geomatrix has archived meteorological data sets from the University of Washington (UW) based on numerical simulations of Pacific Northwest weather with MM5. The proposed dataset for the BART CALMET analysis will use three calendar years of hourly MM5 output data from January 2003 through December 2005, computed on a 12-km mesh size with 38 vertical sigma levels.

MM5 is run by UW in "forecast mode", not "prognostic mode" or "hindcast mode", and is initialized twice per day at 00Z and 12Z. The first few simulated hours of an MM5 run, when divergence and vertical motion at scales smaller than the initialization dataset are still developing, should be discarded. On the other hand, predictions typically stray from reality with time as the simulations proceeds. The compromise is to use forecast hours 12 to 24 from each run for the CALMET dataset. Since MM5 simulations are initiated twice per day, only 12 hours from each run are needed to create a dataset with no gaps in time. However, an additional hour of MM5 output (forecast hour 12) is needed to convert forecast hour 13's accumulated precipitation to an hourly precipitation rate.

Observational data are needed by both CALMET (to provide cloud cover and ceiling height) and METSTAT (to provide verification data). The UCAR dataset ds472.0, *TDL U.S. and Canada Surface Hourly Observations*, will be used for both. These data are available from UCAR[1].

5. MISSING DATA

The initial data recovery for the MM5 archive is greater than 99 percent. The UW saves their MM5 output data in a compressed format using the Linux utility *gzip*, and occasionally a compressed file becomes corrupted during data transfer and storage. Additionally, the UW MM5 runs are initialized from the National Center for Environmental Prediction's (NCEP) GFS model. On a few occasions, NCEP was performing a backup test and the GFS model was not run for that time period. With no data to serve as initial conditions, MM5 was not run for that initialization time. This leaves occasional 12-hour gaps in the data coverage.

Missing periods (when the GFS initialization data were not available) will be re-run using UK Meteorological Office (UKMO) data to provide the initial conditions to MM5. Shorter missing periods (when data transfer and storage corrupts the file) will be filled by extracting the data from the UW tape archive, or re-running MM5 (using GFS initialization data) when tape extraction is not possible. The final data recover rate for the MM5 archive will be 100 percent: no missing data in the three-year time span.

6. CALMM5 PROCEDURES

The CALMM5 program is used to convert raw MM5 output to a format readable by CALMET. CALMM5 version 2.6, level 060330, will be used. This version of CALMM5 can read

[1] See http://dss.ucar.edu/datasets/ds472.0

MM5v3 format files directly, and performs the conversion from accumulated to hourly precipitation as it runs, but cannot tolerate any missing data. The output is the newer 3D.DAT/2D.DAT format. A truncated sample CALMM5 "3D.DAT" is included in Appendix A. We will include a few extra hours at the end of each file, to facilitate its use in time zones other than GMT-8. The 3D.DAT files will include all MM5 sigma levels up to and including 0.26 (the lowest 31 of 38 levels).

Since we will have no missing data, one CALMM5 run will be performed for each month. The files for forecast hours 12-24 from each run will be included in each CALMM5 input file. Although this results in two MM5 files with data valid for the same time period (i.e. forecast hour 24 from the previous run, and forecast hour 12 from the current run both represent the same hour) CALMM5 uses forecast hour 12 data only to convert forecast hour 13's precipitation field from "accumulated precipitation" to "hourly precipitation" as required by CALMET. Forecast hour 13's precipitation field is then subtracted from hour 14's precipitation field, and so on to the end of the CALMM5 run.

7. CALMET PROCEDURES

The proposed modeling procedures follow the recommendations of the Interagency Agency Workgroup on Air Quality Modeling (IWAQM) and the Federal Land Managers Air Quality Related Values Workgroup (FLAG), outlined in the FLAG Phase I Report. EPA endorsed these procedures in advance in the IWAQM Phase II report.

The CALPUFF modeling system is equipped with a host of modeling options, but Geomatrix proposes to use the procedures and defaults recommended by the FLAG Phase I Report except where noted in the following discussion, and summarized in Table 1. A sample CALMET input file can be found in Appendix B.

CALMET, the meteorological preprocessor component of the CALPUFF system, will be used to combine the MM5 simulation data, surface observations, terrain elevations, and land use data into the format required by the dispersion modeling component CALPUFF. In addition to specifying the three-dimensional wind field, CALMET also estimates the boundary layer parameters used to characterize diffusion and deposition by the dispersion model. CALMET default options will be used except where noted in Table 1.

The CALPUFF modeling system is in the process of being upgraded. The most recent "beta" release of CALMET (version 6.211, level 060414) will be used. There were substantial

improvements made to the CALPUFF modeling system with the release of version 6, including better algorithms over water and improved mixing height algorithms.

Major features of the CALMET application and input data preparation are as follows:

- The 12-km MM5 winds for January 2003 through December 2005 will be used to initialize the three-dimensional wind field predictions. Forecast hours 13-24 from each 00Z and 12Z MM5 run will be used (see precipitation discussions below).
- CALMET objective procedures will be used with local terrain and land use data to adjust the MM5 12-km wind fields to 12 km and 4 km mesh size grids. The pressure-based vertical level MM5 fields will be reduced and layer-averaged resulting in 10 vertical levels from the surface to 4,000 m.
- The "no observations" option (NOOBS=1) in the beta version of CALMET will be used to extract hourly precipitation and upper air temperature lapse rates from the MM5 data set.
- Local observed wind speed and wind direction will not be used in the preparation of the wind fields. The wind fields used will depend solely on the MM5 winds and the objective procedure applied by CALMET. This will be accomplished be selecting the non-default interpolation options $R1=R2=10^{-6}$.
- The relative humidity data will be extracted from the MM5 simulations (rather than using the nearest observation, generally from lowland areas) by setting IRHPROG=1.
- Surface observations from within the study domain will be used to provide hourly cloud cover and ceiling height data. The source of surface meteorological data will be the ds472.0 dataset used by the METSTAT analysis. Stations selected from the archive are shown in Figure 2 and listed in Table 2. Only those stations with greater than 90% data recovery rates for ceiling height will be used. This criterion eliminates 91 of the 206 available stations.
- Based on advice from the CALPUFF model author,[2,3] we will select ICOARE=10 to use the COARE algorithm for surface fluxes over water. Related options include setting IWARM=ICOOL=0, since MM5's sea surface temperature (SST) is a skin temperature.
- Based on guidance from IDEQ, we will set IMIXH=1 to use the default Maul-Carson scheme rather than the new Batchvarova and Gryning scheme. In addition,

[2] Joseph Scire, personal communication, 4/14/2006

[3] Joseph Scire et al., 2005. Evaluation of Enhancements to the CALPUFF Model for Offshore and Coastal Applications, *Proceedings of the 10th International Conference on Harmonisation with Atmospheric Dispersion Modelling for Regulatory Purposes. Sissi (Malia), Crete, Greece, 17-20 October 2005.*

the minimum and maximum allowed mixing heights over water will be the same as for over land.

- To take advantage of the new over-water mixing height (and surface flux) schemes, land use category JWAT1=JWAT2=55 will be used. In the absence of an extensive buoy data set, it was previously customary to disable CALMET's schemes for over water by selecting JWAT1=JWAT2=100.
- The datum used for MM5 data by CALMET is "NWS84". The CALMET coordinate system will also be based on this datum so CALMET grid points at 12-km intervals will align with the MM5 grid points.

Two datasets will be produced, with 4 km and 12 km mesh sizes, respectively. The CALMET applications will use the same terrain adjustment procedure options only the mesh sizes and grid definitions will differ. We estimate that three years of the 12 km CALMET files will occupy about 70 gigabytes (GB), and the 4 km CALMET files will occupy about 600 GB.

8. PRECIPITATION CORRECTION

MM5 outputs "accumulated [since the beginning of the MM5 run] precipitation", but CALMET requires hourly (accumulated over an hour) precipitation. Using previous versions of CALMM5 to process multiple UW MM5 simulations into a single CALMM5 data set has sometimes result in spikes in precipitation at 00Z and 12Z. Versions of the CALMM5 program after version 2.0 can make this correction if it encounters more than one hour of MM5 data. We will process a full month of MM5 data in one CALMM5 run, making sure to include enough hours in the beginning of the run to produce a valid precipitation field for even the first hour.

To double-check the precipitation corrections, Geomatrix will plot hourly time series of precipitation and verify that there is no "spike" of rain at 00Z and 12Z.

9. STATISTICAL ANALYSIS

Geomatrix will perform statistical analyses of both the MM5 output and the CALMET output. If possible, both analyses will use the METSTAT software, to facilitate fair comparisons of "before" and "after" CALMET. Bret Anderson (EPA) is developing a version of METSTAT that reads CALMET files. If this version is available before the conclusion of the project, Geomatrix will perform a METSTAT analysis of the CALMET output. If Mr. Anderson's version is not available in time, we will perform a statistical analysis using PRTMET and typical statistical metrics.

The MM5 statistical analysis will closely follow the WRAP analysis[4], and the reader is referred to the cited publication for details. For observational data, METSTAT can read both UCAR's DS472 formatted files and ASCII formatted files. We will use the DS472 data.

The CALMET statistical analysis will use METSTAT for certain features (if available) but will also include the more traditional wind rose plots at several key sites. METSTAT will be useful for evaluating wind speed and direction, temperature, humidity, etc. over the entire domain. By selecting sub-domains and which CALMET files to process, regional and seasonal trends can be investigated. Diurnal trends may require some code alterations to filter the input by hour of the day, but can be accomplished. If the METSTAT program is unavailable, we will perform a more traditional evaluation using the utility PRTMET to extract data from the CALMET files.

[4] *Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States* (March 2005). Available at http://pah.cert.ucr.edu/aqm/308/reports/mm5/DrftFnl_2002MM5_FinalWRAP_Eval.pdf.

TABLES

TABLE 1

NON DEFAULT CALMET OPTIONS

Modeling Protocol BART CALMET Project

Idaho, Oregon and Washington

CALMET Variable	Selected Value	Rationale
NOOBS	1	Use MM5 upper air data.
NPSTA	-1	Use MM5 precipitation data.
IEXTRP	-1	Since we will use MM5 for upper levels, do not extrapolate observed surface winds aloft. (Note, the similarity profile method (iextrp = -4) also is not applicable in complex terrain.)
RMIN2	-1	Not used, since iextrp=-1 and noobs=1
IPROG	14	Use MM5 as a first guess but allow CALMET to adjust for terrain. Note CALMET terrain for the same mesh size is more resolved than the MM5 terrain, because the later is smoothed to reduce the noise in the numerical solutions.
TERRAD	12	Allow CALMET to adjust winds to local terrain for about 1 MM5 grid point (12 km).
R1 & R2	1.e-6	Do not allow CALMET to use the observed winds. We will use the MM5 solutions and CALMET terrain adjustment procedures. We could also do this with noobs=2, but we do not want the CALMET algorithm for cloud cover.
NSMTH	1, 2, 2, 3, 3, 4, 4, 4, 4, 4	With MM5-based wind fields, it is not necessary to smooth the winds to the extent indicated by the CALMET defaults.
ITWPROG	2	Use MM5 lapse rates and air-sea temperature difference over water.
IRHPROG	1	Use MM5 relative humidity.
ITPROG	2	Use MM5 surface temperature.
SIGMAP	12	A larger default radius of interpolation results in “bull-eyes” of precipitation due to the CALMET weighting scheme applied to the MM5 precipitation predictions. Set the radius to the MM5 mesh size.

TABLE 2

METEOROLOGICAL STATIONS
Modeling Protocol BART CALMET Project
Idaho, Oregon and Washington

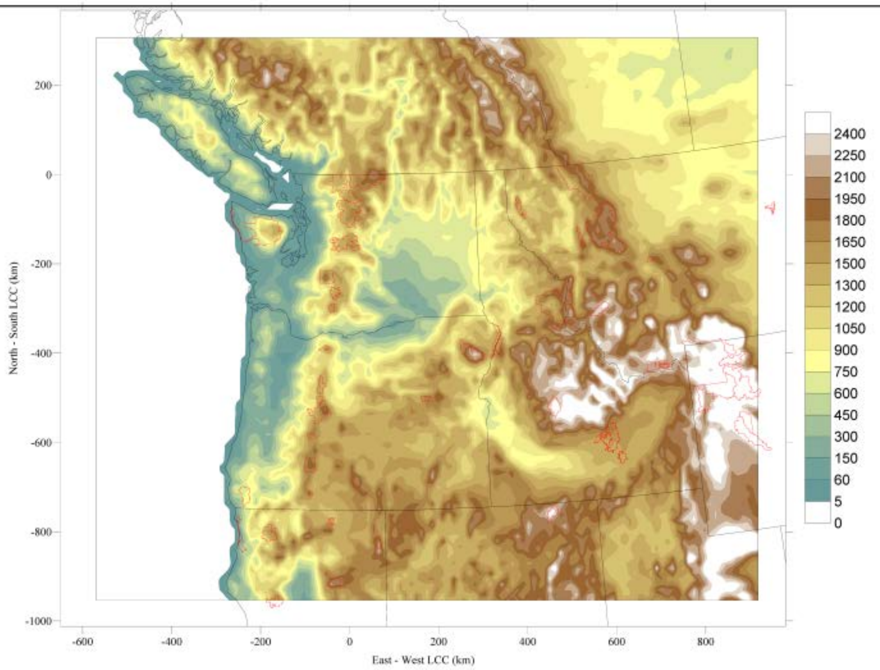
Site	USAF ID[a]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
CWCL	714740	-33.918	231.62	51.15	121.5	3468	Clinton (Auto)
CWLY	718910	-40.274	132.855	50.233	121.583	846	Lytton
CYKA	718870	37.462	183.122	50.7	120.45	1135	Kamloops
CYLW	712030	111.874	105.13	49.967	119.383	1411	Kelowna
CYQL	718740	570.498	97.354	49.633	112.8	3048	Lethbridge
CYQQ	718930	-271.392	83.695	49.717	124.9	79	Comox
CYRV	718820	191.16	215.11	50.967	118.183	1453	Revelstoke
CYVR	718920	-153.574	21.788	49.183	123.183	9	Vancouver
CYXC	718800	363.404	78.17	49.617	115.783	3081	Cranbrook
CYXH	718720	709.459	155.009	50.017	110.717	2352	Medicine Hat
CYXX	711080	-96.449	4.384	49.033	122.367	190	Abbotsford
CYYC	718770	472.149	248.529	51.117	114.017	3556	Calgary
CYYF	718890	97.81	51.039	49.467	119.6	1122	Penticton
CYYJ	717990	-172.887	-35.026	48.65	123.433	62	Victoria Intl Ap
CYYN	718700	912.299	214.141	50.283	107.683	2684	Swift Current
CYZT	711090	-434.428	198.47	50.683	127.367	72	Port Hardy
CZPC	718755	489.487	77.029	49.517	113.983	3904	Pincher Creek Arp
KAAT	999999	35.037	-806.628	41.491	120.564	4366	Alturas
KACV	725495	-252.585	-856.977	40.979	124.106	200	Arcata
KALW	999999	202.125	-308.128	46.1	118.283	1207	Walla Walla
KAST	727910	-214.499	-302.33	46.15	123.883	22	Astoria ASOS
KAWO	727945	-83.937	-88.631	48.17	122.17	138	Arlington Muni
KBFI	999999	-94.364	-156.883	47.533	122.3	16	Boeing Field
KBKE	726886	242.819	-441.691	44.843	117.809	3367	Baker
KBLI	999999	-108.675	-20.486	48.8	122.533	159	Bellingham
KBNO	726830	159.432	-579.755	43.583	118.95	4170	Burns ASOS
KBOI	726810	372.045	-572.462	43.567	116.217	2868	Boise
KBPI	726710	860.382	-632.392	42.567	110.1	6969	Big Piney (AMOS)
KBTM	726785	633.019	-292.451	45.965	112.501	5539	Butte
KBYI	725867	572.204	-667.869	42.542	113.766	4156	Burley
KBZN	999999	735.54	-300.255	45.783	111.15	4462	Bozeman ASOS
KCEC	725946	-259.451	-770.072	41.783	124.233	56	Crescent City
KCLM	999999	-179.411	-92.172	48.117	123.5	290	Port Angeles
KCOD	726700	914.052	-413.015	44.517	109.017	5095	Cody (AMOS)
KCOE	999999	301.859	-124.686	47.767	116.817	2158	Coeur Dalene AWOS
KCTB	727796	611.128	-8.312	48.617	112.383	3837	Cutbank
KCVO	999999	-174.945	-480.847	44.5	123.283	241	Corvallis (AWOS)
KDEW	999999	258.087	-104.945	47.97	117.41	2205	Deer_Park
KDLN	999999	637.435	-369.143	45.25	112.55	5240	Dillon
KDLS	726988	-12.957	-363.142	45.619	121.171	235	The Dalles

Site	USAF ID[(a)]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
KEAT	727825	57.976	-171.913	47.398	120.201	1229	Wenatchee
KEKO	725825	424.565	-864.508	40.826	115.787	5049	Elko Regional Airprt
KELN	999999	35.311	-214.818	47	120.517	1705	Ellensburg/Bowers
KENV	725810	568.031	-863.635	40.733	114.033	4239	Wendover (AUTOB)
KEPH	727826	108.077	-180.833	47.308	119.515	1259	Ephrata
KEUG	726930	-170.985	-522.137	44.117	123.217	373	Eugene ASOS
KEUL	726813	339.553	-567.509	43.63	116.63	2428	Caldwell
KEVW	999999	804.446	-779.878	41.275	111.032	6601	Evanston
KFCA	727790	480.75	-55.044	48.3	114.267	2973	Kalispell ASOS
KFHR	999999	-143.67	-50.173	48.517	123.017	126	Friday Harbor
KGEG	727850	250.792	-141.475	47.633	117.533	2365	Spokane ASOS
KGTF	727750	697.527	-121.003	47.483	111.367	3657	Great Falls ASOS
KHIO	999999	-147.016	-369.017	45.548	122.954	229	Hillsboro/Portland
KHLN	727720	662.505	-220.599	46.6	112	3898	Helena ASOS
KHQM	727923	-214.76	-213.917	46.973	123.93	12	Hoquiam
KHRI	999999	129.999	-339.584	45.826	119.261	646	Hermiston
KHVR	727770	796.66	7.579	48.55	109.767	2599	Havre ASOS
KIDA	999999	694.475	-550.166	43.517	112.067	4744	Idaho Falls
KJAC	999999	796.471	-528.866	43.6	110.733	6444	Jackson
KJER	999999	516.349	-652.638	42.728	114.453	4047	Jerome
KKLS	999999	-141.479	-308.088	46.117	122.9	16	Kelso (AWOS)
KLGU	999999	732.501	-733.406	41.783	111.85	4452	Logan
KLKV	999999	47.747	-733.885	42.167	120.4	4728	Lakeview (AWOS)
KLLJ	727833	518.689	-459.56	44.517	114.217	5072	Challis ASOS
KLMT	999999	-58.563	-735.592	42.15	121.733	4091	Klamath Falls
KLVM	726798	789.408	-302.553	45.698	110.441	4652	Livingston
KLWS	727830	294.823	-273.806	46.383	117.017	1437	Lewiston ASOS
KLWT	726776	840.925	-148.881	47.05	109.467	4144	Lewistown
KMEH	999999	195.533	-372.798	45.5	118.4	3726	Meacham (AMOS)
KMFR	725970	-148.391	-710.826	42.367	122.867	1329	Medford
KMHS	999999	-106.558	-824.655	41.317	122.317	3543	Mt Shasta ASOS
KMLP	999999	386.772	-153.263	47.454	115.67	6000	Mullan Pass Vor.
KMMV	999999	-161.387	-406.453	45.196	123.132	160	Mcminnville
KMSO	727730	506.635	-201.97	46.917	114.083	3189	Missoula
KMWH	999999	122.738	-192.155	47.2	119.317	1188	Moses Lake
KMYL	999999	372.465	-430.781	44.883	116.1	5025	McCall (RAMOS)
KNUW	999999	-117.935	-68.685	48.35	122.65	47	Whidbey Island.NAS
KOGD	999999	726.441	-799.096	41.183	112.017	4456	Ogden
KOLM	727920	-139.314	-216.848	46.967	122.9	200	Olympia
KOMK	727890	105.458	-56.95	48.461	119.519	1301	Omak
KONO	999999	307.459	-527.592	44.017	117.017	2190	Ontario
KONP	999999	-233.295	-469.954	44.583	124.05	161	Newport
KOTH	999999	-253.664	-594.549	43.417	124.25	17	North Bend
KPAE	999999	-92.493	-115.72	47.917	122.283	604	Everett
KPDT	726880	161.157	-354.13	45.683	118.85	1495	Pendleton ASOS
KPDX	726980	-120.265	-364.038	45.6	122.6	39	Portland

Site	USAF ID[a]	X_{LCC} (km)	Y_{LCC} (km)	Lat (°N)	Lon (°W)	Elev (m)	Name
KPIH	725780	659.92	-618.775	42.917	112.6	4478	Pocatello
KPSC	999999	139.686	-292.018	46.267	119.117	404	Pasco
KPUW	999999	285.776	-235.486	46.744	117.114	2551	Pullman-Moscow Rgnl
KPVU	999999	762.646	-899.785	40.217	111.717	4492	Provo
KPWT	999999	-128.323	-161.604	47.483	122.767	482	Bremerton AWOS
KRBG	999999	-185.351	-616.663	43.233	123.367	525	Roseburg ASOS
KRBL	725910	-103.127	-950.438	40.15	122.25	353	Red Bluff ASOS
KRDD	999999	-106.636	-912.642	40.5	122.3	499	Redding
KRDM	999999	-11.622	-508.383	44.267	121.15	3084	Redmond
KRNT	999999	-88.377	-160.554	47.5	122.217	72	Renton
KRXE	999999	710.772	-514.258	43.832	111.806	4858	Rexburg
KSEA	727930	-94.509	-165.829	47.45	122.3	450	Seattle-Tacoma
KSFF	999999	265.091	-137.246	47.667	117.333	1952	Spokane/Felts
KSHN	999999	-156.812	-185.972	47.25	123.15	279	Shelton
KSKA	999999	242.351	-141.834	47.633	117.65	2461	Fairchild Afb
KSLC	725720	735.52	-843.229	40.767	111.967	4227	Salt Lake City
KSLE	726940	-152.137	-436.699	44.917	123	201	Salem ASOS
KSMN	999999	538.403	-393.179	45.117	113.883	3970	Salmon
KSPB	999999	-137.845	-344.331	45.78	122.84	56	Scappoose
KTCM	742060	-108.418	-197.813	47.15	122.483	285	Mcchord Afb
KTIW	999999	-115.473	-185.142	47.267	122.583	292	Tacoma
KTTD	999999	-106.005	-369.556	45.551	122.409	29	Portland/Troutdale
KTWF	999999	516.107	-679	42.483	114.483	4150	Twin Falls
KUAO	726959	-133.863	-401.335	45.25	122.77	197	Aurora State
KUIL	727970	-255.48	-107.22	47.95	124.55	205	Quillayute
KVUO	999999	-123.976	-361.815	45.62	122.65	20	Vancouver (ASOS)
KWMC	725830	260.408	-865.2	40.9	117.8	4314	Winnemuca ASOS
KYKM	727810	34.366	-261.351	46.567	120.533	1066	Yakima
KSIY	725955	-117.765	-774.232	41.783	122.467	2634	Montague/Ssk AWOS

(a) Sites with no USAF ID number are assigned “999999”.

FIGURES

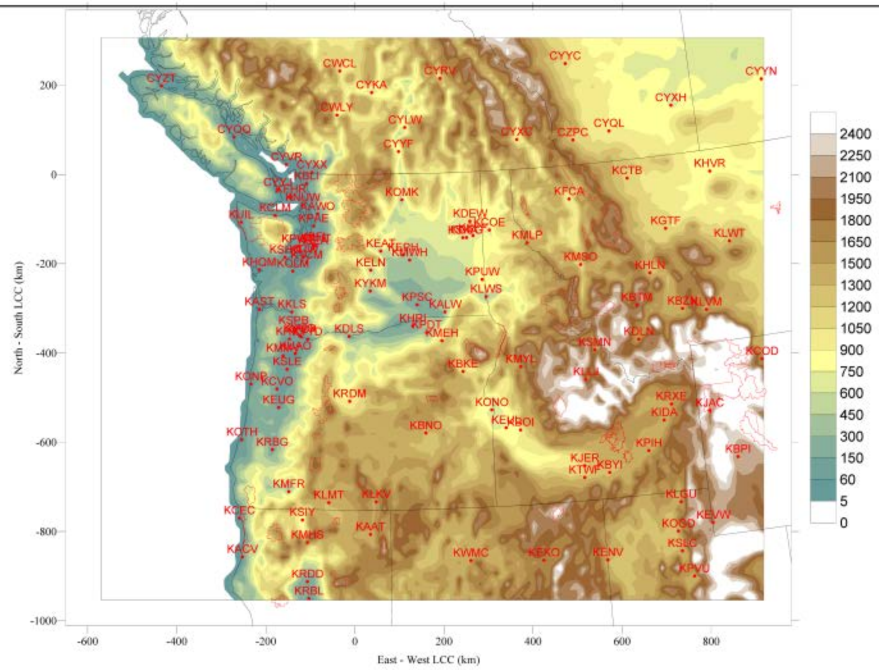


GEOMATRIX

MODELING DOMAIN, WITH 12KM CALMET TERRAIN (M) AND CLASS I AREAS
BART CALMET Dataset Project
Idaho, Oregon and Washington

Proposal No.
012173.000

Figure
1



![GEOMATRIX]

METEOROLOGICAL STATIONS INCLUDED
BART CALMET Dataset Project
Idaho, Oregon and Washington

Proposal No.
012173.000

Figure
2

Appendix A

SAMPLE CALMM5 OUTPUT "3D.DAT" FILE

```
3D.DAT          2.1            Header Structure with Comment Lines
   1
Produced by CALMM5 Version: 2.6     , Level: 060330
  1  1  1  0  0  1
LCC   49.0000 -121.0000  30.00  60.00  -846.000  -990.000  12.000 151 112 37
  1  4  6  5  2  1  0  0  1  1  1  1  1  1  1  1  1  1  1  1 25
2003010101  768 125 106  31
  24   4 148 109   1  31 -129.5095 -107.3765  39.5357  51.8399
0.9975
0.9925
0.9875
0.9825
0.9750
0.9650
0.9550
0.9450
0.9350
0.9250
0.9150
0.9050
0.8900
0.8700
0.8450
0.8150
0.7850
0.7550
0.7250
0.6950
0.6600
0.6200
0.5800
0.5400
0.5000
0.4600
0.4200
0.3800
0.3400
0.3000
0.2600
  24   4  39.8966 -127.8947    0 16   39.9568 -127.8286    0
  25   4  39.9061 -127.7502    0 16   39.9662 -127.6840    0
  26   4  39.9154 -127.6057    0 16   39.9754 -127.5394    0
  27   4  39.9244 -127.4612    0 16   39.9844 -127.3947    0
  28   4  39.9333 -127.3166    0 16   39.9931 -127.2499    0
  29   4  39.9420 -127.1720    0 16   40.0017 -127.1052    0
  30   4  39.9504 -127.0273    0 16   40.0101 -126.9603    0
  31   4  39.9587 -126.8826    0 16   40.0182 -126.8155    0
...
... (truncated) ...
...
140 109  51.2576 -108.7779  667  2   51.3041 -108.6764  663
 141 109  51.2406 -108.6023  659  2   51.2869 -108.5007  656
 142 109  51.2233 -108.4268  652  2   51.2695 -108.3251  647
 143 109  51.2058 -108.2514  645  2   51.2519 -108.1496  640
 144 109  51.1880 -108.0762  640  2   51.2340 -107.9742  635
 145 109  51.1700 -107.9011  637  5   51.2158 -107.7990  631
```

```
 146 109  51.1518 -107.7261  635  5   51.1974 -107.6239  627
 147 109  51.1333 -107.5512  632  5   51.1788 -107.4489  624
 148 109  51.1146 -107.3765  629  2   51.1600 -107.2740  620
2003010101 24  4 1021.5 0.00 0      0.0  343.2   286.1    6.27   218.7
5.4   2
85.8
1019    18 286.0 219  5.8  0.00 62 5.64-2.000
1015    54 285.7 219  6.1  0.00 61 5.45-2.000
1011    91 285.4 220  6.3  0.00 61 5.34-2.000
1006   128 285.0 220  6.4  0.00 61 5.27-2.000
 999   183 284.5 221  6.6  0.00 62 5.18-2.000
 991   257 283.8 222  6.8  0.00 63 5.11-2.000
 982   331 283.1 223  7.0  0.00 65 5.04-2.000
 973   407 282.4 224  7.1  0.00 67 4.99-2.000
 964   482 281.7 225  7.3  0.00 69 4.95-2.000
 955   559 281.0 226  7.4  0.00 71 4.90-2.000
 946   636 280.3 227  7.6  0.00 73 4.86-2.000
 937   713 279.5 228  7.7  0.00 76 4.82-2.000
 924   831 278.4 230  8.0  0.00 80 4.76-2.000
 906   990 277.0 232  8.5  0.00 85 4.67-2.000
 884  1192 275.3 238  9.3  0.00 89 4.48-2.000
 857  1441 274.5 248  9.9  0.01 68 3.30-2.000
 830  1696 274.1 255 10.5  0.01 45 2.20-2.000
 803  1959 273.7 258 11.2  0.01 30 1.51-2.000
 777  2229 273.0 259 11.7  0.01 24 1.17-2.000
 750  2506 271.9 264 12.3  0.01 24 1.10-2.000
 719  2841 270.2 268 14.6  0.01 37 1.58-2.000
 684  3239 267.5 270 17.7  0.00 84 3.05-2.000
 649  3655 267.5 277 20.7  0.00 95 3.68 0.012 0.013
 613  4091 266.0 281 22.1  0.01 95 3.44 0.012 0.010
 578  4548 263.9 283 23.9  0.00 92 3.01 0.010 0.002
 543  5030 261.3 283 26.0 -0.01 89 2.53-2.000
 508  5540 258.4 283 28.2 -0.02 85 2.04-2.000
 473  6081 254.9 282 29.1 -0.02 81 1.56-2.000
 437  6658 251.1 280 29.3 -0.02 77 1.15-2.000
 402  7276 247.0 278 29.7 -0.02 73 0.82-2.000
 366  7943 242.2 276 30.1 -0.02 70 0.56-2.000
2003010101 25  4 1021.6 0.00 0      0.0  342.9   286.0    6.24   219.7
5.2   2
85.7
1019    18 285.9 220  5.6  0.00 62 5.61-2.000
1015    54 285.6 220  5.9  0.00 61 5.42-2.000
1011    91 285.3 221  6.1  0.00 61 5.31-2.000
1006   128 285.0 222  6.2  0.00 61 5.24-2.000
1000   183 284.5 222  6.4  0.00 62 5.15-2.000
 991   257 283.8 224  6.6  0.00 63 5.08-2.000
 982   331 283.1 225  6.7  0.00 65 5.01-2.000
 973   407 282.4 226  6.8  0.00 67 4.96-2.000
 964   482 281.6 227  7.0  0.00 69 4.91-2.000
 955   559 280.9 228  7.1  0.00 71 4.87-2.000
 946   636 280.2 229  7.3  0.00 73 4.83-2.000
 938   713 279.5 230  7.4  0.00 76 4.79-2.000
 924   831 278.4 231  7.7  0.00 79 4.72-2.000
 906   990 276.9 234  8.1  0.00 84 4.63-2.000
 884  1192 275.2 240  9.0  0.00 89 4.43-2.000
 857  1441 274.4 251  9.6  0.01 68 3.29-2.000
```

```
 830  1696 274.0 257 10.3  0.01 44 2.16-2.000
 804  1959 273.7 260 11.1  0.01 29 1.44-2.000
 777  2229 273.0 261 11.6  0.01 24 1.15-2.000
 750  2506 271.9 266 12.3  0.01 25 1.15-2.000
 719  2841 270.0 269 14.7  0.01 41 1.74-2.000
 684  3239 267.4 271 17.8  0.00 87 3.15 0.001 0.007
 649  3655 267.5 278 20.5  0.00 95 3.67 0.012 0.018
 613  4091 265.9 281 22.0  0.01 95 3.41 0.013 0.014
 578  4548 263.8 283 23.9  0.00 92 2.99 0.011 0.002
 543  5030 261.3 283 25.9 -0.01 89 2.52-2.000
 508  5540 258.4 283 28.0 -0.02 85 2.03-2.000
 473  6081 254.9 283 29.1 -0.02 81 1.56-2.000
 437  6658 251.1 281 29.4 -0.02 76 1.14-2.000
 402  7276 247.0 278 29.7 -0.02 72 0.81-2.000
 366  7943 242.2 277 30.1 -0.01 69 0.55-2.000
... (truncated) ...
```

Appendix B

SAMPLE CALMET INPUT FILE

```
CALMET.INP      2.1             Hour Start and End Times with Seconds
BART CALMET dataset, 373x316x4km mesh, Jan 2003 4km Run
12 km MM5 used for temp, rh, prec and all winds (Note, LCC coord)
ds472.0 surface obs for cloud cover, ceiling height, etc.
---------------- Run title (3 lines) ------------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT= geo/geo.4km.dat    !
SURF.DAT      input    ! SRFDAT= sfc/pacnw.2003.sfc !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    * PRCDAT=            *
WT.DAT        input    * WTDAT=             *

CALMET.LST    output   ! METLST= 2003.01.4km.out  !
CALMET.DAT    output   ! METDAT= 2003.01.4km.met  !
PACOUT.DAT    output   * PACDAT=            *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  0   !
    Number of overwater met stations
                             (NOWSTA) No default     ! NOWSTA =  0  !

NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:

    Number of MM4/MM5/3D.DAT files
                             (NM3D) No default       ! NM3D =  1  !

    Number of IGF-CALMET.DAT files
                             (NIGF)   No default     ! NIGF =  0  !

                       !END!
--------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  * UPDAT=UP1.DAT*    *END*
UP2.DAT       input     2  * UPDAT=UP2.DAT*    *END*
UP3.DAT       input     3  * UPDAT=UP3.DAT*    *END*
--------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
```

```
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
SEA1.DAT       input     1  * SEADAT=SEA1.DAT*    *END*
SEA2.DAT       input     2  * SEADAT=SEA2.DAT*    *END*
SEA3.DAT       input     3  * SEADAT=SEA3.DAT*    *END*
-------------------------------------------------------------------------------
Subgroup (d)
------------------------------------------------
MM4/MM5/3D.DAT files (consecutive or overlapping)
------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
MM51.DAT       input   1 ! M3DDAT=/home/mm5/monthly/2003.01.12km.m3d ! !END!
-------------------------------------------------------------------------------
Subgroup (e)
-------------------------------------------------
IGF-CALMET.DAT files (consecutive or overlapping)
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
IGFn.DAT       input     1  * IGFDAT=CALMET0.DAT *    *END*
-------------------------------------------------------------------------------
Subgroup (f)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT=                *
PROG.DAT      input      * PRGDAT=                *

TEST.PRT      output     * TSTPRT=                *
TEST.OUT      output     * TSTOUT=                *
TEST.KIN      output     * TSTKIN=                *
TEST.FRD      output     * TSTFRD=                *
TEST.SLP      output     * TSTSLP=                *
DCST.GRD      output     * DCSTGD=                *

-------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must have
           an 'END' (surround by delimiters) at the end of EACH LINE

                         !END!


-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:    Year   (IBYR)  --    No default   ! IBYR  =  2003 !
                       Month  (IBMO)  --    No default   ! IBMO  =  01 !
                       Day    (IBDY)  --    No default   ! IBDY  =  1  !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR  =  0  !
                       Second (IBSEC) --    No default   ! IBSEC =  0  !
```

```
     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  2003 !
                       Month  (IEMO)  --    No default   ! IEMO  =  02 !
                       Day    (IEDY)  --    No default   ! IEDY  =  1  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  0  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

      UTC time zone         (ABTZ) -- No default      ! ABTZ = UTC-0800 !
         (character 8)
         PST = UTC-0800, MST = UTC-0700 , GMT = UTC-0000
         CST = UTC-0600, EST = UTC-0500

     Length of modeling time-step (seconds)
     Must divide evenly into 3600 (1 hour)
     (NSECDT)                         Default:3600     ! NSECDT =  3600  !
                                      Units: seconds

     Run type           (IRTYPE) -- Default: 1        ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular           Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      Flag to stop run after
      SETUP phase (ITEST)             Default: 2       ! ITEST=  2   !
      (Used to allow checking
      of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of
                  COMPUTATIONAL phase after SETUP

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST  = 0.000  !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.000  !
```

```
UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN =  10 !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N  !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      ! RLAT0 =  49.0N !
(RLON0)                    No Default      ! RLON0 = 121.0W !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                    No Default      ! XLAT1 = 30.0N !
(XLAT2)                    No Default      ! XLAT2 = 60.0N !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E


Datum-region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84    NWS 6370KM Radius, Sphere
ESR-S     ESRI REFERENCE 6371KM Radius, Sphere
```

```
     Datum-region for output coordinates
     (DATUM)                    Default: WGS-G     ! DATUM = NWS-84  !
                                                *** Same as UW MM5 ***


     Horizontal grid definition:
     ---------------------------

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =   373  !
            No. Y grid cells (NY)      No default     ! NY =   316  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = -572. !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = -956. !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ = 10 !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE =0.,20.,40.,65.,120.,200.,400.,700.,1200.,2200.,4000. !

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?              (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                            Default: 1    ! IFORMO =  1  !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)


    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)       Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
```

```
(NOTE: parameters below control which
       met. variables are printed)

Print interval
(IPRINF) in hours                  Default: 1     ! IPRINF = 12  !
(Meteorological fields are printed
 every  1  hours)


Specify which layers of U, V wind component
to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T)        Defaults: NZ*0
! IUVOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
-----------------------


Specify which levels of the W wind component to print
(NOTE: W defined at TOP cell face --  6  values)
(IWOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! IWOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !


Specify which levels of the 3-D temperature field to print
(ITOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! ITOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)            Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                (0 = do not print,
                 1 = print)
  --------      ------------------

!  STABILITY  =          1          ! - PGT stability class
!  USTAR      =          0          ! - Friction velocity
!  MONIN      =          0          ! - Monin-Obukhov length
!  MIXHT      =          1          ! - Mixing height
!  WSTAR      =          0          ! - Convective velocity scale
!  PRECIP     =          1          ! - Precipitation rate
!  SENSHEAT   =          0          ! - Sensible heat flux
!  CONVZI     =          0          ! - Convective mixing ht.


Testing and debug print options for micrometeorological module

   Print input meteorological data and
   internal variables (LDB)         Default: F       ! LDB = F !
   (F = Do not print, T = print)
   (NOTE: this option produces large amounts of output)
```

```
       First time step for which debug data
       are printed (NN1)                Default: 1       ! NN1 =  1  !

       Last time step for which debug data
       are printed (NN2)                Default: 1       ! NN2 =  1  !

       Print distance to land
       internal variables (LDBCST)      Default: F       ! LDBCST = F !
       (F = Do not print, T = print)
       (Output in .GRD file DCST.GRD, defined in input group 0)

    Testing and debug print options for wind field module
    (all of the following print options control output to
     wind field module's output files: TEST.PRT, TEST.OUT,
     TEST.KIN, TEST.FRD, and TEST.SLP)

       Control variable for writing the test/debug
       wind fields to disk files (IOUTD)
       (0=Do not write, 1=write)        Default: 0       ! IOUTD =  0  !

       Number of levels, starting at the surface,
       to print (NZPRN2)                Default: 1       ! NZPRN2 =  1  !

       Print the INTERPOLATED wind components ?
       (IPR0) (0=no, 1=yes)             Default: 0       !  IPR0 =  0  !

       Print the TERRAIN ADJUSTED surface wind
       components ?
       (IPR1) (0=no, 1=yes)             Default: 0       !  IPR1 =  0  !

       Print the SMOOTHED wind components and
       the INITIAL DIVERGENCE fields ?
       (IPR2) (0=no, 1=yes)             Default: 0       !  IPR2 =  0  !

       Print the FINAL wind speed and direction
       fields ?
       (IPR3) (0=no, 1=yes)             Default: 0       !  IPR3 =  0  !

       Print the FINAL DIVERGENCE fields ?
       (IPR4) (0=no, 1=yes)             Default: 0       !  IPR4 =  0  !

       Print the winds after KINEMATIC effects
       are added ?
       (IPR5) (0=no, 1=yes)             Default: 0       !  IPR5 =  0  !

       Print the winds after the FROUDE NUMBER
       adjustment is made ?
       (IPR6) (0=no, 1=yes)             Default: 0       !  IPR6 =  0  !

       Print the winds after SLOPE FLOWS
       are added ?
       (IPR7) (0=no, 1=yes)             Default: 0       !  IPR7 =  0  !

       Print the FINAL wind field components ?
       (IPR8) (0=no, 1=yes)             Default: 0       !  IPR8 =  0  !

!END!

-------------------------------------------------------------------------------
```

```
INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS =  1   !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM4/MM5/3D for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM4/MM5/3D for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA = 115  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5/3D precip data)
                                    (NPSTA)  No default     ! NPSTA = -1  !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD =  0  !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover computed from prognostic fields

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS =  2  !
       (1 = unformatted (e.g., SMERGE output))
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                   (IFORMP)  Default: 2     ! IFORMP =  2  !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
                                   (IFORMC)  Default: 2     ! IFORMC =  2  !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
```

```
(0 = NO, 1 = YES)

Use O'Brien procedure for adjustment
of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
(0 = NO, 1 = YES)

Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
(0 = NO, 1 = YES)

Extrapolate surface wind observations
to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -1  !
(1 = no extrapolation is done,
 2 = power law extrapolation used,
 3 = user input multiplicative factors
     for layers 2 - NZ used (see FEXTRP array)
 4 = similarity theory used
 -1, -2, -3, -4 = same as above except layer 1 data
     at upper air stations are ignored

Extrapolate surface winds even
if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
(0 = NO, 1 = YES)

Layer-dependent biases modifying the weights of
surface and upper air stations (BIAS(NZ))
  -1<=BIAS<=1
Negative BIAS reduces the weight of upper air stations
  (e.g. BIAS=-0.1 reduces the weight of upper air stations
by 10%; BIAS= -1, reduces their weight by 100 %)
Positive BIAS reduces the weight of surface stations
  (e.g. BIAS= 0.2 reduces the weight of surface stations
by 20%; BIAS=1 reduces their weight by 100%)
Zero BIAS leaves weights unchanged (1/R**2 interpolation)
Default: NZ*0
         ! BIAS =  -1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1 ,  1  !
*** If you leave BIAS(1..NZ) = 0, you get a warning. ***

Minimum distance from nearest upper air station
to surface station for which extrapolation
of surface winds at surface station will be allowed
(RMIN2: Set to -1 for IEXTRP = 4 or other situations
 where all surface stations should be extrapolated)
                                      Default: 4.     ! RMIN2 = -1.0 !

Use gridded prognostic wind field model
output fields as input to the diagnostic
wind field model (IPROG)              Default: 0      ! IPROG =  14  !
(0 = No, [IWFCOD = 0 or 1]
 1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
 2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
 3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
 4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
 5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
 13 = Yes, use winds from MM5/3D.DAT file as Step 1 field [IWFCOD = 0]
 14 = Yes, use winds from MM5/3D.DAT file as initial guess field [IWFCOD = 1]
 15 = Yes, use winds from MM5/3D.DAT file as observations [IWFCOD = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)          Default: 1      ! ISTEPPG =  1   !

Use coarse CALMET fields as initial guess fields (IGFMET)
(overwrites IGF based on prognostic wind fields if any)
```

```
                                       Default: 0      ! IGFMET =  0  !

RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence     Default: F      ! LVARY =  F !
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)        No default      ! RMAX1 = 200. !
                                       Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                       No default      ! RMAX2 = 200. !
                                       Units: km
   Maximum radius of influence over water
   (RMAX3)                             No default      ! RMAX3 = 200. !
                                       Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                       Units: km
   Radius of influence of terrain
   features (TERRAD)                   No default      ! TERRAD = 12. !
                                                      *** MM5 grid mesh **

                                       Units: km
   Relative weighting of the first
   guess field and observations in the
   SURFACE layer (R1)                  No default      ! R1 = 1.00E-6 !
   (R1 is the distance from an         Units: km
   observational station at which the
   observation and first guess field are
   equally weighted)

   Relative weighting of the first
   guess field and observations in the
   layers ALOFT (R2)                   No default      ! R2 = 1.00E-6 !
   (R2 is applied in the upper layers  Units: km
   in the same manner as R1 is used in
   the surface layer).

   Relative weighting parameter of the
   prognostic wind field data (RPROG)  No default      ! RPROG = 0. !
   (Used only if IPROG = 1)            Units: km
   ------------------------

   Maximum acceptable divergence in the
   divergence minimization procedure
   (DIVLIM)                            Default: 5.E-6  ! DIVLIM= 5.0E-06 !

   Maximum number of iterations in the
   divergence min. procedure (NITER)   Default: 50     ! NITER =  50  !

   Number of passes in the smoothing
   procedure (NSMTH(NZ))
   NOTE: NZ values must be entered
        Default: 2,(mxnz-1)*4

   ! NSMTH =  1 ,  2 ,  2 ,  3 ,  3 ,  4 ,  4 ,  4 ,  4 ,  4  !
```

```
   Maximum number of stations used in
   each layer for the interpolation of
   data to a grid point (NINTR2(NZ))
   NOTE: NZ values must be entered       Default: 99.

   ! NINTR2 =  99,  99,  99,  99,  99,  99,  99,  99,  99,  99  !

   Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1. !

   Empirical factor controlling the
   influence of kinematic effects
   (ALPHA)                               Default: 0.1    ! ALPHA = 0.1 !

   Multiplicative scaling factor for
   extrapolation of surface observations
   to upper layers (FEXTR2(NZ))          Default: NZ*0.0
   ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0. !
   (Used only if IEXTRP = 3 or -3)


BARRIER INFORMATION

   Number of barriers to interpolation
   of the wind fields (NBAR)             Default: 0      ! NBAR =  0  !

   Level (1 to NZ) up to which barriers
   apply (KBAR)                          Default: NZ     ! KBAR =  10  !

   THE FOLLOWING 4 VARIABLES ARE INCLUDED
   ONLY IF NBAR > 0
   NOTE: NBAR values must be entered     No defaults
         for each variable               Units: km

      X coordinate of BEGINNING
      of each barrier (XBBAR(NBAR))      ! XBBAR = 0. !
      Y coordinate of BEGINNING
      of each barrier (YBBAR(NBAR))      ! YBBAR = 0. !

      X coordinate of ENDING
      of each barrier (XEBAR(NBAR))      ! XEBAR = 0. !
      Y coordinate of ENDING
      of each barrier (YEBAR(NBAR))      ! YEBAR = 0. !


DIAGNOSTIC MODULE DATA INPUT OPTIONS

   Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 =  0  !
      0 = Compute internally from
          hourly surface observations
      1 = Read preprocessed values from
          a data file (DIAG.DAT)

      Surface met. station to use for
      the surface temperature (ISURFT)   No default     ! ISURFT =  98 !
      (Must be a value from 1 to NSSTA)
      (Used only if IDIOPT1 = 0)
      --------------------------

   Domain-averaged temperature lapse
   rate (IDIOPT2)                        Default: 0     ! IDIOPT2 =  0  !
      0 = Compute internally from
```

```
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       from a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale lapse rate (IUPT) No default     ! IUPT   =  1  !
   (Must be a value from 1 to NUSTA)
   (Used only if IDIOPT2 = 0)
   --------------------------

   Depth through which the domain-scale
   lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
   (Used only if IDIOPT2 = 0)         Units: meters
   --------------------------

Domain-averaged wind components
(IDIOPT3)                             Default: 0     ! IDIOPT3 =  0  !
   0 = Compute internally from
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1  !
   (Must be a value from -1 to NUSTA)
   (Used only if IDIOPT3 = 0)
   --------------------------

   Bottom and top of layer through
   which the domain-scale winds
   are computed
   (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1., 1000. !
   (Used only if IDIOPT3 = 0)    Units: meters
   --------------------------

Observed surface wind components
for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
   0 = Read WS, WD from a surface
       data file (SURF.DAT)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

Observed upper air wind components
for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
   0 = Read WS, WD from an upper
       air data file (UP1.DAT, UP2.DAT, etc.)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

LAKE BREEZE INFORMATION

   Use Lake Breeze Module  (LLBREZE)
                                    Default: F      ! LLBREZE = F !

    Number of lake breeze regions (NBOX)            ! NBOX =  0  !

 X Grid line 1 defining the region of interest
                                                 ! XG1 = 0. !
 X Grid line 2 defining the region of interest
                                                 ! XG2 = 0. !
 Y Grid line 1 defining the region of interest
                                                 ! YG1 = 0. !
```

```
        Y Grid line 2 defining the region of interest
                                                      ! YG2 = 0. !

         X Point defining the coastline (Straight line)
                   (XBCST)  (KM)   Default: none    ! XBCST = 0. !

         Y Point defining the coastline (Straight line)
                   (YBCST)  (KM)   Default: none    ! YBCST = 0. !

         X Point defining the coastline (Straight line)
                   (XECST)  (KM)   Default: none    ! XECST = 0. !

         Y Point defining the coastline (Straight line)
                   (YECST)  (KM)   Default: none    ! YECST = 0. !


       Number of stations in the region     Default: none ! NLB =  0 !
       (Surface stations + upper air stations)

       Station ID's  in the region   (METBXID(NLB))
       (Surface stations first, then upper air stations)
         ! METBXID =  0 !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                             Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                             Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                             Default: 2400.  ! CONSTN = 2400.!
       Overwater mixing ht. equation
       (CONSTW)                             Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                  Default: 1.E-4  ! FCORIOL = 1.0E-04!
                                            Units: (1/s)

    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)              Default: 1      ! IAVEZI =  1  !

       Max. search radius in averaging
       process (MNMDAV)                     Default: 1      ! MNMDAV =  1  !
                                            Units: Grid
                                                   cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)               Default: 30.    ! HAFANG = 30. !
                                            Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                   Default: 1      ! ILEVZI =  1  !
       (must be between 1 and NZ)
```

```
CONVECTIVE MIXING HEIGHT OPTIONS:
   Method to compute the convective
   mixing height(IMIHXH)                Default: 1      ! IMIXH =  1  !
       1: Maul-Carson for land and water cells
      -1: Maul-Carson for land cells only -
          OCD mixing height overwater
       2: Batchvarova and Gryning for land and water cells
      -2: Batchvarova and Gryning for land cells only
          OCD mixing height overwater

   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overland (THRESHL)                   Default: 0.05   ! THRESHL = 0.05 !
   (expressed as a heat flux            units: W/m3
    per meter of boundary layer)


   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overwater (THRESHW)                  Default: 0.05   ! THRESHW = 0.05 !
   (expressed as a heat flux            units: W/m3
    per meter of boundary layer)


   Option for overwater lapse rates used
   in convective mixing height growth
   (ITWPROG)                            Default: 0      ! ITWPROG =  2  !
   0 : use SEA.DAT lapse rates and deltaT (or assume neutral
       conditions if missing)
   1 : use prognostic lapse rates (only if IPROG>2)
       and SEA.DAT deltaT (or neutral if missing)
   2 : use prognostic lapse rates and prognostic delta T
       (only if iprog>12 and 3D.DAT version# 2.0 or higher)

   Land Use category ocean in 3D.DAT datasets
   (ILUOC3D)                            Default: 16     ! ILUOC3D =  16  !
   Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
         if MM4.DAT,           typically iluoc3d = 7


OTHER MIXING HEIGHT VARIABLES

   Minimum potential temperature lapse
   rate in the stable layer above the
   current convective mixing ht.        Default: 0.001  ! DPTMIN = 0.001 !
   (DPTMIN)                             Units: deg. K/m
   Depth of layer above current conv.
   mixing height through which lapse    Default: 200.   ! DZZI = 200.   !
   rate is computed (DZZI)              Units: meters

   Minimum overland mixing height       Default:  50.   ! ZIMIN = 50.   !
   (ZIMIN)                              Units: meters
   Maximum overland mixing height       Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                              Units: meters
   Minimum overwater mixing height      Default:  50.   ! ZIMINW = 50.  !
   (ZIMINW) -- (Not used if observed    Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height      Default: 3000.  ! ZIMAXW = 3000.!
   (ZIMAXW) -- (Not used if observed    Units: meters
   overwater mixing hts. are used)
```

```
OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                          Default: 10      ! ICOARE =  10   !
       0: original deltaT method (OCD)
      10: COARE with no wave parameterization (jwave=0, Charnock)
      11: COARE with wave option jwave=1 (Oost et al.)
          and default wave properties
     -11: COARE with wave option jwave=1 (Oost et al.)
          and observed wave properties (must be in SEA.DAT files)
      12: COARE with wave option 2 (Taylor and Yelland)
           and default wave properties
     -12: COARE with wave option 2 (Taylor and Yelland)
          and observed wave properties (must be in SEA.DAT files)

      Coastal/Shallow water length scale (DSHELF)
      (for modified z0 in shallow water)
      ( COARE fluxes only)
                                     Default : 0.        ! DSHELF = 0. !
                                     units: km

       COARE warm layer computation (IWARM)              ! IWARM =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)                Default: 0

       COARE cool skin layer computation (ICOOL)         ! ICOOL =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)                Default: 0

RELATIVE HUMIDITY PARAMETERS

   3D relative humidity from observations or
   from prognostic data? (IRHPROG)      Default:0        ! IRHPROG =  1 !

      0 = Use RH from SURF.DAT file
          (only if NOOBS = 0,1)
      1 = Use prognostic RH
          (only if NOOBS = 0,1,2)

TEMPERATURE PARAMETERS

   3D temperature from observations or
   from prognostic data? (ITPROG)       Default:0        ! ITPROG =  2  !

      0 = Use Surface and upper air stations
          (only if NOOBS = 0)
      1 = Use Surface stations (no upper air observations)
          Use MM5/3D for upper air data
          (only if NOOBS = 0,1)
      2 = No surface or upper air observations
          Use MM5/3D for surface and upper air data
          (only if NOOBS = 0,1,2)

   Interpolation type
   (1 = 1/R ; 2 = 1/R**2)               Default:1         ! IRAD =  1  !

   Radius of influence for temperature
   interpolation (TRADKM)               Default: 500.     ! TRADKM = 500. !
                                        Units: km

   Maximum Number of stations to include
   in temperature interpolation (NUMTS) Default: 5        ! NUMTS = 10  !

   Conduct spatial averaging of temp-
```

```
       eratures (IAVET)  (0=no, 1=yes)       Default: 1        ! IAVET =  1  !
       (will use mixing ht MNMDAV,HAFANG
        so make sure they are correct)

       Default temperature gradient          Default: -.0098   ! TGDEFB = -0.0098 !
       below the mixing height over          Units: K/m
       water (TGDEFB)

       Default temperature gradient          Default: -.0045   ! TGDEFA = -0.0045 !
       above the mixing height over          Units: K/m
       water (TGDEFA)

       Beginning (JWAT1) and ending (JWAT2)
       land use categories for temperature                    ! JWAT1 =  55  !
       interpolation over water -- Make                       ! JWAT2 =  55  !
       bigger than largest land use to disable

   PRECIP INTERPOLATION PARAMETERS

       Method of interpolation (NFLAGP)      Default: 2       ! NFLAGP =  2  !
        (1=1/R,2=1/R**2,3=EXP/R**2)
       Radius of Influence  (SIGMAP)         Default: 100.0   ! SIGMAP = 12. !
        (0.0 => use half dist. btwn          Units: km   *** MM5 grid mesh ***
         nearest stns w & w/out
         precip when NFLAGP = 3)
       Minimum Precip. Rate Cutoff (CUTP)    Default: 0.01    ! CUTP = 0.01 !
        (values < CUTP = 0.0 mm/hr)          Units: mm/hr
!END!

-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  NSSTA  records in all)


             1     2
         Name   ID           X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ----------------------------------------------------------
! SS1  ='CWCL'  714740     -33.918     231.620  8 10.0 !
! SS2  ='CWLY'  718910     -40.254     132.822  8 10.0 !
! SS3  ='CYKA'  718870      37.462     183.122  8 10.0 !
! SS4  ='CYLW'  712030     111.894     105.162  8 10.0 !
! SS5  ='CYQL'  718740     570.501      97.322  7 10.0 !
! SS6  ='CYQQ'  718930    -271.390      83.727  8 10.0 !
! SS7  ='CYRV'  718820     191.179     215.143  8 10.0 !
! SS8  ='CYVR'  718920    -153.554      21.755  8 10.0 !
! SS9  ='CYXC'  718800     363.423      78.204  8 10.0 !
! SS10 ='CYXH'  718720     709.434     155.038  7 10.0 !
! SS11 ='CYXX'  711080     -96.471       4.353  8 10.0 !
! SS12 ='CYYC'  718770     472.126     248.559  7 10.0 !
! SS13 ='CYYF'  718890      97.809      51.071  8 10.0 !
! SS14 ='CYYJ'  717990    -172.866     -35.027  8 10.0 !
! SS15 ='CYYN'  718700     912.324     214.112  6 10.0 !
! SS16 ='CYZT'  711090    -434.451     198.439  8 10.0 !
! SS17 ='CZPC'  718755     489.505      77.062  7 10.0 !
! SS18 ='KAAT'  999999      35.069    -806.671  8 10.0 !
! SS19 ='KACV'  725495    -252.603    -856.997  8 10.0 !
```

```
! SS20 ='KALW'  999999    202.148    -308.127  8 10.0 !
! SS21 ='KAST'  727910   -214.477    -302.331  8 10.0 !
! SS22 ='KAWO'  727945    -83.937     -88.631  8 10.0 !
! SS23 ='KBFI'  999999    -94.365    -156.915  8 10.0 !
! SS24 ='KBKE'  726886    242.788    -441.671  8 10.0 !
! SS25 ='KBLI'  999999   -108.653     -20.486  8 10.0 !
! SS26 ='KBNO'  726830    159.432    -579.787  8 10.0 !
! SS27 ='KBOI'  726810    372.019    -572.431  7 10.0 !
! SS28 ='KBPI'  726710    860.378    -632.360  7 10.0 !
! SS29 ='KBTM'  726785    632.986    -292.422  7 10.0 !
! SS30 ='KBYI'  725867    572.209    -667.836  7 10.0 !
! SS31 ='KBZN'  999999    735.544    -300.287  7 10.0 !
! SS32 ='KCEC'  725946   -259.428    -770.105  8 10.0 !
! SS33 ='KCLM'  999999   -179.410     -92.139  8 10.0 !
! SS34 ='KCOD'  726700    914.025    -412.987  7 10.0 !
! SS35 ='KCOE'  999999    301.836    -124.656  8 10.0 !
! SS36 ='KCTB'  727796    611.146      -8.278  7 10.0 !
! SS37 ='KCVO'  999999   -174.922    -480.848  8 10.0 !
! SS38 ='KDEW'  999999    258.087    -104.945  8 10.0 !
! SS39 ='KDLN'  999999    637.435    -369.143  7 10.0 !
! SS40 ='KDLS'  726988    -12.926    -363.185  8 10.0 !
! SS41 ='KEAT'  727825     58.006    -171.891  8 10.0 !
! SS42 ='KEKO'  725825    424.608    -864.548  8 10.0 !
! SS43 ='KELN'  999999     35.289    -214.818  8 10.0 !
! SS44 ='KENV'  725810    568.059    -863.665  7 10.0 !
! SS45 ='KEPH'  727826    108.056    -180.845  8 10.0 !
! SS46 ='KEUG'  726930   -171.008    -522.104  8 10.0 !
! SS47 ='KEUL'  726813    339.553    -567.509  7 10.0 !
! SS48 ='KEVW'  999999    804.462    -779.876  7 10.0 !
! SS49 ='KFCA'  727790    480.729     -55.045  7 10.0 !
! SS50 ='KFHR'  999999   -143.690     -50.141  8 10.0 !
! SS51 ='KGEG'  727850    250.815    -141.506  8 10.0 !
! SS52 ='KGTF'  727750    697.509    -121.037  7 10.0 !
! SS53 ='KHIO'  999999   -146.987    -369.028  8 10.0 !
! SS54 ='KHLN'  727720    662.505    -220.599  7 10.0 !
! SS55 ='KHQM'  727923   -214.737    -213.896  8 10.0 !
! SS56 ='KHRI'  999999    130.006    -339.562  8 10.0 !
! SS57 ='KHVR'  727770    796.639       7.576  7 10.0 !
! SS58 ='KIDA'  999999    694.449    -550.137  7 10.0 !
! SS59 ='KJAC'  999999    796.494    -528.863  7 10.0 !
! SS60 ='KJER'  999999    516.353    -652.584  7 10.0 !
! SS61 ='KKLS'  999999   -141.478    -308.056  8 10.0 !
! SS62 ='KLGU'  999999    732.505    -733.438  7 10.0 !
! SS63 ='KLKV'  999999     47.747    -733.852  8 10.0 !
! SS64 ='KLLJ'  727833    518.664    -459.530  7 10.0 !
! SS65 ='KLMT'  999999    -58.539    -735.592  8 10.0 !
! SS66 ='KLVM'  726798    789.397    -302.586  7 10.0 !
! SS67 ='KLWS'  727830    294.803    -273.839  8 10.0 !
! SS68 ='KLWT'  726776    840.903    -148.884  7 10.0 !
! SS69 ='KMEH'  999999    195.533    -372.798  8 10.0 !
! SS70 ='KMFR'  725970   -148.414    -710.793  8 10.0 !
! SS71 ='KMHS'  999999   -106.581    -824.622  8 10.0 !
! SS72 ='KMLP'  999999    386.752    -153.286  8 10.0 !
! SS73 ='KMMV'  999999   -161.372    -406.464  8 10.0 !
! SS74 ='KMSO'  727730    506.654    -201.936  7 10.0 !
! SS75 ='KMWH'  999999    122.716    -192.156  8 10.0 !
! SS76 ='KMYL'  999999    372.467    -430.814  7 10.0 !
! SS77 ='KNUW'  999999   -117.935     -68.685  8 10.0 !
! SS78 ='KOGD'  999999    726.421    -799.131  7 10.0 !
! SS79 ='KOLM'  727920   -139.313    -216.816  8 10.0 !
! SS80 ='KOMK'  727890    105.473     -56.993  8 10.0 !
! SS81 ='KONO'  999999    307.434    -527.561  7 10.0 !
```

```
! SS82 ='KONP'  999999    -233.296    -469.986  8 10.0 !
! SS83 ='KOTH'  999999    -253.662    -594.516  8 10.0 !
! SS84 ='KPAE'  999999     -92.470    -115.688  8 10.0 !
! SS85 ='KPDT'  726880     161.158    -354.163  8 10.0 !
! SS86 ='KPDX'  726980    -120.265    -364.038  8 10.0 !
! SS87 ='KPIH'  725780     659.917    -618.742  7 10.0 !
! SS88 ='KPSC'  999999     139.663    -291.986  8 10.0 !
! SS89 ='KPUW'  999999     285.747    -235.477  8 10.0 !
! SS90 ='KPVU'  999999     762.617    -899.756  7 10.0 !
! SS91 ='KPWT'  999999    -128.346    -161.636  8 10.0 !
! SS92 ='KRBG'  999999    -185.376    -616.694  8 10.0 !
! SS93 ='KRBL'  725910    -103.127    -950.438  8 10.0 !
! SS94 ='KRDD'  999999    -106.636    -912.642  8 10.0 !
! SS95 ='KRDM'  999999     -11.622    -508.351  8 10.0 !
! SS96 ='KRNT'  999999     -88.400    -160.554  8 10.0 !
! SS97 ='KRXE'  999999     710.776    -514.224  7 10.0 !
! SS98 ='KSEA'  727930     -94.509    -165.829  8 10.0 !
! SS99 ='KSFF'  999999     265.111    -137.213  8 10.0 !
! SS100='KSHN'  999999    -156.812    -185.972  8 10.0 !
! SS101='KSKA'  999999     242.353    -141.866  8 10.0 !
! SS102='KSLC'  725720     735.491    -843.200  7 10.0 !
! SS103='KSLE'  726940    -152.136    -436.667  8 10.0 !
! SS104='KSMN'  999999     538.423    -393.145  7 10.0 !
! SS105='KSPB'  999999    -137.845    -344.331  8 10.0 !
! SS106='KTCM'  742060    -108.396    -197.813  8 10.0 !
! SS107='KTIW'  999999    -115.450    -185.111  8 10.0 !
! SS108='KTTD'  999999    -106.013    -369.567  8 10.0 !
! SS109='KTWF'  999999     516.133    -679.030  7 10.0 !
! SS110='KUAO'  726959    -133.863    -401.335  8 10.0 !
! SS111='KUIL'  727970    -255.480    -107.220  8 10.0 !
! SS112='KVUO'  999999    -123.976    -361.815  8 10.0 !
! SS113='KWMC'  725830     260.408    -865.200  8 10.0 !
! SS114='KYKM'  727810      34.388    -261.319  8 10.0 !
! SS115='KSIY'  725955    -117.790    -774.263  8 10.0 !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit integer for station ID

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  3  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        -----------------------------------------------
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)
```

Initial Metstat Report

INITIAL METSTAT REPORT
CALMET Fields for BART
Idaho, Oregon and Washington

1.0 INTRODUCTION

EPA published the Best Available Retrofit Technology (BART) standards under the Regional Haze Rule on July 6, 2005. Appendix Y, "Guideline for Best available Retrofit Technology Determination" (the BART Guideline) details EPA's recommendations to states for conducting BART analyses. According to the BART Guideline, each state may determine which BART-eligible sources are actually subject to BART using the CALPUFF dispersion model. The CALPUFF model is run using a meteorological data set developed with the CALMET program.

The Idaho Department of Environmental Quality (IDEQ), in cooperation with the Washington Department of Ecology (DOE) and Oregon Department of Environmental Quality (ODEQ) issued a contract to Geomatrix Consultants for the development of CALMET meteorological datasets. These datasets will provide consistent meteorology for the dispersion modeling that will be conducted by each state to determine which sources are subject to BART.

The CALMET dataset will be based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at the University of Washington (UW). Although the UW performs many MM5 runs operationally, at several grid spacings, this project will use only the 12 km grid-spacing runs that have been initialized from the NCEP GFS product. MM5 is run in a forecast mode for these runs, not in “hindcast” mode with nudging and both beginning and ending boundary conditions.

This report is an initial attempt to quantify the quality of the UW 12 km MM5 forecast data using the METSTAT[1] analysis package. Although there are many statistical techniques and statistical packages available, the METSTAT package was specified by IDEQ in the contract for this project. It was developed by ENVIRON for WRAP, and has been widely used by RPOs to assess the quality of MM5 data.

[1] The February 15, 2005 version of METSTAT from http://www.camx.com/down/support.php was used.

The METSTAT package pairs observations with MM5 predictions in space and in time, then performs various statistical manipulations and aggregates the results for output. This approach is appropriate when the problem at hand relies on pairings in space/time for its accuracy. If the desire is to predict the wind speed at a particular receptor for a particular hour (e.g. for wind power generation) then this method of first pairing in space/time and then assessing statistics is appropriate.

CALPUFF is *not* such a model. We do not ask CALPUFF to predict the concentration at a particular Class I area on a particular hour or day. Instead, we ask that CALPUFF predict a range of concentrations for a period of time (3 years, in most cases). Then we evaluate that distribution using some statistical technique (find the 98^{th} percentile value, or the 100^{th} percentile value) and compare the result to a regulatory threshold.

The pairing in time is irrelevant to our application. It does not matter whether the wind speed predicted at a particular location matches each hour observed at that location. What matters is whether the distribution of predictions at a location matches the distribution of observations at that location. We want to be assured that the range of dispersion conditions we model is similar to the range of conditions we observe. We should be computing statistics from each of the full distributions, then comparing those statistics to find the differences between the predictions and observations. It does not matter whether the modeled worst dispersion conditions occurred on the same day as observed, only that it occurred at some time during the multi-year period.

Nonetheless, we wish to compare the UW 12 km MM5 prognostic data with other MM5 runs using a common method, namely METSTAT.

1.1 VERIFICATION DATA

The NCAR/UCAR dataset ds472.0 was used for this test. The METSTAT package includes a program, ds472fdda, to reformat the ds472 data to "RALPH" version 2 format used by the RAMS system and the METSTAT program. This program was run as needed for the months in each analysis. Although METSTAT does not output a report on which stations it found in the specified domain, a plot showing the ds472 stations in the domain is shown in Figure 1. A full listing is given in Appendix A.

1.2 MISSING DATA

The MM5 runs initialized 2002071500 and 2002072512 are missing (i.e. a total of 24 hours of missing data) and have not, as of this writing, yet been re-run by UW. It is not expected that the METSTAT results with and without the two missing initializations would differ significantly.

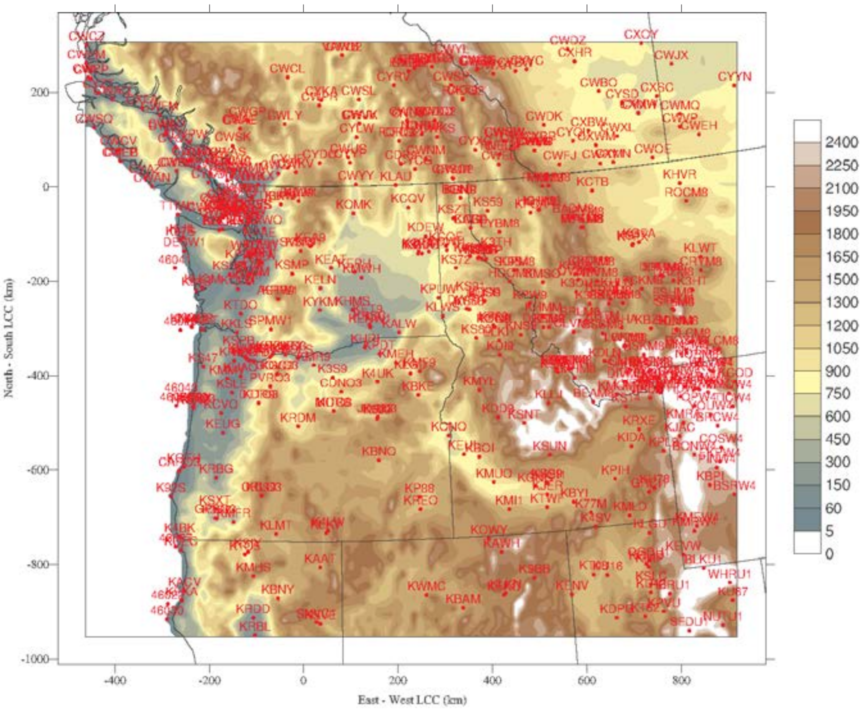


Figure 1. Stations from ds472 in the Pacific NW BART domain

1.3 STATISTICAL PERFORMANCE BENCHMARKS

The METSTAT package statistical methods are summarized in Section 3 of the WRAP 2002 MM5 report[2]. The relevant statistical parameters include root mean square error (RMSE), mean bias, gross error, and index of agreement (IOA). The first two are relatively

[2] Kemball-Cook et al., 2005. "Draft Final Report, Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States." Prepared for the Western Regional Air Partnership (WRAP), by Environ International Corporation.

straightforward. Note that for RMSE, larger errors are weighted more heavily due to the squaring.

The gross error is the mean of the absolute value of the prediction minus the observation, and is elsewhere called the mean absolute error. The index of agreement is a measure of the match between the departure of each prediction from the observed mean and the departure of each observation from the observed mean. Thus, the correspondence between predicted and observed values across the domain at a given time may be quantified in a single metric and displayed as a time series. The index of agreement has a theoretical range of 0 to 1, the latter score suggesting perfect agreement. The WRAP 2002 MM5 report gives statistical benchmarks for evaluating meteorological model performance, shown in Table 1.

Table 1. Statistical benchmarks

	Wind Speed	Wind Direction	Temperature	Humidity
RMSE	≤ 2 m/s			
Mean Bias	≤ ± 0.5 m/s	≤ ± 10°	≤ ± 0.5K	≤ ± 1 g/kg
Gross Error		≤ 30°	≤ 2 K	≤ 2 g/kg
IOA[(a)]	≥ 0.6		≥ 0.8	≥ 0.6

(a) In the WRAP 2002 MM5 report, Table 3 uses "≤" instead of "≥", which is presumably a typo.

These benchmarks were suggested by Emery and Tai (2001)[3] and are not necessarily intended to give a passing or failing grade to any particular meteorological model application, but rather to put its results into the proper context. For example, expectations for meteorological model performance for the U.S. west coast might not be as high as a simpler domain located over the Midwest. The key to the benchmarks is to understand how poor or good the results are relative to the universe of other model applications run for various areas of the U.S.

2.0 PREVIOUS STATISTICAL PERFORMANCE RESULTS

The quality of the MM5 data has been studied by UW[4]. They have a website[5] that features recent (90 days) and long-term (2 years) statistics for 12, 24, 36, and 48 hour forecasts. They do not give numerical results, only graphs of mean absolute error (MAE) and bias time series. One feature of their verification system is their observation quality control procedures. A

[3] Emery, C.A. and E. Tai. 2001. "Enhanced meteorological modeling and performance evaluation for two Texas ozone episodes." Prepared for the Texas Natural Resource Conservation Commission, by ENVIRON International Corporation.
[4] Mass, C., D. Ovens, M. Albright, and K. Westrick, 2002: "Does Increasing Horizontal Resolution Produce Better Forecasts?: The Results of Two Years of Real-Time Numerical Weather Prediction in the Pacific Northwest." *Bull. Amer. Meteor. Soc.,* **83**, 407-430.
[5] http://www.atmos.washington.edu/mm5rt/verify.html

series of tests are performed on the raw data, including a range check (reasonable minima and maxima), a step check ("spike" removal), persistence check (constant data removal), and a spatial check (remove outliers compared to nearby stations). There are no such Q/A checks in the METSTAT program, nor is the ds472 dataset filtered or subject to extra Q/A procedures.

Approximate (estimated by eye) statistical quantities for the UW 12 km MM5 data, for the 12-hour and 24-hour forecasts, are shown in Table 2. The table is similar in organization to the METSTAT results that follow, though mean absolute error (MAE) takes the place of the root mean square error (RMSE) for wind speed. The METSTAT definition of gross error is the same as the UW's definition of mean absolute error.

Table 2. Approximate statistical performance from the UW verification web site.

Parameter	Statistic	Benchmark	12-hr Fcst	24-hr Fcst
Wind Speed	MAE, m/s	N/A	3.3	3.5
	Mean Bias, m/s	$\leq \pm 0.5$	-0.1	-0.1
	IOA	≥ 0.6	N/A	N/A
Wind Direction	Mean Bias, °	$\leq \pm 10$	12	8
	Gross Error, °	≤ 30	50	48
Temperature	Mean Bias, K	$\leq \pm 0.5$	0.5	-0.8
	Gross Error, K	≤ 2	2.4	2.2
	IOA	≥ 0.8	N/A	N/A
Relative Humidity	Mean Bias, %	$\leq \pm 1$	3	4
	Gross Error, %	N/A	14	15
	IOA	≥ 0.6	N/A	N/A

3.0 METSTAT RESULTS

Please see the accompanying Microsoft Excel spreadsheets for the customary METSTAT graphs, and accompanying data tables. We present selected results, focusing on the WRAP benchmarks.

3.1 JANUARY AND JULY 2002

Initially, METSTAT was run using the January and July 2002 MM5 and ds472 data. A sub-set of the stations were used, based upon declared locations (in latitude and longitude) in the station tables available on the UCAR ds472 page[6] and the modeling domain. All stations listed as within the domain were used.

[6] Station libraries (listings) are available at http://dss.ucar.edu/datasets/ds472.0/station_libraries.

Table 3 shows the benchmark results of the METSTAT analysis for January and July 2002. Statistical parameters which meet the benchmarks are shown in bold text.

Table 3. Initial METSTAT results for Jan and Jul 2002

Parameter	Statistic	Benchmark	Jan 2002	Jul 2002
Wind Speed	RMSE, m/s	≤ 2	2.59	2.28
	Mean Bias, m/s	≤ ± 0.5	**0.08**	**-0.46**
	IOA	≥ 0.6	**0.64**	**0.62**
Wind Direction	Mean Bias, °	≤ ± 10	12.2	**8.0**
	Gross Error, °	≤ 30	52.7	53.9
Temperature	Mean Bias, K	≤ ± 0.5	-0.54	-0.59
	Gross Error, K	≤ 2	2.54	2.71
	IOA	≥ 0.8	**0.91**	**0.91**
Humidity	Mean Bias, g/kg	≤ ± 1	**0.05**	**0.13**
	Gross Error, g/kg	≤ 2	**0.49**	**1.30**
	IOA	≥ 0.6	**0.92**	**0.72**

As can be seen, several of the statistical measures fail to meet the benchmark goals. The RMSE of the wind speed exceed the benchmark by 14-30%, but the mean bias and IOA of the wind speed are in the acceptable range. The mean bias of the wind direction for July is acceptable, but exceeds the benchmark for January. The gross error of the wind direction is more than 25% higher than the benchmark, but the IOA meets the benchmark. Humidity is perhaps the best-performing parameter, as it meets all benchmark criteria.

3.2 JANUARY AND JULY 2004

The UW MM5 data from 2002 was run using MM5 version 3-4. It is possible that the later version of MM5 performs better. In particular, the UW started running MM5 version 3-6-3 in January 2004. A METSTAT analysis of January and July 2004 was performed, and the results presented in Table 4. This analysis also used all the stations within the domain.

The behavior of the latest version of MM5 is about the same as for the 2002 runs. Most statistical parameters exceed their benchmark values. Except for perhaps the gross error of the wind direction, most statistical parameters do not wildly exceed the benchmarks.

Table 4. Initial METSTAT results for Jan and Jul 2004

Parameter	Statistic	Benchmark	Jan 2004	Jul 2004
Wind Speed	RMSE, m/s	≤ 2	2.64	2.16
	Mean Bias, m/s	$\leq \pm 0.5$	**0.11**	**-0.41**
	IOA	≥ 0.6	**0.67**	**0.63**
Wind Direction	Mean Bias, º	$\leq \pm 10$	13.9	**7.9**
	Gross Error, º	≤ 30	55.2	53.6
Temperature	Mean Bias, K	$\leq \pm 0.5$	0.69	-1.16
	Gross Error, K	≤ 2	3.06	2.61
	IOA	≥ 0.8	**0.89**	**0.91**
Humidity	Mean Bias, g/kg	$\leq \pm 1$	**0.36**	**0.12**
	Gross Error, g/kg	≤ 2	**0.63**	**1.23**
	IOA	≥ 0.6	**0.90**	**0.74**

3.3 JANUARY AND JULY 2002, REDUCED VERIFICATION SET

As a rough Q/A check of the ds472 data, we removed from consideration all stations whose WBAN number does not start with a "2". The ds472 station list has a column for the WMO station number and another column for the WBAN number, as well as columns for the call sign. For example, the station at Seattle-Tacoma airport has the call sign "KSEA", the WMO number 727930, and the WBAN number 24233. In contrast, "Rainier Paradise" has the call sign "ASFW1", has no WMO number, and no WBAN number.

We sorted the list and performed a METSTAT analysis using only these selected stations (WBAN numbers 24XXX [US] or 25XXX [Canada]), eliminating sites like Nutters Ranch, UT and Salmon KRSA, ID from consideration. This reduced the number of observation sites from 468 sites to 113 sites, which are presumably of higher quality.

Table 5 shows the benchmark results of the METSTAT analysis for January and July 2002 for the reduced set of stations. Statistical parameters which meet the benchmarks are again shown in bold text. It is striking how similar the results are to the full run with all sites. In several cases, the metric for the reduced set was actually worse, presumably due to less statistical power (fewer data points).

Table 5. METSTAT results for Jan and Jul 2002, using selected surface stations

Parameter	Statistic	Benchmark	Jan 2002	Jul 2002
Wind Speed	RMSE, m/s	≤ 2	2.46	2.28
	Mean Bias, m/s	≤ ± 0.5	**-0.39**	-0.79
	IOA	≥ 0.6	**0.66**	**0.61**
Wind Direction	Mean Bias, º	≤ ± 10	10.9	**9.4**
	Gross Error, º	≤ 30	52.3	53.5
Temperature	Mean Bias, K	≤ ± 0.5	**-0.43**	**-0.49**
	Gross Error, K	≤ 2	2.44	2.61
	IOA	≥ 0.8	**0.90**	**0.93**
Humidity	Mean Bias, g/kg	≤ ± 1	**0.06**	**0.22**
	Gross Error, g/kg	≤ 2	**0.50**	**1.34**
	IOA	≥ 0.6	**0.91**	**0.70**

3.3 JANUARY AND JULY 2002, DIURNAL CYCLE

To investigate the performance of the MM5 model at different times of the day, we limited the MM5 data to forecast hours 19-23. By choosing either all the 00Z initializations or all the 12Z initializations, and since local standard time is GMT-8, we effectively limited the input data to METSTAT to 11:00 – 15:00 or 23:00 – 03:00 PST.

The results are shown in Table 6. All sites were used for this run, not just the “reduced set”. Again, the statistics are remarkably stable. About the only conclusion that can be drawn is that the mean wind speed is under-predicted during the day and over-predicted during the night (insufficient diurnal range); more so during the summer than during the winter. The wind direction prediction was improved for the daytime during summer.

Table 6. METSTAT results for Jan and Jul 2002, using selected surface stations

Parameter	Statistic	Benchmark	Jan 2004		Jul 2004[b]	
			11-15[a]	**23-03**	**11-15**	**23-03**
Wind Speed	RMSE, m/s	≤ 2	2.78	2.56	2.48	2.15
	Mean Bias, m/s	$\leq \pm 0.5$	**-0.08**	**0.25**	-1.00	**0.10**
	IOA	≥ 0.6	**0.64**	**0.64**	0.59	**0.61**
Wind Direction	Mean Bias, °	$\leq \pm 10$	13.38	12.3	**7.33**	10.53
	Gross Error, °	≤ 30	53.71	53.46	49.57	60.14
Temperature	Mean Bias, K	$\leq \pm 0.5$	**-0.49**	-0.52	-0.83	**-0.26**
	Gross Error, K	≤ 2	2.50	2.67	2.78	2.53
	IOA	≥ 0.8	**0.89**	**0.91**	**0.93**	**0.92**
Humidity	Mean Bias, g/kg	$\leq \pm 1$	**-0.08**	**0.13**	**-0.78**	**0.80**
	Gross Error, g/kg	≤ 2	**0.52**	**0.51**	**1.35**	**1.26**
	IOA	≥ 0.6	**0.90**	**0.92**	**0.71**	**.07**

(a) Local hour, e.g. "11-15" means 11:00 AM to 3:00 PM PST (but never PDT).

(b) July has two missing initializations, which caused METSTAT to calculate erroneous statistics. The July numbers were calculated by hand from the available data.

4.0 CONCLUSIONS

Overall, the UW MM5 12 km prognostic data meets most of the benchmark criteria. The mean biases and gross errors (mean absolute error) of most parameters either meet or are close to the benchmarks. The RMSE of the wind speed, which may not be the best measure due to the heavy weighting of large errors, and the gross error of the wind direction were the only two parameters that were relatively far from their respective benchmarks. From a visual inspection of the hourly plot of temperature, it is clear that most of the gross error in the temperature comes from insufficient diurnal range. The daytime highs are not high enough, and the lows are not low enough. This is a well-known feature of the MM5 model, at least when using the simpler soil parameterizations. Considering that temperature is not a crucial parameter for CALPUFF, perhaps less attention should be paid to the relatively high gross errors. The wind direction is not too heavily biased, and the relatively high gross errors could be a result of a mismatch in the timing of weather fronts in MM5. This could be an artifact of the "pairing in time" issue of the METSTAT program discussed above. Overall, the MM5 data is acceptable.

APPENDIX A: Surface Stations from ds472 in the Pacific NW BART domain

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
46010	COLUMBIA	46.2	124.2	-237.823	-296.071
46022	EEL RIVER	40.72	124.52	-287.466	-883.48
46027	ST GEORGES	41.85	124.38	-270.909	-762.416
46029	COL RIVER BAR	46.12	124.51	-261.217	-303.687
46030	BLUNTS REEF	40.42	124.53	-289.707	-915.745
46040	BUOY C FOULWEATHER	44.8	124.4	-259.054	-445.629
46041	CAPE ELIZABETH	47.34	124.75	-272.926	-172.02
46050	YAQUINA BAY	44.62	124.53	-269.801	-464.509
ASFW1	RAINIER PARADISE	46.7861	121.7422	-54.657	-237.641
BADM8	BADGER PASS	48.1333	113.0333	570.34	-64.786
BEAM8	BEAGLE SPRINGS	44.4667	112.9833	613.263	-456.186
BEVM8	BEAVER CREEK	44.95	111.35	731.432	-390.889
BLBM8	BLACK BEAR	44.5	111.1167	754.978	-436.682
BLKU1	BLACKS FORK COMM.	40.9667	110.55	847.47	-807.835
BLOM8	BLODDY DICK	45.1667	113.5	566.821	-385.187
BLTW4	BEARTOOTH LAKE	44.7833	109.5667	868.315	-390.816
BLWW4	BLACK WATER	44.3833	109.8	856.7	-435.852
BONI1	BONNERS FERRY	48.6958	116.3222	331.683	-23.034
BONO3	BONNEVILLE	45.6333	121.95	-71.403	-361.24
BONW4	BONDURANT SCHOOL DCP	43.2006	110.405	827.458	-568.085
BOXM8	BOX CANYON	45.2833	110.25	809.552	-344.807
BRCW4	BURROUGHS CREEK	43.7	109.6667	877.182	-507.072
BRLM8	BARKER LAKE	46.1	113.1333	584.624	-282.813
BSCM8	BASIN CREEK	45.8	112.5167	633.694	-310.161
BSKM8	LONE MOUNTAIN	45.2833	111.4333	720.883	-356.117
BSRW4	FARSON DCP	42.3167	109.4833	912.592	-652.182
CABI1	CABINET GORGE	48.0856	116.0583	354.422	-87.369
CANW4	CANYON	44.7167	110.5333	796.268	-407.949
CARO3	CAPE ARAGO	43.34	124.38	-264.148	-602.362
CDNO3	CONDON	44.95	119.95	79.7	-434.5
CDP9	DEER PARK	49.4167	118.05	206.356	48.607
CFE9	FERNIE	49.5	115.05	415.343	69.209
CFQ9	FAUQUIER	49.8667	118.0833	202.263	96.919
CGL9	GLA ROGRS PASS	51.2833	117.5167	234.909	251.007
CKT9	KOOTNAI WESTGATE	50.6333	116.0667	336.941	186.19
CLCM8	COLE CREEK	45.2	109.35	878.172	-344.177
CLVM8	CALVERT CREEK	45.8833	113.3333	572.029	-307.413
CMDM8	CLOVER MEADOW	45.0225	111.8478	692.978	-387.587
CND9	NEW DENVER	49.9833	117.3833	250.23	111.441
CNU9	NAKUSP	50.2333	117.8	220.33	137.114
COPM8	COPPER BOTTOM	47.05	112.6	613.44	-177.344
COSW4	COLD SPRING	43.2667	109.65	885.043	-552.974
COWI1	COEUR D'ALENE	47.6789	116.8017	303.435	-134.049
CPCM8	COPPER CAMP	47.0833	112.7333	603.37	-174.8
CRLO3	CRATER LAKE	42.8967	122.1328	-89.283	-654.944

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CRRM8	CARROT BASIN	44.9667	111.2833	736.247	-388.497
CRSQ2	CRESTON	49.1	116.5167	315.471	19.572
CRYM8	CRYSTAL LAKE	46.7903	109.5122	841.617	-176.959
CWAD	CAPE MUDGE LIGHT HOU	50	125.2	-290.644	115.206
CWAE	WHISTLER	50.13	122.95	-134.695	123.222
CWAN	AMPHITRITE_POINT	48.92	125.55	-321.432	0.51
CWAQ	ALERT_BAY	50.58	126.93	-405.516	185.08
CWAS	PAM ROCKS	49.5	123.3	-160.798	56.075
CWBA	BANFF	51.1833	115.5667	367.029	247.567
CWBO	BROOKS (AUTO)	50.55	111.85	625.073	202.587
CWCL	CLINTON (AUTO)	51.15	121.5	-33.918	231.62
CWCV	NOOTKA LIGHTSTATION	49.6	126.62	-391.759	78.278
CWCZ	ADDENBROKE_ISL_(LH)	51.6	127.87	-460.209	299.824
CWDD	DUNCANDAM	50.25	116.9667	277.594	141.503
CWDK	CLARESHOLM (AUTO)	50	113.6333	509.06	131.023
CWDZ	DRUMHELLER_EAST	51.43	112.67	559.405	290.854
CWEB	ESTEVAN PT.(AUTO)	49.3833	126.55	-388.503	54.677
CWEH	E.END CYP.(AUTO)	49.45	108.9833	837.349	111.345
CWEL	ENTRANCE ISLAND	49.2167	123.8	-196.788	26.727
CWEL	ELKO	49.3	115.1	413.443	47.491
CWEM	EGG ISLAND LGT_STN	51.25	127.83	-460.755	261.96
CWEZ	SATURNA	48.7833	123.05	-145.307	-21.462
CWFJ	CARDSTON_(AUT)	49.2	113.28	541.693	47.63
CWFM	CHATHAM POINT	50.3333	125.4333	-304.781	151.917
CWGB	BALLENAS ISLAND	49.35	124.16	-221.5	41.997
CWGP	PEMBERTON ARPT	50.3	122.7333	-119.343	141.183
CWGT	SISTERS ISLAND	49.4833	124.4333	-240.023	57.114
CWGW	SPARWOOD AUTO	49.75	114.8833	424.906	96.912
CWHC	VANCOUVER HARBOUR	49.3	123.1167	-148.562	34.211
CWJR	CRESTON CAMPBELL	49.08	116.5	316.766	17.491
CWJV	VERNON AUTOB	50.2333	119.2833	118.182	133.976
CWJX	LEADER AIRPORT	50.9	109.5	779.241	260.616
CWKH	MALAHAT	48.5833	123.5333	-180.213	-41.973
CWKS	KASLO	49.9167	116.9167	282.862	105.832
CWKV	HOPE SLIDE	49.2833	121.2333	-16.458	30.476
CWLM	VICTORIA	48.4167	123.3167	-165.335	-60.34
CWLP	HERBERT ISLAND	50.95	127.64	-450.649	228.637
CWLY	LYTTON	50.2333	121.5833	-40.274	132.855
CWMM	P._MEADOWS_CS_AUTO8	49.2	122.68	-118.16	22.73
CWMP	PINCHER CK (AUTO)	49.5167	114	488.324	76.927
CWMQ	MAPLECREEK_(AUTO8)	49.9	109.47	796.72	154.288
CWMR	MERRY ISLAND	49.47	123.92	-204.221	54.261
CWNM	NELSON AUTO.	49.49	117.3	258.443	58.665
CWNP	NAKUSP AUTOB	50.2667	117.8167	219.037	140.663
CWOE	ONEFOUR	49.12	110.47	739.037	61.558
CWPC	PINCHER CK (AUTO)	49.5167	114	488.324	76.927
CWPF	ESQUIMALT HARBOUR	48.4333	123.4333	-173.594	-58.31

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CWPI	PINE_ISLAND_(MAPS)	50.98	127.73	-456.471	232.37
CWPR	PRINCETON AUTO8	50.6	120.5167	32.974	172.315
CWQC	PORT_ALBERNI_(MARS)	49.25	124.83	-268.927	33.301
CWQK	RACE ROCKS	48.3	123.5333	-181.176	-72.408
CWRT	CROWSNEST	49.63	114.48	453.918	86.251
CWRY	MILK RIVER (AUTO)	49.1333	112.05	628.477	49.484
CWSK	SQUAMISH ARPT	49.7833	123.1667	-150.661	86.293
CWSL	SALMON ARM AUTOB	50.7	119.2833	117.104	184.25
CWSP	SHERINGHAM POINT	48.3833	123.9167	-208.246	-62.529
CWSP	SPILLAMACHEEN	50.9167	116.4	312.443	215.334
CWSQ	SPRING ISLAND	50	127.4167	-443.724	125.37
CWSW	SPARWOOD/ELK_VALLEY	49.75	114.88	425.135	96.93
CWUS	SUMMERLAND AUTO	49.5667	119.65	94.132	61.738
CWVF	SAND HEADS LIGHTH	49.1	123.3	-162.034	13.061
CWVG	VICTORIA/GONZALES	48.4167	123.3167	-165.335	-60.34
CWVK	VERNON	50.2333	119.2833	118.182	133.976
CWVP	CYPRESS_HILLS_PARK	49.65	109.52	797.134	127.157
CWVV	VIC._HARTLAND_AUTO8	48.53	123.47	-175.89	-47.84
CWWA	WEST VANCOUVER	49.3333	123.1833	-153.134	37.918
CWWK	WHITE ROCK	49.0167	122.7667	-124.688	3.151
CWXA	BOW VALLEY(AUTO)	51.0833	115.0667	401.552	239.208
CWXL	BOW_ISLAND	49.63	111.45	664.064	107.41
CWYJ	VICTORIA UNIV	48.45	123.3	-164.041	-56.796
CWYL	YOHO PARK	51.45	116.3333	313.619	273.027
CWYY	OSOYOOS	49.0333	119.4333	110.377	4.643
CWZA	AGASSIZ AMOS	49.25	121.7667	-53.923	27.128
CWZG	BANFF_(MARS)	51.2	115.55	368.033	249.441
CXBR	BROCKET AGDM	49.62	113.82	499.855	89.11
CXBW	BARNWELL AGDM	49.8	112.3	603.211	118.861
CXFA	FANNY ISLAND	50.45	125.99	-342.212	166.716
CXHR	HUSSAR AGDM	51.18	112.5	573.639	265.232
CXMN	MASINASIN AGDM	49.13	111.66	655.787	52.259
CXMW	MEDICINE HAT RCS	50.03	110.72	709.049	156.4
CXOY	OYEN AGDM	51.38	110.35	715.127	303.964
CXSC	SCHULER AGDM	50.31	110.09	748.15	192.025
CXWM	WRENTHAM AGDM	49.5	112.12	619.215	88.143
CYAE	ALTA LAKE	50.1167	122.95	-134.73	121.79
CYAZ	TOFINO	49.0833	125.7667	-335.674	18.931
CYBA	BANFF	51.1833	115.5667	367.029	247.567
CYBL	CAMPBELL RIVER	49.95	125.2667	-295.541	110.075
CYBW	CALGARY/SPRINGBAN	51.1	114.3667	448.685	244.721
CYCD	NANAIMO	49.05	123.8667	-202.113	8.975
CYCG	CASTLEGAR	49.3	117.6333	236.029	37.213
CYDC	PRINCETON	49.4667	120.5167	33.71	50.286
CYEP	ESTEVAN POINT	49.3833	126.55	-388.503	54.677
CYGC	MT.FIDELITY	51.2333	117.7	222.773	245.093
CYGE	GOLDEN	51.3	116.9667	271.895	254.548

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
CYHE	HOPE	49.3667	121.4833	-33.947	39.526
CYKA	KAMLOOPS	50.7	120.45	37.462	183.122
CYLW	KELOWNA	49.9667	119.3833	111.874	105.13
CYPB	PORT ALBERNI	49.25	124.8333	-269.158	33.312
CYPW	POWELL RIVER	49.8167	124.5	-243.114	93.163
CYQL	LETHBRIDGE	49.6333	112.8	570.498	97.354
CYQQ	COMOX	49.7167	124.9	-271.392	83.695
CYRV	REVELSTOKE	50.9667	118.1833	191.16	215.11
CYSD	SUFFIELD_AIRPORT	50.27	111.18	674.318	178.069
CYVB	VAVENBY	51.5833	119.7833	81.527	278.891
CYVR	VANCOUVER	49.1833	123.1833	-153.574	21.788
CYWH	VICTORIA MAR.RAD.	48.3667	123.3875	-170.543	-65.563
CYXC	CRANBROOK	49.6167	115.7833	363.404	78.17
CYXH	MEDICINE HAT	50.0167	110.7167	709.459	155.009
CYXX	ABBOTSFORD	49.0333	122.3667	-96.449	4.384
CYYC	CALGARY	51.1167	114.0167	472.149	248.529
CYYF	PENTICTON	49.4667	119.6	97.81	51.039
CYYJ	VICTORIA INTL AP	48.65	123.4333	-172.887	-35.026
CYYN	SWIFT CURRENT	50.2833	107.6833	912.299	214.141
CYZT	PORT HARDY	50.6833	127.3667	-434.428	198.47
CZPC	PINCHER CREEK ARP	49.5167	113.9833	489.487	77.029
CZPN	PINCHER CREEK AUT	49.5167	114	488.324	76.927
DAZM8	DAISY PEAK	46.6667	110.3333	783.589	-198.438
DCDQ2	DUNCAN DAM	50.25	116.97	277.367	141.491
DDMM8	DEADMAN CREEK	46.8	110.6833	756.18	-187.613
DESW1	DESTRUCTION IS.	47.68	124.49	-252.43	-136.39
DHLM8	DARKHORSE LAKE	45.1667	113.5833	560.543	-385.774
DIAW1	DIABLO DAM	48.7167	121.15	-10.727	-30.471
DIVM8	DIVIDE	44.8	112.05	680.395	-413.058
DPYM8	DUPUYER CREEK	48.0667	112.75	591.291	-69.85
DRBM8	DARBY	46.0247	114.1769	507.946	-297.984
DTTO3	DETROIT DAM	44.7244	122.2536	-95.721	-458.497
DWRI1	DWORSHAK DAM	46.5028	116.3233	345.357	-258.221
EKPW4	ELKHEART PARK	43	109.75	881.31	-582.453
ELKI1	ELK CITY	45.8358	115.4581	414.123	-325.583
FDLQ2	FIDELITY MOUNTAIN	51.23	117.72	221.437	244.682
FNEQ2	FERNIE	49.5	115.05	415.343	69.209
FQRQ2	FAUQUIRE	49.8667	118.0833	202.263	96.919
FRHM8	FROHNER MEADOWS	46.45	112.2	649.607	-238.244
FSHM8	FISHER CREEK	46.2667	110.4333	781.936	-241.986
FTMM8	FLATTOP MOUNTAIN	48.8	113.85	505.638	1.07
GEBQ2	GOLDEN	51.3	116.9667	271.895	254.548
GOVO3	GOVERNMENT CAMP	45.3014	121.7411	-56.051	-397.037
GPSO3	GRANTS PASS	42.4372	123.3578	-187.175	-702.219
GRCI1	GRACE	42.5833	111.7333	731.867	-646.863
GRPQ2	ROGERS PASS	51.2833	117.5167	234.909	251.007
HBRU1	SNAKE CRK POWERHOUSE	40.55	111.5	776.114	-862.018

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
HGHM8	HUNGRY HORSE DAM	48.3428	114.0217	497.802	-48.963
HOOM8	HOODOO BASIN	46.9833	115.0333	436.644	-200.438
HOXO3	HOOD RIVER	45.6847	121.5175	-38.9	-356.02
HQSI1	HEADQUARTERS	46.6311	115.8097	382.351	-242.137
IPDI1	ISLAND PARK	44.4167	111.4	734.509	-448.196
ISLI1	ISLAND PARK	44.4167	111.4	734.509	-448.196
JDRO3	JOHN DAY	44.4233	118.9594	156.401	-489.583
K1O5	MONTAGUE/ROHRER	41.7333	122.55	-124.553	-779.485
K20S	BONNEVILLE DAM	45.6333	121.95	-71.403	-361.24
K27U	SALMON	45.1833	113.9	536.51	-386.169
K38S	DEER LODGE	46.4	112.8	606.019	-248.287
K3DU	DRUMMOND	46.6667	113.15	577.431	-222.382
K3HT	HARLOWTON	46.4333	109.8333	823.574	-218.247
K3S8	GRANTS PASS	42.4333	123.3167	-183.927	-702.733
K3S9	CONDON	45.2333	120.1833	61.663	-404.292
K3TH	THOMPSON FALLS	47.6	115.3667	407.627	-136.135
K4BK	BROOKINGS	42.05	124.2833	-262.284	-741.24
K4HA	WHITEHALL	45.8667	111.9667	673.809	-298.552
K4LW	LAKE VIEW	42.2167	120.35	51.69	-728.476
K4SV	STREVELL	42.0167	113.25	618.366	-720.245
K4UK	UKIAH	45.1333	118.9333	156.435	-413.323
K53S	POINT WILSON LS	48.15	122.75	-125.546	-90.022
K5J0	JOHN_DAY_STATE_ARPT	44.4	118.97	155.652	-492.105
K75S	BURLINGTON	48.4667	122.4167	-101.052	-56.463
K76S	OAK HARBOR	48.25	122.6667	-119.352	-79.405
K77M	MALTA	42.3	113.3333	608.826	-690.554
K84S	GRAY'S HARBOR	46.9167	124.1	-227.419	-219.469
K87S	QUILLAYUTE R LS	47.9	124.6333	-261.712	-112.318
K92S	CAPE BLANCO	42.8333	124.5667	-281.15	-656.129
K95S	YAQUINA BAY	44.6167	124.05	-233.159	-466.37
K9BB	WELLS	41.1167	114.9667	488.962	-828.633
K9S4	SUPERIOR	47.2	114.8833	445.826	-176.406
KAAT	ALTURAS	41.4914	120.5644	35.037	-806.628
KACV	ARCATA	40.9792	124.1058	-252.585	-856.977
KALW	WALLA WALLA	46.1	118.2833	202.125	-308.128
KAST	ASTORIA ASOS	46.15	123.8833	-214.499	-302.33
KAWH	ELKO/WILD HORSE RSV	41.6667	115.7833	419.015	-774.2
KAWO	ARLINGTON_MUNI	48.17	122.17	-83.937	-88.631
KBAM	BATTLE MOUNTAIN	40.6167	116.8667	337.899	-892.205
KBFI	BOEING FIELD	47.5333	122.3	-94.364	-156.883
KBKE	BAKER	44.8428	117.8086	242.819	-441.691
KBLI	BELLINGHAM	48.8	122.5333	-108.675	-20.486
KBN9	BONNERS FERRY	48.6833	116.3167	332.151	-24.353
KBNO	BURNS ASOS	43.5833	118.95	159.432	-579.755
KBNY	BURNEY	40.8833	121.6667	-54.388	-871.978
KBOI	BOISE	43.5667	116.2167	372.045	-572.462
KBPI	BIG PINEY (AMOS)	42.5667	110.1	860.382	-632.392

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KBTM	BUTTE	45.9647	112.5006	633.019	-292.451
KBVS	SKAGIT RGNL ARPT	48.4708	122.4208	-101.336	-56.017
KBYI	BURLEY	42.5417	113.7661	572.204	-667.869
KBZN	BOZEMAN ASOS	45.7833	111.15	735.54	-300.255
KC99	CRATER LAKE HQ	42.9	122.1333	-89.318	-654.589
KCEC	CRESCENT CITY	41.7833	124.2333	-259.451	-770.072
KCG9	CABINET GORGE	48.0833	116.0667	353.835	-87.653
KCLM	PORT ANGELES	48.1167	123.5	-179.411	-92.172
KCOD	CODY (AMOS)	44.5167	109.0167	914.052	-413.015
KCOE	COEUR DALENE AWOS	47.7667	116.8167	301.859	-124.686
KCQV	COLVILLE MUNICIPAL	48.55	117.8833	221.643	-44.086
KCTB	CUTBANK	48.6167	112.3833	611.128	-8.312
KCVO	CORVALLIS (AWOS)	44.5	123.2833	-174.945	-480.847
KCZK	CASCADE LOCKS	45.6833	121.8833	-66.337	-355.93
KD15	WOODLAND PARK	47.5	115.8833	370.977	-149.365
KD99	DIABLO DAM	48.7167	121.15	-10.727	-30.471
KDB9	DARBY	46.0167	114.0167	519.919	-297.811
KDD9	DEADWOOD DAM	44.3167	115.6333	411.972	-489.21
KDEW	DEER_PARK	47.97	117.41	258.087	-104.945
KDI9	DIXIE	45.55	115.4667	415.6	-356.237
KDLN	DILLON	45.25	112.55	637.435	-369.143
KDLS	THE DALLES	45.6194	121.1714	-12.957	-363.142
KDPG	DUGWAY PRV GNDS	40.2	112.9333	663.233	-912.41
KDR9	DETROIT DAM	44.7167	122.25	-95.459	-459.328
KEA9	LAKE WENATCHEE	47.8333	120.8	14.338	-125.403
KEAT	WENATCHEE	47.3978	120.2014	57.976	-171.913
KEKA	EUREKA	40.8	124.1667	-258.298	-876.072
KEKO	ELKO REGIONAL AIRPRT	40.8264	115.7875	424.565	-864.508
KELN	ELLENSBURG/BOWERS	47	120.5167	35.311	-214.818
KENV	WENDOVER (AUTOB)	40.7333	114.0333	568.031	-863.635
KENW1	KENNEWICK	46.2111	119.1011	140.985	-297.958
KEPH	EPHRATA	47.3081	119.5147	108.077	-180.833
KET9	ELTOPIA	46.4	119.1667	135.648	-277.796
KETM	ELLISTON	46.5667	112.4333	631.112	-227.653
KEUG	EUGENE ASOS	44.1167	123.2167	-170.985	-522.137
KEUL	CALDWELL	43.63	116.63	339.553	-567.509
KEVW	EVANSTON	41.275	111.0322	804.446	-779.878
KFCA	KALISPELL ASOS	48.3	114.2667	480.75	-55.044
KFHR	FRIDAY HARBOR	48.5167	123.0167	-143.67	-50.173
KFN9	FENN PASS	46.1	115.55	405.336	-297.756
KGEG	SPOKANE ASOS	47.6333	117.5333	250.792	-141.475
KGFA	MALMSTROM AFB	47.5	111.1833	710.523	-117.61
KGNG	GOODING	42.9167	114.7667	490.082	-634.337
KGO9	GOVERNMENT CAMP	45.3	121.75	-56.725	-397.181
KGRF	FORT LEWIS	47.0833	122.5833	-115.862	-204.834
KGTF	GREAT FALLS ASOS	47.4833	111.3667	697.527	-121.003
KHD9	HEADQUARTERS	46.6333	115.8	383.05	-241.855

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KHH9	HUNGREY HORSE DAM	48.35	114	499.279	-48.057
KHIF	HILL AFB	41.1167	111.9667	731.276	-805.767
KHIO	HILLSBORO/PORTLAND	45.5481	122.9544	-147.016	-369.017
KHLN	HELENA ASOS	46.6	112	662.505	-220.599
KHMM	HAMILTON/RAVALLI_CO	46.25	114.15	507.877	-273.713
KHMS	HANFORD	46.5667	119.6	103.258	-260.548
KHQM	HOQUIAM	46.9728	123.9303	-214.76	-213.917
KHR9	HOOD R EXP STA	45.6833	121.5167	-38.841	-356.17
KHRI	HERMISTON	45.8258	119.2611	129.999	-339.584
KHVR	HAVRE ASOS	48.55	109.7667	796.66	7.579
KIDA	IDAHO FALLS	43.5167	112.0667	694.475	-550.166
KJAC	JACKSON	43.6	110.7333	796.471	-528.866
KJER	JEROME	42.7275	114.4531	516.349	-652.638
KJNW	NEWPORT SAWRS PT	44.6333	124.05	-233.091	-464.589
KKLG	KELLOGG	47.5333	116.1333	352.652	-146.925
KKLS	KELSO (AWOS)	46.1167	122.9	-141.479	-308.088
KLAU	LAURIER	49	118.2333	195.083	3.353
KLGD	LA GRANDE (AWOS)	45.28	118	226.5	-395.348
KLGU	LOGAN	41.7833	111.85	732.501	-733.406
KLKN	ELKO WFO	40.86	115.7425	427.988	-860.656
KLKV	LAKEVIEW (AWOS)	42.1667	120.4	47.747	-733.885
KLLJ	CHALLIS ASOS	44.5167	114.2167	518.689	-459.56
KLMT	KLAMATH FALLS	42.15	121.7333	-58.563	-735.592
KLVM	LIVINGSTON	45.6983	110.4408	789.408	-302.553
KLWS	LEWISTON ASOS	46.3833	117.0167	294.823	-273.806
KLWT	LEWISTOWN	47.05	109.4667	840.925	-148.881
KMEH	MEACHAM (AMOS)	45.5	118.4	195.533	-372.798
KMEW4	KEMMERER DCP	41.8	110.5833	833.148	-719.237
KMF9	MT.FANNY	45.3167	117.7333	246.472	-390.623
KMFR	MEDFORD	42.3667	122.8667	-148.391	-710.826
KMHS	MT SHASTA ASOS	41.3167	122.3167	-106.558	-824.655
KMI1	SAYLOR CREEK AFR	42.5	115.5	435.589	-683.252
KMLD	MALAD CITY	42.1667	112.3167	690.821	-696.565
KMLP	MULLAN_PASS_VOR	47.4542	115.6697	386.772	-153.263
KMMV	MCMINNVILLE	45.1961	123.1322	-161.387	-406.453
KMQM	MONIDA	44.5667	112.3167	662.909	-440.194
KMR9	MORO	45.4833	120.7167	21.239	-377.729
KMRA	MORAN S. WNW	43.85	110.5833	804.56	-500.734
KMRW4	KEMMERER	41.7167	110.6667	827.667	-728.99
KMSO	MISSOULA	46.9167	114.0833	506.635	-201.97
KMUO	MOUNTAIN HOME AFB	43.05	115.8667	402.795	-626.181
KMWH	MOSES LAKE	47.2	119.3167	122.738	-192.155
KMYL	MCCALL (RAMOS)	44.8833	116.1	372.465	-430.781
KNNCR	COLUMBIA R LS	46.1833	124.1833	-236.654	-297.913
KNOW	PORT ANGELES CGAS	48.1333	123.4	-172.187	-90.608
KNS9	NO. STAR RANCH	45.9167	114.8333	460.066	-313.51
KNUW	WHIDBEY IS.NAS	48.35	122.65	-117.935	-68.685

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KOGD	OGDEN	41.1833	112.0167	726.441	-799.096
KOLM	OLYMPIA	46.9667	122.9	-139.314	-216.848
KOMK	OMAK	48.4614	119.5192	105.458	-56.95
KONO	ONTARIO	44.0167	117.0167	307.459	-527.592
KONP	NEWPORT	44.5833	124.05	-233.295	-469.954
KOOI1	FENN RANGER STATION	46.1033	115.5486	405.416	-297.396
KOR6	MITCHELL	44.5667	120.1667	63.662	-475.847
KORS	ORCAS ISLAND ARPT	48.7081	122.9103	-135.605	-29.79
KOTH	NORTH BEND	43.4167	124.25	-253.664	-594.549
KOTX	SPOKANE WFO	47.6808	117.6278	243.742	-136.668
KOV9	OVANDO	47.0167	113.1333	574.969	-184.859
KOWY	OWYHEE	41.95	116.1	391.741	-745.381
KP60	YELLOWSTONE(AMOS)	44.55	110.4167	807.447	-424.526
KP69	LOWELL	46.1442	115.5964	401.57	-293.255
KP88	ROME (RAMOS)	42.8333	117.8833	245.536	-657.609
KPAE	EVERETT	47.9167	122.2833	-92.493	-115.72
KPDT	PENDLETON ASOS	45.6833	118.85	161.157	-354.13
KPDX	PORTLAND	45.6	122.6	-120.265	-364.038
KPIH	POCATELLO	42.9167	112.6	659.92	-618.775
KPL9	PALISADES DAM	43.35	111.2167	762.431	-560.221
KPQR	PORTLAND WFO	45.5606	122.5369	-115.608	-368.359
KPSC	PASCO	46.2667	119.1167	139.686	-292.018
KPUW	PULLMAN-MOSCOW RGNL	46.7439	117.1136	285.776	-235.486
KPVU	PROVO	40.2167	111.7167	762.646	-899.785
KPW9	POWELL	46.5167	114.5167	478.43	-247.437
KPWT	BREMERTON AWOS	47.4833	122.7667	-128.323	-161.604
KRBG	ROSEBURG ASOS	43.2333	123.3667	-185.351	-616.663
KRBL	RED BLUFF ASOS	40.15	122.25	-103.127	-950.438
KRDD	REDDING	40.5	122.3	-106.636	-912.642
KRDM	REDMOND	44.2667	121.15	-11.622	-508.383
KREO	ROME	42.59	117.87	247.606	-683.703
KRNT	RENTON	47.5	122.2167	-88.377	-160.554
KRR9	RAINIER PARADISE	46.7833	121.7333	-54.005	-237.948
KRXE	REXBURG	43.8317	111.8061	710.772	-514.258
KS06	MULLAN AWRS	47.4667	115.8	377.241	-152.545
KS14	SPENCER	44.3	112.1	682.565	-466.84
KS47	TILLAMOOK	45.42	123.82	-212.553	-380.821
KS59	LIBBY	48.4	115.5333	389.724	-51.213
KS68	OROFINO	46.4833	116.25	350.889	-259.993
KS72	ST.MARIES	47.3167	116.5667	322.561	-171.978
KS80	GRANGEVILLE	45.9167	116.1	365.68	-320.043
KS91	ELK RIVER	46.7667	116.1833	353.983	-229.324
KSEA	SEATTLE-TACOMA	47.45	122.3	-94.509	-165.829
KSEW	STANWOOD WFO	47.6872	122.2553	-90.863	-140.405
KSFF	SPOKANE/FELTS	47.6667	117.3333	265.091	-137.246
KSHN	SHELTON	47.25	123.15	-156.812	-185.972
KSIY	MONTAGUE/SSK AWOS	41.7833	122.4667	-117.765	-774.232

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
KSKA	FAIRCHILD AFB	47.6333	117.65	242.351	-141.834
KSLC	SALT LAKE CITY	40.7667	111.9667	735.52	-843.229
KSLE	SALEM ASOS	44.9167	123	-152.137	-436.699
KSMN	SALMON	45.1167	113.8833	538.403	-393.179
KSMP	STAMPEDE PASS ASOS	47.2833	121.3333	-24.37	-184.45
KSNT	STANLEY_RANGER_STN	44.17	114.93	467.068	-501.064
KSPB	SCAPPOOSE	45.78	122.84	-137.845	-344.331
KSS9	SHOSHONE	42.9667	114.4333	515.802	-626.886
KST9	STEVENS PASS	47.7333	121.0833	-6.105	-136.161
KSUN	HAILEY	43.5	114.3	521.46	-568.913
KSVE	SUSANVILLE	40.3833	120.5667	35.497	-925.991
KSXT	SEXTON SMT ASOS	42.6167	123.3667	-187.31	-682.907
KSZT	SANDPOINT ARPT	48.2994	116.56	317.197	-66.538
KT08	HILL/EAGLE TACR	41.0833	113.4167	614.604	-821.533
KT62	TOOELE/ARMY DEPOT	40.1667	112.2	723.693	-909.63
KTCM	MCCHORD AFB	47.15	122.4833	-108.418	-197.813
KTDO	TOLEDO	46.4833	122.8	-133.154	-268.91
KTFX	GREAT FALLS WFO	47.4597	111.3847	696.533	-123.676
KTIW	TACOMA	47.2667	122.5833	-115.473	-185.142
KTTD	PORTLAND/TROUTDALE	45.5511	122.4089	-106.005	-369.556
KTWF	TWIN FALLS	42.4833	114.4833	516.107	-679
KU16	EAGLE RANGE	41.05	113.0667	643.238	-822.353
KU33	JOHN DAY	44.4333	118.95	157.095	-488.491
KU42	SALT LAKE CITY MUNI	40.62	111.99	735.405	-859.15
KU67	ROOSEVELT	40.2667	109.9167	908.924	-875.646
KU78	SODA SPRINGS	42.65	111.5833	742.82	-638.359
KUAO	AURORA STATE	45.25	122.77	-133.863	-401.335
KUIL	QUILLAYUTE	47.95	124.55	-255.48	-107.22
KUP9	UPPER BAKER DAM	48.65	121.6833	-48.617	-37.445
KVUO	VANCOUVER_(ASOS)	45.62	122.65	-123.976	-361.815
KWEY	W.YELLOWSTONE WSO	44.65	111.1	754.261	-420.54
KWMC	WINNEMUCA ASOS	40.9	117.8	260.408	-865.2
KWYS	WEST YELLOWSTONE	44.6833	111.1167	752.555	-417.149
KYKM	YAKIMA	46.5667	120.5333	34.366	-261.351
LCKM8	LICK CREEK	45.5	111.9667	678.241	-337.67
LMHM8	LEMHI RIDGE	44.9833	113.4333	573.706	-404.316
LTWW4	LITTLE WARM	44.5	109.75	858.745	-422.908
LVRM8	LAKEVIEW RIDGE	44.5833	111.8333	699.458	-434.309
LWTM8	LOWER TWIN	45.5	111.9167	681.979	-337.245
LYBM8	LIBBY 32 SSE	47.9739	115.2253	414.948	-95.342
MANM8	MANY GLACIER	48.8	113.6667	518.566	2.242
MITO3	MITCHELL	44.5667	120.1667	63.662	-475.847
MNPM8	MONUMENT PEAK	45.2167	110.2333	811.761	-351.724
MPLM8	MADISON PLATEAU	44.5833	111.1167	753.876	-427.805
MRQW4	MARQUETTE CREEK	44.3	109.2333	901.057	-438.485
MTKM8	MOUNT LOCKART	47.9167	112.8167	588.17	-86.374
NDRQ2	NEW DENVER	49.9833	117.3833	250.23	111.441

ID	Name	Lat (°N)	Lon (°W)	xlcc (km)	ylcc (km)
NEVM8	NEVADA CREEK	46.8333	112.5167	621.962	-199.842
NORM8	NORTHEAST ENTERANCE	45	110	832.429	-372.38
NUTU1	NUTTERS RANCH	39.8	110.25	888.494	-929.261
NWPO3	NEWPORT	44.61	124.07	-234.714	-467.031
OGDU1	OGDEN PIONEER	41.2439	111.9475	731.278	-791.982
OVDM8	OVANDO 9SSE	46.8969	113.0619	581.445	-197.146
PCKM8	PICKFOOT CREEK	46.5833	111.2667	716.452	-216.064
PINW4	PINEDALE DCP	42.8833	109.85	875.267	-595.97
PLCM8	PLACER BASIN	45.4167	110.1	818.837	-329.091
PRKW4	PARKER PEAK	44.7333	109.9167	842.644	-399.872
PRPM8	PORCUPINE	46.1167	110.4667	781.591	-258.277
PVRO3	PEAVINE RIDGE	45.05	121.9333	-70.879	-423.874
RADQ2	KOOTENAY NATL PARK	50.62	116.0667	337.03	184.76
RKPM8	ROCKER PEAK	46.3667	112.25	646.906	-247.539
ROCM8	ROCKY BOY	48.1833	109.65	810.45	-30.271
SDMM8	SADDLE MOUNTAIN	45.7	110.4333	789.942	-302.297
SFDU1	SCOFIELD DAM	39.7858	111.1189	817.242	-940.037
SFSM8	SOUTH FORK SHIELDS	46.0833	110.4333	784.527	-261.504
SHCM8	SHORT CREEK	44.9667	111.95	685.948	-394.419
SHOI1	SHOSHONE	42.9383	114.4169	517.338	-629.822
SISW1	SMITH ISLAND	48.32	122.84	-131.577	-71.613
SLNI1	SALMON KSRA	45.1875	113.9008	536.409	-385.725
SNVC1	SUSANVILLE 2SW	40.4167	120.6631	27.565	-922.428
SPMW1	SPENCER MEADOWS	46.1833	121.9333	-69.461	-302.211
SPRM8	SPUR PARK	46.7833	110.6167	761.267	-188.76
SUPM8	SUPERIOR	47.1931	114.8908	445.337	-177.187
SVNW1	STEVENS PASS	47.733	121.0833	-6.105	-136.193
SYLW4	SYLVAN LAKE	44.4833	110.15	828.642	-428.9
SYRW4	SYLVAN ROAD	44.4667	110.0333	837.743	-429.451
THUW4	THUMB DIVIDE	44.3667	110.5667	798.624	-445.545
TIBM8	TIZER BASIN	46.35	111.85	676.561	-246.014
TICW4	TIMBER CREEK	44.0333	109.1833	909.07	-466.252
TOPW4	TWO OCEAN PLATEAU	44.15	110.2167	828.384	-465.056
TPEM8	TEPEE CREEK	44.7833	111.7	707.097	-411.807
TTIW1	TATOOSH ISLAND	48.39	124.74	-266.931	-59.367
UBKW1	UPPER BAKER DAM	48.65	121.6833	-48.617	-37.445
VAVQ2	VAVENBY	51.5833	119.7833	81.527	278.891
WALM8	WALDRON	47.9167	112.7833	590.563	-86.128
WEYM8	W. YELLOWSTONE 9WNW	44.7867	111.1317	750.053	-406.272
WHRU1	WHITEROCKS	40.6131	109.9286	902.808	-838.797
WHTM8	WHITE MILL	45.05	109.9	839.207	-366.018
WLVW4	WOLVERINE	44.8	109.65	861.777	-389.941
WPOW1	WEST POINT	47.66	122.44	-104.271	-143.102
WSKM8	WHISKEY CREEK MT	44.6	111.15	751.129	-426.339
WWPI1	WALLACE WOODLAND	47.4794	115.9089	369.264	-151.692
YOUW4	YOUNTS PEAK	43.9333	109.8167	862.159	-483.889

ID-OR-WA BART Modeling Protocol:

Summary of Comments and Responses

The BART modeling protocol developed by Washington, Oregon, and Idaho was distributed to BART-eligible sources in the three-state region, the Federal Land Managers (FLMs), and EPA Region 10 in early June 2006. Comments were received in the period up to June 30, 2006. Many comments have been addressed by clarifications or modifications to the protocol, and the protocol is greatly improved with these changes. Significant comments relating to modeling and technical issues are summarized below, together with responses.

Comments Grouped by Topic

General Comments 1: Class I areas and Columbia River Gorge National Scenic Area (CRGNSA).

Comments: The CRGNSA and all Class I areas beyond 200 km should not be included in the analysis.

Response: Inclusion of CRGNSA in the analysis is for information purposes only. The inclusion of all Class I areas within 300 km is based on EPA "Guidelines on Air Quality Modeling" (Section 6.1 of Appendix W).

General Comments 2: Ozone and ammonia backgrounds.

Comments: 1) Provide justification for backgrounds; 2) Use an OZONE.DAT file to allow CALPUFF to choose the ozone concentration at each computational grid point based on the nearest monitoring value; 3) Use monthly or seasonally varying O_3 background; 4) Vary ammonia background by Class I area; 5) Use the ammonia limiting method in POSTUTIL; 6) Use ammonia data from WRAP.

Response: Ozone data in Washington, Oregon and Idaho were analyzed, and an annual background concentration of 60 ppb for domain was determined to be representative. Using varying ozone concentrations for each grid point, including the use of an OZONE.DATA file, is not considered suitable for conditions in the modeling domain. An ammonia background concentration of 17 ppb was determined to be appropriate based on the presence of high ammonia-emitting areas in the three-state region that are not adequately represented in the WRAP modeling. It is recognized that ammonia values may

be lower in Class I areas, but the analysis must account for plume transport through ammonia-rich areas. Clarification was added to Section 3.6.3.

General Comments 3: Natural Background and Class I areas.

Comments: 1) Clarify the basis for determining natural background (20% best days or annual average); 2) Provide basis for the 20% best-days natural background numbers that are given in Appendix B; 3) Clarify the use of the alternative method in the EPA Guidance on Developing Natural Background to refine the background values used in the modeling; 4) The natural background is too low (conservative), and should be adjusted to include the contribution of natural carbon and sea salt; 5) Use the new IMPROVE Rayleigh scattering estimates developed in November 2005, instead of the default value of 10; 6) Add the Jarbidge Wilderness area in Nevada to the list of Class I areas in the modeling.

Response: 1) The 20% best days natural background will be used and is consistent with the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125).   The protocol was clarified to reflect these comments. The use of the new IMPROVE formula for calculating visibility extinction, including the addition of sea salt, has not been approved by the FLMs for the BART analysis. The new Rayleigh scattering formula will also not be used, which is consistent with FLM recommendations. The Jarbidge Wilderness was added to the Class I area list.

General Comments 4: BART Exemption thresholds.

Comments: 1) Multiple or grouped sources should be compared to the 1.0 dv (“cause” threshold) not to the 0.5 dv (“contribute” threshold); 2) Provide information on how the multi-source analysis will be managed, including data sharing among states; 3) Clarify the use of the 98th percentile dv change versus the highest dv change, and how this metric is linked to the method for estimating natural background; 4) Calculate the change in visibility on a receptor-by-receptor basis, not on the Class I area.

Response: Following the BART modeling guidance, the contribution threshold is 0.5 dv and will be applied to individual sources. In the multi-source assessment, the 0.5 dv value is used only as a marker to indicate that a further analysis of these sources will be carried out; it is not considered a contribution threshold. The additional analysis of these multiple sources will look at the frequency, magnitude, duration, and other factors to determine if these sources, if any, will be considered significant and Subject to BART. Section 2.7.1 has been clarified regarding these multi-source assessments. Emissions and modeled concentration data will be shared among the three states. The 98^{th} percentile change in dv will be used in conjunction with the 20% best days natural background and is based on the EPA BART guidelines and comments of the FLMs. The assessment of visibility change will be based on a receptor-by-receptor basis.

General Comments 5: Multi-source modeling and assessment methodology.

Comments: 1) The reference to FLAG and the use of "magnitude, frequency, duration" in Exemption modeling should be removed as these factors only apply in the Determination phase of the modeling; 2) Clarify the difference between the BART Exemption modeling and Determination modeling; (for example, if a source is determined to be Subject to BART based on the multi-source analysis, should not the BART Determination also be based on group analysis?).

Response: Consistent with the EPA BART Guidelines, the FLAG and IWAQM reports will be used as general guidance for the visibility assessment. The single-source BART Exemption analyses will be based on the 0.5 dv contribution threshold and will not consider the frequency, magnitude, and duration of impairment (consistent with BART Guideline). For the evaluation of multi-source impacts, the BART Exemption analyses will consider an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each sources in the multi-source group. Section 2.7.2 has been clarified for the Determination phase.

General Comments 6: Inclusion of VOC and ammonia-emitting sources in the BART modeling.

Comments: 1) Remove VOCs and ammonia from the visibility analysis; 2) If VOCs are modeled, justify basis for VOC speciation.

Response: Section 2.3 in the protocol has been modified to read, "Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds that require a full BART exemption analysis." For Washington, "VOC emissions will be included in the BART exemption analysis if the greater-than-six carbon VOC gases exceed 250 tons/year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms."

General Comments 7: Definition of Bart-eligible sources.

Comments: Confusion on definition of BART-eligible source.

Response: Section 2.1 in protocol has been clarified to show that a "BART-eligible source" refers to the entire facility that has BART-eligible emission units."

General Comments 8: Characterization of facility emissions.

Comment: 1) Clarify under what conditions emission units and pollutants can be excluded in the BART Exemption modeling; 2) Do not include fugitive emissions; 3) Describe how different operating scenarios might be included; 4) Clarify the modeling of HNO_3.

Response: Section 2.4 was clarified on the exemption of pollutants and individual emission units and specifically the exemption of fugitive emissions for sources that are greater than 10km from a Class I area. Different operating scenarios are not addressed in the protocol; if this is a significant issue for an individual source, it will be addressed on a case-by-case basis. HNO_3.modeling is addressed in Section 3.6.1.

General Comments 9: PM speciation.

Comments: 1) Clarify how PM will be speciated, especially the inclusion of the condensable fraction of emissions and scavenging coefficients for PM species; 2) Address the possible double-counting of SO_4 in PM_{10} condensables with gaseous SO_2; 3) Correct the problem with the speciation references in the appendices; 4) Add additional sources of speciation data than those listed in the appendices; 5) Make reference to the NPS Web site for speciation information.

Response: Section 3.6.1 was modified to give a better description of PM speciation, size fractionation, treatment of condensables, and the modeling of SO_2 and H2SO_4 to ensure no double-counting. The statement "The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions" was added. Appendix G was removed and three information sources were included in Section 3.6.1. A chart showing the default PM size fractions to be used in CALPUFF was included in the protocol:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.48	2
PMC	2.5	5

General Comments 10: CALMET modeling.

Comments: 1) The CALMET modeling protocol was not available for public review, yet the work is already under way; 2) Make clear that states, not Geomatrix, is responsible for the protocol for developing the CALMET data set; 3) Correct the years of CALMET data that is shown in section 3.1.2; 4) Clarify how the 12-km CALMET data will be used; 5)

Describe how the CALMET data will be provided; 6) Describe how the MM5 will be evaluated.

Response: Clarification was added to Section 3.5. Due to time and resource constraints, an initial CALMET protocol and the development of the data set was started prior to the finalizing of the protocol. The FLMs and EPA were consulted throughout this process, and the initial draft of the CALMET protocol was reviewed and approved before the work began. The years of CALMET data given in the protocol have been corrected. Only the 4-km CALMET data will be used for BART modeling, but both the 4 km and 12 km met data will be available for other air quality analyses. Individual facilities will contact the appropriate state agency to discuss options for obtaining the CALMET data. The MM5 data was evaluated using METSTAT, a publicly available statistical program.

General Comments 11: CALPUFF model versions.

Comments: 1) Clarify reasons for using Version 6 as this is not consistent with other RPO protocols; 2) Correct the listing of versions in the protocol; 3) Update the protocol and the appendices to reflect the use of Version 6.

Response: Version 6 is the most recent version of CALPUFF and was made available after other protocols in other regions were completed. It was felt important that the most recent version be used, in part because of the improved over-water algorithm. The protocol was corrected to show Version 6 of the CALPUFF modeling system. Appendices were updated to include the new parameters in Version 6.

General Comments 12: CALPUFF modeling parameters.

Comments: Comments on CALPUFF: 1) Clarify the meaning of the phrase "protocol will generally follow FLAG and IWAQM;" 2) Use puff-splitting; 3) Use building downwash; 4) Base source elevations on the same terrain files as the receptor elevations.

Response: The FLAG and IWAQM reports were used as guidance documents during the development of the protocol, and are specifically referenced in the EPA BART guidelines. Puff-splitting and building downwash will not be used in CALPUFF based on the recommendations from FLMs. Clarification was added to Section 3.6.4 to state that source and receptor elevations will be the actual elevations, and will not be based on the DEM data used for the development of the windfields in CALMET.

General Comments 13: CALPOST

Comments: 1) Describe how OC (SOA) is treated in CALPUFF, POSTUTIL, and CALPOST.

Response: Clarification was added to Sections 3.6 and 3.7.

General Comments 14: BART modeling implementation.

Comments: 1) Clarify if the protocol is required for all BART-eligible sources, or can the use of higher resolution met data, or other refined model options, be used to address local conditions; 2) Show the BART schedule, including the estimated time and resources required by IDEQ and WRAP; 3) Describe the process for determining and prioritizing BART control measures, including the sensitivity of the visibility modeling to PM, SO_2, and NO_x emissions; 4) Comment on the observation that control technologies that do not produce visibility improvements will not be determined to be BART.

Response: These local or state-specific issues are not addressed in the protocol, and should be discussed separately with each state agency. In addition, this response to comments is intended only to address the modeling and technical analysis issues of the BART process and not to respond to questions or comments of a legal nature.

Specific Comments

Specific Comment 1: Terminology.

Comment: The term "BART exemption modeling" is not used in the BART Guidelines (40 CFR part 51, Appendix Y). It is suggested that a term that is more directly tied to Appendix Y be used.

Response: The terms in the BART Guidelines are not clear; therefore, the modeling protocol distinguishes between "BART Exemption modeling" (a process to exempt sources from being Subject to BART) and "BART Determination modeling" (a process to determine the level of controls, together with other factors, necessary to meet BART).

Specific Comment 2: Typo

Comment: Put "or" between two bullets in Section 2.4.

Response: The change was incorporated in the protocol.

Specific Comment 3: BART-eligible emission units

Comment: Include a list of all BART-eligible units.

Response: A listing of all BART-eligible units was not included in the protocol as there are potentially a large number of individual emission units, and there may be changes in the actual units included in the modeling as the analysis proceeds. Only a list of BART-eligible sources is included in the protocol.

Specific Comment 4: Model performance evaluation.

Comment: 1) In the protocol, include a section on performance evaluation that addresses the accuracy of the estimated visibility compared to monitored visibility impairment; 2) In the modeling reports, include a summary of a model performance evaluation using the PM_{10} SIP evaluation as guidance; 3) Describe why the protocol and analysis will not result in an overly conservative result, even as a screening approach.

Response: A section on model performance evaluation was not included in the protocol because it is not appropriate for the type of modeling analysis. In order to complete a model evaluation, several data sets are required covering the same time period: meteorological data, actual emissions data from all source types, and monitoring data. The purpose of the BART analysis is to determine the impact on a Class I area of an individual source or a group of sources. All other emissions that are present in the modeling domain that would contribute to impairment at a monitor are not included in the analysis. As a result, the BART modeled visibility impairment can not be compared to monitoring data. Also, the metrological data and emissions data must be in the same time period as the monitoring data.

The mesoscale meteorological data (MM5) is being evaluated against actual meteorological observation data as well as the CALMET output files.

The protocol is based on recommendations in the BART Guideline, FLAG report, and IWAQM report. In addition, the BART Exemption modeling approach that is described in this protocol is virtually identical to visibility analyses that have been a part of NSR for sources in the Pacific NW for over five years, and is not considered overly protective of visibility.

Subject to BART Modeling Analysis

Subject-to-BART Analysis

For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[1]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[2], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[1] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[2] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: Nu-West, Pocatello, Idaho

The East Sulfuric Acid Plant of Nu-West in Agrium, Idaho has been determined to be BART-eligible. The *Potential to Emit* (PTE) for the unit listed in Table 1 exceeds 250 tons per year (tn/yr) for the haze-causing pollutants SO_2, and the source was put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers. (Particulate emissions were not provided but visibility impacts due to SO2 are so low that particulates are unlikely to influence the conclusion anyway).

Table 1. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Agrium						
	East Sulfuric Acid Plant	10	1973		258	

Speciation of Emissions

PM10 emissions were not addressed in this analysis, therefore, no speciation was needed.

Table 2. Facility information, stack parameters, and speciation of emissions.

Facility Information	**Facility_ID**	**ID-6**
	Facility_Name	Nu-West (Agrium)
Unit Information	Unit_ID	220
	Unit_Description	East Sulfuric Acid Plant
Control Information	Control_ID	1
	Control_Description	Existing Control - Ver. 2
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	12
	Longitude_Easting (km)	455.658
	Latitude_Northing (km)	4724.52
	Base_Elevation (m)	1882
Stack Parameter	Stack_Height (m)	33.5
	Stack_Diameter (m)	2.3
	Stack_Exit_Temperature (K)	347.6
	Stack_Exit_Velocity (m/s)	11.5
Emission Rate (lb/hr)	SO_2	258
	SO_4	0
	NO_X	0
	HNO_3	0
	NO_3	0
	PMC	0
	PMF	0
	EC	0
	SOA	0

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas. The eastern edge of several Class I areas did not retain a 50 km buffer, because the MM5 domain does not extend for enough east, but visibility impacts for those areas are10% or less of the threshold, so this is not a significant problem.

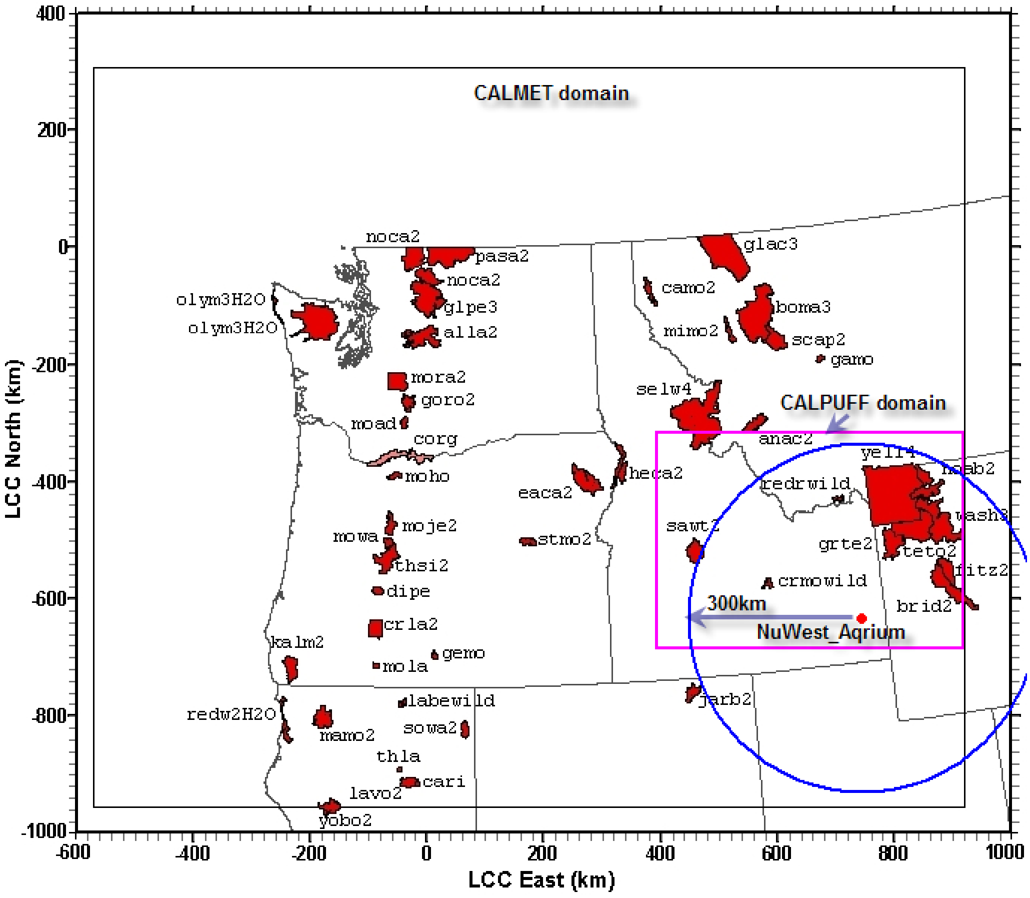

Figure 1. Modeling domain for Nu-West, Agrium, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the East Sulfuric Acid Plant are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 3. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the Nu-West East Sulfuric Acid Plant.

Source Name: ID6, Nu-West East Sulfuric Acid Plant								
Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003-2005)
Sawtooth Wilderness, ID	0.012	0	0.029	0	0.035	0	0.027	0
Red Rock Lakes Wilderness, MT	0.051	0	0.069	0	0.059	0	0.057	0
North Absaroka Wilderness, WY	0.024	0	0.038	0	0.044	0	0.038	0
Craters of the Moon Wilderness, ID	0.048	0	0.056	0	0.08	0	0.073	0
Bridger Wilderness, WY	0.046	0	0.044	0	0.051	0	0.049	0
Fitzpatrick Wilderness	0.032	0	0.022	0	0.038	0	0.032	0
Grand Teton National Park, WY	0.099	0	0.114	0	0.126	0	0.120	0
Teton Wilderness, WY	0.057	0	0.072	0	0.073	0	0.069	0
Washakie Wilderness, WY	0.026	0	0.041	0	0.045	0	0.038	0
Yellowstone National Park, WY	0.062	0	0.102	0	0.11	0	0.101	0

Class I Area of Greatest Impact

The East Sulfuric Acid Plant had the greatest impact on the Grand Teton National Park. Details of the 22 highest calculated changes in deciview for Grand Teton National Park for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the East Sulfuric Acid Plant. Secondary sulfate is the only pollutant that impacts the visibility in Class I areas.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2.

The top 22 delta-deciview values predicted for the Grand Teton Nation Park are plotted in Figure 3.

Table 4. The top 22 highest Delta-deciview values and related modeling output data at Grand Teton National Park.

Rank	YEAR	DAY	DV(Total)	DV(BKG)	DELTA_DV	F(RH)	%_SO4	%_NO3	%_OC	%_EC	%_PMC	%_PMF
1	2004	18	2.454	2.091	0.362	2.62	100	0	0	0	0	0
2	2005	28	2.32	2.091	0.228	2.62	100	0	0	0	0	0
3	2003	11	2.291	2.091	0.199	2.62	100	0	0	0	0	0
4	2004	8	2.285	2.091	0.193	2.62	100	0	0	0	0	0
5	2005	25	2.283	2.091	0.191	2.62	100	0	0	0	0	0
6	2004	22	2.278	2.091	0.187	2.62	100	0	0	0	0	0
7	2005	358	2.259	2.077	0.182	2.55	100	0	0	0	0	0
8	2005	17	2.246	2.091	0.155	2.62	100	0	0	0	0	0
9	2004	323	2.205	2.053	0.153	2.43	100	0	0	0	0	0
10	2003	8	2.243	2.091	0.151	2.62	100	0	0	0	0	0
11	2003	334	2.2	2.053	0.148	2.43	100	0	0	0	0	0
12	2005	23	2.235	2.091	0.144	2.62	100	0	0	0	0	0
13	2003	46	2.188	2.044	0.144	2.39	100	0	0	0	0	0
14	2005	19	2.232	2.091	0.141	2.62	100	0	0	0	0	0
15	2004	15	2.233	2.091	0.141	2.62	100	0	0	0	0	0
16	2005	58	2.178	2.044	0.134	2.39	100	0	0	0	0	0
17	2004	16	2.221	2.091	0.13	2.62	100	0	0	0	0	0
18	2003	350	2.206	2.077	0.129	2.55	100	0	0	0	0	0
19	2005	63	2.14	2.013	0.126	2.24	100	0	0	0	0	0
20	2005	24	2.213	2.091	0.121	2.62	100	0	0	0	0	0
21	2004	10	2.213	2.091	0.121	2.62	100	0	0	0	0	0
22	2003	14	2.212	2.091	0.12	2.62	100	0	0	0	0	0

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

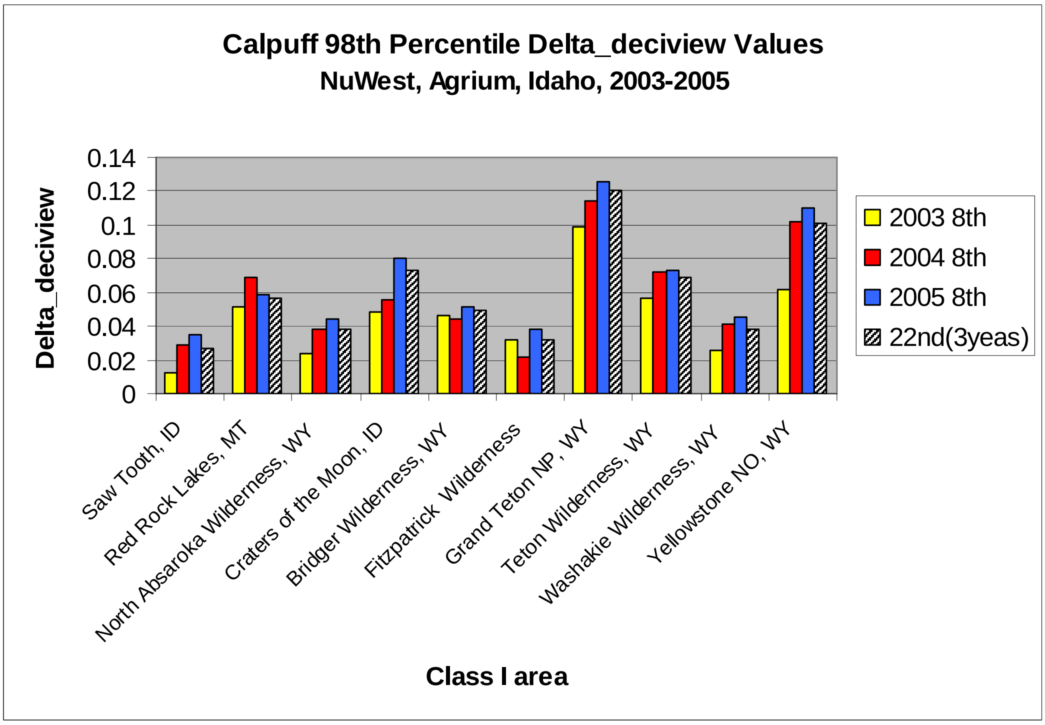

Figure 2. 98th percentile values of Delta-deciview in the Class I areas. Source is Nu-WestEast Sulfuric Acid Plant at Agrium, Idaho.

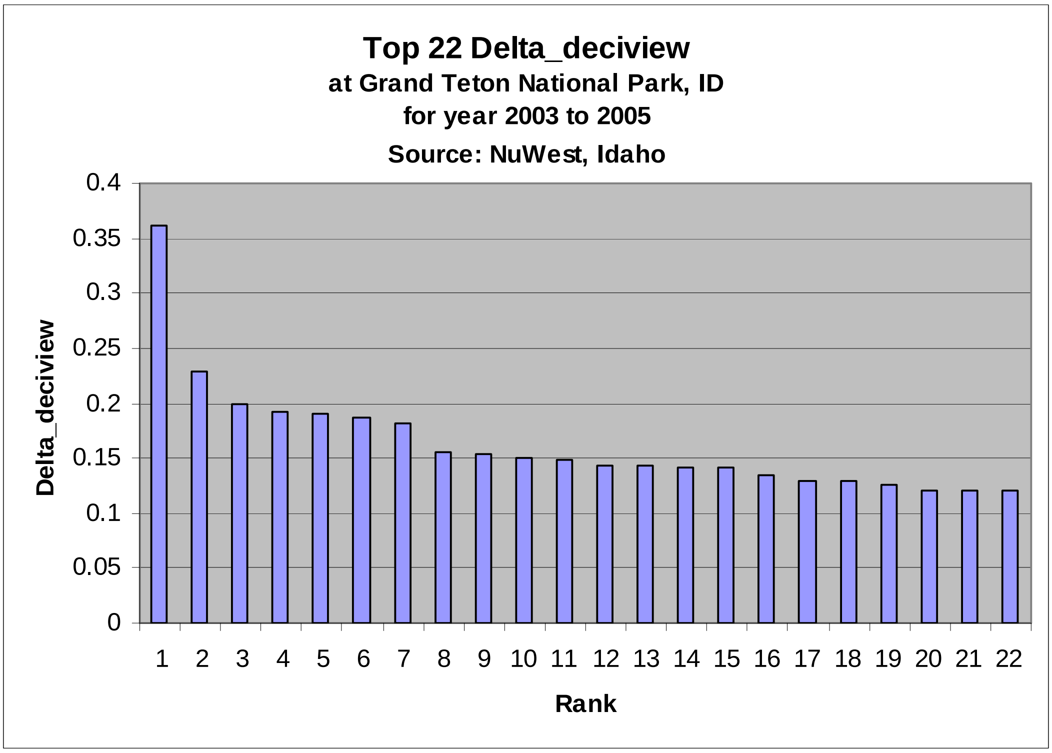

Figure 3. Top 22 highest Delta-deciview values at the Grand Teton National Park. Source is Nu-West East Sulfuric Acid Plant at Agrium, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days. Sulfate is the only pollutant modeled for this facility.

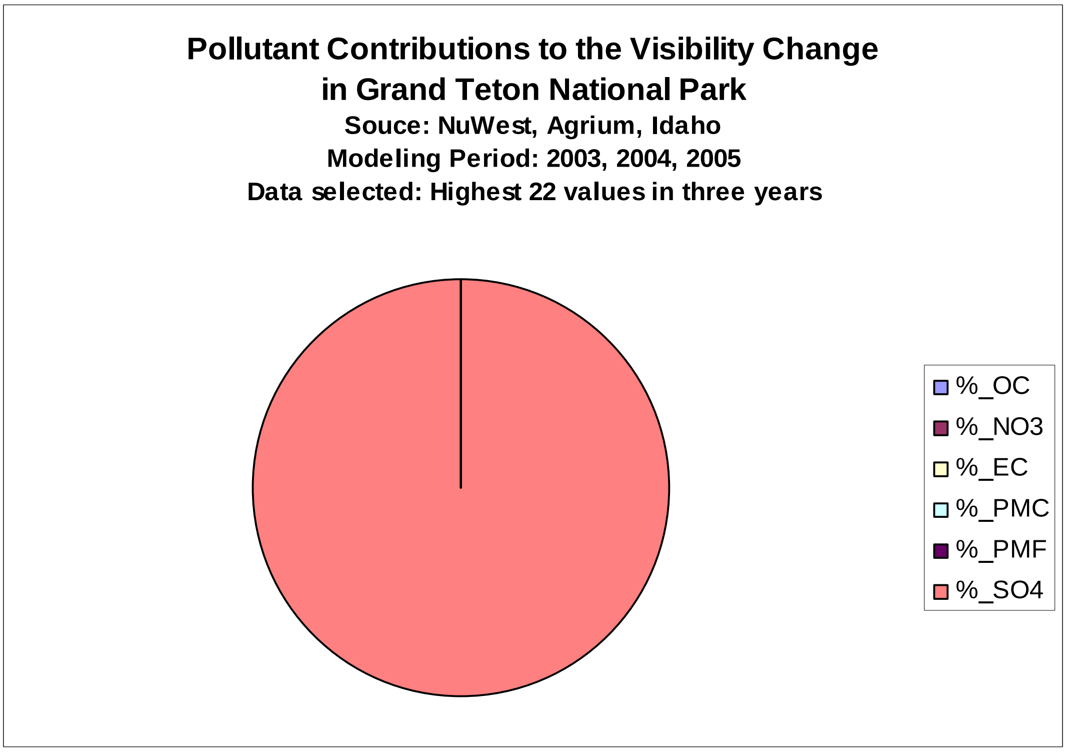

Figure 4. The pollutant contribution from Nu-West-Agrium East Sulfuric Acid Plant to visibility change at the Grand Teton National Park, WY. Secondary sulfate is the only contributor.

Seasonal Variation of Visibility Degradation

The analyses showed that the most significant impact to the visibility occurs in the cold season, between November and February. In the modeling period from year 2003 to 2005, significant seasonal variations are observed for the Nu-West East Sulfuric Acid Plant. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increase, however the effect is minimal in the dry and hot summertime. The degree of the variation depends on the relative location of the source and the Class I areas, and the meteorological conditions as well. The modeling results for Grand Teton (where the highest values were predicted) are shown in Figure 5.

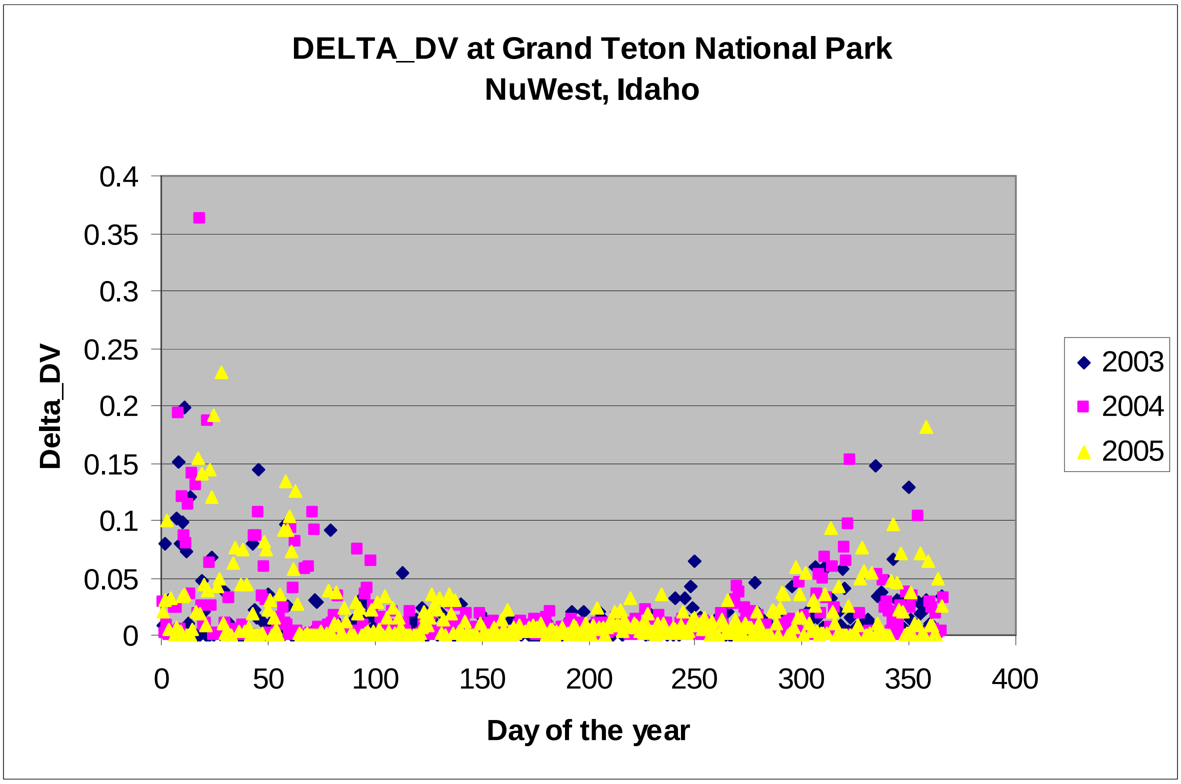

Figure 5. Seasonal impact from Nu-West East Sulfuric Acid Plant at Agrium, ID, to the Grand Teton Nation Park. Higher days are predicted for January 2004.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the stagnation conditions in south Idaho during the episode in January 2004. Under such conditions, pollutants pool up in the valleys and slowly transport to the Class I areas with very little dispersion.

Figure 7 shows a contour map of the number of days of impact higher than or equal to 0.5 deciview in the three-year period. The results show minimal dispersion and transport and the pollutants are limited in a small area due to the geological and meteorological conditions and relatively low emission rate.

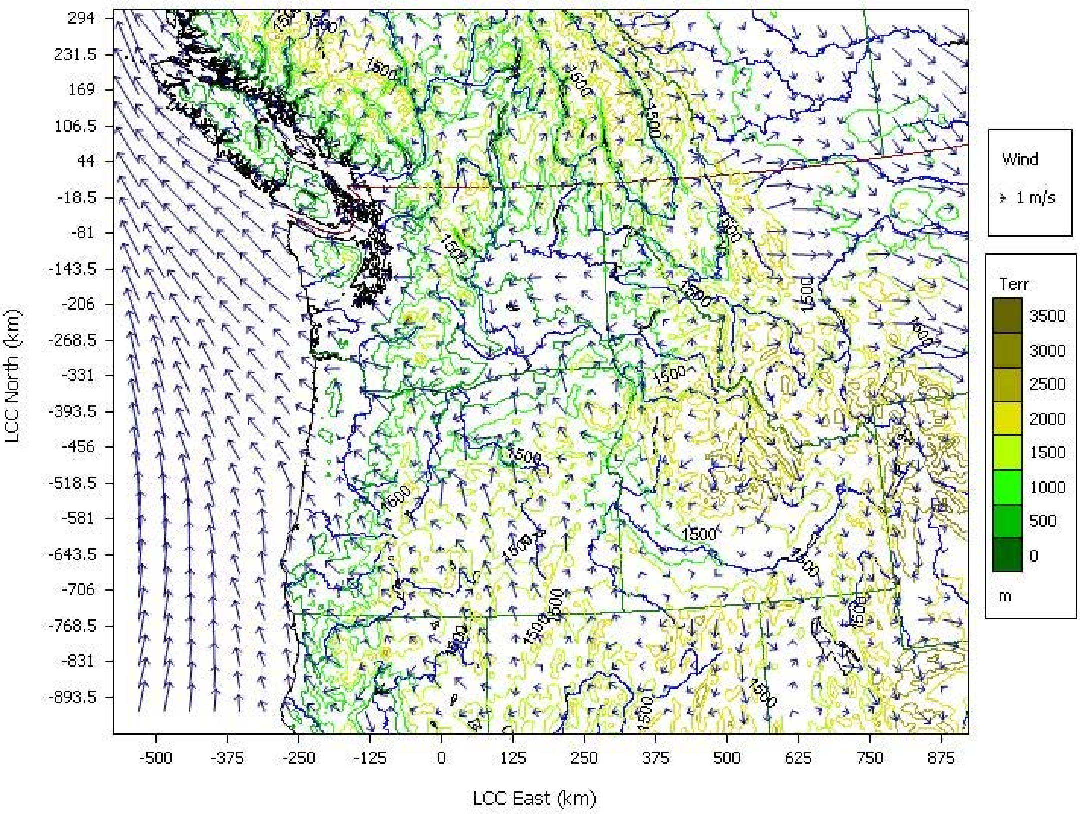

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Grand Teton National Park. A strong stagnation system persisted in the Snake River Valley for more than 2 weeks. However, the pollutants are limited in a small area (see Figure 7) due to the geological conditions.

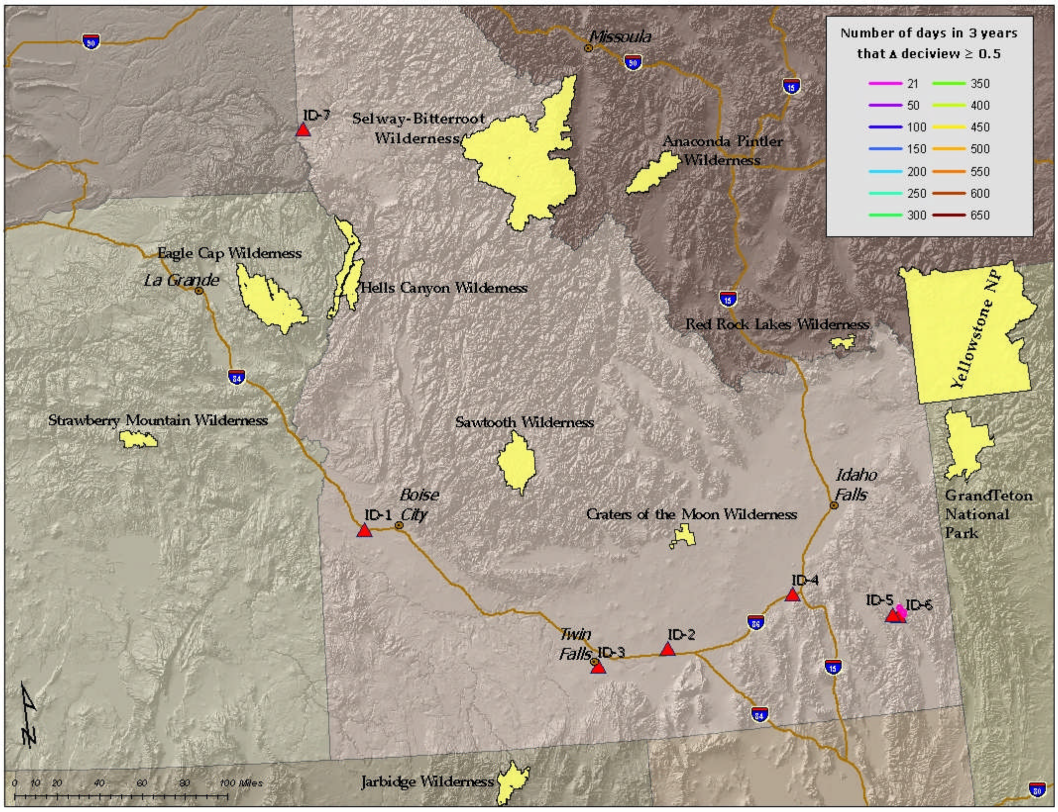

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: Nu-West East Sulfuric Acid Plant at Agrium, Idaho (ID-2). The Grand Teton National Park is the most significantly impacted area by the source because of its location, however, contours do not extend beyond the immediate vicinity of the facility because the impact is so low.

Summary and Conclusions

The CALPUFF model demonstrated that during the period from year 2003 to 2005, the Nu-West **East Sulfuric Acid Plant** Agrium facility, had no impacts to visibility with the 8^{th} annual highest value higher than or equal to 0.5 deciview in any Class I area within a distance of 300 km from the source.

The highest delta-deciview value of 0.362 was predicted in the Grand Teton National Park on January 18, 2004. The 3-year 22^{nd} highest value was 0.12, predicted for January 22, 2003 in the Grand Teton National Park. The 1-year eighth-highest delta-deciview value was 0.126 on March 4, 2005, also in the Grand Teton National Park.

The major contributor is secondary sulfate, SO_4, the pollutant is limited to a small area near the source, and the impact occurs mostly in winter time when a high pressure system persists in the area, and the atmosphere is stagnant with poor dispersion.

The results showed that the Nu-West East Sulfuric Acid Plant Agrium facility is not subject to BART.

Appendix: CALPUFF Modeling Setup for Nu-West, Agrium, Idaho

Scenario Summary

Scenario Information

Scenario Name: wzI60444
Title: ID-6 4km Existing Control version 3; 2004 through 2005 corrected
Scenario Description: ID-6; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID: 1
Number of Species: 9
Species Names: SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory: Y:\airmodel\calpuff\runs\bart\wzI60444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources: 1
Source_Elevation_Option: Model

Source 1

Source Category

Category: Point

Facility Information

Facility ID: ID-6
Facility Name: NuWest (Agrium)

Unit Information

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Unit ID:	220
Unit Description:	East Sulfuric Acid Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	455.658
Northing (km):	4724.52
Base Elevation (m):	1882

Source Location under Domain Projection and Datum

XEasting (km):	745.828
YNorthing (km):	-635.426

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1888.830
bar_12km (m):	1946.845

Stack Parameters

Height (m):	33.5
Diameter (m):	2.3
Exit Temperature (K):	347.6
Exit Velocity (m/s):	11.5

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	258.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	0.00000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	32.50745
SO4 (g/s):	0.00000
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.00000
EC (g/s):	0.00000
SOA (g/s):	0.00000

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	10

ID:	brid2

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Name:	Bridger Wilderness
State:	WY
# Total Receptors:	684
# Receptors In Calmet Domain:	585
Position In Receptor List:	1 - 585
ID:	crmowild
Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	586 - 856
ID:	fitz2
Name:	Fitzpatrick Wilderness
State:	WY
# Total Receptors:	316
# Receptors In Calmet Domain:	316
Position In Receptor List:	857 - 1172
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	1173 - 1678
ID:	noab2
Name:	North Absaroka Wilderness
State:	WY
# Total Receptors:	567
# Receptors In Calmet Domain:	567
Position In Receptor List:	1679 - 2245
ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	2246 - 2467
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2468 - 2820
ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	2821 - 3760
ID:	wash3

Subject-to-bart analysis
For Nu-West East Sulfuric Acid Plant, Agrium, Idaho

Name:	Washakie Wilderness
State:	WY
# Total Receptors:	509
# Receptors In Calmet Domain:	508
Position In Receptor List:	3761 - 4268

ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	4269 - 5183

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	68
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

- The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.
- The source is “subject to BART” if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98^{th} percentile change in *deciviews*—a measure of visibility impairment[3]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[4], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

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[3] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[4] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

BART Eligible Source: Potlatch Pulp and Paper Mill, Lewiston, Idaho

Three units of the Potlatch **Pulp and Paper Mill** in Lewiston, Idaho have been determined to be BART-eligible, as shown in Table 1. The *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants PM_{10}, SO_2 and NO_x, and the source has been put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 5. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Potlatch Pulp & Paper - Lewiston		Facility 3				
	No. 4 Recovery Furnace		1970	40.63	184.0	39.50
	No. 4 Smelt Dissolving Tank		1970	8.28	0.14	0.85
	Lime Kiln 4		1976	5.20	3.42	25.80

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* ($PM_{2.5}$), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF).

Source Classification Codes, unit identifiers, and PMC and $PM_{2.5}$ fractions are taken from the 2005 National Emission Inventory submittal from Facilities, $PM_{2.5}$ speciation was taken from SMOKE2.1 for SAPRC99.

Detailed, speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 6. Facility information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-7	ID-7	ID-7
	Facility_Name	Potlatch Pulp and Paper	Potlatch Pulp and Paper	Potlatch Pulp and Paper
Unit Information	Unit_ID	189	157	512
	Unit Description	No. 4 Recovery Furnace (Boiler)	No. 4 Smelt Dissolving Tank	Lime Kiln #4
Control Information	Control ID	41	41	41
	Control Description	Existing Control - Ver. 3	Existing Control - Ver. 3	Existing Control - Ver. 3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27	NAD27	NAD27
	Projection	UTM	UTM	UTM
	UTM Zone	11	11	11
	Longitude Easting (km)	502.063	502.079	502.172
	Latitude Northing (km)	5141.662	5141.661	5141.572
	Base Elevation (m)	238	238	238
Stack Parameter	Stack Height m)	99.1	65.5	46.8
	Stack Diameter (m)	2.7	0.9	1.13
	Stack_Exit Temperature (K)	449.8	344.3	463.7
	Stack_Exit Velocity (m/s)	13.1	14.3	24.1
Emission Rate (lb/hr)	SO_2	184	0.143	3.42
	SO_4[a]	11.27	2.89142	2.07433
	NO_X[a]	39.5	0.85	25.8
	HNO_3	0	0	0
	NO_3	0.07668	0.01966596	0.01411
	PMC	12.36777	1.031688	0
	PMF[b]	10.4542	2.681151	1.92348
	EC	0.432412	0.110899	0.07956
	SOA	1.774868	0.455194	0.32656

a. It is assumed that all Sulfate is ammonium sulfate, and all nitrate is ammonium nitrate. Ammonium Sulfate = 1.375 x SO4, and Ammonium Nitrate = 1.29 X NO3.
b. PMF is the fine particulate matter other than SO4, NO3, EC and SOA

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

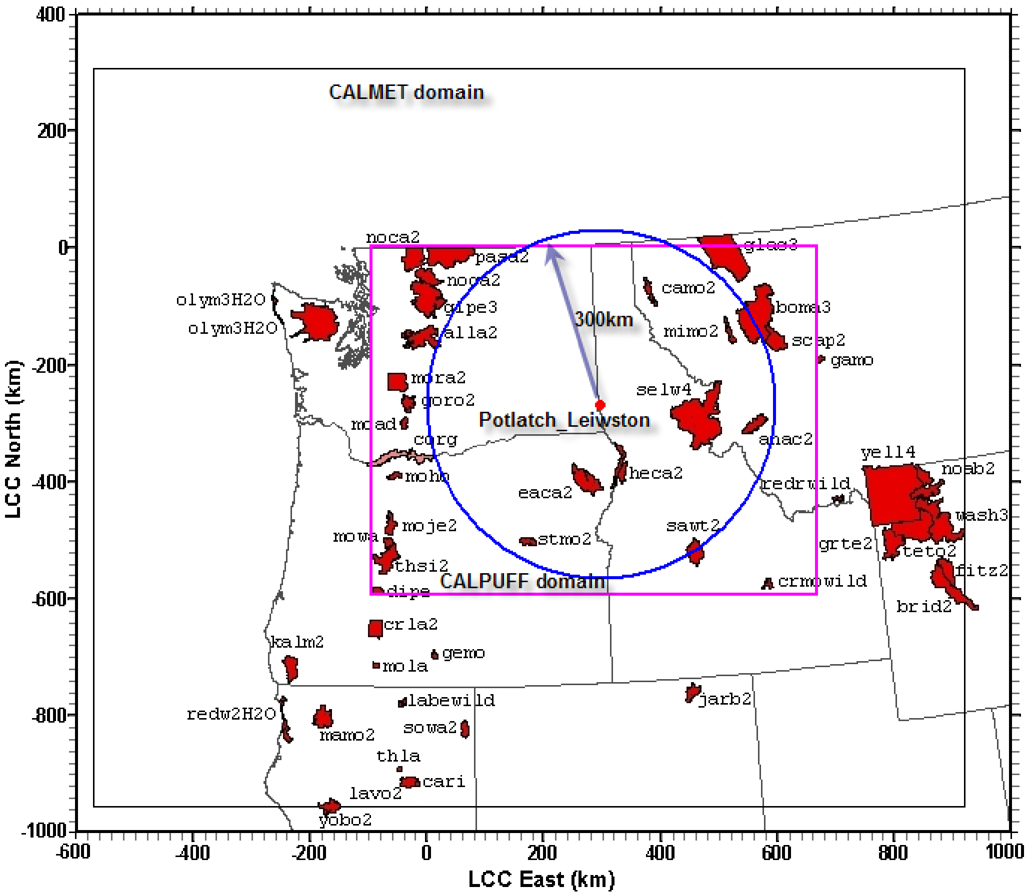

Figure 6. Modeling domain for the Potlatch Pulp Mill No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho
The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Source Name: ID7 Potlatch, ID								
Class I Area	**Change in Visibility Compared Against 20% Best Days Natural Background Conditions**							
	Delta-Deciview Value larger than 0.5 from one year period						**Delta-Deciview Value larger than 0.5 from 3 year period**	
	2003		**2004**		**2005**		**2003-2005**	
	8th highest	**Total days**	**8th highest**	**Total days**	**8th highest**	**Total days**	**22nd Highest**	**Number of Days**
Alpine Lakes Wilderness, WA	0.115	0	0.176	0	0.166	0	0.159	0
Anaconda-Pintler Wilderness, WY	0.058	0	0.057	0	0.051	0	0.057	0
Bob Marshall Wilderness, MT	0.056	0	0.065	0	0.049	0	0.057	0
Cabinet Mountains Wilderness, MT	0.101	0	0.137	0	0.1	0	0.109	0
Eagle Cap, OR	0.14	0	0.17	1	0.209	0	0.171	1
Hells Canyon, ID	0.31	2	0.323	5	0.213	1	0.292	8
Mission Mountain Wilderness, MT	0.08	0	0.08	0	0.056	0	0.078	0
Saw Tooth, ID	0.023	0	0.033	0	0.028	0	0.028	0
Scapegoat Wilderness, MT	0.036	0	0.056	0	0.039	0	0.044	0
Seway-Bitteroot, ID	0.196	0	0.224	1	0.173	1	0.207	2
Strawberry Mountain, OR	0.064	0	0.055	0	0.1	0	0.07	0

Table 7. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho.

Class I Area of Greatest Impact

The Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** had the greatest impact on the Hells Canyon Wilderness. Details of the 22 highest calculated changes in deciview for Hells Canyon Wilderness for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Secondary aerosols of sulfate and nitrate formed from SO_2 and NO_2 emissions are the dominating pollutants impacting the visibility in Class I areas.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 7. The top 22 delta-deciview values predicted for the Hells Canyon Wilderness area are plotted in Figure 8. Greater variation was predicted for Hells Canyon area, but less in the other areas.

Table 8. The top 22 highest Delta-deciview values and related modeling output data at Hells Canyon Wilderness.

22 highest values at the Hells Canyon Wilderness area by source: Potlatch, ID											
Rank	**YEAR**	**DV(Total)**	**DV(BKG)**	**DELTA_DV**	**F(RH)**	**%_SO_4**	**%_NO_3**	**%_OC**	**%_EC**	**%_PMC**	**%_PMF**
1	2004	3.314	2.373	0.94	3.45	70.96	26.59	0.71	0.43	0.27	1.04
2	2004	3.149	2.373	0.775	3.45	75.7	22.1	0.65	0.39	0.2	0.95
3	2004	3.145	2.373	0.772	3.45	66.32	30.43	0.92	0.56	0.41	1.36
4	2004	2.927	2.305	0.623	3.12	67.86	26.7	1.41	0.86	1.1	2.08
5	2005	2.981	2.425	0.556	3.7	64.19	32.07	1.04	0.63	0.54	1.53
6	2003	2.706	2.155	0.552	2.41	72.74	20.49	1.81	1.1	1.18	2.67
7	2004	2.888	2.373	0.514	3.45	62.05	34.46	1.03	0.63	0.32	1.51
8	2003	2.811	2.305	0.506	3.12	62.35	33.86	1.04	0.63	0.59	1.53
9	2003	2.795	2.305	0.49	3.12	66.51	29.58	1.1	0.67	0.53	1.61
10	2004	2.555	2.103	0.451	2.17	56.38	33.48	2.61	1.59	2.09	3.85
11	2003	2.481	2.103	0.377	2.17	62.56	29.35	2.23	1.36	1.23	3.28
12	2004	2.502	2.155	0.348	2.41	61.52	32.45	1.68	1.02	0.86	2.47
13	2003	2.407	2.067	0.34	2	62.5	27.15	2.77	1.69	1.81	4.08
14	2004	2.39	2.067	0.323	2	73.51	17.1	2.56	1.56	1.49	3.78
15	2004	2.476	2.155	0.321	2.41	62.55	31.63	1.64	1	0.77	2.41
16	2004	2.419	2.103	0.316	2.17	64.14	28.42	2.02	1.23	1.2	2.98
17	2003	2.417	2.103	0.313	2.17	70.66	24	1.46	0.89	0.85	2.15
18	2003	2.298	1.987	0.311	1.63	72.39	16.71	2.94	1.79	1.84	4.33
19	2003	2.377	2.067	0.31	2	64.65	26.02	2.49	1.52	1.66	3.67
20	2005	2.327	2.022	0.305	1.79	68.45	24.04	2.13	1.3	0.94	3.14
21	2004	2.396	2.103	0.292	2.17	65.61	28.02	1.71	1.04	1.09	2.53
22	2003	2.467	2.176	0.292	2.51	62.47	31.44	1.66	1.01	0.98	2.44

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

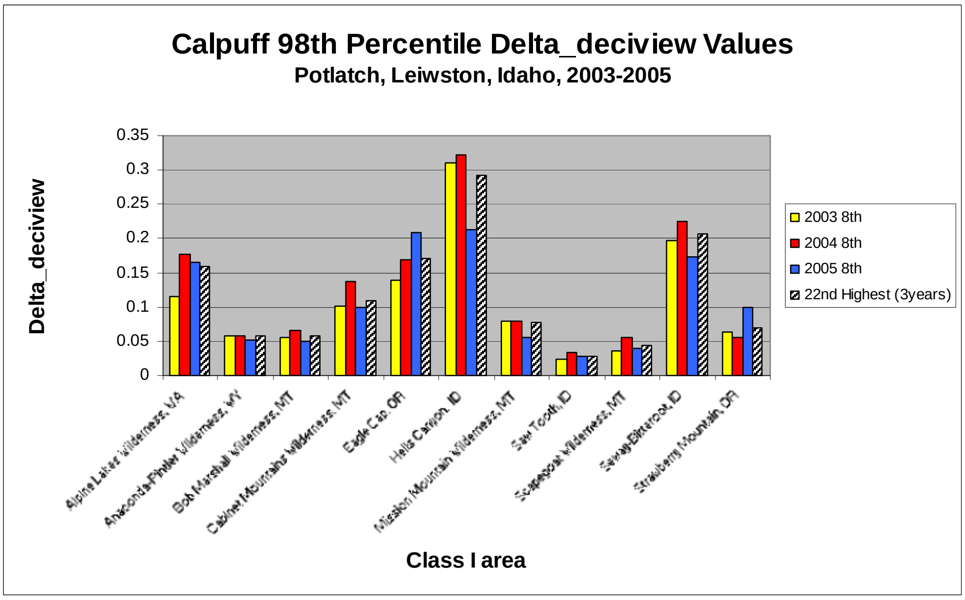

Figure 7. 98th percentile values of Delta-deciview in the Class I areas. Sources are Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho.

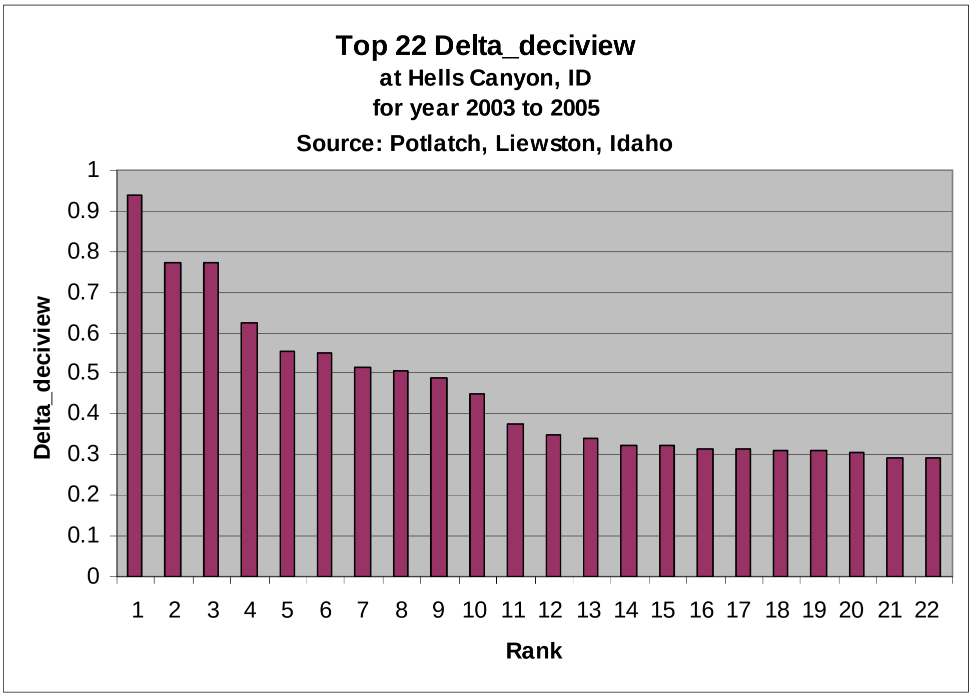

Figure 8. Top 22 highest Delta-deciview values at the Hells Canyon Wilderness area. Sources are Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

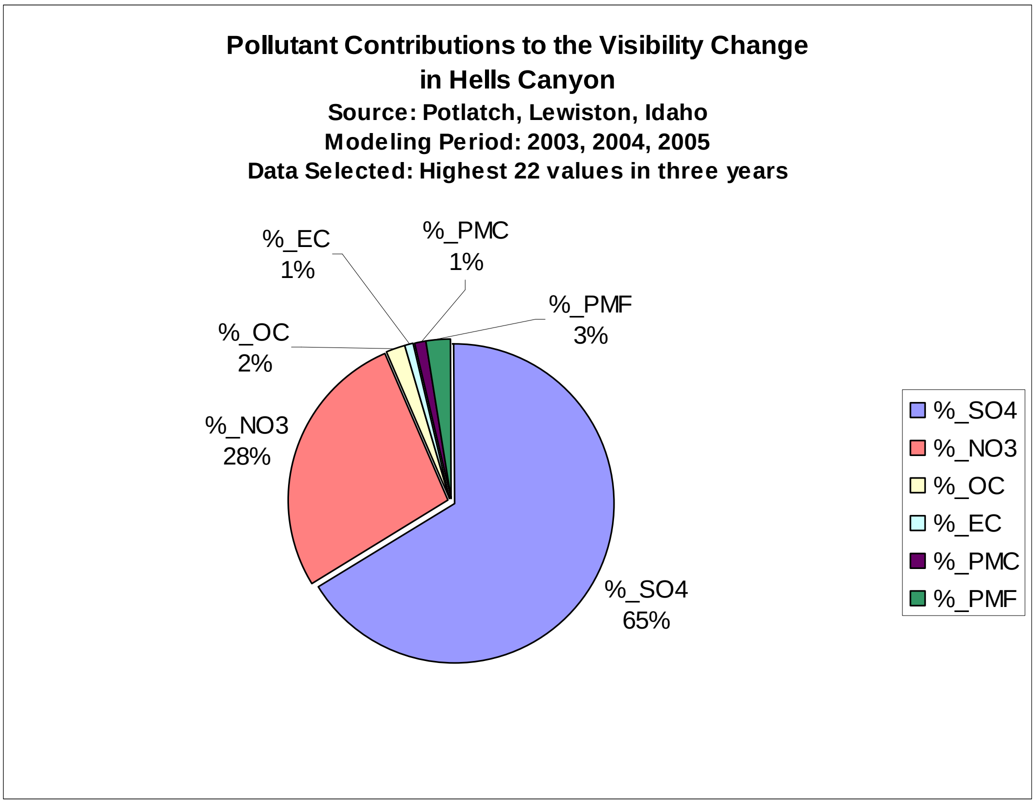

Figure 9. The pollutant contribution from Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 to visibility change at the Hells Canyon Wilderness area, Idaho.

Seasonal Variation of Visibility Degradation

The analyses showed that the higher impact to the visibility occurs in the cold season, as shown in Figure 5, however, the variation is less significant compared to the sources in the other areas modeled by DEQ. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increase, however the effect is minimal in the dry and hot summertime. The degree of the variation depends on the relative location of the source and the Class I areas, and the meteorological conditions as well.

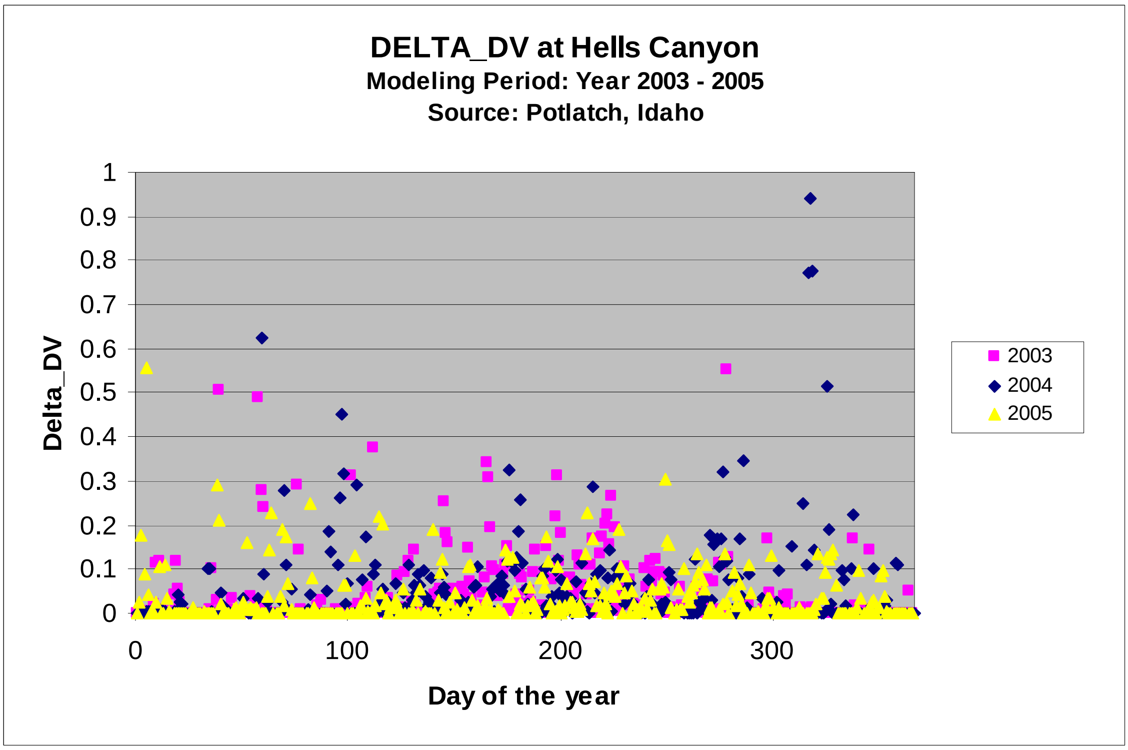

Figure 10. Seasonal impact from Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 to the Hells Canyon Wilderness area, Idaho. Higher days are predicted in colder seasons.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valley and slowly transport to the Class I areas with very little dispersion. Figure 7 is the contour map of the number of days of impact higher than or equal to 0.5 deciview in the three year period, clearly showing the effects of the terrain.

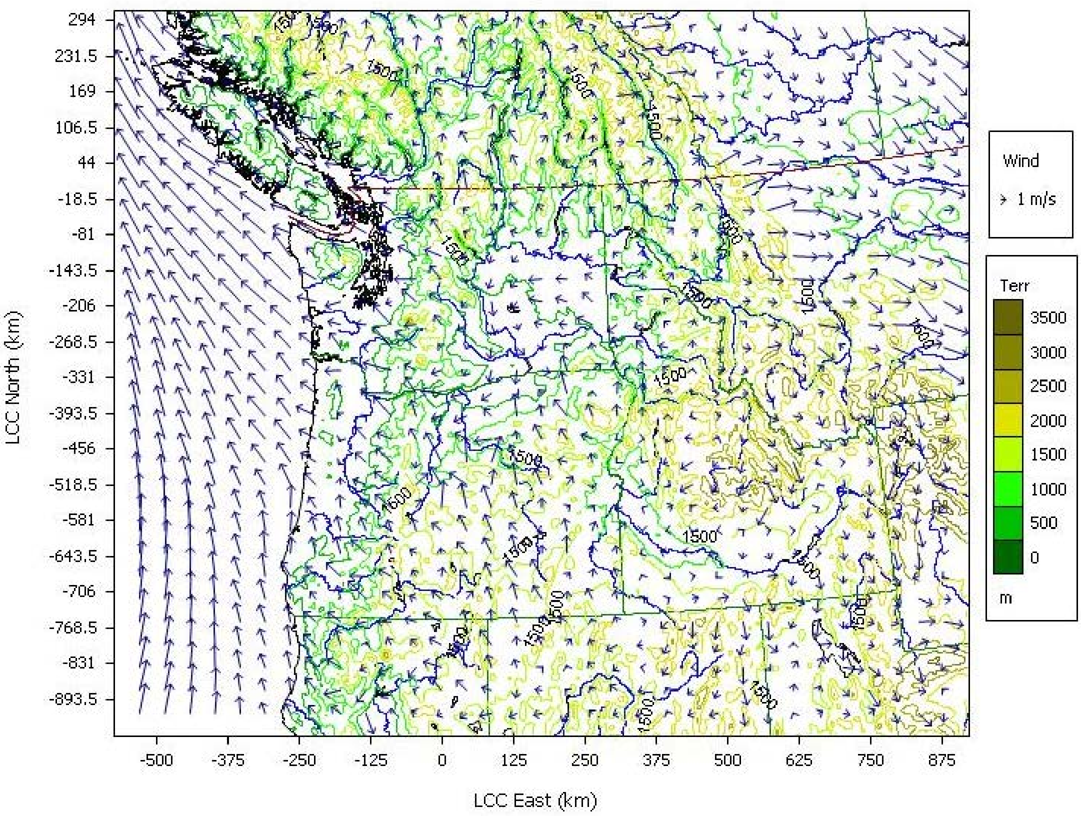

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Hells Canyon. A strong stagnation system persisted in the area for more than 2 weeks. The pollutants were elevated near the sources, slowly dispersed and transported to the Class I areas.

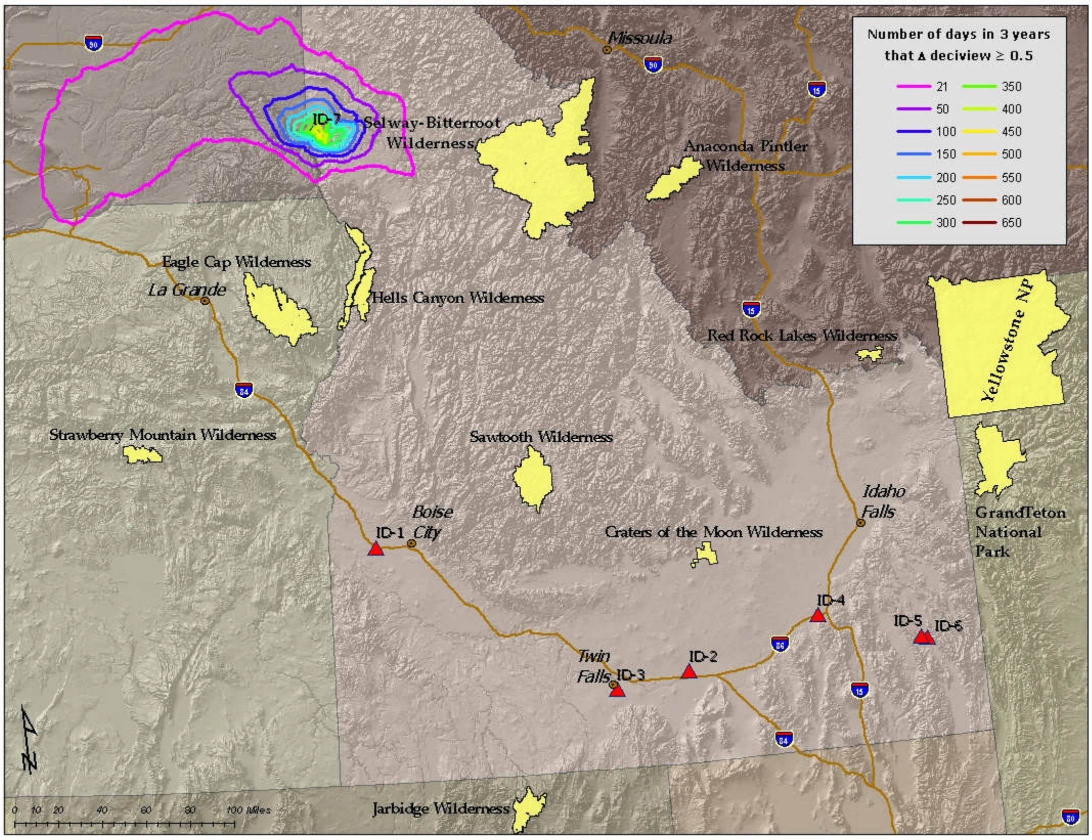

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4 at Lewiston, Idaho (ID-2). The pattern of dispersion strongly indicates the effects of the terrain. The Hells Canyon Wilderness area is the nearest and most impacted by the source because of its location (Table 3).

Summary and Conclusions

The CALPUFF model predicted no impact during 2003 to 2005 from the Potlatch **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** at Lewiston, Idaho, to visibility with the 8^{th} annual highest value or the 22^{nd} 3-year highest value higher than or equal to 0.5 deciview in any Class I area within the 300 km from the facility.

Hells Canyon Wilderness had the highest delta-deciview value (0.94), and the highest number of days of visibility degradation (8 days, 2003-2005). The eighth-highest delta-deciview value was 0.323.

The major contributors are SO_2 and NO_x, precursors of sulfate and nitrate aerosols formed in wintertime under the conditions of low temperatures and high relative humidity. The impact occurs mostly in wintertime when a high-pressure system persists in the area for a long period (3-4 days or more), the atmosphere is stagnant with poor dispersion, and the pollutants may be transported to the certain Class I areas relatively undiluted.

The results have demonstrated that the Potlatch facility with units of **No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4** is not subject to BART.

Appendix: CALPUFF Modeling Setup for Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Scenario Summary

Scenario Information
Scenario Name: wzI70444
Title: ID-7 4km Existing Control version 3; 2004 through 2005 corrected
Scenario Description: ID-7; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information
Species Group ID: 1
Number of Species: 9
Species Names: SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory
Working Directory: Y:\airmodel\calpuff\runs\bart\wzI70444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources
Number of Sources: 3
Source_Elevation_Option: Model

Source 1

Source Category
Category: Point

Facility Information
Facility ID: ID-7
Facility Name: Potlatch Pulp and Paper

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Unit Information

Unit ID:	157
Unit Description:	No. 4Smelt Dissolving Tank

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.079
Northing (km):	5141.661
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.806
YNorthing (km):	-268.584

Model Source Base Elevation In Calmet Domain

bar_4km (m):	360.164
bar_12km (m):	470.846

Stack Parameters

Height (m):	65.5
Diameter (m):	0.9
Exit Temperature (K):	344.3
Exit Velocity (m/s):	14.3

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.14300
SO4 (lb/hr):	2.89142
NOX (lb/hr):	0.85000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.01967
PMC (lb/hr):	1.03169
PMF (lb/hr):	2.68115
EC (lb/hr):	0.11090
SOA (lb/hr):	0.45519

Emission Rate (Unit: g/s)

SO2 (g/s):	0.01802
SO4 (g/s):	0.36431
NOX (g/s):	0.10710
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00248
PMC (g/s):	0.12999
PMF (g/s):	0.33782
EC (g/s):	0.01397
SOA (g/s):	0.05735

Source 2

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

Source Category

Category:	Point

Facility Information

Facility ID:	ID-7
Facility Name:	Potlatch Pulp and Paper

Unit Information

Unit ID:	189
Unit Description:	No. 4 Recovery Furnace (Boiler)

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.063
Northing (km):	5141.662
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.790
YNorthing (km):	-268.584

Model Source Base Elevation In Calmet Domain

bar_4km (m):	360.198
bar_12km (m):	470.828

Stack Parameters

Height (m):	99.1
Diameter (m):	2.7
Exit Temperature (K):	449.8
Exit Velocity (m/s):	13.1

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	184.00000
SO4 (lb/hr):	11.27406
NOX (lb/hr):	39.50000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.07668
PMC (lb/hr):	12.36777
PMF (lb/hr):	10.45420
EC (lb/hr):	0.43241
SOA (lb/hr):	1.77487

Emission Rate (Unit: g/s)

SO2 (g/s):	23.18361
SO4 (g/s):	1.42051
NOX (g/s):	4.97692
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00966
PMC (g/s):	1.55831

PMF (g/s):	1.31721
EC (g/s):	0.05448
SOA (g/s):	0.22363

Source 3

Source Category

Category:	Point

Facility Information

Facility ID:	ID-7
Facility Name:	Potlatch Pulp and Paper

Unit Information

Unit ID:	512
Unit Description:	Lime Kiln #4

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	502.172
Northing (km):	5141.572
Base Elevation (m):	238

Source Location under Domain Projection and Datum

XEasting (km):	297.900
YNorthing (km):	-268.666

Model Source Base Elevation In Calmet Domain

bar_4km (m):	357.075
bar_12km (m):	468.407

Stack Parameters

Height (m):	46.8
Diameter (m):	1.13
Exit Temperature (K):	463.7
Exit Velocity (m/s):	24.1

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	3.42000
SO4 (lb/hr):	2.07433
NOX (lb/hr):	25.80000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.01411
PMC (lb/hr):	0.00000
PMF (lb/hr):	1.92348
EC (lb/hr):	0.07956
SOA (lb/hr):	0.32656

Emission Rate (Unit: g/s)

Subject-to-bart analysis
For Potlatch No. 4 Recovery Furnace, No. 4 Smelt Dissolving Tank, and Lime Kiln 4, Lewiston, Idaho

SO2 (g/s):	0.43091
SO4 (g/s):	0.26136
NOX (g/s):	3.25075
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00178
PMC (g/s):	0.00000
PMF (g/s):	0.24235
EC (g/s):	0.01002
SOA (g/s):	0.04115

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	11

ID:	alla2
Name:	Alpine Lakes Wilderness
State:	WA
# Total Receptors:	693
# Receptors In Calmet Domain:	693
Position In Receptor List:	1 - 693

ID:	anac2
Name:	Anaconda-Pintler Wilderness
State:	MT
# Total Receptors:	267
# Receptors In Calmet Domain:	267
Position In Receptor List:	694 - 960

ID:	boma3
Name:	Bob Marshall Wilderness
State:	MT
# Total Receptors:	788
# Receptors In Calmet Domain:	788
Position In Receptor List:	961 - 1748

ID:	camo2
Name:	Cabinet Mountains Wilderness
State:	MT
# Total Receptors:	167
# Receptors In Calmet Domain:	167
Position In Receptor List:	1749 - 1915

ID:	eaca2
Name:	Eagle Cap Wilderness
State:	OR
# Total Receptors:	596
# Receptors In Calmet Domain:	596
Position In Receptor List:	1916 - 2511

ID:	heca2
Name:	Hells Canyon Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2512 - 2864

ID:	mimo2
Name:	Mission Mountain Wilderness
State:	MT
# Total Receptors:	130
# Receptors In Calmet Domain:	130
Position In Receptor List:	2865 - 2994

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2995 - 3347

ID:	scap2
Name:	Scapegoat Wilderness
State:	MT
# Total Receptors:	423
# Receptors In Calmet Domain:	423
Position In Receptor List:	3348 - 3770

ID:	selw4
Name:	Selway-Bitterroot Wilderness
State:	ID
# Total Receptors:	575
# Receptors In Calmet Domain:	575
Position In Receptor List:	3771 - 4345

ID:	stmo2
Name:	Strawberry Mountain Wilderness
State:	OR
# Total Receptors:	114
# Receptors In Calmet Domain:	114
Position In Receptor List:	4346 - 4459

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	120
Ending Column:	310
Beginning Row:	91
Ending Row	240

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the J.R. Simplot Siding Plant, Pocatello, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is “subject to BART” if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[5]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[6], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[5] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[6] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: J.R. Simplot Siding Plant, Pocatello, Idaho

Five units of the **J.R. Simplot Siding Plant** in Pocatello, Idaho have been determined to be BART-eligible, as shown in Table 9.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 9. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Five units of the **J.R. Simplot Siding Plant** in Pocatello, Idaho have been determined to be BART-eligible (Table 1). The *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants PM_{10} and NO_x, and the source was put in service between August 7, 1962 and August 7, 1977, so the source is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Table 9. Emissions rates used for BART modeling.

Facility	Emission Unit	BART Category	Year Installed	Maximum 24-hour emission rate (lb/hr)		
				PM_{10}	SO_2	NO_x
Simplot – Don Siding Facility		Facility 13				
	Granulation No. 2 plant, ID240		1964	14.1		
	East Reclaim Cooling Tower, ID372		1966	91.6		
	West Reclaim Cooling Tower, ID371		1976	86.6		
	Ammonium sulfate plant, ID1		1964	2.7		
	Ammonia Plant, ID2					60

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$), ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Source classification codes, unit identifiers and PMC and PM2.5 fractions are taken from the 2005 National Emission Inventory submitted from Facilities; PM2.5 speciation is taken from SMOKE2.1 for SAPRC99.

PM size fractions used are as follows: Fine : mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed, speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 10. Facility information, stack parameters, and speciation of emissions.

	Facility_ID	**ID-4**	**ID-4**	**ID-4**	**ID-4**	**ID-4**
Facility Information	Facility_Name	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant	J.R. Simplot Don Siding Plant
Unit Information	Unit_ID	240	372	371	1	2
	Unit Description	Granulation 2	East Reclaim Cooling Towers	West Reclaim Cooling Towers	Ammonium Sulfate Plant	Ammonia Plant
Control Information	Control_ID	41	41	41	41	41
	Control Description	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3	Existing Control - Ver.3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27	NAD27	NAD27	NAD27	NAD27
	Projection	UTM	UTM	UTM	UTM	UTM
	UTM_Zone	12	12	12	12	12
	Longitude Easting (km)	375.401	375.789	375.789	375.422	375.493
	Latitude Northing (km)	4751.567	4751.509	4751.509	4751.62	4751.477
	Base_Elevation (m)	1355	1355	1355	1355	1355
Stack Parameter	Stack_Height (m)	45.7	10.7	11.6	23.2	18.3
	Stack_Diameter (m)	1.8	10.7	10.7	0.5	1.2
	Stack_Exit_ Temperature (K)	310.9	297	297	311	505
	Stack_Exit_ Velocity (m/s)	12.7	11.9	11.9	14.9	20
Emission Rate (lb/hr)	SO_2	0	0	0	0	0
	SO_4 [a]	0.53	3.76	3.55	0	0
	NO_X	0	0	0	0	60
	HNO_3	0	0	0	0	0
	NO_3	0.047	0.63	0.60	0	0
	PMC	0	0	0	0	0
	PMF[b]	11.38	73.77	69.81	2.7	0
	EC	0.66	1.50	1.42	0	0
	SOA	1.3	10.31	9.76	0	0

a. All of sulfate particulates are assumed to be ammonium sulfate,
(NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate
(NH4)NO3 = 1.29*NO3 (Mass)
b. Fine particulate particles (<2.5µm) other than SO4, NO3, EC and SOA. (PMF includes condensable particulate matters)

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 11:

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

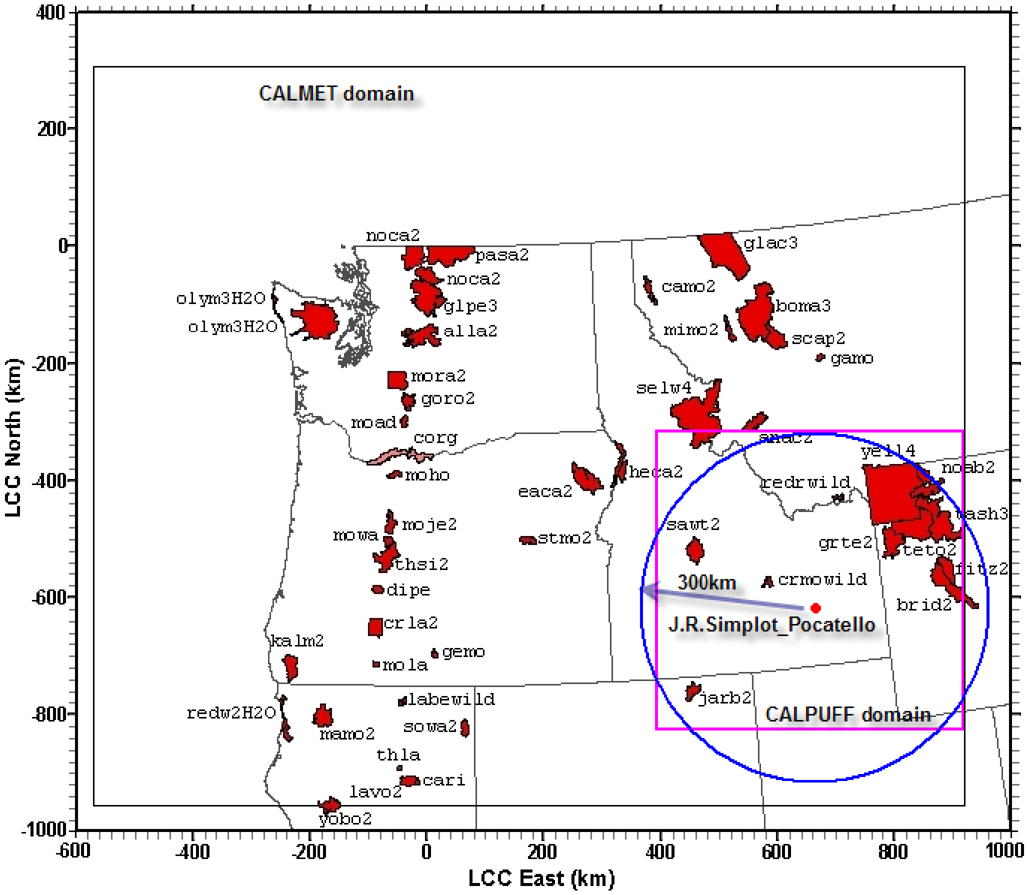

Figure 11. Modeling domain for J.R. Simplot Siding Plant, Pocatello, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the **J.R. Simplot Siding Plant**, Pocatello are shown in Table 3, which highlights the two threshold values for BART:

- 8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change
- 22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 11. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the J.R. Simplot Pocatello facility, Idaho.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days
Bridger Wilderness, WY	0.048	0	0.033	0	0.041	0	0.041	0
Craters of the Moon, ID	0.237	0	0.376	4	0.244	0	0.278	4
Fitzpatrick Wilderness	0.036	0	0.027	0	0.03	0	0.031	0
Grand Teton NP, WY	0.121	0	0.084	0	0.101	0	0.105	0
Jarbidge Winderness, NV	0.026	0	0.015	0	0.039	0	0.028	0
North Absaroka Wilderness, WY	0.035	0	0.025	0	0.034	0	0.033	0
Red Rock Lakes, MT	0.11	0	0.11	0	0.107	0	0.11	0
Sawtooth, ID	0.024	0	0.038	0	0.039	0	0.038	0
Teton Wilderness, WY	0.06	0	0.055	0	0.063	0	0.06	0
Washakie Wilderness, WY	0.038	0	0.031	0	0.038	0	0.037	0
Yellowstone NP, WY	0.117	0	0.106	0	0.139	0	0.116	0

Class I Area of Greatest Impact

The units had the greatest impact on the Craters of the Moon. Details of the 22 highest calculated changes in deciview for Craters of the Moon for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year in the Craters of the Moon areas, but less in the other class I areas.

The top 22 delta-deciview values predicted for the Craters of the Moon are plotted in Figure 3

Table 12. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon.

22nd Highest values at Grand Teton National Park by J.R. Simplot at Pocatello, ID											
Rank	YEAR	DV (Total)	DV (BKG)	DELTA DV	F(RH)	% SO_4	% NO_3	% OC	% EC	% PMC	% PMF
1	2004	2.995	2.208	0.787	3.13	14.59	44.98	12.3	5.28	0	22.84
2	2004	2.851	2.19	0.661	3.04	11.57	55.07	10.01	4.58	0	18.77
3	2004	2.834	2.19	0.644	3.04	12.62	51.18	10.93	4.85	0	20.42
4	2004	2.79	2.19	0.6	3.04	14.09	45.84	12.23	5.26	0	22.59
5	2005	2.699	2.208	0.491	3.13	18.07	32.51	15.29	6.16	0	27.97
6	2005	2.677	2.208	0.469	3.13	18.94	29.44	16.04	6.37	0	29.21
7	2004	2.635	2.19	0.445	3.04	17.88	31.76	15.55	6.41	0	28.4
8	2004	2.604	2.19	0.414	3.04	16.4	37.06	14.26	5.98	0	26.3
9	2004	2.62	2.208	0.412	3.13	15.4	42.15	13	5.49	0	23.96
10	2005	2.577	2.19	0.387	3.04	23.85	10.12	20.87	7.72	0	37.44
11	2003	2.592	2.208	0.383	3.13	5.8	76.73	4.77	2.94	0	9.76
12	2005	2.59	2.208	0.382	3.13	10.89	58.35	9.13	4.31	0	17.32
13	2004	2.584	2.208	0.376	3.13	18.44	30.97	15.58	6.41	0	28.6
14	2005	2.579	2.208	0.371	3.13	17.82	33.32	15.06	6.2	0	27.61
15	2005	2.504	2.135	0.369	2.77	13.7	43.44	13.05	5.63	0	24.18
16	2004	2.497	2.135	0.362	2.77	12.37	48.54	11.75	5.3	0	22.04
17	2004	2.566	2.208	0.358	3.13	15.71	40.97	13.26	5.6	0	24.47
18	2004	2.479	2.135	0.344	2.77	14.48	40.42	13.81	5.86	0	25.42
19	2004	2.552	2.208	0.343	3.13	22.73	15.82	19.29	7.35	0	34.81
20	2004	2.336	2.035	0.301	2.28	14.56	30.29	16.87	7.11	0	31.17
21	2003	2.475	2.19	0.285	3.04	16.68	35.92	14.49	6.16	0	26.75
22	2004	2.487	2.208	0.278	3.13	8.23	67.7	6.85	3.63	0	13.59

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

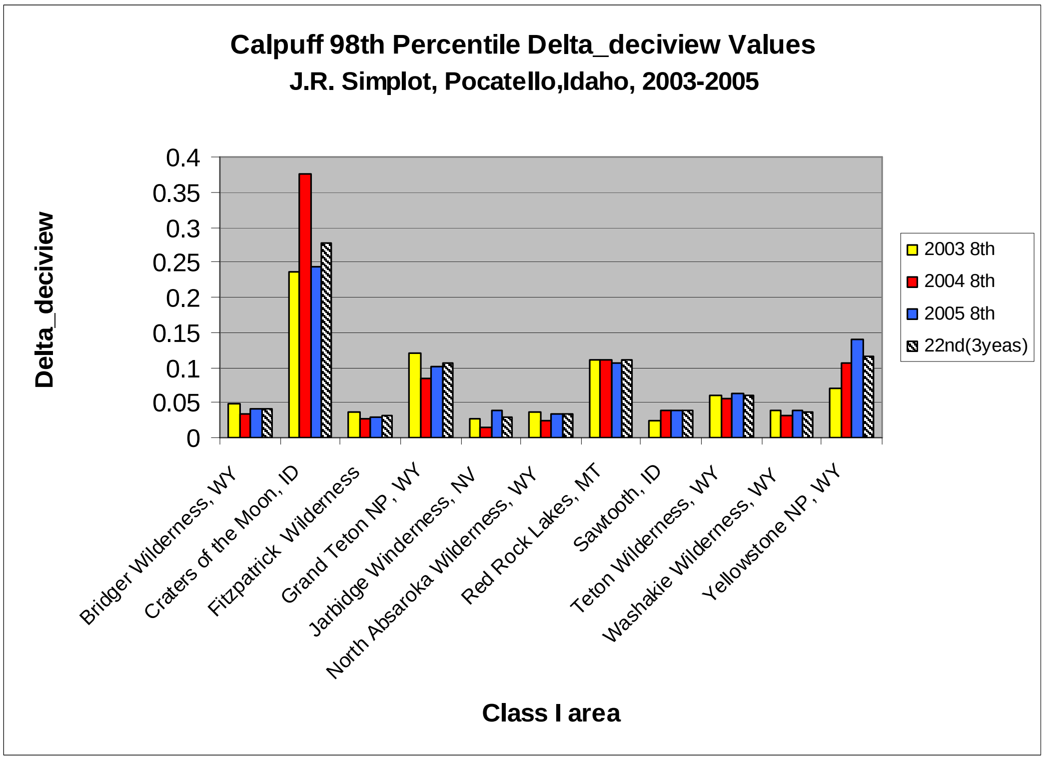

Figure 12. 98th percentile values of delta-deciview in Class I areas for J.R. Simplot, Pocatello, Idaho.

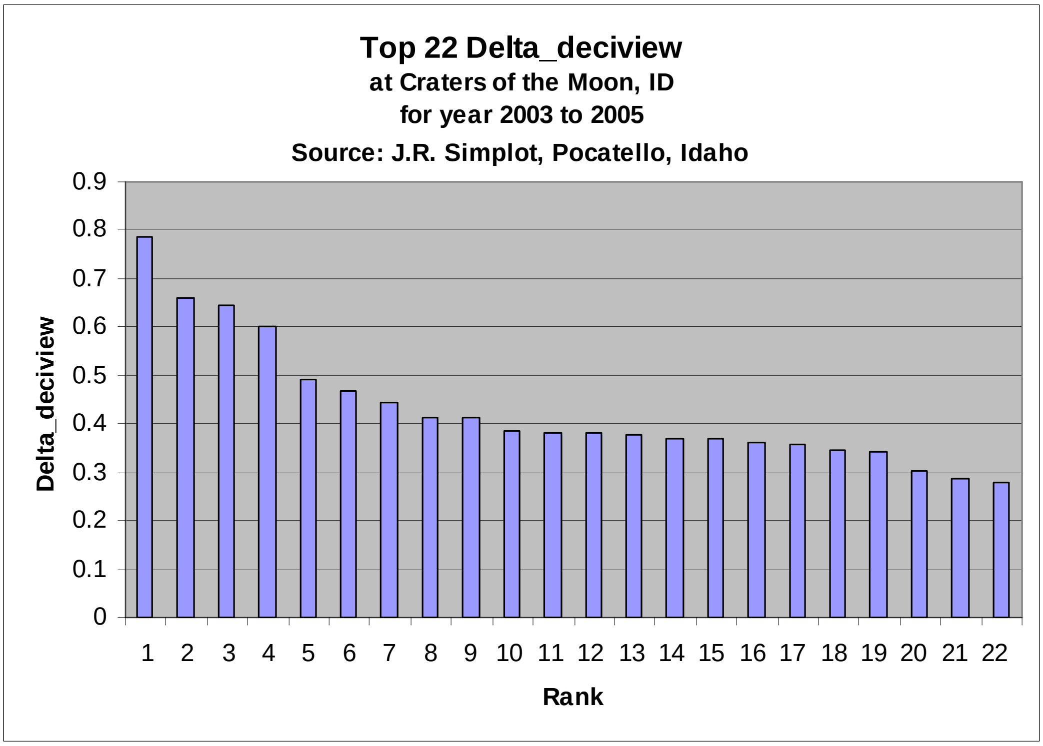

Figure 13. Top 22 highest Delta-deciview values (yeqr 2003 to 2005) at Craters of the Moon. Emission source: J.R. Simplot, Pocatello, Idaho.

Dominating Pollutants for Visibility Impact

Figure 4 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

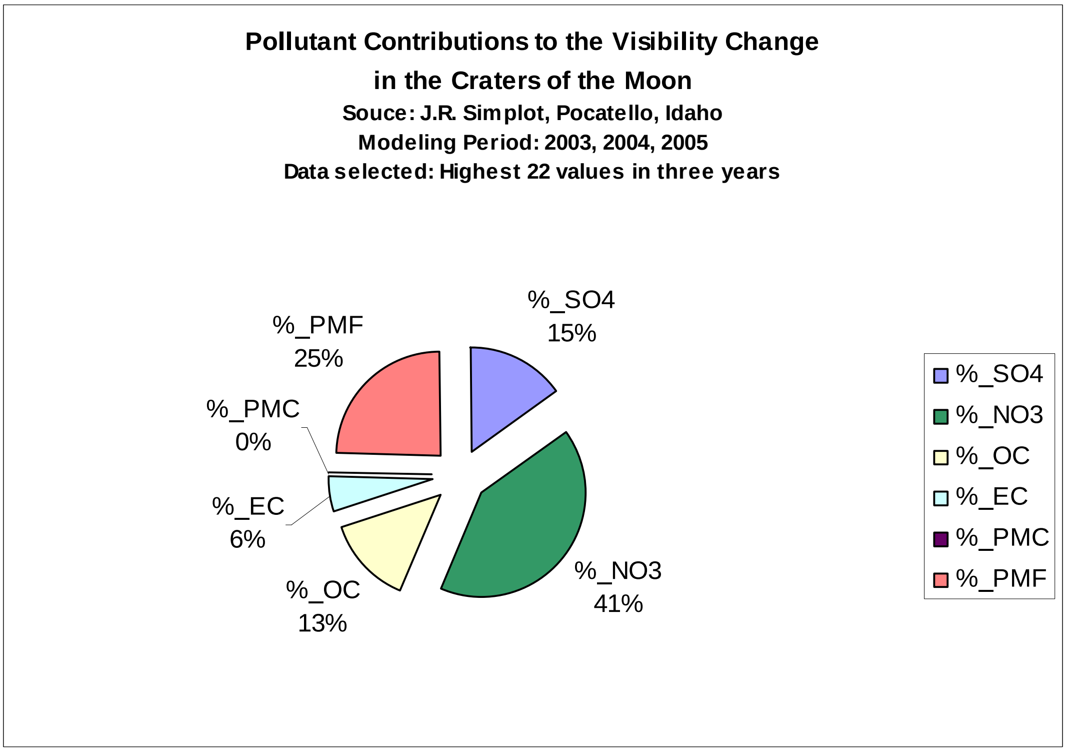

Figure 14. The pollutant contribution from J.R. Simplot Siding Plant, Pocatello, Idaho, to visibility change at Craters of the Moon.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for Craters of the Moon occurs between November and February.

The 2004 peak impact appears to have been the result of winter meteorological conditions favorable for hygroscopic aerosol formation, as discussed in the following section. The effect is minimal in the dry, hot summertime.

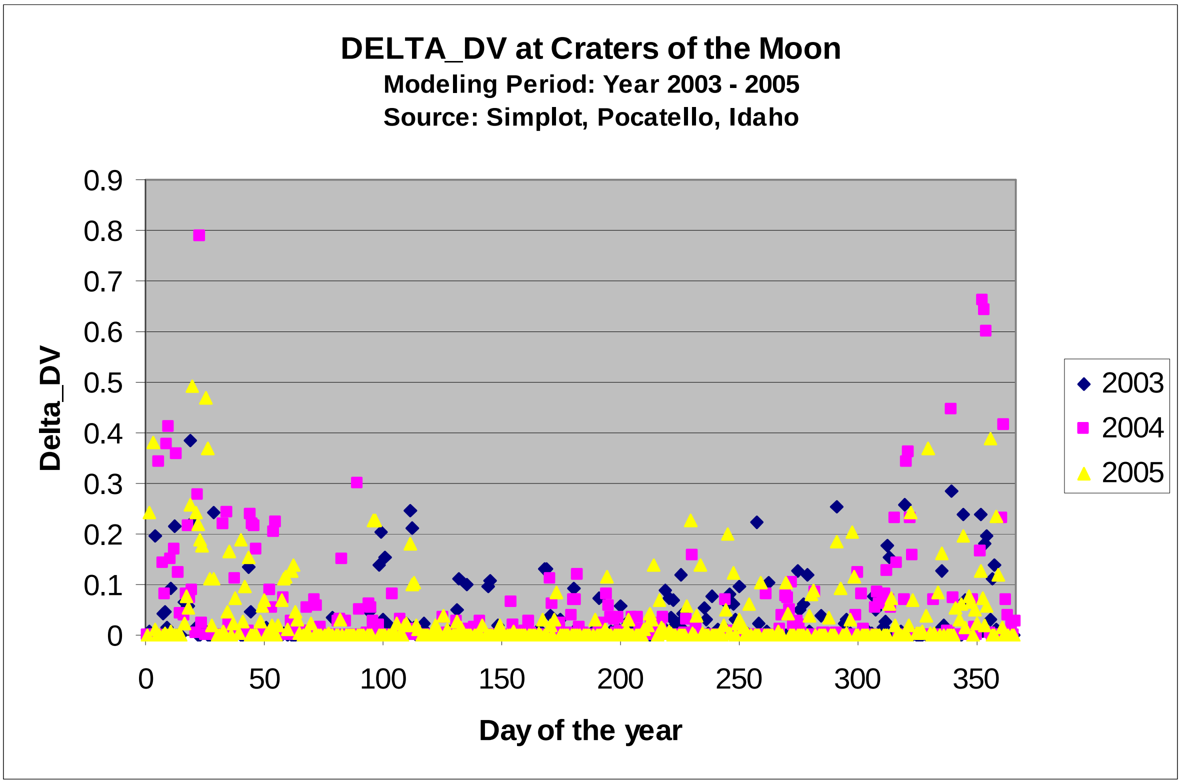

Figure 15. Seasonal impact from J.R. Simplot Siding Plant, Pocatello, Idaho to Craters of the Moon. Greater impacts are predicted in colder weather.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 6 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valley and slowly transport to the Class I areas with very little dispersion.

Figure 7 shows contour map of the number of days of impact higher than or equal to 0.5 deciview in the three year period, clearly showing the effect of the terrain.

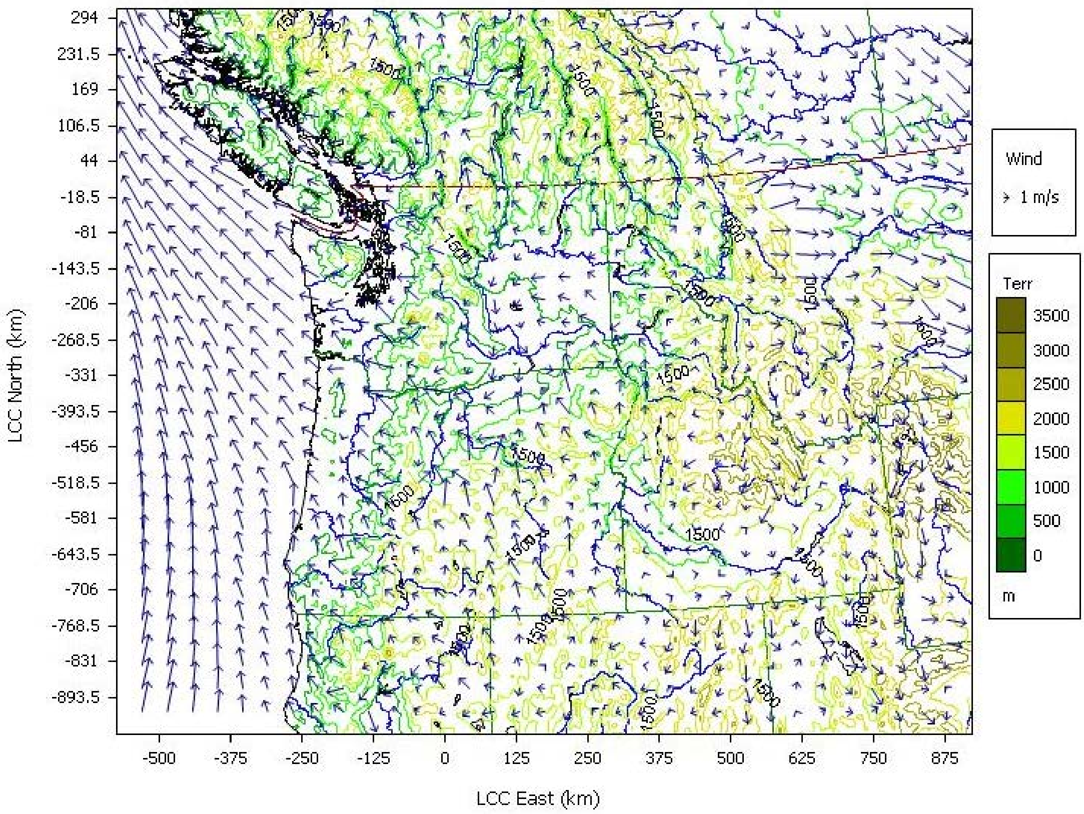

Figure 6. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than 2 weeks. The pollutants were elevated near the sources, slowly dispersed and transported to the Class I areas.

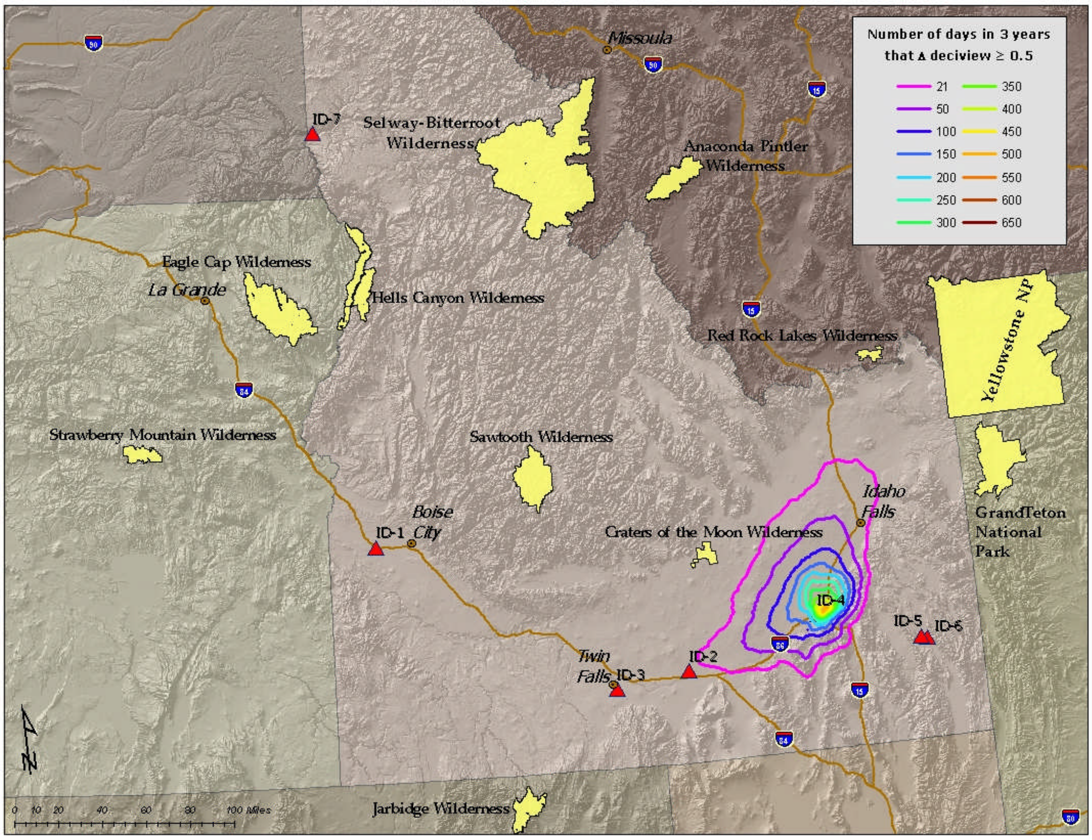

Figure 7. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: J.R. SIMPLOT at Pocatello, Idaho (ID-4). The pattern of dispersion strongly indicates the effects of the terrain. The Craters of the Moon Wilderness area is the nearest and most significantly impacted area by the source because of its location, but still below the threshold.

Summary and Conclusions

The CALPUFF model showed that during the period of year 2003 to 2005, the impact to visibility from the **J.R. Simplot Siding Plant** in Pocatello, Idaho, does not exceed the threshold of the 8^{th} annual highest or 22^{nd} 3-year highest value of 0.5 deciview in any Class I areas within 300 km from the source.

Craters of the Moon had the highest delta-deciview value (0.787 in the year 2004) and the highest number of days of visibility degradation (4 days, 2004). The eighth-highest delta-deciview value was 0.376 (in the year of 2004).

The impact is higher in winter, when a high pressure system persists in the area for a long period (3-4 days or more), the atmosphere is stagnant with poor dispersion, and the pollutants may be transported to Class I areas relatively undiluted.

The analysis has demonstrated that the **J.R. Simplot Siding Plant** is not subject to BART.

Appendix: CALPUFF Modeling Setup for J.R. Simplot, Pocatello, Idaho

Scenario Summary

Scenario Information

Scenario Name: wzI40444
Title: ID-4 4km Existing Control version 3 all units; 2004 through 2005 corrected
Scenario Description: ID-4; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); all units; 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory: Y:\airmodel\calpuff\runs\bart\wzI40444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources: 5
Source_Elevation_Option: Model

Source 1

Source Category

Category: Point

Facility Information

Facility ID: ID-4
Facility Name: J.R. Simplot Don Siding Plant

Unit Information

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Unit ID:	1
Unit Description:	Ammonium Sulfate Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.422
Northing (km):	4751.62
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	665.793
YNorthing (km):	-618.990

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1415.065
bar_12km (m):	1423.761

Stack Parameters

Height (m):	23.2
Diameter (m):	0.5
Exit Temperature (K):	311
Exit Velocity (m/s):	14.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	2.70000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.00000
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.34019
EC (g/s):	0.00000
SOA (g/s):	0.00000

Source 2

Source Category

Category:	Point

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Unit ID:	2
Unit Description:	Ammonia Plant

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.493
Northing (km):	4751.477
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	665.878
YNorthing (km):	-619.119

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1422.260
bar_12km (m):	1427.879

Stack Parameters

Height (m):	18.3
Diameter (m):	1.2
Exit Temperature (K):	505
Exit Velocity (m/s):	20

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	0.00000
NOX (lb/hr):	60.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.00000
PMF (lb/hr):	0.00000
EC (lb/hr):	0.00000
SOA (lb/hr):	0.00000

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.00000
NOX (g/s):	7.55987
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.00000
PMF (g/s):	0.00000
EC (g/s):	0.00000
SOA (g/s):	0.00000

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

Source 3

Source Category
Category: Point

Facility Information
Facility ID: ID-4
Facility Name: J.R. Simplot Don Siding Plant

Unit Information
Unit ID: 240
Unit Description: Granulation 2

Control Strategy Applied
Control ID: 41
Control Description: Existing Control - Ver. 3

Source Location and Base Elevation
Datum: NAD27
Projection: UTM
UTM Zone: 12
Easting (km): 375.401
Northing (km): 4751.567
Base Elevation (m): 1355

Source Location under Domain Projection and Datum
XEasting (km): 665.779
YNorthing (km): -619.043

Model Source Base Elevation In Calmet Domain
bar_4km (m): 1417.514
bar_12km (m): 1425.123

Stack Parameters
Height (m): 45.7
Diameter (m): 1.8
Exit Temperature (K): 310.9
Exit Velocity (m/s): 12.7

Emission Rate (Unit: lb/hr)
SO2 (lb/hr): 0.00000
SO4 (lb/hr): 0.53091
NOX (lb/hr): 0.00000
HNO3 (lb/hr): 0.00000
NO3 (lb/hr): 0.04651
PMC (lb/hr): 0.00000
PMF (lb/hr): 11.38000
EC (lb/hr): 0.66000
SOA (lb/hr): 1.30000

Emission Rate (Unit: g/s)
SO2 (g/s): 0.00000
SO4 (g/s): 0.06689
NOX (g/s): 0.00000
HNO3 (g/s): 0.00000
NO3 (g/s): 0.00586

PMC (g/s):	0.00000
PMF (g/s):	1.43386
EC (g/s):	0.08316
SOA (g/s):	0.16380

Source 4

Source Category

Category:	Point

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Unit ID:	371
Unit Description:	West Reclaim Cooling Towers

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.789
Northing (km):	4751.509
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	666.157
YNorthing (km):	-619.053

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1419.012
bar_12km (m):	1429.917

Stack Parameters

Height (m):	11.6
Diameter (m):	10.7
Exit Temperature (K):	297
Exit Velocity (m/s):	11.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	3.55382
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.59775
PMC (lb/hr):	0.00000
PMF (lb/hr):	69.80585
EC (lb/hr):	1.42090
SOA (lb/hr):	9.75566

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.44777
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.07532
PMC (g/s):	0.00000
PMF (g/s):	8.79539
EC (g/s):	0.17903
SOA (g/s):	1.22919

Source 5

Source Category

Category:	Point

Facility Information

Facility ID:	ID-4
Facility Name:	J.R. Simplot Don Siding Plant

Unit Information

Unit ID:	372
Unit Description:	East Reclaim Cooling Towers

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	375.789
Northing (km):	4751.509
Base Elevation (m):	1355

Source Location under Domain Projection and Datum

XEasting (km):	666.157
YNorthing (km):	-619.053

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1419.012
bar_12km (m):	1429.917

Stack Parameters

Height (m):	10.7
Diameter (m):	10.7
Exit Temperature (K):	297
Exit Velocity (m/s):	11.9

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	0.00000
SO4 (lb/hr):	3.75562
NOX (lb/hr):	0.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.63169
PMC (lb/hr):	0.00000

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

PMF (lb/hr):	73.76989
EC (lb/hr):	1.50158
SOA (lb/hr):	10.30966

Emission Rate (Unit: g/s)

SO2 (g/s):	0.00000
SO4 (g/s):	0.47320
NOX (g/s):	0.00000
HNO3 (g/s):	0.00000
NO3 (g/s):	0.07959
PMC (g/s):	0.00000
PMF (g/s):	9.29485
EC (g/s):	0.18920
SOA (g/s):	1.29899

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	11
ID:	brid2
Name:	Bridger Wilderness
State:	WY
# Total Receptors:	684
# Receptors In Calmet Domain:	585
Position In Receptor List:	1 - 585
ID:	crmowild
Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	586 - 856
ID:	fitz2
Name:	Fitzpatrick Wilderness
State:	WY
# Total Receptors:	316
# Receptors In Calmet Domain:	316
Position In Receptor List:	857 - 1172
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	1173 - 1678
ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	1679 - 1852
ID:	noab2
Name:	North Absaroka Wilderness

Subject-to-bart analysis
For the J.R. Simplot Siding Plant, Pocatello, Idaho

State:	WY
# Total Receptors:	567
# Receptors In Calmet Domain:	567
Position In Receptor List:	1853 - 2419

ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	2420 - 2641

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	2642 - 2994

ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	2995 - 3934

ID:	wash3
Name:	Washakie Wilderness
State:	WY
# Total Receptors:	509
# Receptors In Calmet Domain:	508
Position In Receptor List:	3935 - 4442

ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	4443 - 5357

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	33
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the TASCO Riley Boiler, Nampa, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). A BART determination is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Six BART-eligible sources have been identified in Idaho.

The source is *subject to BART* if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews* (delta-deciview)—a measure of visibility impairment[7]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[8], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

Refer to the *BART Modeling Protocol* for details on the modeling methodology used in this subject-to-BART analysis.

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[7] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[8] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: TASCO Riley Boiler, Nampa

The **Riley Boiler** of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Nampa, Idaho has been determined to be BART-eligible. Rated at 350 million BTUs per hour, the **Riley Boiler** is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1969, and was put into service between August 7, 1962 and August 7, 1977.

The **Riley Boiler's** *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 2,770 tn/yr), nitrogen oxide (NO_x, 1,708 tn/yr), and particulate matter (PM, 55 tn/yr), so this emission unit is eligible for inclusion in the subject-to-BART analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period (2003 – 2005) over which CALPUFF modeling for this emission unit was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 13. Emissions rates used for subject-to-BART analysis.

Facility/Unit	Maximum 24-hour emission rate (lb/hr)		
TASCO-Nampa	SO_2	NO_x	PM_{10}*
Riley Boiler, Unit 30	632.5	390	12.61
* See note in the Table 2			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* ($PM_{2.5}$), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Particulate speciation for the coal-fired **Riley Boiler** was calculated using the Microsoft Excel workbook prepared by the National Park Service for dry bottom pulverized coal-fired boilers with fabric filtration:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

PM size fractions used are as follows: Fine: mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed speciated emissions, stack parameters, and location used in the analysis are presented in Table 2.

Table 14. Emission unit information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-1
	Facility_Name	Amalgamated Sugar – Nampa
Emission Unit Information	Unit_ID	30
	Unit_Description	Riley Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 3
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	11
	Longitude_Easting (km)	534.391
	Latitude_Northing (km)	4828.031
	Base_Elevation (m)	753
Stack Parameter	Stack_Height (m)	65
	Stack_Diameter (m)	2.1
	Stack_Exit_Temperature (K)	427
	Stack_Exit_Velocity (m/s)	16
Emission Rate (lb/hr)	SO_2 (sulfur dioxide)	632.5
	SO_4 (sulfate)	6.415[a]
	NO_X (nitrogen oxides)	390
	HNO_3 (nitric acid)	0
	NO_3 (nitrate)	0[a]
	PMC (coarse particulate matter)	0.79
	PMF (fine particulate matter)	0.76[b]
	EC (elemental carbon)	0.03
	SOA (secondary organic aerosol)	2.21

a. All of sulfate particulates are assumed to be ammonium sulfate,
(NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate
(NH4)NO3 = 1.29*NO3 (Mass)
b. The fine particulates other than SO4, NO3, EC and SOA.

CALPUFF Model Setup

Modeling of the BART-eligible emission unit was performed in accordance with the *BART Modeling Protocol* and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 16.

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA guidance and the *BART Modeling Protocol*, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

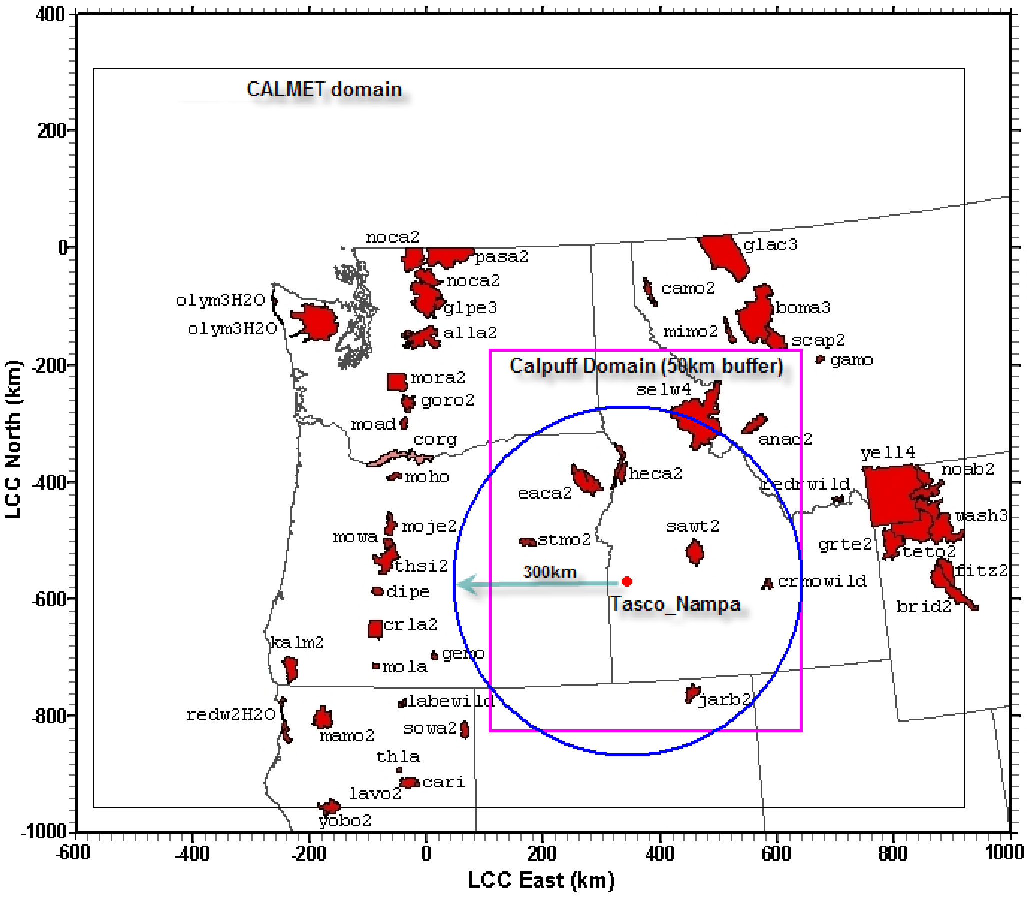

Figure 16. Modeling domain for TASCO Riley Boiler, Nampa, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF subject-to-BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in Appendix 1.

Results

Subject-to-BART analysis results for the TASCO **Riley Boiler**, Nampa are shown in Table 3, which highlights the following two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for delta-deciview in the each year.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for delta-deciview over three years.

For both threshold values, the determining criterion is a delta-deciview of at least 0.5 deciview.

Table 15. Change in Visibility Compared Against 20% Best Days Natural Background Conditions for Class I areas within 300 km from the TASCO Riley Boiler, Nampa.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.161	2	0.224	2	0.153	0	0.196	2
Eagle Cap Wilderness, OR	0.87	20	1.355	46	1.302	46	1.325	112
Hells Canyon National Recreation Area, ID	0.772	13	1.031	27	0.9	21	0.936	61
Jarbidge Wilderness, NV	0.151	0	0.198	1	0.201	1	0.179	2
Sawtooth Wilderness, ID	0.239	2	0.294	4	0.265	0	0.271	6
Selway-Bitterroot Wilderness, ID and MT	0.186	0	0.305	1	0.264	2	0.243	3
Strawberry Mountain Wilderness, OR	0.782	12	0.639	13	1.596	31	0.943	56

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Class I Areas Affected

Based on the analysis, the TASCO **Riley Boiler** impacted the following Class I areas with the 98th percentile highest delta-deciview greater than 0.5 during the modeling period 2003-2005:

Eagle Cap Wilderness, Oregon

Hells Canyon National Recreation Area, Idaho

Strawberry Mountain Wilderness, Oregon

The 98th percentile highest values for the all Class I areas are plotted in Figure 2.

Area of Greatest Impact

The **Riley Boiler** had the greatest impact on the Strawberry Mountain Wilderness in December 2005 (1.596, the 8th highest in 2005) and the highest 22nd (1.325) on the Eagle Cap Wilderness in January, 2004. Details of the 22 highest calculated changes, ranked in order of delta-deciview (change from 20% best days natural background), for Eagle Cap for the three-year modeling period are listed in Table 16. Table 16 also shows the relative contributions to visibility degradation for each of the emission species for the BART-eligible emission unit. Sulfate and nitrate are the main contributors.

Total of 112 days with delta-deciview higher than or equal to 0.5 were predicted for Eagle Cap Wilderness, the highest in the all Class I areas, followed by 61 days in the Hells Canyon Wilderness, and 56 days in the Strawberry Mountain Wilderness, during the modeling period.

The number of impacted days in 3 years for the concerned Class I areas are plotted in Figure 19.

Table 16. The 22 highest Delta-deciview values and related modeling output data at Eagle Cap Wilderness area.

Rank	YEAR	DAY	RECEPTOR	DV(Total)	DV(BKG)	DELTA_DV	F(RH)	%_SO4	%_NO3	%_OC	%_EC	%_PMC	%_PMF
1	2003	21	753	5.052	2.466	2.586	3.77	57.66	42.18	0.14	0	0	0.01
2	2004	22	716	4.691	2.466	2.225	3.77	63.09	36.75	0.13	0	0	0.01
3	2004	335	735	4.534	2.396	2.137	3.44	44.75	54.96	0.25	0.01	0.01	0.02
4	2004	338	753	4.578	2.508	2.07	3.97	57.23	42.6	0.15	0	0	0.01
5	2005	55	716	4.318	2.337	1.982	3.16	53.95	45.83	0.19	0.01	0.01	0.02
6	2005	16	716	4.324	2.466	1.857	3.77	49.9	49.9	0.17	0.01	0	0.01
7	2004	16	753	4.314	2.466	1.848	3.77	62.51	37.34	0.13	0	0	0.01
8	2003	38	716	3.998	2.337	1.661	3.16	44.11	55.6	0.24	0.01	0.01	0.02
9	2005	33	716	3.923	2.337	1.586	3.16	56.18	43.6	0.2	0.01	0.01	0.02
10	2003	345	861	4.068	2.508	1.56	3.97	40.64	59.1	0.22	0.01	0	0.02
11	2003	318	716	3.913	2.396	1.516	3.44	44.63	55.13	0.2	0.01	0.01	0.02
12	2005	322	550	3.911	2.396	1.514	3.44	53.14	46.67	0.16	0.01	0	0.01
13	2003	18	716	3.963	2.466	1.497	3.77	57.1	42.74	0.14	0	0	0.01
14	2004	18	716	3.947	2.466	1.48	3.77	55.17	44.64	0.16	0.01	0	0.01
15	2004	13	550	3.936	2.466	1.469	3.77	52.01	47.77	0.2	0.01	0.01	0.02
16	2004	322	753	3.798	2.396	1.402	3.44	54.34	45.45	0.18	0.01	0.01	0.02
17	2005	15	716	3.861	2.466	1.395	3.77	50.72	49.1	0.15	0.01	0	0.01
18	2005	56	273	3.703	2.337	1.366	3.16	50.44	49.32	0.21	0.01	0.01	0.02
19	2003	11	550	3.826	2.466	1.36	3.77	53.84	45.96	0.17	0.01	0.01	0.01
20	2004	19	753	3.821	2.466	1.355	3.77	53.75	46.04	0.18	0.01	0	0.02
21	2005	27	716	3.805	2.466	1.339	3.77	60.71	39.17	0.1	0	0	0.01
22	2004	14	550	3.791	2.466	1.325	3.77	55.94	43.86	0.17	0.01	0.01	0.01

Day: Ordinal day of year
RECEPTOR ID: Identifier for modeled air receptor
DV(total): total deltadeciview including background and change due to the modeled emission source.
DV(BKG): Background deltadeciview.
DELTA_DV: Change in the 20% best days natural background (in deciviews) due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller) other than SO4, NO3, EC and OC.

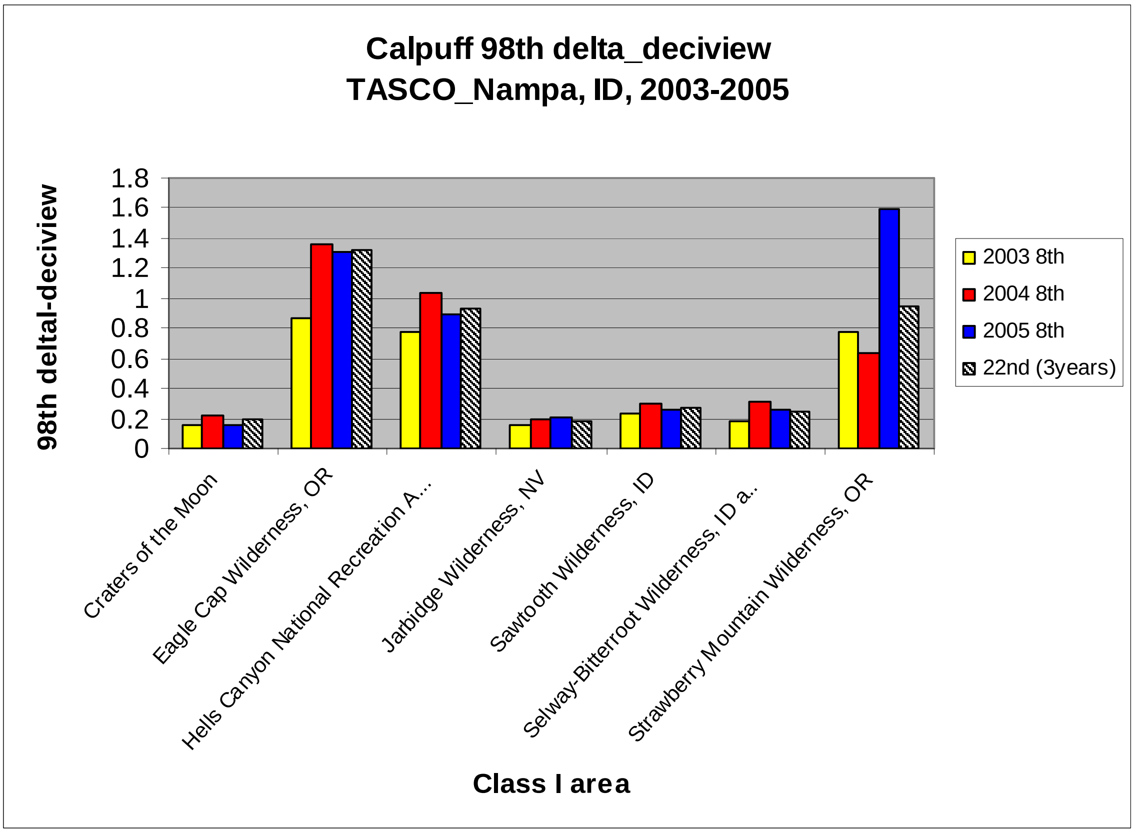

Figure 17. 98th percentile values of delta-deciview in Class I areas for TASCO Riley Boiler, Nampa, Idaho.

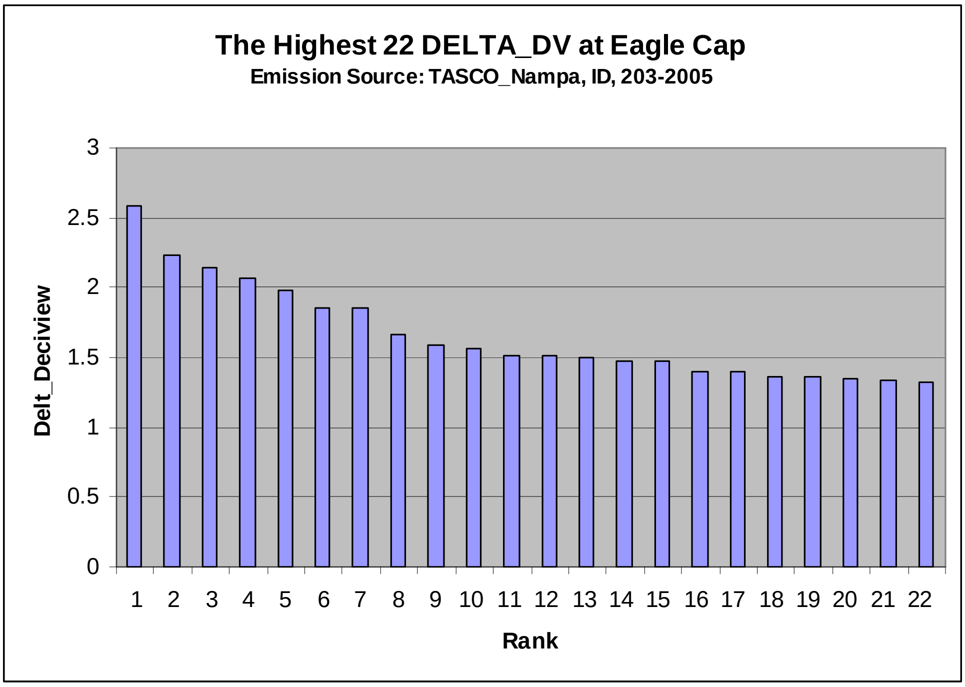

Figure 18. Top 22 highest Delta-deciview values at Eagle Cap Wilderness area for the TASCO Riley Boiler, Nampa, Idaho.

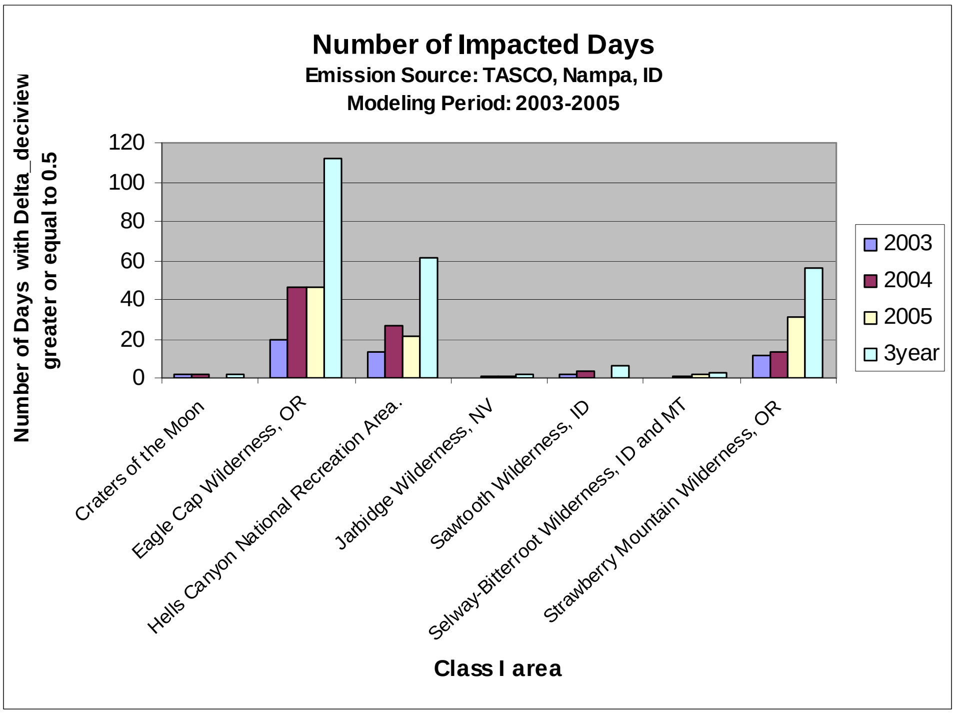

Figure 19. Number of days when the delta-deciview is greater than or equal to 0.50 in the Class I areas during the modeling period, 2003 to 2005.

Dominating Pollutants for Visibility Impact

Figure 20 shows the percentage contribution of the pollutants for the average of the highest 22 days in Eagle Cap in the modeling period from 2003 to 2005. Sulfate and nitrate are the dominating pollutants responsible for the visibility deterioration.

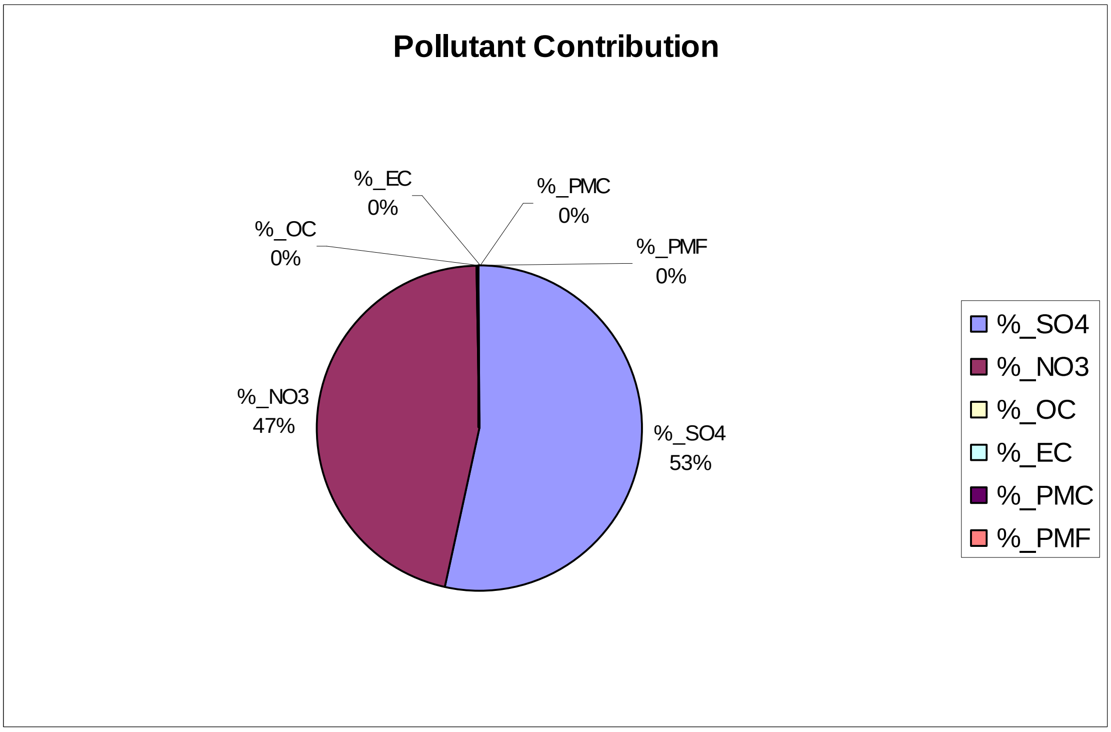

Figure 20. The pollutant contribution from the TASCO Riley Boiler, Nampa, Idaho, to visibility change at Eagle Cap Wilderness area, Oregon. The total contribution from Sulfate and Nitrate is almost 100%.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Eagle Cap Wilderness occurs between November and February.

The higher impact appears to have been the result of winter meteorological conditions favorable for hygroscopic aerosol formation, as discussed in the following section. The effect is minimal in the dry, hot summertime.

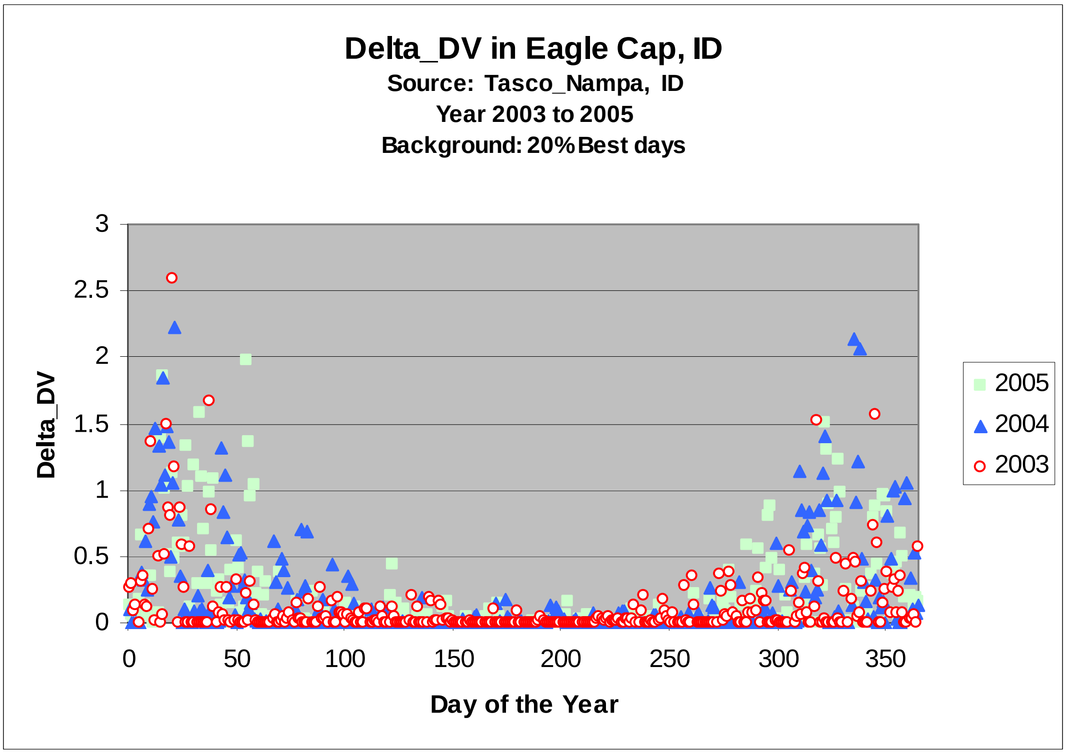

Figure 21. Seasonal impact from the TASCO Riley Boiler, Nampa, Idaho to Eagle Cap Wilderness area, Oregon, which is located about 120 km north-west from the source.

Meteorological and Geological Conditions

The impact to visibility in Class I areas is strongly dependent on meteorological and geological conditions. Figure 22 shows the strong stagnation conditions that occurred during the episode of January 2004. During such an episode, pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain (geological condition) also strongly influences impact of emission sources in Idaho's Treasure Valley area on the Class I areas. Figure 23 shows a contour map of number of impact days equal to or higher than 0.5 delta-deciview. The channeling effect of the terrain is clearly shown, indicating that Treasure Valley sources are likely to affect Class I areas to the northwest under winter conditions.

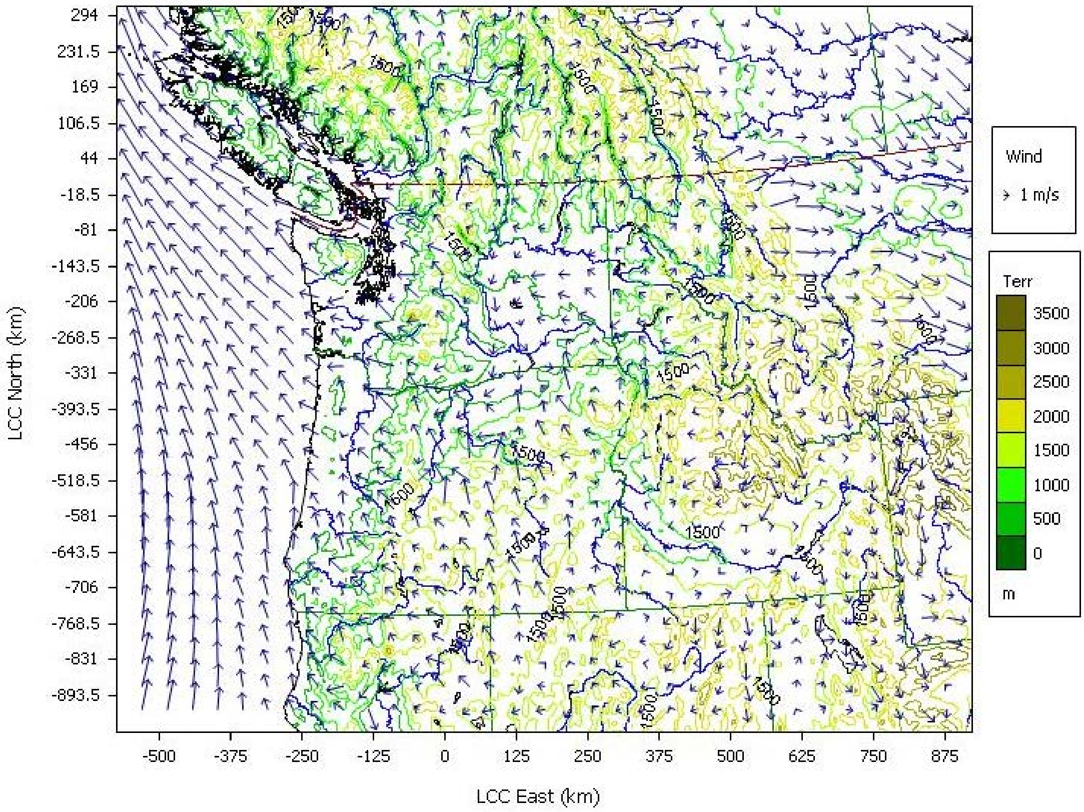

Figure 22. Wind field in the modeling domain. In January 2004, a strong stagnation system persisted in the Snake River Valley, Idaho, where the TASCO Riley Boiler is located, for more than 2 weeks. Pollutants were elevated near their sources, then were slowly dispersed and transported to the Class I areas.

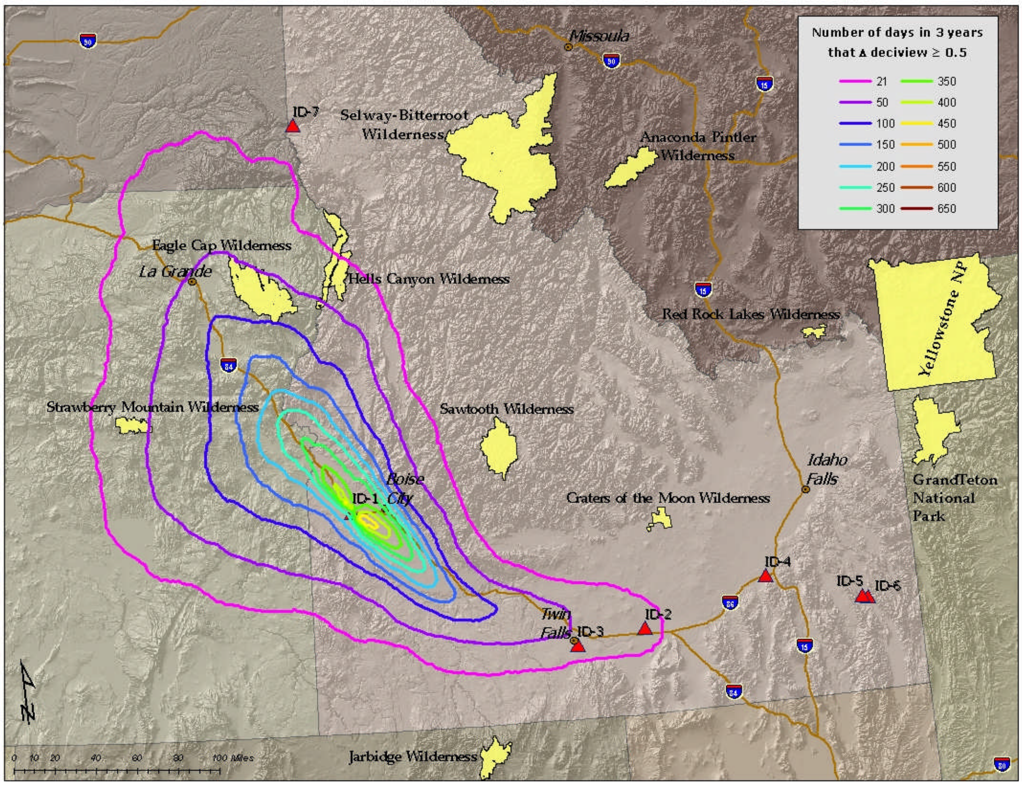

Figure 23. Wind field in the modeling domain. In January 2004, a strong stagnation system persisted in the Snake River Valley, Idaho, where the TASCO Riley Boiler is located, for more than 2 weeks. Pollutants were elevated near their sources, then were slowly dispersed and transported to the Class I areas

Sensitivity Analysis

DEQ performed a sensitivity analysis on the CALPUFF modeling analysis for the Riley Boiler at TASCO, Nampa. The purpose of the sensitivity analysis was to represent the least conservative parameters to show that further refinements (e.g. hourly ozone) are not likely to alter the conclusion, resulting from the *BART Modeling Protocol* analysis, that the Riley Boiler at TASCO's Nampa facility subject-to-BART. **It should be noted that this sensitivity analysis does not imply approval of these "bounding" parameters by DEQ, the EPA and Federal Land Managers.**

The parameters included in the sensitivity analysis include puff splitting, building downwash, low ozone background (10 ppb, the low end of observed vales), and the use of annual average for natural background.

The results of the sensitivity analysis are summarized in Figure 24 and Figure 25, and Table 17. The predicted impact levels based on this less conservative sensitivity analysis in the all Class I areas are lower; however, the predicted visibility deterioration in Eagle Cap Wilderness Area, Strawberry Mountain Wilderness Area, and Hells Canyon National Recreation Area is still significantly higher than the 0.5 dv threshold.

Details of the model setup used for the sensitivity analysis are provided in Appendix 2.

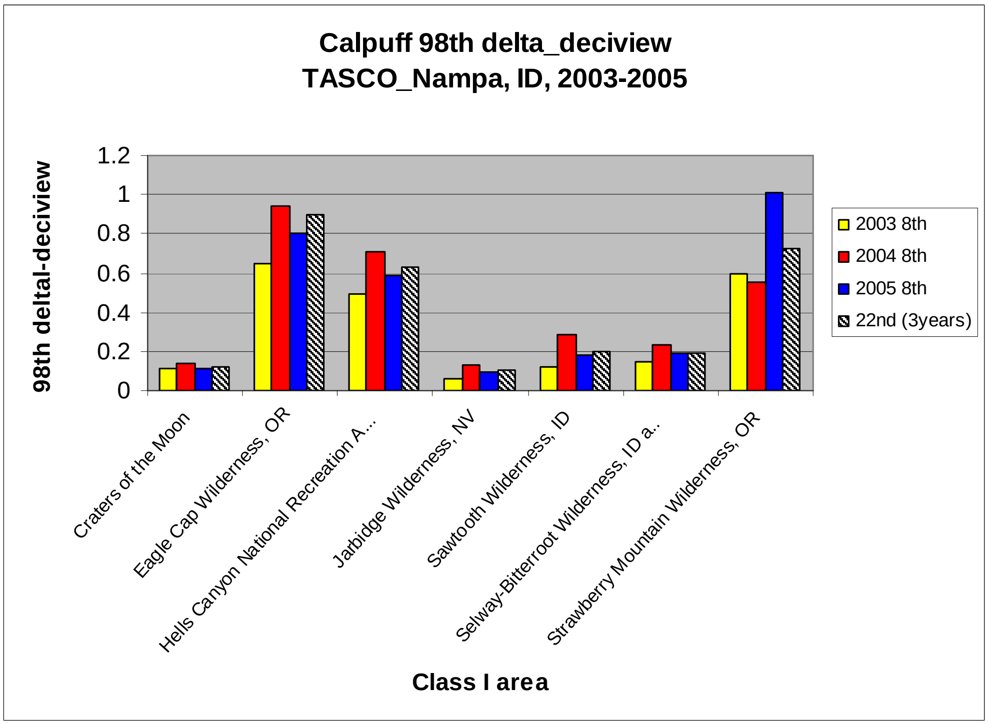

Figure 24. Analysis: 98th percentile values of delta-deciview in the Class I areas

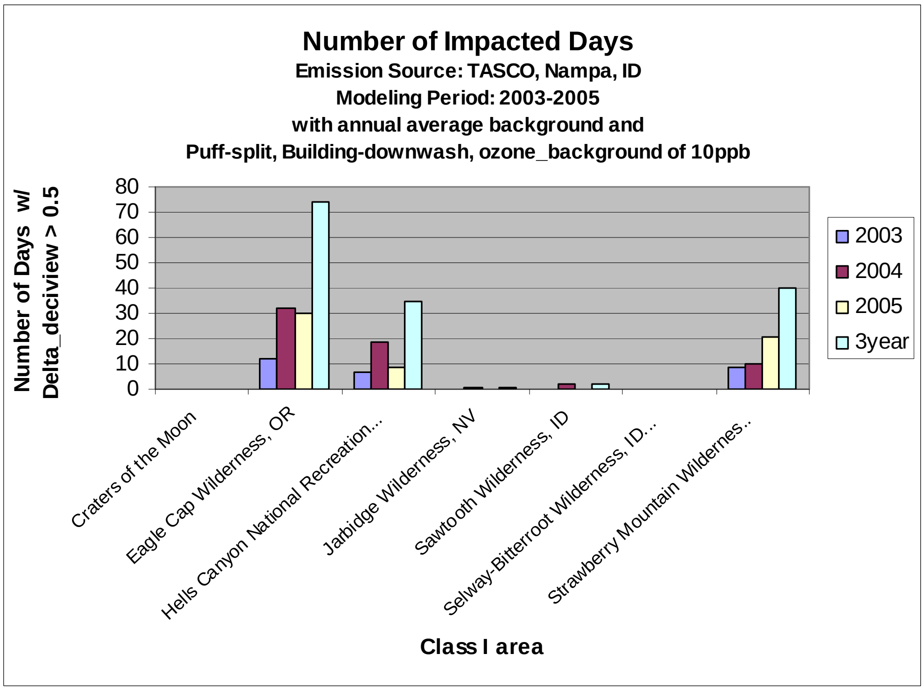

Figure 25. Sensitivity Analysis: Number of days in the Class I areas where the delta-deciview was greater than or equal to 0.5dv

Table 17. Sensitivity Analysis: Change in visibility for Class I areas within 300 km from the TASCO Riley Boiler, Nampa.

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.111	0	0.142	0	0.115	0	0.117	0
Eagle Cap Wilderness, OR	0.646	12	0.944	32	0.806	30	0.895	74
Hells Canyon National Recreation Area, ID	0.494	7	0.708	19	0.591	9	0.632	35
Jarbidge Wilderness, NV	0.064	0	0.128	1	0.097	0	0.101	1
Sawtooth Wilderness, ID	0.124	0	0.283	2	0.179	0	0.201	2
Selway-Bitterroot Wilderness, ID and MT	0.149	0	0.236	0	0.194	0	0.187	0
Strawberry Mountain Wilderness, OR	0.593	9	0.553	10	1.006	21	0.729	40

a. The 8th highest delta-deciview for the calendar year.
b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
c. The 22nd highest delta-deciview value for the 3-year period.
d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Summary and Conclusions

The CALPUFF model predicted that emissions from the **Riley Boiler** at the TASCO Sugar Plant, Nampa, Idaho, impacted visibility with the 98th percentile highest delta-deciview of more than 0.5 deciview on the Class I areas of Eagle Cap Wilderness, OR, Strawberry Mountain Wilderness, OR, and Hells Canyon Wilderness, ID, during the period of year 2003 to 2005.

Eagle Cap Wilderness area had the highest number of days (112 days in 3 years) with delta-deciview value greater than 0.5. The highest 1-year 8th high delta-deciview (1.596, year 2005) was found in Strawberry Mountain Wilderness.

The major contributors to visibility deterioration from the **Riley Boiler** of the TASCO, Nampa facility are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for 3 to 4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The subject-to-BART analysis, which followed the *BART Modeling Protocol,* and additional extensive sensitivity analysis have demonstrated that the **Riley Boiler** of the TASCO, Nampa facility is subject to BART.

Appendix 1: CALPUFF Modeling Setup for TASCO Riley Boiler, Nampa, Idaho

Scenario Summary

Scenario Information

Scenario Name: wzl10444

Title: ID-1 4km Existing Control version 3; 2004 through 2005 corrected

Scenario Description: ID-1; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID: 1

Number of Species: 9

Species Names: SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory: Y:\airmodel\calpuff\runs\bart\wzl10444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources: 1

Source_Elevation_Option: Model

Source 1

Source Category

Category: Point

Facility Information

Facility ID: ID-1

Facility Name: Amalgamated Sugar - Nampa

Unit Information

Unit ID: 30

Unit Description: Riley Boiler

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	534.391
Northing (km):	4828.031
Base Elevation (m):	753

Source Location under Domain Projection and Datum

XEasting (km):	344.051
YNorthing (km):	-569.801

Model Source Base Elevation In Calmet Domain

bar_4km (m):	759.705
bar_12km (m):	764.555

Stack Parameters

Height (m):	65
Diameter (m):	2.1
Exit Temperature (K):	427
Exit Velocity (m/s):	16

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	632.50000
SO4 (lb/hr):	6.41455
NOX (lb/hr):	390.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.79000
PMF (lb/hr):	0.76000
EC (lb/hr):	0.03000
SOA (lb/hr):	2.21000

Emission Rate (Unit: g/s)

SO2 (g/s):	79.69366
SO4 (g/s):	0.80822
NOX (g/s):	49.13917
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.09954
PMF (g/s):	0.09576
EC (g/s):	0.00378
SOA (g/s):	0.27846

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	7
ID:	crmowild

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Name:	Craters of the Moon NM - Wilderness
State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271

ID:	eaca2
Name:	Eagle Cap Wilderness
State:	OR
# Total Receptors:	596
# Receptors In Calmet Domain:	596
Position In Receptor List:	272 - 867

ID:	heca2
Name:	Hells Canyon Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	868 - 1220

ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	1221 - 1394

ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1395 - 1747

ID:	selw4
Name:	Selway-Bitterroot Wilderness
State:	ID
# Total Receptors:	575
# Receptors In Calmet Domain:	575
Position In Receptor List:	1748 - 2322

ID:	stmo2
Name:	Strawberry Mountain Wilderness
State:	OR
# Total Receptors:	114
# Receptors In Calmet Domain:	114
Position In Receptor List:	2323 - 2436

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	171
Ending Column:	304
Beginning Row:	33
Ending Row	195

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Appendix 2: Sensitivity Analysis: CALPUFF Modeling Setup for TASCO Riley Boiler, Nampa, Idaho

Scenario Summary

Scenario Information
Scenario Name: wzI10445
Title: ID-1 4km Existing Control version 3; 2004 through 2005 corrected
Scenario Description: ID-1; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 3 (Control_ID = 41); 2004 through 2005 corrected; O3 = 10ppb; Puff splitting on with nsplit=2; building downwash (assume stack name is SPB3 in bpip input file)

Species Group Information
Species Group ID: 1
Number of Species: 9
Species Names: SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory
Working Directory: Y:\airmodel\calpuff\runs\bart\wzI10445

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources
Number of Sources: 1
Source_Elevation_Option: Model

Source 1

Source Category
Category: Point

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Facility Information

Facility ID:	ID-1
Facility Name:	Amalgamated Sugar - Nampa

Unit Information

Unit ID:	30
Unit Description:	Riley Boiler

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 3

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	534.391
Northing (km):	4828.031
Base Elevation (m):	753

Source Location under Domain Projection and Datum

XEasting (km):	344.051
YNorthing (km):	-569.801

Model Source Base Elevation In Calmet Domain

bar_4km (m):	759.705
bar_12km (m):	764.555

Stack Parameters

Height (m):	65
Diameter (m):	2.1
Exit Temperature (K):	427
Exit Velocity (m/s):	16

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	632.50000
SO4 (lb/hr):	6.41455
NOX (lb/hr):	390.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	0.79000
PMF (lb/hr):	0.76000
EC (lb/hr):	0.03000
SOA (lb/hr):	2.21000

Emission Rate (Unit: g/s)

SO2 (g/s):	79.69366
SO4 (g/s):	0.80822
NOX (g/s):	49.13917
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.09954
PMF (g/s):	0.09576
EC (g/s):	0.00378
SOA (g/s):	0.27846

Subject-to-bart analysis
For the TASCO Riley Boiler, Nampa, Idaho

Class I Areas
Searching Radius (km): 300km
Number of Class I Areas: 7

ID: crmowild
Name: Craters of the Moon NM - Wilderness
State: ID
Total Receptors: 271
Receptors In Calmet Domain: 271
Position In Receptor List: 1 - 271

ID: eaca2
Name: Eagle Cap Wilderness
State: OR
Total Receptors: 596
Receptors In Calmet Domain: 596
Position In Receptor List: 272 - 867

ID: heca2
Name: Hells Canyon Wilderness
State: ID
Total Receptors: 353
Receptors In Calmet Domain: 353
Position In Receptor List: 868 - 1220

ID: jarb2
Name: Jarbidge Wilderness
State: NV
Total Receptors: 174
Receptors In Calmet Domain: 174
Position In Receptor List: 1221 - 1394

ID: sawt2
Name: Sawtooth Wilderness
State: ID
Total Receptors: 353
Receptors In Calmet Domain: 353
Position In Receptor List: 1395 - 1747

ID: selw4
Name: Selway-Bitterroot Wilderness
State: ID
Total Receptors: 575
Receptors In Calmet Domain: 575
Position In Receptor List: 1748 - 2322

ID: stmo2
Name: Strawberry Mountain Wilderness
State: OR
Total Receptors: 114
Receptors In Calmet Domain: 114
Position In Receptor List: 2323 - 2436

Computational Domain
Minimum Buffer (km): 50
Beginning Column: 171
Ending Column: 304

```
Beginning Row:               33
Ending Row                   195
```

Calpuff Run Period Definition

```
Base Time Zone:              8 (Pacific Standard)
Calpuff Beginning Time:      01/01/2003 00:00:00
Calpuff Ending Time:         01/01/2006 00:00:00
Calpuff Time Step(Second):   3600
```

Subject-to-BART Analysis

For the TASCO Erie City Boiler, Paul, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[9]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[10], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

[9] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[10] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

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BART Eligible Source: TASCO Erie City Boiler, Paul

The **Erie City Boiler** of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Paul, Idaho has been determined to be BART-eligible. Rated at 280 million BTUs per hour, the **Erie City Boiler** is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1964, and was put into service between August 7, 1962 and August 7, 1977.

The **Erie City Boiler's** *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 1,051 tn/yr), nitrogen oxide (NO_x, 1,314 tn/yr), and particulate matter (PM, 272 tn/yr), so this unit is eligible for inclusion in the subject-to-BART modeling analysis of visibility impairment in Class I areas.

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles with aerodynamic diameters less than 10 micrometers.

Table 18. Emissions rates used for BART modeling.

Facility/Unit	**Maximum 24-hour emission rate (lb/hr)**		
TASCO-Paul	**SO_2**	**NO_x**	**PM_{10} ***
Erie City Boiler, Unit 10	26.55	261.67	62.1
*see note of Table 2.			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF) (see Table 2).

Particulate speciation for the coal-fired **Erie City Boiler** was calculated using the workbook prepared by the National Park Service for dry bottom pulverized coal-fired boilers with wet scrubbers:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

PM size fractions used are as follows: Fine : mean diameter = 0.5 µm, standard deviation = 1.5 µm. Coarse: mean diameter = 5µm, standard deviation = 1.5µm.

Detailed speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 19. Facility information, stack parameters, and speciation of emissions.

Facility Information	**Facility_ID**	**ID-2**
	Facility_Name	**Amalgamated Sugar - Paul**
Unit Information	Unit_ID	10
	Unit_Description	Erie City Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 5
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	12
	Longitude_Easting (km)	273.819
	Latitude_Northing (km)	4721.176
	Base_Elevation (m)	1264
Stack Parameter	Stack_Height (m)	34.1
	Stack_Diameter (m)	3.1
	Stack_Exit_Temperature (K)	313.7
	Stack_Exit_Velocity (m/s)	7.74
Emission Rate (lb/hr)	Sulfur dioxide (SO_2)	26.55
	Sulfate (SO_4)	9.03
	Nitrogen oxides (NO_X)	261.67
	Nitric acid (HNO_3)	0
	Nitrates (NO_3)	0
	Coarse Particulate Matter, 2.5 to 10 micrometers in size, (PMC)	13.29
	Fine Particulate Matter, < 2.5 micrometers in size, (PMF)	32.04
	Elemental Carbon, (EC)	1.24
	Secondary Organic Aerosol (SOA)	3.11
Note: All of sulfate particulates are assumed to be ammonium sulfate, (NH4)2SO4 = 1.375*SO4 (Mass) All of nitrate particulates are assumed to be ammonium nitrate (NH3)NO3 = 1.29*NO3 (Mass)		

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 1.

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

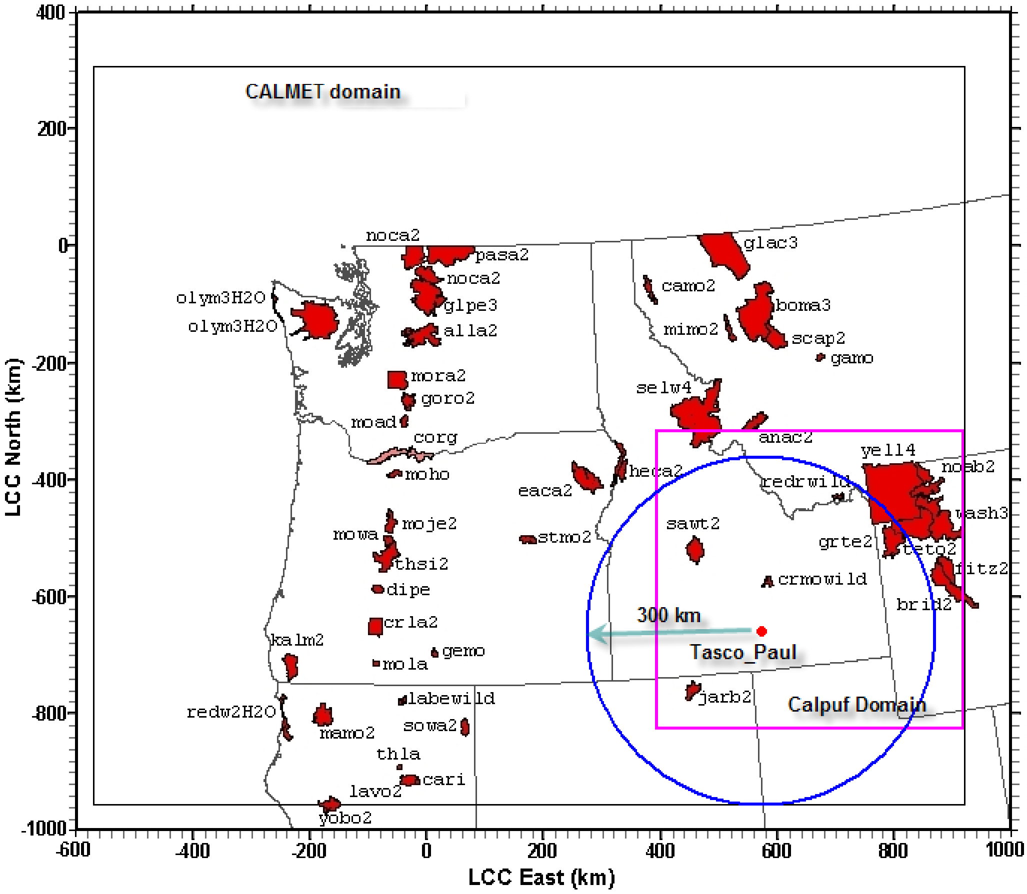

Figure 26. Modeling domain for TASCO Erie City Boiler, Paul, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

Subject-to-bart analysis
For the TASCO Erie City Boiler, Paul, Idaho

The meteorological inputs (CALMET outputs) needed by CALPUFF for the analysis were prepared by Geomatrix, Inc under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. Figure 1 shows the region that CALMET output covers for the years 2003-2005 at a 4 km resolution.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the TASCO **Erie City Boiler**, Paul are shown in Table 3, which highlights the two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 20. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the TASCO Erie City Boiler, Paul, Idaho.

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
Class I Area	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003,2004,2005)
Yellowstone NP, WY	0.079	1	0.087	0	0.1	0	0.086	1
Red Rock Lakes, MT	0.073	0	0.088	0	0.08	0	0.081	0
Sawtooth, ID	0.046	0	0.045	0	0.063	0	0.053	0
Teton Wilderness, WY	0.051	0	0.053	0	0.067	0	0.056	0
Jarbidge Wilderness, NV	0.05	0	0.061	0	0.071	0	0.061	0
Yellowstone NP, WY	0.079	1	0.087	0	0.117	0	0.086	1
Craters of the Moon, ID	0.398	4	0.412	3	0.324	4	0.380	11

Class I Area of Greatest Impact

The Erie City Boiler had the greatest impact on the Craters of the Moon Wilderness. Details of the 22 highest calculated changes in deciview for Craters of the Moon for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year.

The top 22 delta-deciview values predicted in the Craters of the Moon Wilderness are plotted in Figure 3.

Table 21. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon Wilderness.

Rank	YEAR	DAY	RECEPTOR ID	DV (Total)	DV (BKG)	DELTA DV	F(RH)	% SO_4	% NO_3	% OC	% EC	% PMC	% PMF
1	2003	90	7	2.983	2.035	0.948	2.28	16.54	71.89	2.26	2.26	1.22	3.56
2	2004	32	14	2.989	2.129	0.861	2.74	14.81	77.22	1.55	1.55	0.88	2.67
3	2004	27	243	3.066	2.208	0.858	3.13	17.63	74.13	1.62	1.62	0.81	3.19
4	2005	18	7	3.054	2.208	0.846	3.13	13.46	82.26	0.87	0.87	0.28	2.83
5	2004	341	271	3.025	2.19	0.835	3.04	12.53	81.7	1.13	1.13	0.58	4.37
6	2003	365	3	2.875	2.19	0.685	3.04	13.27	80.77	1.2	1.2	0.46	5.93
7	2003	3	7	2.817	2.208	0.609	3.13	13.61	80.02	1.26	1.26	0.61	3.69
8	2005	315	179	2.74	2.135	0.605	2.77	15.06	76.78	1.6	1.6	0.83	2.76
9	2005	364	271	2.769	2.19	0.58	3.04	15.21	77.9	1.34	1.34	0.74	4.14
10	2005	10	21	2.756	2.208	0.548	3.13	12.67	83.4	0.79	0.79	0.32	3.54
11	2003	337	271	2.732	2.19	0.542	3.04	12.75	81.86	1.06	1.06	0.54	2.75
12	2004	24	271	2.7	2.208	0.492	3.13	11.89	83.07	0.99	0.99	0.52	2.36
13	2003	20	271	2.689	2.208	0.481	3.13	13.36	82.76	0.77	0.77	0.33	3.7
14	2004	335	233	2.605	2.135	0.47	2.77	12.35	81.83	1.17	1.17	0.44	2.62
15	2004	3	7	2.661	2.208	0.453	3.13	14.53	78.36	1.42	1.42	0.62	4.49
16	2003	279	7	2.404	1.971	0.434	1.97	14.68	75.81	1.89	1.89	0.87	3.25
17	2004	360	192	2.609	2.19	0.419	3.04	11.79	84.03	0.85	0.85	0.29	3.11
18	2004	346	271	2.602	2.19	0.412	3.04	14.67	78.92	1.27	1.27	0.61	5.91
19	2004	276	7	2.38	1.971	0.409	1.97	12.81	78.33	1.73	1.73	0.93	2.19
20	2003	81	271	2.439	2.035	0.404	2.28	17.19	70.72	2.36	2.36	1.26	4.42
21	2003	335	271	2.588	2.19	0.398	3.04	10.74	84.67	0.93	0.93	0.33	2.62
22	2004	46	7	2.509	2.129	0.38	2.74	14.11	81.11	0.98	0.98	0.31	2.95

Day: Ordinal day of year
RECEPTOR ID: Identifier for modeled air receptor
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

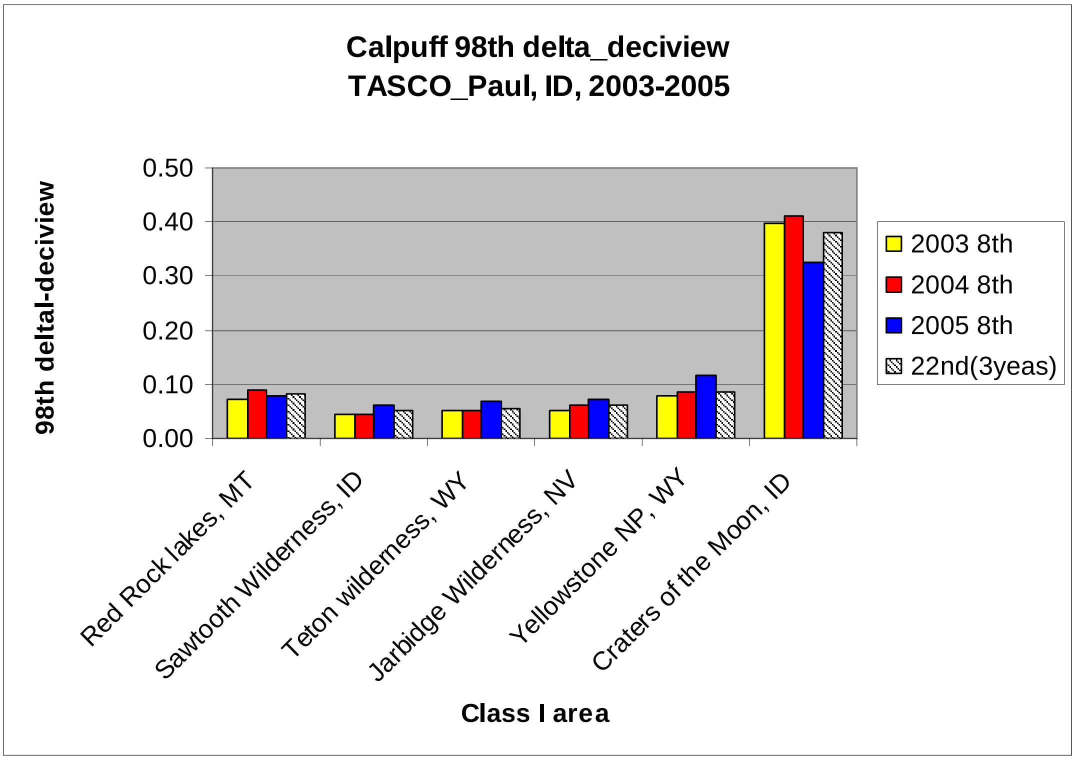

Figure 27. 98th percentile values of delta-deciview in Class I areas for TASCO Erie City Boiler, Paul, Idaho.

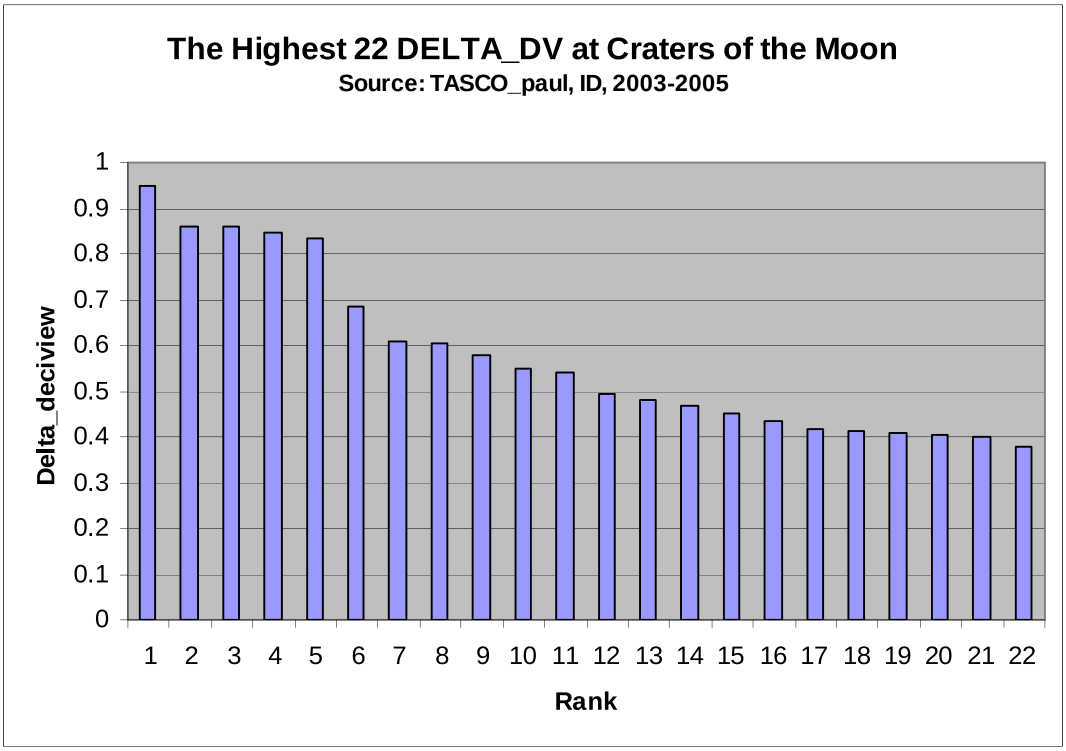

Figure 28. Top 22 highest Delta-deciview values at Craters of the Moon for TASCO Erie City Boiler, Paul, Idaho.

Dominating Pollutants for Visibility Impact

Figure 29 shows the average percentage contributions of the pollutants for the highest 22 days in Craters of the Moon in the modeling period from 2003 to 2005. This is the three-year average of the worst days; impacts may vary considerably for different meteorological conditions and for different areas.

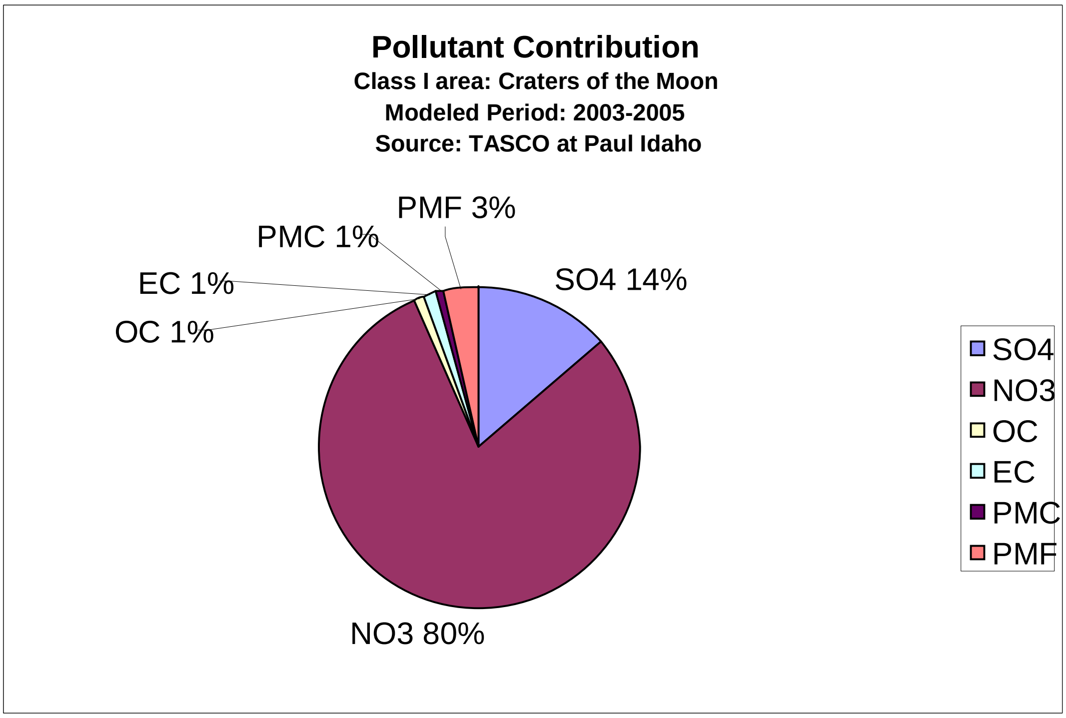

Figure 29. The pollutant contribution from TASCO Erie City Boiler, Paul, Idaho, to visibility change at Craters of the Moon Wilderness.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Craters of the Moon Wilderness occurs between November and March.

Although some variations are observed in the modeling period from 2003 to 2005, the variation is not as significant as predicted for the other sources in the area.

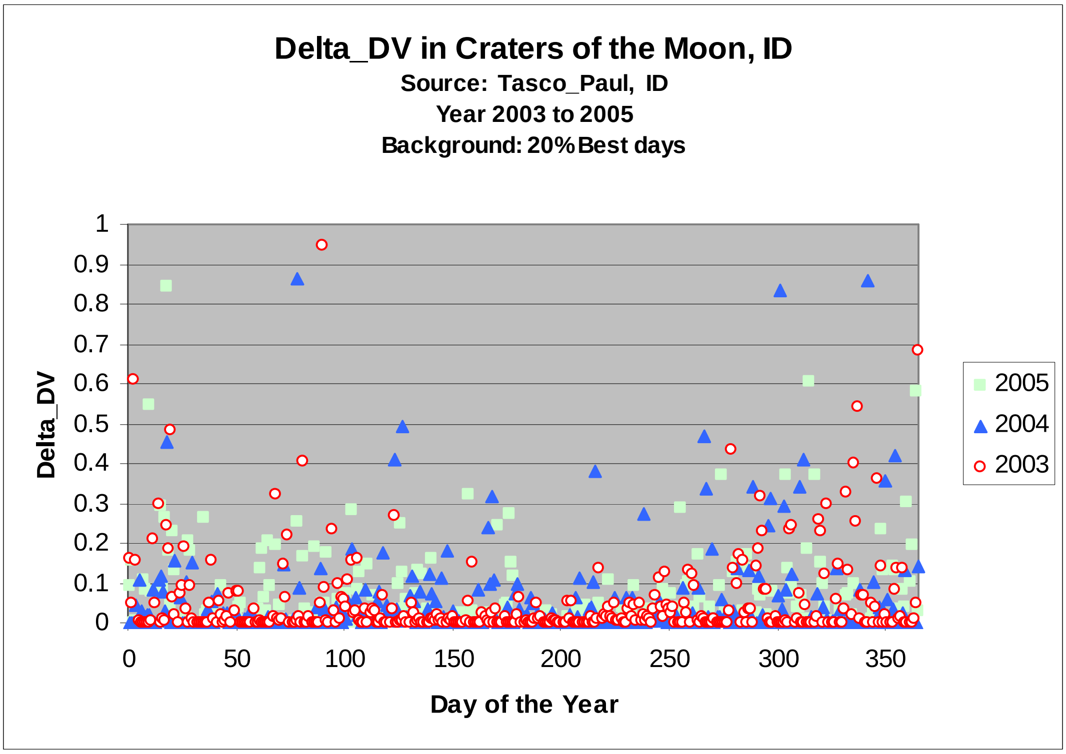

Figure 30. Seasonal impact from TASCO Erie City Boiler, Paul, Idaho to Craters of the Moon Wilderness.

Meteorological and Geological Conditions

The visibility impact to the Class I areas is strongly dependent on the meteorological and geological conditions. Figure 31 shows the strong stagnation conditions during the episode in January 2004. Pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain also strongly influences the impact of emission sources. Figure 7 shows a contour map of the number of days, during the modeled period of 2003 to 2005, having an impact higher than or equal to 0.5 deciviews. The channeling effect of the terrain is clearly shown. Because there is no Class I area on the main path of the pollutants, the impact to the visibility in the Class I areas in concern is not significant.

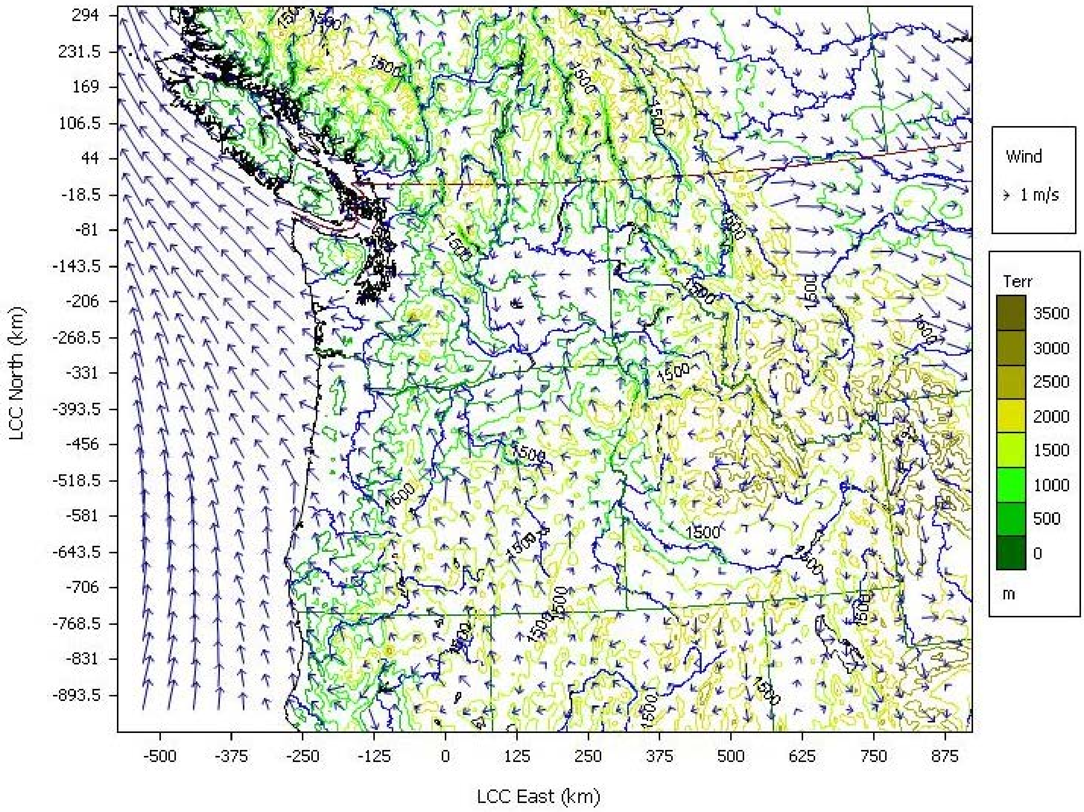

Figure 31. Wind field in the modeling domain for January 15, 2004, one of the high delta-deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than two weeks. The pollutants were elevated near the sources, slowly dispersed, and transported to the Class I areas.

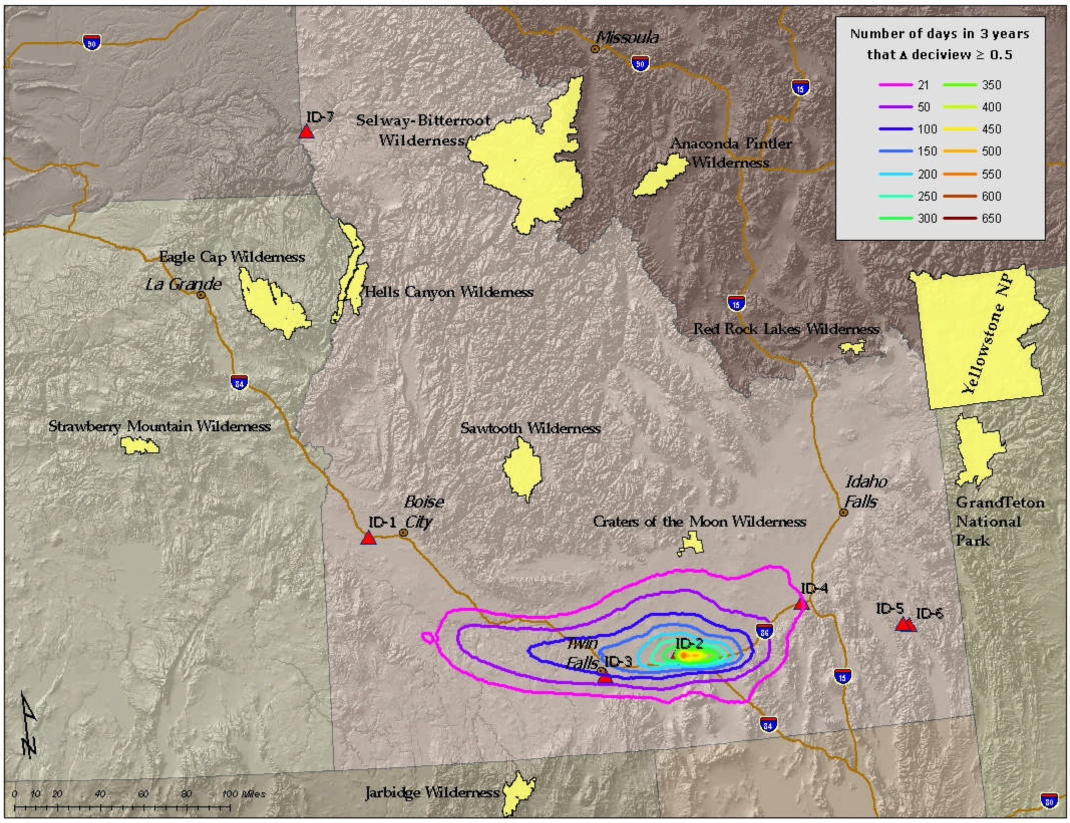

Figure 32. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: TASCO's Erie City boiler at Paul, Idaho. The pattern of dispersion strongly indicates the channeling effects of the terrain. The Craters of the Moon Wilderness is the most significantly impacted Class 1 area because of its location.

Summary and Conclusions

Craters of the Moon had the highest delta-deciview value (0.948) and the highest number of days of visibility degradation (11 days with the delta deciview greater than 0.5, 2003-2005). The eighth highest delta-deciview value in any year was 0.412 (Craters of the Moon, 2004), and the 22nd highest value in the three years was 0.38.

The major contributors to visibility degradation from the TASCO Erie City Boiler are SO_2 and NO_x, precursors of sulfate and nitrate aerosols formed in winter under the conditions of low temperatures and high relative humidity. The impact is greatest when a high pressure system persists in the area for 3-4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported to the Class I area relatively undiluted.

The analysis has demonstrated that the TASCO Erie City Boiler is not subject to BART.

Appendix: CALPUFF Modeling Setup for TASCO Erie City Boiler, Paul, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI20444
Title:	ID-2 4km; Existing Control version 5; 2004 through 2005 corrected

Scenario Description: ID-2; 4km; partical size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 5 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory:	Y:\airmodel\calpuff\runs\bart\wzI20444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category:	Point

Facility Information

Facility ID:	ID-2
Facility Name:	Amalgamated Sugar - Paul

Unit Information

Unit ID:	10

Unit Description:	Erie City Boiler

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 5

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	12
Easting (km):	273.819
Northing (km):	4721.176
Base Elevation (m):	1264

Source Location under Domain Projection and Datum

XEasting (km):	572.203
YNorthing (km):	-660.305

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1268.958
bar_12km (m):	1272.286

Stack Parameters

Height (m):	34.1
Diameter (m):	3.1
Exit Temperature (K):	313.7
Exit Velocity (m/s):	7.74

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	26.55000
SO4 (lb/hr):	9.03273
NOX (lb/hr):	261.67000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	13.28940
PMF (lb/hr):	32.04360
EC (lb/hr):	1.24200
SOA (lb/hr):	3.10500

Emission Rate (Unit: g/s)

SO2 (g/s):	3.34524
SO4 (g/s):	1.13810
NOX (g/s):	32.96987
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	1.67444
PMF (g/s):	4.03743
EC (g/s):	0.15649
SOA (g/s):	0.39122

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	7
ID:	crmowild
Name:	Craters of the Moon NM - Wilderness

State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	272 - 777
ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	778 - 951
ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	952 - 1173
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1174 - 1526
ID:	teto2
Name:	Teton Wilderness
State:	WY
# Total Receptors:	940
# Receptors In Calmet Domain:	940
Position In Receptor List:	1527 - 2466
ID:	yell4
Name:	Yellowstone NP
State:	WY
# Total Receptors:	915
# Receptors In Calmet Domain:	915
Position In Receptor List:	2467 - 3381

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	373
Beginning Row:	33
Ending Row	160

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)

Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Subject-to-BART Analysis

For the TASCO Foster Wheeler Boiler, Twin Falls, Idaho

Modeling Group
Technical Services
Department of Environmental Quality

July 2007

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Introduction

Under the *Regional Haze Rule* of the *Clean Air Act*, each state must set "reasonable progress goals" toward improving visibility in *Class I* areas—areas of historically clear air, such as national parks—and develop a plan to meet these goals. In December 2007, Idaho must submit a state implementation plan (SIP) to the U.S. Environmental Protection Agency (EPA), addressing how it will improve and protect visibility in its Class I areas and those Class I areas outside its borders.

BART Requirements

One strategy for addressing emissions from large, industrial sources is to implement *Best Available Retrofit Technology* (BART). BART is required for any source that meets the following conditions:

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. Common BART eligible sources may include coal-fired boilers, pulp mills, refineries, phosphate rock processing plants, and smelters. Seven BART-eligible sources have been identified in Idaho.

The source is "subject to BART" if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews*—a measure of visibility impairment[11]—is equal to or greater than a contribution threshold of 0.5 deciviews. This determination is made by modeling.

Determining the Subject-to-BART Status of Idaho Sources

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[12], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision.

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[11] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

[12] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

BART Eligible Source: TASCO Foster Wheeler Boiler, Twin Falls

The Foster Wheeler Boiler of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Twin Falls, Idaho has been determined to be BART-eligible. Rated at 308 million BTUs per hour, the Foster Wheeler Boiler is classified as a fossil-fuel boiler of more than 250 million BTUs per hour heat input, was installed in 1973, so it was put into service between August 7, 1962 and August 7, 1977.

The Foster Wheeler Boiler's *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 1,648 tn/yr) and nitrogen oxide (NO_x, 962 tn/yr).

Particulate matter (PM, 138 tn/yr) emissions do not trigger eligibility but must be included in the visibility modeling analysis for determining whether the unit is subject-to-BART, according to the EPA Guidance..

Emission Rates

Maximum 24-hour emission rates for the three-year meteorological period over which CALPUFF modeling for this facility was performed are shown in Table 1. Particulate matter (PM_{10}) in this table includes all particles less than 10 micrometers in size.

Table 22. Emissions rates used for BART modeling.

Facility/Unit	Maximum 24-hour emission rate (lb/hr)		
TASCO-Twin Falls	SO_2	NO_x	PM_{10}*
Foster Wheeler Boiler, Unit 10	291	174	28.7
* See note of Table 2			

Speciation of Emissions

To simulate the visibility-impairing characteristics of particulate matter properly, particulate matter was further speciated into categories of particulate composition: *coarse particular matter* (PMC), particulate matter consisting of particles between 2.5 and 10 micrometers in diameter, and *fine particulate matter* (PM2.5), particulate matter consisting of particles with diameters less than 2.5 micrometers. $PM_{2.5}$ is speciated further to ammonium sulfate ($(NH4)_2SO_4$),ammonium nitrate (NH_4NO_3), elemental carbon (EC), and secondary organic aerosol (SOA), and all other fine particulate matter less than 2.5 um in diameter (PMF). (see Table 2). Particulate speciation for the coal-fired Foster Wheeler Boiler was calculated using the Excel workbook prepared by the National Park Services for coal-fired Boilers-Spreader Stoker using fabric filter for control:

http://www2.nature.nps.gov/air/Permits/ect/ectCoalFiredBoiler.cfm

Detailed speciated emissions used in the modeling for the facility, along with information about the facility, such as location and stack parameters, are presented in Table 2.

Table 23. Facility information, stack parameters, and speciation of emissions.

Facility Information	Facility_ID	ID-3
	Facility_Name	Amalgamated Sugar - Twin Falls
Unit Information	Unit_ID	10
	Unit_Description	Foster Wheeler Boiler
Control Information	Control_ID	41
	Control_Description	Existing Control - Ver. 6
Datum, Projection, Source Location and Base Elevation	Datum	NAD27
	Projection	UTM
	UTM_Zone	11
	Longitude_Easting (km)	711.018
	Latitude_Northing (km)	4711.77
	Base_Elevation (m)	1161
Stack Parameter	Stack_Height (m)	48
	Stack_Diameter (m)	2
	Stack_Exit_Temperature (K)	416.5
	Stack_Exit_Velocity (m/s)	15
Emission Rate (lb/hr)	Sulfur dioxide (SO2)	291
	Sulfate (SO4)	15.33
	Nitrogen oxides (NOX)	174.00
	Nitric acid (HNO3)	0
	Nitrates (NO3)	0
	Coarse Particulate Matter, 2.5 to 10 micrometers in size, (PMC)	1.32
	Fine Particulate Matter, < 2.5 micrometers in size, (PMF)	1.00
	Elemental Carbon, (EC)	0.03
	Secondary Organic Aerosol (SOA)	5.26

Note: All of sulfate particulates are assumed to be ammonium sulfate, (NH4)2SO4 = 1.375*SO4 (Mass)
All of nitrate particulates are assumed to be ammonium nitrate (NH3)NO3 = 1.29*NO3 (Mass)

CALPUFF Model Setup

Modeling of the facility was performed in accordance with the BART Modeling Protocol and implemented using a DEQ-developed interface to the CALPUFF Modeling system. The domain (the spatial extent) of the modeling analysis for the facility is shown in Figure 33

The blue circle represents a region of 300 kilometers (km) radius, centered at the source. In accordance with EPA requirements and the modeling protocol, all Class I areas within this circle were included in the analysis.

The pink rectangle shows the resultant computational modeling domain used for the analysis. The shape of the domain is determined by the selected Class I areas plus an additional 50 km of buffer zone extending out from the furthermost extent of the Class I areas.

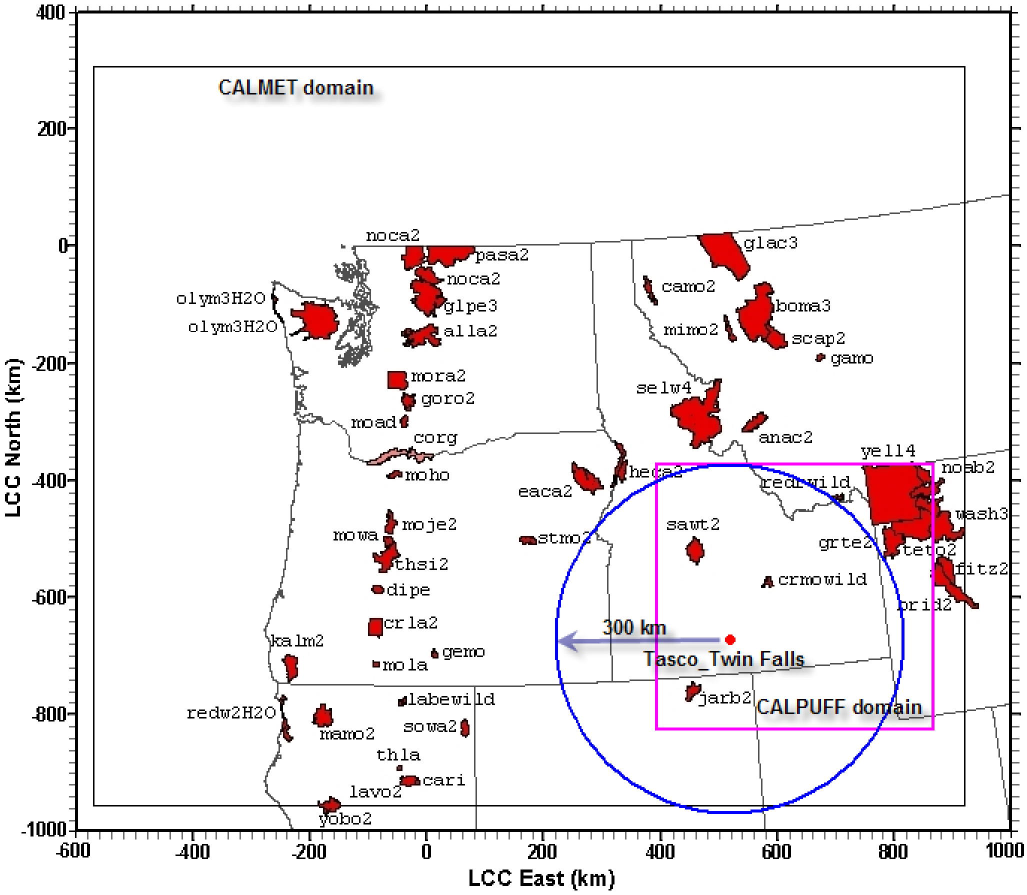

Figure 33. Modeling domain for TASCO Foster Wheeler Boiler, Twin Falls, Idaho. The CALMET meteorological domain covers the northwest region. Class I areas inside a 300 km radius centered at the source—including those areas only partially within the circle—are included in the CALPUFF BART modeling domain. An additional buffer distance of 50 km, extending from the outer extent of Class 1 areas near the domain boundary, was added for modeling purposes.

The meteorological inputs needed by CALPUFF for the analysis were prepared by Geomatrix, Inc using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution, as shown in Figure 1.

Details of the model setup, emission data, and information about the modeled Class I areas are provided in the Appendix.

Results

CALPUFF modeling results for the TASCO Foster Wheeler Boiler, Twin Falls are shown in Table 3. Two threshold values for BART were listed:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for deciview change

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for deciview change over three years

For both threshold values, the determining criterion is a change of at least 0.5 deciview.

Table 24. The number of days with 98th percentile daily change larger than or equal to 0.5 deciview for Class I areas within 300 km from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005			
Class I Area	8th highest	Total days	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days (2003,2004,2005)
Great Teton NP, WY	0.076	0	0.073	0	0.085	0	0.073	0
Red Rock Lakes, MT	0.072	0	0.072	0	0.066	0	0.072	0
Sawtooth, ID	0.033	0	0.061	0	0.05	0	0.047	0
Jarbidge Wilderness, NV	0.107	0	0.152	2	0.101	0	0.124	2
Craters of the Moon, ID	0.211	0	0.381	3	0.256	1	0.270	4

Class I Areas Affected

Based on the model results, none of the Class I areas was affected significantly (with the value of 98th percentile over 0.5 deciview) by the Foster Wheeler Boiler, Twin Falls, Idaho.

Area of Greatest Impact

The Foster Wheeler Boiler had the greatest impact on the Craters of the Moon National Monument in February 1, 2004. Details of the 22 highest calculated changes in deciview for the three-year modeling period are listed in Table 4, ranked in order of deciview change over background.

Table 4 also shows the relative contributions to visibility degradation for each of the emission components of the facility. Sulfate and nitrate are the main contributors.

Variation of Impact by Year

The 8th highest values of each year and the 22nd highest for three years 2003 through 2005 are plotted in Figure 2, which shows that the 8th highest value varies significantly from year to year.

The top 22 delta-deciview values predicted in the Craters of the Moon National Monument area are plotted in Figure 3.

Table 25. The top 22 highest Delta-deciview values and related modeling output data at Craters of the Moon Wilderness Area.

22 highest at Craters of the Moon, Source: TASCO Foster Wheeler Boiler, Twin Falls												
Rank	YEAR	DAY	DV (Total)	DV (BKG)	DELTA DV	F(RH)	% SO4	% NO3	% OC	% EC	% PMC	% PMF
1	2004	19	2.945	2.208	0.737	3.13	59.97	39.12	0.84	0.01	0.02	0.04
2	2004	27	2.887	2.208	0.679	3.13	64.28	34.66	0.98	0.01	0.02	0.05
3	2005	17	2.787	2.208	0.579	3.13	66.11	33.07	0.76	0.01	0.01	0.04
4	2004	341	2.738	2.19	0.548	3.04	44.6	53.54	1.71	0.02	0.05	0.08
5	2004	346	2.669	2.19	0.479	3.04	47.68	50.51	1.66	0.02	0.05	0.08
6	2004	21	2.687	2.208	0.479	3.13	73.06	26.25	0.64	0.01	0.01	0.03
7	2005	361	2.668	2.19	0.478	3.04	49.18	49.35	1.36	0.02	0.04	0.06
8	2003	346	2.64	2.19	0.451	3.04	53.07	45.33	1.47	0.02	0.04	0.07
9	2004	41	2.563	2.129	0.435	2.74	55.98	42.86	1.06	0.01	0.02	0.05
10	2004	340	2.607	2.19	0.417	3.04	47.11	51.32	1.44	0.02	0.04	0.07
11	2005	305	2.551	2.135	0.416	2.77	40.81	55.72	3.18	0.04	0.1	0.15
12	2004	32	2.51	2.129	0.381	2.74	45.87	51.69	2.24	0.03	0.07	0.11
13	2003	323	2.506	2.135	0.371	2.77	40.74	56.93	2.13	0.03	0.07	0.1
14	2005	311	2.491	2.135	0.356	2.77	45.69	51.71	2.38	0.03	0.07	0.11
15	2004	359	2.528	2.19	0.338	3.04	50.25	48.25	1.39	0.02	0.02	0.07
16	2004	336	2.522	2.19	0.332	3.04	53.47	45.31	1.14	0.02	0.01	0.05
17	2004	46	2.436	2.129	0.307	2.74	61.78	37.03	1.11	0.02	0.02	0.05
18	2005	360	2.48	2.19	0.29	3.04	45.64	53.13	1.14	0.02	0.03	0.05
19	2005	274	2.252	1.971	0.281	1.97	38.91	56.27	4.4	0.06	0.15	0.21
20	2004	335	2.415	2.135	0.28	2.77	44.78	53.52	1.58	0.02	0.03	0.08
21	2003	81	2.309	2.035	0.275	2.28	39.69	56.98	3.05	0.04	0.09	0.15
22	2004	20	2.478	2.208	0.27	3.13	69.24	30	0.71	0.01	0.01	0.03

Day: Ordinal day of year
DV(total): total delta deciview including background and change due to the modeled emission source.
DV(BKG): Background delta deciview.
DELTA_DV: Change of deciview due to the modeled pollutants
F(RH): relative humidity factor, varies month by month
%_SO4: contribution to the impact to the visibility from sulfate
%_NO3: contribution to the impact to the visibility from nitrate
%OC: contribution to the impact to the visibility from organic carbon
%_EC: contribution to the impact to the visibility from elemental carbon
%_PMC: contribution to the impact to the visibility from coarse particulates (2.5-10µm)
%_PMF: contribution to the impact to the visibility from fine particulates (2.5µm or smaller)

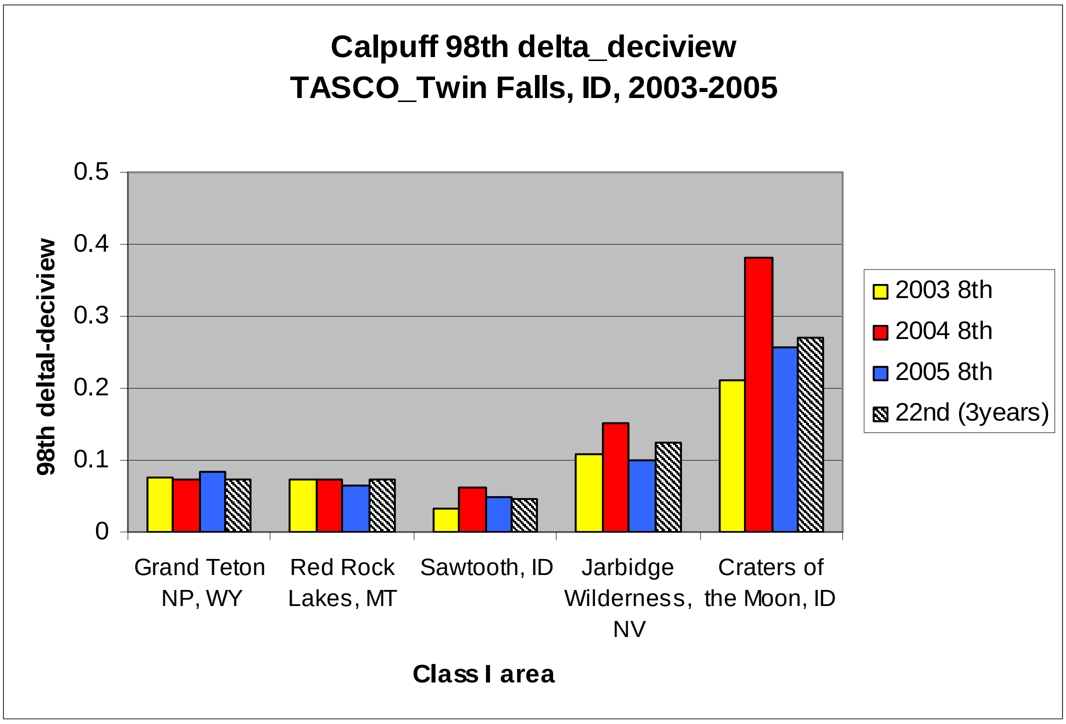

Figure 34. 98th percentile values of delta-deciview in Class I areas for the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

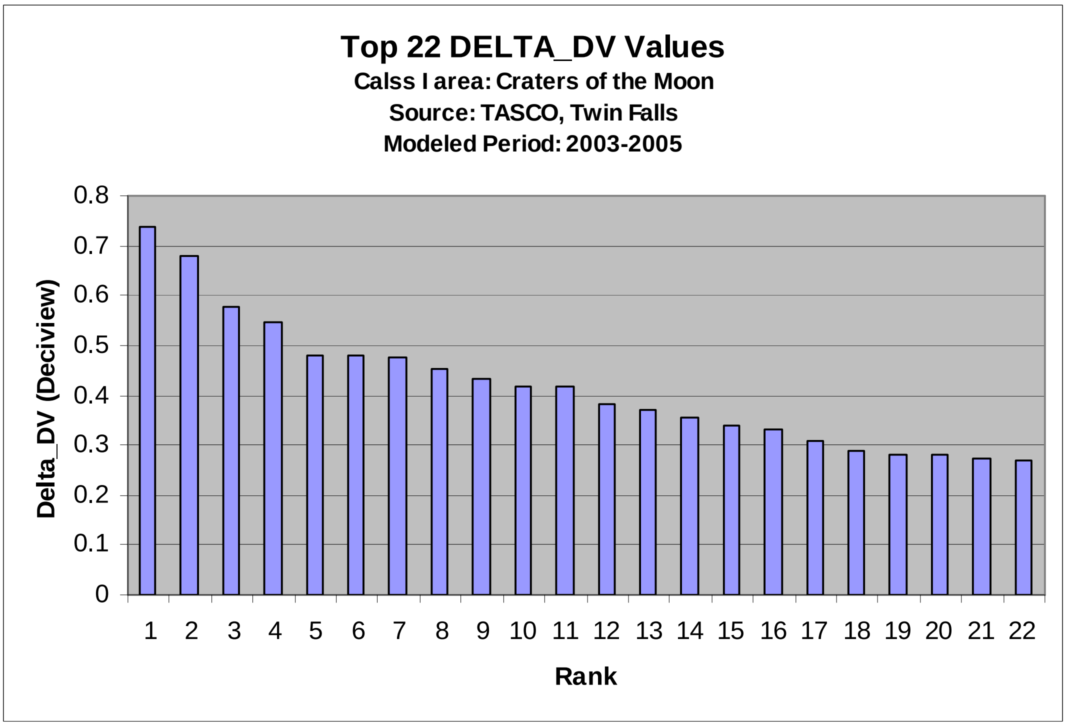

Figure 35. Top 22 highest Delta-deciview values at Craters of the Moon Wilderness area for the TASCO Foster Wheeler Boiler, Twin Falls, Idaho.

Dominating Pollutants for Visibility Impact

The results showed secondary aerosols of sulfate and nitrate formed from SO_2 and NO_2 emissions from the TASCO Foster Wheeler Boiler, Twin Falls are the dominating pollutants impacting the visibility in Class I areas. Figure 36 shows the percentage contributions of the pollutants for the average of the highest 22 days in the modeling period from 2003 to 2005. This is the three-year average of the worst days.

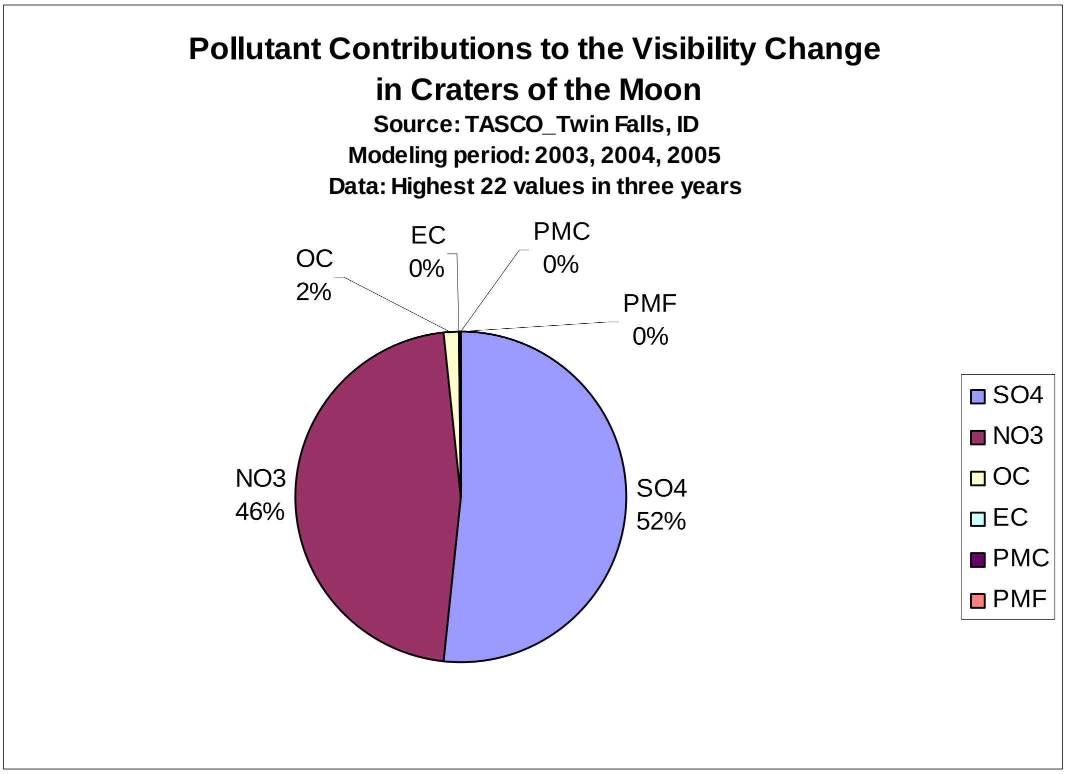

Figure 36. The pollutant contribution from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho, to visibility change at Craters of the Moon WIldeness, Idaho. The total contribution from Sulfate and Nitrate is about 98%.

Seasonal Variation of Visibility Degradation

Figure 5 shows that the most significant impact to visibility for the Craters of the Moon Wilderness occurs between November and February.

In the modeling period from 2003 to 2005, significant seasonal variations are observed, and it is especially noticeable for 2004. When the winter meteorological conditions are favorable for hygroscopic aerosols formation, the delta-deciview dramatically increases; the effect is minimal in the dry and hot summertime.

It should be noted that the highest values for the Craters of the Moon, which occurred during January 2004, are much higher than the most highest values in January of 2003 and 2005. An investigation indicated that this winter peak was due to the unusual meteorological conditions during the period and the relative location of the facility and the

Class I Area (see Figure 38 and Figure 39 in the next section) in the broad Snake River valley.

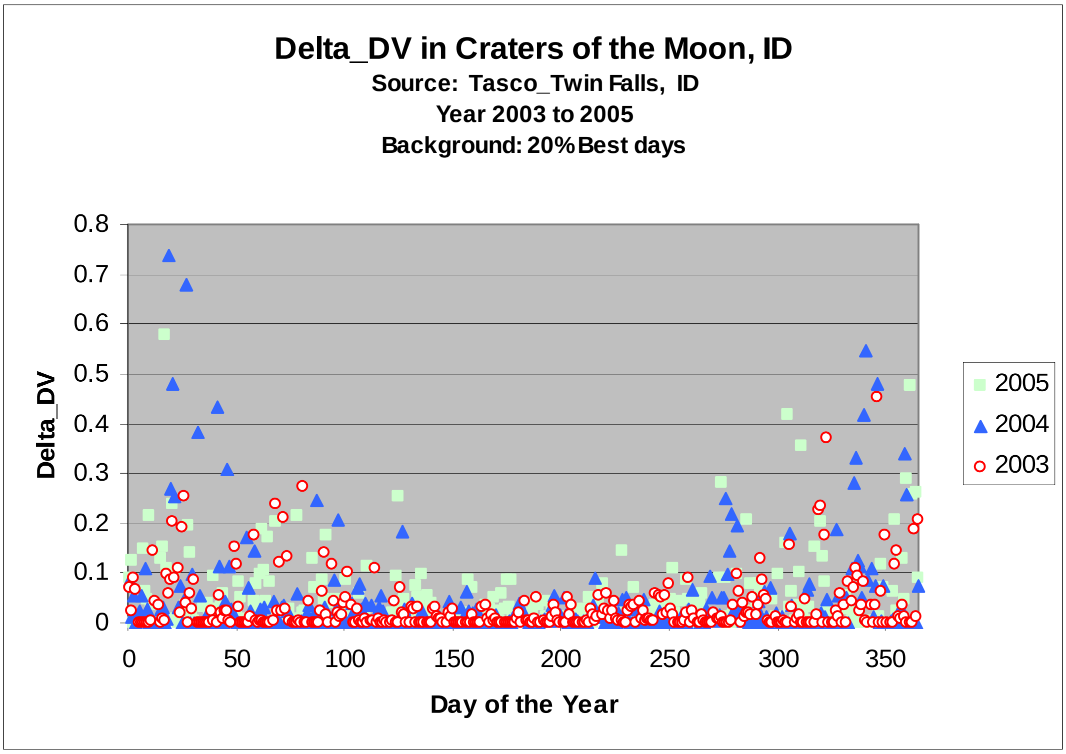

Figure 37. Seasonal impact from the TASCO Foster Wheeler Boiler, Twin Falls, Idaho to Craters of the Moon National Monument area, Oregon, which is located about 120 km north-west from the source.

Meteorological and Geological Conditions

The impact to visibility in Class I areas is strongly dependent on meteorological and geological conditions. Figure 7 shows the strong stagnation conditions that occurred during the episode of January 2004. During such an episode, pollutants pool up in the valleys and slowly transport to the Class I areas with little dispersion.

Terrain also strongly influences impact of emission sources in the area. Figure 39 shows a contour map of the number of days of deciview change higher than or equal to 0.5. The channeling effect of the terrain is clearly shown, indicating that sources are unlikely to significantly affect Class I areas in the region under the investigation.

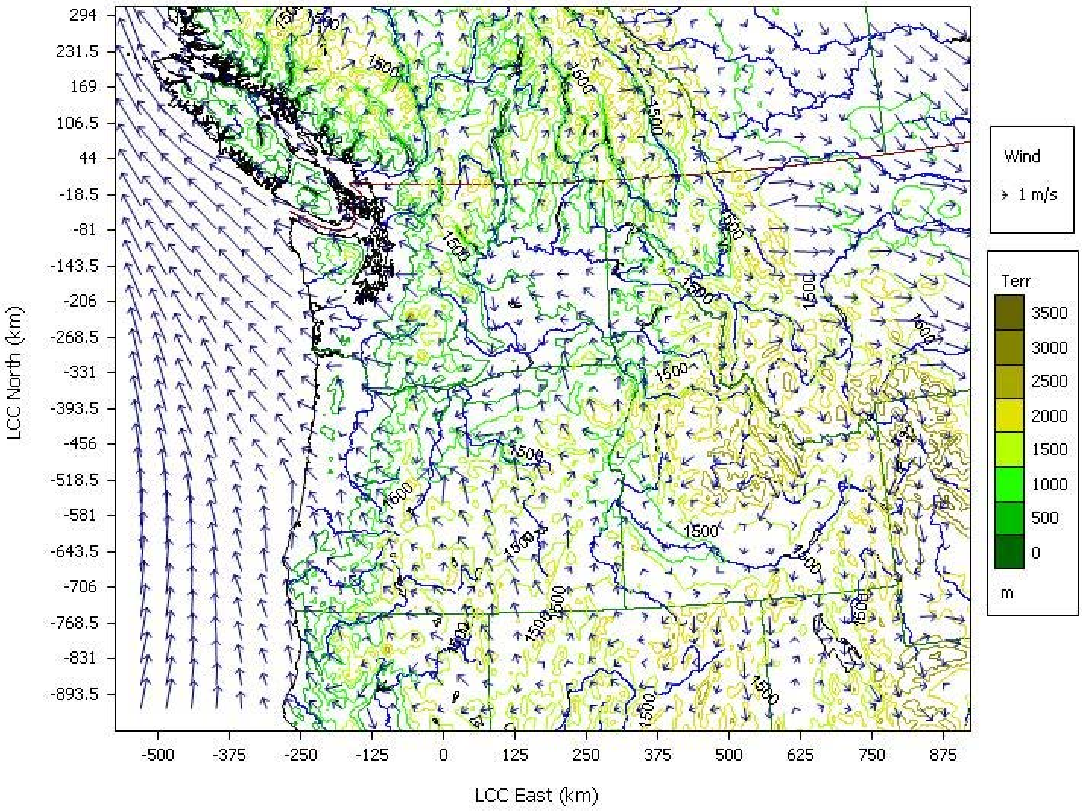

Figure 38. Wind field in the modeling domain for January 15, 2004, one of the high delta_deciview days at Craters of the Moon. A strong stagnation system persisted in the Snake River Valley for more than two weeks. The pollutants were elevated near the sources, slowly dispersed, and transported to the Class I areas.

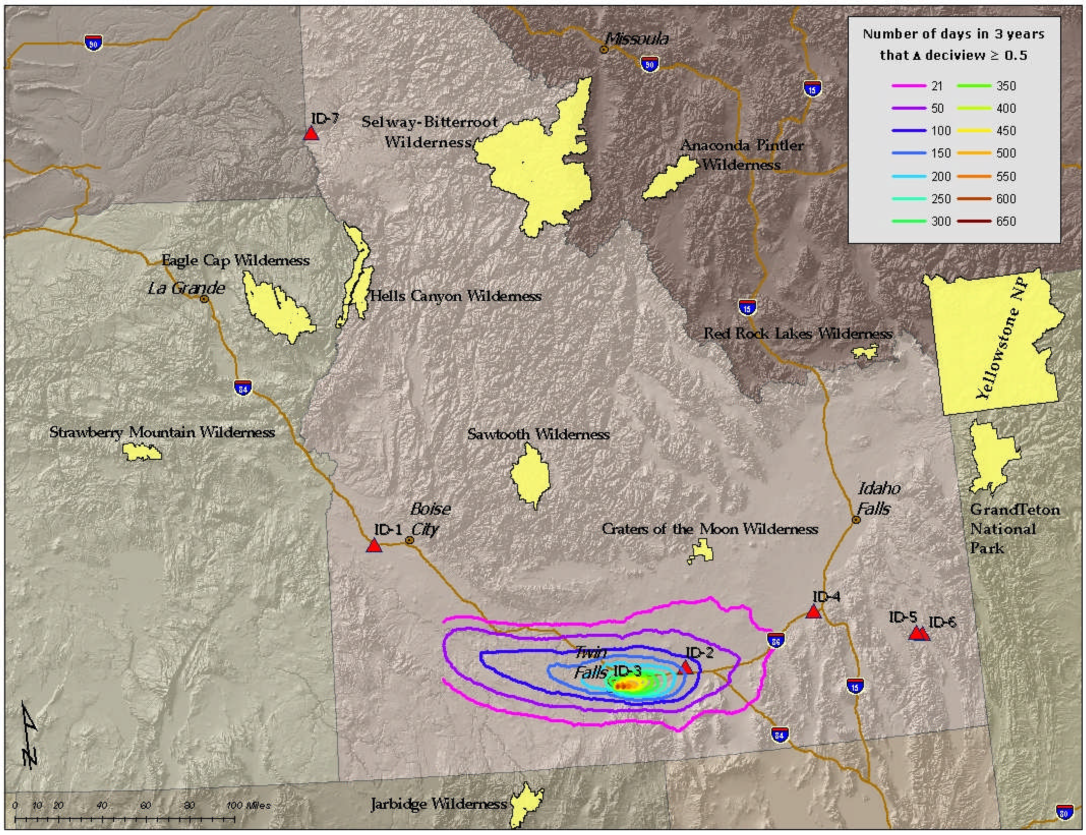

Figure 39. Contour map of number of impact days equal to or higher than 0.5 delta-deciview. Modeling period: 2003-2005. Source: TASCO Foster WheelerBoiler at Twin Falls, Idaho (ID-3). The pattern of dispersion strongly indicates the channeling effects of the terrain. The Craters of the Moon Wilderness area is the most significantly impacted area by the source because of its location.

Summary and Conclusions

Craters of the Moon had the highest delta-deciview value (0.737) and the highest number of days of visibility degradation (4 days with the delta deciview greater than 0.5, 2003-2005). The eighth-highest delta-deciview value for Craters of the Moon was 0.381 and the 22nd highest of 0.27.

The major contributors to visibility degradation from the Foster Wheeler Boiler are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for 3 to 4 days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The analysis has demonstrated that the TASCO Foster Wheeler Boiler in Twin Falls is not subject to BART.

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Appendix: CALPUFF Modeling Setup for TASCO Foster Wheeler Boiler, Twin Falls, Idaho

Scenario Summary

Scenario Information

Scenario Name:	wzI30444	
Title:	ID-3 4km Existing Control version 6; 2004 through 2005 corrected	

Scenario Description: ID-3; 4km; particle size distribution(0.5/1.5 for fine, 5/1.5 for coarse); model source elevation; Existing Control version 6 (Control_ID = 41); 2004 through 2005 corrected

Species Group Information

Species Group ID:	1
Number of Species:	9
Species Names:	SO2, SO4, NOX, HNO3, NO3, PMC, PMF, EC, SOA

Calpuff Working Directory

Working Directory: Y:\airmodel\calpuff\runs\bart\wzI30444

Domain Projection and Datum

Projection:	Lambert Conic Conformal	
Origin of Projection:	Latitude: 49	Longitude: -121
Matching Latitudes:	Latitude 1: 30	Latitude 2: 60
Offset(km):	XEasting: 0	YNorthing: 0
Datum:	NWS	

Calmet Domain

Domain Name and Short Name:	bart_4km	bar_4km
Grid Origin(km):	X: -572	Y: -956
Grid Spacing(km):	4	
NX and NY:	NX: 373	NY: 316

Sources

Number of Sources:	1
Source_Elevation_Option:	Model

Source 1

Source Category

Category: Point

Facility Information

Facility ID:	ID-3
Facility Name:	Amalgamated Sugar - Twin Falls

Unit Information

Unit ID: 10

Unit Description:	Foster Wheeler Boiler

Control Strategy Applied

Control ID:	41
Control Description:	Existing Control - Ver. 6

Source Location and Base Elevation

Datum:	NAD27
Projection:	UTM
UTM Zone:	11
Easting (km):	711.018
Northing (km):	4711.77
Base Elevation (m):	1161

Source Location under Domain Projection and Datum

XEasting (km):	519.842
YNorthing (km):	-673.500

Model Source Base Elevation In Calmet Domain

bar_4km (m):	1168.283
bar_12km (m):	1190.666

Stack Parameters

Height (m):	48
Diameter (m):	2
Exit Temperature (K):	416.5
Exit Velocity (m/s):	15

Emission Rate (Unit: lb/hr)

SO2 (lb/hr):	291.00000
SO4 (lb/hr):	15.33592
NOX (lb/hr):	174.00000
HNO3 (lb/hr):	0.00000
NO3 (lb/hr):	0.00000
PMC (lb/hr):	1.32152
PMF (lb/hr):	1.00551
EC (lb/hr):	0.02873
SOA (lb/hr):	5.25736

Emission Rate (Unit: g/s)

SO2 (g/s):	36.66538
SO4 (g/s):	1.93229
NOX (g/s):	21.92363
HNO3 (g/s):	0.00000
NO3 (g/s):	0.00000
PMC (g/s):	0.16651
PMF (g/s):	0.12669
EC (g/s):	0.00362
SOA (g/s):	0.66242

Class I Areas

Searching Radius (km):	300km
Number of Class I Areas:	5

ID:	crmowild
Name:	Craters of the Moon NM - Wilderness

State:	ID
# Total Receptors:	271
# Receptors In Calmet Domain:	271
Position In Receptor List:	1 - 271
ID:	grte2
Name:	Grand Teton NP
State:	WY
# Total Receptors:	506
# Receptors In Calmet Domain:	506
Position In Receptor List:	272 - 777
ID:	jarb2
Name:	Jarbidge Wilderness
State:	NV
# Total Receptors:	174
# Receptors In Calmet Domain:	174
Position In Receptor List:	778 - 951
ID:	redrwild
Name:	Red Rock Lakes Wilderness
State:	MT
# Total Receptors:	222
# Receptors In Calmet Domain:	222
Position In Receptor List:	952 - 1173
ID:	sawt2
Name:	Sawtooth Wilderness
State:	ID
# Total Receptors:	353
# Receptors In Calmet Domain:	353
Position In Receptor List:	1174 - 1526

Computational Domain

Minimum Buffer (km):	50
Beginning Column:	242
Ending Column:	360
Beginning Row:	33
Ending Row	146

Calpuff Run Period Definition

Base Time Zone:	8 (Pacific Standard)
Calpuff Beginning Time:	01/01/2003 00:00:00
Calpuff Ending Time:	01/01/2006 00:00:00
Calpuff Time Step(Second):	3600

Amalgamated Sugar Company (TASCO)

Best Available Retrofit Technology Determination

Department of Environmental Quality

Amalgamated Sugar Company (TASCO) Best Available Retrofit Technology Determination

July 17, 2009

Amalgamated Sugar Company (TASCO)
Best Available Retrofit Technology Determination

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History of BART

The 1977 Clean Air Act (CAA) Amendments created Part C of the Act entitled Prevention of Significant Deterioration of Air Quality and includes Sections 160-169. The intent of the Prevention of Significant Deterioration (PSD) provisions is to maintain good air quality in areas that attain the national air quality standards and provide special protections for National Parks Wilderness Areas. Part C is divided into two subparts. Subpart 1 established the initial classification of Class I and Class II areas. Class I areas include: Section 162(a)

> *"(1)International Parks,*
>
> *(2) national wilderness areas which exceed 5,000 acres in size,*
>
> *(3) national memorial parks which exceed 5,000 acres in size, and*
>
> *(4) national parks which exceed six thousand acres in size and which are in existence on the date of the enactment of the Clean Air Act Amendments of 1977 shall be Class I areas and may not be redesignated. . . .*
>
> *(b) All areas in such State designated . . . as attainment or unclassifiable which are not established as class I under subsection (a) shall be class II areas . . . ."*

The Class I areas that met this criteria and were in existence on or before 1977 became known as "mandatory class I federal areas." Although states could designate other areas as Class I areas after 1977, PSD and other portions of the Regional Haze Rule focus on those Class I areas in existence on or before 1977.

Based on the classification of an area, the amount of allowable degradation which is from new or modified air pollution sources is determined. In National Parks and other Class I areas smaller amounts of degradation known as "increment" are allowed. The PSD program under Part C, Subpart 1 primarily focuses on emission from 1977 forward and will be further discussed in the chapters on Reasonable Progress and Long Term Strategies.

Visibility is called out much stronger in Part C, Subpart 2 and set the national goal of "the prevention of any future and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution" (CAA Section 169(A). In an effort to remediate the existing impairments to visibility, the Section 169(A)(2)(A) includes "a requirement that each major stationary source which is in existence on the date of enactment of this section, but which has not been in operation for more than fifteen years as of such date, . . .emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area, shall procure, install and operate, as expeditiously as practicable (and maintain thereafter) the best available retrofit technology, as determined by the state."

To carry out Congress' intent to install BART on certain emission sources, EPA promulgated the "Regional Haze Rule" [64 FR 35714 (July 1, 1999)]. These rules were challenged, and on May 24, 2002, the U. S. Court of Appeals for the District of Columbia vacated the Regional Haze Rule and remanded the BART provisions in the Rule.

Revisions to the rule were published on July 6, 2005 [70 FR 39104 (July 6, 2005)]. The BART rule can also be found under 40 CFR 51.308(e). As part of the July 6, 2005 rule revisions, EPA published Appendix Y guidance for the implementation of BART. The guidance can be found beginning at 70 FR 39156 (July 6, 2005).

In the spring of 2006, the Department of Environmental Quality (DEQ) went through a negotiated rulemaking process to develop rules for Regional Haze. During this process rules were negotiated for the implementation of BART and Reasonable Progress Goals. These rules pertaining to BART can be found at IDAPA 58.01.01.668. During the negotiated rule making process, it was recommended by industry representatives to follow EPA Appendix Y Guidance on the BART determination process but not incorporate the guidance into rule under IDAPA. A threshold of visibility impact of 0.5 deciviews in any Class I Federal Area was established through negotiated rule making as "contributing" to visibility impairment.

BART Process

The BART provision applies to "major stationary sources" from 26 identified source categories which have the potential to emit 250 tons per year or more of any air pollutant. The CAA requires that only sources which were built or in operation during a specific 15-year time interval be subject to BART. The BART provision applies to sources that existed as of the date of the 1977 CAA amendments (that is, August 7, 1977) but which had not been in operation for more than 15 years (that is, not in operation as of August 7, 1962). The first phase of the BART process is developing a list of BART "eligible" facilities which include those major facilities from the 26 identified source categories that have a potential to emit 250 tons per year of any light impairing pollutant.

The CAA requires BART review when any source meeting the above description "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in any Class I area. In most cases, the determination of whether a facility is causing or contributing to visibility impairment is done through modeling. Any BART-eligible facility with an impact of one deciview is considered "causing" visibility impairment, and in Idaho the threshold for "contributing" to impairment is 0.5 deciview[13]. Any BART-eligible facility causing or contributing to visibility impairment is BART "subject." BART subject facilities are required to go through a process to determine what if any controls will be required.

BART Eligibility

The source is *BART-eligible*, meaning that it falls into one of 26 sector categories, was built between 1962 and 1977, and annually emits more than 250 tons of a haze-causing pollutant. The Riley Boiler of The Amalgamated Sugar Company, LLC (TASCO) Sugar Plant in Nampa, Idaho has been determined to be BART-eligible. The Boiler is rated at 350 million BTUs per hour which meets the BART criteria as a fossil-fuel boiler of more

[13] A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions—from pristine to highly impaired. A deciview is the minimum perceptible change to the human eye.

than 250 million BTUs per hour heat input, was installed in 1969, and was put into service between August 7, 1962 and August 7, 1977.

The Riley Boiler's *Potential to Emit* (PTE) exceeds 250 tons per year (tn/yr) for the haze-causing pollutants sulfur dioxide (SO_2, 2,770 tn/yr), nitrogen oxide (NO_x, 1,708 tn/yr), and particulate matter (PM, 55 tn/yr), so this emission unit is eligible for inclusion in the subject-to-BART analysis of visibility impairment in Class I areas. Following this criteria the Riley Boiler at the Nampa TASCO plant is BART-eligible.

BART Subject

The source is *subject to BART* if it is reasonably anticipated to cause or contribute to impairment of visibility in a Class I area. According to the Guidelines for Best Available Retrofit Technology (BART) Determinations contained in 40 CFR Part 51, Appendix Y, a source is considered to contribute to visibility impairment if the modeled 98th percentile change in *deciviews* (delta-deciview)—a measure of visibility impairment—is equal to or greater than a contribution threshold of 0.5 deciviews. Although Appendix Y does provide for thresholds less than 0.5 deciviews and cumulative impacts, it was determined through negotiated rulemaking with industry, federal land management agencies, DEQ and the public that the "contribute" threshold for a single source would be established at 0.5 deciviews. (See IDAPA 58.01.01.668.02.b.) As suggested in Appendix Y guidance, the determination was made by modeling.

DEQ used the CALPUFF air dispersion modeling system (version 6.112) to determine if the 0.5 deciview threshold is exceeded by any of the BART-eligible sources in Idaho. The modeling of BART-eligible sources was performed in accordance with the *BART Modeling Protocol*[14], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision. Refer to the *BART Modeling Protocol* for details on the modeling methodology used in this subject-to-BART analysis (See Appendix A).

The Idaho DEQ, in cooperation with Washington State of Ecology and Oregon Department of Environmental Quality contracted with Geomatrix Consultants to develop CALMET datasets to use for the CALPUFF BART modeling. The CALMET datasets were based on Penn State and National Center of Atmospheric Research Mesoscale Model (MM5) runs performed at Washington University. There were two CALMET datasets produced--one using 12km mesh size and another using 4 km mesh size[15]. (See Appendix B.)

As part of the contract, Geomatrix Consultants ran MESTAT to quantify the quality of the MM5 files used as the meteorological dataset in CALMET—used in the CALPUFF modeling. MESOSTATE pairs the MM5 forecasted data with meteorological observations

---

[14] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

[15] *Modeling Protocol for BART CALMET datasets, Idaho Oregon and Washington,*Geomatrix Consultants Inc., July 12, 2006

and then performs various statistical manipulations and aggregates the results for output.[16] (See Attachment C.).

Subject-to-BART analysis results for the TASCO Riley Boiler, Nampa are shown in Table 1, which highlights the following two threshold values for BART:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) cutoff for delta-deciview in the each year.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) cutoff for delta-deciview over three years.

The determining criterion for both values is a delta-deciview of at least 0.5 deciview. Table 26. Change in Visibility Compared Against 20% Best Days Natural Background

Class I Area	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Craters of the Moon	0.161	2	0.224	2	0.153	0	0.196	2
Eagle Cap Wilderness, OR	0.87	20	1.355	46	1.302	46	1.325	112
Hells Canyon National Recreation Area, ID	0.772	13	1.031	27	0.9	21	0.936	61
Jarbidge Wilderness, NV	0.151	0	0.198	1	0.201	1	0.179	2
Sawtooth Wilderness, ID	0.239	2	0.294	4	0.265	0	0.271	6
Selway-Bitterroot Wilderness, ID and MT	0.186	0	0.305	1	0.264	2	0.243	3
Strawberry Mountain Wilderness, OR	0.782	12	0.639	13	1.596	31	0.943	56

e. The 8th highest delta-deciview for the calendar year.
f. Total number of days in 1 year that exceeded 0.5 delta-deciviews.
g. The 22nd highest delta-deciview value for the 3-year period.
h. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

These findings were based on the emission rates and other facility parameters provided by TASCO at the time of the analysis[17]. Based on the analysis, the TASCO Riley Boiler impacted the following Class I areas with the 98th percentile highest delta-deciview greater than 0.5 during the modeling period 2003-2005:

[16] *INTITIAL METSTAT REPORT CALMET Fields for BART Idaho, Oregon and Washington,* Geomatrix Consultants

[17] The delta deciview impact for each of the Class I areas identified in the Subject-to-BART analysis changed slightly in the final determination process due to refinements in facility parameters such as stack velocities as provided by TASCO.

Eagle Cap Wilderness, Oregon

Hells Canyon National Recreation Area, Idaho

Strawberry Mountain Wilderness, Oregon

In conclusion, the CALPUFF model predicted that emissions from the Riley Boiler at the TASCO Sugar Plant, Nampa, Idaho, impacted visibility with the 98th percentile highest delta-deciview of more than 0.5 deciview on the Class I areas of Eagle Cap Wilderness, OR; Strawberry Mountain Wilderness, OR; and Hells Canyon Wilderness, ID, during the period of year 2003 to 2005.

Eagle Cap Wilderness area had the highest number of days (112 days in three years) with delta-deciview value greater than 0.5. The highest one-year 8th high delta-deciview (1.596, year 2005) was found in Strawberry Mountain Wilderness.

The major contributors to visibility deterioration from the Riley Boiler of the TASCO, Nampa facility are SO_2 and NO_2, precursors of sulfate and nitrate aerosols formed in winter under conditions of low temperature and high relative humidity. The impact is greatest when a high-pressure system persists in the area for three to four days or more, the atmosphere is stagnant with poor dispersion, and the pollutants transported remain relatively undiluted.

The subject-to-BART analysis, which followed the *BART Modeling Protocol*, and additional extensive sensitivity analysis have demonstrated that the Riley Boiler of the TASCO, Nampa facility is subject to BART. TASCO was notified of the subject-to-BART findings by letter on July 19, 2007. (See attachment A.)

1.2.3. BART Determination

The third phase of the BART process is the determination of technically feasible control technologies. The Clean Air Act defines five factors in making a determination. They include:

- The cost of compliance,
- The energy and non-air quality environmental impacts of compliance,
- Any existing pollution control technology in use at the source,
- The remaining useful life of the source, and
- The degree of visibility improvement which may reasonably be anticipated from the use of BART.

In making the BART determination TASCO was requested to follow Appendix Y guidance for the implementation of BART as found at 70 FR 39156 (July 6, 2005). Although this guidance was required for Electrical Generation Units (EGUs), EPA has determined there is no reason the guidance cannot be used for other BART categories. The five steps as described in Appendix Y determination process can be summarized as follows:

STEP 1 – Identify all available retrofit emissions control techniques (three categories)

- Pollution prevention (use of inherently lower-emitting processes/practices)

- Use of (and where already in place, improvement in the performance of) add-on controls
- Combination of pollution prevention and add-on controls

STEP 2 – Determine technically feasible options

- Available (commercial availability)
- Applicable (Has it been used on the same or a similar source type?)

STEP 3 – Evaluate technically feasible options

- Make sure you express the degree of control using a metric that ensures an “apples to apples” comparison of emissions performance levels among options (e.g., lb SO2/MMBtu).
- Give appropriate treatment and consideration of control techniques that can operate over a wide range of emission performance levels (evaluate most stringent control level that the technology is capable of achieving plus other scenarios).

STEP 4 – Impact analysis

- Cost of compliance (Identify emission units, design parameters, develop cost estimates.)
  - Baseline emissions rate should represent a realistic depiction of anticipated annual emissions from the source. In general, for the existing sources subject to BART, you will estimate the anticipated annual emissions based upon actual emissions from a baseline period.
- Energy impacts
  - Direct energy consumption for the control device, not indirect energy impacts
- Non-air quality environmental impacts
  - Solid or hazardous waste generation or discharges of polluted water from a control device
- Remaining useful life
  - Can be included in the cost analysis

STEP 5 – Determine visibility impacts (improvements)

- Run the model at pre-control and post-control emission rates
  - Pre-control emission rates = max 24-hour used in BART subject modeling
  - Post-control emission rates = % of pre-control rates (e.g., 95% control efficiency)
  - Calculate results for each receptor as the change in Deciviews compared against natural visibility
- Determine net visibility improvement
  - Consider frequency, magnitude, and duration components of impairment
  - Can compare 98th percent days

TASCO BART Determination

After several consultations with TASCO concerning emission rates, facility parameters and the BART process, TASCO submitted a "Best Available Retrofit Technology Determination – Riley Boiler" on November 20, 2007. After reviewing the document, DEQ requested that TASCO revise the document to include some additional control technologies that were technically feasible, evaluate them using the five steps listed above and provide additional cost and financial detail. TASCO revised the document and resubmitted the information on February 6, 2009. As part of the revisions, DEQ performed the CALPUFF modeling to identify changes in visibility based on the emission estimates and facility parameters provided by TASCO for each of the technically feasible control technologies for each BART identified pollutant. The remainder of this document will review the February 6, 2009 BART determination as submitted by TASCO, comments on issues raised in the document, and provide DEQ's determination on the selection of the Best BART technologies based on the categories listed above.

Particulate BART Control Technology Selection

In determining the "best" BART control technology for particulate controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

In consultation with DEQ, the following particulate control technologies were identified:

- Existing baghouse
- Enhanced baghouse
- Wet Electrostatic Precipitator (Wet ESP)
- Dry Electrostatic Precipitator (Dry ESP)

STEP 2 – Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Existing Baghouse - The existing baghouse efficiently reduces PM to very low levels. Measured PM emissions are 0.036 lbs/MMBTU, well below the previously proposed industrial boiler MAACT standard of 0.07 lbs/MMBTU. Control efficiencies for baghouses are reported at 99.0 to 99.9%. For this analysis the control efficiency was assumed to be 99% efficient.

Enhanced Baghouse – The addition of a baghouse module may marginally improve the removal efficiency of the existing baghouse. This option would expand the number of modules from four to five resulting in reduced baghouse velocities and pressure drop. Adding another baghouse module to the Riley Boiler baghouse will be difficult and expensive because of physical space limitations near the existing baghouse. PM control efficiency for the additional baghouse is assumed to be 99.0%.

Wet Electrostatic Precipitator – A Wet ESP consists of a series of collection surfaces in the device that removes particulate using an electrical field. The plates are continuously or intermittently cleaned using a circulating water system. Control efficiencies for Wet ESP systems are reported to be 99.0 to 99.9%. For the purposes of this evaluation, the control efficiency is assumed to be 99%.

Because of physical space limitations, the installation of the Wet ESP will require demolition and the removal of the existing baghouse and installation of the WET ESP in its place. In addition the system will produce saturated vapor conditions in the stack during some operation scenarios. A liner will be needed to be installed in the existing stack to protect the stack from corrosive conditions.

Dry Electrostatic Precipitator – A Dry ESP is very similar in operation to the Wet ESP option considered above. The particulate to be removed is charged in an electric field and attracted to a collection plate. Control efficiencies for Dry ESP system are reported at 99.0 to 99.9% efficient. For this evaluation the control efficiency is assumed to be 99.0%.

This information is summarized in Table 2, below.

Table 27. Technically Feasible Options

Pollutant	Technology	Feasibility	Reason Not Feasible
PM	Existing Baghouse	Yes	None
	Enhanced Baghouse	Yes	None
	Wet ESP	Yes	None
	Dry ESP	Yes	None

In conclusion, all particulate technologies identified are technically feasible options for the Riley Boiler .

STEP 3 – Evaluate technically feasible options

In this step, all of the technically feasible options were ranked in order of effectiveness of each control technology identified as technically feasible. Control effectiveness was based on manufacture's performance data, engineering estimates, and demonstrated effectiveness of the technology on the Riley Boiler. This data is summarized in Table 3.

Table 28. Control Technology Efficiency Evaluation

Pollutant	Control Option	BART Baseline	BART Baseline	Removal Efficiency	Expected Maximum	Expected Annual

		Maximum Emission rate (lbs/hour)	Annual Average Emissions (tons/year)		Emission Rate (lbs/hour)	Emissions (tons/year)
Particulate	Existing Baghouse	12.4	34.5	99.0%	12.4	34.5
	Enhanced Baghouse	12.4	34.5	99.0%	12.4	34.5
	Dry ESP	12.4	34.5	99.0%	12.4	34.5
	Wet ESP	12.4	34.5	99.0%	12.4	34.5

Since all control technologies have the same removal efficiency no single control technology is ranked higher than the other for emissions removal.

STEP 4 **–** Impact analysis

The use of the existing baghouse stands out as the best BART control technology since it will not require additional costs. The existing baghouse has the added environmental benefits of not requiring additional water or electricity. The benefit of adding an additional bag house is so small the benefits are outweighed by the costs. In conclusion, the best BART alternative for particulate is the existing baghouse.

STEP 5 – Determine visibility impacts (improvements)

Since all control technologies have the same removal efficiency there is no merit in modeling specifically for the particulate control scenarios.

Sulfur Dioxide (SO_2) BART Control Technology Selection

In determining the "best" BART control technology for SO_2 controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

- Low sulfur coal (LSC)
- Wet flue gas desulfurization (FGD)
- Spray dry FGD
- Dry lime FGD
- Dry Trona injection FGD

STEP 2 – Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Low Sulfur Coal (LSC) – Currently the Nampa plant uses coal that is limited to 1% sulfur by weight to comply with the Rules for Control of Air Pollution in Idaho. The average

actual percent sulfur for the baseline period is approximately 0.75%. This option will look at using 0.6% sulfur with an actual reduction of 15%.

Wet Flue Gas Desulfurization (WET FGD) – A WET FGD system typically consists of saturated absorber towers located downstream of a particulate control device. The absorbers are usually configured as a flooded tray system or spray tower. Flue gas entering the absorber reacts with slurred limestone or slaked lime to remove SO_2 at the liquid/gas surface boundary. The reaction forms insoluble products or solids that are further treated with forced oxidation to convert to gypsum which is a marketable by product. The treated flue gas passes through a mist eliminator system to remove water droplets from the flue gas stream. The flue gas leaving the absorber is saturated with water vapor and can present a visible steam plume from the stack.

Wet FGD systems offer one of the highest SO_2 removal efficiencies of the available control technologies with a removal efficiency of 95% or greater. This is also a technology which EPA is heavily invested and supports. The Installation of Wet FGD will require significant modification of the facility. Key site-specific considerations are as follows:

Wet FGD results in saturated stack conditions during periods of Riley only operation (Shared stack operation during beet campaign with the B&W Boiler is not anticipated to result in saturated stack conditions). The resulting condensation formed in the stack is anticipated to have very low pH values that will require installation of a stack liner to protect the integrity of the stack. Condensed vapors will need to be neutralized. Installation of a stack liner is estimated at $2,000,000.

Since Wet FGD is a wet process, it will generate a wastewater stream. The actual wet process is expected to be contained within the Wet FGD system with a slip stream discharged for wastewater treatment.

Spray Dryer Flue Gas Desulfurization (Spray Dry FGD) **–** Spray Dry FGD consists of a spray dryer reactor to be located between the exhaust outlet of the boiler and upstream of a particulate removal device (usually an electrostatic precipitator or baghouse). The reactor consists of a spray dryer absorber tower and support equipment. Flue gas is introduced into a vessel and contacts an atomized spray pattern of lime slurry generated by either a set of dual fluid nozzles or a rotary atomizer. The reaction to remove SO_x occurs on lime slurry droplets as they are evaporated from the heat of the flue gas to form a dry particle.

Because the exit temperature of the reactor must be maintained at a set temperature above the adiabatic saturation temperature of the flue gas (controlled by slurry feed rate), the product removed from the system is in dry form. The emission control efficiency of the reactor increases as the exit flue gas temperature approaches the adiabatic saturation temperature of the flue gas. The approach temperature is typically set at 30-40° F above adiabatic saturation temperature (corresponding to removal efficiencies of 90-80% respectively). Recycling fly ash into the lime slurry feed mixture may increase emission control efficiency depending on the chemical characteristics of the ash.

For the purposes of this evaluation a control efficiency of 80% will be assumed (a higher temperature 40° F was assumed to protect the baghouse).

A spray Dry FGD retrofit project will require modifications of the TASCO Nampa facility. The particulate loading to the baghouse will increase as a result of installing a spray dryer.

In addition to the ash entering the reactor with flue gas, the spent lime contributes to overall particulate loading. Approximately 60% of the formed solids are predicted to drop out in the reactor while 40% will be carried to the baghouse for removal. The increase in particulate loading will likely require an additional baghouse.

Dry Lime Injection Flue Gas Desulfurization (Dry Lime FGD) – Dry Lime FGD consists of injecting pulverized lime (milled to less than 10 microns) into the flue gas upstream of the baghouse. The emission control efficiency of a Dry Lime FGD is critically dependent upon:

Particle Size – The smaller the particle size, the greater the surface area for reaction. Lime is milled to less than 10 microns using a ball mill. The smaller size of the particles is also important to avoid downstream depositing of dust in the equipment and ductwork.

Temperatures – Reaction rates increase with increased temperatures of the flue gas.

Flue Gas Mixing – Good lime particle mixing with the flue gas is important to provide uniform distribution of lime reactant in the baghouse.

The control efficiency for DLIFGD is reported to vary between 45 to 55%. For the purposes of this evaluation, the control efficiency is assumed at 55%.

Dry Trona Injection Flue Gas Desulfurization (Dry Trona FGD) – Trona is a naturally occurring source of sodium carbonate that is available from mines in Wyoming. Similar to Dry Lime FGD, Dry Trona FGD consists of injecting pulverized Trona (milled to less than 10 microns) into the flue gas downstream of the existing baghouse and upstream of a new baghouse. The injection system requirements and technical characteristics are very similar to the Dry Lime FGD system discussed above.

The control efficiency for Dry Trona FGD is reported to range between 55 to 65%. For the purposes of this evaluation, the control efficiency is assumed at 65%.

This information is summarized in Table 4, below.

Table 29. Technically SO_2 Feasible Options

Pollutant	Technology	Feasibility	Reason Not Feasible
SO_2	Low Sulfur Coal	Yes	None
	Wet FGD	Yes	None
	Spray Dry FGD	Yes	None
	Dry Lime FGD	Yes	None
	Dry Trona FGD	Yes	None

STEP 3 – Evaluate technically feasible options

Based on the control efficiency rates listed above, TASCO determined the baseline maximum hourly emission rates, baseline average annual emission rate, anticipated control

efficiency of emission controls, expected maximum hourly emission rate and expected annual emission rates. This data is summarized in Table 5, below.

Table 30. Technically Feasible SO_2 Options

Pollutant	Control Option	BART Baseline Maximum Emission Rate (lbs/hour)	BART Baseline Annual Average Emissions (tons/year)	Removal Efficiency	Expected Maximum Emission Rate (lbs/hour)	Expected Annual Emissions (tons/year)
SO_2	Low Sulfur Coal	522	1457	15%	444	1238
	Dry Lime FGD	522	1457	55%	235	655
	Dry Trona FGD	522	1457	65%	183	510
	Spray Dry FGD	522	1457	80%	104	291
	Wet FGD	522	1457	95%	26	73

STEP 4 – Impact analysis

TASCO did a cost evaluation for each of the control technologies reviewed. A complete cost evaluation can be found in Appendix D & E of "*Best Available Retrofit Technology (BART) Determination Analysis, 2009.* These findings were based on EPA fact sheets, engineering and performance test data, and information and discussions with equipment vendors. Table 6 summarizes those results.

Table 31. Impact Analysis for NO_x

Control Scenario	Baseline Emissions (tons/yr	Removal Efficiency (percent)	Annual Emissions Reductions (tons/yr	Total Reductions	Total Capital Costs (x 1,000)	Total Annual Costs (x 1,000)	Cost Effectiveness	Incremental Cost Effectiveness
Low Sulfur Coal	1,457	15%	219	219	0	$1,024	$4,685	
Dry Lime FGD	1457	55%	801	801	$11,281	$2,687	$3,353	$2,857
Dry Trona FGD	1,457	65%	947	947	$11,281	$2442	$2,557	-$1678
Spray Dry FGD	1,457	80%	1,166	1,166	$12,970	$2,521	$2,163	$360
Wet FGD	1,457	95%	1,384	1,384	$22,006	$4,034	$3,353	$6,940

After reviewing TASCO's evaluation, DEQ has concerns with the installation of Wet FGD. In reviewing TASCO's BART Determination Analysis for the Riley Boiler, and specifically looking into wastewater treatment processes associated with Wet Flue Gas Desulfurization (Wet FGD), TASCO's submittal does not present technical specifications or much detail regarding the wastewater treatment process. It's not immediately clear that the costs of the wastewater treatment process are included in the estimates presented in their submittal; however, there appear to be many vendors who provide wastewater treatment processes as part of a Wet FGS project, so it is assumed that the cost of wastewater management is contained within the cost estimates provided for the Wet FGD process itself.

There are several variables that make it very difficult to speculate about the volume of wastewater that might be produced, or any constituent concentrations in wastewater from the process. The source and composition of (1) the coal fired in the boiler, and (2) the limestone used in the Wet FGS process will largely dictate the constituents and constituent concentrations in the wastewater, but there are likely to be significant concentrations of chlorides, fluorides, sulfate, arsenic, mercury, selenium, boron, cadmium, zinc, iron, aluminum, and inert fines that will require some sort of treatment prior to any discharge. Because the wastewater stream is saturated with calcium sulfate (i.e., gypsum), scaling is a major issue with operation and maintenance of process units and piping. The wastewater will also be hot, somewhat acidic, and will have high levels of total dissolved solids. There's also information available that indicates the presence of nitrates in the wastewater. Many of these constituents have primary or secondary quality standards in the *Ground Water Quality Rule*, and any proposal involving land application would almost certainly require impact assessments and/or permitting before DEQ would allow them to go forward.

It is entirely possible to design treatment units to manage and remove the majority of these constituents from the wastewater. The gypsum is a marketable product that would likely be precipitated out of solution and recovered as a commodity. The metals can also be precipitated, although many of these are regulated as hazardous wastes at relatively low concentrations (i.e., the hazardous waste program would probably want to be involved with management of these solids). There are also other processes that can be used to reduce residual levels of dissolved solids and nitrates in the final effluent, although it's important to note that more treatment generally means more cost and more oversight required. The potential volume and quality of the final, treated effluent is very difficult to speculate about without knowing more about the wastewater that will be produced by the Wet FGD process and the treatment processes that will be used to manage that wastewater.

With respect to TASCO's existing wastewater treatment system, the facility is presently treating most of its wastewater on site in an aerated lagoon and sending it to the municipal treatment plant operated by the City of Nampa during off-peak hours. To continue with this operation, a very high degree of wastewater treatment will be required, and substantial improvements to the existing treatment process will almost certainly be required. It would be expected that the city might have concerns about any potential increase in the volume of wastewater discharged to its system. This could mean that the City would need to expand its treatment system or that TASCO might look to land application to manage the new wastewater stream.

TASCO does still have a wastewater land application permit with DEQ, but the facility has only utilized land application for a very small fraction of its total wastewater load in recent years. The company land applied ~12MG in the 2005 season (6% of total WW generated), ~5MG in the 2006 season (3% of total WW generated), ~1MG in the 2007 season (1% of total WW generated), and no wastewater was land applied in the 2008 season. As a result of this reduction in land applied wastewaters, we have seen improving trends in its ground water monitoring wells. Historically, there were issues with nitrates, chlorides, and total dissolved solids concentrations in ground water around the site. While some exceedances of the associated ground water quality standards still exists, most monitoring wells have shown improving trends in ground water quality in recent years, and the DEQ Boise Regional Office is encouraging TASCO to continue to minimize wastewater land application at this time.

Although wastewater treatment processes are available to produce a high-quality effluent that could be successfully land applied under a permit from DEQ, these processes will be fairly complex and expensive, and will likely require dedicated staff to operate and maintain. **Additionally, the reduction in wastewater land application in recent years has improved historic issues with ground water quality that have generally been associated with TASCO's operation**, so any proposal to increase loading rates from a new source of wastewater would require a complete permit application that includes a ground water impact assessment showing no adverse impacts to existing ground water quality. We would issue a permit with enforceable limits and comprehensive monitoring/reporting requirements to ensure protection of ground water quality, assuming that the application and impact assessments can be technically verified and approved.

STEP 5 – Determine visibility impacts (improvements)

Since TASCO believed running the CALPUFF modeling for the various control technology scenarios would be costly, DEQ performed the CALPUFF modeling in-house and invited TASCO to have a contractor review the modeling if deemed necessary. Because each scenario can change the stack velocities and temperatures, it was important that DEQ work closely with TASCO. DEQ worked very closely with TASCO facility engineers to determine the modeling inputs for each of the scenarios.

Table 7, below, summarizes the modeling results for SO2 controls

Table 32. SO_x Control Visibility Improvement

Eagle Cap Wilderness, OR	Change in Visibility Compared Against 20% Best Days Natural Background Conditions								
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period		Annual Cost
	2003		2004		2005		2003-2005		($x 1,000)
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)	
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzi10469)	0.956	23	1.454	49	1.388	55	1.399	127	
Base Riley Boiler Scenario (wzi10471)	0.721	15	1.086	41	1.109	41	1.086	97	$0
SO2 Control Scenario 1 - Lower Sulfur Coal (wzi10475)	0.682	15	1.016	39	1.028	36	1.014	90	$1,024
SO2 Control Scenario 2 - Dry Lime Injection (wzi10476)	0.586	9	0.814	28	0.806	29	0.806	66	$2,687
SO2 Control Scenario 3 - Dry Trona Injection (wzi10477)	0.565	9	0.764	24	0.739	25	0.761	58	$2,422
SO2 Control Scenario 4 - Spray Dryer FGD (wzi10478)	0.527	9	0.703	22	0.707	20	0.686	51	$2,521
SO2 Control Scenario 5 - Wet FGD (wzi10479)	0.499	7	0.647	19	0.645	17	0.638	43	$4,053

Conclusion - As part of the impact analysis, non-air quality environmental concerns are to be taken into consideration. Although Wet FGD has a 15% greater removal efficiency over the next closest control of Spray Dry FGD, the potential for reversing the current trend of

improvements to ground water due to TASCO land applying outweigh the environmental benefits. TASCO is currently sending pretreated wastewater to the City of Nampa. There is a high likelihood that an increase in TASCO's waste stream would be greater than the city can currently handle. This would more than likely lead to TASCO requesting to increase land application of waste water. For these reasons, DEQ will not be including Wet FGD in the control options even though the technology is technically feasible for improvements in air quality and visibility.

Nitrogen Oxides (NO_x) BART control technology selection

In determining the "best" BART control technology for NO_x controls on the Riley Boiler, DEQ worked in conjunction with TASCO using the five steps as described in EPA Appendix Y.

STEP 1 – Identify all available retrofit emissions control techniques

DEQ in consultation with TASCO identified the following control technologies appropriate for boilers:

- Low NO_x Burners (LNB)
- Low NO_x Burners with Over-fired Air (LNB/OFA)
- Ultra Low NO_x Burners (ULNB)
- Selective Catalytic Reduction (SCR)
- Selective Non-catalytic Reduction (SNCR)

STEP 2 - Determine technically feasible options

In this step, DEQ relied heavily on TASCO engineers to provide the technical feasibility because of plant specific requirements and their familiarity with plant operations. DEQ did review the information as provided below:

Low NOx Burners - LNBs incorporate staged fuel or staged combustion air to control the flame temperature of the boiler. Several low NO_x burner systems are available with different levels of cost and performance capabilities. The estimates for NO_x removal range in removal efficiency from 30-60%.

According to TASCO, low NO_x burner retrofit projects are technically challenging and require significant engineering evaluations to properly size and adapt a supplied low NO_x burner system to a given boiler and burner configuration.

Low NO_x Burners with Over-Fired Air – These systems inject a portion of the combustion air downstream of the fuel burner system to lower flame temperatures and the formation of NO_x. Over-fired air as a stand alone retrofit technology can be difficult to control causing combustion issues with pulverized coal boiler, including water wall corrosion and reduced boiler efficiencies. When combined with a low NO_x burner and reasonable combustion air control, NO_x removal efficiencies can approach 65%.

Ultra Low NO_x Burners – These systems are upgraded LNB designs which involve further control and staging of combustion air and fuel. ULNB was determined not technically feasible on the Riley Boiler. The boiler's existing firebox is not large enough to accept the full burner/flame management system required by the ULNB.

Selective Catalytic Reduction – SCR systems reduce NO_x by injecting ammonia and urea into the flue gas before it passes through a catalytic grid to reduce the NO_x to N_2. This technology requires the flue gas exhaust from the Riley baghouse to be heated to 500° C before injecting ammonia or urea and passing the hot gases through the selective catalytic grid. After treatment, heat is recovered in a heat exchanger to minimize operating costs to reheat the flue gas. This technology is capable of reducing NO_x emissions by 70% to 90%. For the purposes of this evaluation a control efficiency of 90% is assumed.

Selective Non-Catalytic Reduction (SNCR) – SNCR consists of injecting ammonia or urea into boiler flue gases in a narrow temperature zone of 1550 to 1950° F. To achieve these temperatures, the injection point must be located between the Riley Boiler economizer and the air pre-heater. The process relies on good gas mixing in the narrow high temperature zone to reduce NO_x to N_2 as the flue gas moves through the ductwork. Boiler load swings can lead to temperature changes at the injection that can significantly reduce removal efficiencies. In addition, injection points can lead to "ammonia slip" or the condition where unreacted ammonia passes through downstream equipment, including the baghouse and discharges from the stack. The gas path for the Riley Boiler lacks the necessary residence time to reliably remove the NO_x. The results of upsets could lead to "ammonia slip." DEQ is concerned about the issues with ammonia emissions due to the Riley Boiler's close proximity to the City of Nampa.

This information is summarized in Table 8, below.

Table 33. Technically Feasible Options for NO_x

Pollutant	Technology	Feasibility	Reason Not Feasible
NO_x	Low NO_x Burners	Yes	None
	Low NO_x Over-Fired Air	Yes	None
	Ultra NO_x Low Burners	No	Boiler Firebox is not large enough to support the flame management system.
	Selective Catalytic Reduction	Yes	None
	Selective Non-Catalytic Reduction	No	Boiler gas path does not have adequate residence time for reliable control

STEP 3 – Evaluate technically feasible options

Based on the control efficiency rates listed above, TASCO determined the baseline maximum hourly emission rates, baseline average annual emission rate, anticipated control efficiency of emission controls, expected maximum hourly emission rate and expected annual emission rates. This data is summarized in Table 9, below.

Table 34. Impact Analysis for NO_x

Pollutant	Control Option	BART Baseline Maximum Emission Rate (lbs/hour)	BART Baseline Annual Average Emissions (tons/year)	Removal Efficiency	Expected Maximum Emission Rate (lbs/hour)	Expected Annual Emissions (tons/year)
NO_x	Low NO_x Burners	374	1042	50.0%	187	521
	LNB/OFA	374	1042	65.0%	131	364
	SCR	374	1042	90.0%	37	104

STEP 4 – Impact Analysis

TASCO did a cost evaluation for each of the control technologies reviewed. A complete cost evaluation can be found in Appendix D & E of "*Best Available Retrofit Technology (BART) Determination Analysis, 2009.* These findings were based on EPA fact sheets, engineering and performance test data, and information and discussions with equipment vendors. Table 10, below, summarizes those results.

Table 35. Impact Analysis for NO_x

Control Scenario	Baseline Emissions (tons/yr	Removal Efficiency (percent)	Annual Emissions Reductions (tons/yr	Total Reductions	Total Capital Costs (x 1,000)	Total Annual Costs (x 1,000)	Cost Effectiveness	Incremental Cost Effectiveness
Low NO_x Burners	1,042	50%	521	521	$2,720	$480	$921	
Low NO_x Burners OFA	1,042	65%	677	677	$4,875	$860	$1,270	$2,431
SCR	1,042	90%	938	938	$16,702	$3,534	$3,768	$10,245

In addition to the control technologies reviewed above, TASCO has provided information relating to operational changes at the facility after the regional haze base years of 2000-2004. In 2006, TASCO installed a new pulp steam dryer system which better utilized current steam production and allowed several old pulp dryers to shut down. The pulp drying typically occurs during the fall and winter months when TASCO's emissions show the greatest impact on the 20% worst days. The following Table 11 is a summary of the emission reductions attributed to the shutdown of the old pulp dryers.

Table 36. Pollution Reductions from Shutdown of Pulp Dryers

Pollutant	Maximum Hourly (lbs/hr)	Average Annual (tons/year)
Particulate	98.1	113
SO_2	17.8	20.6
NO_x	191	221

There are no incremental costs associated with the shutdown of the pulp dryers since they were installed in 2006. As part of the impact and visibility improvements TASCO requested that DEQ look at the visibility improvements associated with the pulp dryer shut down and determine that the reductions from the new steam dryers could be used as an alternative to BART.

STEP 5 – Determine visibility impacts (improvements)

Since TASCO believed running the CALPUFF modeling for the various control technology scenarios would be costly, DEQ performed the CALPUFF modeling in-house and invited TASCO to have a contractor review the modeling if deemed necessary. Because each scenario can change the stack velocities and temperatures it was important that DEQ work with TASCO. DEQ worked very closely with TASCO facility engineers to determine the modeling inputs for each of the scenarios. The modeling scenarios include the Riley Boiler with and without the shutdown of the pulp dryers to identify the visibility improvement attributed to the shutdown of the old dryers. The baseline used for the remaining control scenarios included the reductions from the pulp dryers to simulate current operating conditions. The following is a breakdown of the costs and changes to visibility at Eagle Cap Wilderness (This wilderness area showing the greatest impact form the Riley Boiler.) based on the NO_x controls identified as technically feasible. Similar changes occurred at the other Class I areas impacted by the Riley Boiler. (See Appendix.) Table 12, below, also includes the incremental costs associated with the various NO_x control technologies. Since some of the pulp dryers were shut down to meet PM_{10} NAAQS requirements incremental costs were not included for this scenario. TASCO has found it financially advantageous to shut down additional pulp dryers for cost savings in coal usage.

Table 37. NO_x Visibility Improvements

Eagle Cap Wilderness, OR	Change in Visibility Compared Against 20% Best Days Natural Background Conditions									
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period		Change in Visibility	Incremental Cost
	2003		2004		2005		2003-2005		2003-2005	($/ton)
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest	Number of Days[d] (2003-2005)		
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzI10469)	0.956	23	1.454	49	1.388	55	1.399	127	0.000	
Base Riley Boiler Scenario (wzI10471)	0.721	15	1.086	41	1.109	41	1.086	97	0.313	$0
NOx Control Scenario 1 – LNB (wzI10472)	0.511	11	0.822	29	0.871	29	0.816	69	0.270	$0
NOx Control Scenario 2 – LNB w/ OFA (wzI10473)	0.454	7	0.743	24	0.803	25	0.736	56	0.350	$2,431
NOx Control Scenario 3 – SCR (wzI10474)	0.383	6	0.625	16	0.653	18	0.613	40	0.473	$10,245

Looking at changes in visibility improvements the shutdown of the pulp dryers provided more visibility improvement than LNB and is nearing the improvement of LNB with Over-Fire-Air. The largest improvement in visibility attributed to NO_x controls would come for Selective Catalytic Reduction (SCR). However, the incremental cost of $10,000 per ton for the additional 15% removal efficiency is relatively high. An option for TASCO would be taking permanent permit limits to account for the shutdown of all the pulp dryers and installing LNB with Over-Fire-Air.

Conclusion – BART Control Determination

In conclusion, TASCO has two options for NO_x controls. It can install SCR on the Riley Boiler or install LNB with Over-Fire-Air and take permit limits for shutting down all the pulp dryers. Although Wet FGD has the promise of providing greater emission reductions than Spray Dry FGD, the benefits of Wet FGD are outweighed by the possibility of requiring land application of wastewater. After reviewing the particulate controls, the current baghouse has the same reductions as other options at no additional expense. DEQ is, therefore, recommending a combination of the baghouse, Low NOx Burners with Over-Fire-Air (plus permit limits reflecting shut down of all pulp dryers), and Spray Dry FGD as the "best" of BART technologies. Below is a summary table showing the visibility improvements based upon the "best" of BART control technologies identified in this determination. It should be noted the Base Riley Boiler scenario includes the current baghouse and pulp dryer shutdown.

Table 38. Visibility Improvement - Best BART Alternatives

Eagle Cap Wilderness, Or	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-deciview value larger than 0.5 from one year period						Delta-deciview value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8^{th} highest[a]	Total days[b]	8^{th} highest	Total days	8^{th} highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Base Riley Boiler Scenario (wzi10471)	0.721	15	1.086	41	1.109	41	1.086	97
Base Riley Boiler Plus Pulp Dryer Full Operation Scenario (wzi10469)	0.956	23	1.454	49	1.388	55	1.399	127
NO_x Scenario 2 + SO2 Scenario 4 (wzi10484)	0.228	1	0.319	1	0.330	1	0.319	3

EPA Executive Summary TASCO Financial Hardship

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 981 01-31 40

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DEPARTMENT OF
ENVIRONMENTAL QUALITY

FEB 18 2010

AIR, WASTE AND TOXICS

Martin Bauer, Administrator
Air Quality Division
Idaho Department of
Environmental Quality 1410 N.
Hilton
Boise, Idaho 83706

Dear Mr. Bauer:

At your request, EPA Region 10 has completed and enclosed a copy of our analysis of TASCO's claim that it cannot afford BART and Idaho's initial BART determination identified in the "Best Available Retrofit Technology (BART) Determination Analysis: Riley Boiler", dated February 6, 2009, for the TASCO Nampa Facility. This analysis contains data and information provided by TASCO that TASCO claims as 'Confidential Business Information (CBI). Thus we treat this report as containing CBI.

We have determined that TASCO can afford BART as identified in the initial BART determination made by IDEQ. If you have additional questions or would like to discuss this analysis, please contact either myself at 206-553-6985 or Mr. Steve Body at 206-553-0782.

Sincerely

Mahbubul Islam

Mahbubul Islam, Manager
State & Tribal Air Programs Unit

Enclosure

Executive Summary excerpt

from: An Affordability Analysis of The Amalgamated Sugar Company LLC's Affordability Claim with respect to the Best Available Retrofit Technology (BART) for the Riley Boiler at the Nampa, Idaho facility

February 12, 2010

prepared by

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U.S. EPA - Region 10

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EXECUTIVE SUMMARY

NOTE: **THIS SUMMARY IS WRITTEN FOR PUBLIC VIEWING AND DOES NOT INCLUDE CONFIDENTIAL BUSINESS INFORMATION (CBI). THE FULL REPORT DOES CONTAIN CBI AND IS SUBJECT TO DISCLOSURE REQUIREMENTS AT 40 CFR PART 2.**

As a result of the Riley Boiler at The Amalgamated Sugar Company LLC (TASCO) Nampa, Idaho facility being identified as a Best Available Retrofit Technology (BART) source by the Idaho Department of Environmental Quality (DEQ), and DEQ's visibility impact modeling which indicated the Riley Boiler exceeded the BART exemption of 0.5 deciview (dv) at any one Federal Class I area, TASCO conducted a site specific BART Determination Analysis for the Riley Boiler (TASCO 2009b), according to EPA Guidelines (EPA Appendix Y).

The BART determination derived from this Determination Analysis has an estimated capital cost of $17.8 million, and estimated annual operation and maintenance (O&M) costs of $3.4 million. TASCO and the State of Idaho have agreed on the BART control technology and specified emission limitations, and they concur on the BART related costs. This BART determination consists of a bag house for particulate matter (which is already in place and operating), a low NOx burner with overfire, and dry gas desulfurization for SO_2. In accordance with Federal BART requirements, the BART controls must be installed and operating by approximately April 30, 2016.

In TASCO's cover letter to its BART Determination Analysis, the company mentions that the above cited BART related costs would affect the "ongoing economic viability of the Nampa facility and TASCO as a whole", and that "affordability is a critical element of the BART determination" (TASCO 2009a). In support of its claims of 'ongoing economic viability' and 'affordability', the company provided reasons and information in the BART Determination Analysis. Subsequently, TASCO provided additional reasons and substantial additional information supporting its claim directly to DEQ and EPA.

In determining BART, the EPA Guidelines indicate the State may take into consideration the economic effects of requiring the use of a particular technology. In the selection process the State may also consider any of the economic effects that are determined to have a severe impact on the plant's or the company's operations. DEQ decided to consider TASCO's affordability claim, but does not have the technical capability to conduct a thorough 'affordability analysis.' The EPA does have this analytical capability, and conducted this affordability analysis. A copy was provided to DEQ.

The purpose of the affordability analysis was to determine the validity of TASCO's affordability claim, i.e., that the company cannot fund the control technology identified in the BART determination. The analysis took into consideration:

- The estimated capital and O&M costs of the BART determination;
- compliance with BART emission limits required no later than approximately April 30, 2016;
- TASCO's continuing viability, i.e., the company's ability to continue as a going concern;
- The reasons provided by TASCO to support its affordability claim;
- The information provided by TASCO and obtained from other sources; - BART related costs are considered to be a cost of doing business, and are not an investment with an expected financial return;
- The TASCO/Snake River Sugar Company (SRSC) owner/operator, management and financial relationships;
- TASCO's financial related commitments; and that
- BART related regulatory events [i.e., DEQ issuing a permit, followed by EPA approval of Idaho's Regional Haze State Implementation Plan (SIP), or in lieu of a SIP the issuance of a Federal Implementation Plan (HP) by EPA] will occur subsequent to the completion of the BART Determination Analysis.

Throughout this BART determination process, it appears that without the issuance of a permit and/or an approved SIP, TASCO's approach to the BART costs has been that the company has no financial or legal obligation to actually address these costs, and that all available funds are already committed for contractual reasons or as part of internal business decisions. A consequence of this approach has been that since about mid-2007, when TASCO was first made aware of the forthcoming BART obligation, the company has made no attempt to actively fund the prospective BART costs. It appears that TASCO does not intend to address the prospect of actually funding the BART costs until a permit is issued, and even then BART funding could depend on certain subsequent events. At the time of issuing a permit there will then exist a legal (regulatory) requirement that has to be met by TASCO and would require the company to make a financial related response. TASCO had to be aware that a decision not to proactively address BART costs prior to the issuance of a permit could make funding the BART related costs difficult.

A review of the company's past and current financial condition through September 30, 2009, which was supported by additional relevant information, indicates that overall the company is in relatively sound financial health. Its annual revenues have remained relatively consistent, the company has been able to meet all of its financial obligations including significant contractually obligated annual cash distributions to its owners, and has maintained regular repayments of its loans.

Taking into consideration TASCO's recent and current operating and financial condition, including annual cash distributions; its known current and future financial obligations and restrictions; how the company has decided to address funding the BART costs until now; the company's most recent audit related issues; the TASCO-SRSC relationship issues; the stipulated time period - defined by when the company becomes obligated to comply with the forthcoming issuance of a permit by DEQ, estimated to be no later than approximately June 2010, and ends with the BART emissions limit compliance date of

approximately April 30, 2016 - it appears TASCO can afford to fund BART capital and annual O&M costs at a level of approximately $3.8 million dollars per year — an amount sufficient to cover the estimated BART capital costs by April 30, 2016, and subsequent annual O&M costs. The conclusion is that TASCO can afford to fund the BART.

Best Available Retrofit Technology (BART) Analysis

For P4 Production, L.L.C.

Best Available Retrofit Technology (BART) Analysis

for

P4 Production, L.L.C.
Soda Springs, Idaho

Facility ID No. 029-00001

Photo Credit: Peter Clegg (posted on Google Earth)

Prepared by:

Cheryl A. Robinson, P.E., Staff Engineer

Mary Anderson, CPM, Modeling Coordinator

Idaho Department of Environmental Quality
Air Quality Division

August 4, 2009

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There are no technically feasible options for controlling PM emissions from #9 furnace (including the #9 CO flare). 347

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Acronyms, Units, and Chemical Nomenclatures

acfm	actual cubic feet per minute
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
Btu	British thermal unit
CFR	Code of Federal Regulations
CO	carbon monoxide
DEQ	Department of Environmental Quality
DSD	duct spray drying
ENE	east-northeast
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitator
FGD	flue gas desulfurization
FSI	furnace sorbent injection
HE	high energy
IDAPA	a numbering designation for all administrative rules in Idaho promulgated in accordance with the Idaho Administrative Procedures Act
km	kilometer
LAER	Lowest Achievable Control Technology
lb/hr	pound per hour
LCDA	Lime Concentrated Dual Alkali
LSD	Lime Spray Drying
LSFO	Limestone Forced Oxidation
m	meter(s)
mi	mile(s)
MACT	Maximum Achievable Control Technology
MEL	magnesium-enhanced lime
MMBtu	million British thermal units
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_4OH	ammonium hydroxide
NNE	north-northeast
NNW	north-northwest
NOx	nitrogen oxides
NSPS	New Source Performance Standards
P4	P4 Production, L.L.C.
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PSD	Prevention of Significant Deterioration
PTE	potential to emit
RACT	Reasonably Available Control Technology
RBLC	(EPA's) RACT/BACT/LAER Clearinghouse
Rules	Rules for the Control of Air Pollution in Idaho
scf	standard cubic feet
SCR	selective catalytic reduction
SIP	State Implementation Plan
SNCR	Selective non-catalytic reduction
SO_2	sulfur dioxide
THFC	tap hole fume collector
T.O.	thermal oxidizer
T/yr	tons per year
VOC	volatile organic compound

1. Executive Summary

The P4 Production, L.L.C. (P4) facility located in Soda Springs, Idaho, produces elemental phosphorus. Coke, quartzite, phosphate ore, and clinker are delivered to the site by truck or railcar. The coke and quartzite are dried, if needed, and screened. Phosphate ore is fed to a rotary kiln (calciner) to form heat-hardened nodules. The exhaust from the kilns is controlled by a dust knockout chamber, nodulizing kiln spray tower, four parallel cyclonic separators, and four parallel hydrosonic scrubbing systems. The hydrosonic scrubbing system includes an SO_2 scrubbing system.

Nodules are then combined with coke and quartzite and heated in a reducing environment in one of three electric furnaces. The furnace vent gases, which contain the phosphorus product in a vapor state, pass through two electrostatic precipitators to remove entrained particles. The vent gas is then sent to water spray condensers where the gases are cooled, and the product phosphorus is condensed. The vent gas is then sent to the nodulizing kiln or a furnace flare to oxidize carbon monoxide (CO) to carbon dioxide. After this project has been completed, a thermal oxidizer will be used for any CO furnace gas that cannot be accommodated by the kiln, and the flares will only be used during startup, shutdown, schedules maintenance, safety measures, upset and breakdown in accordance with IDAPA 58.01.01.130-136. The condensed phosphorus is pumped to settling/storage tanks and then loaded into water-sealed railroad cars for shipment. Slag and ferrophosphorus are regularly removed from the furnaces (a procedure referred to as “tapping”) and stockpiled on site. Emissions associated with tapping the furnaces are collected and controlled by the Tap Hole Fume Collector Scrubber (THFC).

Two sources at P4 were identified as potential BART-Eligible Sources (as defined at IDAPA 58.01.01.006.14), the phosphate ore nodulizing kiln (#5 Kiln) and the #9 Furnace (#9 THFC and #9 CO Flare). The Idaho Department of Environmental Quality (DEQ) has completed a determination to identify all BART-Eligible Sources at the P4 facility. The results of the BART determinations (pursuant to IDAPA 58.01.01.668) for these two emission units are summarized in Table 1.1.

P4 is under a consent order to meet BACT for CO emissions from the #7 furnace and to install the same controls on the #8 and #9 furnaces. P4 has proposed using a thermal oxidizer and high energy (HE) venturi scrubber along with controlling operations to balance the CO produced in the furnaces to match the fuel needs for the kiln, the CO BACT Measures. P4 has applied for a Tier II operating permit that will include federally-enforceable requirements for the SO_2 scrubber system and for the CO BACT measures.

Table 1.1. BART FOR P4 PRODUCTION, L.L.C. BART-ELIGIBLE UNITS

Emission Unit	Regional Haze Pollutant	BART Determination	BART Emission Limit	Nearest Mandatory Class I Area(s)
Nodulizing Kiln (#5 Kiln)	SO_2	Existing Federally Enforceable Controls: Limit coal sulfur content to a maximum of 1% by weight. BART: Lime Concentrated Dual Alkali (LCDA) SO_2 scrubbing system	143 lb/hr	Grand Teton National Park ~113 km (~70.2 mi) to the north-northeast (NNE) Bridger Wilderness ~ 143 km (~88.8 mi) to the east-northeast (ENE) Teton Wilderness ~164 km (~102 mi) to the NNE Fitzpatrick Wilderness ~ 164 km (~102 mi) to the ENE Yellowstone National Park ~166 km (~103 mi) to the NNE Washakie Wilderness 184 km (~115 mi) to the NNE Craters of the Moon National Monument ~165 km (~103 mi) to the north-northwest (NNW)
	NO_x	Existing Federally Enforceable Controls: None BART: No additional controls.	n/a	
	PM	Existing Federally Enforceable Controls: Knockout chamber, spray tower, four parallel high energy (HE) venturi scrubbers, and four parallel cyclonic separators BART: No additional controls.	n/a	
#9 Furnace (#9 THFC & #9 CO Flare)	SO_2	Existing Federally Enforceable Controls: #9 THFC: None #9 CO Flare: None BART: #9 THFC: No additional controls #9 CO Flare: No additional controls	n/a	
	NO_x	Existing Federally Enforceable Controls: None BART: #9 THFC: No additional controls #9 CO Flare: No additional controls	n/a	
	PM	Existing Federally Enforceable Controls: #9 THFC: wet venturi scrubber #9 CO Flare: None BART: #9 THFC: No additional controls #9 CO Flare: No additional controls	Furnace THFC: $\le$ 352,000 lb/hr: 0.2 lb per ton of material fed to furnace > 352,000 lb/hr: Process Weight Flare: 0.2 lb per 100 lb burned	

2. Introduction

2.1 Source Description and Background

The P4 facility located in Soda Springs, Idaho, produces elemental phosphorus. Coke, quartzite, phosphate ore, and clinker are delivered to the site by truck or railcar. The coke and quartzite are dried, if needed, and screened. Phosphate ore is fed to a rotary kiln (calciner) to form heat-hardened nodules. The exhaust from the kilns is controlled by a dust knockout chamber, nodulizing kiln spray tower, and four parallel hydrosonic scrubbing systems.

Nodules are then combined with coke and quartzite and heated in a reducing environment in one of three electric furnaces. The furnace vent gases, which contain the phosphorus product in a vapor state, pass through two electrostatic precipitators to remove entrained particles. The vent gas is then sent to water spray condensers where the gases are cooled, and the product phosphorus is condensed. The vent gas is then sent to the nodulizing kiln or a furnace flare to oxidize carbon monoxide (CO) to carbon dioxide. After this project has been completed, a thermal oxidizer will be used for any CO furnace gas that cannot be accommodated by the kiln, and the flares will only be used during startup, shutdown, schedules maintenance, safety measures, upset and breakdown in accordance with IDAPA 58.01.01.130-136. The condensed phosphorus is pumped to settling/storage tanks and then loaded into water-sealed railroad cars for shipment. Slag and ferrophosphorus are regularly removed from the furnaces (a procedure referred to as “tapping”) and stockpiled on site. Emissions associated with tapping the furnaces are collected and controlled by the Tap Hole Fume Collector Scrubber (THFC).

Criteria for determining whether an emission unit is subject to Best Available Retrofit Technology (BART) are described in the next section.

2.2 BART-Eligible Sources

A BART-Eligible Source is “any [of 26 listed categories of] stationary sources of air pollutants, including any reconstructed source, which was not “in operation” prior to August 7, 1962, and was in existence on August 7, 1977, and has a potential to emit two hundred fifty (250) tons per year or more of any air pollutant [including fugitive emissions, to the extent quantifiable].” IDAPA 58.01.01.006.14. Among the identified categories of stationary sources are “phosphate rock processing plants.” IDAPA 58.01.01.006.14.m.

When the P4 elemental phosphorus plant began operation in 1952, the emission units consisted of the #4 Kiln, #7 Furnace, #8 Furnace, #7/8 CO Flare, and ancillary equipment/processes and buildings, including nodule screening and crushing operations. The #5 Kiln replaced the #4 Kiln in 1965 and the #9 Furnace (including the #9 CO Flare) was added in 1966. Two pollution control devices, a nodule cooler spray tower and nodule crushing and screening scrubber, were added in 1970. In 1989, the #7 furnace transformer was replaced to increase the power output and therefore increase the production capacity of that furnace by about 12 percent. The #7 furnace hearth was replaced in 1994 by rebuilding the furnace hearth at a lower elevation and modifying the riser duct, which increased the #7 furnace production by about 16 percent. To control kiln emissions, four (4) high-energy tandem nozzle venturi scrubbers were brought on-line in September of 1987, and an SO_2 scrubbing system was installed in 2005. P4 has submitted an application for a Tier II operating permit, which was revised and re-submitted as a permit to construct application.

Potential to Emit (PTE) is defined as “the maximum capacity of a facility or stationary source to emit an air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed,

shall be treated as part of its design if the limitation or the effect it would have on emissions is state or federally enforceable." IDAPA 58.01.01.006.81 (emphasis added).

The PTE for P4 emission units is summarized in Table 2.1 for the BART-eligible emission units based on limitations contained in the federally-enforceable Tier I operating permit and expected federally-enforceable limitations to be incorporated in a Tier II operating permit or a permit to construct.

Table 2.1 P4 EMISSION UNIT PTE

Emission Unit	Year Installed	Idaho SIP Regional Haze Pollutant	"Current" PTE (T/yr)	2004 CEER Actual Emissions (T/yr) [a]	Notes
Nodulizing Kiln (#5 Kiln)	1965	SO_2	626.4 [b]	12,252	Actual emissions are from combustion and phosphate ore-related emissions.
		NO_x	3,750.7 [b]	1,625	
		PM	89.4 [b]	38	
#9 Furnace (including the #9 CO Flare)	1966	SO_2	#9 Furnace: 117.8[a] #9 CO Flare: 6.0 [b]	0.12	CEER Actuals are #9 CO Flare emissions only.
		NO_x	#9 Furnace: 65.7[a] #9 CO Flare: 6.7 [b]	0.13	
		PM	#9 Furnace: 163.6[a] #9 CO Flare: 31.7 [b]	0.65	
Total PTE from BART-eligible units		SO_2	1,124		Total PTE exceeds 250 T/yr
		NO_x	3,823		Total PTE exceeds 250 T/yr
		PM	285		Total PTE exceeds 250 T/yr

[a] Letter, P4 to Michael Edwards, September 6, 2006.

[b] Based on expected federally-enforceable limits to be included in a requested permit to construct

DEQ has concluded that:

1. The P4 facility is a "phosphate rock processing plant;"
2. The #5 Nodulizing Kiln and the #9 Furnace are the only emission units at P4 that began operation after August 7, 1962 and were in existence on August 7, 1977; and
3. PTE for both the #5 Nodulizing Kiln and the #9 Furnace exceed 250 tons per year of any air pollutant.

Based on the conclusions above, DEQ has determined that the #5 Kiln and the #9 Furnace (including the #9 CO Flare) emission units at P4 are BART-eligible sources.

2.3 BART Analysis Methodology

Best Available Retrofit Technology (BART) is defined as "an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by [a BART-eligible source]. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and 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." IDAPA 58.01.01.006.16.

P4 submitted a BACT analysis for SO_2 emissions from the #5 Kiln,[18] and a CO BACT analysis for the #7 Furnace and #7/#8 CO Flare. P4 proposed that CO BACT is installation of a thermal oxidizer and scrubber along with operational controls to balance CO production from the furnaces to match the fuel consumption requirements in the kiln. Pursuant to the requirements of a consent order, P4 will apply the same technology to the #9 furnace and #9 CO flare. This information was used by DEQ as the starting point for evaluating BART for BART-eligible sources.

This analysis addresses the following five basic steps for a case-by-case BART analysis:

Step 1. Identify all available retrofit control technologies. This must include identification of the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies. This list is considered complete if it includes the maximum level of control each technology is capable of achieving.

To begin Step 1 of the BART analysis, the U.S. Environmental Protection Agency's (EPA) Reasonably Available Control Technology (RACT)/BACT/Lowest Achievable Control Technology (LAER) Clearinghouse (RBLC) database was queried for recent BACT determinations for large industrial sources. The search parameters were for all permits (draft or final) issued since 2001 that included SO_2, NO_x, or PM as a controlled pollutant.

Step 2. Eliminate technically infeasible options.

The decision regarding whether a particular technology was "technically feasible" was based on discussions found in Section IV.D.2 (STEP 2 of EPA's Guidelines for BART Determinations Under the Regional Haze Rule, 40 C.F.R. Part 51, Appendix Y. Control technologies are technically feasible if either:

(1) They have been installed and operated successfully for the type of source under review under similar conditions, or

(2) The technology could be applied to the source under review.

Judgment was used to narrow the list of options if some options were clearly inferior (e.g., controls that are more costly but don't achieve the reductions of other controls).

Step 3. Evaluate control effectiveness of the remaining control technologies.

Step 4. Evaluate impacts of each remaining control technology, including:

- An estimate of the cost of compliance,
- An evaluation of the energy impacts of each BART option,
- An evaluation of the non-air quality impacts of each BART option, and

[18] Tier II operating permit application, Revision 1, received August 1, 2006. Appendix H, SO_2 BACT for Kiln.

- The remaining useful life of the source.

Step 5. ***Evaluate visibility*** *impacts.* Visibility impacts were not evaluated for each technology. See Section 4 for a discussion of the visibility impacts. Step 5 for this BART analysis is to ***Select BART***.

3. BART-Eligible Emission Units Subject to a MACT Standard

None of the potentially BART-subject emission units at P4 are subject to a MACT standard.

4. Baseline Conditions and Visibility Impacts for BART-Eligible Emission Units

Facility-specific visibility impacts for the potentially BART-eligible emission units at P4 have not been modeled. In addition, DEQ determined that CALPUFF modeling for the these emission units was not necessary based on the conclusion that P4 is currently implementing control technologies that meet BART for the #5 Kiln and the #9 Furnace and #9 CO Flare. Federally-enforceable permit conditions will be put in place that require P4 to use these BART technologies. DEQ will conduct visibility impact analyses based on emissions within an airshed.

5. BART Analysis for the Nodulizing Kiln (#5 Kiln)

The Nodulizing Kiln (#5 Kiln) is used to produce phosphate nodules for processing in the facility's furnaces. Phosphate ore, dried underflow solids from the current scrubber tower clarifier, and ore dust from the kiln's drop out chamber are heated to high temperatures (1,500^{o}C) to remove organic material and to thermally agglomerate the mixture to a nodular form. The 325-foot long rotary kiln is primarily fueled by carbon monoxide (CO), a by-product of the plant's three electric arc furnaces. Coal and natural gas are used as supplemental fuel sources. The overall gas flow rate exiting the kiln is approximately 263,800 actual cubic feet per minute (acfm).

Existing federally-enforceable process and air pollution controls for the kiln that are addressed in the facility's current Tier I (Title V) operating permit No. T1-029-0001, issued December 30, 2002 (which has been administratively extended beyond the December 30, 2006 expiration date), consist of:

- A limit on the sulfur content of the coal to no more than 1% by weight.
- A dust knockout chamber, spray tower, four parallel Hydro-Sonic© scrubbers, and four parallel cyclonic separators. The hydrosonic scrubbers were brought on-line in September 1987 in response to a January 1986 Consent Order. These tandem nozzle fixed-throat free-jet scrubbers are required for control of PM/PM_{10} and polonium-210 emissions (a radionuclide) found in the phosphate ore.

The initial control device is a settling chamber where large particles are removed. The exhaust flow is then routed to a concrete tower where it passes through water sprays to remove soluble gases and particulate matter. The exhaust flow is then routed to the four parallel Hydro-Sonic© scrubbers for removal of submicron particles and entrained particle-laden water. The exhaust gases exit the scrubbers and pass though cyclonic separators and fans prior to exiting to the atmosphere though four stacks.

A lime concentrated dual alkali (LCDA) scrubber to control SO_2 emissions from the kiln was installed by P4 in 2005 in accordance with the requirements of a December 30, 2002 consent order issued by DEQ. The LCDA scrubbing process uses the existing hydrosonic scrubbers to absorb SO_2 with a solution of sodium salts comprised of sodium sulfite and bisulfite, the active absorbent species. Some sodium sulfate will also be produced. The spent solution of sodium sulfite/bisulfite/sulfate is continuously withdrawn to a dual-reactor system, where it is treated with hydrated lime. The lime regenerates the scrubbing solution and precipitates calcium sulfite/sulfate solids. The solids are removed from the system through thickening and filtration, and the regenerated solution is returned to the scrubber as feed material. In addition to the hydrosonic scrubbers, the LCDA scrubbing system includes raw material storage tanks, two reactor tanks, thickener/clarifier, filtration (feed tank with vacuum filtering process), and a double-lined landfill with leachate collection.

5.1 Kiln SO_2 BART Analysis

SO_2 is formed in the kiln almost exclusively by the oxidation of sulfur present in the process material feed. Small amounts of SO_2 are formed during the limited use of coal and natural gas as kiln fuel.

5.1.1 Identify Control Technologies

In support of a BACT analysis submitted in 2006, P4 searched the RBLC for all permits (draft or final) issued since 2001 that included SO_2 as a controlled pollutant. This search yielded 376 facilities. Processes that were inherently different than the nodulizing kiln at the P4 facility were eliminated from this initial list. For example, all cement kilns were eliminated because the calcium-containing materials processed in these kilns provide for inherent SO_2 removal not found in the feed to the P4 kiln.

The remaining facilities found in the search of the RBLC database included the following process codes:

- 11.110 – External combustion-Solid fuels and solid fuels mixtures –Coal (includes bituminous, subbituminous, anthracite, and lignite),
- 11.130 – External combustion-Solid fuels and solid fuels mixtures-Other solid fuels and solid fuel mixtures,
- 11.900 – External combustion-Other fuels and combinations (e.g. solid/liquid, liquid/gas) wood, gas & oil fired,
- 62.010 – Inorganic chemicals manufacturing,
- 81.002 – Metallurgical Industry, and
- 90.000 – Mineral products.

None of the facilities found employing SO_2 control technologies were under RBLC plant process code 90.013 for elemental phosphorus plants. The BACT emission limits, therefore, are not directly applicable to the P4 nodulizing kiln due the uniqueness of this process. The control technologies, though, are applicable and have been included in this evaluation.

As part of developing this BART analysis, DEQ reviewed RBLC technologies listed as of July 2008 for these process codes, and confirmed that the 2006 search results are still representative of BACT for these sources. Control technologies that are available to control SO_2 from the #5 Kiln, in top-down order, include:

Wet Flue Gas Desulfurization (FGD)

- Lime or limestone based wet flue gas desulfurization (FGD): ~75 to 98 percent control[19]

Dry FGD

- Lime Spray Drying (LSD) or lime spray dryer absorber: ~82 to 95 percent control[3]
- Humidified In-Duct Injection:
  - ~50 to 70 percent control (when followed by a baghouse)[20]
  - ~ 35 to 50 percent control (when followed by an ESP)[4]
- Convective Pass Injection: ~50 to 70 percent control[4]
- Furnace Sorbent Injection (FSI):
  - Hydrated lime: ~ 50 to 65 percent control[4]
  - Limestone ~ 40 to 50 percent control [4]
- In-Duct Spray Drying (DSD): ~ 50 to 60 percent control (when followed by an ESP)[4]

Regenerative FGD Processes

- Wet: sodium sulfite, magnesium oxide, sodium carbonate, and amine: up to 97% control[3]
- Dry: activated carbon.

Process Controls

- Reducing the fuel sulfur content,
- Reducing the sulfur content of other feed material.

The following discussion of available SO_2 controls was compiled by P4 from the RBLC search; searches of the major California Air Pollution Control Agencies web sites (California Air Resources Board, South Coast Air Pollution Control Agency, San Diego County Air Pollution Control Agency, and the Bay Area Air Quality Management District); EPA Regions 4 and 5 websites; EPA Headquarters website; and a review of SO_2 control literature.

Process Controls

Process controls can reduce emissions in a variety of ways, depending on the source. If the emission unit is primarily a combustion source, reducing the sulfur content of the fuel can reduce SO_2 formation. Examples of this type of process control include use of low sulfur distillate oil, natural gas, or coal, if available. If the source is a process unit that includes the addition of feed material, reducing the sulfur content of the feed can control SO_2.

Add-On Controls

There are two major types of add-on controls for SO_2 removal: once-through and regenerable. In once-through technologies, the SO_2 is permanently bound to the sorbent that must be disposed of a waste or utilized as a by-product (i.e., gypsum). In regenerable technologies, SO_2 can be released from the sorbent during its regeneration and the SO_2 may be further processed to yield H_2SO_4, elemental sulfur, or liquid

[19] EPA, *Controlling SO_2 Emissions: A Review of Technologies*. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-00/093. November 2000.

[20] Barbara Toole-O'Neil, editor, chair, *Dry Scrubbing Technologies for Flue Gas Desulfurization*, Consortium Review Committee, Ohio Coal Research Consortium, Publisher: Springer, 1998.

SO_2.[21] The initial capital costs and annual operation and maintenance (O&M) costs for regenerable technologies are generally higher than for once-through technologies. Regenerable technologies are usually only economically feasible if a reliable buyer can be found for the by-product.[3]

The most common type of once-through controls, wet scrubbing and dry scrubbing, are collectively known as flue gas desulfurization [FGD] processes. The terms “wet” and “dry” refer to the relative moisture state of the by-product from the process and not necessarily the state of the sorbent in the process.

Wet FGD Processes
In wet scrubbing systems, the flue gas is passed though a slurry consisting of a sorbent in an aqueous medium where the flue gas is cooled to the adiabatic saturation temperature. Particulate and gaseous oxides of sulfur are removed by absorption or chemical reaction. The by-product slurry from this process is dewatered for disposal or sold commercially.

Wet scrubbing systems generally use lime, limestone, or magnesium oxide as sorbents. Limestone is the most common sorbent used in wet scrubbers. In this system, SO_2 reacts with calcium carbonate to form calcium sulfite and carbon dioxide. In the most common version of limestone wet scrubbing, air is injected into the scrubber reactor to oxidize the calcium sulfite to gypsum (hydrous calcium sulfate). Depending on local market conditions, the gypsum can be sold as a product or disposed of as a stable material. This process known as Limestone Forced Oxidation (LSFO) has become the preferred wet FGD process for coal-fired electrical power plants. One reason for the popularity of LSFO is that it minimizes gypsum scaling problems in the absorber.

Additives can reduce the liquid-to-gas ratio and improve sorbent utilization to enhance the efficiency of SO_2 removal in LFSO systems. Organic acids, such as dibasic acid, are commonly added to LFSO systems to improve their SO_2 removal efficiency.

Another variant of limestone scrubbing is Limestone Inhibited Oxidation (LISO). In this process, emulsified sodium thiosulfate is added to the limestone slurry feed to prevent the oxidation of $CaSO_3$ to gypsum in the absorber by lowering the slurry oxidation level. Other widely used wet FGD technologies are lime, magnesium-enhanced lime (MEL), and dual alkali processes. In the lime process, $Ca(OH)_2$ slurry is sprayed counter-current to the flue gas flow. The lime slurry is more reactive than the limestone slurry resulting in a smaller absorber compared to a limestone based system. The lime sorbent, however, is generally more expensive than the limestone sorbent.

The MEL process is a variation of the lime process. The lime sorbent in this process contains magnesium. This addition makes the slurry more alkaline removing more SO_2 compared to a similar conventional lime process. The dual (or double) alkali process uses a sodium solution for scrubbing followed by lime treatment of the scrubbing solution. A sodium sulfite solution is sprayed into an open spray tower or another scrubbing arrangement to remove SO_2 from the flue gas. Lime is added to the product solution in an external tank to recover the sodium solution and form a calcium sulfite-rich sludge. This sludge can be oxidized with air to convert it to gypsum, if desired. This process uses lower-liquid/gas ratios than most other wet FGD processes. The process calcium sulfite/sulfate sludge (if not oxidized) is disposed in a lined landfill.

[21] Srivastava, R.K and W. Jozewicz, *Flue Gas Desulfurization: State of the Art*. Journal of the Air and Waste Management Association, Volume 51, p. 1676-1688. December 2001.

Another variant of wet scrubbing process is the use of ammonia to combine with SO_2 to form various ammonia salts (ammonia sulfate and ammonium bisulfate). These salts can be sold as a marketable byproduct for use in fertilizers.

In summary, available wet scrubbing technologies for SO_2 removal are:

- Lime-Concentrated Dual Alkali,
- Limestone Forced Oxidation,
- Limestone Inhibited Oxidation,
- Lime,
- Magnesium-enhanced Lime, and
- Ammonia.

Dry FGD Processes

The simplest form of dry scrubbing does not include any added sorbent. In coal-fired combustion devices, naturally occurring alkaline materials found in the coal ash absorb the SO_2 in the flue gas. This process occurs on a filter fabric, the main purpose of which is to capture particulate matter. The alkaline portion of the captured particles will absorb SO_2 until this portion is neutralized or until the particles are removed from the filter bad during a cleaning cycle. The removal efficiency of this type of SO_2 removal is varies widely but is relatively low compared to wet FGD processes and is estimated to be approximately 25 to 40 percent.

In dry scrubbers with added sorbent, a chemical slurry is atomized and injected into the flue gas stream (close to saturation) where droplets react with the SO_2 as they evaporate. The resulting dry by-product is collected in the bottom of the dryer or in the particulate removal equipment (such as an electrostatic precipitator [ESP] or a baghouse). The most widely used type of dry FGD process is Lime Spray Drying (LSD). In this process, lime slurry is mixed with the hot flue gas in a spray tower. Simultaneous heat and mass transfer between the alkali in the finely dispersed lime slurry and the SO_2 in the gaseous phase result in a series of reactions a drying of the reacted products. The resulting by-products include calcium sulfate, calcium sulfite, fly ash, and unreacted lime. A portion of this by-product maybe recycled into the spray tower to enhance SO_2 removal. The by-product can usually be disposed of in a non-hazardous waste landfill.[3]

Other forms of dry FGD processes inject the sorbent as a dry powder into the flue gas at a variety of locations in the processes. The resulting by-product is captured down stream in particulate removal equipment. These types of dry FGD processes include Furnace Sorbent Injection (FSI) and Duct Spray Drying (DSD). Both of these processes have been used in coal-fired boilers.

In FSI, dry sorbent is injected directly into the section of the combustion device where temperatures are between 950 and 1,000^oC (1742 ^oF – 1832 ^oF). Sorbent particles (most often lime and sometime limestone) decompose and become porous solids with high surface areas. The end product consisting of calcium sulfate and unreacted sorbent leave the combustion device ands are captured as a solid in a particulate collection device. In a variant of FSI, after the reaction has occurred in the combustion device, water is sprayed on the flue gas to improve SO_2 removal efficiency and improve sorbent utilization.

In the DSD process, slaked lime slurry is sprayed directly into the ductwork upstream of an ESP. The SO_2 in the flue gas reacts with the alkaline slurry droplets as they dry to form calcium sulfate and calcium sulfite. A residence time of at 1-second and preferably 2-second is required for maximum SO_2 removal.

The water entering with the lime sorbent humidifies the flue gas for better SO_2 removal. The particles are then captured in the ESP. The by-products normally can be disposed of in a lined landfill.[3]

In summary, available top-down dry scrubbing technologies for SO_2 removal are:

- Lime Spray Drying (LSD, added sorbent),
- Furnace Sorbent Injection (FSI) or dry sorbent injection, and
- Duct Spray Drying.

Regenerative Processes

Amine processes are the most mature regenerative sulfur removal technology, especially in petroleum refining. This process involves absorption of SO_2 within an aqueous amine absorbent. The amine is regenerated thermally to release the SO_2 stream. SO_2 may then be treated by conventional technologies to produce sulfuric acid as a by-product.

5.1.2 Eliminate Technically Infeasible Options

Process Controls

The 2002 Tier I operating permit limits the maximum sulfur content of the coal. Western coals may run as high as 5 to 6% sulfur by weight. Limiting the maximum sulfur content of the coal to 1% by weight is technically feasible.

Pipeline quality natural gas is inherently a very low sulfur fuel. Further reductions in the natural gas sulfur content were not considered.

The phosphate ore contains sulfur, but removal of sulfur from the ore prior to placing it in the kiln is technically infeasible.

Wet FGD Processes

In determining which SO_2 control technology to install in response to a 2002 Consent Order, P4 conducted extensive research and development on the technical feasibility of a variety of SO_2 control technologies in order to meet the unique requirements of the kiln. P4 initially screened hundreds of control technologies, eliminating most as infeasible for the requirements of the kiln. A wide array of requirements and considerations were used to screen these technologies and select a handful that would prove feasible and successful for the P4 kiln. These requirements included: SO_2 emissions, particulate emissions, solid waste properties, process availability/reliability, reuse of existing equipment, raw material supply/quality/cost, integration with existing operations, demonstrated use of technology in similar applications, and flexibility over a wide range of operating conditions. Recycle processes were examined carefully versus once-through processes due to the potential for the buildup of naturally-occurring radioactive materials. Some of the wet scrubbing options were determined infeasible due to potential sodium or calcium salt buildup (scaling) on the current emission control system and for interfering with the cadmium capture (sulfiding) system.

This screening process resulted in the following options:

- Three options involving alkali scrubbing - LSFO and a variant of Dual Alkali scrubbing (Lime Concentrated Dual Alkali scrubbing [LCDA]).

- A system that would scrub the venturi off-gas with ammonium hydroxide (NH_4OH) solution to form a potentially salable by-product (ammonium bisulfite/sulfite solution).
- Two similar systems involving regenerative scrubbing of venturi off-gas with a proprietary amine, yielding a sulfuric acid by-product.

Dry FGD Processes
Approximately 64 percent of the SO_2 emissions in the United States are produced by the electric power generating units that burn fossil fuels, predominantly coal.[3] Consequently, the majority of the FGD processes in use today have been designed to address SO_2 emission reductions from these electric generating units. The nodulizing kiln at the P4 facility is unlike an electric power generating unit and some of the FGD processes developed for coal combustion units are not technically feasible. Specifically, technically infeasible processes include those that involve injection of sorbent into the combustion chamber. The feed to the kiln is closely regulated to produce nodules that are usable in the furnaces. The addition of lime or limestone into the combustion chamber of the nodulizing kiln is not compatible with the process of nodule preparation and, is therefore, deemed to be technically infeasible. Any SO_2 removal process that utilizes injection of sorbent into the combustion chamber such as FSI and its variations were eliminated from further consideration.

5.1.3 Evaluate Control Effectiveness for Remaining Technologies

All remaining control technologies are capable of removal efficiencies of 97%. The remaining SO_2 control technologies are:

Once-Through Wet FGD Processes:

- LSFO,
- LCDA, and
- Ammonia Scrubbing.

Regenerative Processes:

- Amine scrubbing.

5.1.4 Evaluate Control Technology Impacts

5.1.4.1 Cost of Compliance

BART analyses require a baseline case for the emission unit be selected as a reference point for comparison of alternatives. This baseline case represents a realistic scenario of the upper boundary of uncontrolled emissions from the source.[3] The 2001- 2002 actual emission were chosen for this scenario. This emission rate of 11,914 tons per year was based on P4's Enoch Mine phosphate ore composition, kiln on-stream time, and total daily feed to the kiln for 2001-2002. Cost effectiveness calculations were based on this baseline emissions value.

A summary of the cost effectiveness of each remaining technology is presented below:

Table 5.1.1 COST COMPARISON FOR SO_2 CONTROLS FOR THE #5 KILN

Scrubbing Technology	Initial Capital Costs ($\$x10^6$/yr)	Annual O&M[a] costs ($\$x10^6$/yr)	Total Annualized cost[b] ($\$x10^6$/yr)	Annualized cost per ton of SO_2 removed (\$/ton SO_2)
LSFO	21.2	4.4	7.42	$642
LCDA	12.2	3.7	5.44	$466
Ammonia Scrubbing	28.7	6.1	10.20	$881
Regenerative Amine Scrubbing	30.3	5.5	9.81	$849
a. O&M – operations and maintenance b. 7% discount rate over 10 years				

Cost effectiveness calculations are detailed in Appendix H to P4's Tier II operating permit application received on June 26, 2003. Operation and maintenance costs include operating labor, maintenance labor and materials, reagents, disposal of residuals, and energy.

The cost comparisons shown in Table 5.1.1 reflect the annualized cost compared to having no SO_2 controls installed. As shown in the table, LCDA was estimated to have the lowest annualized cost per ton of SO_2 removed. However, P4 is currently required to operate its existing LCDA scrubbing system whenever the kiln is operating. Because each of the SO_2 control technologies shown in the table have similar maximum control efficiencies of about 97%, the incremental cost of replacing the existing LCDA scrubbing system with a different system—even if higher control efficiencies could be reached—would be excessive.

5.1.4.2 Energy Impacts

Energy impacts from a control technology generally occur in one of two ways. First, if the flue gas temperature needs to be elevated in order for the control technology to work most efficiently, the cost of heating may be so large that it negatively impacts the cost effective of this control option. Second, if the energy cost (i.e., electric power) for operating a control technology is a disproportionately large part of the overall operation costs, compared to another technology given the same removal efficiency, the latter technology would be chosen as BART. Conversely, a control technology that uses less energy that the baseline condition would be looked upon more favorably than one that does not, given identical removal efficiencies. Both of these types of impacts are discussed in the cost effectiveness section.

None of the technically feasible technologies requires reheat of the flue gas or has disproportionate energy costs during operations. All will use more energy than the existing operation.

5.1.4.3 Non-Air Quality Environmental Impacts

Environmental considerations in a BART analysis concentrate on impacts other than on air quality from the pollutant under consideration. The focus is on impacts to solid or hazardous waste generation, discharges of pollutants to water, or emissions of pollutants not directly considered in the analysis. The LSFO process produces a solid gypsum by-product (after dewatering). This by-product can usually be disposed of in a non-hazardous waste landfill or, if market conditions are favorable, sold as a raw material. This process then has the potential positive environmental benefit of reusing the by-product as a raw material. One possible negative impact is the generation of fugitive dust from limestone stockpiles if these are not properly managed.

In the LCDA process, SO_2 is absorbed by a solution of sodium sulfite and sodium bisulfate. The spent sodium sulfite/bisulfite/sulfate solution is continuously withdrawn to a dual-reactor system where it is reacted with lime. The lime regenerates the scrubbing solution and precipitates calcium sulfite/sulfate solids. The filter cake resulting from dewatering the solids may be disposed of in a permitted, lined landfill. The use of ammonia scrubbing has the potential positive environmental benefit of reusing the by-product (ammonium bisulfite/sulfite solution) as a raw material. Regenerative amine scrubbing produces liquid sulfuric acid as a by-product. This presents potential heath and safety concern regarding the handing and storage of this material. With proper health and safety procedures, and a stable market for sulfuric acid sales, these environmental impacts will be significantly reduced.

5.1.4.4 Remaining Useful Life

The #5 Kiln is expected to remain in service for the life of the P4 facility. This criterion is not a factor in determining BART.

5.1.5 SO_2 BART for the Nodulizing Kiln (#5 Kiln)

Since all four remaining technologies are capable of 97% removal from baseline condition, the balancing factors of environmental, energy, and economic impacts would dictate the chosen technology. Based on the evaluation above, LCDA was selected by P4 as the preferred alternative for SO_2 control for the kiln emissions. It had the lowest cost per ton of SO_2 removed, a low probability of causing significant environmental impacts, and was a proven, mature technology. It was also compatible with the existing Hydro-Sonic© scrubbers that would continue to be used to control particulate/radionuclide emissions. The evaluation in this subsection was based on a comparison of control technologies versus no controls, and demonstrates that an LCDA scrubbing system would be selected as BART if the facility had no SO_2 controls on the kiln emissions.

P4 is currently required to limit coal sulfur content to a maximum of 1% by weight, and to operate its existing LCDA scrubbing system whenever the kiln is operating. The LCDA scrubbing system is expected to have a control efficiency of 97% for SO_2, which is reflected in the emissions estimates for this pollutant. The requirement to control SO_2 emissions contained in the 2002 DEQ consent order will be made federally-enforceable by incorporation into a permit to construct.

5.2 Kiln PM/PM_{10} BART Analysis

5.2.1 Identify Control Technologies

In response to a request from DEQ, P4 identified all technically available kiln particulate pollution control technologies in September 2006. The control technologies were evaluated and determined to be either technically feasible or infeasible.

The current particulate pollution control equipment on the kiln consists of a dust knockout chamber, spray tower, four parallel high-energy tandem nozzle venturi scrubbers, and four parallel cyclonic separators. The venturi scrubbers were brought on-line in September 1987 in response to a January 1986 Consent Order. A BACT analysis was not performed during the pollution control selection process, however pilot plant tests were performed on three (3) different technologies: venturi scrubber, catenary grid scrubber, and wet electrostatic precipitator (ESP). These technologies are included in the list below.

The following is a list of the available control technologies (in approximately top-down order, i.e., technologies with better control efficiencies are listed first) from the pilot plant testing and RBLC search that was performed in September 2006.

- Baghouse/Fabric Filter,
- Electrostatic Precipitator (ESP),
- Venturi Scrubber,
- Wet ESP,
- Rotoclone Scrubber,
- Catenary Grid Scrubber,
- Packed Scrubber, and
- Good Combustion Control.

5.2.2 Eliminate Technically Infeasible Options

Baghouse/Fabric Filter: This technology is best used in a dry environment. In a moist environment, the fabric can become blinded and the hopper can be bridged. The kiln exhaust gas is a moisture-laden stream because it is first sent through a spray tower to cool the gas stream from approximately 800 ^{o}C to 71 ^{o}C (1472^{o}F to 160 ^{o}F).

ESP: This technology is technically infeasible for the same reasons as a baghouse/fabric filter.

Rotoclone Scrubber: This type of centrifugal or dynamic scrubber is considered a medium energy (medium pressure drop) scrubber and does not have the particulate removal efficiency of a high-energy scrubber. This technology does not have the control efficiency for sub-micron particulate matter that is needed in this application.

Packed Scrubber: The normal use for this technology is for the removal of gases and vapors from a gas stream; however, some types have been used for particulate removal. Coarsely packed beds are very effective at removing coarse dusts and mists. Finely packed beds may be used to remove smaller particulates, but because of pressure drop considerations, the velocity must be kept relatively low. Therefore, finely packed beds have a greater tendency to plug and are generally limited to gas streams with relatively low grain loading.

Catenary Grid Scrubber: P4 conducted a pilot plant test on a slipstream of kiln exhaust gas. The technology was susceptible to plugging of the straightening vanes, and fan vibrations due to buildup. The pilot plant test showed that the scrubber was effective at removing larger particles, but not sub–micron material. Therefore, this technology was not recommended for use in this application.

Good Combustion Control: Combustion in the kiln is carefully controlled to ensure that the kiln temperature stays in the range at which sintering of the phosphate ore occurs, which is 1400^{o}C – 1459^{o}C (2552 ^{o}F – 2658^{o}F). Good combustion controls generally focus on ensuring adequate mixing and providing excess air to promote complete combustion. Excess air tends to cool the combustion chamber and therefore requires more fuel to maintain the high temperatures necessary for sintering the ore. Good combustion control is not feasible in this application.

P4 determined that the following two options were technically feasible:

Wet ESP: A pilot plant test was performed on a slipstream of kiln exhaust gas. The pilot plant test showed that the wet ESP is capable of reducing particulate emissions to an acceptable level. However, the technology is susceptible to fouling, scaling, and plugging from raw water quality. During the testing, the ESP had to be shutdown every two weeks in order to clean the plates and troughs of buildup and sedimentation.

Venturi Scrubber: A pilot plant test was performed on a slipstream of kiln exhaust gas. The pilot plant test showed that the tandem nozzle venturi scrubber was capable of reducing particulate emissions to an acceptable level with some nozzle plugging occurring. However, the problem was eliminated by adding water upstream of the first nozzle to wet the throat area of the nozzle. Venturi scrubber outlet emissions were insensitive to changes in inlet particulate loading, and water solids concentrations had no significant impact on particulate emissions.

5.2.3 Evaluate Control Effectiveness for Remaining Technologies

Wet ESP: On the pilot plant test, the wet ESP was found to have a particulate removal efficiency of approximately 93%. However, with the maintenance problems associated with this technology, it was not recommended for use in this application.

Venturi Scrubber: On the pilot plant test, the tandem nozzle venturi scrubber was found to have a particulate removal efficiency of approximately 95%. Therefore, high-energy tandem nozzle venturi scrubbers were recommended and installed on the kiln to control particulate emissions.

5.2.4 Evaluate Control Technology Impacts

As shown in Table 2.1, PTE emissions of SO_2 and NO_x from the #5 Kiln are substantially greater than estimated PM_{10} emissions. SO_2 emissions are about seven times higher, and NO_x emissions are almost 42 times larger. Because P4 selected the most stringent technically-feasible option available in 1987 (the HE venturi scrubbers), the following impacts were not evaluated:

1) Cost of Compliance,
2) Energy Impacts,
3) Non-air Quality Environmental Impacts, and
4) Remaining Useful Life.

5.2.5 PM/PM_{10} BART for the Nodulizing Kiln (#5 Kiln)

The evaluation in this subsection was based on a comparison of RBLC control technologies identified in 2006 versus no controls. Since 2006, there have been no additional technically-feasible controls identified with greater control efficiency than the HE venturi scrubbers already installed to control particulate emissions from the kiln.

P4 is currently required to use a dust knockout chamber, spray tower, high-energy tandem nozzle venturis, and cyclonic separators to control PM/PM_{10} emissions from the kiln.

If a new technically feasible PM/PM_{10} control technology were identified that has control efficiency greater than 95%, the relatively low level of PM/PM_{10} emissions would cause the incremental cost of replacing the existing group of control devices to be excessive. No additional PM/PM_{10} controls are needed to meet BART criteria.

5.3 Kiln NO_x BART Analysis

5.3.1 Identify Control Technologies

NO_x is formed in the kiln almost exclusively as thermal NO_x due to the high temperatures required to sinter the phosphate ore into nodules. NO_x is also formed when either coal or natural gas is used to supplement or replace the CO normally used to fire the kiln.

P4 conducted a search of EPA's RBLC Clearinghouse database for potential BART options for the control of NO_x emissions from large rotary kilns. The following is a list of the available control technologies that were identified:

- Good combustion control,
- Low NO_x burner, and
- Selective non-catalytic reduction (SNCR).

5.3.2 Eliminate Technically Infeasible Options

Good Combustion Practices: The temperature at which thermal NO_x is formed is approximately 1300^{o}C (2372^{o}F). The temperature at which sintering of the phosphate ore occurs is 1400^{o}C to 1459^{o}C (2552 ^{o}F to 2658^{o}F). Therefore, it is not feasible to lower the temperature in the kiln to minimize or prevent the formation of thermal NO_x.

Low NOx Burner, Limit Excess Air: The temperature required for a low NO_x burner is too low to sinter the phosphate ore and form the required nodules. Sintering of the ore takes place at 1400^{o}C to 1459^{o}C, and low NO_x burners must be controlled to operate at temperatures well below 1300 ^{o}C (2372 ^{o}F), the temperature at which thermal NO_x is formed.

Selective catalytic reduction: Not included in the RBLC. If a SCR system were installed at the back end of the kiln prior to the particulate control system, the heavy particulate loading in the gas stream would foul the catalyst. Also, the temperature of the kiln offgas would be much too high for SCR to be effective. SCR is only effective in a temperature range of 300^{o}C to 400^{o}C (572 ^{o}F to 752 ^{o}F). If the SCR system were installed after the particulate control system to prevent catalysts fouling, the temperature of the gas stream would be too low for SCR to function properly. Also, the high moisture content in the gas stream after the particulate control system would cause the SCR system to be inoperable due to water molecules coating the surface of the catalyst and preventing mass transfer for the catalytic reaction to occur.

Selective Non-catalytic Reduction, Low NO_x Burners, top Air Duct: SNCR technology utilizes a reducing agent, the most popular being ammonia, in the gas stream at temperatures between 900 ^{o}C and 1000^{o}C (1652 ^{o}F to 1832 ^{o}F) for optimum NO_x control. The kiln off gas temperature at the exit of the kiln is between 730 ^{o}C and 900 ^{o}C (1346 ^{o}F to 1652 ^{o}F), with the normal temperature being 750 ^{o}C (1382 ^{o}F). This is well below the minimum required temperature for SNCR to work effectively. Also, the existing ductwork, refractory, and waste heat boiler are not capable of handling gas streams at these temperatures for sustained periods of time. The heavy particulate loading in the kiln off gas stream would make it difficult to inject the liquid ammonia without plugging the spray injectors, and also may hinder the ammonia and NO_x chemical reaction by adsorption on the dust particles. P4's existing process layout would likely not allow enough room for the needed auxiliary burners and SNCR control equipment. If SNCR were installed after the particulate control system, the temperature of the gas stream as it exits the

particulate control system (approximately 80°C or 176°F) would be too low for the control system to function properly.

5.3.3 NO_x BART for the Nodulizing Kiln (#5 Kiln)

As demonstrated in the evaluation in this subsection, the required operating temperature range in the #5 Kiln precludes using typical NO_x control technologies. There are no technically feasible retrofit control technologies to control NO_x from the #5 kiln.

6. BART Analysis for the #9 Furnace and #9 CO Flare

Nodules from the #5 Kiln are combined with coke and quartzite and heated (in a reducing environment) in one of three electric furnaces. This reaction results in the production of phosphorus gas, along with CO and entrained particulate matter. The furnace off gas, composed primarily of CO, water, and trace quantities of fluoride, phosphorus, phosphorous compounds, and particulate matter, is sent to the #5 Kiln where the CO is used as fuel for the kiln.

At times, there may be more CO produced than can be burned in the kiln. During such times, the CO gas will be treated in the thermal oxidizer. During periods of startup, shutdown, scheduled maintenance, safety measures, upset and breakdown, the CO from the #7 and #8 furnaces is flared using the #7/8 CO Flare. CO from the #9 furnace is flared using the #9 CO Flare. The 7/8 and #9 CO Flares are typical unassisted flares. The gas first passes through a liquid knockout system to remove water and condensibles before reaching the flare At the top of the flare stack is a flare tip comprised of the burners, a system to mix the fuel and air, and a pilot light to ignite the mixture.

Pursuant to a December 30, 2002 Consent Order issued by DEQ, P4 is required to implement BACT for the #7 furnace CO emissions or install a thermal oxidizer, whichever is more effective in reducing CO emissions. P4 is also required to apply such CO control technology on the #8 and #9 furnaces. P4 submitted a CO BACT analysis for the #7 Furnace and #7/8 CO Flare as part of the Tier II operating permit application received June 26, 2003. P4 proposed as BACT a combination of a thermal oxidizer (98% efficient), using flaring (80 to 98% efficient, to be used on a limited basis during certain operating conditions or process upsets), and controlling plant operations to balance the rate of CO production in the furnaces to match the fuel needs for the kiln.

Emissions from furnace slag tapping and the process stream ESP dust oxidation chamber from each furnace are controlled by a cyclonic separator and venturi scrubber known as the #7, #8, and #9 Furnace Tap Hole Fume Collectors (THFC).

Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through each furnace vent stack when the furnace is shut down. In the Tier II operating permit application received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFCs.

Because the #7 furnace process is representative of all three furnaces, the BACT analysis completed by P4 for the #7 furnace as part of the Tier II application was used as the starting point for the BART analysis for the #9 Furnace and #9 CO Flare. The #9 Furnace is the largest of the three furnaces, but the operations are essentially the same as the #7 furnace and #7/8 CO Flare.

6.1 #9 Furnace and #9 Flare SO_2 BART Analysis

SO_2 emissions points associated with the #9 Furnace and #9 CO Flare include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 2.35 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): 48.48 T/yr
- #9 Furnace Treater Heat Vent (natural gas burner): 0.03 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 1.05 T/yr

Total SO_2 emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 138 tons per year.

This BART analysis will focus on the two major sources of SO_2 for the furnace (the THFC stack and the #9 CO Flare).

6.1.1 Identify Control Technologies

#9 THFC
Available technologies for removing SO_2 from a gas stream are described in Section 5.1.1 for the #5 Kiln.

#9 CO Flare:
The RBLC database was searched for recent BACT determinations for SO_2 control on flares. Four facilities and 27 processes were found. The industries found were: Petroleum/Natural Gas Production and Refining, Municipal Waste, and Chemical Manufacturing. In each entry, the control listed was "pollution prevention." These pollution prevention measures involved process controls that limit the sulfur content of the flare feed.

6.1.2 Eliminate Technically Infeasible Options

#9 THFC
A detailed review of technical feasibility for all of the available technologies listed in Section 5.1.1 was not conducted. The SO_2 emissions from the THFC stack are relatively small (~50 T/yr, if the furnace vent gases are rerouted to this stack). Installing new SO_2 controls for this waste stream will not be economically feasible.

#9 CO Flare:
Process Controls: The process controls described in the RBLC database for flares included the use of low-sulfur fuel burned at the flare or a reduction in sulfur content of a feedstock for a process upstream of the flare. The production of elemental phosphorus in the #9 Furnace is a highly controlled process. The furnace is operated to optimize the production of elemental phosphorus. This production process does not directly depend on a fossil fuel source or other controllable sulfur-containing feed material. Therefore, process controls to reduce the sulfur in the waste gas to the flare for SO_2 control are technically infeasible for the #9 CO flare.

6.1.3 Evaluate Effectiveness for Remaining Control Technologies

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

6.1.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

6.1.5 SO_2 BART for #9 Furnace and #9 CO Flare

There are no technically feasible options for controlling SO_2 emissions from the #9 furnace (including the #9 CO flare).

None of the control technologies identified for SO_2 control are technically feasible on the #9 CO flare. BART for the #9 CO Flare is "no additional controls."

6.2 #9 Furnace and #9 Flare PM BART Analysis

Particulate emissions points associated with the #9 Furnace and #9 CO Flare include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 6.58 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): 26.28 T/yr
- #9 Furnace Treater Heat Vent (natural gas burner): 0.58 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 0.003 T/yr

Total PM emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 155 tons per year.

This BART analysis will focus on the two major sources of PM_{10} for the furnace (the THFC stack and the #9 CO Flare).

6.2.1 Identify Control Technologies

#9 THFC

Particulate emissions from #9 Furnace slag tapping and the ESP dust oxidation chamber are currently controlled by a cyclonic separator and venturi scrubber known as the #9 Furnace THFC.

#9 Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through the #9 Furnace vent stack when the furnace is shut down. In Tier II operating permit application materials received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFC.

Available technologies for removing PM from a gas stream, in top-down order, include:

	Total PM	PM <0.3μm
• Baghouse/Fabric Filter:	98 to 99.9%	99 to 99.98%
• ESP:	99 to 99.7%	80 to 95%
• Particle Scrubber	95 to 99%	30 to 85%
- High energy (e.g., venturi)		
- Medium energy		
- Low energy (e.g., spray tower)		
• Mechanical Collector (e.g., cyclone)	70 to 90%	0 to 15%

#9 CO Flare:

P4 queried the RBLC for a process type that included the word "flare" and "PM" as the pollutant. The search yielded 23 facilities with 32 processes. Of these 23 facilities, seven were chemical or plastics manufacturing facilities, four were crude oil refineries, four were landfills, three were oil exploration operations, three were natural gas treating facilities, one was a steel foundry and one was a grain processing plant. Databases from several California regulatory bodies and the Texas Commission on

Environmental Quality (formerly the Texas Natural Resource Conservation Commission) were also queried for updated flare BACT information compared to the extensive discussion in the SENES BACT (2002a). No new information was found.

The most common control technologies for PM for flares in the RBLC were good combustion practices (smokeless flare) or proper operation. One included steam-assisted combustion (from a vacuum tank degasser in a steel foundry). This enhancement reportedly increases the efficiency of flares by providing better mixing with combustion air. The gas streams burned at all of these facilities have a higher heating value and higher VOC content than the gas stream from the P4 furnaces (which is about 300 Btu/scf). None of these facilities burned CO in their flare; therefore, none of these BACT determinations are directly applicable to the P4 furnaces.

6.2.2 Eliminate Technically Infeasible Options

#9 THFC

A detailed review of technical feasibility for the available PM control technologies was not conducted. The PM/PM_{10} emissions from the THFC stack are relatively small (~33 T/yr, if the furnace vent gases are rerouted to this stack). Installing new or retrofit PM controls for this waste stream will not be economically feasible.

#9 CO Flare:

No retrofit options for controlling PM emissions from flares have been identified.

6.2.3 Evaluate Control Effectiveness for Remaining Technologies

There are no technically feasible options for controlling PM emissions from #9 furnace (including the #9 CO flare).

6.2.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling PM emissions from #9 furnace (including the #9 CO flare).

6.2.5 PM BART for #9 Furnace and #9 CO Flare

#9 THFC

PM BART for the #9 Furnace Vent is to reroute the #9 Furnace vent emissions through the THFC. Because the emissions from the THFC stack already pass through a cyclonic separator and venturi scrubber, and because the PM/PM10 emissions are quite low (~33 T/yr), PM BART for the THFC is “no additional controls.”

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#9 CO Flare:

No retrofit control technologies were identified for PM control on the #9 CO flare. PM BART for the #9 CO Flare is “no additional controls.”

6.3 #9 Furnace and #9 CO Flare NO_x BART Analysis

6.3.1 Identify Control Technologies

NO_x emissions points associated with the #9 Furnace include:

- #9 Furnace Vent Riser (P4 has proposed routing these emissions to the THFC stack): 0.75 T/yr
- #9 Furnace THFC Stack (ferrophosphorus and calcium silicate slag tapping): not estimated
- #9 Furnace Treater Heat Vent (natural gas burner): 4.83 T/yr
- #9 Furnace Explosion Seal Vent (upsets only): 0.0056 T/yr

Total NO_x emissions associated with the #9 Furnace have been estimated (3/25/09 P4 emissions inventory). The total emissions from the three furnaces with T.O. control is 119 tons per year.

This BART analysis will focus on the two major sources of NO_x for the furnace (the THFC stack and the #9 CO Flare).

#9 THFC

NO_x from #9 THFC are currently uncontrolled.

#9 Furnace pressure relief vessel vent gases are currently vented directly to the atmosphere through the #9 Furnace vent stack when the furnace is shut down. In Tier II operating permit application materials received on November 30, 2007 (Revision 2 to the 2003 application), P4 proposed routing these emissions through the THFC.

Available technologies for removing NO_x from a gas stream include:

- Low NO_x burner,
- Overfire Air,
- Reburning,
- Flue Gas Recirculation,
- SCR,
- Selective non-catalytic reduction (SNCR),
- Good combustion control.

#9 CO Flare:

P4 searched the RBLC database for recent BACT determinations for NO_x control from flares. Twenty-one entries for NO_x were found. The industries found were Petroleum/Natural Gas Production and Refining, Municipal Waste, Utility and Large/Industrial-Size Boilers, Commercial/Institutional-Size Boilers, Miscellaneous Combustion, and Chemical Manufacturing. The NOx controls found were listed as: “no controls feasible,” “general control device requirements,”(refers to 40 CFR §60.18 and §63.11) and “good design and proper operating practices.”

As discussed in the SENES BACT analyses, steam injection is a technology that is used on flares to help prevent smoking and to improve the overall efficiency of the flare. Injection of steam is widely used as a standard operating procedure on VOC flares to create turbulent mixing of air and the fuel for more complete combustion and to provide some cooling of the flare tip and stack.

6.3.2 Eliminate Technically Infeasible Options

#9 THFC
A detailed review of technical feasibility for the available NO_x control technologies was not conducted. The NO_x emissions from the THFC stack are relatively small (~23 T/yr, if the furnace vent gases are rerouted to this stack). Installing new or retrofit NO_x controls for this waste stream will not be economically feasible.

#9 CO Flare:
None of the NO_x controls found in the RBLC or elsewhere apply to flares that use CO as their primary fuel. These flares burned volatile organic compounds (VOC), landfill gas, refinery fuel gas, natural gas, or other hydrocarbon-derived fuel. Therefore, none of the process controls or BACT emissions limits identified in the RBLC are directly applicable to the No.7/8 CO Flare. In addition, the fuels that are combusted in most of the flares found in the RBLC or elsewhere have a higher heat input than CO giving these flares a hotter peak temperature and, therefore, a higher NO_x emission rate per unit of fuel gas than the No.7/8 CO flare.

Good design as a control technology applies to new flares and is not an economically feasible retrofit option. Installing new or retrofit NO_x controls for this waste stream will not be economically feasible.

6.3.3 Evaluate Control Effectiveness for Remaining Technologies

There are no technically feasible options for controlling NOx emissions from #9 furnace (including the #9 CO flare).

6.3.4 Evaluate Control Technology Impacts

There are no technically feasible options for controlling NOx emissions from #9 furnace (including the #9 CO flare).

6.3.5 NO_x BART for #9 Furnace and #9 CO Flare

#9 THFC
Because the NO_x emissions are quite low (~23 T/yr), NO_x BART for the #9 THFC is “no additional controls.”

#9 CO Flare:
No retrofit control technologies were identified for NO_x control on the #9 CO Flare. NO_x BART for the #9 CO Flare is “no additional controls.”

Appendix A – RBLC Summaries

RBLC (RACT-BACT-LAER Clearinghouse) Report for NOx Control on Kilns

Report Date: 8/28/2006

#	Date	Company	Facility	Location	Process Unit	NOx Control	Other Limits
1	8/24/2006	Western Greenbirer Co-Generation, LLC	Western Greenbirer Co-Generation, LLC	WV	Cementitious Material Kiln		
2	8/3/2006	Georgia Pacific Corp	Monticello Mill	MS	Lime Kiln	Good Combustion Practices	
3	10/25/2004	Graymont PA Inc	Graymont Bellefonte Plant	PA	#7 Lime Kiln		
4	6/29/2006	Western Lime Corporation	Western Lime Corporation	MI	Lime Kiln	Low NOx Burner, Limit Excess Air	
5	6/21/2005	Pope & Talbot	Halsey Pulp Mill	OR	Lime Kiln	Good Combustion Control	
6	1/17/2006	Hoeganaes Corp	Hoeganaes Corp	TN	Rotary Kiln	Proper Combustion Control	Operating hours are limited to 8,000 hours/12 consecutive months
7	11/16/2005	Georgia Pacific Corp	Monticello Mill	MS	Lime Kiln	Good Combustion Practices, Kiln Design	
8	1/12/2004	Roanoke Cement	Roanoke Cement	VA	Lime Kiln	Good Combustion Practices	CEMS
9	10/10/2003	Weyerhaeuser	Flint River Operations	GA	Rotary Lime Kiln		
10	9/17/2003	Vulcan Materials	Vulcan Materials	IL	Lime Kiln	Best Combustion Practices	
11	9/17/2003	Continental Cement Company	Continental Cement Company	MO	Rotary Kiln & Pyroprocessing System	Selective Non-catalytic Reduction, Low NOx Burners, Top Air Duct	
12	1/3/2003	LaFarge Corp	LaFarge Corp	IA	Kiln	Good Combustion Practices	
13	3/12/2004	Carolina Stalite Company	Gold Hill	NC	Rotary Expanding Kiln	Good Combustion Techniques	
14	3/17/2005	International Paper	Mansfield Mill	LA	Lime Kiln	Good Process Controls	Water content of lime
15	1/4/2005	Donahue Industries	Donahue Industries Paper Mill	TX	Lime Kiln		
16	9/18/2001	Lehigh Portland Cement Company	Lehigh Portland Cement Company	MD	Preheater/Precalciner Kiln	5-stage preheater/precalciner pyroprocessing plant	Any add-on Nnx emissions control has been determined to be either technically or environmentally infeasible
17	9/22/1998	Holnam, Laporte Co.	Holnam, Laporte Co.	CO	Calciner/Kiln	Special Process: Design of burner/kiln to control alkali from limestone	
18	12/4/2001	Signal Mountain Cement Co, LP	Signal Mountain Cement Co, LP	TN	Dry Feed Kiln	Good Combustion Practices	
19	1/4/2005	Chemical Lime, LTD	Lime Plant	TX	Kiln		
20	6/6/2002	Ash Grove Cement Co.	Ash Grove Cement Co.	UT	Kiln	Low NOx Burner	400 lb/hr at 90% of max production capacity
21	10/7/2002	Weyerhaeuser Co.	Weyerhaeuser Co.	MS	Lime Kiln	Effective operation of kiln	
22	12/4/2002	Westvaco Corp., Chemical Division	Westvaco Corp., Chemical Division	KY	Woodbase Carbon Acid/Mixing, Activation Kiln	Low NOx Burner	
23	3/3/2004	Holnam, Devil's Slide Plant	Holnam, Devil's Slide Plant	UT	Kiln	Low NOx Burner	
24	9/17/2002	Willamette Industries	Marlboro Mill	SC	Kiln	Good Combustion Control	

NOTE: NOx Control column = blank: original RBLC report had (N)

RBLC (RACT-BACT-LAER Clearinghouse) Report for NOx Control on Flares
Report Date: 5/10/2006

#	Date	Company	Facility	Location	Process Unit	NOx Control	Other Limits
1	12/21/2005	New England Waste Services, Inc.	New England Waste Services of Vermont, Inc.	VT	Landfill Gas Flare	NO2 emissions: Low emissions design	
2	10/25/2004	Steelcorr, Inc.	Bluewater Project	AR	Degasser Hotwell Flare		
3	7/5/2005	Charter Manufacturing Co., Inc.	Charter Steel	OH	Vacuum Oxygen Degasser Vessel w/Flare		Emissions from NG combustion from flare; only during oxygen lancing degassing process for low carbon and stainless steel production.
4	12/30/2004	Degussa Engineered Carbons LP	Baytown Carbon Black Plant	TX	Dryers, Boilers, Flare	Good combustion practice and design	
5	12/30/2004	Degussa Engineered Carbons Inc	Borger Carbon Black Plant	TX	Dryers, Boilers, Flare	Good combustion practice and design	
6	10/28/2002	Conoco, Inc.	Ponca City Refinery	OK	Flare	Limit fuel to pipeline grade natural gas	
7	4/6/2004	Valero Refining Company	Corpus Christi Refinery	TX	Main Flare		
					Ground Flare		
8	1/3/2005	Atofina Petrochemicals, Inc.	La Porte Polypropylene Plant	TX	Monument No. 2 Flare	None indicated	
					Train No. 8 Flare	None indicated	
9	1/3/2005	Reliant Energy, Inc.	Limestone Electric Generating Station	TX	FCCU Flare	None indicated	
					HCU Flare	None indicated	
10	1/5/2005	Exxon Mobil Chemical Company	Baytown Olefins Plant	TX	Primary Flare	None indicated	
					Secondary Flare	None indicated	
					Flare, Flarex	None indicated	
11	10/27/2005	City of LA, Bureau of Sanitation	City of LA, Bureau of Sanitation	CA	Landfill, Gas Gathering System Flare		
12	1/3/2005	Vetrotex America	Saint-Gobain Vetrotex America	TX	Propane Flare	None indicated	
13	1/4/2005	Trifinery Petroleum Service	Trigeant Corpus Christi	TX	Flare, Flare	None indicated	
					Plant Flare	No NOx control listed	
14	1/4/2005	Vetrotex America	Vetrotex America	TX	Propane Flare	None indicated	
15	1/16/2004	Cabot Corporation	Ville Platte	LA	Units 1&2 Flare	Design and proper operation	
16	7/24/2003	Formosa Plastics Corp.	Formosa - High Density Polyethylene II	TX	Elevated Flare	None indicated	
17	8/30/2004	Exxon Chemical Company	Exxon Baytown Olefins Plant	TX	Secondary Flare		
18	7/3/2003	MCUA Landfill Gas Utilization Project	MCUA	NJ	Open Flare	None	
19	11/17/2004	Fina Oil & Chemical Company	Port Arthur Refinery	TX	Flare		
20	7/25/2003	Praxair Incorporated	Praxair Synthesis Gas Plant	TX	Flare	None indicated	
21	1/5/2005	Equistar Chemicals, LP	Equistar Chemicals, LP	TX	Cold Flare	None indicated	
22	10/25/2004	Fina Oil and Chemical Company	Port Arthur Refinery	TX	Flare		
23	8/30/2004	Fina Oil and Chemical Company	Atofina's Port Arthur Complex	TX	Flare		
24	10/29/2002	Grain Processing Corp.	Grain Processing Corp.	IN	Watewater Treatment Plant Flare	Flare limited to 520 hr/yr	
25	9/29/2003	Union Carbide Chem & Plastics Co. Inc.	Low Pressure Polyethylene Plant No. 2	TX	Large Flare		
					Small Flare	None indicated, BACT is applied.	
26	12/18/2001	City of Stockton Municipal Utilities Dept	City of Stockton Municipal Utilities Dept	CA	Digester Gas-Fired Flare	No control that is not integral to the flare	
27	9/16/2002	Chevron USA	Chevron USA	MS	SOCMI Distillation Process with Flare	NO2: Flare is used to reduce NOx emissions from the process	
28	1/4/2005	Formosa Plastics Corporation	Marine Loading Facility	TX	Dock Flare	None indicated	
29	12/18/2001	Texaco Exploration and Production	Texaco Exploration and Production	CA	Gas Flare	Kaldair, Coanda Effect, electronic ignition	
30	4/11/2006	Westlake Petrochemicals Corp	Ethylene Manufacturing Complex Petro II Unit	LA	Flare		Emission limits reflect those established by PSD-LA-595(M1). Limits unchanged by PSD-LA-595(M2).

NOTE: NOx Control column = blank; original RBLC report had (N) or ()

Report for NO_x Control on Flares, continued

RBLC (RACT-BACT-LAER Clearinghouse) Report for PM Control on Kilns – Report Date: 9/25/2006

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
1	8/16/2006	Cutler-Magner Company	CLM - Superior	WI	Lime Kiln	High temperature membrane (PTFE) fabric filter baghouse; preheater lime kiln	
2	6/28/2006	Big River Industries, Inc.	Gravelite Division	LA	Nos 1-4 Rotary Kilns	Venturi Scrubber	
3	6/19/2006	US Gypsum Company	US Gypsum Company	VA	Drying Kiln		
4	5/24/2006	Weyerhaeuser, Inc.	Red River Mill	LA	Lime Kiln No. 2	Electrostatic Precipitator (ESP)	
5	4/26/2006	Western Greenbrier Co-Generation, L.L.C.	Western Greenbrier Co-Generation, L.L.C.	WV	Cementitious Material Kiln	Baghouse	Kiln exhaust combined with CFB exhaust and emitted from a commor stack
6	3/30/2006	Suwanne American Cement	Branford Cement Plant	FL	Kiln w/In-Line Raw Mill	Baghouse	
7	1/25/2006	Sierra Pacific Industries	Skagit County Lumber Mill	WA	7 Dry Kilns		
8	10/21/2005	Dalitalia, L.L.C.	Muskogee Porcelain Floor Tile Plant	OK	Kilns	Use of natural gas fuel	
9	10/14/2005	Dalitalia, L.L.C.	Muskogee Porcelain Floor Tile Plant	OK	Kilns	Wet Scrubber	
10	8/30/2005	Arkansas Lime Company	Arkansas Lime Company	AR	Lime Kiln, SN-30Q	Baghouse	
11	3/4/2005	Georgia Pacific Corporation	Monticello Mill	MS	Lime Kiln	Venturi Scrubber	
12	12/20/2004	Florida Crushed Stone Company	Brooksville Cement Plant (FCS)	FL	Clinker Kiln	Baghouse	
13	11/5/2004	Florida Rock Industries, Inc.	Thompson S. Baker - Cement Plant (FRI)	FL	In Line Kiln/ Raw Mill	ESP	
14	10/25/2004	Graymont PA Inc	Graymont Bellefonte Plant	PA	#6 Lime Kiln, #7 Lime Kiln	Fabric Filters	
15	6/29/2006	Western Lime Corporation	Western Lime Corporation	MI	Lime Kiln	Fabric Filters	Use of propane or No. 2 Oil with no stone feed c startup
16	9/29/2005	Lehigh Cement Company	Lehigh Cement Company	IA	Kiln /Calciner/Preheater	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
17	7/18/2005	Carmeuse Liome, Inc.	Maple Grove Gacility	OH	Rotary Kiln (2)	Baghouse	
18	8/30/2006	Georgia Pacific Corporation	Monticello Mill	MS	Lime Kiln	Scrubber	
19	8/31/2006	Roanoke Cement	Roanoke Cement	VA	Lime Kiln	Electrostatic Precipitators & Good Combustion Practices	
20	10/10/2003	Weyerhaeuser - Flint River Operations	Weyerhaeuser - Flint River Operations	GA	Rotary Lime Kiln	ESP	
21	9/5/2003	GCC Dacotah	GCC Dacotah	SD	Rotary Kiln #6	Fabric Filters	
22	4/6/2005	Georgia-Pacific Corp.	El Dorado Sawmill	AR	Lumber Drying Kiln	Proper Maintenance and Operation	
23	9/17/2003	Vulcan Materials	Vulcan Materials	IL	Lime Kiln	Baghouse	
24	9/17/2003	Continental Cement Company	Continental Cement Company, L.L.C.	MO	Rotray Kiln	Fabric Filters	
25	1/3/2003	LaFarge Corporation	LaFarge Corporation	IA	Preheater/Precalciner Kiln	Baghouse	
26	5/13/2004	Meadwestvaco Kentucky, Inc.	Meadwestvaco Kentucky, Inc/Wickliffe	KY	Lime Kiln	Scrubber	
27	3/2/2004	Georgia Pacific Corporation	Port Hudson Operations	LA	Lime Kiln No. 1	Wet Scrubbers	
28					Lime Kiln No. 2	ESP	
29	3/12/2004	Carolina Stalite Company	Gold Hill	NC	Rotary Expanding Kiln	Wet Lime Slurry Injection	
30	8/10/2005	Longview Fibre Company	Longview Fibre Company	WA	Lime Kilns 1, 2, 3, 4, and 5		
31	12/22/2003	Bowater	Bowater Coated Paper Division	SC	Lime Kiln, No. 2	ESP	
32	11/24/2003	Ash Grove Cement Company	Portland Cement Clinkering Plant	WA	Kiln Exhaust Stack	Baghouse	
33	9/25/2006	The Dow Chemical Company	The Dow Chemical Company	MI	Incinerator, Rotary Kiln, Hazardous Waste	Venturi Scrubber	
34	3/17/2005	International Paper	Mansfield Mill	LA	Lime Kiln	Venturi Scrubber using Caustic Solution	
35	1/5/2005	Alamo Cement Company II, LTD	Portland Cement Manufacturing Plant	TX	Grinding/Preheating Kiln, K-19	ESP	
36	5/17/2004	International Paper Company	Riegelwood Mill	NC	Lime Kiln	ESP and Fixed Throat Spray Venturi-Type Wet Scrubber	
37	8/22/2006	Crown Paper Company	St. Francisville Mill	LA	Lime Kiln, Emission Pt. RC-01	None Indicated	Stack tests will be conducted

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
38	4/6/2005	Weyerhaeuser Company	Weyerhaeuser Company	MS	Kilns, Dry Lumber, 5; AA-007	Good Combustion Control	AA-007: No controls feasible
39	8/14/2006	Donahue Industries, Inc.	Paper Mill	TX	Lime Kiln	Scrubber	
40	12/27/2001	Gulf Lumber Company	Mobile	AL	Dry Kilns; Lumber Dry Kilns	Good Engineering Practices	
41	3/2/2004	Rio Grande Portland Cement Corp.	Rio Grande Portland Cement Corp.	CO	Kiln, Clinker Cooler	High temerature fabric filter baghouse for clinker cooler	
42					Preheater/Precalciner , Kiln	High temperature filter baghouse	
43	1/4/2005	Temple-Inland Forest Products Corporation	Temple-Inland Pineland Manufacturing Complex	TX	(2) Kiln Drying, Studmills 1&2, EPN91&92	No Controls Required	
44					(4) Kilns 1-4, Drying, Sawmill, EPN101-104	No Controls Required	
45	9/18/2001	Lehigh Portland Cement Company	Lehigh Portland Cement Company	MD	Preheater/Precalciner Kiln	Enclosure, Wet Suppresion Systems and Paved Roads	Control Effciencies Ra from 60-90%
46	12/9/2003	Suwanee American Cement Company, Inc.	Suwanee American Cement Company, Inc.	FL	In Line Kiln & Raw Mill	Baghouse	
47	2/10/2003	Arkansas Lime Company	Arkansas Lime Company	AR	Rotary Lime Kiln, No. 2	Baghouse	
48	12/18/2001	Watsontown Brick Company	Watsontown Brick Company	PA	Kiln, Brick Tunnel	Dustex, PDE-3630-14-40 Fabric Filter	Polymide Bags @ 206 AC
49	3/11/2002	Holnam, Inc.	Holnam, Inc.	MI	Cement Kilns, Wet Process (2)	Fabrick Filter, Slurry Scrubber	
50	1/20/2005	Meadwestvaco Kentucky, Inc.	Wickliffe Carbon Plant	KY	Activation Kiln	Wet Fan, Reverse Jet Scrubber, and Brink Mist Eliminator	
51					Drying Kiln	Baghouse	
52					Activation Kiln	Rotoclone Scrubber	
53	1/4/2005	Texas Lime Co	Texas Lime	TX	Lime Kiln No 4 & No 6	None Indicated	
54	3/2/2004	Holnam, Florence	Holnam, Florence	CO	Kiln/Preheater/Bypass & Clinker Cooler Exhaust	Baghouse	
55	4/18/2002	General Shale Products Corp., L.L.C.	General Shale Products Corp., L.L.C.	AR	Kiln, Aggregate	Natural Gas Usage, Wet Scrubber, and Good Combustion	
56	3/10/2004	Lone Star Industries, Inc.	Lone Star Industries, Inc.	IN	Kiln Operation	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
57	1/4/2005	North Texas Cement Company	North Texas Cement Company	TX	Main Kiln/Scrubber Stack	Scrubber and Baghouse	
58	1/4/2005	Champion International Corporation	Camden Complex	TX	(3) Kilns No 1-3, K-01 thru -03	None Indicated	
59	12/3/2003	Holnam, Laporte Co.	Holnam, Laporte Co.	CO	Calciner/Kiln	Baghouse	
60	5/20/2004	Lone Star Industries, Inc.	Lone Star Industries, Inc.	IN	Cement Kiln, Wet Process, Coal	ESP	
61	1/4/2005	Capitol Aggregates, LTD.	Capitol Cement Division	TX	Dry/Wet Kiln	Baghouse	
62	2/26/2003	IMC-Agrico Company	IMC-Agrico Company	FL	Kilns A, B	Packed Scrubber using Pond Water	
63					Kiln C	Caustic Solution Sprayed into Back of Wet Scrubber	
64	1/27/2003	Holnam, Inc.	Holnam, Inc.	MI	Cement Kilns, Wet Process (2)	Baghouse	
65	4/6/2005	Weyerhaeuser Company	Wright City Mill	OK	No. 3 Pine Lumber Kiln		
66	10/9/2002	Illinois Cement Company	Illinois Cement Company	IL	Kiln	Fabric Filter	
67	12/4/2001	Signal Mountain Cement Company, LP		TN	Dry Feed Kiln	Baghouse	
68	9/26/2002	Macmillan Bloedel Packaging	Macmillan Bloedel Packaging	AL	High Temp Lumber Kiln		
69	3/3/2004	Ash Grove Cement Compant	Durkee Facility	OR	Kiln	Baghouse	
70	4/25/2002	Palmetto Lime, L.L.C.	Palmetto Lime, L.L.C.	SC	Vertical Shaft Kilns	Baghouse	
71	12/18/200 1	Continental Lime, Inc.	Continental Lime, Inc.	MT	Kiln-Lime, Two	Baghouse	
72	3/8/2002	Weyerhaeuser, Company		AL	Lumber Dry Kilns		
73	4/2/2004	Weyerhaeuser, Company	Greenville Sawmill	NC	Drying Kilns, 7		
74	1/4/2005	Chemical Lime LTD	Lime Plant	TX	Kiln	Baghouse	
75	2/24/2003	Southdown, Inc.	Southdown, Inc.	FL	Kiln 1, 2	Fabric Filters, Good Combustion	
76	8/28/2006	Casie Ecology Oil Salvage	Casie Ecology Oil Salvage	NJ	Kiln	Fabric Filter, Cyclone, Afterburner, Quench	
77	12/17/200	Florida Rock Industries,	Florida Rock Industries, Inc.	FL	Kiln	ESP	

#	Date	Company	Facility	Location	Process Unit	PM Control	Other Limits
	3	Inc.					
78	4/6/2005	Weyerhaeuser Company	Wright City	OK	No 4 Pine Lumber Mill		
79	6/6/2002	Ash Grove Cement Company	Ash Grove Cement Company	UT	Kiln	Baghouse	
80	4/6/2005	Hankins Lumber Company	Hankins Lumber Company	MS	Lumber Dry Kilns (5)		
81	10/7/2002	Weyerhaeuser Company	Weyerhaeuser Company	MS	Lime Kiln	ESP	
82	12/4/2002	Westvaco Corporation, Chemical Division	Westvaco Corporation, Chemical Division	KY	Activation Kiln	Venturi Scrubber	
83					Activation Kiln	Rotoclone Scrubber	
84	10/7/2002	Buckeye Florida, LP	Buckeye Florida, LP	FL	Lime Kiln	ESP	
85	12/4/2001	Western Lime Corporation	Western Lime Corporation	WI	Lime Kiln #2	Pulse-Jet Baghouse	
86	9/6/2002	Riverwood International Corporation	Riverwood International Corporation	GA	Kilns 1 & 2	Venturi Scrubber for each Kiln	
87	8/31/2006	Apple Grove Pulp and Paper Company, Inc.	Apple Grove Pulp and Paper Company, Inc.	WV	Lime Kilns (2)	Fabric Filter	
88	3/3/2004	Holnam, Inc.	Devils Slide Plant	UT	Kiln	Baghouse	
89	9/26/2002	Chemical Lime Company of Alabama, Inc.	O'Neal Quarry	AL	Kiln Dust Bin	Baghouse	
90	9/17/2002	Willamette Industries	Marlboro Plant	SC	Lime Kiln	ESP	
91	12/18/2001	Continental Lime Inc.	Cricket Mtn. Lime Plant	UT	Kiln #4	Baghouse	

NOTE: PM Control column = blank; original RBLC report had (N)

P4 BART Determination Modeling

DATE: August 24, 2010

TO: Mike Edwards, Regional Haze Coordinator, Idaho DEQ

FR: Rick Hardy and Wei Zhang, Technical Services Division, Idaho DEQ

SUBJECT: **BART Determination Modeling-Final Report**

We have conducted CALPUFF modeling to determine the improvements to Regional Haze conditions resulting from 2002 upgrades on BART-eligible sources at Monsanto's P4 Plant in Soda Springs, Idaho.

Methods

Emission Rates

Emission rates and stack parameters for the BART-eligible sources were obtained from the emission rates and parameters submitted by P4 as part of their 2009 revisions to their Permit to Construct application materials ("Combined PTC" worksheet revised 3/25/2009).

The BART-eligible sources were determined to be the nodulizing calciner or kiln, which has 4 identical venturi scrubber stacks and Furnace # 9, including fugitive emissions and ancillary equipment related directly to those operations as shown in Table 1. Fugitive emissions include the FeP Slag Tapping Hood Fugitives and FeP Slag Pot Receiving Fugitives associated with Furnace #9. Subsequent modifications to use a thermal oxidizer instead of a flare to dispose of excess carbon monoxide are also included in the PTC for future operations. To reduce simulation times and in view of the relatively small quantity of associated emissions in comparison to the larger included point sources, the fugitive emissions and the #9 Furnace Diesel Burner emissions (in the Base Scenario only) are all combined together with the #9 THFC Stack emissions and assumed to be released with the same stack parameters as shown for the #9 THFC Stack emissions. The total fugitive plus Diesel Burner emissions of all pollutants (SO_2, NOx, and PM_{10}) included with the #9 THFC stack emissions are 0.2% of the total emissions in the base year and 0.5% of the total emissions in the future year scenario. This approximation is justified because the emissions are small and combining them together is expected to have an insignificant, yet conservative effect on the final results for receptors located many kilometers away. The effect is slightly conservative because these fugitive and minor source emissions are all treated as if released from one point, minimizing initial dispersion. In addition, the kiln emissions were modeled as if released from one of the scrubber stacks, however the plume rise is simulated correctly using this approach and the effect of combining emissions at one point on predicted concentrations at the distant receptors should be insignificant.

Stack parameters and combined short-term maximum emissions rates used in the modeling are shown in Tables 2 and 3, respectively. Actual maximum emissions are used to represent the pre-BART Base Year operations, while the Potential to Emit (PTE) emission rates are used for the future scenario, in accordance with BART rules. The apparent increase in NOx emissions from the kiln is due primarily to the difference between actual and PTE estimates, rather than any real process change.

A very small portion of the total haze-causing emissions are composed of PM_{10} (particulate emissions smaller than ten micrometers in diameter). While total PM_{10} emissions are based on source tests, speciation of primary particulate matter emissions into haze-contributing

components was accomplished by applying speciation profiles from the Speciate Database documentation (http://www.epa.gov/ttnchie1/software/speciate/ index.html) for elemental phosphorous manufacturing and FeP Slag handling. In these profiles, Fine Particulate Matter (< 2.5 µm) and Coarse Particulate Matter (2.5 µm – 10 µm) are not differentiated, however it was conservatively assumed that after accounting for the haze contributing particulate species SO_4, NO_3, EC and OC, the remainder of the primary PM_{10} mass consists of Fine Particulate Matter (PMF). Again, the effect of this assumption will be very small and will be conservative. Source test total PM_{10} emissions were used along with the Speciate profiles to estimate individual species emissions, resulting in ammonium sulfate and ammonium nitrate emissions as part of the total PM_{10} emission rates. Finally, ammonium sulfate and ammonium nitrate emission rates were stoichiometrically adjusted to reflect only the sulfate (SO4) and nitrate (NO3) components, the forms expected as inputs for CALPUFF.

Modeling Methodology

The CALPUFF air dispersion modeling system (version 6.112) was used to determine the delta deciview (ΔDV) impacts and the number of days per year and per 3 years above the 0.5 ΔDV threshold that is considered significant in the BART modeling. The modeling was performed in accordance with the *BART Modeling Protocol*[22], which was jointly developed by the states of Idaho, Washington, and Oregon, and which has undergone public review and revision. The meteorological inputs needed by CALPUFF for the analysis were the same data set used for all agency-conducted BART analyses in the Pacific Northwest. It was prepared by Geomatrix, Inc. under the direction of representatives from the states of Washington, Idaho, and Oregon and using *Fifth Generation Mesoscale Meteorological Model* (MM5) data generated by the University of Washington. The result was a CALMET output file for the years 2003-2005 that covers the entire Pacific Northwest at a 4 km resolution that was statistically evaluated against National Weather Service data sets throughout the Northwest and was approved by EPA and key federal land managers to be acceptable for this purpose. The meteorological and computational domains are shown in Figure 1 along with all 11 Class I areas within 300 km of the source. The computational domain includes a 50 km buffer distance from any Class I receptors except on the eastern edge where the available MM5 data set does not allow for it. This may result in a minor error in the results for Bridger, Fitzpatrick, Washakie and North Absaroka Wilderness areas but does not affect any of the 3 most impacted Class I areas (Grand Teton, Yellowstone and Craters of the Moon). The meteorological domain was expanded to correct this problem when the switch from MM5 to the Weather Research Forecast (WRF) model occurred at the University of Washington, however it is not feasible to revisit the modeling with the newer domain.)

Pre-BART Base-Year Modeling Results

Regional haze impacts were computed at all 11 Class I areas within 300 km of the source, as shown in Figure 1. Time series modeled impacts for the Base Year and Future (Post BART) simulations are shown in Figures 2 and 3 for Grand Teton National Park and Craters of the Moon National Monument, respectively. The time series graphs show the inter-annual variation and seasonal variation in modeled impacts over the 3 year modeling period. Highest impacts occur in the cooler months, from November through February when the atmosphere is more stable and nitrate volatilization is minimized by the cooler temperatures.

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[22] *Modeling Protocol for Washington, Oregon and Idaho: Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation.* http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_BART_modeling_protocol.pdf

Haze impacts are summarized in Table 4 for the pre-2002, Existing Control, Base-Year scenario before BART controls were installed and in Table 5 for the Future, Permitted Control Scenario under Normal Operations (the highest future emission operating scenario for haze contributing pollutants). The tables show the results obtained from modeling only the BART-eligible sources, both before and after controls. These tables highlight the following two threshold values used in BART modeling analyses:

8th highest value for each of the years modeled (2003-2005), representing the 98th percentile (8/365 = 0.02) benchmark for delta-deciview (ΔDV) in the each year. In addition the numbers of days in each year above the 0.5 ΔDV threshold for BART-subject analysis are shown.

22nd highest value for the entire period from 2003 through 2005, representing the 98th percentile (22/1095 = 0.02) benchmark for ΔDV over three years. In addition the number of days in all three years above the 0.5 ΔDV threshold for BART-subject analysis is shown.

The highest 98th percentile haze impacts under the existing, pre-BART control scenario were projected to occur at Grand Teton National Park (1.61 ΔDV), with the second highest occurring at Yellowstone National Park (1.41 ΔDV) as shown in Table 4. This occurs due to the frequent wintertime winds carrying the plume toward the NNE. Class I areas to the west of P4 receive relatively less frequent and less severe haze impacts, as seen in the results for Jarbidge, Sawtooths, and to some extent, Craters of the Moon National Monument. Of the 11 Class I areas within 300 km of P4, only three of them were not impacted above 0.5 ΔDV under the Base Year emissions (Fitzpatrick, Jarbidge and Sawtooth Wilderness areas.)

Post-BART Modeling Results

Future year (Post-BART) modeling results are shown in Table 5. When the BART controls were simulated, the highest 98th percentile impacts over the three year period were reduced from 1.61 to 1.068 ΔDV at Grand Teton National Park and from 1.41 to 0.841 ΔDV at Yellowstone, a more than 0.5 ΔDV reduction at both sites. Craters of the Moon haze impacts were lowered 47%, from 1.266 to 0.671 ΔDV.

Eleven Class I areas within 300 km of the P4 facility were included in this analysis. Overall, of 3 of 11 Class I areas originally over 1.0 ΔDV, two dropped below 1.0 (Craters of the Moon and Yellowstone) while one (Grand Teton NP) remained just above 1.0 ΔDV. Of 5 areas originally between 0.5 and 1.0 ΔDV, 4 of them dropped below the 0.5 ΔDV benchmark (Bridger, North Absaroka, Red Rock Lakes, and Washakie Wilderness areas). Of the 8 areas originally over 0.5 ΔDV, 4 are now below and 4 remain above. Only Grand Teton National Park remains above the 1.0 ΔDV benchmark, while only Craters of the Moon, Teton Wilderness and Yellowstone remain above 0.5 ΔDV.

The net improvement for each Class I area is summarized in Table 6 where the difference in 98th percentile ΔDV values and in days over 0.5 ΔDV are shown for each Class I area. A net reduction of 317 days over 0.5 ΔDV was realized for all 11 Class I areas together, a 52% reduction in days overall. Of this overall reduction in days, 44% of the reduced days were concentrated in the Grand Teton NP, Teton Wilderness and Yellowstone NP where some of the most visited and most scenic views are located.

Table 1 BART-Eligible Source Emission Estimates, lb/hr

Type	Process	Source	Emission Point	Pollutant	Actual Base-Year Emissions[a], lb/hr	Potential Future Emissions[b], lb/hr
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	SO2	3003.31	143.01
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	SO2	4.33	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	SO2	Not Installed	144.37
Pt/Fug	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***SO2***	***5.79***	***40.52***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*SO2*	*2.05*	*33.42*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*SO2*	*0.22*	
Fug	*Furnace #9*	*FeP Slag Tapping Hood Fug.*	*#9 Furnace Bldg*	*SO2*	*1.52*	*1.64*
Fug	*Furnace #9*	*FeP Slag Pot Receiving Fugitives*	*Outside*	*SO2*	*2.00*	*5.46*
	Note: All Emissions can not occur simultaneously.		**Total:**	**SO2**	**3013.42**	**327.90**
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	NOx	389.39	856.33
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	NOx	4.77	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	NOx	0.00	73.97
Pt	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***NOx***	***1.57***	***5.67***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*NOx*	*no data[c]*	*5.67*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*NOx*	*1.57*	*Discontinued*
			Total:	**NOx**	**395.73**	**935.96**
Pt	Kiln	Kiln CO, Coal, & Gas Combustion	Kiln Stacks (4)	PM10	15.05[d]	30.00[d]
Pt	Furnace #9	CO to Flare	#9 CO Flare Stack	PM10	20.75	On Standby
Pt	Thermal Oxidizer	CO to Thermal Oxidizer	T.O. Scrubber Stack 1	PM10	0.00	20.90
Pt	***Sum of Small Sources (below) modeled together***		***#9 THFC Stack***	***PM10***	***1.58***	***6.00***
Pt	*Furnace #9*	*FeP Slag Tapping*	*#9 THFC Stack*	*PM10*	*1.43*	*6.00*
Pt	*Furnace #9*	*Diesel Burner*	*Treater Heat Vent*	*PM10*	*0.16*	*Discontinued*
			Total:	**PM10**	**37.38**	**56.90**

Notes: a)FCE Estimate 2001-2002 base year, Prior to Scrubber Installation b)Permitted PTE Future Scenario 1: Normal Operations includes Kiln running, with furnaces at peak power (only #9 Furnace is BART Eligible), flares on pilot only; c)No data for FeP Slag Tapping NOx emissions. Estimated to be < 1 lb/hr; d)P4 reported minor H_2SO4 emissions based on an assumed ratio of SO3/SO2 (not based on measurements). However the SPECIATE profiles applied to the PM10 shown here also include SO4. To assure consistency with the PM10 speciation, and to avoid double-counting of the primary SO4 the reported H_2SO4 (14 lb/hr Base Year and 2.6 lb/hr Future Scenario) is assumed to be included in the PM10 emissions shown in this table and in speciated form as SO4 in Table 3.

Table 2 Stack Parameters for Modeled Sources

Unit Description	Easting, km	Northing, km	Base Elevation, m	Stack Height, m	Stack Diameter, m	Stack Gas Temp, K	Stack Exit Velocity, m/s
Existing Control 2000-2003 Base Year							
Nodulizing Kiln – 4 identical stacks [a]	451.804	4726.349	1826	65	1.4	343	24.63
#9 CO flare	451.836	4725.979	1826	65	1.55	353	25.12
#9 furnace - FeP slag tap stack	451.908	4725.859	1826	22.3	0.945	318	16.83
PTC Future Control with Normal Operations							
Nodulizing Kiln - All 4 together	451.804	4726.349	1826	65	1.4	343	24.63
Thermal Oxidizer scrubber stack	451.836	4725.979	1826	65	1.55	353	25.12
#9 furnace - FeP slag tap stack	451.908	4725.859	1826	22.3	0.945	318	16.83

Note: (a) There is one kiln with 4 identical scrubber stacks (Multiple stacks allow turn-down while maintaining velocity through the venturi throats). Stacks are in a square pattern, each within 3 m of their centroid location. Total maximum Kiln emissions were modeled as if coming from one stack so plume rise is unaffected. A minor conservatism is built in due to concentrating emissions at one point, however the effect is negligible at the distance of all Class I areas.

Table 3 Hourly Emission Rates for Modeled Sources

Unit Description	Gas and Primary Aerosol Species Emission Rate, lb/hr[a]								
	SO2	SO4	NOX	HNO3	NO3	PMC	PMF	EC	OC
Existing Control 2000-2003 Base Year									
Nodulizing Kiln–total emissions from 4 identical stacks	3003.3	3.49	389.4	0.0	0.013	0.0	9.4	0.08	0.75
#9 CO flare	4.3	4.80	4.8	0.0	0.017	0.0	13.0	0.11	1.04
#9 furnace - FeP slag tap, THFC stack [b]	5.8	0.01	1.6	0.0	0.002	0.0	1.1	0.27	0.16
PTC Future Control with Normal Operations[c]									
Nodulizing Kilns - All 4 together	143.0	6.95	856.3	0.0	0.025	0.0	18.8	0.16	1.50
Thermal Oxidizer scrubber stack	144.4	4.84	74.0	0.0	0.018	0.0	13.1	0.11	1.04
#9 furnace - FeP slag tap, THFC stack [b]	40.5	0.05	5.7	0.0	0.006	0.0	4.8	0.46	0.68

Notes: (a) Species definitions: SO2 is sulfur dioxide gas, SO4 is sulfate aerosol, NOx is the sum of nitric oxide and nitrogen dioxide gases, HNO3 is nitric acid gas, NO3 is nitrate aerosol, PMC is coarse particulate matter (2.5 – 10 µm), PMF is fine particulate matter (< 2.5µm), EC is elemental carbon aerosol and OC is organic carbon aerosol. (b) The #9 Tap Hole Fume Collector (THFC) stack emissions include other minor point and fugitive emissions combined together, including FeP Slag Tapping, Diesel Burner (Base Year only), FeP Slag tapping hood fugitives and FEP Slag Pot Receiving fugitives; (c) Future year emissions of NOx and PM species reflect Potential to Emit (PTE) rather than "actual emissions" as reflected in Base Year emissions. Apparent increases of NOx and PM result primarily from this treatment, required under BART rules. One exception is the Thermal oxidizer which does cause a minor NOx increase in comparison to the CO flare that it replaces.

Table 4 Haze Modeling Results for P4 Existing Control 2000-2003 Base Year

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value > 0.5 over one year period						Delta-Deciview Value >0.5 over 3 year period	
	2003		2004		2005		2003-2005	
Impacted Class I Areas within 300km range from P4 Facility	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Bridger Wilderness, WY	0.724	22	0.706	15	0.724	23	0.720	60
Craters of the Moon NM - Wilderness, ID	0.669	12	1.188	23	1.742	36	1.266	71
Fitzpatrick Wilderness, WY	0.495	7	0.424	4	0.510	9	0.495	20
Grand Teton NP, WY	1.482	42	1.664	49	1.662	57	1.610	148
Jarbidge Wilderness, NV	0.111	1	0.147	1	0.416	5	0.253	7
North Absaroka Wilderness, WY	0.338	4	0.568	8	0.613	11	0.538	23
Red Rock Lakes Wilderness, MT	0.756	10	1.045	16	1.120	24	0.882	50
Sawtooth Wilderness, ID	0.21	2	0.425	5	0.501	9	0.403	16
Teton Wilderness, WY	0.895	20	1.026	33	1.015	34	0.993	87
Washakie Wilderness, WY	0.396	4	0.572	11	0.583	11	0.563	26
Yellowstone NP, WY	0.886	23	1.557	39	1.413	43	1.413	105

Notes: a)The 8th highest delta-deciview for the calendar year; b) Total number of days in 1 year that exceeded 0.5 delta-deciviews; c)The 22nd highest delta-deciview value for the 3-year period; d) Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Table 5 Haze Modeling Results for P4 BART PTC Future Control under the Normal Operations Scenario

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value > 0.5 over one year period						Delta-Deciview Value >0.5 over 3 year period	
	2003		2004		2005		2003-2005	
	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Bridger Wilderness, WY	0.517	8	0.487	7	0.439	4	0.483	19
Craters of the Moon NM - Wilderness, ID	0.522	8	0.671	13	0.779	17	0.671	38
Fitzpatrick Wilderness, WY	0.310	2	0.269	0	0.299	1	0.296	3
Grand Teton NP, WY	0.998	32	1.086	33	1.077	41	1.068	106
Jarbidge Wilderness, NV	0.047	0	0.074	0	0.143	2	0.094	2
North Absaroka Wilderness, WY	0.243	0	0.298	1	0.348	4	0.297	5
Red Rock Lakes Wilderness, MT	0.366	4	0.492	7	0.518	9	0.478	20
Sawtooth Wilderness, ID	0.111	1	0.178	0	0.204	0	0.179	1
Teton Wilderness, WY	0.584	9	0.626	14	0.642	14	0.610	37
Washakie Wilderness, WY	0.252	1	0.303	2	0.321	3	0.309	6
Yellowstone NP, WY	0.520	10	1.059	28	0.844	21	0.841	59

Notes: a)The 8th highest delta-deciview for the calendar year; b) Total number of days in 1 year that exceeded 0.5 delta-deciviews; c)The 22nd highest delta-deciview value for the 3-year period; d) Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

Table 6 Improvement in Regional Haze Resulting from P4 BART Controls (Base Year Impacts – Future PTE Impacts)

Impacted Class I Areas within 300km range from P4 Facility	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Improvement in Highest Delta-Deciview Values and Reduction in Days > 0.5ΔDV for Indiv dual Years						Improvement over 3 year Period	
	2003		2004		2005		2003-2005	
	Decrease in 8th Highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 8th highest	Days >0.5ΔDV Reduced	Decrease in 22nd Highest	Total days > 0.5ΔDV Reduced
Bridger Wilderness, WY	0.207	14	0.219	8	0.285	19	0.237	41
Craters of the Moon NM, ID	0.147	4	0.517	10	0.963	19	0.595	33
Fitzpatrick Wilderness, WY	0.185	5	0.155	4	0.211	8	0.199	17
Grand Teton NP, WY	0.484	10	0.5 8	16	0.585	16	0.542	42
Jarbidge Wilderness, NV	0.064	1	0.073	1	0.273	3	0.159	5
North Absaroka Wilderness, WY	0.095	4	0.27	7	0.265	7	0.241	18
Red Rock Lakes Wilderness, MT	0.39	6	0.553	9	0.602	15	0.404	30
Sawtooth Wilderness, ID	0.099	1	0.247	5	0.297	9	0.224	15
Teton Wilderness, WY	0.311	11	0.4	19	0.373	20	0.383	50
Washakie Wilderness, WY	0.144	3	0.269	9	0.262	8	0.254	20
Yellowstone NP, WY	0.366	13	0.498	11	0.569	22	0.572	46
Total Reduction in Days > 0.5 ΔDV		**72**		**99**		**146**		**317**

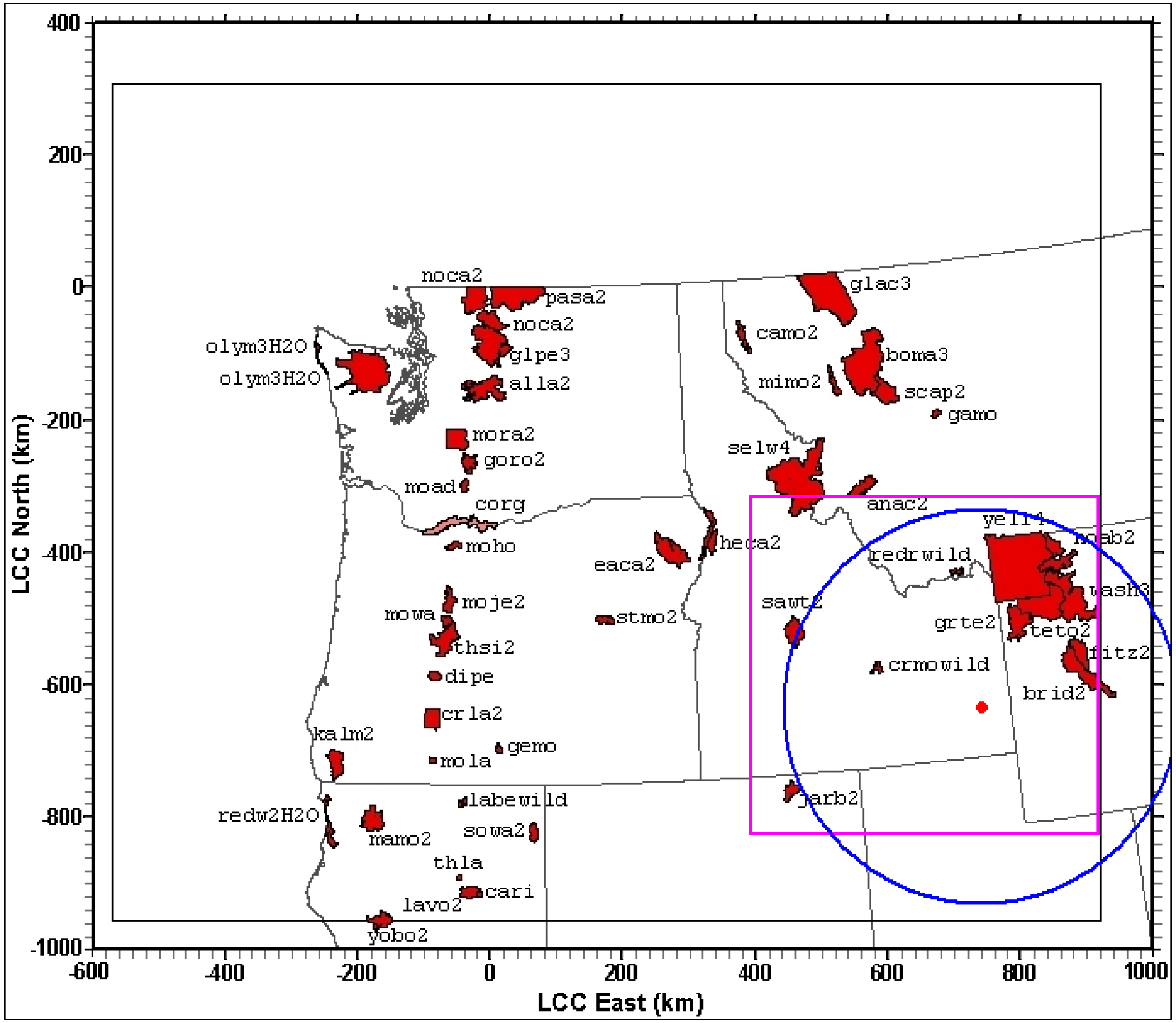

Figure 40 MM5 Meteorological modeling domain (black line) and CALMET/CALPUFF computational domain (pink line), showing Class I Areas within 300km considered in this analysis (blue circle). The red dot locates the P4 facility.

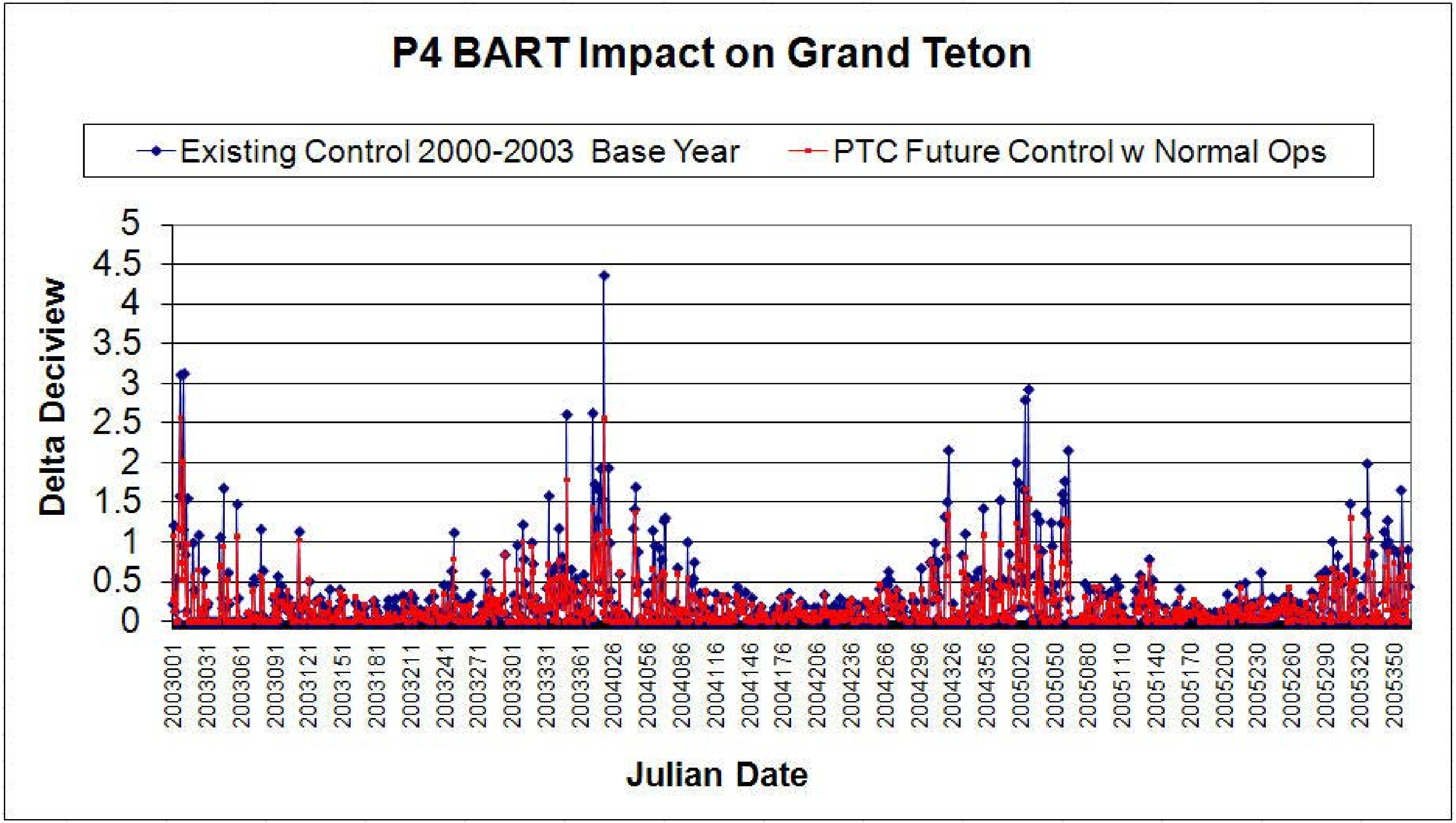

Figure 41 Time series of simulated haze impacts (ΔDV) at Grand Teton National Park for each day of the 3 year modeling period. X-axis labels show Year followed by Julian Day. This figure depicts inter-annual and seasonal variation in base year and future/controlled impacts.

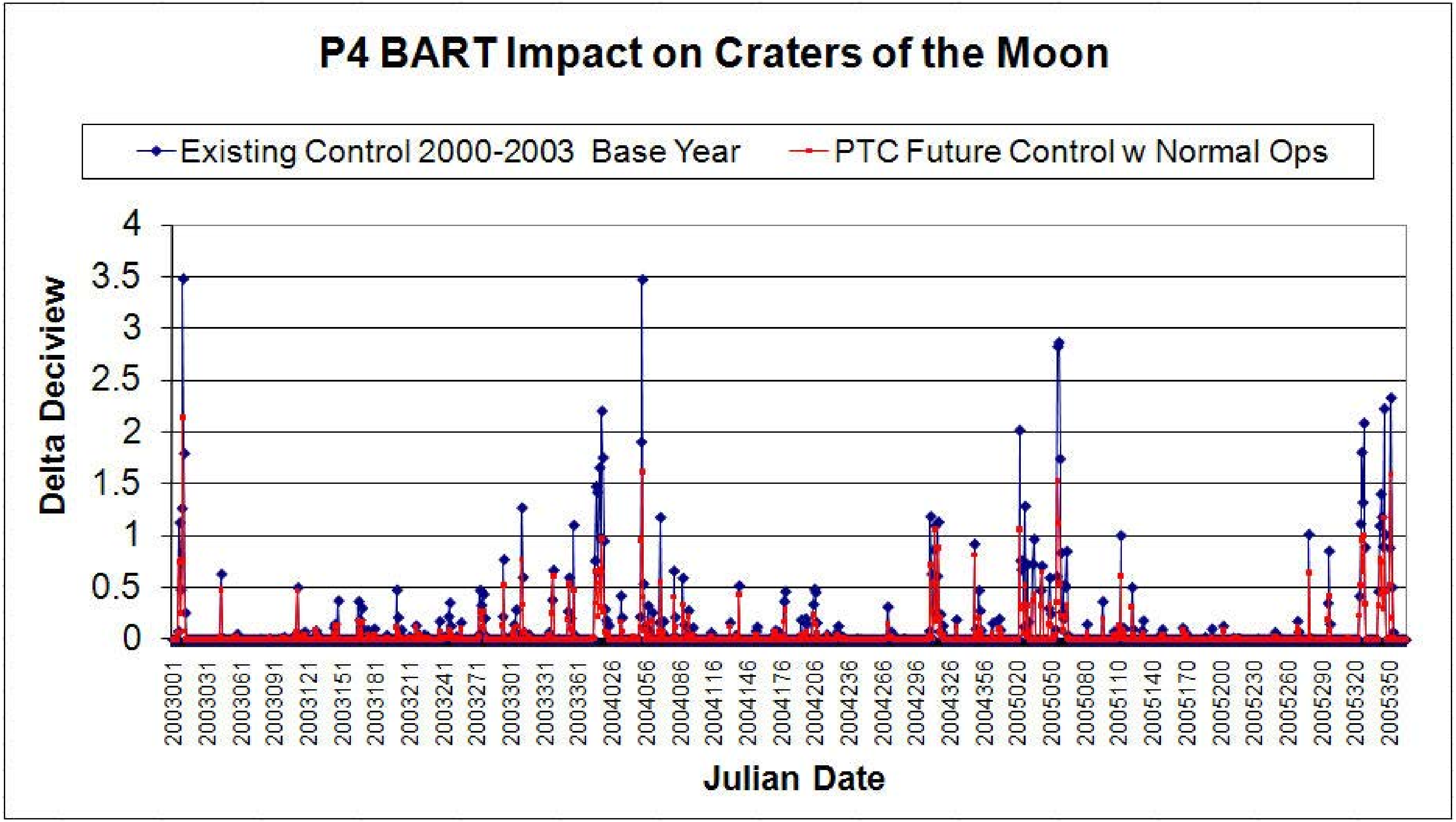

Figure 42 Time series of simulated haze impacts (ΔDV) at Craters of the Moon National Monument for each day of the 3 year modeling period. X-axis labels show Year followed by Julian Day. This figure depicts inter-annual and seasonal variation in base year and future/controlled impacts.

Appendix G: Reasonable Progress Goals

Appendix to Chapter 11 of the State Implementation Plan

Idaho State Wide emissions used to develop percentage source contribution for each light impairing pollutant in Figure 11-1.

Idaho Statewide Emissions (tons/year) Plan02d (2002)						
Pollutant						
Source Category	Sulfate	Nitrate	Primary Organic Aerosol	Elemental Carbon	Fine Particulate	Course Particulate
Point	17,613	11,487	106	11	305	643
Area	3,280	30,318	425	192	4,749	2,933
On-Road Mobile	1,662	44,611	383	390	0	238
Off-Road Mobile	3,702	27,922	747	1,859	0	0
Anthropgenic Fire	895	3,461	8,454	1,331	1,536	1,354
Natural Fire	12,008	39,401	47,883	9,938	3,013	25,323
Road Dust	0	0	150	11	2,153	19,690
Fugitive Dust	0	0	156	11	2,687	17,496
Wind Blown Dust	0	0	0	0	5,050	45,451
Total	39,159	157,199	58,304	13,743	19,492	113,127

Appendix H: Long Term Strategies

Appendix to Chapter 12 of the
State Implementation Plan

Appendix H

Appendix I: Future Commitments and FLM/Public Consultation

Appendix to Chapter 13 of the State Implementation Plan

Appendix I

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Letter to FLMs notifying them of 60-day review Period

June 3, 2010

Re: Idaho's Regional Haze Plan for Federal Land Managers' 60-Day Review

Dear (Federal Land Managers):

As required by 40 CFR 51.308(h)(2), the Idaho Department of Environmental Quality (DEQ) is submitting Idaho's Regional Haze Plan (40 CFR 51.308 for the FLMs 60-day review. This plan is available online at: www.deq.idaho.gov/air/data_reports/planning/regional_haze_sip.cfm. The first five chapters provide a basic overview of the regional haze basic planning elements, consultation through WRAP, monitoring and other technical tools relied upon to develop the plan, and an introduction to Idaho's Class I areas. Chapters 6 through 9 provide information on Idaho's emissions inventory, the pollutants causing visibility impairment in Idaho and surrounding states, and establishes baseline, natural conditions and uniform rate of progress for each of Idaho's Class I areas. Chapter 10 covers Idaho's Best Available Retrofit Technology (BART) process and the determinations on the two BART subject facilities. Chapters 11 and 12 establish reasonable progress goals and long term strategies for Idaho. Chapter 13 covers the formal consultation process and future Regional Haze Plan requirements.

Because of time constraints, DEQ is submitting this plan to the federal land managers (FLMs) without a finalized permit for Amalgamated Sugar Company (TASCO). During the public comment period for TASCO's BART permit, TASCO submitted comments, continuing to contest EPA economist's findings and analysis that TASCO could afford BART as outlined in the draft permit. An executive summary of the economist's findings can be found in Appendix F of the Plan. TASCO has also submitted "receptor oriented source apportionment" results developed by Cooper Environmental Services (CES). TASCO feels the results show that the Riley Boiler visibility impacts are below the 0.5 deciview impact threshold and are exempt from BART.

In order to meet the deadline final submittal to EPA, DEQ is continuing on our timeline and submits this Regional Haze Plan for the FLMs 60-day review period. DEQ expects to review TASCOs extensive comments in the near future and may be submitting those responses to the FLMs, if appropriate, as soon as they are completed. We will be responding to the FLMs comments on TASCOs BART permit after the 30-day review.

During the next 60 days, DEQ will provide in person consultation on the Regional Haze Plan upon request. If you have questions or concerns, please call Mike Edwards at (208) 373-0438.

Sincerely,

Martin Bauer
Administrator
Air Quality Division

MB/me

Initial Comments of USDA Forest Service

Regarding the Idaho Regional Haze State Plan and Best Available Retrofit Technology Determinations

July 7, 2010

General Comments

The USDA Forest Service appreciates the opportunity to provide comment on the draft Idaho Regional Haze State Implementation Plan. While we feel there are issues with the RP analysis and the timelines to achieve natural conditions that need to be resolved, we were very pleased with the thoroughness of Idaho's efforts, and look forward to working with Idaho to resolve any outstanding issues.

Specific Comments:

Section 1.11 – The Western Regional Air Partnership

Idaho should consider rewriting this section to reflect the WRAP's new charter and webpage as well as previous WRAP work.

Chapter 7 – Pollutants Causing Visibility Impairment

Idaho identified OMC as the primary visibility impairing PM-fine component at both Sawtooth and Selway-Bitteroot Class I areas (69% and 52% respectively) in the baseline period of 2000-2004. This is contrasted by Hells Canyon and Craters of the Moon Class I areas where NO3 was the primary component leading to visibility impairment (50% and 39% respectively). On page 55 of the document, Idaho states that is "important to identify whether the source (…of OMC) is strictly wild fire or whether there are sources outside the normal fire season contributing to the problem." However, on page 192 of the document, it appears that Idaho has concluded that "it is almost exclusively from wildfire and therefore isn't a prime pollutant to look at for reductions from anthropogenic sources" without any further technical analysis to support this conclusion.

For the Sawtooth Wilderness (Section 7.4), Idaho identifies an OMC pattern (Figures 7.25 and 7.26) which indicates significant organic mass carbon in November and December. Idaho indicates that "Because organic mass carbon appears to remain steady into the early winter, there may be localized slash burning or wood stoves. This is something that will require further investigation during this Regional Haze SIP planning period."

According to Idaho's open burning rules, any citizen/entity is permitted to burn approved materials after October 21 without an open burning permit. This practice has been demonstrated to significantly increase localized PM2.5 concentrations into November in other parts of Idaho. The town of Stanley, ID is located approximately 3 miles north of the Sawtooth IMPROVE monitor; they share the same narrow valley. Data from the Stanley Remote Automated Weather Station (RAWS), which is adjacent to the IMPROVE monitor, indicates that the IMPROVE monitor is downwind of Stanley during daytime hours, and upwind of Stanley at night. Idaho should investigate whether free open burning by private entities after October 21 is contributing to the increased OMC

concentrations, and if these elevated concentrations are representative of an impact to the Class I Airshed.

Another possible suggestion would be to examine the use of receptor oriented analytical techniques such as positive matrix factorization (PMF) or principal components analysis (PCA) with IMPROVE data which do not require an *a priori* knowledge of source chemical characteristics. At a minimum, Idaho could augment the existing analysis by examining the relationship of total carbonaceous mass (TC) (IMPROVE TOR: OC1 – OC4, OP, EC1 – EC3) to non-soil potassium (IMPROVE: K - 0.6*Fe). Park et al. (2007) examined such a method that could readily be employed to further examine the origins of OMC.

Chapter 8 – Emission Inventory

Since 2007, the Montana/Idaho Airshed Group has been identifying prescribed burning activities as either natural or anthropogenic in accordance with WRAP guidelines. Members of this group include all of the major burners in Montana, and all but two major burners in Idaho. It will be a simple matter to assess whether emissions are being reduced from major anthropogenic burning. Idaho DEQ also has an established agricultural burning program which will allow emissions from those sources to be tracked.

However, private burning, especially after October 21, is a significant issue in Idaho for which DEQ has shown reluctance to address. While these sources may not necessarily impact Class I visibility, they potentially could impact IMPROVE monitor values. These emissions, to the best of our knowledge, are not a part of any WRAP emissions inventory.

FLMs and scientists have recognized the importance of fire as a natural process, and the benefits of allowing some fires to naturally treat the landscape are well documented. Over time, allowing fire to return to its natural role in Class I areas will result in an overall decrease in natural fire emissions. This is evident in the Selway-Bitterroot Wilderness. Fires have been allowed to burn in the wilderness as a natural process for more than 30 years, with the result that most fire that occur in the wilderness are of a relatively small size and produce relatively small amounts of smoke.

Chapter 9 – Source Apportionment

Under 40 CFR 51.308(d)(3)(iii), a state must document the technical basis it is relying upon to meet is reasonable progress goals. Chapter 4 of the document provides a brief summary of the WRAP technical support system (TSS) and IMPROVE air quality data. Chapter 9 of the document describes the air quality modeling source apportionment techniques relied upon to help inform strategy development. However, the document does not provide information regarding performance evaluations of either prognostic meteorological model data or the base case results from the WRAP Base02 inventory that are relied upon in this chapter. Idaho should augment this section to document both meteorological and photochemical model performance evaluations.

Likewise, the document does not describe how the component specific relative response factors (RRF's) were calculated. We request that documentation be added detailing the RRF calculations for each Class I area covered in Chapter 9.

Records for natural fires (wildfires) can be found by accessing ICS-209 records or checking with either the Eastern Great Basin or the Northern Rockies Coordination Centers. Records would indicate the duration of the fire and the total acres burned.

Prescribed burning records can be obtained through the MT/ID Airshed Group (of which Idaho DEQ is a member) dating back to 2004.
In looking at impacts to other Class I areas outside of Idaho, Idaho is using a clustering mechanism from the WRAP Attribution of Haze report to examine their contribution to only three additional Class I areas located totally outside of Idaho – Eagle Cap Wilderness (west of Idaho), Jarbidge Wilderness (South of Idaho, and Cabinet Wilderness (East of Northern Idaho). Eagle Cap and Jarbidge are part of Cluster 7, and Cabinet Wilderness is part of Cluster 9. A third cluster, Cluster 8, includes the Class I areas in Southern Idaho (Sawtooth , Craters of the Moon, and Yellowstone).
First, 51.308(d)(3)(ii) requires that the State must demonstrate that it has included all measures necessary to obtain its share of the emissions reductions necessary to meet the progress goal for the area. The discussion in Section 9.3 is presented in terms of the Idaho's contribution to a representative Class I area in each cluster. This approach does not address the specific requirement of 51.308(d)(ii) to examine the efficacy of a state's emission reduction measures to help meet the *progress goal of the area* which can only addressed by examination of the reasonable progress of specific Class I areas.
Second, we have concern about the methodologies used to generate the Attributes of Haze Work Group cluster analysis. According to Section 9.3, the WRAP Attributes of Haze Work Group used the CMAQ-TSSA results to develop the clusters previously described. According to the Attribution of Haze Phase I report, the CMAQ-TSSA results used to perform the cluster analysis were based upon a beta release of CMAQ 4.4 (p. 2-27 AOH Phase I report). Model performance evaluations of CMAQ 4.4beta indicated serious problems with mass conservation which were not resolved in time for development of many the WRAP work products, which ultimately prompted WRAP to use CAMx-PSAT rather than CMAQ-TSSA for geographical source apportionment. We believe that the cluster analysis of base case model results is a technically viable approach; however, it is not appropriate to base the cluster analysis upon TSSA results from CMAQ 4.4beta.
We reviewed the methodology used to assess contribution of primary organic carbon using the Weighted Emissions Potential (WEP) (description available at http://vista.cira.colostate.edu/docs/wrap/attribution/WEPMethods.doc) and have technical concerns. If the WEP analysis used the WRAP Plan02d inventory (which is unclear from the documentation), this represents a planning inventory, and day specific fire events are lost in the development of the planning inventory. According to p.5 of the document "Development of 2000-04 Baseline Period and 2018 Projection Year Emission Inventories", each event added to the 2000-2004 fire planning inventory was assigned a random date within the month of occurrence of the original Phase II fire inventory record with all other records cloned (copied). The fundamental weakness in this approach is that the actual fire activity data is for calendar year 2002, and therefore the approach assumes that the location and size of fires will be constant throughout the baseline period. The correspondence of location of fire events is only valid for the base year of 2002 for which actual fire activity data is used in the inventory. Therefore, any correspondence between the 20% best/worst days outside the 2002 base year for the inventory is an artificial construct and has no actual correlation to 20% best/worst days in the IMPROVE dataset for the other 4-years that make up the haze baseline period.

Chapter 10 - Best Available Retrofit Technology

Table 10 - 2 (Emission Rates Modeled) shows an increase in several pollutants between the base year and future controls scenario. Idaho has acknowledged errors in the table and the modeling input, and that the modeling will be revised accordingly. We would like an opportunity to review and provide comments on the revised BART determination once the revised modeling is completed.

Chapter 11 - Reasonable Progress Goals

Idaho has determined that the source categories identified in Chapter 11 of the draft implementation plan will not be subject to control requirements at this time because it would 1) require an additional 1-2 years to model individual sources within the source category to determine if the source(s) impact Class I areas and 2) require an additional 2-3 years to develop appropriate rules, and for sources to acquire the necessary capital and install controls (p. 204 – "Based upon the "time necessary for compliance", additional controls are unreasonable at this time").

We disagree with this determination for several reasons. First, the timeframe for implementation of individual source controls is consistent with the required timeframes for BART as established under 40 CFR 51.308(e)(1)(iv). Therefore, the timeframe for implementation of potential controls under reasonable progress can be accomplished within the first planning cycle and can be used to help achieve the RP goals of that cycle. Second, the requirement for additional modeling is not consistent with the regulatory framework established with the four factors that need to be considered for reasonable progress determinations under 40 CFR 51.308(d)(1)(i)(A). In its analysis, the State of Idaho has already demonstrated that the cost of compliance and time necessary for compliance for both NOx and SO2 controls are reasonable. The degree of visibility benefit as implied by the stated need for additional air quality modeling is not one of the four factors that must be considered for reasonable progress requirements.

Chapter 12 – Long Term Strategy

Section 12.3.1 discusses other Class I areas impacted by Idaho emissions by use of cluster analysis techniques to examine representative Class I areas. As discussed in our review of Section 9.3, we believe this approach does not satisfy the requirements of 51.308(d)(3)(ii), which specifically requires examination of the state's emissions reduction measures to help meet the *progress goal of the area* which can only addressed by examination of the reasonable progress of specific Class I areas.

Letter from: United States Department of the Interior FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
National Wildlife Refuge System
Branch of Air Quality
7333 W. Jefferson Ave., Suite 375
Lakewood, CO 80235-2017

IN REPLY REFER TO:

FWS/ANWS-AR-AQ

July 23, 2010

Mr. Martin Bauer
Administrator, Air Quality Division
Idaho Department of
Environment Quality 1410
North Hilton
Boise, Idaho 83706

Dear Mr. Bauer:

On June 3, 2010, we received Idaho's draft regional haze implementation plan for review. We appreciate the opportunity to work closely with the State through the development and review of this plan. Cooperative efforts such as these ensure that, together, we will continue to make progress toward achieving natural visibility conditions at our National Parks and Wilderness Areas.

This letter acknowledges that the U.S. Department of the Interior, National Park Service and U.S. Fish and Wildlife Service have received and conducted a substantive review of the Idaho draft Regional Haze Rule implementation plan in fulfillment of your requirements under the federal regulations 40 CFR 51.308(i)(2). Please note, however, that only the U.S. Environmental Protection Agency (EPA) can make a final determination regarding the document's completeness and, therefore, ability to receive federal approval from EPA.

As outlined in a letter to each State dated August 1, 2006, our review focused on eight basic content areas. The content areas reflect priorities for the Federal Land Management agencies, and we have enclosed comments associated with these priorities.

We look forward to your response, as per section 40 CFR 51.308(i)(3). For further information regarding our comments, please contact Pat

Brewer, National Park Service, at (303) 969-2153, or Tim Allen, Fish and Wildlife Service, (303) 914-3802.

TAKE PRIDE
IN AMERICA

Again, we appreciate the opportunity to work closely with the State and compliment you on your hard work and dedication to improving visibility in our Class I national parks and wilderness areas.

Sincerely,

Christine L. Shaver
Chief, Air
Resources Division
National Park Service

Sincerely,

Sandra V. Silva
Chief, Branch of Air Quality
U.S. Fish & Wildlife Service

Enclosure

cc:

Steve Body
Office of Air, Waste and Toxics
U.S. EPA Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

Judy Rocchio
National Park Service
Pacific West Regional Office
1111 Jackson Street, Suite 700
Oakland, CA 94607

James A. Morris, Superintendent
Craters of the Moon National Monument
P.O. Box 29
Arco, ID 83213

Rick Coleman, Regional Chief
U.S. Fish and Wildlife Service
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134 Union Blvd.
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Bill West, Refuge Manager
Red Rocks Lakes National Wildlife Refuge
27650B South Valley Road
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Brian McManus, Chief Branch of Fire Management
National Interagency Fire Center
3833 South Development Ave.
Boise, Idaho 83705

John Reber, Physical Scientist
Physical Science Resource Program Lead
Intermountain Regional Office
National Park Service
12795 W. Alameda Parkway
Denver, CO 80225-0287

Comments of the National Park Service and US Fish and Wildlife Service
Regarding the Idaho Regional Haze State Implementation Plan
July 23, 2010

On June 3, 2010, the State of Idaho submitted a draft Regional Haze Rule State implementation plan (SIP), pursuant to the requirements codified in federal rule at 40 CFR 51.308(i)(2), to the U.S. Department of the Interior, National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS). The NPS Air Resources Division staff and FWS Branch of Air Quality staff have conducted a substantive review of the Idaho draft plan, and provide the comments listed below.

We look forward to your response as per section 40 CFR 51.308(i)(3), and would be willing to work with Idaho Department of Environmental Quality (Idaho DEQ) staff towards resolving the major issues discussed below. For further information, please contact Pat Brewer, National Park Service, at (303) 969-2153, or Tim Allen, Fish and Wildlife Service, (303) 914-3802.

General Comments

The State identifies the baseline emission inventory (referred to as “02b”) and the future emission inventory (referred to as “1 8d”) however, a summary of the inventory development and implementation is not provided. Discussion of the modeling system is also absent from Idaho’s draft Regional Haze SIP. The State, working with the Western Regional Air Partnership (WRAP), utilized originally developed inventories, meteorology, and non guideline models in fulfilling many of the requirements of the Regional Haze Rule. Therefore, a robust discussion of these technical products, performance evaluations, and applicability to the Haze Rule is required.

The emissions impacting individual Class I areas within Idaho appear to be distinctly different between several of these areas. Idaho should clearly explain these differences and maintain these distinctions in its discussion of meeting its regional haze goals.

Specific Comments

Chapter 3. Introduction to Idaho Class I Areas

While Figure 3-1 accurately depicts the Class I areas within Idaho’s state boundaries, it does not adequately depict all Class I areas potentially impacted by air pollution sources located within the State. For example, Red Rocks Lakes Wilderness located on the border of Idaho and Montana, and Grand Teton National Park just east of the state boundary in Wyoming are not included on this map. This could potentially mislead the reader to think that the figure is inclusive of all impacted Class I areas. Please include all Class I areas both within Idaho and

nearby outside the State, within the domain represented on the map, so that the reader has a sense of the full list of impacted areas.

Chapter 4. Technical Information and Data Relied Upon in This Plan

The description provided in Chapter 4 is of the original, or 'old', IMPROVE equation. Please clarify if this equation was used throughout the SIP. It is our current understanding that WRAP supported analyses and most Best Available Retrofit Technology (BART) calculations utilized the newer version of the IMPROVE equation.

Chapter 7. Pollutants Causing Visibility Impairment in Idaho Class I Areas

Figure 7-1 illustrates a distinct differences in pollutant impacts between the Class I areas. For example, impacts at Craters of the Moon National Monument and Hells Canyon Wilderness Area are clearly dominated by nitrate NO_3. Organic Carbon (OC) dominates the baseline monitoring at the Yellowstone National Park, and the Sawtooth, and Selway Wilderness Areas. Since these areas are clearly impacted in distinct patterns, more discussion explaining these differences should be included in the SIP. The distinctions elucidated by this discussion should be maintained throughout the SIP, as it is clear that these areas should have different focus in identifying effective controls.

Chapter 8. Emission Source Inventory

The discussion of emissions growth from the baseline to 2018 indicates growth, from point and area sources, in nitrogen oxides (NO_x), volatile organic compounds (VOC), OC, elemental carbon (EC), fine and coarse particulate matter (PM fine, PM coarse), and ammonia. However, in later sections of the SIP, naturally occurring emissions from fire and inadequate time to implement additional sulfate and nitrate emission controls are explained as the reasons that Idaho cannot meet its Uniform Rate of Progress goals. Please discuss Idaho's reasons for excluding controls that could reduce these additional visibility impairing pollutants for which the inventories indicate emissions are growing.

Chapter 9. Source Apportionment

While some areas may share an IMPROVE monitoring site, impacts to Class I Areas should be discussed and evaluated individually. Impacts from neighboring states should also be discussed for each individual Class I Area. Clustering Class I Areas for source apportionment analyses is not a valid approach.

Figure 9-68 on page 131, is scaled to the entire US. Please zoom into the region around Idaho for a better illustration. Also, figures 9-7 and 9-70 appear to be mislabeled.

Please provide more discussion regarding the individual species glide slopes presented on pages 158-164. These graphs depict that the Uniform Rate of Progress goals will be met on an individual pollutant basis, however many of these pollutants are also predicted to increase.

The SIP asserts that reductions from sulfate and organic carbon are overshadowed by increases to natural fire. However, it was previously stated in Chapter 8-*Emission Source Inventory*, that

natural fire emissions estimates were held constant in the analysis. Please explain these statements in more detail.

Chapter 10. Best Available Retrofit Technology (BART) Evaluation

The BART modeling protocol, agreed to by Idaho, Washington, and Oregon, stated that the 20% best natural condition will be used for all BART analyses. The tables on pages 172-175 indicate that both 20% best natural condition and annually averaged natural condition were used for certain analyses. Please clarify if the tables are incorrectly labeled, or if Idaho varied from the agreed protocol to utilize 20% best natural condition for all BART analyses.

The BART source impact improvement is described in terms of the number of days the delta-deciview is over 0.5. While this is an accurate method to describe the frequency of visibility impacts, more information should be included to illustrate the magnitude of improvement to visibility impairment. For example, since many BART sources impact more than one Class I area, the FLMs recommend that BART determinations consider visibility improvements at multiple Class I areas.

With respect to the BART determination for the P4 Productions facility, questions remain as to the feasibility of Selective non-Catalytic Reduction Technology for the nodulizing kiln. Given the large visibility impacts of the P4 Production facility at Yellowstone and Grand Teton National Parks, as well as other Class I units, we ask that Idaho revisit this analysis. In addition, we ask that Idaho clarify what P4 Production sources are BART-eligible.

Chapter 11. Idaho Reasonable Progress Goal Demonstration

The State makes a declaration that based on "time necessary for compliance", additional controls are unreasonable. Considering that the State has missed the 2007 deadline for submittal of its Haze SIP to EPA, it seems counterproductive to now suggest that it is unreasonable to implement controls for lack of time. Idaho should revisit this statement and reconsider the importance of the goals of the Regional Haze Rule.

There appears to be a slight math error in Table 11-2-*Idaho Statewide 2002 Point Source Sulfate Emissions*. Table 11-1-*Idaho 2002 Statewide Emissions by Pollutant and Source*, Table 11-2-*Idaho Statewide 2002 Point Source Sulfate Emissions*, and Table 11-4-*Idaho Statewide 2002 Area Source Sulfate Emissions*, should refer to SO_2 and NO_x emissions rather than sulfate and nitrate emissions. Please define the acronym RRF referred to in Table 11-12-*Summary of Idaho Class I Area Sulfate and Nitrate Visibility Improvement 20% Worst Days*.

Chapter 12. Long Term Strategy

Please explain why Red Rocks Lakes Wilderness is not presented in Table 12-12 *Idaho's Contribution of SO_x and NO_x in Surrounding Class I Areas*.

Please explain in more detail Idaho's consultation with the State of Wyoming concerning this attribution.

Please describe in more detail how Idaho's Prevention of Significant Deterioration (PSD) program benefits the State's regional haze program.

And lastly, please specify whether Idaho requires Best Management Practices and emissions tracking when implementing its Smoke Management program.

State of Idaho Department of Environmental Quality

Response to comments and questions submitted during the federal land managers' 60-day review of the Idaho Regional Haze State Implementation Plan (SIP)

Introduction

The Regional Haze Rule (40 CFR 51.308(i)(2)) requires consultation between the state and federal land managers (FLMs) related to development and implementation of the regional haze plan. The FLMs are given at least 60 days to comment on the regional haze plan prior to holding any public hearings or comment periods on the plan. The federal land managers comment period for the Idaho Regional Haze SIP was held from June 3, 2010, through August 5, 2010.The USDA Forest Service submitted written comments on July 7, 2010, followed by conference call with the USDA Forest Service, the National Park Service, and the U.S. Fish and Wildlife Service the same day. The U.S. Department of Interior, Fish and Wildlife Service submitted written comments on July 23, 2010.

The Regional Haze Rule (40 CFR 308(i)(3)) requires the state to respond to comments made by the FLMs during the comment period. What follows are the responses to those comments.

Comment 1: U.S. Forest Service

Idaho should consider rewriting this section to reflect the WRAP's new charter and webpage as well as previous WRAP work.

Response:

Idaho acknowledges the changes to the WRAP charter, and will modify the RH SIP to reflect these changes during the public comment period if time permits.

Comment 2: U.S. Forest Service

Idaho identified OMC as the primary visibility impairing PM-fine component at both Sawtooth and Selway-Bitterroot Class I areas (69% and 52% respectively) in the baseline period of 2000-2004. This is contrasted by Hells Canyon and Craters of the Moon Class I areas where NO3 was the primary component leading to visibility impairment (50% and 39% respectively). On page 55 of the document, Idaho states that is "important to identify whether the source (…of OMC) is strictly wild fire or whether there are sources outside the normal fire season contributing to the problem." However, on page 192 of the document, it appears that Idaho has concluded that "it is almost exclusively from wildfire and therefore isn't a prime pollutant to look at for reductions from anthropogenic sources" without any further technical analysis to support this conclusion.

For the Sawtooth Wilderness (Section 7.4), Idaho identifies an OMC pattern (Figures 7.25 and 7.26) which indicates significant organic mass carbon in November and December. Idaho indicates that "Because organic mass carbon appears to remain steady into the early winter, there may be localized slash burning or wood stoves. This is something that will require further investigation during this Regional Haze SIP planning period."

Response:

The plan at section 11.3.1 now reflects the state's willingness to investigate the usefulness of a woodstove ordinance in Stanley, Idaho. The IMPROVE monitor is located very close to Stanley, Idaho, A small town with numerous woodstoves, which is suspected of impacting the IMPROVE monitor.

The question of controls on organic carbon is also addressed at section 9.4.

Comment 3: U.S. Forest Service

According to Idaho's open burning rules, any citizen/entity is permitted to burn approved materials after October 21 without an open burning permit. This practice has been demonstrated to significantly increase localized PM2.5 concentrations into November in other parts of Idaho. The town of Stanley, ID is located approximately 3 miles north of the Sawtooth IMPROVE monitor; they share the same narrow valley. Data from the Stanley Remote Automated Weather Station (RAWS), which is adjacent to the IMPROVE monitor, indicates that the IMPROVE monitor is downwind of Stanley during

daytime hours, and upwind of Stanley at night. Idaho should investigate whether free open burning by private entities after October 21 is contributing to the increased OMC concentrations, and if these elevated concentrations are representative of an impact to the Class I Airshed.

Response:

There is very little private land and virtually no agricultural crop lands in the Stanley basin. If burning is occurring during the winter months, it is more than likely occurring on federal lands and changing the rules would do little if anything to change OMC levels during the fall season. As pointed out above, more than likely the emissions are from woodstoves in Stanley.

Comment 4: U.S. Forest Service

Another possible suggestion would be to examine the use of receptor-oriented analytical techniques such as positive matrix factorization (PMF) or principal components analysis (PCA) with IMPROVE data which do not require an *a priori* knowledge of source chemical characteristics. At a minimum, Idaho could augment the existing analysis by examining the relationship of total carbonaceous mass (TC) (IMPROVE TOR: OC1 – OC4, OP, EC1 – EC3) to non-soil potassium (IMPROVE: K - 0.6*Fe). Park et al. (2007) examined such a method that could readily be employed to further examine the origins of OMC.

Response:

While PMF is a good analytical tool for carbon-based pollutants, the techniques employed cannot differentiate wood burned in wood stoves, slash piles, or hunters' warming fires. The best solution for identifying high wintertime impacts from carbon is local observation, which is what the state is proposing.

Comment 5: U.S. Forest Service

Since 2007, the Montana/Idaho Airshed Group has been identifying prescribed burning activities as either natural or anthropogenic in accordance with WRAP guidelines. Members of this group include all of the major burners in Montana, and all but two major burners in Idaho. It will be a simple matter to assess whether emissions are being reduced from major anthropogenic burning. Idaho DEQ also has an established agricultural burning program which will allow emissions from those sources to be tracked.

However, private burning, especially after October 21, is a significant issue in Idaho for which DEQ has shown reluctance to address. While these sources may not necessarily impact Class I visibility, they potentially could impact IMPROVE monitor values. These emissions, to the best of our knowledge, are not a part of any WRAP emissions inventory.

FLMs and scientists have recognized the importance of fire as a natural process, and the benefits of allowing some fires to naturally treat the landscape are well documented. Over time, allowing fire to return to its natural role in Class I areas will result in an overall decrease in natural fire emissions. This is evident in the Selway-Bitterroot Wilderness. Fires have been allowed to burn in the wilderness as a natural process for more than 30 years, with the result that most fire that occur in the wilderness are of a relatively small size and produce relatively small amounts of smoke.

Response:

The state agrees that natural fire plays an important role in reducing overall natural fire emissions over time. The state also agrees there are some issues with some of the small private burners after October 21st with activities such as slash piles. DEQ has developed a very comprehensive crop residue burning program. DEQ will continue to improve its open burning program through Idaho's negotiated rule process. The outcome which is then submitted to EPA for SIP approval.

Comment 6: U.S. Forest Service

Under 40 CFR 51.308(d)(3)(iii), a state must document the technical basis it is relying upon to meet is reasonable progress goals. Chapter 4 of the document provides a brief summary of the WRAP technical support system (TSS) and IMPROVE air quality data. Chapter 9 of the document describes the air quality modeling source apportionment techniques relied upon to help inform strategy development. However, the document does not provide information regarding performance evaluations of either prognostic meteorological model data or the base case results from the WRAP Base02 inventory that are relied upon in this chapter. Idaho should augment this section to document both meteorological and photochemical model performance evaluations.
Likewise, the document does not describe how the component specific relative response factors (RRF's) were calculated. We request that documentation be added detailing the RRF calculations for each Class I area covered in Chapter 9.

Response:

Information on model performance, meteorological data, and Relative Reduction Factors (RRFs) are available in Appendix E of the plan. This Appendix will also lead the reader to other Web sites with additional information.

Comment 7: U.S. Forest Service

Records for natural fires (wildfires) can be found by accessing ICS-209 records or checking with either the Eastern Great Basin or the Northern Rockies Coordination Centers. Records would indicate the duration of the fire and the total acres burned. Prescribed burning records can be obtained through the MT/ID Airshed Group (of which Idaho DEQ is a member) dating back to 2004.

Response:

The WRAP fire emission forum reviewed fire data from many sources. This information was incorporated into the base year modeling and held constant in future years. The state agrees this is a good source of information.

Comment 8: U.S. Forest Service

In looking at impacts to other Class I areas outside of Idaho, Idaho is using a clustering mechanism from the WRAP Attribution of Haze report to examine their contribution to only three additional Class I areas located totally outside of Idaho – Eagle Cap Wilderness (west of Idaho), Jarbidge Wilderness (South of Idaho, and Cabinet Wilderness (East of Northern Idaho). Eagle Cap and Jarbidge are part of Cluster 7, and Cabinet Wilderness is part of Cluster 9. A third cluster, Cluster 8, includes the Class I areas in Southern Idaho (Sawtooth , Craters of the Moon, and Yellowstone).
First, 51.308(d)(3)(ii) requires that the State must demonstrate that it has included all measures necessary to obtain its share of the emissions reductions necessary to meet the progress goal for the area. The discussion in Section 9.3 is presented in terms of the Idaho's contribution to a representative Class I area in each cluster. This approach does not address the specific requirement of 51.308(d)(ii) to examine the efficacy of a state's emission reduction measures to help meet the *progress goal of the area* which can only addressed by examination of the reasonable progress of specific Class I areas.
Second, we have concern about the methodologies used to generate the Attributes of Haze Work Group cluster analysis. According to Section 9.3, the WRAP Attributes of Haze Work Group used the CMAQ-TSSA results to develop the clusters previously described. According to the Attribution of Haze Phase I report, the CMAQ-TSSA results used to perform the cluster analysis were based upon a beta release of CMAQ 4.4 (p. 2-27 AOH Phase I report). Model performance evaluations of CMAQ 4.4beta indicated serious problems with mass conservation which were not resolved in time for development of many the WRAP work products, which ultimately prompted WRAP to use CAMx-PSAT rather than CMAQ-TSSA for geographical source apportionment. We believe that the cluster analysis of base case model results is a technically viable approach; however, it is not appropriate to base the cluster analysis upon TSSA results from CMAQ 4.4beta.

Response:

The cluster analysis that was used in section 9.3 has been removed as suggested and each of the Class I areas impacted by Idaho have been included in the analysis.

Comment 9: U.S. Forest Service

We reviewed the methodology used to assess contribution of primary organic carbon using the Weighted Emissions Potential (WEP) (description available at http://vista.cira.colostate.edu/docs/wrap/attribution/WEPMethods.doc) and have technical concerns. If the WEP analysis used the WRAP Plan02d inventory (which is unclear from the documentation), this represents a planning inventory, and day specific fire events are lost in the development of the planning inventory. According to p.5 of the document

"Development of 2000-04 Baseline Period and 2018 Projection Year Emission Inventories", each event added to the 2000-2004 fire planning inventory was assigned a random date within the month of occurrence of the original Phase II fire inventory record with all other records cloned (copied). The fundamental weakness in this approach is that the actual fire activity data is for calendar year 2002, and therefore the approach assumes that the location and size of fires will be constant throughout the baseline period. The correspondence of location of fire events is only valid for the base year of 2002 for which actual fire activity data is used in the inventory. Therefore, any correspondence between the 20% best/worst days outside the 2002 base year for the inventory is an artificial construct and has no actual correlation to 20% best/worst days in the IMPROVE dataset for the other 4-years that make up the haze baseline period.

Response:

The state agrees the WEP analysis isn't as robust as CMAQ or other dispersion models but it is a good tool to begin building a weight of evidence. Hopefully, before the next Regional Haze SIP is due, there will be new analytical tools for the job.

Comment 10: U.S. Forest Service

Table 10 - 2 (Emission Rates Modeled) shows an increase in several pollutants between the base year and future controls scenario. Idaho has acknowledged errors in the table and the modeling input, and that the modeling will be revised accordingly. We would like an opportunity to review and provide comments on the revised BART determination once the revised modeling is completed.

Response:

There were some changes to the modeling for Monsanto/P4 which was provided in draft form to some of the FLMs. The finalized modeling information for P4 is included toward the back of Appendix F. The FLMs are still free to comment any time up to the end of the public comment period.

Comment 11: U.S. Forest Service

Idaho has determined that the source categories identified in Chapter 11 of the draft implementation plan will not be subject to control requirements at this time because it would 1) require an additional 1-2 years to model individual sources within the source category to determine if the source(s) impact Class I areas and 2) require an additional 2-3 years to develop appropriate rules, and for sources to acquire the necessary capital and install controls (p. 204 – "Based upon the "time necessary for compliance", additional controls are unreasonable at this time").

We disagree with this determination for several reasons. First, the timeframe for implementation of individual source controls is consistent with the required timeframes for BART as established under 40 CFR 51.308(e)(1)(iv). Therefore, the timeframe for

implementation of potential controls under reasonable progress can be accomplished within the first planning cycle and can be used to help achieve the RP goals of that cycle. Second, the requirement for additional modeling is not consistent with the regulatory framework established with the four factors that need to be considered for reasonable progress determinations under 40 CFR 51.308(d)(1)(i)(A). In its analysis, the State of Idaho has already demonstrated that the cost of compliance and time necessary for compliance for both NO_x and SO2 controls are reasonable. The degree of visibility benefit as implied by the stated need for additional air quality modeling is not one of the four factors that must be considered for reasonable progress requirements.

Response:

The State agrees the timeframe for implementation of individual source controls is consistent with the required timeframes for BART as established under 40 CFR 51.308(e)(1)(iv). The state agrees modeling is not a regulatory requirement under the four factors. However, as with BART, the state must prove to some satisfaction that a source category is causing or contributing to visibility impairment in Class I areas before there is sufficient evidence to undertake rulemaking. Although modeling is not required under the four-factor analysis, it will be an integral part of the state rulemaking process. The state will need to identify the impacts as part of determining the "cost of compliance" such as incremental costs. Since this is a *State* Implementation Plan, the state will use state rules to implement future long-term strategies which will take some "time necessary for compliance."

Comment 12: U.S. Forest Service

Section 12.3.1 discusses other Class I areas impacted by Idaho emissions by use of cluster analysis techniques to examine representative Class I areas. As discussed in our review of Section 9.3, we believe this approach does not satisfy the requirements of 51.308(d)(3)(ii), which specifically requires examination of the state's emissions reduction measures to help meet the *progress goal of the area* which can only addressed by examination of the reasonable progress of specific Class I areas.

Response:

Section 12.3.1 has been updated to include additional Class I areas impacted by Idaho emissions.

Comment 1: Fish and Wildlife

While Figure 3-1 accurately depicts the Class I areas within Idaho's state boundaries, it does not adequately depict all Class I areas potentially impacted by air pollution sources located within the State. For example, Red Rocks Lakes Wilderness located on the border of Idaho and Montana, and Grand Teton National Park just east of the state boundary in Wyoming are not included on this map. This could potentially mislead the reader to think that the figure is inclusive of all impacted Class I areas. Please

include all Class I areas both within Idaho and nearby outside the State, within the domain represented on the map, so that the reader has a sense of the full list of impacted areas.

Response:

The map has been updated to reflect suggestions.

Comment 2: Fish and Wildlife

The description provided in Chapter 4 is of the original, or 'old', IMPROVE equation. Please clarify if this equation was used throughout the SIP. It is our current understanding that WRAP-supported analyses and most Best Available Retrofit Technology (BART) calculations utilized the newer version of the IMPROVE equation.

Response:

The IMPROVE equation is now noted as the old equation. Readers are also referred to the IMPROVE Web site for information on the revised equation.

Comment 3: Fish and Wildlife

Figure 7-1 illustrates a distinct differences in pollutant impacts between the Class I areas. For example, impacts at Craters of the Moon National Monument and Hells Canyon Wilderness Area are clearly dominated by nitrate NO_3. Organic Carbon (OC) dominates the baseline monitoring at the Yellowstone National Park, and the Sawtooth, and Selway Wilderness Areas. Since these areas are clearly impacted in distinct patterns, more discussion explaining these differences should be included in the SIP. The distinctions elucidated by this discussion should be maintained throughout the SIP, as it is clear that these areas should have different focus in identifying effective controls.

Response:

While the state agrees there are similarities in impacts at some Class I areas. The question becomes how to group Class I areas. The WRAP tried this approach with the Cluster Analysis of Class I areas and as pointed out in the comments on Chapter 9, "clustering Class I areas for source apportionment analysis is not a valid approach." The Regional Haze Rule requires the state to address each individual Class I area when looking at source contribution.

In establishing Reasonable Progress Goals, the rule leaves implementation of the Regional Haze Rule up to the states requiring that in establishing the goals the state consider the four-factor analysis as outlined under 40 CFR 308(d)(1)(i)(A). Grouping Class I areas together based on similarities in impacts and then analyzing individual sources that maybe impacting those Class I areas is both costly and time consuming. The BART process is a good example of the difficulties in implementing this type of approach.

Instead, Idaho has chosen to take a regional approach in identifying effective controls. Rather than looking at individual facilities and specific pollutants that are impacting a group of Class I areas, the state will analyze point, area, and mobile source categories on a state wide basis. Simply because a Class I area is more heavily impacted by one pollutant doesn't mean a source close to that Class I area shouldn't control other pollutants that could be adding to the regional impact.

Comment 4: Fish and Wildlife

The discussion of emissions growth from the baseline to 2018 indicates growth, from point and area sources, in nitrogen oxides (NO_x), volatile organic compounds (VOC), OC, elemental carbon (EC), fine and coarse particulate matter (PM fine, PM coarse), and ammonia. However, in later sections of the SIP, naturally occurring emissions from fire and inadequate time to implement additional sulfate and nitrate emission controls are explained as the reasons that Idaho cannot meet its Uniform Rate of Progress goals. Please discuss Idaho's reasons for excluding controls that could reduce these additional visibility impairing pollutants for which the inventories indicate emissions are growing.

Response:

This is now addressed in section 9.4. A review of Chapter 8 and the emissions is also a good source of information. With the exception of growth in area source VOCs, most of the point and area emissions by pollutants listed above are relatively small. And although the increase in VOCs from area source is substantial, the number of source categories contributing and the contribution from each source category are not very conducive to controls and enforcement. As an example, personal care products are one of the bigger source categories. Setting standards and enforcing those standards on personal care products at the state level would be very costly and not very effective.

Comment 5: Fish and Wildlife

While some areas may share an IMPROVE monitoring site, impacts to Class I Areas should be discussed and evaluated individually. Impacts from neighboring states should also be discussed for each individual Class I Area. Clustering Class I Areas for source apportionment analyses is not a valid approach.

Response:

See response to comment 7.

Comment 6: Fish and Wildlife

Figure 9-68 on page 131, is scaled to the entire US. Please zoom into the region around Idaho for a better illustration. Also, figures 9-7 and 9-70 appear to be mislabeled.

Response:

Figures 9-7 and 9-70 have been edited. Figure 9-68 is a standard graphic from the WEP analysis and the current scaling is sufficient to make the point that Idaho isn't contributing to some Washington Class I areas.

Comment 7: Fish and Wildlife

Please provide more discussion regarding the individual species glide slopes presented on pages 158-164. These graphs depict that the Uniform Rate of Progress goals will be met on an individual pollutant basis, however many of these pollutants are also predicted to increase.

The SIP asserts that reductions from sulfate and organic carbon are overshadowed by increases to natural fire. However, it was previously stated in Chapter 8-*Emission Source Inventory*, that natural fire emissions estimates were held constant in the analysis. Please explain these statements in more detail.

Response:

Section 9.4 has been updated to include the pollutant glide slopes for several additional Class I areas. A discussion on natural fire and organic carbon is also included.

Comment 8: Fish and Wildlife

The BART modeling protocol, agreed to by Idaho, Washington, and Oregon, stated that the 20% best natural condition will be used for all BART analyses. The tables on pages 172-175 indicate that both 20% best natural condition and annually-averaged natural condition were used for certain analyses. Please clarify if the tables are incorrectly labeled, or if Idaho varied from the agreed protocol to utilize 20% best natural condition for all BART analyses.

Response:

The graphs have been updated to reflect that the 20% best natural conditions were used.

Comment 9: Fish and Wildlife

The BART source impact improvement is described in terms of the number of days the delta deciview is over 0.5. While this is an accurate method to describe the frequency of visibility impacts, more information should be included to illustrate the magnitude of improvement to visibility impairment. For example, since many BART sources impact more than one Class I area, the FLMs recommend that BART determinations consider visibility improvements at multiple Class I areas.

Response:

Information on the Class I areas within 300km of the Amalgamated Sugar plant in Nampa and of the P4 Production/Monsanto facility are available in Tables 10-14 and 10-15. Additional information on these facilities is available in Appendix F.

Comment 10: Fish and Wildlife

With respect to the BART determination for the P4 Productions facility, questions remain as to the feasibility of Selective non-Catalytic Reduction Technology for the nodulizing kiln. Given the large visibility impacts of the P4 Production facility at Yellowstone and Grand Teton National Parks, as well as other Class I units, we ask that Idaho revisit this analysis. In addition, we ask that Idaho clarify what P4 Production sources are BART-eligible.

Response:

As requested, an e-mail was sent to Don Sheperd with the National Park Services on August 9, 2010, which addressed the issue of installing SNCR in the kiln. The contents of the e-mail follow.

```
Don,

The e-mail from James McCulloch from Monsanto explains why SNCR won't
work with in the Kiln. If you need additional information, please let
me know.

Thanks,

Mike e.

-----Original Message-----
From: MCCULLOCH, JAMES R [AG/1850]
[mailto:james.r.mcculloch@monsanto.com]
Sent: Thursday, August 05, 2010 10:27 AM
To: Mike Edwards
Cc: Carole Zundel; William Rogers; Robert Wilkosz
Subject: RE: technical feasibility of SNCR on the #5 nodulizing kiln at
P4

Mike,

In response to your email, I have reviewed the work associated with P4
Production's BART analysis.  I also reviewed the EPA document that Don
referenced (with hyperlink) below.

In response to Don's request for further discussion on "injecting
ammonia into the rotary kiln", the following should be considered:

On page 47 of EPA's guidance document, it states that "SNCR will
function best in an oxidizing atmosphere".  Then on page 48, in Table
8-1, suitable temperature/temperature ranges are presented (870°C -
1100°C).
```

Temperature profiles from P4's kiln shows temperatures at the firing end and mid-Kiln up to 1700°C. At these temperatures, injecting ammonia at or near the kiln inlet would actually increase NOx emissions. The section of kiln that shows acceptable temperatures is ~250 feet in from the firing end of the kiln, but this zone is a reducing environment with short residence time, which would inhibit NOx removal efficiency. In addition, while EPA's guidance refers to injection into a rotary kiln, those injections were at other points in the process, or at one end of the kiln or the other (i.e. precalciner, preheater tower, feed inlet, fuel inlet or flue gas).

These facts support P4's original position that SNCR would not function properly, and is not technically feasible as BART for NOx removal in our kiln.

If necessary, P4 could pursue an additional review of the guidance document from EPA by an outside contractor experienced in oxidizer, air heater, and combustion systems. Let me know if you would like us to pursue that option.

If you have further questions, please feel free to call me at (208) 547-1233.

Regards,

Jim McCulloch

Comment 11: Fish and Wildlife

The State makes a declaration that based on “time necessary for compliance”, additional controls are unreasonable. Considering that the State has missed the 2007 deadline for submittal of its Haze SIP to EPA, it seems counterproductive to now suggest that it is unreasonable to implement controls for lack of time. Idaho should revisit this statement and reconsider the importance of the goals of the Regional Haze Rule.

Response:

See the response to Comment 10.

Comment 12: Fish and Wildlife

There appears to be a slight math error in Table 11-2-*Idaho Statewide 2002 Point Source Sulfate Emissions*. Table 11-1-*Idaho 2002 Statewide Emissions by Pollutant and Source*, Table 11-2- *Idaho Statewide 2002 Point Source Sulfate Emissions*, and Table 11-4-*Idaho Statewide 2002 Area Source Sulfate Emissions*, should refer to SO_2 and NO_x emissions rather than sulfate and nitrate emissions. Please define the acronym RRF referred to in Table 11-12-*Summary of Idaho Class I Area Sulfate and Nitrate Visibility Improvement 20% Worst Days*.

Response:

The suggested changes have been made. Table 11-12 defines RRF and refers the reader to Appendix E for more information.

Comment 13: Fish and Wildlife

Please explain why Red Rocks Lakes Wilderness is not presented in Table 12-12 *Idaho's Contribution of* SO_x *and* NO_x *in Surrounding Class I Areas*.

Response:

Red Rocks Lakes Wilderness and several other Class I areas are now included in Table 12-12.

Comment 14: Fish and Wildlife

Table 12-2 Other States' 2018 contribution form the State of Wyoming on Craters of the Moon.

Please explain in more detail Idaho's consultation with the State of Wyoming concerning this attribution.

Response:

Section 12.3.2 has been updated to provide some explanation on the increase shown in Table 12-2. Since Idaho and Wyoming jointly chaired the WRAP Implementation Work Group (IWG), numerous discussions occurred between the two states at the IWG meetings. Details and links to the meetings are available Appendix B.

Comment 15: Fish and Wildlife

Please describe in more detail how Idaho's Prevention of Significant Deterioration (PSD) program benefits the State's regional haze program.

Response:

Section 12.6.1 has been updated to provide a short description of the PSD program.

Comment 16: Fish and Wildlife

And lastly, please specify whether Idaho requires Best Management Practices and emissions tracking when implementing its Smoke Management program.

Response:

DEQ's current smoke management plan for prescribed burning is currently the operating guide of the Montana/Idaho Airshed Group. Both DEQ and the MT/ID Airshed Group promote the use of best management practices. The MT/ID Airshed Group currently submits both approved and completed burns to the Western Regional Air Partnerships Fire Emissions Tracking System (WRAPFets). However, this emissions tracking is not required by DEQ.

Certificate of Hearing

CERTIFICATE OF HEARING

SUBJECT: Proposed Idaho Regional Haze State Implementation Plan

LOCATION: DEQ Conference Center, 1410 N. Hilton, Boise, Idaho

HEARING DATE: September 15, 2010

The undersigned designated hearing officer hereby certifies that on the 15th day of September, 2010, a public hearing was held on the proposed Regional Haze State Implementation Plan, at the DEQ conference center in Boise, Idaho. The hearing commenced at 3:00 p.m. and was adjourned at 3:30 p.m. No members of the public attended the hearing.

The record should also reflect that there are affidavits on file regarding the publication of notice of the opportunity for public comment, and that was published at least 30 days prior to the close of the scheduled comment period as specified in 40 CFR 51.102 and adopted by reference in the Department of Environmental Quality rules, IDAPA 58-01-01-107.03.a. Such publication was made in the Coeur d'Alene Press, Lewiston Tribune, Boise Idaho Statesman, Twin Falls Times News, Pocatello Idaho State Journal, and Idaho Falls Post Register on August 31st, 2010, which included notice of this public hearing. This publication was timely made and other necessary notice requirements have been met.

DATED this 15th day of September, 2010.

Diane M Tappen

Diane Tappen
Hearing Officer

USDA Forest Service Comments Submitted during Public Comment Period.

USDA United States Department of Agriculture | Forest Service | Region One | Northern Region
200 East Broadway
Missoula, MT 59802

File Code: 2580
Date: SEP 1 5 2010

RECEIVED
SEP 2 1 2010
DEPT. OF ENVIRONMENTAL QUALITY
TECHNICAL SERVICES OFFICE

Mr. Rick Hardy
Idaho DEQ, Technical Services Division,
Modeling/Risk Analysis Group
1410 North Hilton Street
Boise, ID 93706-1255

Dear Rick,

Thank you for the BART modeling analysis revision on eligible sources at the P4 Kiln. The USDA Forest Service appreciates the improved clarity and accuracy of these revisions and can now provide additional comments on the BART analysis for this facility.

The Forest Service understands there is a large decrease in SO_2 emissions but the NOx emissions go up slightly due primarily to the use of actual maximum emissions for the base case and the Potential to Emit emissions in future years. Because of this potential increase in NOx and the resulting potential impacts on regional haze, we revisited IDEQ's BART analysis for NOx from this source. The nodulized kiln is the largest source of NOx emissions, with 1,625 tons per year of actual emissions and 3,750 tons per year of permitted emissions.

Idaho DEQ only listed three potentially applicable control technologies for NOx; these are good combustion control, low NOx burners, and selective non-catalytic reduction (SNCR). Idaho DEQ determined all three of these technologies to be technically infeasible and eliminated them due primarily to incompatibility with the exhaust gas temperature.

The final BART rule states:

"Air pollution control technologies can include a wide variety of available methods, systems, and techniques for control of the affected pollutants. Technologies required as BACT or LAER are available for BART purposes and must be included as control alternatives. The control alternatives can include not only existing controls for the source category in question but also take into account technology transfer of controls that have been applied to similar source categories and gas streams".

The Forest Service conducted a search of NOx control technologies for cement kilns. The search revealed LoTox™ has been identified as a technically and economically feasible control technology for cement kilns in Ellis County Texas[i]. The report states this technology should be considered transferable in nature. It has not been used on a cement kiln but it has been used on similar large sources.

Furthermore, where SNCR has been determined technically infeasible due to the exhaust gas temperature stream, LoTox ™ placed in a tail end configuration is applicable to exhaust gas streams of 150-250°F, which is suitable with the stated 176°F exhaust gas stream of P4 kiln. The Forest Service is requesting Idaho DEQ further consider LoTox™ in the BART determination for NOx from the kiln at the P4 facility.

If you have any questions, please contact Thomas Dzomba, Northern Region Air Quality Program Manager, at (406) 329-3672.

Sincerely,

for Jane L. Cottrell
LESLIE A. C. WELDON
Regional Forester

cc: Steve Body, Harv Forsgren

---

[i] Assessment of NOx Emissions Reductions Strategies for Cement Kilns – Ellis County. Prepared for Texas Commission on Environmental Quality. ERG Inc. Cincinnati, OH July 14, 2006. http://www.tceq.state.tx.us/assets/public/implementation/air/sip/agreements/BSA/CEMENT_FINAL_REPORT_70514_final.pdf

Comments Submitted by Charles Johnson during public comment period

RECEIVED

SEP 2 3 2010

DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE AQ PROGRAM

Comments on the deq plan required by the federal haze rule due from the states in a 2003-2008 timeframe its 2010 whats your hurry
deq says that nitrare and sulfate emissions hamper haze in hells canyon wilderness area, which we share with oregon, idaho has 25,000 acres less than oregon.
Desert research institute of nevada verifys this is a winter problem during inversions they alsoverify that vegitation and wildland fires are the main summer problems

Please note dri study on ozone for deq identified the highest readings on ozone monitors July and August of 2007 were from wildland fires inpacting them. In the valley deq did not ask epa to excuse them,thus producing the vehicle emission testing scam.

After saying visibility problems in hells canyon are caused by amalgamated sugar,deq says overall visibility in parks and wilderness areas not a major problem ,adding most of idahos class1areas are in comparison realy clean areas
Make up your mind are they a problem are is the problem deq?
Turist info on hells canyon besides reminding us it is the deepest canyon in america, descritioons that might rival the garden of eden sayTHE SCENIC VISTAS THJAT ARE FOUND HERERIVAL ANY FOUND ON THE CONTINENT

we fully support amalgamated on this issuie, although we have disagreed with their corporate office on other matters
can you absolutly prove that the pollutants from their plant are impacting hells canyon?
Transport of pollutans from asia or fires in siberia can and do inpact the bad air problems here they come in on the stratis wionds
epa also states that 58% of haze is from bigenics like the blues in the summer or the great smokey mountains
amalgamated has supported deqs agenda for at least 6 years as they demand keeping usless vehicle emission testing in ada and extendingto canyon with mccreedy on deqs rump air qualiyty council and roy eugerin writing the testing laws Now you turn on themand say your polution will cost you $18 million HAVE YOU NO SHAME?

I am charles a. johnson 67 n. happy valley rd. nampa, idaho 83687 466-4993

Charles A. Johnson

Copy: Joe Huff ASC

Comments Submitted by Dean DeLorey with Amalgamated Sugar Company LLC (TASCO) during public comment period

THE AMALGAMATED SUGAR COMPANY LLC

1951 S. SATURN WAY, SUITE 100 • BOISE, ID 83709
PHONE: (208) 383-6500 • FAX: (208) 383-6684

RECEIVED
SEP 3 0 2010
DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE A Q PROGRAM

RECEIVED
SEP 3 0 2010
4:00 PM
By R. Greenwood

September 30, 2010

Faye Weber
Air Quality Division
Idaho Dept. of Environmental Quality State Office
1410 North Hilton
Boise, ID 83706

RE: Comments on Idaho's Draft Regional Haze Plan

Dear Ms. Weber;

The Amalgamated Sugar Company LLC (TASCO) appreciates the opportunity to comment on the August 31, 2010 Draft of Idaho's Regional Haze State Implementation Plan. As is evident by the hundreds of pages of documentation, evaluating regional haze at Class I Areas is an extremely complex process.

As described in the plan, potential air quality impacts to Class I Areas are from a variety of emission sources both inside and outside Idaho. Assessing visibility impacts involves complex equations, databases and mathematical models which are not easily accessible or verifiable. As discussed in the plan, due to funding concerns, some of these databases are outdated and inaccurate.

Because of the complexity of the draft plan, TASCO comments are divided into two categories. General comments on the overall plan are provided in Attachment #1, followed by more specific comments in Attachment #2.

If you have any questions, feel free to contact me at (208) 383-6500.

Sincerely,

Dean C. DeLorey

Dean C. DeLorey
Director of Environmental Affairs
The Amalgamated Sugar Company LLC

DCD/ss

Enc.

Cc: IDEQ – Martin Bauer
TASCO – Joe Huff, John McCreedy

Attachment 1

General Comments on Idaho's Draft Regional Haze Plan The Amalgamated Sugar Company LLC September 30, 2010

Attachment 1

General Comments on Idaho's Draft Regional Haze Plan
The Amalgamated Sugar Company LLC
September 30, 2010

Overall Plan Comments. Idaho's Draft Regional Haze Plan relies upon inaccurate emissions inventory and source apportionment modeling data. As discussed throughout the document, due to funding concerns some of the future year emissions inventories are not accurate. These inaccuracies result in a flawed basis for the evaluation of visibility impacts and establish a flawed baseline for development of a plan to improve the condition in Class I areas. For example, PSAT modeling results for sulfates include inaccurate and severely inflated future year SO_2 emissions estimates (page 122). It's not clear whether these inflated SO_2 emission rates were also used in PSAT modeling for all other Class I Areas. If so, then the future impacts are exaggerated and the related future visibility improvement plan is flawed. Another example is the inclusion in future emissions estimates of emissions for SO_2 and NO_x from a 500 MW power plant which was never built in Jerome County (page 88). Including these unreal emissions inflates the future visibility impacts and establishes a flawed baseline from which to plan improvements. In addition, reliance upon these inaccurate emissions estimates ripples into inaccuracies in IDEQ's source apportionment model, which is intended to calibrate the CALPUFF modeling work.

An evaluation of the SO_2 source apportionment modeling shows that there are significant errors. For example, these results include NOx emissions for the power plant which was never built in Jerome County. The errors in the future projected emission rates need to be corrected and source apportionment models rerun for all Class I Areas. Without these corrections, Idaho's Regional Haze Plan is flawed and not approvable. The plan potentially sets in motion expensive improvements that may be unnecessary if the data were corrected. Before submittal to EPA for consideration and before publication in the Federal Register, these errors need to be corrected, and the plan resubmitted to the public for review.

Failure to correct these errors now will inevitably require more resources from IDEQ to be spent in the future. While funding may be short at this time prompting IDEQ to submit the plan before correction, this approach is shortsighted. In addition, implementing a plan based upon flawed data and results could result in expenditures by the Idaho regulated community that may be unnecessary.

Emissions Inventory Summaries. It is recommended that Chapter 8 of the report include overall summaries of Idaho's contribution to the regional haze conditions that address potential pollutants and emission sources in Idaho which may impact visibility in Class I Areas. This information provides the agencies, the regulated community, and the public, an indicator of the scope of the contribution from Idaho in order to develop reasonable and cost effective control measures. Based on a detailed review of the emissions and

source apportionment modeling data in the report the following helpful highlights are suggested for inclusion in Chapter 8 of the plan:

- Point sources in Idaho account for only 4% of the total visibility constituent emissions.
- The largest source of visibility constituents are area sources and natural fires accounting for over 60% of the emissions in Idaho.
- VOC's are the largest visibility constituent in Idaho, accounting for approximately 40% of the total emissions.
- SO_2 accounts for less than 5% of Idaho's total visibility emissions.
- Mobile sources in Idaho currently account for approximately 50% of the overall NO_x emissions while point sources account for less than 10% of the total.
- Regionally, Idaho accounts for less than 10% of the SO_2 and NO_x emissions compared to the surrounding states.
- Wyoming SO_2 emissions account for approximately 30% of the regional emissions primarily due to EGU's.
- Regionally, VOC's are emitted in the largest quantities compared to other constituents.
- Based on source apportionment modeling results, "out of domain" sources account for a majority of the sulfate concentrations in most Class I Areas.

This information provides context for Idaho's Regional Haze Plan. It offers the reader a comparison of the contribution from Idaho in relation to others, and it summarizes the scope of impacts from Idaho on regional haze. This summary along with periodic review and update of emissions inventories will ensure reasonable and cost effective visibility control measures are developed.

These bulleted highlights of data collected for the plan also clarify that Idaho point sources are only a small fraction of overall statewide emission sources contributing to regional haze and are even a smaller fraction of regional and "out of domain" emission sources. Even more specifically, then, Riley boiler emissions from The Amalgamated Sugar Company LLC (TASCO) account for an even smaller fraction of the overall statewide and regional emissions.

Because of the small percentage of point source emissions, any additional emission controls on point sources cannot be reasonably anticipated to result in any improvement in visibility at any Class I Area. This is especially true for SO_2 and/or NO_x emission controls for the Riley boiler at the TASCO Nampa facility required to address "modeled

impacts" at Class I Areas located hundreds of miles upwind of the TASCO facility. Requiring costly emission controls on the TASCO Riley boiler and any other point source to address this level of contribution and based upon inaccurate model results simply does not follow good science, good government, nor common sense principles.

Finally, Idaho's Regional Haze Plan is out of step with current economic realities. During these extremely difficult economic times for both US industry and state/federal governments, resources need to be focused on high priorities, where improvements can be measured and observed. Regarding the visibility improvements urged by the federal Clean Air Act, the focus needs to be on emissions controls associated with improved forest management activities to reduce natural fires, mobile source emission reductions, and emissions reductions associated with regional power plants which clearly impact Class I Areas (out of domain vs. regional plants). The draft plan ignores these realities, ignores the relative contribution of Idaho emissions to the regional impacts in Class I areas, and proposes a path based upon acknowledged inaccuracies and errors. As drafted the plan is not approvable without additional work and further public review.

Attachment 2

Specific Comments on Idaho's
Draft Regional Haze Plan
The Amalgamated Sugar Company LLC
September 30, 2010

Attachment 2

Specific Comments on Idaho's Draft Regional Haze Plan
The Amalgamated Sugar Company LLC
September 30, 2010

Chapter 7 Pollutants & Estimated Visibility Impairment in Idaho

Light Extinction General Comment. Chapter 7 needs to clearly explain that all light extinction values (Mm^{-1}) are estimates based on the equation provided in Chapter 4 (see page 22). Light extinction bar charts labeled as "Monitoring Data" are inaccurate and misleading. Numerous variables and assumptions are required to calculate light extinction values including relative humidity estimates and pollutant concentrations from IMPROVE site samplers. Monitoring data only applies to the pollutant concentrations from the IMPROVE monitors. Please either: 1) For each bar chart with light extinction values, replace "Monitoring Data" with "Estimated Light Extinction Data" or; 2) Clearly explain throughout Section 7 that light extinction values are rough calculated estimates and not measured data.

In addition, visibility impacts throughout Chapter 7 are expressed as light extinction (inverse megameters) while Chapter 11 expresses visibility impacts as deciviews. All charts and data associated with calculated visibility impacts in each chapter should be consistent (either deciviews or Mm-1) so that the data can be easily compared and verified.

Pg 48 Figure 7-11. Hells Canyon Wilderness 20% Worst Days. This pie chart is not accurate and does not properly reflect the magnitude of each calculated light extinction constituent in Figure 7-13. For example, the chart does not properly show that the calculated light extinction for NO_3 is 50% of the total. There are also errors with the other calculated constituents. Please correct.

Chapter 8 Emissions Source Inventory

Pg. 71 General Comment. For SO_2 and NO_x, there are inconsistencies between the data provided in Chapter 8 and source apportionment predicted modeling results in Chapter 9. For example, throughout Section 9 many if not all of the future modeled impacts have not been adjusted for: 1) SO2 controls installed on the rotary kiln at the P4 Production facility in Caribou County and; 2) The elimination of emissions from a 500 MW electric generating unit which was never built in Jerome County. For the Idaho Statewide Inventory, Chapter 8 needs to clearly identify both the actual reductions and those reductions which were modeled in Section 9.

Pg 78 Summary of Idaho Statewide Emissions. At the end of Section 8.1, a new section should be added to the report which summarizes the overall emissions contribution from each visibility constituent and source category for the baseline year and future

projections. Summaries of the Idaho Statewide data are provided in Attachment A. Also include a narrative discussion of the data.

Pg 86 Summary of Regional Emissions Sources. In addition to the bar chart data for each state, summary tables of the emissions table would be beneficial for the report. This data will help the public to better understand the magnitude of emissions from each state. Attachment B provides this data. Please add this summary to the report. Also, regional ammonia emissions is missing from the report.

Other Emissions Data. Source apportionment projections throughout Section 9 include emissions data from other regional planning organizations (CENRAP, Eastern U.S., etc.), countries (Canada, Mexico) and outside the domain. As shown, model projections suggest that SO_2 emissions from outside the domain significantly impact the Class I Areas. Please provide a summary of the overall emissions estimates from these other regional sources and sources outside the domain.

Chapter 9 Source Apportionment

Pg. 88 Corrections to 2018 Emissions Inventory. The report states that due to inadequate funding, the 2018 emissions inventories will not be updated and erroneously include emissions from a 500MW coal fired Electric Generating Unit (EGU) which was never built. Therefore, future year emissions inventories and model predicted visibility impacts are inflated and not accurate. These errors should be corrected before the plan is submitted to EPA for approval.

Pgs 90 thru 194 Sections 9.2 & 9.3 General Comment Source Apportionment Clarification. The report needs to clarify that source apportionment concentration data is based on modeling results and these predicted concentrations are only rough estimates. The current report language regarding visibility impacts for individual pollutants is misleading. For example in Section 9.2.1 it is stated that:

"The regional source contribution pie charts in Figure 9-1 show the WRAP states are only contributing a third of the calculated visibility impairment on the 20% worst days at Craters of the Moon."

This statement should be modified as follows:

"The regional source contribution pie charts in Figure 9-1, based on source apportionment modeling, suggest that the WRAP states are predicted to contribute a third of the calculated visibility impairment on the 20% worst days at Craters of the Moon."

Please provide these corrections or similar corrective language throughout Section 9.0.

Pgs 90 thru 194 Predicted Modeling Impacts – Source Apportionments. PSAT predicted modeling results for sulfates and nitrates are expressed in terms of concentrations ($\mu g/m^3$) (for examples see Figures 9-1 and 9-8). However, for all other visibility constituent

precursors (i.e., OC, EC, Fine PM, Coarse PM), predicted impacts are expressed as percentages and predicted concentrations are not provided. Please include the predicted concentration data for each of these constituents in the report. This data is needed to compare the predicted modeled results to actual measured concentrations at each Class I Area.

Pg 102 and 103 Hells Canyon WEP Predicted OC & EC Impacts Natural Fires. In Figures 9-21 and 9-23, during the 20 % worst days at Hells Canyon, WEP predicted OC and EC impacts are dominated by Idaho natural fires. Please explain why Idaho's downwind natural fire impacts are greater than upwind impacts from Oregon natural fires. For example, predicted OC & EC model impacts for the Eagle Cap Wilderness Area are dominated by Oregon fires with Idaho fires contributing only a small fraction.

Also, predicted PSAT impacts for sulfate and nitrate (Figs. 9-17 and 9-18, respectively) indicate a much lower natural fire impact for the 20% worst days. Therefore, sulfate and nitrate predicted modeling results indicate the highest concentrations occur during the winter while OC & EC model predictions suggest that the highest impacts occur during the summer. Please explain.

Pg. 109 Figure 9-31. Nitrate Concentrations at Sawtooth 20% Worst Days. The bar charts regarding predicted nitrate concentrations for the 20% Worst Days and 20% Best Days appears to be incorrect. The "y axis" predicted concentration ranges for the 20% Best Days, appear to be higher than the 20% Worst Days. Please correct.

Pg. 114 Selway-Bitterroot Predicted Sulfate Impacts (Fig. 9-41). Please explain why natural fires in Idaho are the largest contributor of predicted sulfate concentrations at the Selway-Bitterroot Wilderness Area. Idaho's contributions are significantly greater than any other state. In addition, generally natural fires are not considered to be a significant source of sulfates. Please also explain.

Pg.122 Yellowstone National Park Predicted Sulfate Impacts (Figs. 9-53 & 9-55). As discussed in the draft report, predicted PSAT modeling results for sulfates include inaccurate and severely inflated future year SO2 emissions estimates. Future SO_2 emissions inventories do not account for emissions reductions associated with 2005 SO_2 controls at the P4 Production facility (see pg 228). In addition, the once anticipated EGU in Jerome County was never built. However, future year emissions inventories inaccurately include the emissions from the EGU. It is critical that the source apportionment modeling be updated with 10,000 tons/year less SO_2 emissions. The SIP is critically flawed without these updates. Please discuss.

In addition, please discuss whether overly inflated SO_2 emissions (and NO_x for the Jerome EGU) were utilized for source apportionment modeling for all other Class I Areas included in IDEQ's Draft Regional Haze Plan.

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Pg.125 Nitrate Concentrations at Yellowstone. Predicted nitrate concentrations in Figures 9-57 and 9-58 appear to be switched. Please correct and check all predicted nitrate concentrations for all Class I Areas.

Pg.134 Glacier Park. Please explain why WEP modeling does not include data for Wyoming.

Pg.179 Eagle Cap Wilderness Predicted Sulfate Concentrations. Please explain the major differences in the predicted modeling results for sulfates for the 20% worst days between Eagle Cap and Hells Canyon. State contributions are significantly different between these 2 areas. Hells Canyon model predicted results appear to be overly inflated and in error.

Pg.181 Eagle Cap Wilderness Predicted Nitrate Concentrations. Please explain why the Idaho's contributions for nitrate (Fig. 9-146) and sulfate (Fig. 9-144) are so much different for the Worst 20% Days.

Pg.199 Hells Canyon Projected Visibility on 20% Worst Days. As described in Section 9.3, RPG's for Hells Canyon are set by Oregon. This information is unnecessary for Idaho's draft plan since Oregon has jurisdiction over this area.

Chapter 10 Best Available Retrofit Technology (BART) Evaluation

Pg.214 Section 10.2 BART – Eligible Sources Step 3. Language in Step 3 is not consistent with Appendix Y to Part 51 requirements. The phrase, "The following are definitely visibility impairing pollutants:" is not included in Appendix Y. Please replace with the following language included in Section II.3.of Appendix Y, "Visibility impairing pollutants include the following:"

Pg.222 Section 10.3.2 CALPUFF Modeling Results. Modeling results for the P4 Production facility in Caribou County appear to be mistakenly left out of Section 10.3.2. Please add the P4 modeling results to this table.

Pg.222 Section 10.4 BART Control Determination Process. – Further clarification of the applicability of Appendix Y is recommended in the draft report. Please replace the last sentence on page 222 with the following: "EPA requires each state to follow Appendix Y guidelines for large electric utility generating facilities (EGU's) with capacities of 750 MW's (megawatts) or greater. EPA does not require states to use the guidelines for other sources. Nonetheless IDEQ followed the Appendix Y guidelines for Idaho BART sources, even though the guidelines are not designed for industrial sources."

For example, and as previously discussed with IDEQ, Appendix Y guidelines are not appropriate for grower-owned sugar beet processing facilities with small industrial boilers. Fuel usage rates and emissions from EGU's are orders of magnitude greater than small industrial boilers. Most importantly, significant capital expenditures for EGU's can be passed on to customers through rate increases approved by public utility commissions.

Beet sugar production economics are completely different than EGU's. As a result, these guidelines and specifically Appendix Y cost of compliance recommendations are not appropriate for small industrial boilers at any sugar beet processing facility.

Pg. 223 Section 10.5.1 TASCO NO_x Controls. The cost of the 2006 steam pulp dryer project was $20.1 million. Please add to the report. Also, the second sentence is inaccurate and should be changed as follows: "Pulp drying typically occurs during the fall and winter months. Predicted modeling results suggest that the 20% worst days at Class I Areas are 100 miles upwind of the TASCO facility occur during the winter months."

Pg. 224 Section 10.5 TASCO BART Determination. Section 10.5 is not complete and does not entirely reflect TASCO/IDEQ discussions and correspondence since TASCO's original BART determination was submitted on November 20, 2007 and updated on February 6, 2009. TASCO's affordability analysis (incorrectly referenced as financial hardship in the draft regional haze plan) is only one of many of the components for a BART determination. TASCO's primary concern is that IDEQ mandated BART controls for the Riley boiler will not result in any "degree of improvement and visibility which may reasonably be anticipated" or measurable visibility improvements at any Class I area. TASCO has continually questioned CALPUFF modeling results for predicted impacts at Class I Areas over 100 miles upwind of the TASCO Nampa facility (Hells Canyon, Eagle Cap and Strawberry Mountain Wilderness Areas). TASCO has expressed concern about the agency's reliance upon conservative dispersion modeling as the sole basis for its BART applicability determination for this relatively small industrial source.

TASCO's concerns are well founded based upon past experience with inaccurate air dispersion modeling relied upon by IDEQ that led to a significant capital expenditure at TASCO's Nampa facility. In support of the Treasure Valley PM_{10} Maintenance Plan published in 2002, DEQ relied upon PM_{10} modeling analyses for the Nampa facility which over predicted ambient PM_{10} concentrations attributable to the plant. DEQ modeled a predicted value of 354 $\mu g/m^3$ then added an estimated background concentration of 90$\mu g/m^3$ for an estimated impact of 444 $\mu g/m^3$ from the Nampa facility. This value was above the applicable National Ambient Air Quality Standard of 150 $\mu g/m^3$ and DEQ required to TASCO to reduce emissions at a significant cost. During the interim period when the coal-fired rotary drum pulp dryers were operating, (2004 and 2005) actual PM_{10} concentrations measured by a DEQ approved monitor located at the Nampa facility fence line averaged only 22 $\mu g/m^3$ - twenty times less than the value predicted by modeling – and proving the model to be grossly inaccurate. Notably, monitored $\mu g/m^3$ concentrations did not materially change after the installation of the pulp steam dryer and shutdown of the rotary pulp drum dryers.

In addition, on numerous occasions TASCO provided to IDEQ, several BART alternatives which result in greater overall emissions reductions than IDEQ's Riley boiler BART determination. In addition to the pulp steam dryer project discussed below, TASCO has also requested that IDEQ consider as an additional BART alternative emissions reductions associated with the 2005 termination of sugar beet processing at the

Nyssa facility. The termination of these activities at the Nyssa facility provides significant emissions reductions and additional air quality benefits because the facility is approximately 27 miles closer to the Eagle Cap, Hells Canyon and Strawberry Mountain Wilderness areas where the CALPUFF model predicted the highest impacts. States can approve alternative BART control measures in accordance with 40 CFR 51.308(e) requirements. TASCO's proposed BART alternative of the combination of the shutdown of the Nampa pulp dryers along with the termination of beet processing at the Nyssa facility provides emissions reduction greater than IDEQ's determination for the Riley. These alternatives reduce PM_{10}, SO_2 and NO_x emissions by over 140%. A detailed discussion of these alternatives was submitted to IDEQ on November 18, 2009 (Supplemental Information – Riley BART Determination). It remains unclear why IDEQ rejected consideration of these emission reductions.

Supporting documentation for additional concerns raised by TASCO regarding IDEQ's BART determination for the Riley boiler are detailed in several written submittals to IDEQ. TASCO's most recent comments to IDEQ were submitted on May 19, 2010 as part of TASCO's review of the draft Tier II BART Operating Permit for the Riley boiler.

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Section 10 of the draft plan further omits discussion of obligations imposed by Idaho's rules for development of a regional haze plan. The rules adopted at IDAPA 58.01.01.665-668 afford IDEQ substantial discretion in development of a reasonable long-term strategy for regional haze. These rules require the Department to consider multiple factors and to coordinate with neighboring states to develop a reasonable plan. The draft permit issued by IDEQ to TASCO requires approximately $18,000,000 in emissions controls for the TASCO Riley Boiler that may not achieve any improvement to visibility, according to IDEQ's evaluation. The evaluation omitted consideration and interstate coordination prescribed by the regional haze rules and is unreasonable.

First, IDEQ observes that the highest impacts from TASCO's Nampa boiler are predicted to occur at Eagle Cap Wilderness (high impacts are also predicted to occur at the Strawberry Mountain and Hells Canyon Wilderness Areas) in Oregon. IDEQ states that "[a]lthough Eagle Cap Wilderness is outside of Idaho, the regional haze rule requires that state to address impacts in other states." This is not a completely accurate description of the regional haze rule requirement for interstate impacts. Under IDAPA 58.01.01.677, the Department is to develop a long-term strategy that addresses regional haze within the state and for areas outside the state that may be affected by emissions from the state. Specific requirements for development of the long-term strategy include consideration of the following factors, at a minimum: emissions reductions due to ongoing air pollution programs; source retirement replacement schedules; enforceability of emissions limitations and control measures. (IDAPA 58.01.01.667. 03(c)). Specific provisions for development of the long-term strategy also require interstate coordination with other states to develop coordinated emission management strategies "where Idaho has emissions that are reasonable anticipated to contribute to visibility impairment" in an area located in another state.

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IDEQ failed to conform to the requirements in developing the BART portion of the long-term strategy set forth in Section 10 of the Regional Haze Plan. While IDEQ acknowledges that "the shutdown of the old pulp dryers has provided more visibility improvement than low NO_x burners (LNB) would and nearly the improvement that would be expected from LNB with over-fire-air (LNB w/OFA)," IDEQ nevertheless imposed more emissions controls. These source retirement commitments, now reflected in the Tier II permit issued to TASCO on September 7, 2010 are sufficient NO_x control, according to IDEQ's own evaluation. Consideration of the permanent shutdown is consistent with the factors presented in IDAPA 58.01.01.677.03(c).

IDEQ further failed to conform to the requirements in developing the BART portion of the long-term strategy set forth in Section 10 of the Regional Haze Plan by omitting coordination with the State of Oregon. The "best" BART recommendation presented by IDEQ in Section 10.5 appears to ignore the need to coordinate with Oregon despite IDEQ's emphasis on predicted impacts in Eagle Cap, Strawberry Mountain and Hells Canyon Wilderness areas located in Oregon. IDEQ is required to consult and coordinate on development of an emissions management strategy under IDAPA 58.01.01.667.04. Specifically, the termination of sugar beet processing activities at the TASCO factory in Nyssa, Oregon was overlooked by both Oregon and Idaho in development of a long-term strategy and the impacts of these significant emissions reductions were excluded from any coordinated emissions management strategy, as required by IDAPA.

Under IDAPA 58.01.01.668.02(c)(v) IDEQ is required to consider the degree of improvement in visibility which may reasonably be anticipated to result from the use of BART imposed on TASCO. TASCO urges IDEQ to reconsider the degree of improvement that may reasonably be anticipated to result from the shutdown of pulp dryers in Nampa and the termination of sugar beet processing at the factory in Nyssa, and conclude that these measures are sufficient to achieve the BART portion of a long-term strategy for TASCO. Given IDEQ's statements regarding NO_x and SO_2 emissions sources from Idaho, this approach can be supported in the final plan.

<u>Pg. 224 Section 10.5.1 TASCO NO_x Controls.</u> The first sentence of the second paragraph regarding the economics of shutting down the old pulp dryers is misleading and inaccurate. The capital cost of the pulp steam dryer was $20.1 million. As noted above, this significant environmental improvement project was required because of inaccurate air dispersion modeling as part of IDEQ's 2002 Treasure Valley PM_{10} Maintenance Plan. Even though there are some operating cost savings due to reduced fuel usage rates, these savings only pay for the lease payment for the $20.1 million capital expenditure for the pulp steam dryer.

As discussed above, TASCO has previously requested that IDEQ consider emissions reductions associated with the 2005 shutdown of the Nyssa facility. Equivalent emission control costs for the Riley boiler associated with the Nyssa facility emissions reductions have not been quantified. However, based on a rough estimate the equivalent capital

costs for these SO_2 and NO_x emissions reductions are well above $30 million (based on dry flue gas desulfurization and selective catalytic reduction emissions controls).

<u>Pg. 231 Section 10.8 Visibility Improvements.</u> Visibility improvements in Tables 10.14 for P4 Production and Table 10.15 for the TASCO Riley boiler are expressed utilizing different formats. Predicted visibility improvements in each table should be expressed using similar methodologies. Attachment C provides a summary of P4 Production facility and TASCO Riley boiler predicted modeling results expressed as: 1) Improvement in Highest Delta-Deciview Values and Reduction in Days 0.5 DV for Individual and 3-Year Improvement and 2) Delta-Deciview Value larger than 0.5 from one-year period. The tables need to be included for each facility. Where necessary, please add these tables to the report.

For the P4 Production facility, predicted CALPUFF modeling results in Attachment C were copied from IDEQ's April 2010 and June 2010 Draft Regional Haze Plans. It's unclear why the data changed in each of IDEQ's drafts. The most representative data needs to be included in the final plan.

Attachment A

Idaho Statewide
Emissions Inventory Summaries

Chapter 8.1 Idaho Statewide Emissions Inventory
Summary of Source Categories - Total Emissions
2002 & 2018 Projections

Source Category	2002 (t/y)	2002 %	2018 (t/y)	2018 %
Area	233,327	31%	327,805	43%
On-Road Mobile	75,686	10%	25,499	3%
Off-Road Mobile	57,758	8%	34,567	4%
Anthropogenic Fire	26,600	4%	12,802	2%
Natural Fire	231,974	31%	231,974	30%
Road Dust	22,004	3%	29,040	4%
Fugitive Dust	20,350	3%	28,519	4%
Windblown Dust	50,501	7%	50,501	7%
Point	33,321	4%	27,533	4%
Total	751,521	100%	768,240	100%

Chapter 8.1 Idaho Statewide Emissions Inventory
Summary of Visibility Pollutants
2002 & 2018 Projections

Pollutant	2002 (t/y)	2002 %	2018 (t/y)	2018 %
Volatile Organic Carbon(VOC)	271,211	36%	323,276	42%
Nitrogen Oxides (NOx)	157,200	21%	124,780	16%
Coarse Particulate Matter	113,128	15%	126,635	16%
Fine Particulate Matter	19,493	3%	21,841	3%
Ammonia (NH3)	79,282	11%	80,275	10%
Organic Carbon(OC)	58,304	8%	53,887	7%
Elemental Carbon(EC)	13,743	2%	11,660	2%
Sulfur Dioxide(SO2)	39,160	5%	25,886	3%
Total	751,521	100%	768,240	100%

Idaho Statewide 2002 Emission Inventory (tons/y)
Chapter 8 - IDEQ Draft Regional Haze Plan

Source Category	Total %	Total	VOC	NOx	Coarse PM	Fine PM	NH3	OC	EC	SO2
Point	4%	33,321	2,113	11,487	643	305	1,043	106	11	17,613
Area	31%	233,327	124,137	30,318	2,933	4,749	67,293	425	192	3,280
On-Road Mobile	10%	75,686	26,972	44,611	238	0	1,430	383	390	1,662
Off-Road Mobile	8%	57,758	23,511	27,922	0	0	17	747	1,859	3,702
Anthropogenic Fire	4%	26,600	8,316	3,461	1,354	1,536	1,253	8,454	1,331	895
Natural Fire	31%	231,974	86,162	39,401	25,323	3,013	8,246	47,883	9,938	12,008
Road Dust	3%	22,004			19,690	2,153		150	11	
Fugitive Dust	3%	20,350			17,496	2,687		156	11	
Windblown Dust	7%	50,501			45,451	5,050				
Total	100%	751,521	271,211	157,200	113,128	19,493	79,282	58,304	13,743	39,160

Idaho Statewide Projected 2018 Emission Inventory (tons/y)
Chapter 8 - IDEQ Draft Regional Haze Plan

Source Category	Total %	Total	VOC	NOx	Coarse PM	Fine PM	NH3	OC	EC	SO2
Point	4%	27,533	3,017	12,057	937	386	1,593	133	15	9,395
Area	43%	327,805	203,867	42,068	3,216	6,343	67,898	617	257	3,539
On-Road Mobile	3%	25,499	10,332	12,326	259	0	1,930	341	102	209
Off-Road Mobile	4%	34,567	15,931	17,235	0	0	24	424	663	290
Anthropogenic Fire	2%	12,802	3,967	1,693	655	713	584	4,089	656	445
Natural Fire	30%	231,974	86,162	39,401	25,323	3,013	8,246	47,883	9,938	12,008
Road Dust	4%	29,040			25,987	2,841		197	15	
Fugitive Dust	4%	28,519			24,807	3,495		203	14	
Windblown Dust	7%	50,501			45,451	5,050				
Total	100%	768,240	323,276	124,780	126,635	21,841	80,275	53,887	11,660	25,886

VOC - volatile organic compounds
NOx - nitrogen oxides
Coarse PM - PM10
Fine PM - PM2.5

OC - organic carbon
EC - elemental carbon
NH3 - ammonia
SO2 - sulfur dioxide

Idaho Statewide 2002 Emission Inventory (tons/y)
Chapter 8 - IDEQ Draft Regional Haze Plan

Source Category	SO2		NOx		VOC		OC		EC		Fine PM		Coarse PM		NH3		Total
	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	
Point	17,613	44.98%	11,487	7.31%	2,113	0.78%	106	0.18%	11	0.08%	305	1.56%	643	0.57%	1,043	1.32%	33,322
Area	3,280	8.38%	30,318	19.29%	124,137	45.77%	425	0.73%	192	1.40%	4,749	24.36%	2,933	2.59%	67,293	84.88%	233,328
On-Road Mobile	1,662	4.24%	44,611	28.38%	26,972	9.95%	383	0.66%	390	2.84%	0	0.00%	238	0.21%	1,430	1.80%	75,686
Off-Road Mobile	3,702	9.45%	27,922	17.76%	23,511	8.67%	747	1.28%	1,859	13.53%	0	0.00%	0	0.00%	17	0.02%	57,759
Anthropogenic Fire	895	2.29%	3,461	2.20%	8,316	3.07%	8,454	14.50%	1,331	9.68%	1,536	7.88%	1,354	1.20%	1,253	1.58%	26,600
Natural Fire	12,008	30.66%	39,401	25.06%	86,162	31.77%	47,883	82.13%	9,938	72.31%	3,013	15.46%	25,323	22.38%	8,246	10.40%	231,977
Road Dust		0.00%		0.00%		0.00%	150	0.26%	11	0.08%	2,153	11.04%	19,690	17.41%		0.00%	22,004
Fugitive Dust		0.00%		0.00%		0.00%	156	0.27%	11	0.08%	2,687	13.78%	17,496	15.47%		0.00%	20,350
Windblown Dust		0.00%		0.00%		0.00%		0.00%		0.00%	5,050	25.91%	45,451	40.18%		0.00%	50,502
Total	39,160	100%	157,200	100%	271,211	100%	58,304	100%	13,743	100%	19,493	100%	113,128	100%	79,282	100%	751,528

[a] Chapter 8 - IDEQ Draft Visibility SIP

Idaho Statewide 2018 Projected Emission Inventory (tons/y)
Chapter 8 - IDEQ Draft Regional Haze Plan

Source Category	SO2		NO3		VOC		OC		EC		Fine PM		Coarse PM		NH3		Total
	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	(tons/y)	%	
Point	9,395	36.29%	12,057	9.66%	3,017	0.93%	133	0.25%	15	0.13%	386	1.77%	937	0.74%	1,593	1.98%	27,533
Area	3,539	13.67%	42,068	33.71%	203,867	63.06%	617	1.14%	257	2.20%	6,343	29.04%	3,216	2.54%	67,898	84.58%	327,806
On-Road Mobile	209	0.81%	12,326	9.88%	10,332	3.20%	341	0.63%	102	0.87%	0	0.00%	259	0.20%	1,930	2.40%	25,499
Off-Road Mobile	290	1.12%	17,235	13.81%	15,931	4.93%	424	0.79%	663	5.69%	0	0.00%	0	0.00%	24	0.03%	34,567
Anthropogenic Fire	445	1.72%	1,693	1.36%	3,967	1.23%	4,089	7.59%	656	5.63%	713	3.26%	655	0.52%	584	0.73%	12,802
Natural Fire	12,008	46.39%	39,401	31.58%	86,162	26.65%	47,883	88.86%	9,938	85.23%	3,013	13.80%	25,323	20.00%	8,246	10.27%	231,977
Road Dust		0.00%		0.00%		0.00%	197	0.37%	15	0.13%	2,841	13.01%	25,987	20.52%		0.00%	29,040
Fugitive Dust		0.00%		0.00%		0.00%	203	0.38%	14	0.12%	3,495	16.00%	24,807	19.59%		0.00%	28,519
Windblown Dust		0.00%		0.00%		0.00%		0.00%		0.00%	5,050	23.12%	45,451	35.89%		0.00%	50,502
Total	25,886	100%	124,780	100%	323,276	100%	53,887	100%	11,660	100%	21,841	100%	126,635	100%	80,275	100%	768,247

[a] Chapter 8 - IDEQ Draft Visibility SIP

Table 8.1 Idaho SO_2 Statewide Emission Inventory 2002-2018
Idaho Statewide Sulfate Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	17,613	9,395	-8,218	-46.7%	45%
Area	3,280	3,539	259	7.9%	8%
On-Road Mobile	1,662	209	-1,453	-87.4%	4%
Off-Road Mobile	3,702	290	-3,412	-92.2%	9%
Anthropogenic Fire	895	445	-450	-50.3%	2%
Natural Fire	12,008	12,008	0	0.0%	31%
Total	39,160	25,886	-13,274	-33.9%	100%

Table 8.2 Idaho NO_x Statewide Emission Inventory 2002-2018
Idaho Statewide Nitrate Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	11,487	12,057	570	5.0%	7%
Area	30,318	42,068	11,750	38.8%	19%
On-Road Mobile	44,611	12,326	-32,285	-72.4%	28%
Off-Road Mobile	27,922	17,235	-10,687	-38.3%	18%
Anthropogenic Fire	3,461	1,693	-1,768	-51.1%	2%
Natural Fire	39,401	39,401	0	0.0%	25%
Total	157,200	124,780	-32,420	-20.6%	100%

Table 8.3 Idaho VOC Statewide Emission Inventory 2002-2018
Idaho Statewide VOC Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	2,113	3,017	904	42.8%	1%
Area	124,137	203,867	79,730	64.2%	46%
On-Road Mobile	26,972	10,332	-16,640	-61.7%	10%
Off-Road Mobile	23,511	15,931	-7,580	-32.2%	9%
Anthropogenic Fire	8,316	3,967	-4,349	-52.3%	3%
Natural Fire	86,162	86,162	0	0.0%	32%
Total	271,211	323,276	52,065	19.2%	100%

Table 8.4 Idaho Organic Carbon Statewide Emission Inventory 2002-2018
Idaho Statewide Primary Organic Aerosol Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	106	133	27	25.5%	0%
Area	425	617	192	45.2%	1%
On-Road Mobile	383	341	-42	-11.0%	1%
Off-Road Mobile	747	424	-323	-43.2%	1%
Anthropogenic Fire	8,454	4,089	-4,365	-51.6%	14%
Natural Fire	47,883	47,883	0	0.0%	82%
Road Dust	150	197	47	31.3%	0%
Fugitive Dust	156	203	47	30.1%	0%
Total	58,304	53,887	-4,417	-7.6%	100%

Table 8.5 Idaho Elemental Carbon Statewide Emission Inventory 2002-2018
Idaho Statewide Elemental Carbon Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	11	15	4	36.4%	0%
Area	192	257	65	33.9%	1%
On-Road Mobile	390	102	-288	-73.8%	3%
Off-Road Mobile	1,859	663	-1,196	-64.3%	14%
Anthropogenic Fire	1,331	656	-675	-50.7%	10%
Natural Fire	9,938	9,938	0	0.0%	72%
Road Dust	11	15	4	36.4%	0%
Fugitive Dust	11	14	3	27.3%	0%
Total	13,743	11,660	-2,083	-15.2%	100%

Table 8.6 Idaho PM Fine Statewide Emission Inventory 2002-2018
Idaho Statewide Fine Particulate Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	305	386	81	26.6%	2%
Area	4,749	6,343	1,594	33.6%	24%
On-Road Mobile	0	0	0	0.0%	0%
Off-Road Mobile	0	0	0	0.0%	0%
Anthropogenic Fire	1,536	713	-823	-53.6%	8%
Natural Fire	3,013	3,013	0	0.0%	15%
Road Dust	2,153	2,841	688	32.0%	11%
Fugitive Dust	2,687	3,495	808	30.1%	14%
Windblown Dust	5,050	5,050	0	0.0%	26%
Total	19,493	21,841	2,348	12.0%	100%

Table 8.7 Idaho PM Coarse Statewide Emission Inventory 2002-2018
Idaho Statewide Coarse Particulate Matter Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	643	937	294	45.7%	1%
Area	2,933	3,216	283	9.6%	3%
On-Road Mobile	238	259	21	8.8%	0%
Off-Road Mobile	0	0	0	0.0%	0%
Anthropogenic Fire	1,354	655	-699	-51.6%	1%
Natural Fire	25,323	25,323	0	0.0%	22%
Road Dust	19,690	25,987	6,297	32.0%	17%
Fugitive Dust	17,496	24,807	7,311	41.8%	15%
Windblown Dust	45,451	45,451	0	0.0%	40%
Total	113,128	126,635	13,507	11.9%	100%

Table 8.8 Idaho Ammonia Statewide Emission Inventory 2002-2018
Idaho Statewide Ammonia Emissions (tons/year)

Source Category	Plan02d 2002	Prp18b 2018	Net Change		2002 Source Contribution
Point	1,043	1,593	550	52.7%	1%
Area	67,293	67,898	605	0.9%	85%
On-Road Mobile	1,430	1,930	500	35.0%	2%
Off-Road Mobile	17	24	7	41.2%	0%
Anthropogenic Fire	1,253	584	-669	-53.4%	2%
Natural Fire	8,246	8,246	0	0.0%	10%
Total	79,282	80,275	993	1.3%	100%

Attachment B

Regional Emissions Summaries

Chapter 8 - Regional Emissions Summaries

Section 8.2.2 WRAP 2002 & 2018 SO2 Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	39,163	7.79%	25,891	6.95%
MT	51,923	10.32%	45,794	12.30%
NV	68,979	13.71%	59,731	16.04%
OR	52,449	10.43%	31,537	8.47%
UT	55,640	11.06%	43,380	11.65%
WA	86,323	17.16%	40,325	10.83%
WY	148,487	29.52%	125,692	33.76%
Total	502,964	100.00%	372,350	100.00%

Section 8.2.3 WRAP 2002 & 2018 NOx Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	174,186	9.99%	141,768	11.64%
MT	243,142	13.94%	180,043	14.78%
NV	162,475	9.32%	124,570	10.22%
OR	257,131	14.75%	161,052	13.22%
UT	240,060	13.77%	168,382	13.82%
WA	378,565	21.71%	194,258	15.94%
WY	288,095	16.52%	248,234	20.38%
Total	1,743,654	100.00%	1,218,307	100.00%

Section 8.2.4 WRAP 2002 & 2018 VOC Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	1,105,514	14.75%	1,157,578	14.92%
MT	1,181,318	15.77%	1,174,587	15.14%
NV	897,102	11.97%	897,310	11.57%
OR	1,621,287	21.64%	1,654,231	21.32%
UT	827,515	11.04%	874,292	11.27%
WA	1,042,867	13.92%	994,616	12.82%
WY	816,904	10.90%	1,005,916	12.97%
Total	7,492,507	100.00%	7,758,530	100.00%

Section 8.2.5 WRAP 2002 & 2018 Organic Carbon Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	58,304	16.27%	53,888	15.53%
MT	48,089	13.42%	46,502	13.40%
NV	24,734	6.90%	24,596	7.09%
OR	118,340	33.02%	115,220	33.21%
UT	29,407	8.21%	29,070	8.38%
WA	50,273	14.03%	49,255	14.19%
WY	29,194	8.15%	28,464	8.20%
Total	358,341	100.00%	346,995	100.00%

Section 8.2.6 WRAP 2002 & 2018 Elemental Carbon Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	13,743	15.50%	11,659	15.90%
MT	11,873	13.39%	9,901	13.50%
NV	6,409	7.23%	5,557	7.58%
OR	26,728	30.14%	23,685	32.29%
UT	8,769	9.89%	6,663	9.08%
WA	13,102	14.77%	9,033	12.32%
WY	8,066	9.09%	6,849	9.34%
Total	88,690	100.00%	73,347	100.00%

Section 8.2.7 WRAP 2002 & 2018 PM Fine Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	19,492	8.06%	21,842	8.33%
MT	77,239	31.95%	83,047	31.67%
NV	20,969	8.67%	20,023	7.64%
OR	45,203	18.70%	44,294	16.89%
UT	14,876	6.15%	17,240	6.57%
WA	41,151	17.02%	47,713	18.20%
WY	22,833	9.44%	28,055	10.70%
Total	241,763	100.00%	262,214	100.00%

Section 8.2.8 WRAP 2002 & 2018 PM Coarse Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	113,127	7.95%	126,633	8.00%
MT	621,276	43.69%	675,985	42.69%
NV	161,142	11.33%	159,483	10.07%
OR	170,964	12.02%	202,003	12.76%
UT	97,501	6.86%	109,705	6.93%
WA	155,430	10.93%	193,576	12.23%
WY	102,660	7.22%	116,054	7.33%
Total	1,422,100	100.00%	1,583,439	100.00%

Section 8.2.9 WRAP 2002 & 2018 Ammonia Emissions Summaries Bordering States

State	2002		2018	
	(t/y)	%	(t/y)	%
ID	79,282	23.54%	80,275	23.14%
MT	66,229	19.66%	67,030	19.33%
NV	12,092	3.59%	14,503	4.18%
OR	57,154	16.97%	58,177	16.77%
UT	29,999	8.91%	31,840	9.18%
WA	59,054	17.53%	61,042	17.60%
WY	33,032	9.81%	33,974	9.80%
Total	336,842	100.00%	346,841	100.00%

RegionalEmissionSourceSummary10Sept27.xls

Attachment C

CALPUFF Predicted Modeling Results

P4 Production Facility &
The Amalgamated Sugar Company LLC

CALPUFF Predicted Modeling Results

P4 Production Facility
Caribou County

April 2010

Table -2 Difference in the number of days over .5 decivew based on base year and future controls for P4.

Difference between Existing Control and PTC Future Control with normal operation at P4 (Existing - Future)

	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
Impacted Class I Areas (within 300km range from sources)	8th highest[a]	Total days[b]	8th highest	Total days	8th highest	Total days	22nd Highest[c]	Number of Days[d] (2003,2004,2005)
Bridger Wilderness, WY (brid2)	2.85	82	2.796	97	2.415	95	2.846	274
Craters of the Moon NM - Wilderness, ID (crmowild)	2.419	25	2.48	21	3.077	14	2.621	60
Fitzpatrick Wilderness, WY (fitz2)	1.886	102	1.73	114	1.471	111	1.809	327
Grand Teton NP, WY (grte2)	4.564	48	4.525	64	4.492	57	4.566	169
Jarbidge Wilderness, NV (jarb2)	0.281	3	0.363	5	0.648	9	0.477	17
North Absaroka Wilderness, WY (noab2)	1.443	72	1.545	72	1.606	81	1.521	225
Red Rock Lakes Wilderness, MT (redrwild)	2.158	41	2.212	48	2.24	43	2.209	132
Sawtooth Wilderness, ID (sawt2)	0.64	13	0.732	10	0.916	20	0.779	43
Teton Wilderness, WY (teto2)	3.253	72	3.139	78	3.081	98	3.14	248
Washakie Wilderness, WY (wash3)	1.569	105	1.535	103	1.544	122	1.547	330
Yellowstone NP, WY (yell4)	3.296	58	4.668	64	4.307	86	4.348	208

a. The 8th highest delta-deciview for the calendar year.

b. Total number of days in 1 year that exceeded 0.5 delta-deciviews.

c. The 22nd highest delta-deciview value for the 3-year period.

d. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

10.8 Visibility Improvements Based on Emission Limits

The following tables show the visibility improvements at Monsanto/P4 and TASCO based on the before emission controls and after BART technologies have or will be installed. These tables look at the visibility improvements at all of the class I areas within 300km from the source. The BART controls at P4 reduced the total number of days over 0.5 deciviews impact by 2033 days as shown in table 10-14.

Table 10-14 Difference in the number of days with visibility impairment of more than 0.5 decivew between base year and future controls

Table 10-13 Regional Haze Improvement Due to 2002 Controls on BART Eligible P4 Sources

Impacted Class I Areas (within 300km range from P4)	Change in Visibility Compared Against 20% Best Days Natural Background Conditions (Delta-Deciview Values Larger than 0.5ΔDV in the 3 year period 2003 - 2005)					
	Before BART Upgrades		After BART Upgrades		Difference (Before - After)	
	ΔDV on 22nd Highest Day[a]	Number of Days > 0.5ΔDV[b]	ΔDV on 22nd Highest Day[a]	Number of Days > 0.5ΔDV[b]	Reduction in ΔDV for 22nd Highest Day[a]	Reduction in Days > 0.5ΔDV[b]
Bridger Wilderness, WY (brid2)	4.733	581	1.887	307	2.846	274
Craters of the Moon NM - Wilderness, ID (crmowild)	4.410	153	1.789	93	2.621	60
Fitzpatrick Wilderness, WY (fitz2)	2.881	472	1.072	145	1.809	327
Grand Teton NP, WY (grte2)	8.384	628	3.818	459	4.566	169
Jarbidge Wilderness, NV (jarb2)	0.708	28	0.231	11	0.477	17
North Absaroka Wilderness, WY (noab2)	2.476	318	0.955	93	1.521	225
Red Rock Lakes Wilderness, MT (redrwild)	3.699	238	1.490	106	2.209	132
Sawtooth Wilderness, ID (sawt2)	1.234	59	0.455	16	0.779	43
Teton Wilderness, WY (teto2)	5.379	563	2.239	315	3.14	248
Washakie Wilderness, WY (wash3)	2.528	469	0.981	139	1.547	330
Yellowstone NP, WY (yell4)	7.717	517	3.369	309	4.348	208
Total Days > 0.5ΔDV for all Class I Areas Combined:		4026		1993		2033

a. The 22nd highest delta-deciview value for the 3-year period.

b. Total number of days in the 3-year period that exceed 0.5 delta-deciviews.

June 2010

CALPUFF Predicted Modeling Results

TASCO Riley Boiler
Nampa Facility

Table 8 – Visibility Impact Summary - Eagle Cap Wilderness Area

Control	Reduction in deciviews & days above 0.5 dv																Annual	Cost per
	2003				2004				2005				2003-2005				Cost	Deciview*
Scenario	8th	%	Days	%	8th	%	Days	%	8th	%	Days	%	22nd	%	Days	%	($x1,000)	$x1,000/dv
Base - Riley Boiler only	0.721		15		1.086		41		1.109		41		1.086		97			
NO_X - Low NOx Burners (LNB)	0.210	29%	4	27%	0.264	24%	12	29%	0.238	21%	12	29%	0.270	25%	28	29%	$480	$1,780
NO_X - LNB with overfire air (LNBwOFA)	0.267	37%	8	53%	0.344	32%	17	41%	0.306	28%	16	39%	0.350	32%	41	42%	$860	$2,460
NO_X - Selective Catalytic Reduction (SCR)	0.338	47%	9	60%	0.461	42%	25	61%	0.456	41%	23	56%	0.473	44%	57	59%	$3,534	$7,470
SO_2 - Low Sulfur Coal	0.039	5%	0	0%	0.070	6%	2	5%	0.081	7%	5	12%	0.072	7%	7	7%	$1,024	$14,220
SO_2 - Dry Lime FGD	0.135	19%	6	40%	0.272	25%	13	32%	0.303	27%	12	29%	0.280	26%	31	32%	$2,687	$9,600
SO_2 - Dry Trona FGD	0.156	22%	6	40%	0.322	30%	17	41%	0.370	33%	16	39%	0.325	30%	39	40%	$2,422	$7,450
SO_2 - Spray Dryer FGD	0.194	27%	6	40%	0.383	35%	19	46%	0.402	36%	21	51%	0.400	37%	46	47%	$2,521	$6,300
SO_2 - Wet FGD	0.222	31%	8	53%	0.439	40%	22	54%	0.464	42%	24	59%	0.448	41%	54	56%	$4,053	$9,050
NO_X LNB + SO_2 Dry Trona FGD	0.392	54%	10	67%	0.603	56%	35	85%	0.629	57%	35	85%	0.606	56%	80	82%	$2,902	$4,890
NO_X LNB + SO_2 Spray Dryer	0.427	59%	12	80%	0.684	63%	39	95%	0.692	62%	38	93%	0.684	63%	89	92%	$3,001	$4,410
NO_X LNB + SO_2 Wet FGD	0.451	63%	13	87%	0.727	67%	40	98%	0.757	68%	53	129%	0.738	68%	92	95%	$4,515	$6,600
NO_X LNBwOFA + SO_2 Dry Trona	0.463	64%	13	87%	0.691	64%	39	95%	0.715	64%	38	93%	0.692	64%	90	93%	$3,282	$4,740
NO_X LNBwOFA + SO_2 Spray Dryer	0.493	68%	14	93%	0.767	71%	40	98%	0.779	70%	40	98%	0.767	71%	94	97%	$3,381	$4,410
NO_X LNBwOFA + SO_2 Wet FGD	0.520	72%	14	93%	0.815	75%	41	100%	0.846	76%	41	100%	0.825	76%	96	99%	$4,895	$5,930

Base - Riley Boiler & Pulp Dryers	0.956		23		1.454		49		1.388		55		1.399		127	
Coal-Fired Pulp Dryers Shutdown	0.235	25%	8	35%	0.368	25%	8	16%	0.279	20%	14	26%	0.313	22%	30	24%

* Cost per deciview is the annual cost divided by the corresponding increment of deciview improvement for the 2003-05 period.

The visibility modeling for TASCO looked at the scenarios of the Riley boiler emissions with the shutdown of the old pulp dryers (present emissions), the Riley boiler emissions including the old pulp dryer (baseline conditions), and the Riley Boiler with projected emission reductions from the selected BART technologies. The modeling analysis included all of the class I areas within 300km.

Table 10-15 TASCO, Nampa - BART Visibility Improvements

Class I Area/Scenario	Change in Visibility Compared Against 20% Best Days Natural Background Conditions							
	Delta-Deciview Value larger than 0.5 from one year period						Delta-Deciview Value larger than 0.5 from 3 year period	
	2003		2004		2005		2003-2005	
	8th highest [a]	Total days [b]	8th highest	Total days	8th highest	Total days	22nd Highest [c]	Number of Days [d] (2003,2004,2005)
Eagle Cap Wilderness, Oregon								
Base Riley Boiler Scenario (wzl10471)	0.721	15	1.086	41	1.109	41	1.086	97
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.956	23	1.454	49	1.388	55	1.399	127
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.228	1	0.319	1	0.330	1	0.319	3
Hells Canyon National Recreation Area, ID/OR								
Base Riley Boiler Scenario (wzl10471)	0.577	9	0.888	20	0.763	19	0.786	48
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.799	16	1.056	30	0.954	32	1.018	78
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.187	1	0.255	0	0.214	0	0.228	1
Sawtooth Wilderness Area								
Base Riley Boiler Scenario (wzl10471)	0.207	1	0.249	1	0.208	0	0.224	2
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.318	2	0.327	3	0.268	0	0.317	5
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.064	0	0.066	0	0.057	0	0.064	0
Jarbidge Wilderness, NV								
Base Riley Boiler Scenario (wzl10471)	0.131	0	0.181	0	0.202	0	0.172	0
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.166	1	0.237	2	0.251	2	0.230	5
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.038	0	0.047	0	0.054	0	0.047	0
Craters of the Moon National Monument, ID								
Base Riley Boiler Scenario (wzl10471)	0.183	0	0.197	0	0.144	0	0.192	0
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.215	0	0.245	3	0.208	1	0.232	4
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.054	0	0.060	0	0.041	0	0.054	0
Selway-Bitterroot, ID								
Base Riley Boiler Scenario (wzl10471)	0.151	0	0.289	0	0.235	1	0.219	1
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.197	0	0.337	1	0.294	2	0.255	3
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.042	0	0.076	0	0.064	0	0.058	0

Strawberry Mountain Wilderness, OR								
Base Riley Boiler Scenario (wzl10471)	0.517	8	0.410	6	1.168	23	0.685	37
Base Riley Boiler plus Pulp dryer full operation Scenario (wzl10469)	0.912	13	0.680	16	1.550	31	0.992	60
NOx scenario 2 + SO2 scenario 4 (wzl10484)	0.189	0	0.112	0	0.351	2	0.217	2

DEQ Response to Public Comments

Comments taken from United States Department of Agriculture Forest Service, Received September 21, 2010

Forest Service Comment 1:

The Forest Service conducted a search of NOx control technologies for cement kilns. The search revealed LoTox™ has been identified as a technically and economically feasible control technology for cement kilns in Ellis County Texas. The report states technology should be considered transferable in nature. It has not been used on a cement kiln but it has been used on similar large sources. . . . The Forest Service is requesting Idaho DEQ further consider LoTox™ in the BART determination for NOx from the kiln at the P4 facility.

Reference: Assessment of NOx Emissions Reductions Strategies for Cement Kilns – Ellis Count. Prepared for Texas Commission on Environmental Quality. ERG Inc. OH July 14, 2006.

Response:

DEQ reviewed the document referenced in letter. Reference was dated 2006, the EPA BACT clearing house was reviewed to see if the technology has been installed and in operation on any kilns. The search did not turn up any kilns using the technology within the last 4-years but did show that it was primarily used in the petroleum industry. DEQ contacted Texas Commission on Environmental Quality since the original study was done for Texas to identify appropriate technologies for Cement kilns. According to Erik Hendrickson at the Commission, LoTox™ *was never used because it turned out to be too expense.*

Since this technology has not been proven effective for cement kilns let alone kilns for phosphate production it will not be considered technically feasible at this time. It may prove to be a control technology that can be again reviewed for reasonable progress.

Comments taken from E-mail received from Charles Johnson of Nampa Idaho DEQ, Received on September 23, 2010

Johnson Comment 1:

Mr. Johnson seems to be questioning whether TASCO is causing or contributing to visibility impairment in Hells Canyon Wilderness. “Can you absolutely prove that the pollutants from their plant are impacting Hells Canyon?”

Response:

Based on CALPUFF modeling preformed by DEQ, the Riley Boiler at the TASCO Nampa facility is contributing to visibility impairment in Hells Canyon Wilderness. This information is available in Chapter 10 and Appendix F of the plan.

Comments taken from The Amalgamated Sugar Company LLC (TASCO), Received on September 30, 2010

TASCO Comment 1:

Overall Plan Comments. Idaho's Draft Regional Haze **Plan relies upon inaccurate emissions inventory and source apportionment modeling data**. As discussed throughout the document, due to funding concerns some of the future year emissions inventories are not accurate. These inaccuracies result in a flawed basis for the evaluation of visibility impacts and establish a flawed baseline for development of a plan to improve the condition in Class I areas. For example, PSAT modeling results for sulfates include inaccurate and severely inflated future year SO2 emissions estimates (page 122). It's not clear whether these inflated SO2 emission rates were also used in PSAT modeling for all other Class I Areas. If so, then the future impacts are exaggerated and the related future visibility improvement plan is flawed. Another example is the inclusion in future emissions estimates of emissions for SO2 and NO_x from a 500 MW power plant which was never built in Jerome County (page 88). Including these unreal emissions inflates the future visibility impacts and establishes a flawed baseline from which to plan improvements. In addition, reliance upon these inaccurate emissions estimates ripples into inaccuracies in IDEQ's source apportionment model, which is intended to calibrate the CALPUFF modeling work.

An evaluation of the SO2 source apportionment modeling shows that there are significant errors. For example, these results include NOx emissions for the power plant which was never built in Jerome County. The errors in the future projected emission rates need to be corrected and source apportionment models rerun for all Class I Areas. Without these corrections, Idaho's Regional Haze Plan is flawed and not approvable. The plan potentially sets in motion expensive improvements that may be unnecessary if the data were corrected. Before submittal to EPA for consideration and before publication in the Federal Register, these errors need to be corrected, and the plan resubmitted to the public for review.

Failure to correct these errors now will inevitably require more resources from IDEQ to be spent in the future. While funding may be short at this time prompting IDEQ to submit the plan before correction, this approach is shortsighted. In addition, implementing a plan based upon flawed data and results could result in expenditures by the Idaho regulated community that may be unnecessary.

Response

Emission inventories are a snapshot of emission taken in time based upon assumptions made at that time. The assumptions at the time of the emissions used for the source apportionment included emissions from a power plant in Jerome, Idaho and was part of the WRAP assumption that states would need to increase electrical power to meet future demands – the assumption was also based on a permit application for a power

plant in that area. As the Regional Haze mentions throughout the document, this assumption changed in future emission inventories based upon a moratorium placed on the development of coal fired power plants. In instances where the source apportionment was showing an increase in visibility impacts due to the previous assumptions of a power plant in Jerome, a weight of evidence approach is included to show Idaho is in fact addressing Idaho's reduction in contribution of SO_x *to visibility impairment. The analysis in Chapter 9 on Craters of the Moon Source apportionment and the use of the WEP analysis is an example of using the weight of evidence approach.*

TASCO Comment 2:

Emissions Inventory Summaries. It is recommended that Chapter 8 of the report include overall summaries of Idaho's contribution to the regional haze conditions that address potential pollutants and emission sources in Idaho which may impact visibility in Class I Areas. This information provides the agencies, the regulated community, and the public, an indicator of the scope of the contribution from Idaho in order to develop reasonable and cost effective control measures. Based on a detailed review of the emissions and source apportionment modeling data in the report the following helpful highlights are suggested for inclusion in Chapter 8 of the plan:

- Point sources in Idaho account for only 4% of the total visibility constituent emissions.
- The largest source of visibility constituents are area sources and natural fires accounting for over 60% of the emissions in Idaho.
- VOC's are the largest visibility constituent in Idaho, accounting for approximately 40% of the total emissions.
- SO2 accounts for less than 5% of Idaho's total visibility emissions.
- Mobile sources in Idaho currently account for approximately 50% of the overall NO_X emissions while point sources account for less than 10% of the total.
- Regionally, Idaho accounts for less than 10% of the SO2 and NO_X emissions compared to the surrounding states.
- Wyoming SO2 emissions account for approximately 30% of the regional emissions primarily due to EGU's.
- Regionally, VOC's are emitted in the largest quantities compared to other constituents.
- Based on source apportionment modeling results, "out of domain" sources account for a majority of the sulfate concentrations in most Class I Areas.

This information provides context for Idaho's Regional Haze Plan. It offers the reader a comparison of the contribution from Idaho in relation to others, and it summarizes the scope of impacts from Idaho on regional haze. This summary along with periodic review and update of emissions inventories will ensure reasonable and cost effective visibility control measures are developed.

These bulleted highlights of data collected for the plan also clarify that Idaho point sources are only a small fraction of overall statewide emission sources contributing to regional haze and are even a smaller fraction of regional and "out of domain" emission sources. Even more specifically, then, Riley boiler emissions from The Amalgamated Sugar Company LLC (TASCO) account for an even smaller fraction of the overall statewide and regional emissions.

Because of the small percentage of point source emissions, any additional emission controls on point sources cannot be reasonably anticipated to result in any improvement in visibility at any Class I Area. This is especially true for SO2 and/or NO_X emission controls for the Riley boiler at the TASCO Nampa facility required to address "modeled impacts" at Class I Areas located hundreds of miles upwind of the TASCO facility. Requiring costly emission controls on the TASCO Riley boiler and any other point source to address this level of contribution and based upon inaccurate model results simply does not follow good science, good government, nor common sense principles.

Finally, Idaho's Regional Haze Plan is out of step with current economic realities. During these extremely difficult economic times for both US industry and state/federal governments, resources need to be focused on high priorities, where improvements can be measured and observed. Regarding the visibility improvements urged by the federal Clean Air Act, the focus needs to be on emissions controls associated with improved forest management activities to reduce natural fires, mobile source emission reductions, and emissions reductions associated with regional power plants which clearly impact Class I Areas (out of domain vs. regional plants). The draft plan ignores these realities, ignores the relative contribution of Idaho emissions to the regional impacts in Class I areas, and proposes a path based upon acknowledged inaccuracies and errors. As drafted the plan is not approvable without additional work and further public review.

Response:

There are numerous ways to look at the emission inventory and summarize the data dependent upon the view point of the reader. DEQ has provided links to the various websites that contain the emission inventories and supporting documentation so the reader can make various comparisons. The charts TASCO provided will not change the Reasonable Progress Goals, Long Term Strategies or BART analysis and therefore are not include. The BART process relies upon whether an EPA approved model shows a BART eligible facility is causing or contributing to visibility impairment and not a percentage of a facility's emissions in comparison to other states etc. The BART modeling did demonstrate that Nampa TASCO facility had one boiler over the 1 deciview

threshold which required the facility to go through the 4 factor analysis to determine if emission controls are appropriate.

Chapter 7 Pollutants & Estimated Visibility Impairment in Idaho

TASCO Comment 3:

Light Extinction General Comment. Chapter 7 needs to clearly explain that all light extinction values (Mm^{-1}) are estimates based on the equation provided in Chapter 4 (see page 22). Light extinction bar charts labeled as "Monitoring Data" are inaccurate and misleading. Numerous variables and assumptions are required to calculate light extinction values including relative humidity estimates and pollutant concentrations from IMPROVE site samplers. Monitoring data only applies to the pollutant concentrations from the IMPROVE monitors. Please either: 1) For each bar chart with light extinction values, replace "Monitoring Data" with "Estimated Light Extinction Data" or; 2) Clearly explain throughout Section 7 that light extinction values are rough calculated estimates and not measured data.

In addition, visibility impacts throughout Chapter 7 are expressed as light extinction (inverse megameters) while Chapter 11 expresses visibility impacts as deciviews. All charts and data associated with calculated visibility impacts in each chapter should be consistent (either deciviews or Mm-1) so that the data can be easily compared and verified.

Response:

Several pages in section 4.2 provide an explanation on how IMPROVE monitoring data is used to calculate light extinction. The label at the top of the graphs in Chapter 7 identifies that the data used to calculate light extinction came from IMPROVE "monitoring data" as apposed to "modeled" concentrations.

The Federal Regional Haze rule (40 CFR 51.308(d)(1) and 308(d)(2)) requires "reasonable progress goals," as well as "Baseline and Natural Conditions" to be express in deciview. The monitoring and modeling out puts are expressed as inverse megameters. To avoid rounding errors and other conversion issues, unless expressly required by Regional Haze Rule, light extinction should be expressed in inverse megameters.

TASCO Comment 4:

Pg 48 Figure 7-11. Hells Canyon Wilderness 20% Worst Days. This pie chart is not accurate and does not properly reflect the magnitude of each calculated light extinction constituent in Figure 7-13. For example, the chart does not properly show that the calculated light extinction for NO3 is 50% of the total. There are also errors with the other calculated constituents. Please correct.

Repsonse:

Figure 7-11 has been corrected so each slices of the pie chart is in better proportion to the percent of the pollutants impacting visibility.

Chapter 8 Emissions Source Inventory

TASCO Comment 5:

Pg. 71 General Comment. For SO2 and NO_X, there are inconsistencies between the data provided in Chapter 8 and source apportionment predicted modeling results in Chapter 9. For example, throughout Section 9 many if not all of the future modeled impacts have not been adjusted for: 1) SO2 controls installed on the rotary kiln at the P4 Production facility in Caribou County and; 2) The elimination of emissions from a 500 MW electric generating unit which was never built in Jerome County. For the Idaho Statewide Inventory, Chapter 8 needs to clearly identify both the actual reductions and those reductions which were modeled in Section 9.

Response:

This very issue is both identified and dealt with throughout the document using a weight of evidence approach to resolve issues caused by using different assumptions for the emissions inventories which are the backbone of the models. See Craters of the Moon National Monument in section 9.2 as just one example how WEP analysis and refined emissions inventory are used to build the weight of evidence that Idaho projects reductions in SO_x contributions.

TASCO Comment 6:

Pg 78 Summary of Idaho Statewide Emissions. At the end of Section 8.1, a new section should be added to the report which summarizes the overall emissions contribution from each visibility constituent and source category for the baseline year and future projections. Summaries of the Idaho Statewide data are provided in Attachment A. Also include a narrative discussion of the data.

Response:

This information is already in summary form included in the bar charts shown in Tables 8-9 through 8-16.

TASCO Comment 7:

Pg 86 Summary of Regional Emissions Sources. In addition to the bar chart data for each state, summary tables of the emissions table would be beneficial for the report. This data will help the public to better understand the magnitude of emissions from each state. Attachment B provides this data. Please add this summary to the report. Also, regional ammonia emissions is missing from the report.

Response:

The Ammonia Emissions inventory is provided in Table 8-16. Also see response to comment 6.

TASCO Comment 8:

Other Emissions Data. Source apportionment projections throughout Section 9 include emissions data from other regional planning organizations (CENRAP, Eastern U.S., etc.), countries (Canada, Mexico) and outside the domain. As shown, model projections suggest that SO2 emissions from outside the domain significantly impact the Class I Areas. Please provide a summary of the overall emissions estimates from these other regional sources and sources outside the domain.

Response:

Providing this information in this plan will not change the technical aspects of the plan such as the long term strategies, reasonable progress goals or BART analysis. This information is available on the WRAP Technical support website by clicking on "emissions and source apportionment, selecting a Class I area from the map and then clicking on "emissions data review" at the bottom of the page. The information is available by emission inventory, pollutant, state, Regional Planning Organization (and the states within the region) Canada, Mexico etc.

Chapter 9 Source Apportionment

TASCO Comment 9:

Pg. 88 Corrections to 2018 Emissions Inventory. The report states that due to inadequate funding, the 2018 emissions inventories will not be updated and erroneously include emissions from a 500MW coal fired Electric Generating Unit (EGU) which was never built. Therefore, future year emissions inventories and model predicted visibility impacts are inflated and not accurate. These errors should be corrected before the plan is submitted to EPA for approval.

Response:

Emission inventories were developed during the planning process that used planning assumptions that were appropriate at the time of the emission inventory development. As assumptions changed there was a need to explain the differences in the emissions and modeling which was done through the weight of evidence. See the response to comment 5.

TASCO Comment 10:

Pgs 90 thru 194 Sections 9.2 & 9.3 General Comment Source Apportionment Clarification. The report needs to clarify that source apportionment concentration data is based on modeling results and these predicted concentrations are only rough estimates. The current report language regarding visibility impacts for individual pollutants is misleading. For example in Section 9.2.1 it is stated that:

"The regional source contribution pie charts in Figure 9-1 show the WRAP states are only contributing a third of the calculated visibility impairment on the 20% worst days at Craters of the Moon."

This statement should be modified as follows:

"The regional source contribution pie charts in Figure 9-1, based on source apportionment modeling, suggest that the WRAP states are predicted to contribute a third of the calculated visibility impairment on the 20% worst days at Craters of the Moon."

Please provide these corrections or similar corrective language throughout Section 9.0.

Response:

Section 9.1 provides a three page overview of source apportionment and WEP modeling. The overview provides the reader an overview of what emission inventories are associated with the PSAT CAMx , CMAQ TSSA and WEP models as well as some of the shortcomings of the modeling and emission inventories. The reader is also provided with additional information resources at the bottom page 88. Because the reader has been adequately informed of where the information for source apportionment was derived, it is not misleading and there is no need to change the language.

TASCO Comment 11:

Pgs 90 thru 194 Predicted Modeling Impacts — Source Apportionments. PSAT predicted modeling results for sulfates and nitrates are expressed in terms of concentrations (pg/m^3) (for examples see Figures 9-1 and 9-8). However, for all other visibility constituent precursors (i.e., OC, EC, Fine PM, Coarse PM), predicted impacts are expressed as percentages and predicted concentrations are not provided. Please include the predicted concentration data for each of these constituents in the report. This data is needed to compare the predicted modeled results to actual measured concentrations at each Class I Area.

Response:

The WEP analysis results are presented as a percent of contribution based on the weighting of emission source strength and the residence time of an air mass over

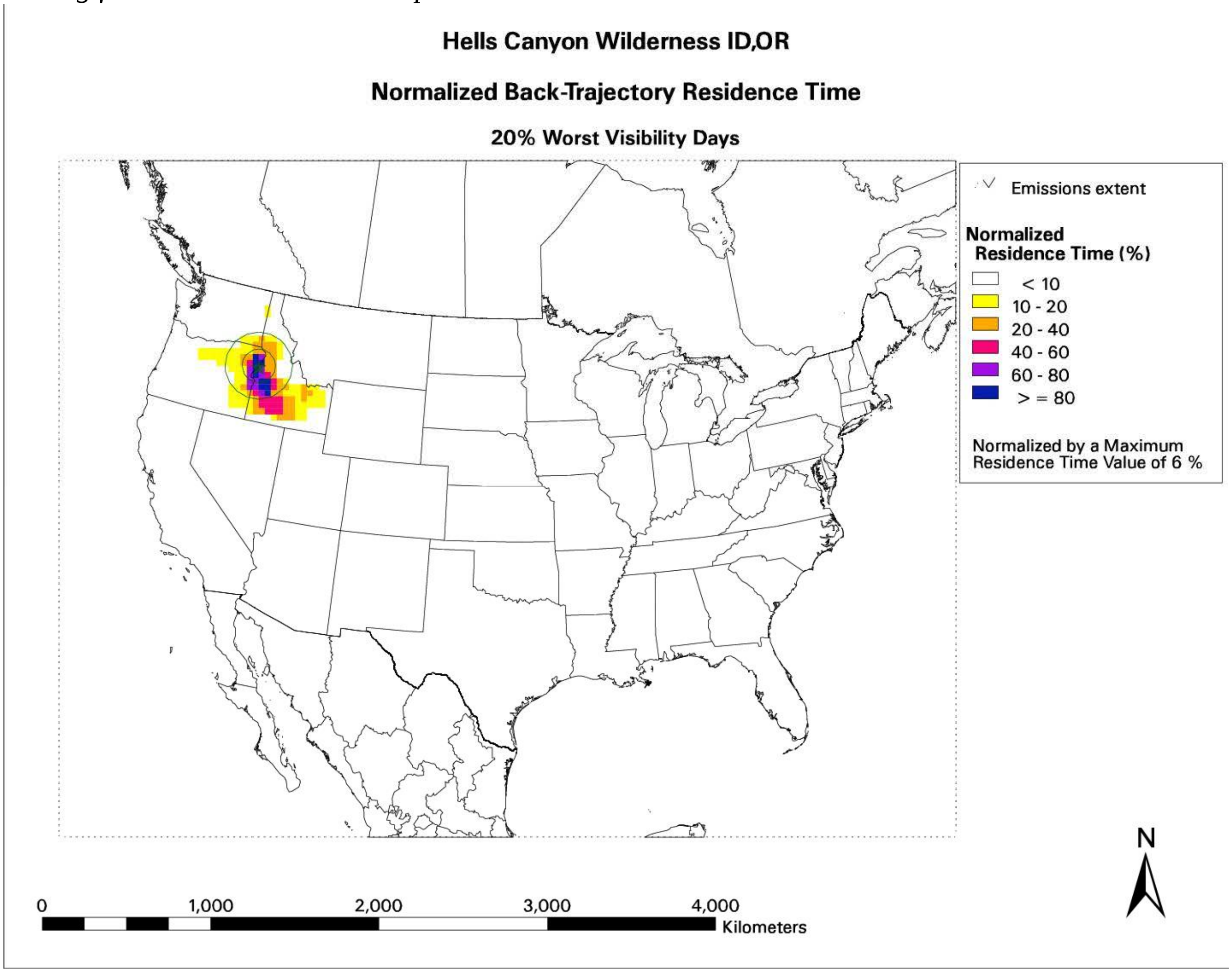
emission source and therefore concentration levels for the other pollutants cannot be provided.

TASCO Comment 12:

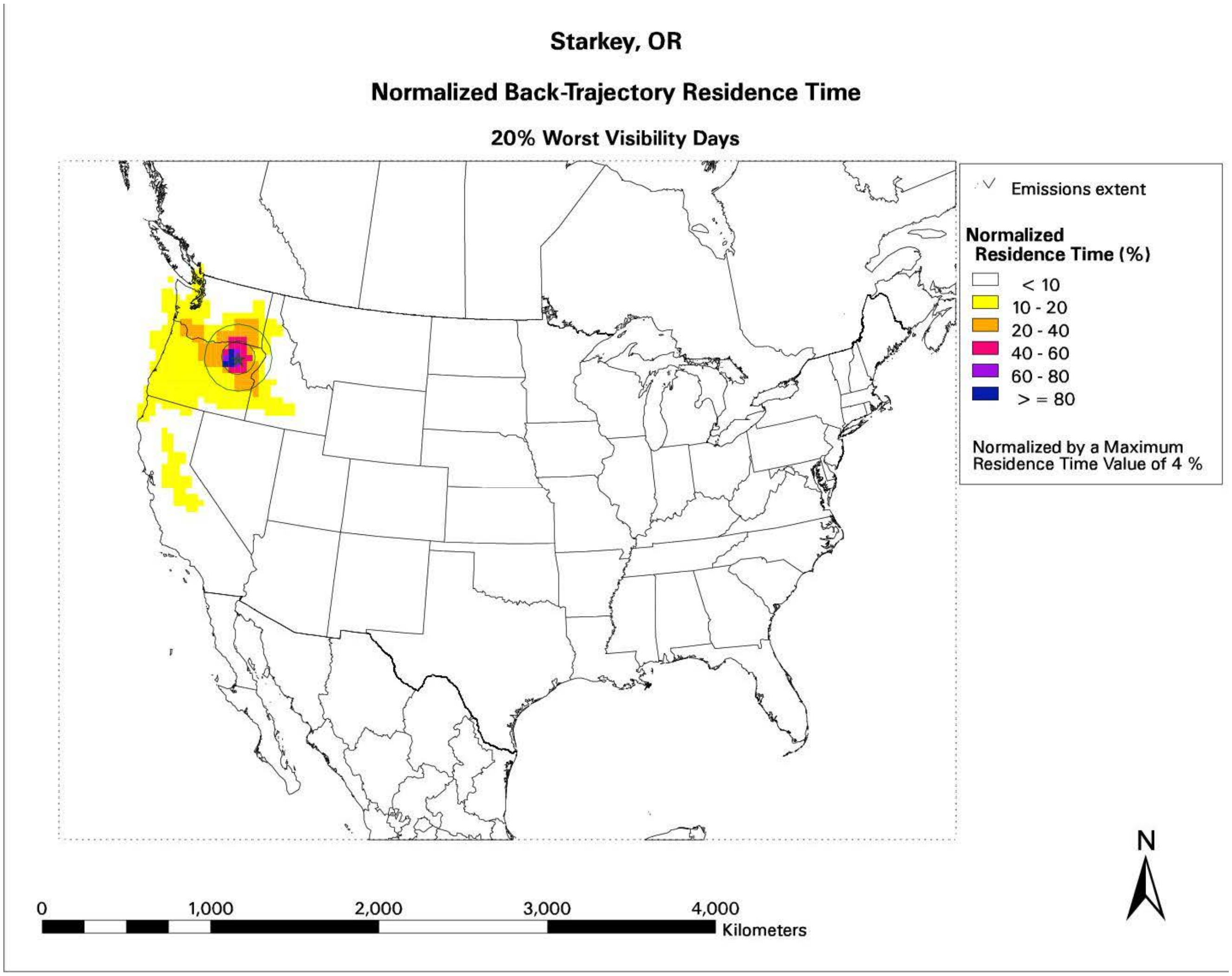
Pg 102 and 103 Hells Canyon WEP Predicted OC & EC Impacts Natural Fires. In Figures 9-21 and 9-23, during the 20 % worst days at Hells Canyon, WEP predicted OC and EC impacts are dominated by Idaho natural fires. Please explain why Idaho's downwind natural fire impacts are greater than upwind impacts from Oregon natural fires. For example, predicted OC & EC model impacts for the Eagle Cap Wilderness Area are dominated by Oregon fires with Idaho fires contributing only a small fraction.

Response:

The assumption that Idaho is always down wind of Hells Canyon is an incorrect assumption. The graphic below taken from the WRAP TSS website shows back trajectories of air masses during the worst 20% days at Hells Canyon are often coming from Idaho's Snake River plan.



In contrast, the back trajectory and residence time of air mass going to Eagle Cap Wilderness are spending more time over Oregon Source. See below.



Comment 13:

Also, predicted PSAT impacts for sulfate and nitrate (Figs. 9-17 and 9-18, respectively) indicate a much lower natural fire impact for the 20% worst days. Therefore, sulfate and nitrate predicted modeling results indicate the highest concentrations occur during the winter while OC & EC model predictions suggest that the highest impacts occur during the summer. Please explain.

Response:

DEQ can not respond to this comment because Figures 9-17 and 9-18 do not show seasonal variations.

Comment 14:

Pg. 109 Figure 9-31. Nitrate Concentrations at Sawtooth 20% Worst Days. The bar charts regarding predicted nitrate concentrations for the 20% Worst Days and 20% Best Days appears to be incorrect. The "y axis" predicted concentration ranges for the 20% Best Days, appear to be higher than the 20% Worst Days. Please correct.

Response:

These figures are correct. The 20% worst days are dominated by organic carbon from fire with only a small portion coming from NOx. See figures 7-20 and 7-28.

TASCO Comment 15:

Pg. 114 Selway-Bitterroot Predicted Sulfate Impacts (Fig. 9-41). Please explain why natural fires in Idaho are the largest contributor of predicted sulfate concentrations at the Selway-Bitterroot Wilderness Area. Idaho's contributions are significantly greater than any other state. In addition, generally natural fires are not considered to be a significant source of sulfates. Please also explain.

Response:

Although the bars representing Idaho's contribution to Sulfate concentrations at Selway-Bitterroot are large in comparison to other states the actual concentration is very low. Since the concentration levels are very low, even a very small amount of sulfate coming from fire ends up showing as a large contribution to the overall impact.

TASCO comment 16:

Pg.122 Yellowstone National Park Predicted Sulfate Impacts (Figs. 9-53 & 9-55). As discussed in the draft report, predicted PSAT modeling results for sulfates include inaccurate and severely inflated future year SO2 emissions estimates. Future SO2 emissions inventories do not account for emissions reductions associated with 2005 SO2 controls at the P4 Production facility (see pg 228). In addition, the once anticipated EGU in Jerome County was never built. However, future year emissions inventories inaccurately include the emissions from the EGU. It is critical that the source apportionment modeling be updated with 10,000 tons/year less SO2 emissions. The SIP is critically flawed without these updates. Please discuss.

In addition, please discuss whether overly inflated SO2 emissions (and NO_x for the Jerome EGU) were utilized for source apportionment modeling for all other Class I Areas included in IDEQ's Draft Regional Haze Plan.

Response:

See response to comment 5 and 9.

TASCO Comment 17:

Pg.125 Nitrate Concentrations at Yellowstone. Predicted nitrate concentrations in Figures 9-57 and 9-58 appear to be switched. Please correct and check all predicted nitrate concentrations for all Class I Areas.

Response:

These results are correct. See figures 7-42 and 7-50 for an explanation similar to response to comment14.

TASCO Comment 18:

Pg.134 Glacier Park. Please explain why WEP modeling does not include data for Wyoming.

Response:

The Regional Haze SIP available on DEQ's website for "public comment" includes Wyoming in the WEP analysis for Glacier National Park.

TASCO Comment 19:

Pg.179 Eagle Cap Wilderness Predicted Sulfate Concentrations. Please explain the major differences in the predicted modeling results for sulfates for the 20% worst days between Eagle Cap and Hells Canyon. State contributions are significantly different between these 2 areas. Hells Canyon model predicted results appear to be overly inflated and in error.

Response:

There are numerous variables that cause changes in concentrations of visibility impairing pollutants at class I areas including: elevation, humidity, source strength of those sources contribution, meteorology (wind direction, air stagnation conditions) temperature etc. The response to comment 12 is only one of the issues playing a part in the difference in concentrations at Hells Canyon Wilderness verse Eagle Cap Wilderness.

TASCO Comment 20:

Pg.181 Eagle Cap Wilderness Predicted Nitrate Concentrations. Please explain why the Idaho's contributions for nitrate (Fig. 9-146) and sulfate (Fig. 9-144) are so much different for the Worst 20% Days.

Response:

During the Best 20% days at Eagle Cap Wilderness, the air mass is spending less time over Idaho's strong nitrate emission sources.

TASCO Comment 21:

Pg.199 Hells Canyon Projected Visibility on 20% Worst Days. As described in Section 9.3, RPG's for Hells Canyon are set by Oregon. This information is unnecessary for Idaho's draft plan since Oregon has jurisdiction over this area.

Response:

As pointed out in section 9.1, the Regional Haze Rule (40 CFR 51.308(d)(d)), "Where the State has emissions that are reasonably anticipated to contribute to visibility impairment in any mandatory Class I Federal area located in another State or States, the State must consult with the other State(s) in order to develop coordinated emission management strategies." Chapter 9 includes Class I areas outside of Idaho in an effort to demonstrate Idaho's long term strategies are improving visibility.

Chapter 10 Best Available Retrofit Technology (BART) Evaluation

TASCO Comment 22:

Pg.214 Section 10.2 BART — Eligible Sources Step 3. Language in Step 3 is not consistent with Appendix Y to Part 51 requirements. The phrase, "The following are definitely visibility impairing pollutants:" is not included in Appendix Y. Please replace with the following language included in Section II.3.of Appendix Y, "Visibility impairing pollutants include the following:"

Response:

The language has been changed.

TASCO Comment 23:

Pg.222 Section 10.3.2 CALPUFF Modeling Results. Modeling results for the P4 Production facility in Caribou County appear to be mistakenly left out of Section 10.3.2. Please add the P4 modeling results to this table.

Response:

As stated on page 22, “Monsanto/P4 Production did not go through the subject-to-BART determination process because the facility had recently undertaken a Best Available Control Technology (BACT) analysis and it was believed the “Best” BART control technologies had been installed during this process. DEQ and P4 agreed to move directly to the BART determination process.”

TASCO Comment 24:

Pg.222 Section 10.4 BART Control Determination Process. — Further clarification of the applicability of Appendix Y is recommended in the draft report. Please replace the last sentence on page 222 with the following: "EPA requires each state to follow Appendix Y guidelines for large electric utility generating facilities (EGU's) with capacities of 750 MW's (megawatts) or greater. EPA does not require states to use the guidelines for other sources. Nonetheless IDEQ followed the Appendix Y guidelines for Idaho BART sources, even though the guidelines are not designed for industrial sources."

For example, and as previously discussed with IDEQ, Appendix Y guidelines are not appropriate for grower-owned sugar beet processing facilities with small industrial boilers. Fuel usage rates and emissions from EGU's are orders of magnitude greater than small industrial boilers. Most importantly, significant capital expenditures for EGU's can be passed on to customers through rate increases approved by public utility commissions.

Beet sugar production economics are completely different than EGU's. As a result, these guidelines and specifically Appendix Y cost of compliance recommendations are not appropriate for small industrial boilers at any sugar beet processing facility.

Response:

States are required to use Appendix Y for EGU’s and encouraged by EPA to use it for other sources. During negotiated rule making which TASCO participated in was decided to not include Appendix Y in the Idaho’s Regional Haze Rule but instead follow it as “guidance” which is what the state has done.

TASCO Comment 25:

Pg. 223 Section 10.5.1 TASCO NO Controls. The cost of the 2006 steam pulp dryer project was $20.1 million. Please add to the report. Also, the second sentence is inaccurate and should be changed as follows: "Pulp drying typically occurs during the fall and winter months. Predicted modeling results suggest that the 20% worst days at Class I Areas are 100 miles upwind of the TASCO facility occur during the winter months."

Response:

Since the costs associated with the steam pulp dryers occurred before the BART process, the costs can not be included as part of the incremental cost increases. During air stagnation periods the Nampa TASCO facility is actually upwind of Eagle Cap Wilderness and Hells Canyon. No change to the language is necessary.

TASCO Comment 26:

Pg. 224 Section 10.5 TASCO BART Determination. Section 10.5 is not complete and does not entirely reflect TASCO/IDEQ discussions and correspondence since TASCO's original BART determination was submitted on November 20, 2007 and updated on February 6, 2009. TASCO's affordability analysis (incorrectly referenced as financial hardship in the draft regional haze plan) is only one of many of the components for a BART determination. TASCO's primary concern is that IDEQ mandated BART controls for the Riley boiler will not result in any "degree of improvement and visibility which may reasonably be anticipated" or measurable visibility improvements at any Class I area. TASCO has continually questioned CALPUFF modeling results for predicted impacts at Class I Areas over 100 miles upwind of the TASCO Nampa facility (Hells Canyon, Eagle Cap and Strawberry Mountain Wilderness Areas). TASCO has expressed concern about the agency's reliance upon conservative dispersion modeling as the sole basis for its BART applicability determination for this relatively small industrial source.

TASCO's concerns are well founded based upon past experience with inaccurate air dispersion modeling relied upon by IDEQ that led to a significant capital expenditure at TASCO's Nampa facility. In support of the Treasure Valley PM10 Maintenance Plan published in 2002, DEQ relied upon PM10 modeling analyses for the Nampa facility which over predicted ambient PM_{10} concentrations attributable to the plant. DEQ modeled a predicted value of 354 fag/m^3 then added an estimated background concentration of 90pg/m^3 for an estimated impact of 444 pg/m^3 from the Nampa facility. This value was above the applicable National Ambient Air Quality Standard of 150 pg/m^3 and DEQ required to TASCO to reduce emissions at a significant cost. During the interim period when the coal-fired rotary drum pulp dryers were operating, (2004 and 2005) actual $PM_1$0 concentrations measured by a DEQ approved monitor located at the Nampa facility fence line averaged only 22 pg/m^3- twenty times less than the value predicted by modeling — and proving the model to be grossly inaccurate. Notably, monitored pg/m^3 concentrations did not materially change after the installation of the pulp steam dryer and shutdown of the rotary pulp drum dryers.

Response:

DEQ used CALPUFF (EPA's recommended model for BART model) and for consistency followed a three state modeling protocol developed for Washington, Oregon and Idaho with input from EPA and Federal Land Managers. The CALPUFF modeling does show visibility improvements based upon the installation of BART controls.

The plan was changed to reflect TASCO's affordability analysis. See section 10.5.

TASCO Comment 27:

In addition, on numerous occasions TASCO provided to IDEQ, several BART alternatives which result in greater overall emissions reductions than IDEQ' s Riley boiler BART determination. In addition to the pulp steam dryer project discussed below, TASCO has also requested that IDEQ consider as an additional BART alternative emissions reductions associated with the 2005 termination of sugar beet processing at the Nyssa facility. The termination of these activities at the Nyssa facility provides significant emissions reductions and additional air quality benefits because the facility is approximately 27 miles closer to the Eagle Cap, Hells Canyon and Strawberry Mountain Wilderness areas where the CALPUFF model predicted the highest impacts. States can approve alternative BART control measures in accordance with 40 CFR 51.308(e) requirements. TASCO's proposed BART alternative of the combination of the shutdown of the Nampa pulp dryers along with the termination of beet processing at the Nyssa facility provides emissions reduction greater than IDEQ's determination for the Riley. These alternatives reduce PM10, SO2 and NO_x emissions by over 140%. A detailed discussion of these alternatives was submitted to IDEQ on November 18, 2009 (Supplemental Information — Riley BART Determination). It remains unclear why IDEQ rejected consideration of these emission reductions.

Supporting documentation for additional concerns raised by TASCO regarding IDEQ's BART determination for the Riley boiler are detailed in several written submittals to IDEQ. TASCO's most recent comments to IDEQ were submitted on May 19, 2010 as part of TASCO's review of the draft Tier II BART Operating Permit for the Riley boiler.

Section 10 of the draft plan further omits discussion of obligations imposed by Idaho's rules for development of a regional haze plan. The rules adopted at IDAPA 58.01.01.665-668 afford IDEQ substantial discretion in development of a reasonable long-term strategy for regional haze. These rules require the Department to consider multiple factors and to coordinate with neighboring states to develop a reasonable plan. The draft permit issued by IDEQ to TASCO requires approximately $18,000,000 in emissions controls for the TASCO Riley Boiler that may not achieve any improvement to visibility, according to IDEQ's evaluation. The evaluation omitted consideration and interstate coordination prescribed by the regional haze rules and is unreasonable.

First, IDEQ observes that the highest impacts from TASCO's Nampa boiler are predicted to occur at Eagle Cap Wilderness (high impacts are also predicted to occur at the Strawberry Mountain and Hells Canyon Wilderness Areas) in Oregon. IDEQ states that "although Eagle Cap Wilderness is outside of Idaho, the regional haze rule requires that state to address impacts in other states." This is not a completely accurate description of the regional haze rule requirement for interstate impacts. Under IDAPA 58.01.01.677, the Department is to develop a long-term strategy that addresses regional haze within the state and for areas outside the state that may be affected by emissions from the state. Specific requirements for development of the long-term strategy include consideration of

the following factors, at a minimum: emissions reductions due to ongoing air pollution programs; source retirement replacement schedules; enforceability of emissions limitations and control measures. (IDAPA 58.01.01.667. 03(c)). Specific provisions for development of the long-term strategy also require interstate coordination with other states to develop coordinated emission management strategies "where Idaho has emissions that are reasonable anticipated to contribute to visibility impairment" in an area located in another state.

Response:

As taken from a letter to Joe Huff (Vice President of Operations and Chief Operations Officer of Amalgamated Sugar) from Martin Bauer (DEQ Administrator of Air Quality Division) on April 1, 2010,

> *"While DEQ agrees with TASCO that the emission reductions from the Nyssa plan improved visibility in several Class I areas, Idaho cannot take credit for these reductions. These reductions have already been credited in the Oregon Regional Haze State Implementation Plan, and Idaho has no mechanism to trade emissions or procedures to enforce control on Oregon facilities as would be required under 40CFR51.308(e)(2)(iii). Idaho would be required to provide a state enforceable condition or permit in our State Implementation Plan to limit the Nyssa, Oregon facility, which Idaho doesn't have the jurisdiction to do."*

During the negotiated rule making for the IDAPA Regional Haze Rules referenced above, DEQ promoted the idea of joining several other WRAP states in a back stop trading program instead of BART. The trading program would have satisfied both Idaho and Federal Regional Haze requirements by setting emission reduction goals for each state and the trading program would only be initiated if the state emission reduction goals were not met. TASCO along with the other facilities involved in the negotiated rule making process decided they didn't want to participate in the program because of the extensive monitoring and reporting requirements.

Also see response to TASCO comment 30 concerning interstate coordination.

TASCO Comment 29:

IDEQ failed to conform to the requirements in developing the BART portion of the long-term strategy set forth in Section 10 of the Regional Haze Plan. While IDEQ acknowledges that "the shutdown of the old pulp dryers has provided more visibility improvement than low NO_X burners (LNB) would and nearly the improvement that would be expected from LNB with over-fire-air (LNB w/OFA)," IDEQ nevertheless imposed more emissions controls. These source retirement commitments, now reflected in the Tier II permit issued to TASCO on September 7, 2010 are sufficient

NO_X control, according to IDEQ's own evaluation. Consideration of the permanent shutdown is consistent with the factors presented in IDAPA 58.01.01.677.03(c).

Response:

TASCO provided a BART determination to DEQ which claimed selective catalytic reduction (SCR) was a “technically feasible” option for TASCO.

DEQ has given credit to TASCO if they wish to take it and install low NOx burners with over-fire-air LNB w/OFA) or they may install SCR.

TASCO Comment 30:

IDEQ further failed to conform to the requirements in developing the BART portion of the long-term strategy set forth in Section 10 of the Regional Haze Plan by omitting coordination with the State of Oregon. The "best" BART recommendation presented by IDEQ in Section 10.5 appears to ignore the need to coordinate with Oregon despite IDEQ's emphasis on predicted impacts in Eagle Cap, Strawberry Mountain and Hells Canyon Wilderness areas located in Oregon. IDEQ is required to consult and coordinate on development of an emissions management strategy under IDAPA 58.01.01.667.04. Specifically, the termination of sugar beet processing activities at the TASCO factory in Nyssa, Oregon was overlooked by both Oregon and Idaho in development of a long-term strategy and the impacts of these significant emissions reductions were excluded from any coordinated emissions management strategy, as required by IDAPA.

Response:

DEQ has been heavily involved in consultation with Oregon and other states through the WRAP process. See Appendix B for a complete list of meetings and participants.

Also see response to TACO comment 28 concerning emission credit for the shut-down of the Nyssa facility.

TASCO Comment 31:

Under IDAPA 58.01.01.668.02(c)(v) IDEQ is required to consider the degree of improvement in visibility which may reasonably be anticipated to result from the use of BART imposed on TASCO. TASCO urges IDEQ to reconsider the degree of improvement that may reasonably be anticipated to result from the shutdown of pulp dryers in Nampa and the termination of sugar beet processing at the factory in Nyssa, and conclude that these measures are sufficient to achieve the BART portion of a long-term strategy for TASCO. Given IDEQ's statements regarding NO„ and SO2 emissions sources from Idaho, this approach can be supported in the final plan.

Response:

See response to comments 28 and 29.

TASCO comment 32

<u>224 Section 10.5.1 TASCO NO„ Controls.</u> The first sentence of the second paragraph regarding the economics of shutting down the old pulp dryers is misleading and inaccurate. The capital cost of the pulp steam dryer was $20.1 million. As noted above, this significant environmental improvement project was required because of inaccurate air dispersion modeling as part of IDEQ's 2002 Treasure Valley PM_{10} Maintenance Plan. Even though there are some operating cost savings due to reduced fuel usage rates, these savings only pay for the lease payment for the $20.1 million capital expenditure for the pulp steam dryer.

As discussed above, TASCO has previously requested that IDEQ consider emissions reductions associated with the 2005 shutdown of the Nyssa facility. Equivalent emission control costs for the Riley boiler associated with the Nyssa facility emissions reductions have not been quantified. However, based on a rough estimate the equivalent capital costs for these SO2 and NO_x emissions reductions are well above $30 million (based on dry flue gas desulfurization and selective catalytic reduction emissions controls).

Response:

See response comments 28 and 29.

TASCO comment 33

<u>Pg. 231 Section 10.8 Visibility Improvements.</u> Visibility improvements in Tables 10.14 for P4 Production and Table 10.15 for the TASCO Riley boiler are expressed utilizing different formats. Predicted visibility improvements in each table should be expressed using similar methodologies. Attachment C provides a summary of P4 Production facility and TASCO Riley boiler predicted modeling results expressed as: 1) Improvement in Highest Delta-Deciview Values and Reduction in Days 0.5 DV for Individual and 3-Year Improvement and 2) Delta-Deciview Value larger than 0.5 from one-year period.

The tables need to be included for each facility. Where necessary, please add these tables to the report. For the P4 Production facility, predicted CALPUFF modeling results in Attachment C were copied from IDEQ's April 2010 and June 2010 Draft Regional Haze Plans. It's unclear why the data changed in each of IDEQ's drafts. The most representative data needs to be included in the final plan.

Response:

As previously mentioned, P4 installed "Best" of BART so there is no need to include the visibility improvements at Class I areas with 300 km based on several technology scenarios. A different format was needed to portray the reductions from the pulp dryers.