Chapter Two – Baseline and Natural Visibility Conditions and Uniform Rate of Progress

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2.1 INTRODUCTION

The goal of the Regional Haze Rule (RHR)(64 FR 35714) is the restoration of natural visibility conditions in the 156 mandatory Class I areas identified pursuant to the 1977 Clean Air Act Amendments. Federal visibility regulations detail how to establish goals to restore visibility to natural conditions by the year 2064 for the Class I areas. These regulations also require states to calculate baseline, current, and natural visibility conditions, which in turn are used to calculate the uniform rate of progress per year to achieve natural conditions by 2064.

Natural visibility is determined by estimating the natural concentrations of visibility impairing pollutants and then calculating total light extinction. Baseline visibility is the starting point for the improvement of visibility conditions. The baseline for this regional haze state implementation plan (SIP) is the years 2000 through 2004. Current conditions are assessed every five years as part of the SIP review, where actual progress in reducing visibility impairment is compared to the reductions committed to in the SIP.

The baseline and current visibility conditions for the Jarbidge Wilderness Area are based on measurements of particulate air pollution at the JARB1 Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring site, as discussed in Chapter One. The revised IMPROVE algorithm was used to calculate the Haze Index for the Jarbidge Wilderness Area.

This chapter presents and interprets the IMPROVE monitoring data to identify the role of individual components in visibility impairment at JARB1. The following chapters will present and interpret the emissions data and modeling results that, with this chapter, are the technical basis for determining Nevada's reasonable progress. The following paragraphs present a synopsis of the analyses of the IMPROVE monitoring data.

Analyses of the JARB1 monitor data have identified a baseline visibility condition of 12.07 deciviews (dv) and natural visibility conditions of 7.87 dv for the 20 percent worst days. The comparison of the initial baseline conditions to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064. The uniform rate of progress glidepath indicates a uniform rate of progress value of 11.09 dv for 2018 worst days leading to restoration of natural visibility conditions by 2064.

Organic matter carbon and elemental carbon extinction account for more than 45 percent of the total average annual reconstructed extinction at the JARB1 monitor for the 20 percent worst days of the baseline. In addition, coarse and fine particle mass extinction account for an additional 30 percent of the average annual extinction at JARB1. Approximately 20 percent of the annual extinction budget is due to the formation of ammonium sulfate and ammonium nitrate due to emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) from predominantly anthropogenic sources. These conclusions support the observations of Nevada Division of Environmental Protection (NDEP) staff, presented in Chapter One, regarding the significant contribution of windblown dust and natural fire emissions to visibility impairment at the Jarbidge Wilderness Area.

2.2 BASELINE CONDITIONS FOR THE JARBIDGE WILDERNESS AREA

Baseline visibility is the annual average of the on-site IMPROVE monitoring data for the least-impaired days (i.e. the 20 percent best days or "best days") and most impaired days (i.e. the 20 percent worst days or "worst days") for the years 2000 through 2004, as specified in 40 CFR 51.308(d)(2)(i). Baseline visibility is equivalent to current visibility conditions for this initial review period and is the reference point against which visibility improvement is tracked.

Nevada has established baseline visibility conditions for the best and worst visibility days at the Jarbidge Wilderness Area using data from IMPROVE monitor JARB1. The average was calculated for the years 2000 through 2004 (the 2000 data is invalid for JARB1 as it fails to meet USEPA's data completeness criteria) for the best and worst days. The baseline calculations were made in accordance with 40 CFR 51.308(d)(2) and USEPA's *Guidance for Tracking Progress Under the Regional Haze Rule* (EPA-454/B-03-004, September 2003).

The baseline conditions are the average of the annual haze index calculated from the IMPROVE monitor data over the five-year baseline period 2000 through 2004 for both the 20 percent worst (12.07 dv) and 20 percent best (2.56 dv) days. Figures 2-1 and 2-2 are photographs of reference vistas representative of baseline extinction conditions for the best and worst days, respectively, at the Jarbidge Wilderness Area.

2.3 NATURAL CONDITIONS FOR THE JARBIDGE WILDERNESS AREA

Natural visibility represents the visibility condition that would be observed in the absence of human-caused impairment. The natural condition for each Class I area represents the visibility goal expressed in deciviews for the 20 percent worst and the 20 percent best days that would exist if there were only naturally occurring impairment. The 20 percent worst days natural conditions correspond to the long-term natural visibility goal to be reached by 2064. 40 CFR 51.308(d)(1) Each state must estimate natural visibility levels for Class I areas within its borders in consultation with federal land managers (FLMs) and other states. 40 CFR 51.308(d)(2)

Natural background visibility is based on annual average concentrations of fine particle components. The natural conditions estimates were calculated consistent with USEPA's *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (EPA-454/B-03-005, September 2003). The natural background visibility for Jarbidge is 7.87 dv for the 20 percent worst days and 1.14 dv for the 20 percent best days.

Figures 2-3 and 2-4 are photographs of reference vistas representative of natural extinction conditions for the best and worst days at the Jarbidge Wilderness Area.

FIGURE 2-1

REFERENCE VISTA OF THE JARBIDGE WILDERNESS AREA
FOR BASELINE BEST DAYS

Reference Vista: Mary's River Peak

Photo taken at 3:00 pm

Haze Index (HI) = 3 deciview

B_{ext} = 13 Mm^{-1}

Visual Range = 300 km / 186 mi

FIGURE 2-2

REFERENCE VISTA OF THE JARBIDGE WILDERNESS AREA
FOR BASELINE WORST DAYS

Reference Vista: Mary's River Peak

Photo taken at 3:00 pm

Haze Index (HI) = 12 deciviews

B_{ext} = 33 Mm^{-1}

Visual Range = 120 km / 75 mi

FIGURE 2-3

REFERENCE VISTA OF THE JARBIDGE WILDERNESS AREA
FOR NATURAL CONDITIONS BEST DAYS

Reference Vista: Mary's River Peak

Photo taken at 9:00 am

Haze Index (HI) = 1 deciview

B_{ext} = 11 Mm^{-1}

Visual Range = 350 km / 218 mi

FIGURE 2-4

REFERENCE VISTA OF THE JARBIDGE WILDERNESS AREA
FOR NATURAL CONDITIONS WORST DAYS

Reference Vista: Mary's River Peak

Photo taken at 9:00 am

Haze Index (HI) = 8 deciviews

B_{ext} = 23 Mm^{-1}

Visual Range = 170 km / 106 mi

2.4 UNIFORM RATE OF PROGRESS GLIDEPATH TO NATURAL CONDITIONS IN 2064

Each state must set goals that provide for reasonable progress towards achieving natural visibility conditions by 2064. The reasonable progress goals must: 1) provide for improvement in visibility for the most impaired days over the period of the implementation plan; and 2) ensure no degradation in visibility for the least impaired days over the same period. States are directed to graphically show a uniform rate of progress (URP) toward natural visibility conditions for each Class I area within the State. The revised IMPROVE II algorithm was used for the calculation of the URP glidepath for the Jarbidge Wilderness Area.

A graph depicting the worst days glidepath for the Jarbidge Wilderness Area was developed in accordance with USEPA guidance for tracking progress (*Guidance for Setting Reasonable Progress Goals Under the Regional Haze Rule*, June 1, 2007), using data collected from the IMPROVE monitor JARB1. The glidepath is one of the indicators used to set reasonable progress goals and is simply a graph portraying a straight line drawn from the level of visibility impairment for the worst days baseline period to the natural background level with 2064 as the attainment date.

The URP is determined by the following equation, which calculates the slope of the glidepath in deciviews per year:

URP = (Baseline Condition – Natural Condition) / 60 years
URP = (12.07 dv – 7.87 dv) / 60 years
URP = 0.07 dv / year reduction

The uniform progress needed by 2018, the end of the first planning period, to achieve worst days natural visibility conditions by 2064 is calculated by multiplying the URP by the number of years in the first planning period (i.e. 2004 to 2018), as follows:

2018 URP = (URP) x (14 years)
2018 URP = 0.07 dv / year x 14 years
2018 URP = 0.98 dv reduction

Table 2-1 provides the URP data for the worst days and identifies the baseline for the best days. The baseline visibility for the 20 percent worst days at the Jarbidge Wilderness Area is calculated to be 12.07 dv. For the baseline 20 percent best days, visibility is calculated to be 2.56 dv. The URP glidepath is shown on Figure 2-5, which depicts the observed annual baseline visibility conditions by solid diamonds with the worst days baseline shown by the line through the solid diamonds. The glidepath for a URP toward reaching the goal of natural conditions is represented by the sloping line with the open triangles identifying the URP at five year intervals. Natural conditions for the worst days are shown by the horizontal line in the middle of the graph. The figure also shows the observed annual baseline conditions for the 20 percent best days by open diamonds with the baseline shown by the short line through the open diamonds. The reasonable progress goal must ensure no degradation in visibility for the best days over the planning period.

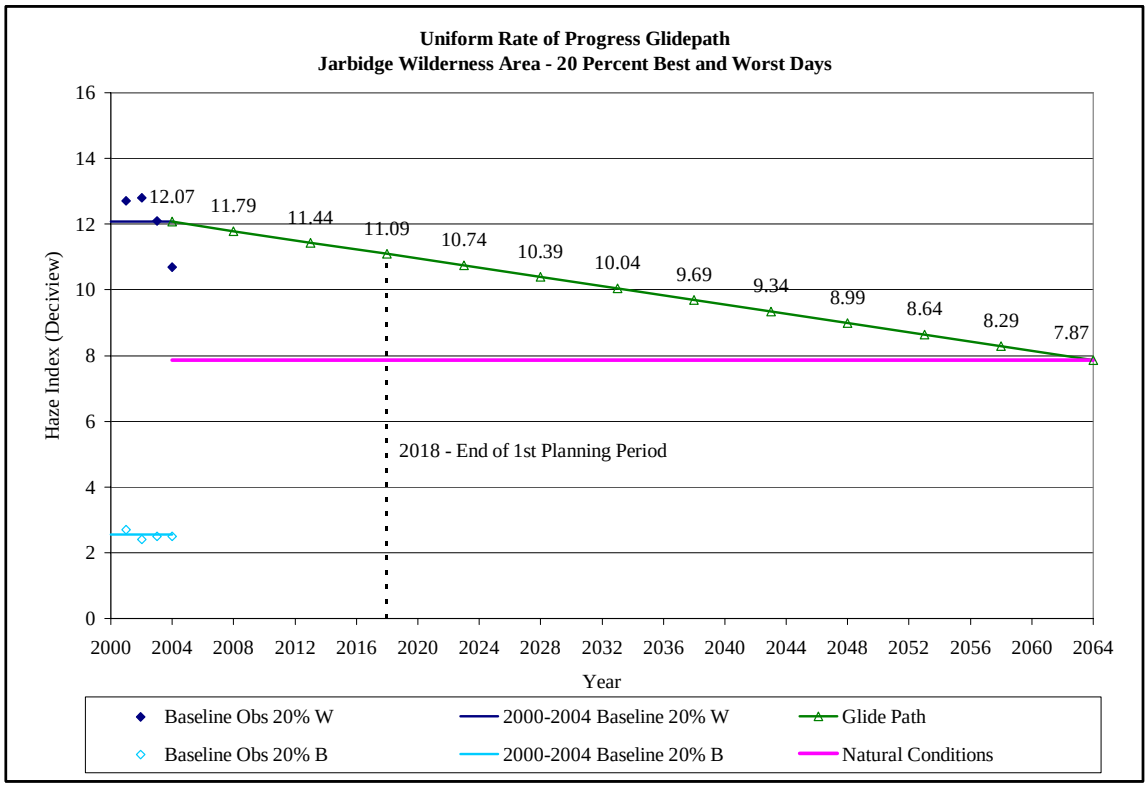
TABLE 2-1

UNIFORM RATE OF PROGRESS FOR THE
JARBIDGE WILDERNESS AREA

Class I Area	20% Worst Days Baseline Condition (dv)	20% Worst Days 2018 Uniform Progress Goal (dv)	2018 Reduction Needed for 20% Worst Days (dv)	20% Worst Days 2064 Natural Conditions (dv)	2064 Reduction Needed for 20% Worst Days (dv)	20% Best Days Baseline Condition (dv)
Jarbidge Wilderness Area	12.07	11.09	0.98	7.87	4.20	2.56

FIGURE 2-5

UNIFORM RATE OF PROGRESS GLIDEPATH FOR THE
JARBIDGE WILDERNESS AREA



2.5 HAZE IMPACTING PARTICLES – BASELINE PERIOD

Some of the fine particles that compose aerosols absorb light, while others reflect or scatter light, resulting in light extinction between the viewer and the light source. The IMPROVE monitor

collects a 24-hour sample of these particles onto a filter, and they are analyzed at a laboratory to determine the standard components of the aerosol extinction.

Monitored Components

The monitored concentrations of PM_{10} are divided into six major components, the first five of which are assumed to be $PM_{2.5}$ and the sixth is $PM_{2.5-10}$. The monitored species are listed below by identifier with the common name in parenthesis.

- SO_4 (sulfate)
- NO_3 (particulate nitrate)
- OC (organic carbon)
- EC (elemental carbon)
- OF (other fine particulate or soil)
- CM (coarse matter)

The concentrations of these species are used in conjunction with the IMPROVE equation to calculate the light extinction.

Emission Species

The statewide emission inventory of pollutants that were used in the emission scenarios for this SIP include:

- SO_2 (Sulfur dioxide)
- SO_x (Sulfur oxides)
- NO_x (Nitrogen oxides)
- POA (Primary organic aerosol)
- EC (Elemental carbon)
- PMF (Particulate matter fine)
- PMC (Particulate matter coarse)
- NH_3 (Ammonia)

The baseline emissions and emission projections are discussed in detail in Chapter Three.

Extinction Species

Visibility conditions are then estimated by relating the IMPROVE 24-hour average PM mass measurements (i.e. concentration data for the species listed above) to the PM components of light extinction as identified in the IMPROVE equation. The extinction components are listed below. The bold text indicates how the monitored extinction components will be identified in the remainder of the SIP.

- Ammonium sulfate [$(NH_4)_2SO_4$] or $\mathbf{SO_4}$
- Particulate ammonium nitrate [$(NH_4)NO_3$] or $\mathbf{NO_3}$
- Organic matter carbon [**OMC**]
- Elemental carbon [**EC**]
- Fine soil [**SOIL**]
- Coarse matter [**CM**]
- **Sea Salt**

2.5.1 Aerosol Composition for the Jarbidge Wilderness Area

Analyses of the IMPROVE monitor data provides important insight to the relative importance of the components of measured visibility impairing pollutants. The monitoring data for the 20 percent worst, 20 percent best, and IMPROVE sample days were analyzed on an annual, monthly, and daily basis to evaluate the causes of visibility impairment during the baseline period.

2.5.1.1 Summary of Aerosol Composition

This section describes the aerosol composition observed at the JARB1 IMPROVE monitor during the baseline period. The following sections present the monitoring data for the 20 percent worst days, 20 percent best days, and all IMPROVE sample days.

Organic matter carbon (OMC) is the most important contributor to fine particulate mass and light extinction on the most impaired days and for all IMPROVE sample days. OMC is also a significant contributor on the least impaired days of the baseline period at JARB1. Elevated levels of OMC and EC and their seasonal signature suggest impact from fire and biogenic sources, which are significant natural sources of primary organic aerosol (POA) and volatile organic compounds (VOCs), components of OMC. Anthropogenic emissions contributing to OMC include carbon from combustion of fossil fuels and wood burning, but are not likely significant sources of OC emissions at this rural site. However significant visibility impacts due to OC emissions from natural fire events are common at the Jarbidge Wilderness Area and explain the large daily, seasonal, and annual variations of the reconstructed OMC extinction described in the next sections.

Coarse matter (CM) or particulate matter with particles having diameters between 2.5 and 10 microns is the second most important contributor to reconstructed extinction for the worst days of the baseline period. CM has a relatively small contribution to visibility impairment on the best days, but is a significant contributor to visibility impairment for IMPROVE sample days. The light extinction efficiency of CM is very low compared to the extinction efficiency for sulfate, nitrate, and carbon, as described in Chapter One. The significant CM contributions to reconstructed extinction suggest the seasonal importance of local and regional transport of particulate matter due to naturally occurring windblown dust events.

Ammonium sulfate (SO_4) or sulfate is an important contributor to visibility impairment at JARB1 for the worst days and IMPROVE sample days. SO_4 is the most significant contributor on the best days. Sulfate particles are formed in the atmosphere from SO_2 emissions. Sulfate particles occur as hydrogen sulfate, ammonium bisulfate and ammonium sulfate depending on the availability of ammonia in the atmosphere. Although SO_4 contributions show some seasonal increases during the summer months, the lack of daily variability suggests the sulfate contributions are influenced by regional transport rather than local sources.

Soil (SOIL) or particulate matter with particles having diameters less than 2.5 microns is a minor contributor to reconstructed extinction for the worst, best and IMPROVE sample days of the baseline period. Episodes of relatively high SOIL contribution coupled with relative high CM

contributions may be indicative of local and regional seasonal transport of particulate matter due to windblown dust events. Occasionally, elevated SOIL can be attributed to long-range transport of international dust episodes originating outside the US.

Elemental carbon (EC) is a minor contributor to visibility impairment at JARB1 for the worst, best and IMPROVE sample days of the baseline period. The light extinction efficiency of EC is high compared to the extinction efficiency for sulfate, nitrate and carbon, as described in Chapter One. Common sources of EC emissions are fire, including agricultural burning, prescribed fire, and natural fire, as well as incomplete combustion of fossil fuels. The seasonality and common trend shared with OMC extinction suggest fire emissions may also be the dominant source of EC extinction at JARB1.

Ammonium nitrate (NO_3) or nitrate is a minor contributor to reconstructed extinction for the worst, best and IMPROVE sample days of the baseline period at JARB1. However, NO_3 is a significant contributor for some individual days. NO_3 is formed in the atmosphere by the reaction of ammonia (NH_3) and nitrogen oxides (NO_x). NO_3 formation is limited by the availability of ammonia and temperature. Ammonia preferentially reacts with SO_2 and sulfate before reacting with NO_x. Particle nitrate is formed at lower temperatures, so NO_3 levels are lower in the summer months and higher in the winter months. Therefore the relative NO_3 contribution to visibility impairment is seasonal as identified below. NO_x emissions are the result of fossil fuel combustion by point, area, on-road, and off-road mobile sources. The relatively minor contribution of NO_3 to reconstructed extinction at JARB1 suggests that formation is limited by both the availability of ammonia and the paucity of NO_x sources in this rural setting.

Sea Salt (SEA SALT) is a trace contributor to reconstructed extinction at JARB1. The new IMPROVE equation uses the chlorine ion from routine IMPROVE measurements to calculate sea salt levels, accounting for the occasional contribution of SEA SALT to extinction at JARB1.

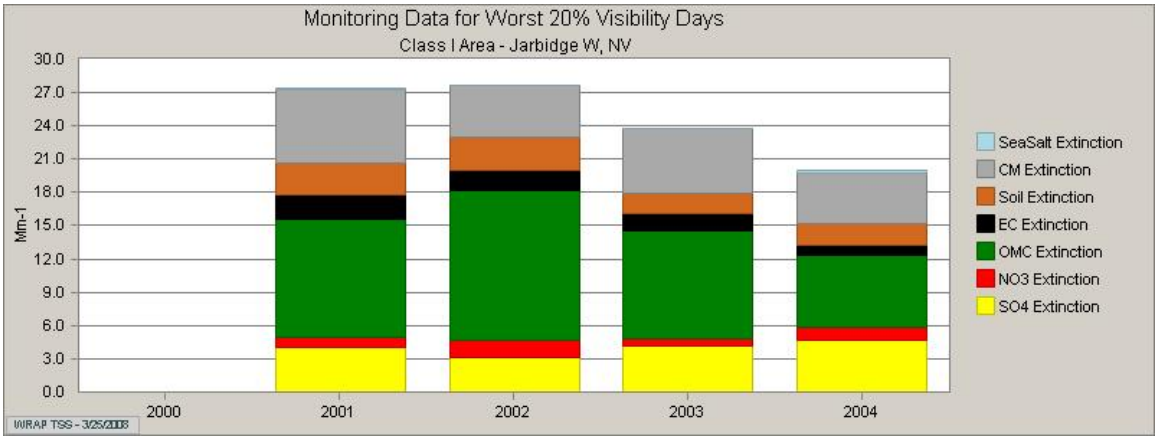
2.5.1.2 20 Percent Worst Days

Figure 2-6 shows the annual reconstructed light extinction over the baseline period based on monitor data from JARB1 site for the 20 percent worst days. The variability of annual worst days reconstructed light extinction is nearly 8 Mm^{-1}.

The line graph shown as Figure 2-7 shows the individual components of the reconstructed light extinction over the baseline period based on JARB1 IMPROVE data for the 20 percent worst days. OMC is the most significant contributor to visibility impairment at JARB1 for the baseline period, followed by CM and SO_4. SOIL, EC, and NO_3 are less significant but sub-equal contributors to visibility impairment for the baseline period.

FIGURE 2-6

ANNUAL RECONSTRUCTED EXTINCTION FOR WORST DAYS
OF THE BASELINE PERIOD



The baseline period annual variation for OMC is nearly 7 Mm^{-1}, indicating the large range of annual effects produced by fire emissions, one of the dominant sources of OMC. 2002 was a bad fire year in the western US, as reflected on Figure 2-7 by the OMC trend. The baseline period variation for CM is over 2 Mm^{-1}, suggesting the range of effects produced by emissions from localized wind events, especially during seasonal drought conditions. The remaining components show less variability during the baseline period.

FIGURE 2-7

ANNUAL RECONSTRUCTED EXTINCTION BY SPECIES FOR
WORST DAYS OF BASELINE PERIOD

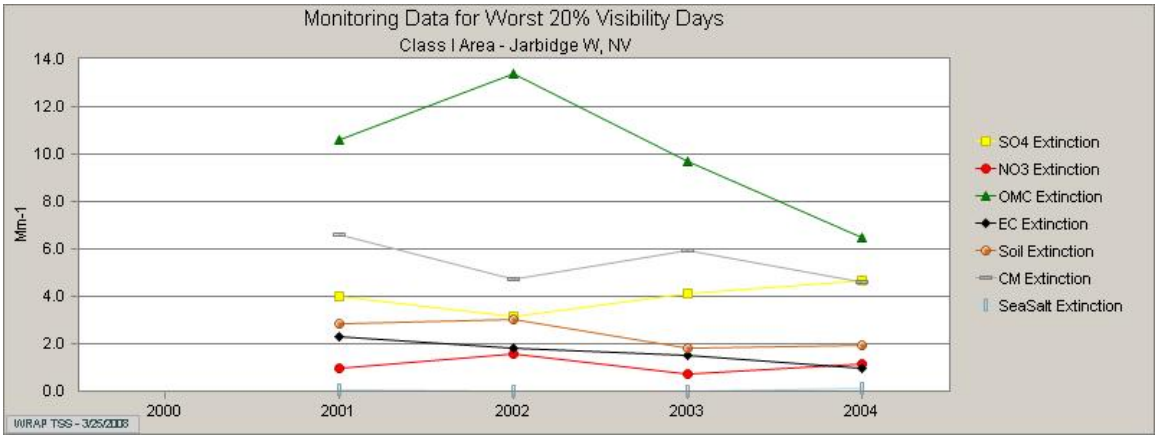
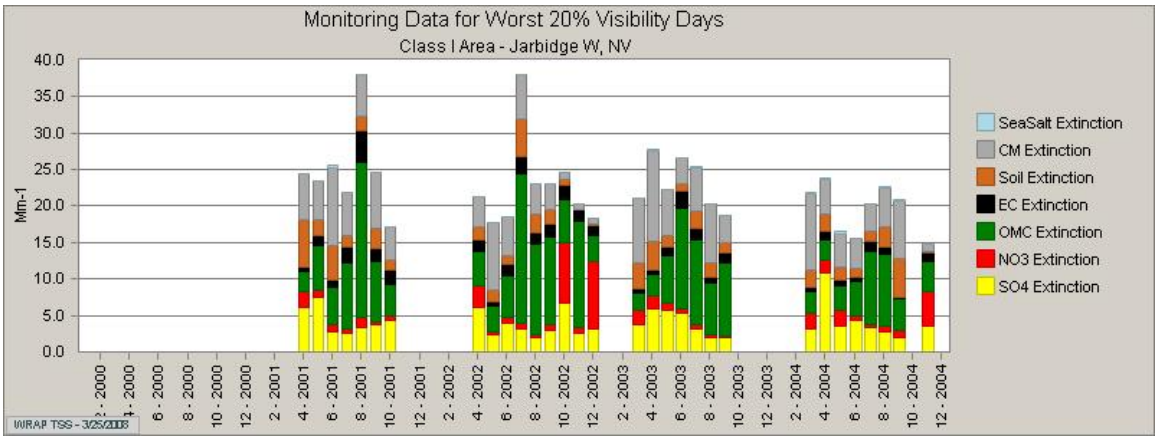


Figure 2-8 displays the monthly distribution of the reconstructed extinction for the 20 percent worst days of the baseline period for the Jarbidge Wilderness Area. The worst days are generally summer events, occurring during the period mid-March to the end of September of each year

with a few exceptions. Fires, dust events, and photochemical processes are elevated during this time frame, which maximizes OMC and EC concentrations, CM and SOIL concentrations, and secondary particulate formation.

FIGURE 2-8

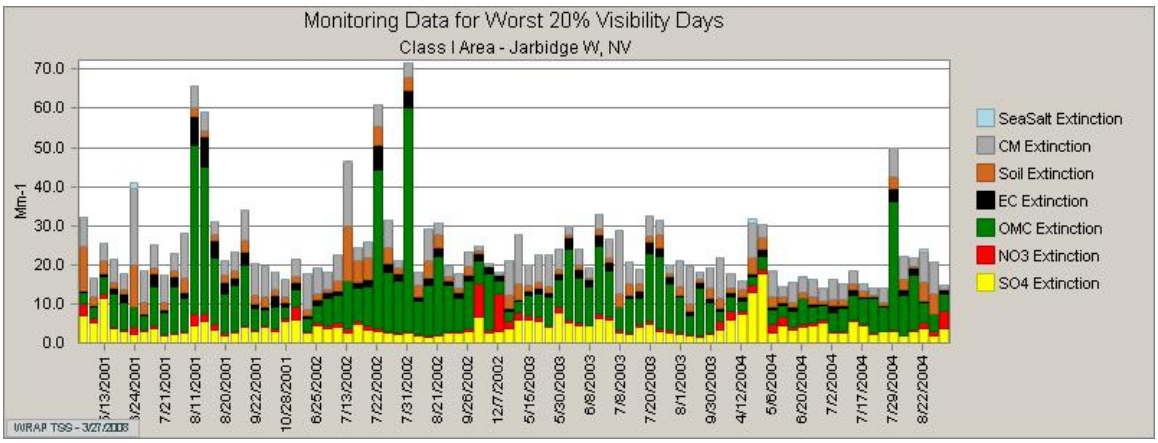
MONTHLY DISTRIBUTION OF WORST DAYS OF BASELINE PERIOD



Daily reconstructed light extinction for the 20 percent worst days of the baseline years at JARB1 is presented in Figure 2-9 and shows OMC, and/or CM are generally the largest components of visibility impairment on the worst days at the Jarbidge Wilderness Area. SOIL, NO_3, and SO_4 are significant components for a handful of days.

FIGURE 2-9

DAILY RECONSTRUCTED LIGHT EXTINCTION FOR
WORST DAYS OF BASELINE PERIOD

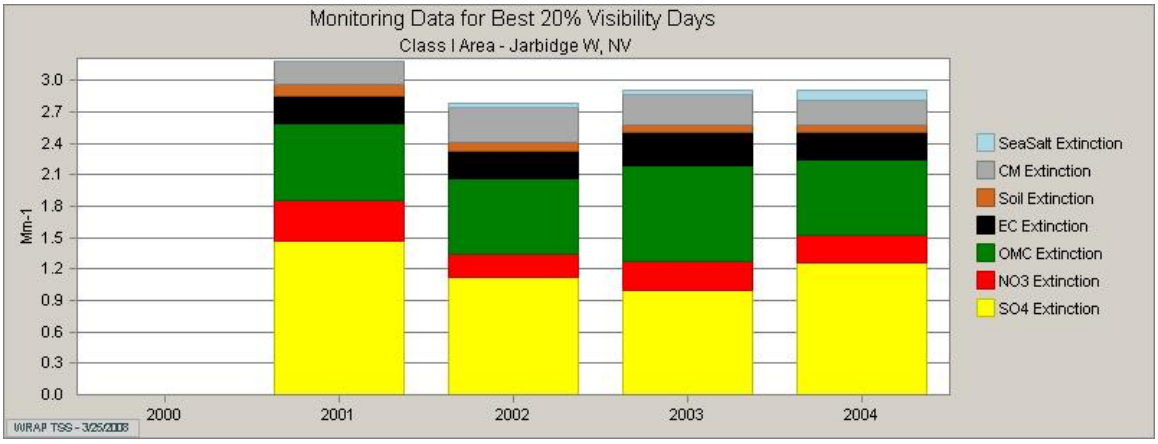


2.5.1.3 20 Percent Best Days

The bar graph shown in Figure 2-10 shows the reconstructed light extinction over the baseline period for the 20 percent best days based on data from JARB1. Note the baseline period annual variation is less than 0.5 Mm^{-1} for the best days, much less than the variability shown for the worst days.

FIGURE 2-10

ANNUAL RECONSTRUCTED EXTINCTION FOR
BEST DAYS OF BASELINE PERIOD



The line graph in Figure 2-11 shows the individual components of the reconstructed light extinction over the baseline period for the 20 percent best days at JARB1. SO_4 and OMC are the most significant contributors to visibility impairment for the best days of the baseline period, followed by sub-equal contributions from NO_3, EC, and CM. SOIL is a minor contributor to visibility impairment for the best days. SO_4 has approximately 0.5 Mm^{-1} variation, while OMC has approximately 0.2 Mm^{-1} variation for the best days of the baseline period.

FIGURE 2-11

ANNUAL RECONSTRUCTED EXTINCTION BY SPECIES FOR
BEST DAYS OF BASELINE PERIOD

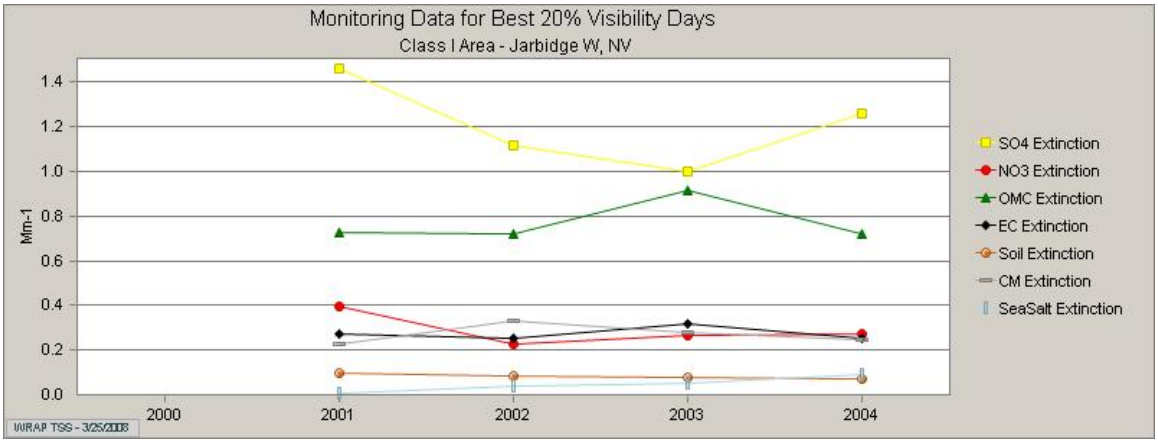
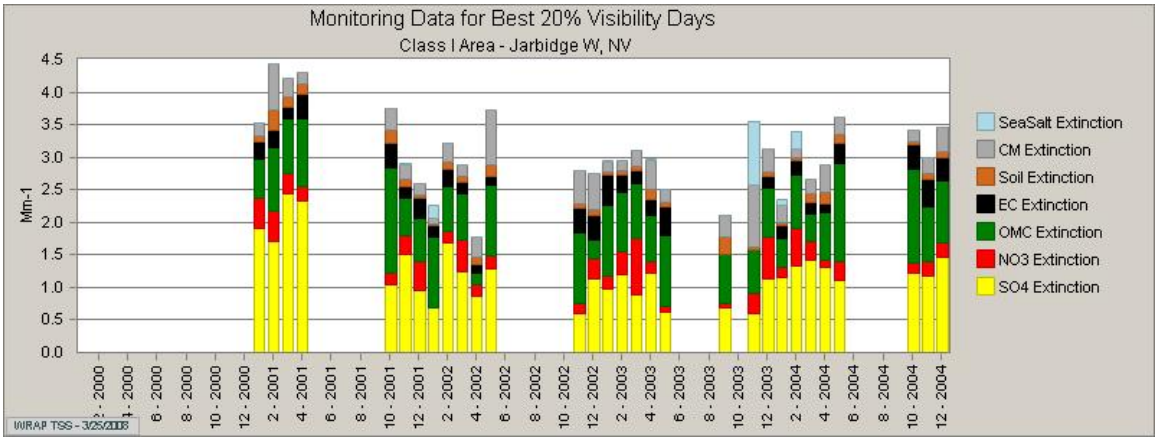


Figure 2-12 displays the monthly distribution of the reconstruction extinction for the 20 percent best days of the baseline period for JARB1. The best days are generally winter events occurring from October to May of each year, when fires, dust events, and photochemical processes are at a minimum.

FIGURE 2-12

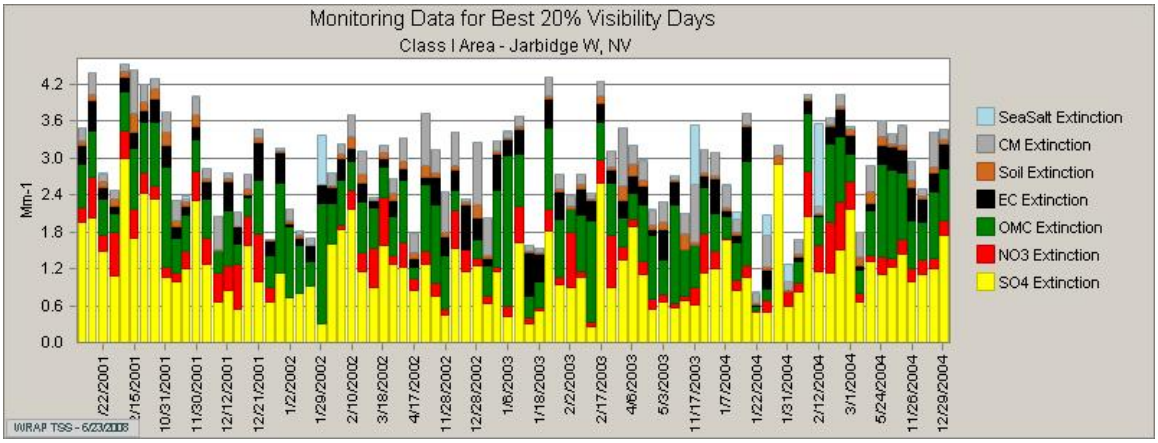
MONTHLY DISTRIBUTION OF BEST DAYS OF BASELINE PERIOD



Daily reconstructed light extinction for the 20 percent best days of the baseline period at JARB1 is presented in Figure 2-13 and shows OMC and/or SO_4 are generally the largest components of visibility impairment on the best days at the Jarbidge Wilderness Area. NO_3, CM, and Sea Salt are significant components for a handful of days.

FIGURE 2-13

DAILY RECONSTRUCTED LIGHT EXTINCTION FOR
BEST DAYS OF BASELINE PERIOD

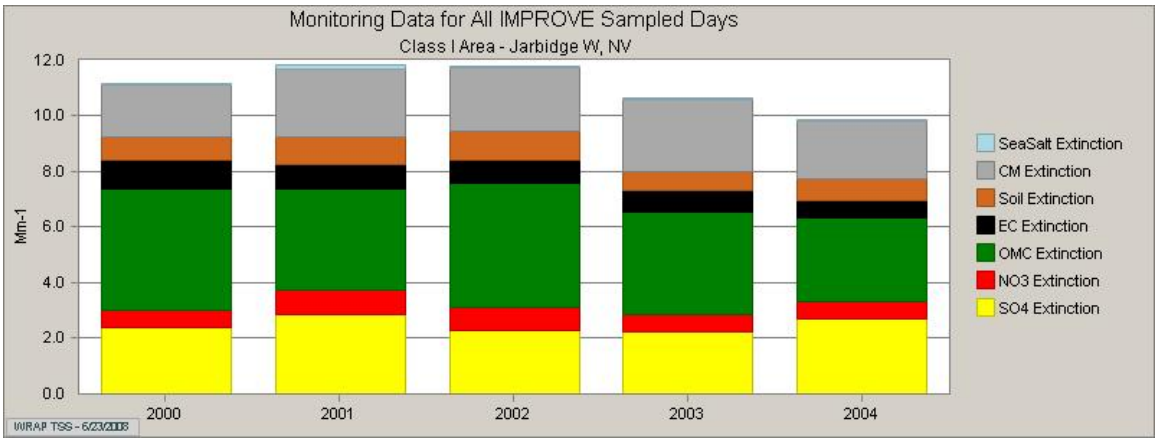


2.5.1.4 All IMPROVE Sample Days

Figure 2-14 shows the annual reconstructed light extinction over the baseline period based on monitor data from JARB1 site for all IMPROVE sample days. The variability of the IMPROVE sample days reconstructed light extinction is approximately 2 Mm^{-1}.

FIGURE 2-14

ANNUAL RECONSTRUCTED EXTINCTION FOR
IMPROVE SAMPLE DAYS OF BASELINE PERIOD

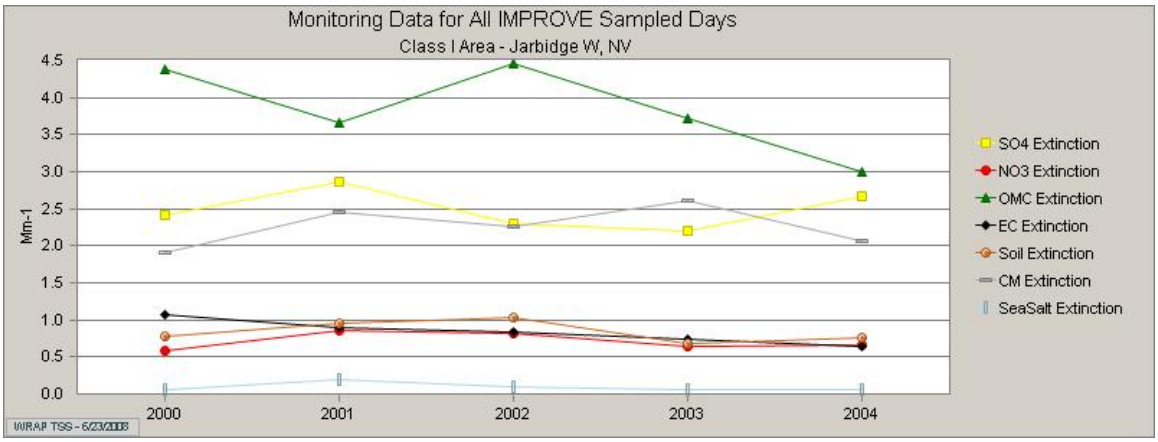


The line graph shown in Figure 2-15 shows the individual components of the annual reconstructed light extinction over the baseline period based on JARB1 IMPROVE data for the IMPROVE sample days. OMC is the most significant contributor to visibility impairment at JARB1 for the IMPROVE sample days of the baseline period, followed by sub-equal CM and

SO_4. SOIL, EC, and NO_3 are minor contributors to visibility impairment for the baseline period IMPROVE sample days.

FIGURE 2-15

ANNUAL RECONSTRUCTED EXTINCTION BY SPECIES FOR
IMPROVE SAMPLE DAYS OF BASELINE PERIOD



The baseline period annual variation for OMC is nearly 1.5 Mm^{-1}, indicating the range of annual effects produced by fire emissions. The baseline period variation for CM and SO_4 is less than 1 Mm^{-1}. The remaining components show less variability during the baseline period for the IMPROVE sample days.

Figure 2-16 displays the monthly reconstructed extinction for the IMPROVE sample days of the baseline period for the Jarbidge Wilderness Area, while Figure 2-17 presents the daily reconstructed light extinction for the IMPROVE sample days of the baseline period. These figures show pronounced seasonality of the reconstructed extinctions with the highest monthly extinctions occurring in the summer months and the lowest monthly extinctions occurring in the winter months. The visibility effects of CM, SOIL, EC, and OMC extinction overwhelm the contributions of SO_4 and NO_3 extinction, especially during the summer months. SO_4 contributes more to visibility impairment during the spring and early summer months, contributing less during the remaining months of the year. The contribution of NO_3 to visibility impairment is greatest during the winter months and is significant for some days. These effects are even more pronounced for the daily reconstructed extinctions presented in Figure 2-17.

FIGURE 2-16

MONTHLY RECONSTRUCTED EXTINCTION FOR
IMPROVE SAMPLE DAYS OF BASELINE PERIOD

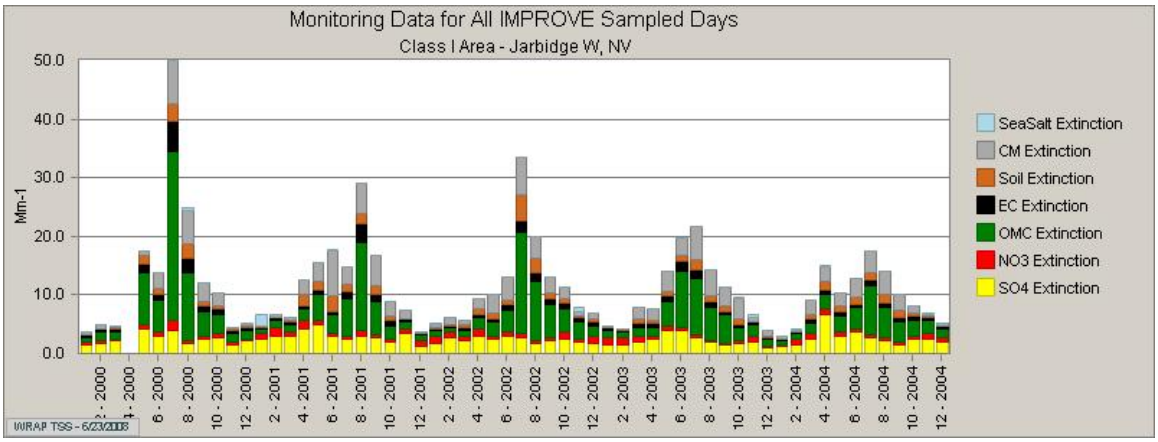
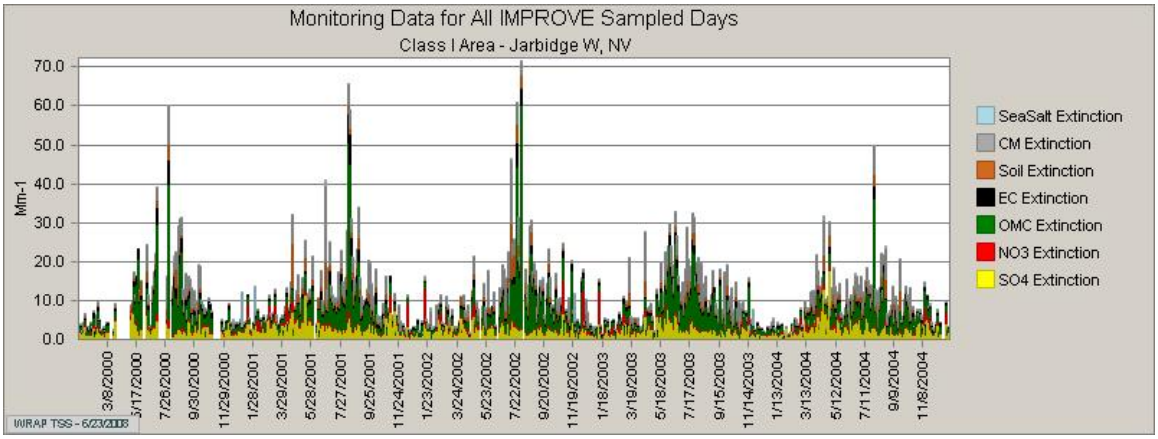


FIGURE 2-17

DAILY RECONSTRUCTED EXTINCTION FOR
IMPROVE SAMPLE DAYS OF BASELINE PERIOD



2.5.2 Comparison of Baseline Extinction for Best and Worst Days

Figure 2-18 compares the average baseline extinction for the 20 percent worst days with the 20 percent best days from the JARB1 monitor. All components of extinction are less on the best days, but significant reductions in CM and OMC extinction result in the majority of the visibility improvement on the best days, confirming the significant role of natural emissions in visibility impairment at the Jarbidge Wilderness Area.

Table 2-2 presents the monitored contributions to reconstructed light extinction by species for the most and least impaired days of the baseline period based on data from the WRAP's

Technical Support System. For the most impaired days, OMC and CM, on average, contribute nearly two thirds of the extinction. Sources of OMC and CM emissions are predominantly natural and uncontrollable, as are SOIL and EC emission sources. SO_4 and NO_3 contribute more than 15 percent and less than 5 percent, respectively to reconstructed extinction for the most impaired days. For the least impaired days, SO_4 and NO_3 contribute more than 40 percent and nearly 10 percent, respectively to the reconstructed extinction. Sources of SO_2 and NO_x emissions are largely anthropogenic and controllable.

FIGURE 2-18

COMPARISON OF BASELINE EXTINCTION FOR
WORST AND BEST DAYS OF BASELINE PERIOD

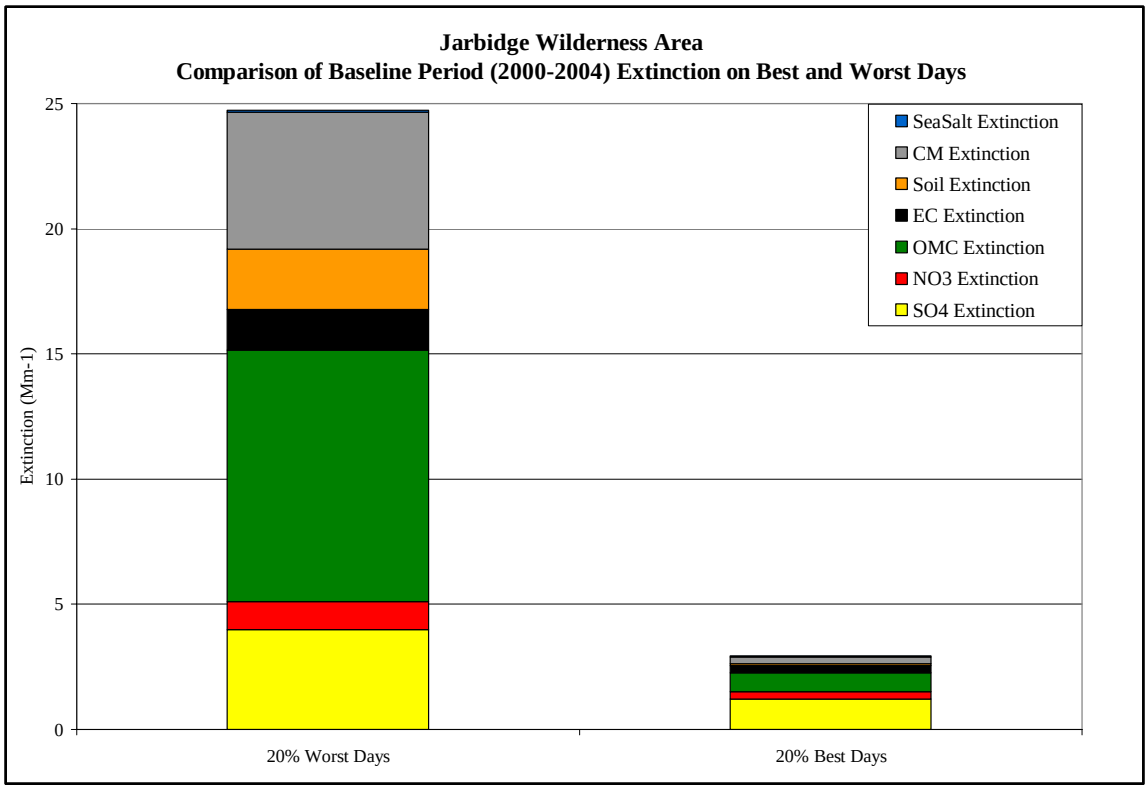


TABLE 2-2

MONITORED CONTRIBUTIONS TO ANNUAL RECONSTRUCTED
EXTINCTION BY SPECIES FOR BASELINE PERIOD

Year	SO_4 Extinction	NO_3 Extinction	OMC Extinction	EC Extinction	SOIL Extinction	CM Extinction	SeaSalt Extinction
20 Pecent Worst Days							
2001	14.6%	3.5%	38.6%	8.4%	10.4%	24.2%	0.3%
2002	11.5%	5.6%	48.4%	6.5%	10.9%	17.1%	0.0%
2003	17.3%	3.1%	40.8%	6.3%	7.7%	24.8%	0.0%
2004	23.6%	5.7%	32.4%	5.0%	9.7%	23.0%	0.7%
Average	**16.7%**	**4.5%**	**40.0%**	**6.5%**	**9.7%**	**22.3%**	**0.3%**
20 Percent Best Days							
2001	45.9%	12.3%	23.0%	8.5%	3.1%	7.2%	0.0%
2002	40.3%	8.3%	25.9%	9.4%	2.9%	11.9%	1.4%
2003	34.2%	9.2%	31.5%	11.0%	2.7%	9.6%	1.7%
2004	43.3%	9.3%	24.7%	8.9%	2.4%	8.2%	3.1%
Average	**40.9%**	**9.8%**	**26.3%**	**9.4%**	**2.8%**	**9.2%**	**1.6%**

2.5.3 Aerosol Pollutant Trends

Figure 2-19 presents the annual monitored light extinction in deciviews for the 20 percent worst and best days and a corresponding trend line. The long-term annual extinction trend for the 20 percent worst days, shown by the diamonds, is essentially flat, although there are large annual variations. The trend for the 20 percent best days, shown by the triangles, has a downward trend indicating improvement in the long-term visibility conditions at the Jarbidge Wilderness Area for the best days.

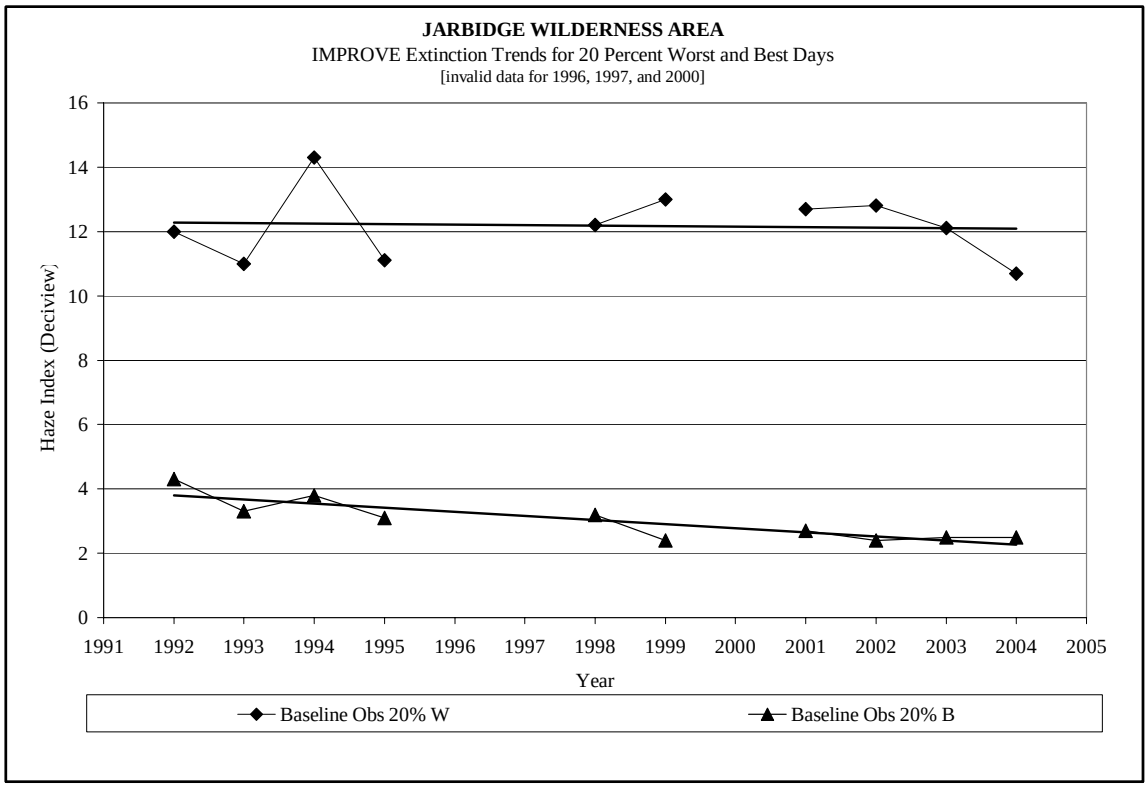
Figure 2-20 shows the annual extinction data on the 20 percent worst days for seven haze causing pollutants from JARB1 for the years 1992 through 2005 with a corresponding color-coded, long-term trend line. The graphs utilize valid data from years prior to and including the baseline period. Data from the years 1996, 1997, and 2000 did not meet the USEPA data completeness requirements (75 percent for the year and 50 percent for each quarter) and therefore don't have calculated annual concentrations.

Examination of the data provides insight into the long-term trends of haze causing pollutants at the JARB1 IMPROVE monitor. SO_4 and NO_3, considered to be emitted by mostly anthropogenic sources, have slight downward trends, although NO_3 is essentially flat. These data suggest slight improvement in the long-term control of SO_2 and NO_x emissions impairing visibility at the Jarbidge Wilderness Area for the worst days.

OMC extinction, despite its large annual variation, has a well-defined, upward long-term trend, suggesting a larger role of fire emissions in regional haze with time. EC, also thought to be largely due to fire emissions, has a flat trend.

FIGURE 2-19

ANNUAL IMPROVE RECONSTRUCTED EXTINCTION TRENDS
FOR WORST AND BEST DAYS



CM, also showing significant annual variations, has a long-term downward trend. SOIL shows an opposite, upward trend, although not as pronounced, perhaps due to increasing contributions to international transport resulting from climate change and increasing population pressure in the developing world.

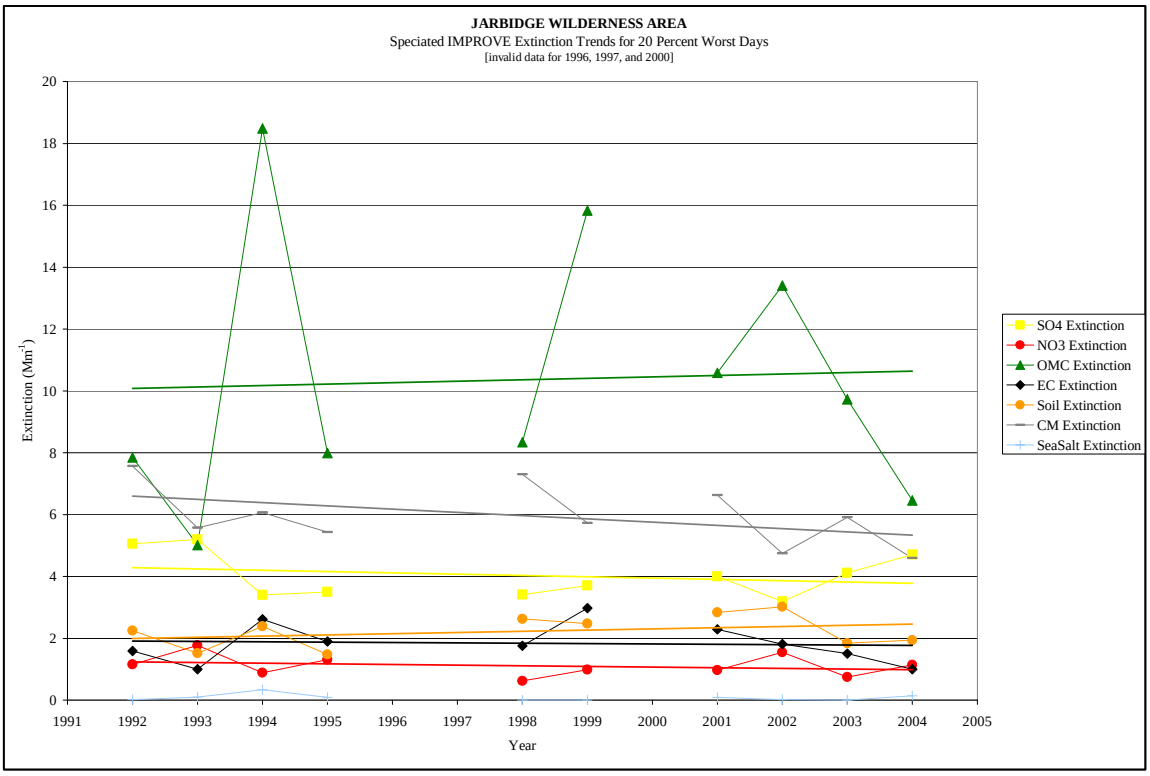
Continued improvements in regional sulfate and, to a lesser degree, nitrate levels are expected in the western states as further controls are realized on major sources as the result of BART and the implementation of other regional haze programs, as well as compliance with ozone and $PM_{2.5}$ standards. We expect these regional downward trends in SO_2 and NO_x emissions will provide continued visibility improvement.

However, the trends in OMC and SOIL are not so encouraging. The wide variations in annual concentrations on the 20 percent worst days may be related to alternating drought and normal precipitation conditions with corresponding increases in carbon emissions due to wildfires and

increases in dust (e.g., CM and SOIL) emissions resulting from increasingly prevalent dry and dusty conditions.

FIGURE 2-20

JARBIDGE WILDERNESS AREA
SPECIATED EXTINCTION TRENDS FOR WORST DAYS



NDEP has analyzed the JARB1 monitor data; identified the baseline and natural visibility conditions; identified a 2018 URP value of 11.09 dv for the worst days; and determined OMC and CM extinction contribute the majority of visibility impairment on the worst days. These data suggest that visibility improvement due to emissions reductions of SO_2 and NO_x from anthropogenic sources may be overwhelmed by seasonally variable OMC and CM, as well as EC and SOIL, extinction contributions due to emissions from natural sources.

These data suggest control of sources of OMC, CM, and SO_2 may be the most effective means of improving visibility impairment at the Jarbidge Wilderness Area. The following chapter discusses Nevada's sources of visibility impairing pollutants.

2.6 REFERENCES

U.S. EPA 2003. Guidance for Tracking Progress under the Regional Haze Rule. EPA-454/B-03-004. September 2003.

U.S. EPA 2003. Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule. EPA-454/B-03-005. September 2003.

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