Air Quality

Introduction

Air quality on the Forest is determined by regional and local sources of air pollution and the weather patterns that disperse these pollutants. Air quality, or the amount of pollution in the atmosphere, can negatively affect Forest resources but the Forest does not have *direct* regulatory authority over external sources of air pollution. One way that the Forest works to improve air quality is by reviewing and commenting on specific air permits issued by state air regulators. The Clean Air Act Amendments of 1977 established the Prevention of Significant Deterioration (PSD) program, under which federally designated Wildernesses such as Dolly Sods and Otter Creek were given special protection from degradation of air quality and associated resources. Companies seeking to upgrade existing or build new facilities must obtain a PSD permit. The Forest reviews and comments on the class I air quality analysis protocol, modeling results and the draft permit for each permit application. The main objective for these reviews is to determine the potential impacts of new sources of pollution on Air Quality Related Values (AQRVs) such as visibility, streams, and vegetation in the class I areas. Results of these assessments are communicated to state and federal air regulators; however, our role remains one of consultation rather than regulation.

Forest-wide direction in the 1986 Land and Resource Management Plan (LRMP) called for the Forest to "*evaluate air quality impacts and assist air pollution control authorities in identifying and preventing adverse impacts to forest and range resources"*. Further, it says the "*Forest will work with Federal and State air quality management agencies to protect Class I air quality in Otter Creek and Dolly Sods Wildernesses"*. Similar direction was incorporated in the revised 2006 Land and Resource Management Plan. As such, the Forest continues to review and comment on PSD permits within the vicinity of the Forest.

Given the role the Forest plays in PSD permitting processes, it is important for us to understand what current levels of air pollution in and near the Forest are, and how those levels of air pollution are impacting Forest resources. For this reason, the 2006 LRMP also calls for the Forest to monitor air quality and associated effects to AQRVs. General direction for Management Prescription 5.0 in the 2006 LRMP requires the Forest "*to plan and provide for air resource monitoring that is needed to insure that class I area AQRVs are protected*." In Fiscal Year 2007, the Forest continued to monitor air quality in cooperation with the Northeastern Forest Experiment Station. Ozone, acid deposition, and meteorology are measured at two sites: the Forest Service research office site in Parsons, WV and at Bearden Knob, a high-elevation site near Davis, WV. Visibility monitoring also continues at the Bearden Knob site.

Additionally, the Forest continued to measure the condition of pollution-sensitive resources, identified as AQRVs in the Class I areas, and across the Forest. The focus has been on the effects of deposition to aquatic and terrestrial ecosystems. Water chemistry is the primary indicator used to monitor aquatic ecosystems, but the Forest has also developed an inventory of aquatic insect species found within the class I area streams. Water chemistry samples were collected for 99 sites in the spring of 2007 and for 98 sites Forest wide in the fall of 2006 (See Aquatics Section). The results of the fall sampling are reported in the aquatics section of this report, while the spring water chemistry results for the Class I areas are reported here.

Considering that many of the streams in the Class I areas and on the Forest are acidic, it is probable that the base status of soils in those watersheds are also affected by acid deposition, which in turn could affect vegetation. To better understand the current condition of sensitive soils on the Monongahela, the Forest has implemented a soils monitoring program. Additionally, the MNF has been collaborating with NRCS to inventory and map soils within the Forest, specifically to understand more about the soil chemistry and the distribution of various soil types (see Soils section of this report).

2007 Program Accomplishments

The following was accomplished in FY 2007:

- The Forest reviewed and provided either preliminary or final input on five Prevention of Significant Deterioration permits proposed or issued by the states of West Virginia and Pennsylvania. Through these processes Forest air specialists also worked with counterparts in the National Park Service to draft preliminary guidance on developing a mitigation plan and developing an inventory for conducting class I cumulative increment modeling in this region of the country.

- The forest provided input on the final draft of the West Virginia Regional Haze State Implementation Plan (SIP) and initial comments on the first draft of the Pennsylvania Regional Haze SIP, which as not gone to public comment yet.

- We continued operation of the IMPROVE aerosol samplers for visibility monitoring.

- We monitored ozone concentrations year-round at the Bearden Knob monitoring site.

- We monitored acid deposition using bulk deposition samplers at the Bearden Knob monitoring site and at the NADP site at the NE research station.

- The Forest continued coordination with researchers and other agencies on implementing the concept of critical loads for managing resources affected by depositions. This coordination occurred through the initiation of a multi-agency effort to look at implementing the concept of critical loads nationally.

Monitoring and Evaluation

FOREST PLAN MONITORING FOR AIR QUALITY

The Monongahela National Forest Land and Resource Plan (2006) outlines air quality monitoring on page IV-8.

11. To what extent is Forest management contributing or responding to air pollution effects on ecosystems and visibility?

12. Are Air Quality Related Values of the Dolly Sods and Otter Creek Wildernesses improving over current adversely affected levels?

13. What are the trends in ambient air pollutant concentrations near the Forest?

Monitoring results for these questions are reported below.

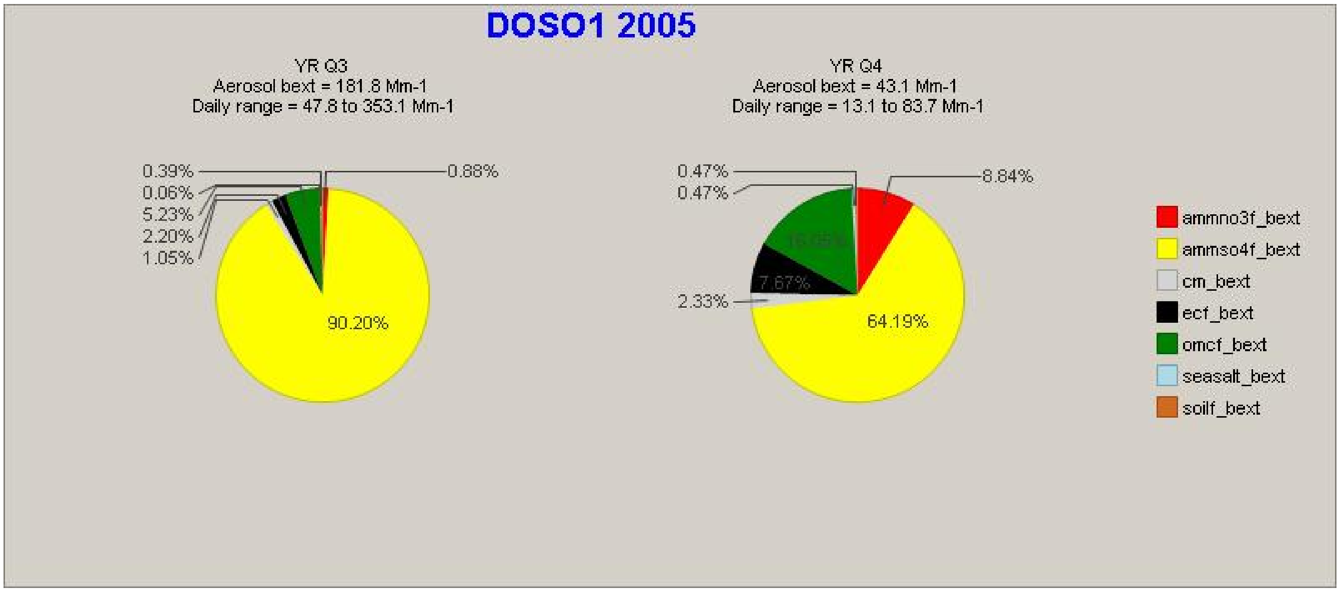
Monitoring Question 11. To what extent is Forest management contributing or responding to air pollution effects on ecosystems and visibility?

Visibility monitoring conducted on the Forest is part of a national effort called IMPROVE (Interagency Monitoring of PROtected Visual Environments). The original purpose of IMPROVE was to determine visibility conditions at class I areas across the country. In 1997, EPA recognized that visibility was impaired at all class I areas and the Regional Haze Rule was adopted. The Regional Haze Rule has a goal of significantly reducing emissions of visibility impairing pollutants and returning visibility to natural conditions by the year 2064. With the advent of these regulations, the role of IMPROVE has now expanded to track changes resulting from emission reductions that will be implemented.

The IMPROVE aerosol samples measure the amounts of various species of fine particulate in the atmosphere—including sulfates, nitrates, and organic carbons—by collecting weekly filter samples and sending these samples for laboratory analysis. Of all the species monitored through the IMPROVE network, sulfates contribute the most to visibility impairment in Dolly Sods and Otter Creek (Figure AQ-1). Using the quantity and types of aerosol data collected in the samplers, values for light extinction and visibility distance can be calculated. The visibility data reflects that although the full range of visibility conditions can be experienced at any time of the year, on average visibility is better in the winter than the summer. This is due to the fact that sulfate levels are significantly higher in the summer than the winter (Figure AQ-1[1]).

[1] Data reported here is for the calendar year 2005, due to the lag time in IMPROVE data analysis and reporting, results are not yet available for calendar year 2007.

Figure AQ-1. 2005 Summer and Winter Fine Particulate Composition



Monitoring Question 11. Evaluation, Conclusions, and Recommendations

Since the Forest began monitoring aerosols in 1993, visibility has improved. The following graphs and images in Figures AQ-3 and AQ-4 show the change that has taken place over the last ten years.[2] As sulfates are the largest component of visibility impairing pollution at Dolly Sods and Otter Creek, most of the visibility improvement can be attributed to reductions in sulfur dioxide emissions made through the Acid Rain Program, part of the 1990 Clean Air Act Amendments. This program called for a total reduction of 10 million tons of sulfur dioxide emissions (half the 1980 level). The first phase of reductions began in 1995 and targeted the highest emitting power sources. The second phase of reductions began in 2000, and targeted power plants with lower emissions. Interestingly, the visibility improvements at Dolly Sods and Otter Creek begin to show up between 1995 and 1996, coincident with the Harrison power plant installing and operating scrubbers that reduced its sulfur dioxide emissions by 95-98 percent. Sulfur dioxide emissions from Harrison totaled about 290,000 tons in 1990, and were reduced to about 16,000 tons by 1996. Emissions at Harrison were reduced again in 2002 to 8,500 tons. Additional reductions have taken place at other power plants upwind of the Forest, and all of these reductions contribute to the improving visibility conditions.

A recent study analyzed IMPROVES and CASTNET data to address spatial and temporal trends in monitored sulfate levels across the United States. The results show that the maximum statistically significant percent decrease in sulfate occurred at Dolly Sods, at a rate of 73 percent (Malm et al.). These trends in part are reflected in Figures AQ-3 through AQ-5 below, showing the 20 percent best and worst visibility days, as well as the annual averages, where the light extinction is decreasing with corresponding increases in the standard visual range for the annual

[2] Data reported here is for the calendar years 1993-2005. Due to the lag time in IMPROVE data analysis and reporting, results are not yet available for calendar year 2006.

averaging period in particular. This trend is not as evident in the 20 percent best visibility days. Additionally, these figures show that despite the significant decreases in sulfate, levels are still high and visibility is still impaired. This is evident in the pictures of Figure AQ-2, which provide a visual representation of the Standard Visual Ranges (SVR) shown in the trend plots.

Figure AQ-2. Pictorial Representation of Best and Worst Monitored Standard Visual Range Values at Dolly Sods

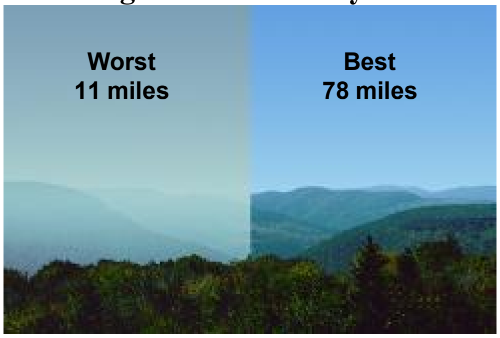


Figure AQ-3. Standard Visual Range (km) and Associated Light Extinction Trends for the 20 Percent Best Visibility Days

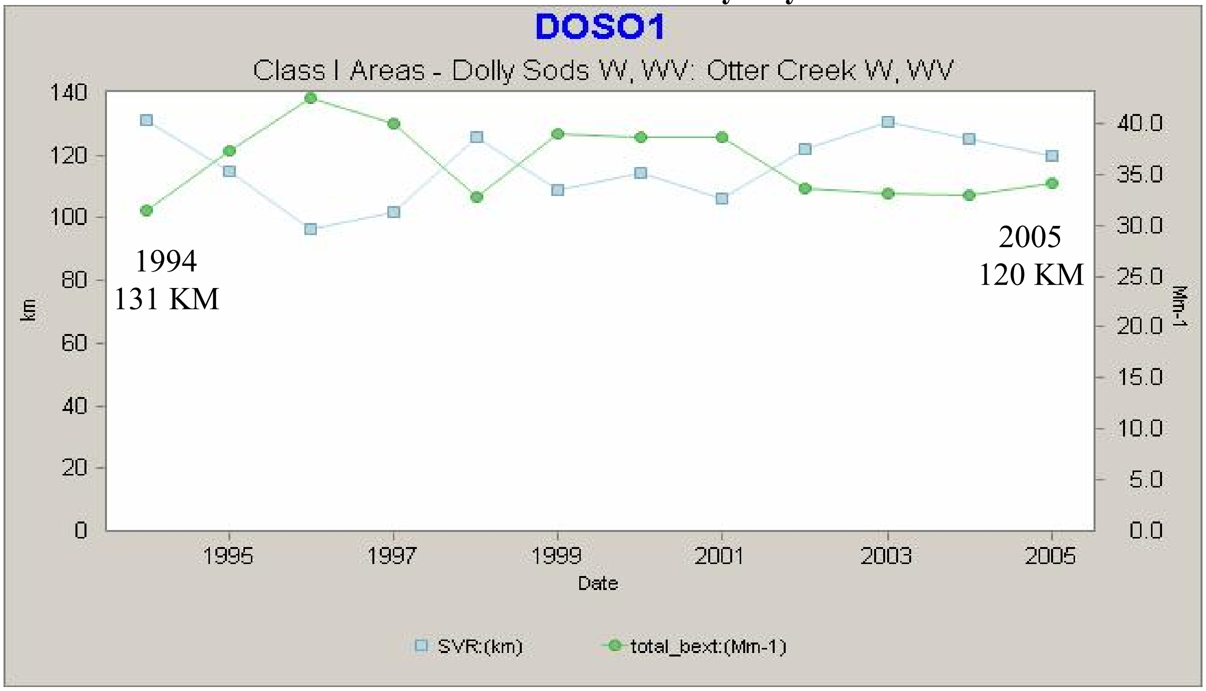


Figure AQ-4. Standard Visual Range (km) and Associated Light Extinction Trends for the 20 Percent Worst Visibility Days

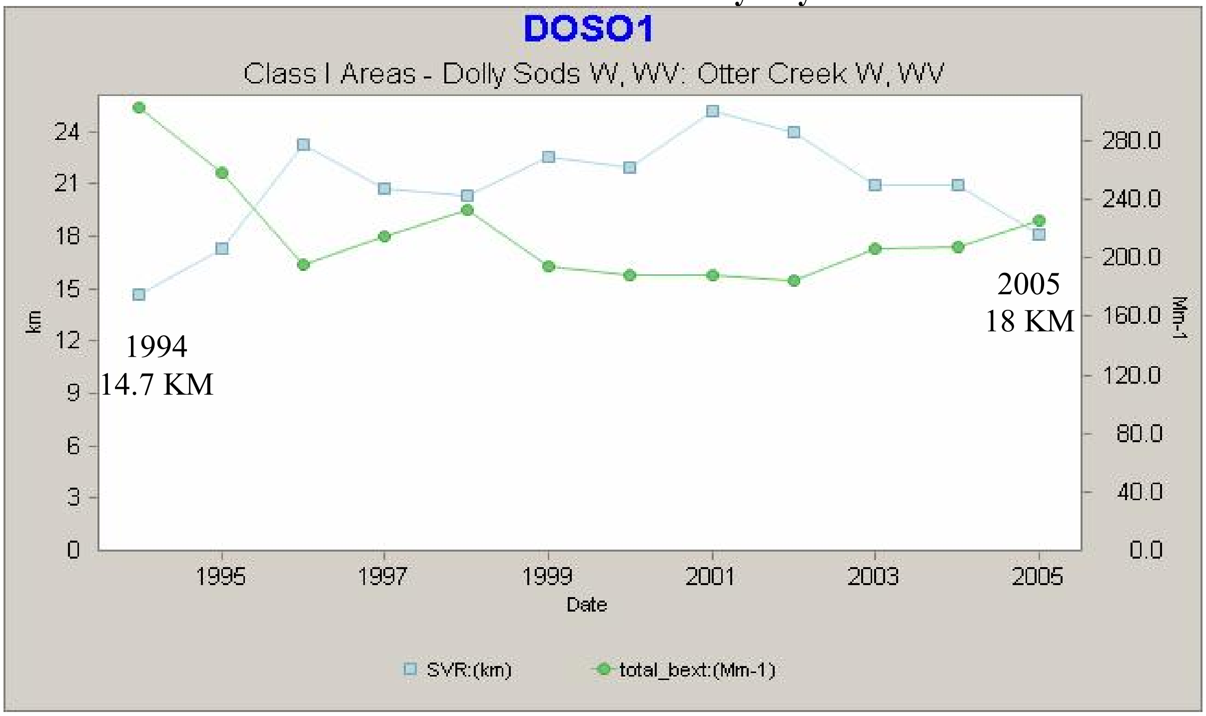
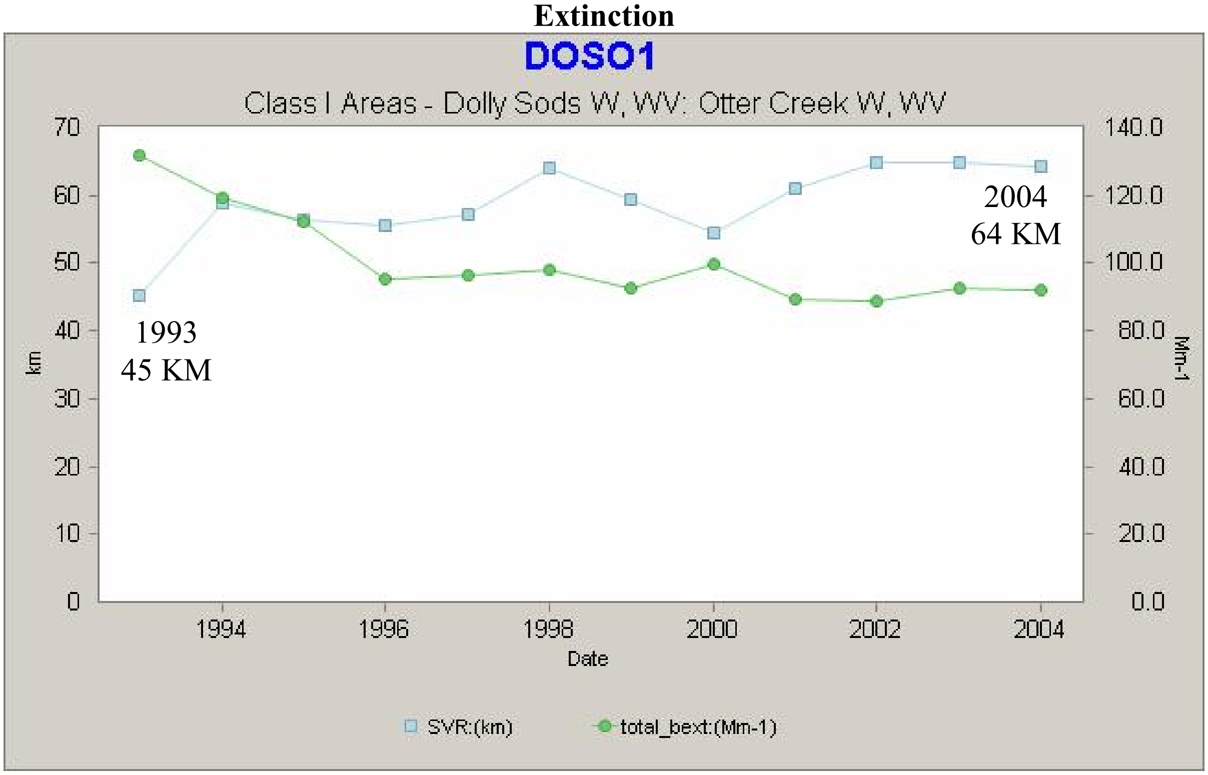


Figure AQ-5. Annual Average Standard Visual Range (km) and Associated Light Extinction



Monitoring Question 12. Are AQRVs in Class I and Class II wildernesses improving over currently adversely affected levels?

Reductions in Sulfur dioxide emission are not only reflected in the visibility monitoring, but are also reflected in the bulk deposition and National Atmospheric Deposition Program measurements from Bearden Knob and Parsons (Figures AQ-6 and AQ-7).

Figure AQ-6. Bulk Deposition for Sulfate and Nitrate at Bearden Knob

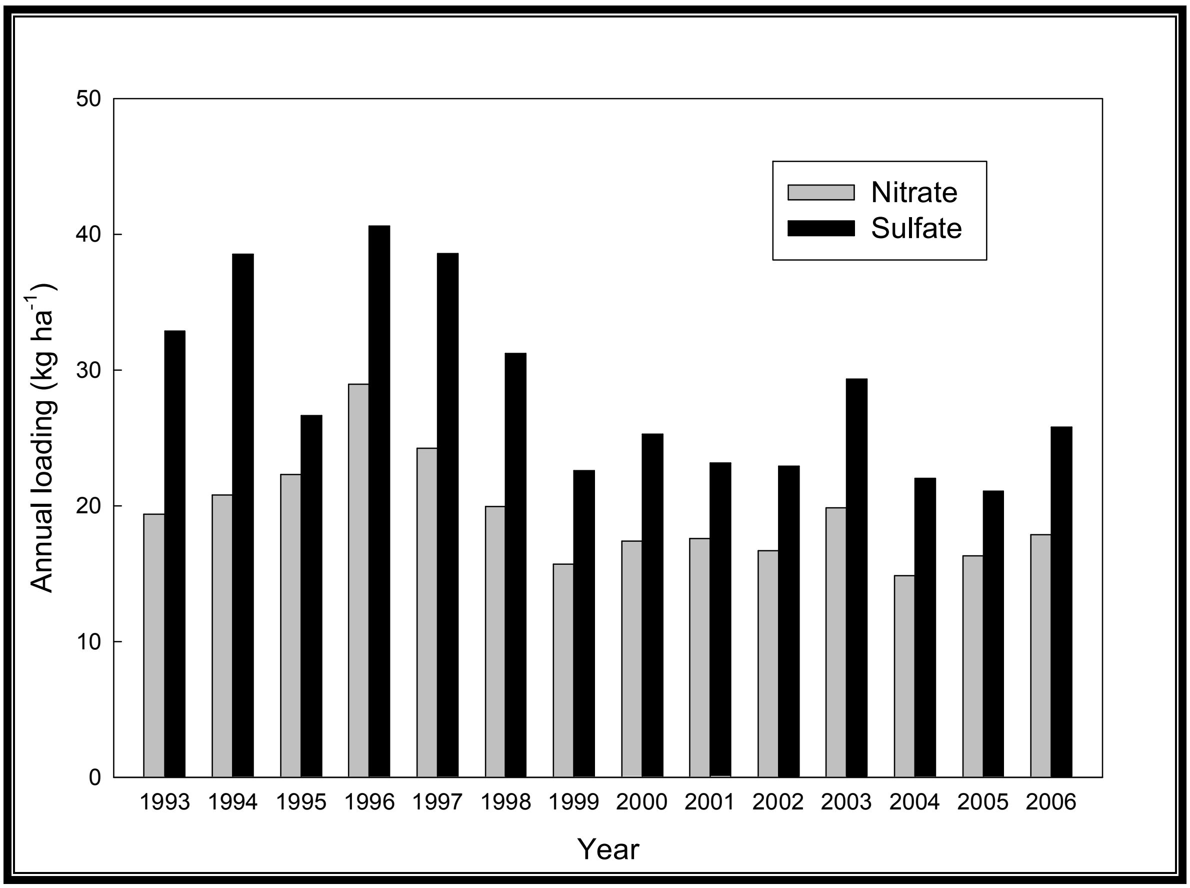
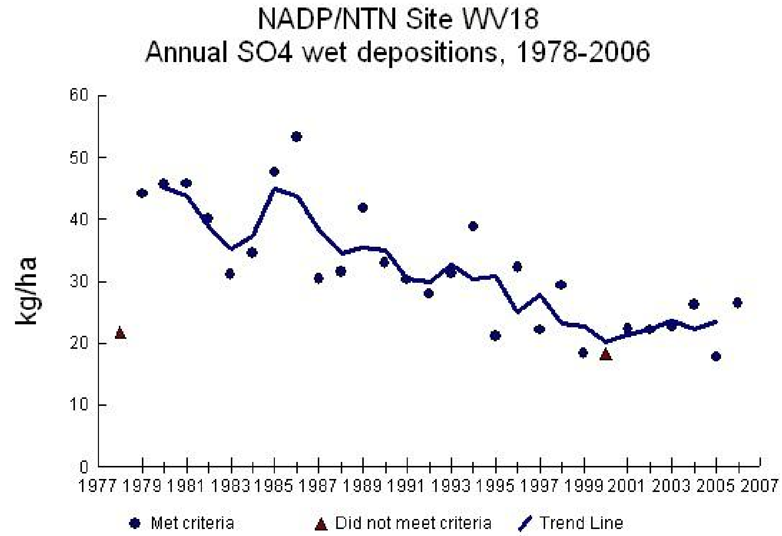
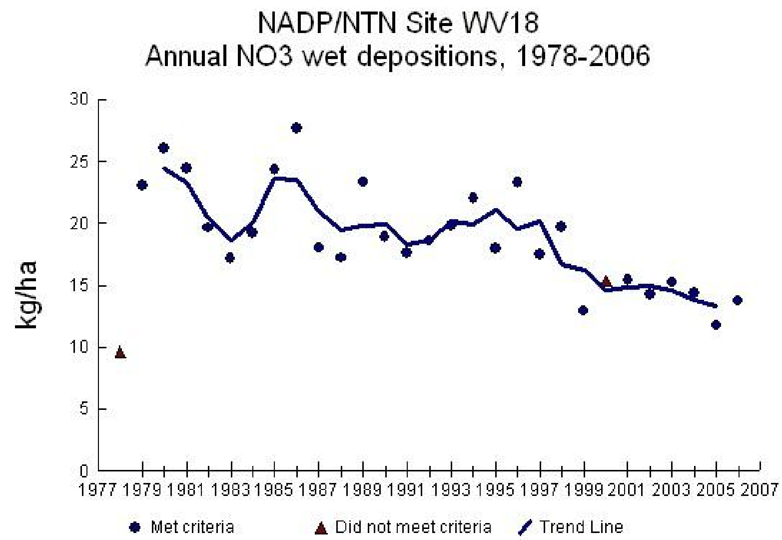


Figure AQ-7. NADP Trends Data for Sulfate and Nitrate at the Parsons Monitoring Site





Monitoring Question 12. Evaluation, Conclusions, and Recommendations

Over the last 15 years, there has been a decreasing trend in both sulfate and nitrate deposition. Although downward trends in SO_2 emissions and SO_4 deposition are predicted to have a positive effect on aquatic and soil resources on the MNF, the reductions are not great enough to reverse all of the degradation that has already taken place. For example, results from modeling projections in the Southern Appalachian Mountain Initiative, and MAGIC modeling results for the MNF show that a number of streams on the Forest have been acidified to the point where they are no longer capable of sustaining aquatic life or have acidified to where only the most tolerant aquatic species remain, will not recover at current levels of deposition. Additionally, these reports found that some systems are so acidified that they will not recover even if we were willing to wait 100 years and deposition went to zero. According to these projections, reductions in SO_2 emissions resulting from the 1990 Clean Air Act amendments will not be enough to restore the chemistry in many of these acidified streams to levels where aquatic life can thrive, even after 100 years. Significant additional emission reductions will be needed to restore already degraded streams, and to protect streams that have not yet degraded significantly.

Monitoring Question 13. What are the trends in ambient air pollutant concentrations near the Forest?

Ozone monitoring has been conducted at two sites on the Forest. One site is located at the Forest Service office complex in Parsons, WV and is part of the national monitoring network, CASTNET (Clean Air Status and Trends Network). The other site is located at Bearden Knob outside of Davis, WV. High or chronic ozone exposure is a human health concern and can harm people with respiratory illnesses, or those involved in vigorous outdoor activities. Ozone can also have harmful effects on vegetation when it enters through the stomata in plant leaves. A National Ambient Air Quality Standard (NAAQS) is set for ozone in the United States to protect human health. The standard is based on a rolling eight-hour average of daily hourly values, with the fourth highest maximum eight-hour value averaged over 3 years. Currently, this value can not exceed 0.085 parts per million (ppm); however the EPA has recently proposed lowering this standard to 0.070 ppm. If EPA implements a new 8-hour ozone standard, it is anticipated that this will affect attainment status for many areas. Although neither site on the Forest is used to determine attainment of the NAAQS, a recent review of the monitoring data from Bearden Knob shows that the NAAQS were exceeded (based on the attainment criteria described above) from 1995-1999. Data from 2004-2006 show that the NAAQS have not been exceeded, but levels remain just below the current standard at approximately 0.077 ppm. The most recent data, from 2006 show that two of the calculated eight-hour averages at Bearden Knob were above 0.080 ppm, with the fourth highest maximum value below this at 0.077 ppm.

Monitoring Question 13. Evaluation, Conclusions, and Recommendations

Although recent data shows that the ozone standard has not been exceeded, research demonstrates that injury to vegetation can occur at levels below the standard. Several metrics are often used to assess ozone and potential effects on vegetation including the W126 (sigmoidally weighted exposure index), and the N100 (the number of hours that average concentrations were greater than or equal to 0.10 ppm). A recent study evaluated the response of vegetation to ozone in these areas from 1988 through 1999 using the combination of the W126, N100 and the presence of moderate or more extreme droughts. These values generally suggested minimal ozone effects, or effects to only highly sensitive tree species, with the exception of 1988. Values at Parsons in 1988 indicate that moderately sensitive and/or resistant tree species could have experience growth reductions due to ozone; however, average Palmer index conditions for 1988 indicated severe drought for most of West Virginia. As a result, high stomatal resistance would have been common, so moderate and severe ozone damage would have been unlikely. Otter Creek and Dolly Sods Wildernesses were evaluated for ozone injury during this drought period, and ozone damage symptoms were less than those observed in 1989-1990 under near normal conditions (Edwards et al. 2004).

SUMMARY RECOMMENDATIONS

Air quality direction under the coming revised LRMP (2005) is similar to that in the current 1986 plan except that it clarifies the Forest's role in the regulatory arena and emphasizes the Forest's responsibility for protecting air quality when conducting management activities. Similarly, the air quality Monitoring and Evaluation items in the coming revised plan break out and clarify monitoring items as they relate to air quality direction (Chapter IV, Monitoring and Evaluation Matrix, Items 11-13). The current 1986 plan simply indicates that we will measure AQRVs including visibility. Under the revised plan we will monitor and assess trends to determine whether or not air pollution concentrations and AQRVs are improving over current adversely affected levels. Additionally, it addresses how the Forest should track to what extent management is contributing or responding to air pollution effects on ecosystems and visibility. This directly ties to the Forest's role in PSD permitting and other regulatory processes, as well as how we are using monitoring data in these efforts. There are also linkages there between air pollution effects on AQRVs such as visibility, soil and water, and how the Forest is responding to these effects in management decisions.

Given the existing and coming direction under the revised LRMP, Visibility, acid deposition and ozone monitoring will continue at Bearden Knob and the Forest Service office in Parsons as part of an ongoing effort to track air pollution trends. This data will be used when assessing the condition of air quality and AQRVs in the class I areas. It will also be used when looking at how management activities may exacerbate or contribute to affected AQRVs. Additionally, the Forest will continue its involvement in PSD permitting processes and other regulatory initiatives, such as the regional planning organizations under the Regional Haze rule in effort to reduce the negative effects of air pollution on the AQRVs in Dolly Sods and Otter Creek Class I areas. In addition, efforts aimed at developing critical loads for class I areas will continue.