

creating chronic stress on vegetation that can lead to effects of concern such as reduced plant growth and yield, shifts in competitive advantages in mixed populations, and decreased vigor leading to diminished resistance to pests, pathogens, and injury from other environmental stresses.

Studies indicate that these effects described here are still occurring in the field under ambient levels of ozone. The economic value of some welfare losses due to ozone can be calculated, such as crop yield loss from both reduced seed production (*e.g.*, soybean) and visible injury to some leaf crops (*e.g.*, lettuce, spinach, tobacco) and visible injury to ornamental plants (*i.e.*, grass, flowers, shrubs), while other types of welfare loss may not be fully quantifiable in economic terms (*e.g.*, reduced aesthetic value of trees growing in Class I areas).

As discussed earlier, aircraft engine emissions of NO<sub>x</sub> contribute to ozone. The proposed standards would aid in the reduction of ozone and, therefore, help reduce crop damage and stress from ozone on vegetation.

#### 4. Visibility

The secondary PM NAAQS is designed to protect against adverse welfare effects which includes visibility impairment. In 1997, EPA established the secondary PM<sub>2.5</sub> NAAQS as equal to the primary (health-based) NAAQS of 15 µg/m<sup>3</sup> (based on a 3-year average of the annual mean) and 65 µg/m<sup>3</sup> (based on a 3-year average of the 98th percentile of the 24-hour average value) (62 FR 38669, July 18, 1997). EPA concluded that PM<sub>2.5</sub> causes adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. In 1997, EPA demonstrated that visibility impairment is an important effect on public welfare and that unacceptable visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote federal Class I areas. In many cities having annual mean PM<sub>2.5</sub> concentrations exceeding annual standard, improvements in annual average visibility resulting from the attainment of the annual PM<sub>2.5</sub> standard are expected to be perceptible to the general population. Based on annual mean monitored PM<sub>2.5</sub> data, many cities in the Northeast, Midwest, and Southeast as well as Los Angeles would be expected to experience perceptible improvements in visibility if the PM<sub>2.5</sub> annual standard were attained.

Furthermore, in setting the PM<sub>2.5</sub> NAAQS, EPA acknowledged that levels of fine particles below the NAAQS may

also contribute to unacceptable visibility impairment and regional haze problems in some areas, and section 169 of the Act provides additional authorities to remedy existing impairment and prevent future impairment in the 156 national parks, forests and wilderness areas labeled as mandatory Federal Class I areas (62 FR 38680–81, July 18, 1997).

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.<sup>70</sup> Fine particles with significant light-extinction efficiencies include organic matter, sulfates, nitrates, elemental carbon (soot), and soil. Size and chemical composition of particles strongly affects their ability to scatter or absorb light. Nitrates typically contribute 1 to 6 percent of average light extinction on hazy days in rural Eastern U.S. locations.<sup>71</sup>

Visibility is important because it directly affects people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, both in where they live and work, and in places where they enjoy recreational opportunities. Visibility is also highly valued in significant natural areas such as national parks and wilderness areas, because of the special emphasis given to protecting these lands now and for future generations.

To quantify changes in visibility, we compute a light-extinction coefficient, which shows the total fraction of light that is decreased per unit distance. Visibility can be described in terms of visual range or light extinction and is reported using an indicator called deciview.<sup>72</sup> In addition to limiting the

<sup>70</sup> National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy of Sciences Committee on Haze in National Parks and Wilderness Areas. National Academy Press, Washington, DC. This book can be viewed on the National Academy Press Website at <http://www.nap.edu/books/0309048443/html/>. See also U.S. EPA Air Quality Criteria Document for Particulate Matter (1996) (available on the internet at <http://cfpub.epa.gov/ncea/cfm/partmatt.cfm>) and Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. These documents can be found in Docket A–99–06, Documents No. II–A–23 and IV–A–130–32.

<sup>71</sup> US EPA Trends Report 2001. This document is available on the internet at <http://www.epa.gov/airtrends/>. A copy of this document is available in Docket No. OAR 2002–0030.

<sup>72</sup> Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. It is typically described in miles or kilometers. Light extinction is the sum of light scattering and absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm<sup>-1</sup>), with larger values representing worse visibility. The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the

distance that one can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes.

In addition, visibility impairment can be described by its impact over various periods of time, by its source, and the physical conditions in various regions of the country. Visibility impairment can be said to have a time dimension in that it might relate to short-term excursions or to longer periods (*e.g.*, worst 20 percent of days and annual average levels). Anthropogenic contributions account for about one-third of the average extinction coefficient in the rural West and more than 80 percent in the rural East. In the Eastern U.S., reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter. While secondarily formed particles still account for a significant amount in the West, primary emissions contribute a larger percentage of the total particulate load than in the East.

Furthermore, it is important to note that even in those areas with relatively low concentrations of anthropogenic fine particles, such as the Colorado Plateau, small increases in anthropogenic fine particulate concentrations can lead to significant decreases in visual range. This is one of the reasons mandatory Federal Class I areas have been given special consideration under the Clean Air Act.<sup>73</sup>

Taken together with other programs, reductions from this proposal would help to improve visibility across the nation, including mandatory Federal Class I areas.

#### C. Other Criteria Pollutants Affected by This Proposed Rule

The standards being proposed today would also help reduce levels of nitrogen dioxide (NO<sub>2</sub>), for which NAAQS have been established. Currently, every area in the United States has been designated to be in attainment with the NO<sub>2</sub> NAAQS.

#### IV. Description of Action

Under the authority of section 231 of the CAA, EPA today proposes to adopt standards equivalent to ICAO's February 1999 NO<sub>x</sub> emission standards (these NO<sub>x</sub> standards were adopted at CAEP/4 in 1998 and approved by the ICAO Council in 1999) and March 1997 test

decibel scale for sound. A deciview of 0 represents pristine conditions. Under many scenic conditions, a change of 1 deciview is considered perceptible by the average person.

<sup>73</sup> The Clean Air Act designates 156 national parks and wilderness areas as mandatory Federal Class I areas for visibility protection.