



Visibility

Resource Brief

Importance

The national parks of the National Capital Region (NCR) offer many types of scenic vistas and historic landscapes. Unfortunately, air pollution interferes with our ability to see them clearly. Small particles suspended in the atmosphere, mostly a result of human-caused air pollution, often create gray or white haze that mutes colors, forms, and textures.

Without the effects of pollution, natural visual range in the Eastern U.S. would be approximately 90 miles, but current visual range averages only 14-24 miles (IMPROVE 2014).

Both the federal Clean Air Act and the National Park Service Organic Act provide protection to air resources in national parks.



Photo: NPS Webcam

Visibility is fairly similar across the entire National Capital Region. This image from the air quality webcam trained on the National Mall shows a visual range of about 40 miles.

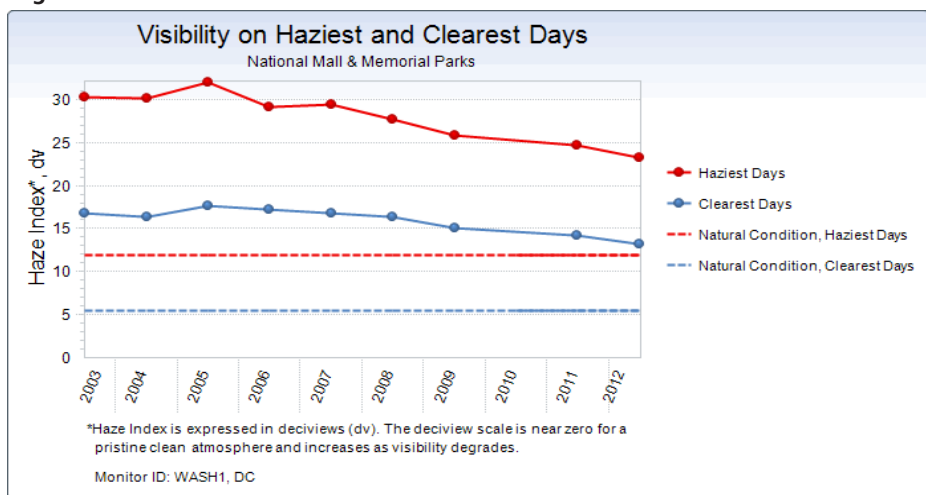
Goals

The NPS has adopted the Clean Air Act “Class I” visibility goal for all parks, including those in the NCR. The aim is to remedy existing, and prevent future, visibility impairment.

The National Capital Region Network, Inventory & Monitoring program (NCRN I&M) currently uses visibility and particulate matter monitoring data in order to:

- Assess seasonal and annual status and trends of visibility in the National Capital Region Network
- Measure the types and amounts of fine particles that cause visibility impairment

Figure 1.



Monitoring

Visibility is a measure of the ability of the atmosphere to scatter and/or absorb light that passes through it. This is affected by types and amounts of fine particulates in the air. The Haze Index, expressed in deciviews (dv), measures changes in visibility due to light extinction and scattering. As the Haze Index rises, visibility decreases.

Fine particles less than 2.5 millionths of a meter in diameter (PM_{2.5}) in the form of sulfates, nitrates, organics, elemental carbon, and soil particles are primarily responsible for visibility impairment.

Data on particulate matter and visibility is collected by the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, a collaboration of federal and state agencies and air quality organizations. IMPROVE particle samplers run for 24 hours every three days collecting both fine particles (PM_{2.5}) and coarse particles (PM₁₀) on filters. Samples are analyzed for mass, chemical elements, sulfate, nitrate, organics, and elemental carbon. The data are used to calculate haze levels in deciviews (dv).

Trends over time for visibility on the clearest and haziest days are calculated by the NPS Air Resource Division



(ARD). To assess visibility condition, the ARD has developed thresholds to define good, moderate, and significant concern conditions, based on the five-year average visibility minus the estimated average natural visibility for an area.

Visibility Condition Thresholds in deciviews (dv) (NPS ARD):

Visibility Condition	Average visibility minus estimated average natural visibility (dv)
Warrants Significant concern	> 8 dv
Warrants Moderate concern	2-8 dv
Good condition	< 2 dv

Results

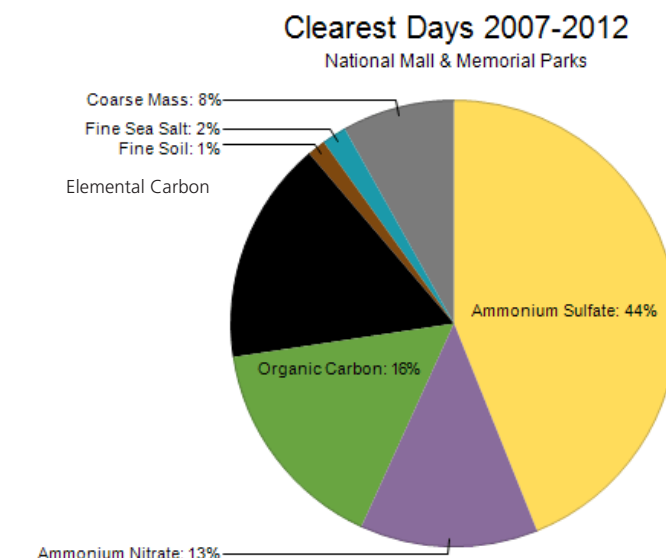
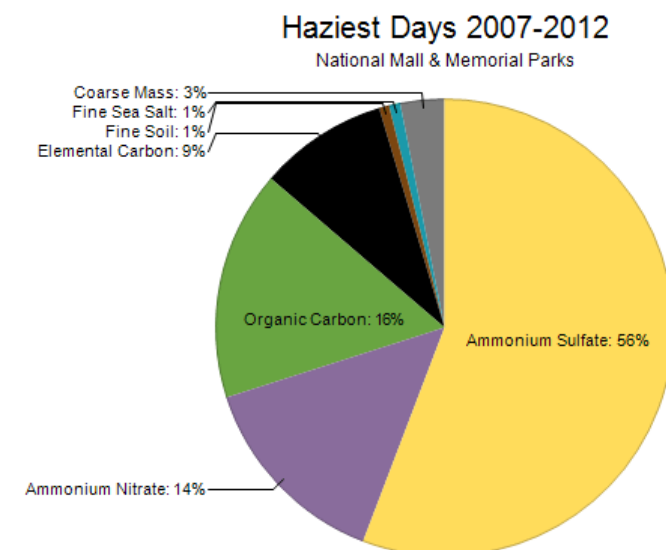
Visibility and particulate matter levels within the NCR are fairly similar from park to park and there are a limited number of monitoring stations where data is gathered. Hence, results presented here are for the National Mall and Memorial Parks (NAMA) in the center of the region.

From 2003-2012, visibility significantly improved on both clearest and haziest days (NPS ARD), based on an analysis of data from the IMPROVE sampler at NAMA (Figure 1).

However, haze estimates provided by NPS ARD for 2008-2012 show that all NCR parks still fall into the “significant concern” category. Haze values on average days are typically more than 8 dv above natural conditions.

What makes up the haze in the NCR? Fine particles of ammonium sulfate (formed from sulfur dioxide emissions primarily from coal-burning power plants) are the biggest contributor on both the haziest and clearest days (Figures 2 and 3). Organic carbon (both natural and man-made), ammonium nitrate (from vehicles, industry, and power plants), and elemental carbon (from diesel and fires) are also primary contributors to haze. Haze levels on the clearest days are much lower and organic carbon and coarse mass (from roadway and agricultural dust) also contribute.

A webcam atop the Netherlands Carillon pointing east toward the National Mall, posts an image online every 15



minutes (see photo, page 1). The webcam is a public outreach tool that provides a current view of a notable landscape along with information about air quality in terms of estimated visual range, ozone and particulate matter levels, and current weather data in the NCR. Visit <http://go.nps.gov/1aczej>.

References

- IMPROVE network website. http://vista.cira.colostate.edu/improve/Overview/hazeRegsOverview_files/v3_document.htm.
 NPS Air Resources Division. NPS Air Quality Conditions and Trends website (under development). Selections: National Mall and Memorial Parks, 2012. <http://www.nature.nps.gov/air/data/products/parks/index.cfm>.
 NPS Air Quality Web Camera for National Mall and Memorial Parks. <http://www.nature.nps.gov/air/WebCams/parks/nacccam/washcam.cfm>.