



North Carolina's air quality is good and getting better.



air

North Carolina's air quality is good and getting better. State leaders, agencies and private industries have taken significant steps in recent years to address air quality problems – notably ozone and particle pollution - and this work is achieving impressive results. Additional reductions are expected as industries and motor vehicles meet more stringent federal requirements.

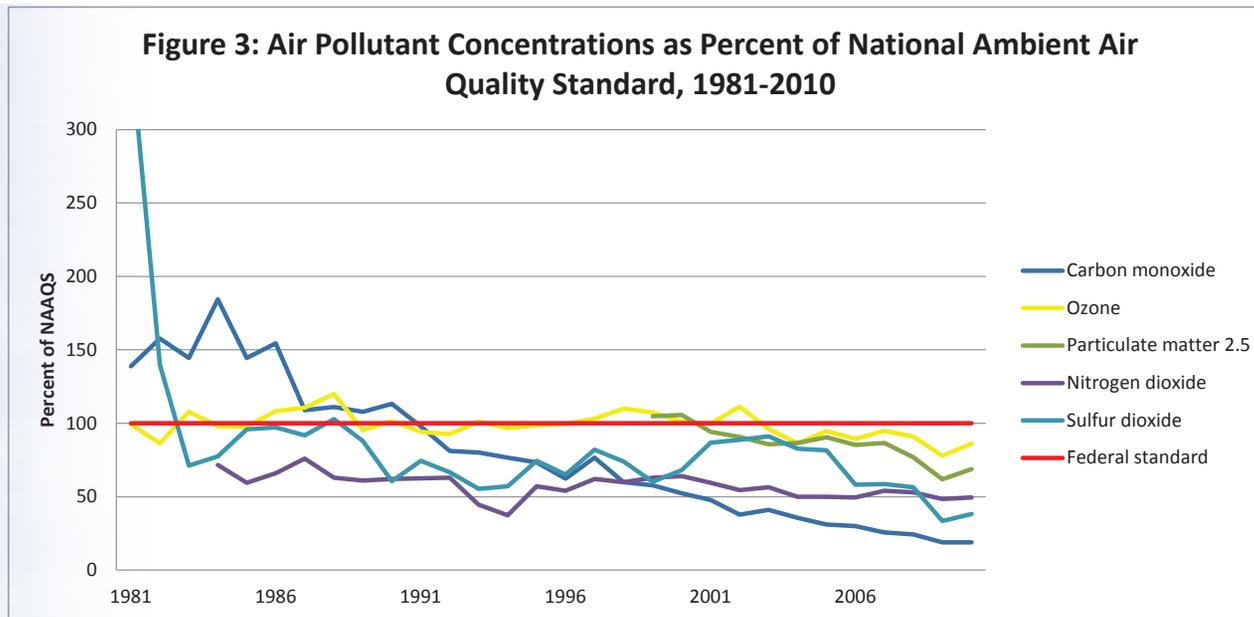
This section provides information about levels of air pollution in the state and state strategies to protect and improve air quality. For more information about air quality in your community, please visit the N.C. Division of Air Quality's [Forecast Center](#) or the U.S. Environmental Protection Agency's [My Environment](#) website.

Air Monitoring

Local and regional air monitoring began with the initial passage of the federal Clean Air Act in the early 1970s. Under the act, EPA set federal standards for six major air pollutants (called "criteria pollutants"): ozone, lead, particulates, carbon monoxide, nitrogen dioxide and sulfur dioxide. The federal standard for each pollutant is set at the level deemed to protect public health and the environment. Concentrations of these pollutants in the air – as measured by air quality monitors - are not supposed to exceed the federal standards.

North Carolina has 65 air quality monitoring sites for criteria pollutants. The monitors are located in 45 counties and operated by DENR's Division of Air Quality (DAQ), local air programs and EPA. The state also has special purpose air quality monitors - nine for measuring acid precipitation and six to measure toxic air pollutants. Although monitors are distributed across the state, monitoring equipment tends to be concentrated in urban areas that have more air quality problems.

Figure 3 depicts the change in air pollution concentrations over time. The majority of the state's air has levels of ozone, nitrogen dioxide, sulfur dioxide, particulate matter and carbon dioxide that are below the National Ambient Air Quality Standards established by the Environmental Protection Agency. The decline in ambient SO₂ is one of the most striking changes in Figure 3. North Carolina's reductions in SO₂ concentrations were experienced after the implementation of the federal acid rain program in 1983 and the N.C. Clean Smokestacks Act in 2002.



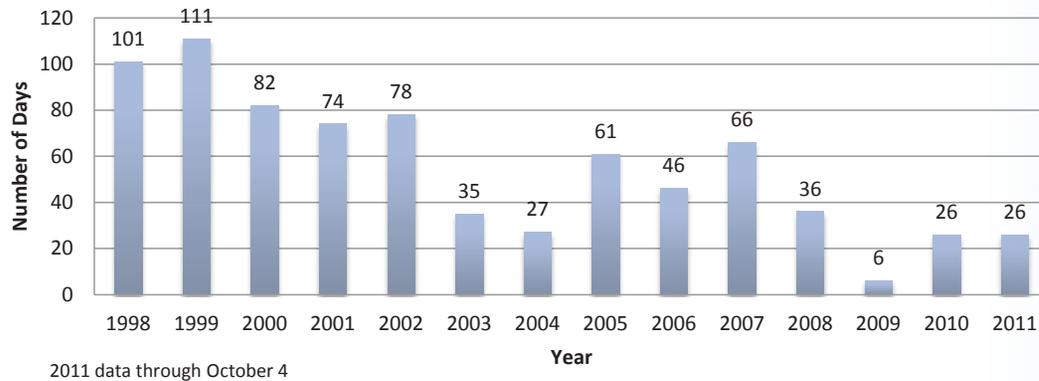
Ozone, a highly reactive form of oxygen, is North Carolina’s most widespread air quality problem. In the upper atmosphere, ozone protects the Earth from damaging solar radiation, but ground-level ozone is unhealthy to breathe and can damage trees and crops. Ozone is a secondary pollutant that forms when nitrogen oxides (NOx) react in the air with volatile organic compounds (VOCs) on hot, sunny days with little wind. Strategies for controlling ozone primarily focus on NOx because the southeastern United States has naturally high levels of VOCs in the air coming from trees and other vegetation.

NOx is formed during the combustion of fuels or other burning. The primary sources of NOx emissions in North Carolina are cars, trucks and other highway vehicles, representing 47 percent of all NOx emissions. Industrial point sources such as boilers and coal-fired power plants represent another 39 percent of emissions. Another significant source is non-road vehicles, which include construction equipment, railroad trains, lawnmowers and airplanes.

In the past, substantial portions of North Carolina had ozone levels exceeding the standard, and areas once designated nonattainment¹ of these standards included more than 30 counties in the Charlotte, Fayetteville, Rocky Mount, Triad and Triangle metro areas, as well as the Great Smoky Mountains National Park. However, as depicted in Figure 4, ozone levels have substantially declined across the state since the 1970s.

¹ Nonattainment areas are regions officially designated by the EPA as not meeting air quality standards and the state must develop plans for bringing such areas back into compliance. Areas that are re-designated to attainment are called maintenance areas.

**Figure 4: North Carolina Statewide 8-Hour Ozone Exceedance Days
2008 8-Hour Standard of 0.075 ppm**



The EPA has adopted more stringent ozone standards several times during the last two decades. In 1997, the federal agency adopted a new 8-hour standard of 0.08 parts per million (ppm) and subsequently discontinued the previous 1-hour standard of 0.125 ppm. In 2008, the EPA lowered the 8-hour standard to 0.075 ppm, but postponed its implementation in 2009 while considering whether to lower the standard to a level ranging from 0.060-0.070 ppm. In September 2011, the EPA announced that it would keep the ozone standard at 0.075 ppm and restart the process of designating nonattainment areas under the 2008 standard.

Currently, the Charlotte metropolitan area is the state’s only designated nonattainment area for the 1997 ozone standard. The area now meets that standard, and North Carolina has requested that EPA remove the nonattainment designation. However, the Charlotte area still violates the 2008 ozone standard and DAQ expects the EPA to designate the area as nonattainment for this standard in 2012. Ozone levels in the Triad metro area also exceeded the 2008 ozone standard during the 2008-2010 period, but met the standard during the 2009-2011 period, so DAQ does not expect a nonattainment designation for this area.

The state and local governments in the Charlotte metropolitan area must develop plans for reducing ozone-causing emissions in nonattainment areas. These plans include specific proposals for curbing ozone, such as measures to reduce emissions from cars, trucks, industries and power plants. Nonattainment designations also result in stricter controls on new industrial emissions. Companies seeking to build large, new industrial sources or expand existing large sources in nonattainment areas must install the most advanced or best-available pollution control technology. New or expanded industrial sources also need to obtain “offsets” if they would be increasing the overall emissions of ozone-forming pollutants in nonattainment areas.

Particle Pollution consists of very small solids and liquid droplets in the air. Unlike other pollutants, which generally consist of a single compound, particle pollution can contain a range of substances such as acids, organic

compounds, metals, soil and dust. Particle pollution can be unhealthy to breathe and contributes to the haze that obscures visibility. Exposure to particle pollution can cause or contribute to lung and heart disease. The EPA adopted a new standard for fine particles in 1997 due to growing concerns about the health effects.

The EPA regulates particle pollution according to the size of individual particles. Smaller particles are more of a concern because they can penetrate deep into a person's lungs and can be absorbed more readily into the bloodstream. Currently, the EPA has standards for fine particles, which are 2.5 micrometers in diameter or less, and coarse particles, which are less than 10.0 micrometers. Although the EPA has no air quality standard for larger particles, North Carolina has a standard for total suspended particulates (TSP) that covers particles larger than 10 micrometers.

A wide range of sources contribute to particle pollution, including power plants and other industry, cars and trucks, wood stoves and outdoor fires. Some particles form during the burning of fuels and others form later when pollutants react in the air. Emissions from coal-fired power plants are considered the largest source of fine particle pollution in North Carolina; this is largely due to sulfur dioxide, which converts in the air to sulfate fine particles, and represents about 33 percent of particle pollution in North Carolina. In 2008 and 2011, substantial portions of eastern North Carolina were affected by particle pollution from large wildfires.

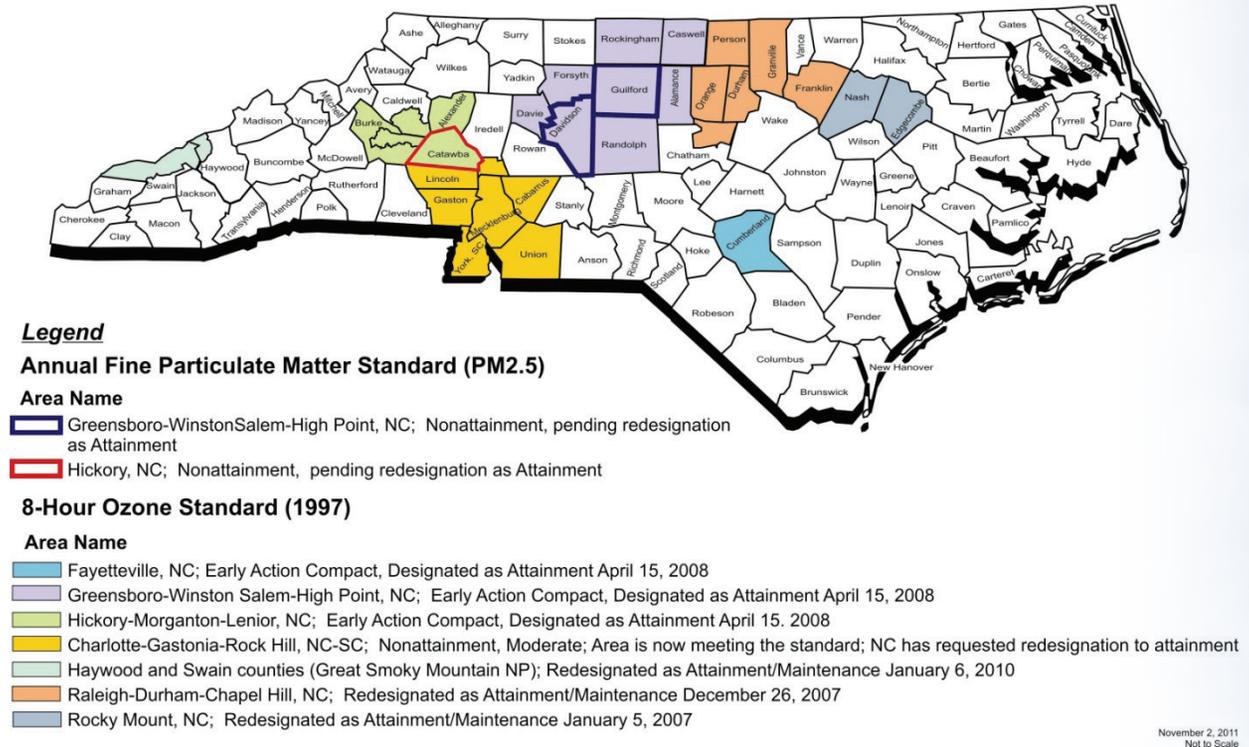
Unlike ozone, which occurs in the warmer months, high levels of particles can occur throughout the year. Typically, particle pollution events are associated with air stagnation events, inversions (when cooler air is trapped near the ground) or during forest fires and other large-scale outdoor burning. For example, high particle levels were measured after the ice storm in December 2002, when many people were using fireplaces to heat their homes due to widespread power outages and cold-air inversions trapped smoke near the ground. Absent such events, particle levels tend to be higher in the summer when higher humidity levels can enhance sulfate formation.

In December 2004, the EPA designated nonattainment areas for fine particle pollution based on air quality monitoring, commuting patterns and other factors. In North Carolina, the EPA designated nonattainment for fine particles (PM 2.5) in three counties: Catawba, Davidson and Guilford. PM 2.5 levels have declined substantially across the state since the 2002 passage of the state's Clean Smokestacks Act, which required substantial reductions in sulfur dioxide emissions at coal-fired power plants. Currently, all of North Carolina meets the fine particle standard and the state has requested that the EPA redesignate Catawba, Davidson and Guilford counties as attainment. The EPA is in the process of finalizing approval of the redesignation for all three counties.

In 2006, the EPA adopted a new 24-hour standard for PM 2.5 in addition to the annual standard. North Carolina has not had any areas that have violated or were designated nonattainment with the daily fine particle standard. Currently all areas are observing PM 2.5 levels that are well under the 24-hour standard.

Lead levels decreased in North Carolina once the EPA banned the use of leaded fuel in most vehicles. North Carolina still monitors for lead, but does so as a subset of the fine-particle pollution network with PM 2.5 monitoring data

Map 1: North Carolina Current Nonattainment and Maintenance Areas



(SO₂) is a pungent gas that is unhealthy to breathe and can damage trees and other vegetation. One of the first regulated air pollutants, SO₂ can be emitted by industries burning coal and fuel oil as well as by certain mining operations. In 2010, the EPA adopted a more stringent standard for SO₂, setting a 1-hour limit of 75 parts per billion (ppb). The new standard replaced two standards that had previously been in effect, a 24-hour standard of 140 ppb and an annual standard of 30 ppb. Industrial facilities account for most (93 percent) of the SO₂ emissions in North Carolina.

North Carolina had no compliance issues under the previous SO₂ standards, but the Wilmington-New Hanover County area has exceeded the new limit in recent years. DAQ has asked the EPA to defer designation of a nonattainment area for the 1-hour SO₂ standard until after 2012 due to the closure of several large sources in the area and the resulting drop in SO₂ levels. The New Hanover County monitor has measured no SO₂ values above the new standard so far in 2011. If the EPA will not agree to postpone the nonattainment decision for the Wilmington-New Hanover County area, North Carolina has recommended that the federal agency only designate

the northwestern corner of New Hanover County, bounded by the Cape Fear and Northeast Cape Fear rivers and the Pender County line.

Nitrogen Dioxide (NO₂), one of six criteria pollutants identified in the federal Clean Air Act, is unhealthy to breathe and contributes to ozone formation. The major source of NO₂ in North Carolina comes from highway vehicles. All of North Carolina complies with the federal NO₂ standard, and measured levels have declined over the years. However, the EPA adopted a more stringent NO₂ standard in 2010, which sets more stringent emissions limits for industries and establishes new monitoring requirements for the states. DAQ will implement the new standard through the permitting process for large industries and is in the process of evaluating the monitoring requirements.

A major development in 2011 was the settlement of a lawsuit against the Tennessee Valley Authority (TVA). In 2006, North Carolina filed a public nuisance lawsuit against the TVA, claiming that the utility's coal-fired plants sent polluted air into North Carolina. This agreement will result in the closure of many uncontrolled units and installation of emission-control equipment on almost all of the remaining units. Nitrogen oxide and sulfur dioxide emissions from these plants are linked to increased incidence of premature mortality, asthma, chronic bronchitis and other cardiopulmonary illnesses in North Carolina. In addition, the TVA will pay \$11.2 million to North Carolina over the next five years to be used for energy efficiency and electricity demand reduction programs.

Other Air Quality Issues

Several air quality issues have emerged or assumed greater importance in recent years for a number of reasons, including population increases and global trends. In addition to EPA's recent efforts to strengthen the sulfur dioxide and ozone standards, the federal agency has also focused attention on visibility, mercury and air toxics.

Visibility

Visibility refers to the clarity of air and the ability to view the landscape unobstructed by haze. Various pollutants cause haze that reduces visibility, including particle pollution, ammonia and sulfur oxides. Visibility has important implications for the state's tourist economy, aesthetics and recreation because haze can obscure views and detract from scenery – a critical issue in the mountains. In the eastern United States, haze from man-made emissions has reduced natural visibility in Class I Areas (national parks and wilderness areas) from about 90 miles to 15-25 miles.

The EPA has no health-based standard for haze, but in 1999 adopted a Regional Haze Rule aimed at improving visibility in national parks and wilderness areas. The rule required states to develop haze control plans, with an ultimate goal of restoring visibility to natural background levels by 2064. DAQ worked with other southeastern states to develop the first regional haze plan to improve visibility through 2018. Work is now underway to evaluate the plan and the next full plan is due in 2018, covering the period through 2028. Efforts to reduce sulfur dioxide emissions, which are the primary source of haze in the southeast, are helping to improve visibility in the area.

Mercury

Mercury is a metal that can be toxic to breathe at high-enough concentrations and can pose serious hazards, caused by eating certain fish, not by inhaling the air, even at low levels due to bio-accumulation in the environment and the food chain. The primary sources of man-made mercury emissions are coal-fired power plants (which account for about two-thirds of the mercury emissions in North Carolina) and other industrial facilities such as incinerators and factories that use mercury in their processes. There also are significant natural sources of mercury air emissions, such as volcanic eruptions, and much of the airborne mercury in North Carolina is transported into the state from other areas.

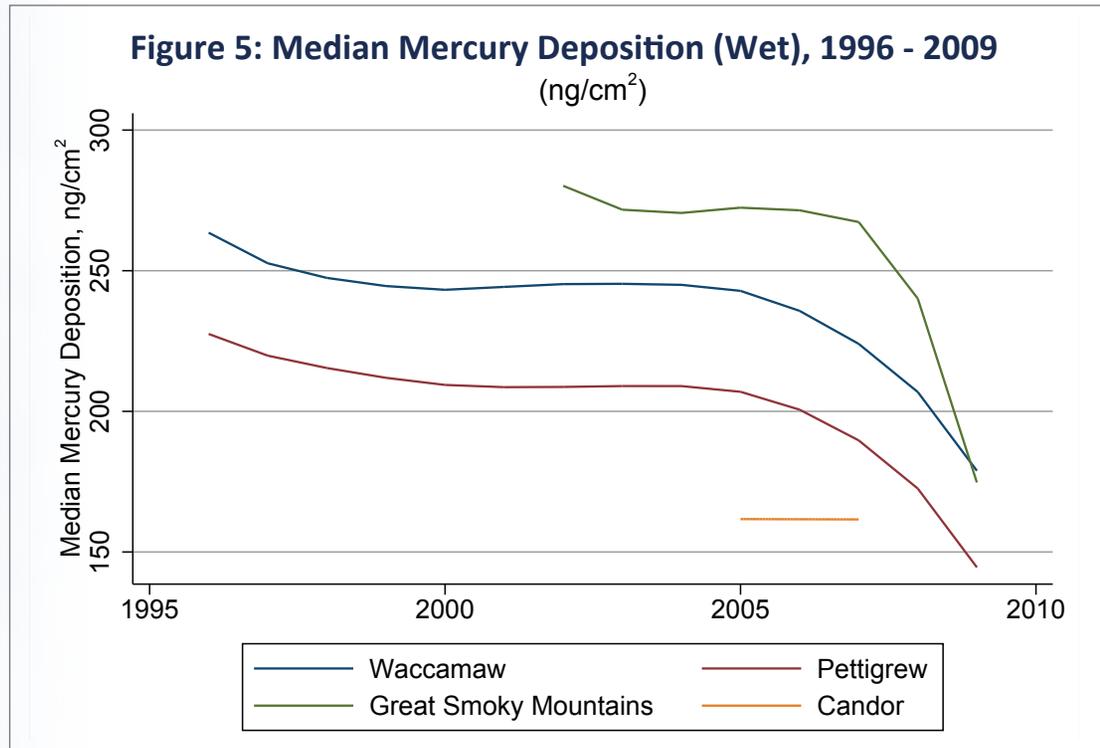
Some of the mercury in air emissions eventually settles to the earth in precipitation or dry particles that reach streams, lakes and coastal waters. When mercury reaches water bodies, certain bacteria can convert it to methyl mercury, a toxic organic form of mercury. Methyl mercury can bio-accumulate in the food chain, eventually reaching potentially harmful levels in the flesh of certain predatory fish. Eating mercury-contaminated fish is particularly hazardous for children, pregnant women (because of the potential impact on fetuses) and people who eat a lot of fish from affected water bodies. Due to such concerns, the EPA lowered the allowable mercury emissions rates from certain industrial facilities in 2010. The more stringent standards are generally applied through the permitting process for large industrial sources.

Coastal areas are especially susceptible to mercury because impacts to the entire aquatic food chain may occur if the water chemistry is conducive to transformation of deposited mercury to the more toxic -methyl mercury. For this reason, DAQ has been conducting mercury monitoring since 1995 at Pettigrew and Waccamaw state parks in the eastern part of the state. An inland site was briefly operated at Candor from 2005 to 2007. Weekly rainwater samples from monitors are analyzed for mercury and the results used to determine long-term trends.

This monitoring method does not directly measure mercury in the air. Factors such as localized sources, long-range transport, and type of mercury (elemental, water-soluble and particulate) affect the amount of mercury in these samples.



Figure 5 depicts the comparison of deposition rates at sites in North Carolina and eastern Tennessee (Great Smoky National Park). These data show a generalized slight downward trend in the deposition rate (measured in units of ng/cm²). Continued monitoring at these sites is necessary to determine if this is a continuing trend. Since the controls placed on large coal-fired utilities under the Clean Smokestacks Act have the additional benefit of reducing mercury emissions, those controls are contributing to any reduction.



Air Toxics

Air toxics include a range of pollutants generally emitted in lower amounts than criteria pollutants but having potentially significant adverse health effects. In addition to mercury, North Carolina and the EPA regulate a number of other toxic air emissions. North Carolina's air toxics rule sets health-based standards on 97 toxic air pollutants, and the EPA regulates 187 hazardous air pollutants through technology-based limits set by industry category that requires the installation of specific controls on emission sources. There are 76 pollutants that are common to both the state and federal lists, and some pollutants appear on one list but not the other. DAQ enforces these limits primarily through the permitting process for facilities that potentially emit air toxins higher than specified health-based standards. Facilities subject to the state air toxics program must demonstrate compliance through computer modeling.

In addition, several DAQ air monitoring programs are aimed at measuring levels of toxic air pollutants, including urban air toxics, mercury deposition and selected metals. Monitoring data are used to track trends and identify potential problem areas but are not used for permitting purposes. To identify the toxic air pollutants with the greatest potential for adverse health effects in North Carolina, a hazard rank was calculated by dividing pollutant concentrations from monitoring data by a “benchmark,” or reference concentration. Figure 6 shows how selected toxic air pollutants have trended since the year 2000. Hexavalent chromium, arsenic and cadmium show slight upward trends. Formaldehyde may have a slight upward overall trend, but since 2007 has been trending slightly downward. The benchmark used for formaldehyde is one developed by EPA and that benchmark was substantially lowered in 2009 as a result of an EPA reassessment of risk posed by formaldehyde. Benzene has generally trended upward since 2002, but since 2007 has been trending slightly downward. As Figure 6 shows, benzene poses the most significant risk of exposure of all toxic air pollutants sampled and analyzed in North Carolina.

