4.2 Air Resources

4.2.1 Introduction

Resource Issues

- Air quality, including sulfur dioxide, ozone, nitrogen dioxide, particulate matter, carbon monoxide, and lead

This section addresses existing air quality in the TVA Power Service Area. Air quality is good, and, based on long-term air pollution trends, improving. TVA and other emissions sources contribute to local and regional air quality primarily through emissions associated with the combustion of fossil fuels (coal, gas, and oil). Although air quality has, for the most part, greatly improved, air quality issues—including ozone, fine particles, and visibility—will continue to challenge the region and nation for years to come.

4.2.2 Regulatory Programs and TVA Management Activities

Through the Clean Air Act (CAA), Congress mandated the protection and enhancement of the nation's air quality resources. National Ambient Air Quality Standards (NAAQS) for the following pollutants have been established to protect the public health and welfare (these NAAQS are shown in detail in Table 4.2-01):

- Sulfur dioxide (SO_2);
- Ozone (O_3);
- Nitrogen dioxide (NO_2);
- Particulate matter less than or equal to 10 micrometers in diameter (PM_{10}) and less than or equal to 2.5 micrometers ($PM_{2.5}$) in diameter;
- Carbon monoxide (CO); and,
- Lead (Pb).

Other regulatory programs affecting emissions include the Acid Rain Control Program and the Regional Haze Rule.

The USEPA promulgated two revised NAAQS in 1997: an 8-hour ozone NAAQS and annual and 24-hour $PM_{2.5}$ NAAQS. Although attainment (air quality equal or better than standard) or non-attainment (air quality worse than standard) status has as yet to be determined, it is likely that a number of areas in and around the Tennessee Valley will not meet one or more of these stringent clean air standards.

Table 4.2-01 National Ambient Air Quality Standards

Pollutant	Standard Value[1]	Standard Type[2]
Particulate Matter (PM_{10})		
Annual arithmetic mean	50 $\mu g/m^3$	Primary & secondary
24-Hour average	150 $\mu g/m^3$	Primary & secondary
Particulate Matter ($PM_{2.5}$)		
Annual arithmetic mean	15 $\mu g/m^3$	Primary & secondary
24-Hour average	65 $\mu g/m^3$	Primary & secondary
Sulfur Dioxide (SO_2)		
Annual arithmetic mean	30 ppb (80 $\mu g/m^3$)	Primary
24-Hour average	140 ppb (365 $\mu g/m^3$)	Primary
3-Hour average	500 ppb (1300 $\mu g/m^3$)	Secondary
Ozone (O_3)		
1-Hour maximum	120 ppb (235 $\mu g/m^3$)	Primary & secondary
8-Hour maximum	80 ppb (157 $\mu g/m^3$)	Primary & secondary
Nitrogen Dioxide (NO_2)		
Annual average	53 ppb (100 $\mu g/m^3$)	Primary & secondary
Carbon Monoxide (CO)		
8-Hour maximum	9 ppm (10 mg/m^3)	Primary
1-Hour maximum	35 ppm (40 mg/m^3)	Primary
Lead (Pb)		
Quarterly average	1.5 $\mu g/m^3$	Primary & secondary

1 ppm = parts per million, ppb = parts per billion, mg/m3 = milligrams per cubic meter, and µg/m3 = micrograms per cubic meter. Parenthetical values are an approximately equivalent concentration.

2 Primary National Ambient Air Quality Standards (NAAQS) protect public health and secondary NAAQS protect public welfare.

4.2.3 Existing Conditions

National Ambient Air Quality Standards

One of the best measures of current air quality is whether or not an area attains the NAAQS. The TVA Power Service Area currently meets all NAAQS. However, three ozone non-attainment areas (Smyth County, Virginia; Birmingham, Alabama; and Atlanta, Georgia) are just outside the TVA Power Service Area. These areas are shown in Figure 4.2-01.

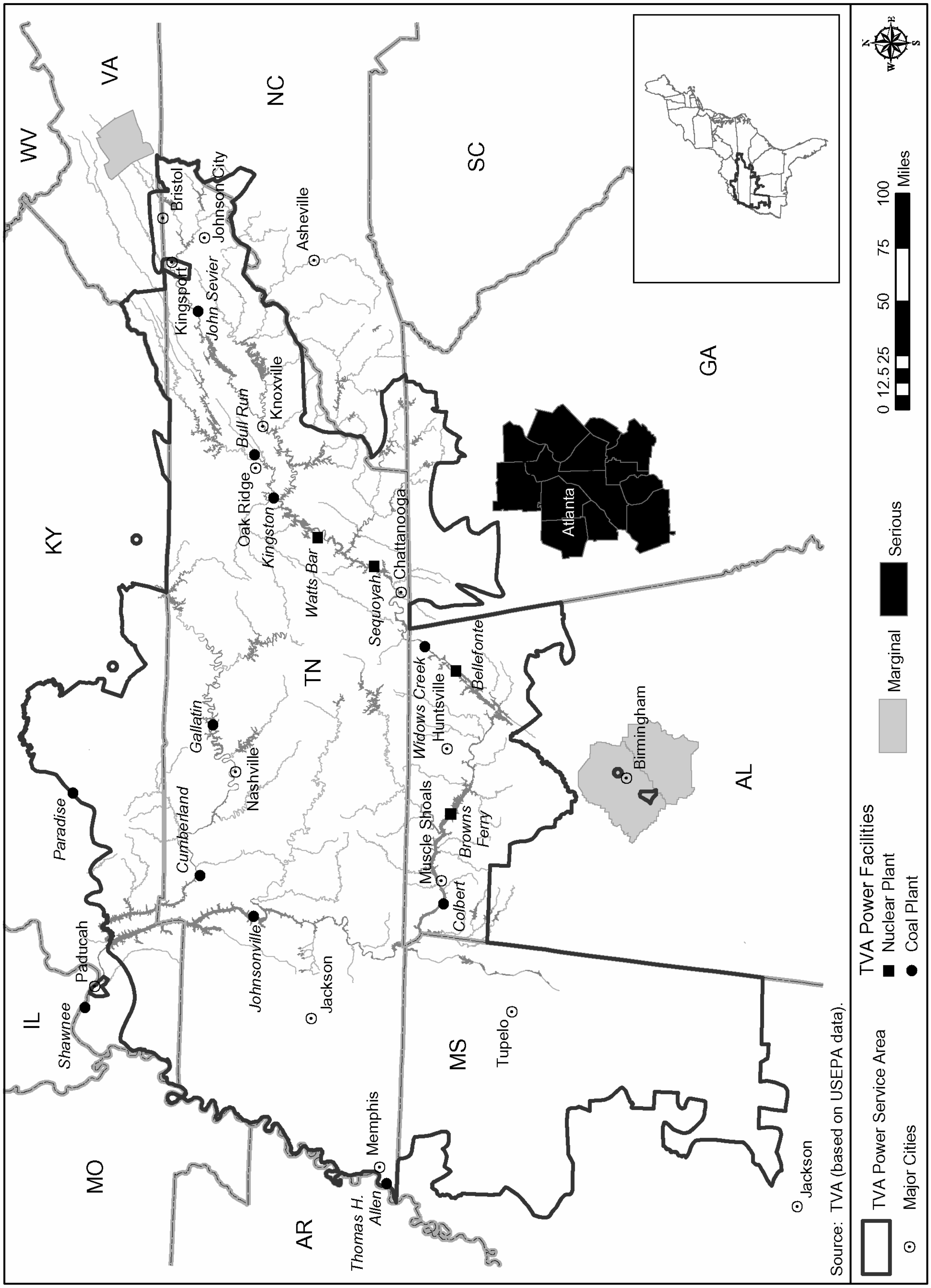


Figure 4.2-01 Ozone Non-Attainment Areas in the Tennessee Valley Region - 1-Hour Standard

Trends in NAAQS Pollutants

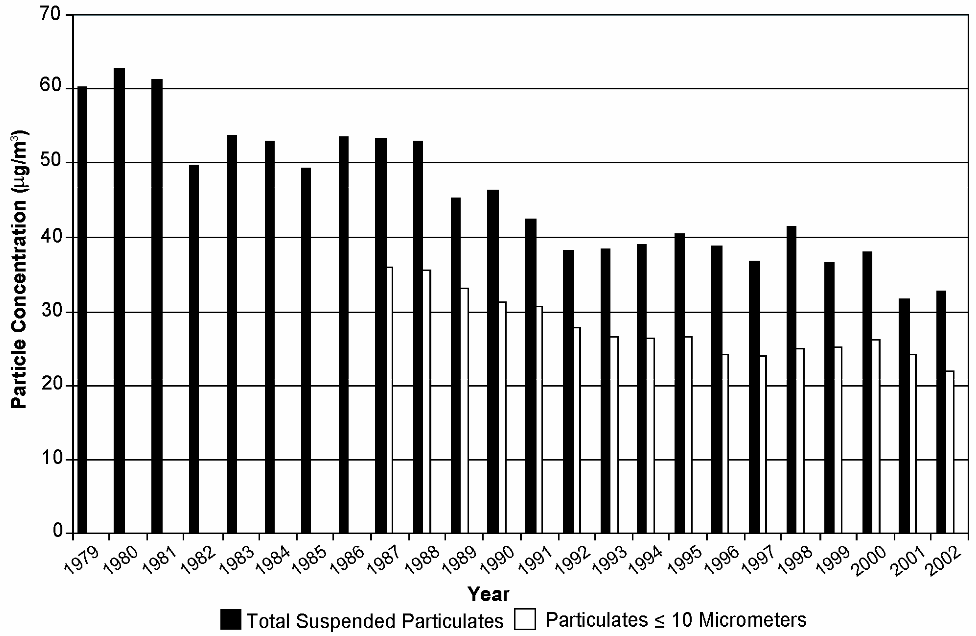
Overall, air quality in and downwind of the Tennessee Valley has greatly improved for over two decades, with significant long-term improvements (decreases) in sulfur dioxide, particulate matter (as measured by total suspended particulates [TSP] and PM_{10}), carbon monoxide, nitrogen dioxide, ozone (1-hour) and lead. Eight-hour ozone levels have not significantly changed over this same period and the fine particulate ($PM_{2.5}$) record is insufficient to establish long-term trends. These trends are consistent with long-term national and regional trends established by the USEPA (2003).

- Total suspended particulates, sulfur dioxide, and carbon monoxide have improved dramatically with air quality levels improving between 40 and 60 percent. All areas meet clean air standards for these pollutants. Two examples, the improvements in particulate matter (TSP, PM_{10}) and sulfur dioxide, are shown in Figures 4.2-02 and 4.2-03, respectively.

- Particulate matter less than 10 microns in diameter, nitrogen dioxide, and lead have improved significantly with air quality levels—improving between 20 and 30 percent. All areas meet NAAQS for these pollutants.

- Ozone levels for 1979 to 2002 are shown in Figure 4.2-04. There has been marginal improvement in the maximum 2nd-highest 1-hour ozone levels (about 7 percent) but no significant improvement in the maximum 4th-highest 8-hour levels. The 8-hour standard is not yet used to determine clean air status. The eventual implementation of this standard will lead to several urban and rural ozone non-attainment areas in and downwind of the TVA Power Service Area. Strategies to lower ozone pollution and bring areas into attainment will require further emissions controls for ozone precursor pollutants (volatile organic compounds [VOCs] and nitrogen oxides [NOx]). TVA already is implementing a nitrogen oxides control program that will considerably lower its contribution to ozone pollution.

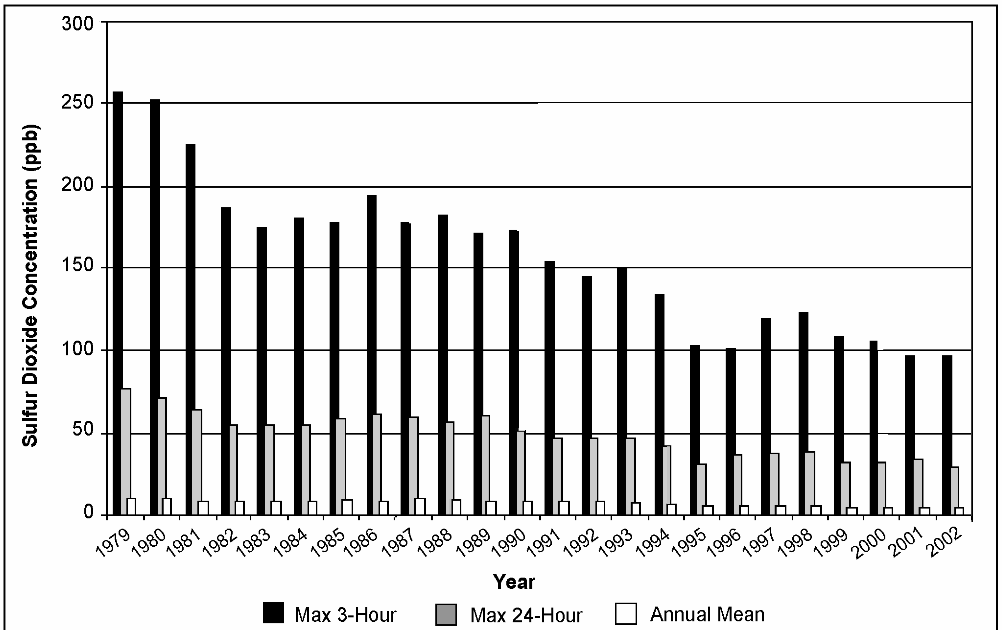
- Fine particulate air pollution–$PM_{2.5}$–could also prove a challenge in the coming years. The fine particulate standards are not yet used to determine clean air status, and there is insufficient record for trend assessment. The eventual implementation of these standards will likely result in several urban $PM_{2.5}$ non-attainment areas in and downwind of the TVA Power Service Area. Strategies to reduce fine particulate levels and bring these areas into attainment will likely require further emissions controls on sources of VOCs, elemental carbon, sulfur dioxide, and, perhaps, nitrogen oxides. TVA's nitrogen oxides and sulfur dioxide emission control programs will considerably lower its contribution to fine particulate air pollution.



Note: The annual average national ambient air quality standard for particulates ≤10 micrometers is 50 µg/m³.

Source: USEPA

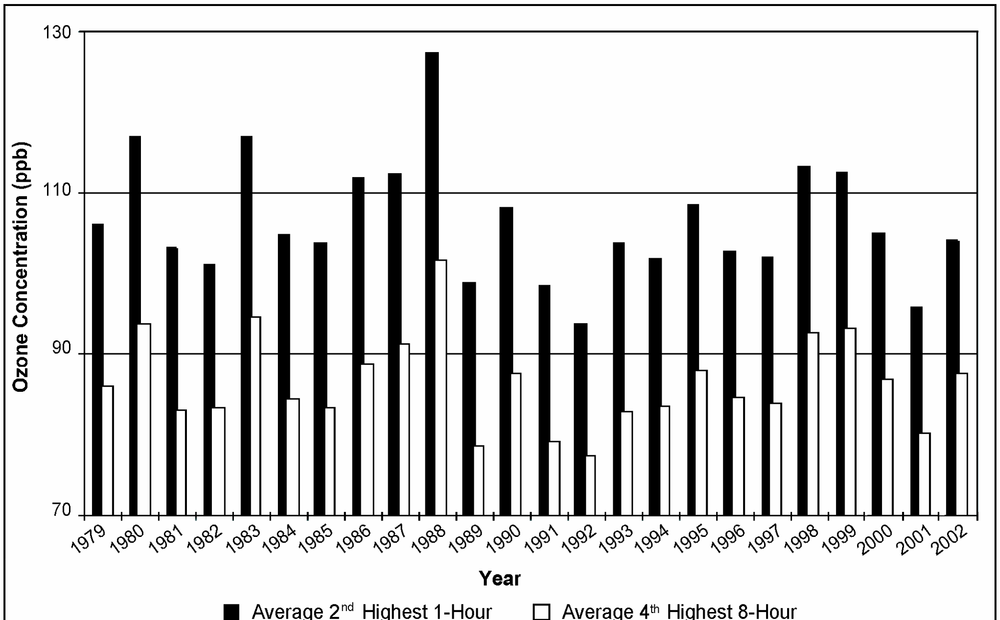
Figure 4.2-02 Air Quality Trends for Particulate Matter in the Tennessee Valley Region (1979 to 2002)



Note: The national ambient air quality primary average annual standard for sulfur dioxide is 30 parts per billion (ppb), the 24-hour primary standard is 140 ppb, and the 3-hour secondary standard is 500 ppb.

Source: USEPA

Figure 4.2-03 Air Quality Trends for Sulfur Dioxide in the Tennessee Valley Region (1979 to 2002)



Note: The national ambient air quality primary and secondary 1-hour standard for ozone is 120 parts per billion (ppb) and the 8-hour primary and secondary standard is 80 ppb.

Source: USEPA

Figure 4.2-04 Air Quality Trends for Ozone in the Tennessee Valley Region (1979 to 2002)

Status of TVA's Emissions

Existing emissions of regulated air pollutants from the TVA power generation system are summarized in Table 4.2-02. Over the long-term, the emissions of principal concern to TVA—sulfur dioxide and nitrogen oxides—have been reduced substantially. System-wide sulfur dioxide emissions have been reduced by 76 percent from the peak in 1977 while nitrogen oxides emissions have been reduced by 51 percent from the peak in 1995. Year-to-year emission changes also vary, depending on changes in demand, fuel type, and type of plant dispatched.

Air Quality-Related Values

An air quality-related value (AQRV) is a term often applied to the non-health impacts of air pollutants. These impacts are relevant to the health and enjoyment of the environment. USEPA's efforts to control pollutant emissions related to AQRVs include the Acid Rain Control Program and the Regional Haze Rule. These programs are primarily directed at managing pollution-caused impacts in national parks and wilderness areas (Class I areas), which have been set aside to preserve and protect the natural environment. Figure 4.2-05 shows the Class I national park and national wilderness areas in and around the Tennessee Valley region.

Table 4.2-02 Summary of TVA Power Plant Emissions of Air Pollutants

Emissions	Estimated Total Actual (tons)	
	2000	2001
Particulate matter	12,853	16,391
Sulfur dioxide	727,355	605,390
Nitrogen oxides	288,016	270,166
Carbon monoxide	12,390	12,446
Volatile organic hydrocarbon	1,531	1,530
Sulfuric acid	6,640	4,663
Total trace elements	19,401	15,679
Mercury	2.2	1.9
Organic hazardous air pollutants	39.6	35.3

Acid rain (also called acid deposition or atmospheric deposition) refers to the production and impact of human-made acidifying air pollutants. Humankinds' principal influence on rainfall acidity is through the emission of sulfur dioxide and nitrogen oxides, which are eventually deposited as gases or particles in rainfall, snow, or fog. Acid rain has been associated with a number of detrimental environmental effects, including declines in fish, agricultural, and forest productivity and accelerated weathering and corrosion of building products.

Visibility is defined as the greatest distance at which an observer can "just" see a black object viewed against the horizon sky. However, visibility is more than simply a measurement of how far an object can be seen; it is related to the conditions that allow appreciation of the inherent beauty of landscape features. Regional visibility is estimated to have declined by as much as 60 percent over the past 50 years in the eastern United States, with the poorest visibility conditions occurring during summer.

The deterioration in visibility is linked to an increase in regional haze, a type of visibility impairment resulting from widely dispersed and intermixed pollutants from many sources. Atmospheric particles and gases that reduce visual contrast and visual range by absorbing and scattering light have their origins in both natural and human-caused processes. For example, the bluish "smoky mountain" haze characteristic of southern Appalachia originates from organic (i.e., carbon-based) aerosols emitted by mountain forests. Much of the light extinction in our regional haze that reduces visibility is due to fine sulfate particles. Sulfates can originate from natural sources, but these are of minor importance. Instead, regional haze is mostly due to fine sulfate particles related to the emission of sulfur dioxide.

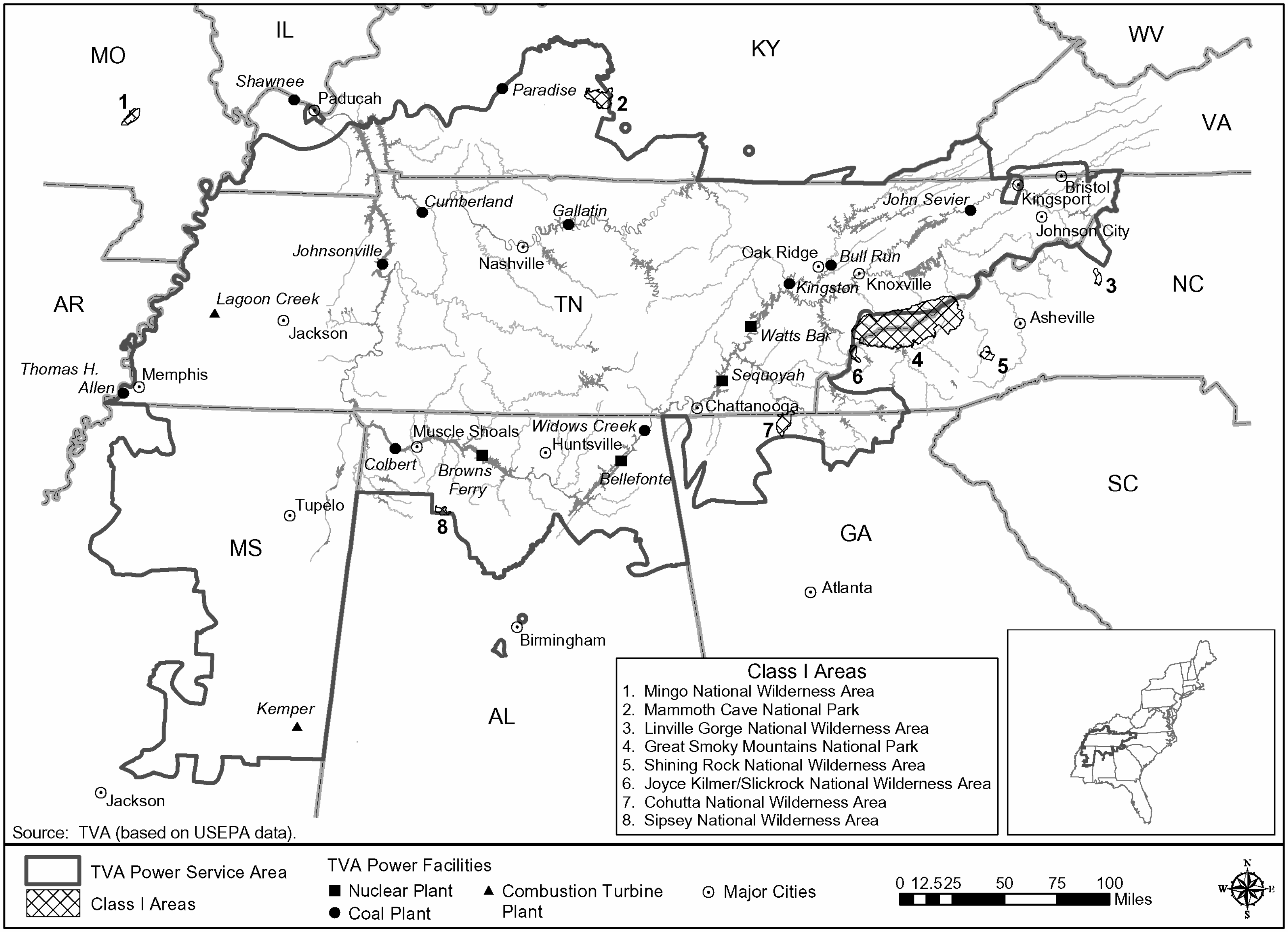


Figure 4.2-05 National Park and National Wilderness Areas Designated as Air Quality Class I Areas for the Prevention of Significant Deterioration in the Tennessee Valley Region

Trends in AQRVs in the Tennessee Valley Region

Significant reductions in acid deposition have been achieved. Figures 4.2-06 and 4.2-07 show the reduction in hydrogen ion concentrations and sulfate in precipitation in the Tennessee Valley region. Environmental management programs to address ozone and $PM_{2.5}$ attainment issues should also lead to further improvements in acid rain and regional haze.

Hazardous Air Pollutants

Hazardous or toxic air pollutants are any of more than 650 chemicals that, with adequate exposure, may cause potential health problems. Examples of toxic pollutants include those defined as hazardous compounds in the CAA (asbestos, beryllium, mercury, vinyl-chloride, benzene, arsenic, and radionuclides), heavy metals (such as chromium, cadmium, and nickel), and persistent bioaccumulating compounds (such as PCBs, dioxin, and pesticides).

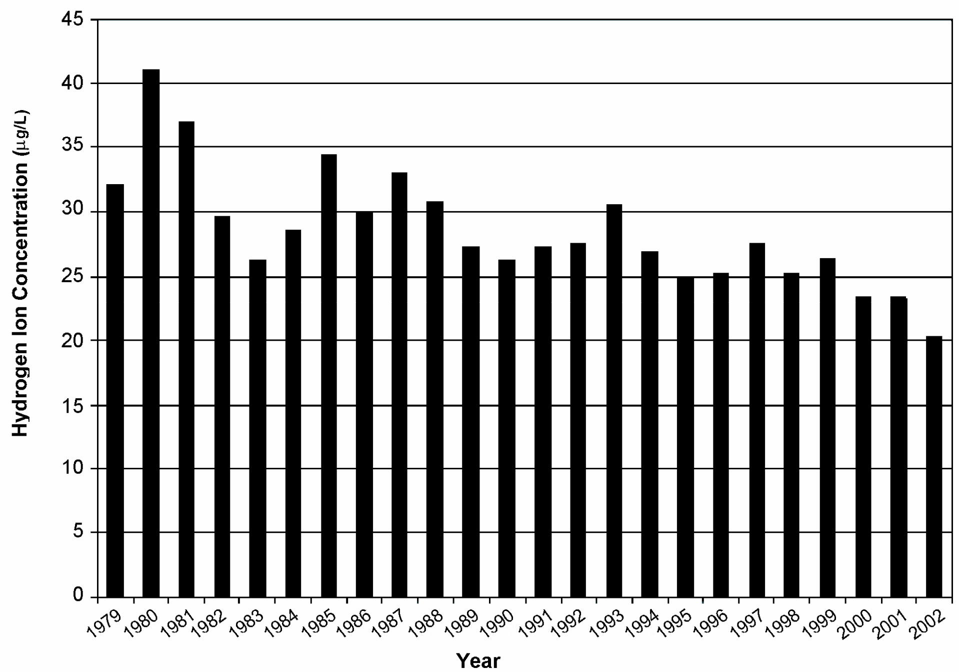
The sources of toxic air pollutants range from very large industries—including those using or producing plastics, pesticides, solvents, fossil fuels, petrochemical fuels, agrochemicals and waste treatment facilities, such as incinerators, sewage treatment plants, and landfills—to very small ones, such as the corner dry cleaners, gas stations, print shops, and common household products. While the total amount of toxic emissions is important, personal exposure to toxic pollutants can be dominated by small, nearby sources.

Status of TVA Emissions

On Earth Day 1997, the USEPA added coal- and oil-fired electric generating units to the list of facilities required to report annual air, water, and land releases of potentially toxic substances to the USEPA-maintained, public-access Toxics Release Inventory (TRI) database beginning in 1998.

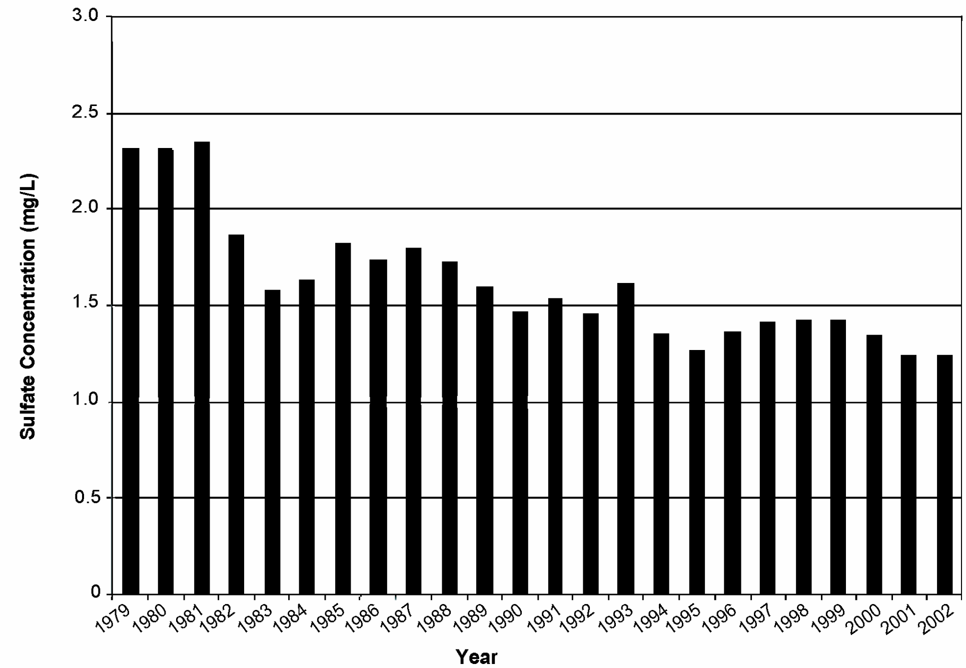
TVA issued its first TRI release reports (for calendar year 1998) on July 1, 1999. These facility-specific reports estimate the land, air, and water release of more than 20 potentially toxic substances, including antimony, arsenic, barium, beryllium, chromium, cobalt, copper, hydrochloric acid, hydrogen fluoride, lead, manganese, nickel, selenium, sulfuric acid, thallium, zinc, n-hexane, and 1,2,4-trimethylbenzene.

While the total amount of TVA's TRI releases is substantial, quantity alone does not provide a meaningful picture of associated health risk. To gain this perspective, it is necessary to estimate human exposure. Beginning in 1999, TVA conducted plant-specific, inhalation risk assessments based on annual air TRI emissions estimates for each of its plants. These risk assessments combine environmental exposure estimates with evolving health effects guidelines developed by USEPA and others. The risk estimates provided by these annual assessments helps TVA gauge the health significance of its TRI releases.



Note: Hydrogen ion concentration is inversely proportional to pH - the higher the concentration, the lower the pH.
Source: National Atmospheric Deposition Program/National Trends Network.

Figure 4.2-06 Rainfall Hydrogen Ion Concentration in the Tennessee Valley Region (1979 to 2002)



Source: National Atmospheric Deposition Program/National Trends Network.

Figure 4.2-07 Rainfall Sulfate Concentration in the Tennessee Valley Region (1979 to 2002)

The results from TVA health risk assessments indicate that emissions of TRI/HAP substances from TVA plants do not pose a significant health risk to either TVA employees or the general public. These findings are consistent with independent assessments (USEPA, EPRI, Harvard University).

Trends in TVA Hazardous Air Pollutant Emissions

TVA's estimated Hazardous Air Pollutant (HAP) emissions vary greatly from year-to-year, depending largely on changes in fossil fuel type and generating load. Emissions control systems also have a significant impact. Utility generating sources presently are not required to control for specific HAP compounds. Existing and planned particle and gaseous emissions reduction programs do and will provide some significant HAP control benefits. The USEPA is in the process of establishing mercury control requirements for utilities.

4.2.4 Expected Future Changes in Emissions

The region is currently in attainment with all clean air standards. The upcoming implementation of the revised 8-hour ozone and fine particulate standards is an emerging challenge. TVA's ongoing sulfur dioxide and nitrogen oxides emissions control programs will further reduce TVA's contribution to both ozone and fine particulate pollution, but attainment of these stringent standards will require significant controls from other source sectors as well. TVA's ongoing emissions control programs will also benefit regional AQRVs, including acid rain and visibility. These environmental control investments should also result in a beneficial effect on TVA HAP/TRI emissions.

NAAQS Pollutants

Controls to Meet the New Ozone NAAQS. Once 8-hour non-attainment areas are determined, state and local environmental regulatory programs will develop plans to achieve the ozone NAAQS. TVA's ongoing nitrogen oxides control program will further reduce TVA's contribution to ozone pollution. It must also be recognized that NOx and VOC controls from other emissions sectors will be needed to attain this standard. Just as TVA NOx emissions are part of the problem, TVA controls are only part of the solution.

Controls to Meet the New Fine Particle NAAQS. Once $PM_{2.5}$ non-attainment areas are determined, state and local environmental regulatory programs will develop plans to achieve this NAAQS. TVA's ongoing sulfur dioxide and nitrogen oxides control programs will further reduce TVA's contribution to $PM_{2.5}$. Additional VOC and elemental carbon controls from other emissions sectors will also be needed to attain this standard.

Controls to Meet AQRV. TVA is fully compliant with the acid rain control program established in the CAA. It is expected that ongoing sulfur dioxide and nitrogen oxides control programs will further reduce TVA's contribution to acid rain. TVA's ongoing sulfur dioxide and nitrogen oxides control programs will further reduce TVA's contribution to regional haze through 2010.

Hazardous Air Pollutants

TVA has reduced emissions of HAPs through application of control devices that capture particulate matter, sulfur dioxide, and nitrogen oxides. The collection of the HAPs is a natural adjunct to the main target of the control. As more control devices are added, further reductions are expected.