# Kentucky Ambient Air Quality Annual Report

# 2004


Commonwealth of Kentucky
Environmental & Public Protection Cabinet
Department for Environmental Protection
Division for Air Quality
803 Schenkel Lane
Frankfort, Kentucky 40601

Kentucky
UNBRIDLED SPIRIT

# TABLE OF CONTENTS

# FOREWORD

The Kentucky Ambient Air Quality Annual Report is produced by the Technical Services Branch of the Kentucky Division for Air Quality. This report presents the summary statistical results of monitoring conducted in calendar year 2004 to measure the outdoor concentrations of air pollutants in the Commonwealth.

The primary source of data for this report is the Air Quality Surveillance Network operated by the Kentucky Division for Air Quality. The report also contains monitoring data collected by the Louisville Metro Air Pollution Control District, the National Park Service and some industries.

## Network Design and Operation

The state has operated an air quality monitoring network since July 1967. The 2004 network included 99 monitors in 33 counties (this total includes monitors operated by the Louisville Metro Air Pollution Control District and the National Park Service at Mammoth Cave).

The monitoring station locations are selected with U.S. Environmental Protection Agency guidance and, in general, are established near high population areas or air pollution sources. Each year the site locations are reviewed to ensure that adequate coverage is being provided.

Many staff hours are devoted to the operation of the monitoring network. Division staff routinely visit the sites to calibrate and maintain the monitoring equipment, collect samples, and verify and document data from the continuous monitors.

Because it is imperative that the air monitoring data be accurate and precise, the Division for Air Quality has an extensive quality assurance program. Staff members audit every air monitor quarterly to ensure that each is operating properly. This audit includes monitors operated by the Louisville Metro Air Pollution Control District, the National Park Service and industrial networks.

Monitoring data is used in several ways. The data is used to demonstrate compliance with and/or progress made toward meeting ambient air quality standards and to identify pollution trends. The data is also used to evaluate public health impacts and the possible need to initiate emergency control procedures.

The public has access to the information through this annual report and, on a daily basis, through the Air Quality Index (AQI) message on our website: www.air.ky.gov/AQIndex.htm or toll free at: 1-800-AIR-IN-KY. This is a 24-hour report on Kentucky's air quality. During the summer months, the public can also access daily ozone level reports through EPA's AIRNOW website at www.epa.gov/airnow.

## Report Organization

This report contains sections on each criteria pollutant with the monitoring data contained in a table arranged alphabetically by county. Wet deposition, toxics and industrial data are presented in separate sections.

The report has been composed and arranged in an attempt to make it "user friendly." Included in the report are: a National Ambient Air Quality Standards table; a table listing monitors by county; maps indicating monitor locations; and pollutant trends graphs.

If you have suggestions or questions concerning this report, please contact Larry Garrison, Technical Services Branch, Division for Air Quality, 803 Schenkel Lane, Frankfort, KY 40601.

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## Ambient Air Quality Standards

| POLLUTANT | MAXIMUM CONCENTRATION | |
|---|---|---|
| | PRIMARY STANDARD | SECONDARY STANDARD |
| **Carbon monoxide** | | |
| 8 hour average | 9 ppm (1) | 9 ppm (1) |
| 1 hour average | 35 ppm (1) | 35 ppm (1) |
| **Sulfur oxides** | | |
| 24 hour average | 0.14 ppm (1) | -- |
| annual average | 0.03 ppm | -- |
| 3 hour average | -- | 0.50 ppm (1) |
| **Nitrogen dioxide** | | |
| Annual average | 0.05 ppm | 0.05 ppm |
| **Lead** | | |
| Calendar Quarter average | 1.5 $\mu g/m^3$ | 1.5 $\mu g/m^3$ |
| **Ozone** | | |
| 1 hour average | 0.12 ppm (4) | 0.12 ppm (4) |
| 8 hour average | 0.08 ppm (5) | 0.08 ppm (5) |
| **Particulate Matter** (measured as $PM_{10}$) | | |
| 24 hour average | 150 $\mu g/m^3$ (3) | 150 $\mu g/m^3$ (3) |
| annual average | 50 $\mu g/m^3$ (2) | 50 $\mu g/m^3$ (2) |
| **Particulate Matter** (measured as $PM_{2.5}$) | | |
| 24 hour average | 65 $\mu g/m^3$ (6) | 65 $\mu g/m^3$ (6) |
| annual average | 15 $\mu g/m^3$ (7) | 15 $\mu g/m^3$ (7) |

The federal Clean Air Act, as amended by the U.S. Congress in 1970, 1977 and 1990, directs the U.S. Environmental Protection Agency (EPA) to establish NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) defining maximum allowable ambient (outdoor) concentrations for criteria pollutants. The term "criteria pollutants" derives from the requirement that EPA must set criteria or standards for each.

There are two standard goal levels for each of the criteria pollutants. The PRIMARY STANDARD is designed to protect the public health. The SECONDARY STANDARD is designed to protect public health and welfare. Welfare covers damage to plants and animals, impairment of visibility and property damage.

Units of measure in the chart are micrograms of pollutants per cubic meter of air ($\mu g/m^3$) and parts of pollutants per million (ppm) parts of air.

Footnotes:

(1) This average is not to be exceeded more than once per year.
(2) The standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 $\mu g/m^3$.
(3) The standard is attained when the expected number of days per calendar year with a twenty-four (24) hour average concentration above 150 $\mu g/m^3$ is equal to or less than one (1).
(4) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm (235 $\mu g/m^3$) is equal to or less than one (1).
(5) The standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average ozone concentration is less than or equal to 0.08 ppm.
(6) The standard is attained when the 3-year average of the annual 98th percentile is less than or equal to 65 $\mu g/m^3$.
(7) The standard is attained when the 3-year average of annual means is less than or equal to 15 $\mu g/m^3$.

## 2004 Kentucky Air Monitoring Network Sites by County

| County | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | $O_3$ | Pb | AcidRn | WS/WD |
|---|---|---|---|---|---|---|---|---|---|
| Bell | 1 | 1 | | | | 1 | | | 1 |
| Boone | | | | | | 1 | | | |
| Boyd | 1 | 2 | 1 | 1 | | 1 | | | 1 |
| Bullitt | 1 | 1 | | 1 | | 1 | | | 1 |
| Campbell | 1 | 1 | 1 | 1 | | 1 | | | |
| Carter | 1 | | | | | 1 | | 1 | 1 |
| Christian | 1 | | | | | | | | |
| Daviess | 1 | 2 | 1 | 1 | | 1 | | | 1 |
| Edmonson[1] | 1 | | | | | 1 | | 1 | |
| Fayette | 2 | 1 | 1 | 1 | | 2 | | | |
| Franklin | 1 | | | | | | | | |
| Graves | | | | | | 1 | | | 1 |
| Greenup | | | 1 | | | 1 | | | |
| Hancock | | | 1 | | | 1 | | | |
| Hardin | 1 | 1 | | | | 1 | | | |
| Harlan | | 1 | | | | | | | |
| Henderson | 1 | 1 | 1 | | | 1 | | | |
| Jefferson[2] | 4 | 2 | 2 | 1 | 2 | 3 | | | 1 |
| Jessamine | | | | | | 1 | | | 1 |
| Kenton | 1 | | | | | 1 | | | 1 |
| Laurel | 1 | 1 | | | | | | | |
| Livingston | | | 1 | | | 1 | | | 1 |
| McCracken | 1 | 2 | 1 | 1 | | 1 | | | |
| McLean | | | | | | 1 | | | 1 |
| Madison | 1 | 1 | | | | | | | |

## 2004 Kentucky Air Monitoring Network Sites by County

| County | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | $O_3$ | Pb | Acid Rn | WS/WD |
|---|---|---|---|---|---|---|---|---|---|
| Marshall | | 1 | | | | | | | |
| Oldham | | | | | | 1 | | | |
| Perry | 1 | 1 | | | | 1 | | | 1 |
| Pike | 1 | 1 | | | | 1 | | | |
| Pulaski | | 1 | | | | 1 | | | |
| Scott | | | | | | 1 | | | |
| Simpson | | | | | | 1 | | | 1 |
| Warren | 1 | 1 | 1 | 1 | | 1 | | | |
| Total | 24 | 22 | 12 | 8 | 2 | 30 | 0 | 2 | 13 |

[1] Operated by the National Park Service.
[2] Operated by the Louisville Metro Air Pollution Control District.

## 2004 Industrial Air Monitoring Network Sites by County

| County | $PM_{2.5}$ | $PM_{10}$ | $SO_2$ | $NO_2$ | CO | $O_3$ | Pb | Acid Rn | WS/WD |
|---|---|---|---|---|---|---|---|---|---|
| Carroll | | 1 | | | | | | | |
| Christian | | | | | | 1 | | | |
| Estill | | | 1 | | | | | | |
| Henderson | | | 2 | | | | | | |
| Madison | | | 1 | | | | | | |
| Scott | | | | | | 1 | | | |
| Trigg | | | | | | 1 | | | |
| Webster | | | 1 | | | | | | |
| Wayne,WV | | | 3 | 1 | | 1 | | | |
| Total | 0 | 1 | 8 | 1 | 0 | 4 | 0 | 0 | 0 |

## Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless, poisonous gas that is produced by the incomplete combustion of carbon containing fuels. The primary source of carbon monoxide is the exhaust from motor vehicles that includes highway and off-road vehicles such as construction equipment. Other sources include industrial processes and coal, kerosene and wood burning stoves in homes.

The main health effect of carbon monoxide is its tendency to reduce the oxygen carrying capacity of blood. Carbon monoxide enters the bloodstream in the lungs where it binds chemically with the hemoglobin in red blood cells. Hemoglobin normally carries oxygen to organs and tissues but because CO binds with the hemoglobin over 200 times more readily than oxygen, the amount of oxygen absorbed into the bloodstream is greatly reduced when CO is present. Depending on the level of exposure, CO can cause fatigue and headaches and can impair vision and reflexes. Unconsciousness and even death may occur at high concentrations. The severity of the effects is related to the length of exposure and concentration level of CO.

Carbon monoxide is monitored continuously by analyzers that operate using the non-dispersive infrared photometry method. In this method, ambient air is drawn into a sample cell and a beam of infrared light is passed through it. Carbon monoxide absorbs infrared light and any decrease in the intensity of the beam is due to the presence of CO. The decrease is directly related to the concentration of CO in the ambient air. A detector measures the difference between the sample cell beam and a duplicate beam passing through a reference cell with no CO present. The difference is translated into a measure of the CO present in the ambient air. Data from the analyzer is transmitted by telemetry for entry into an automated data storage system. In 2004 the Louisville Metro Air Pollution Control District operated two CO monitors in Jefferson County.

| | |
|---|---|
| **Primary NAAQS:** | 8-hour average not to exceed 9 ppm more than once per year.<br>1-hour average not to exceed 35 ppm more than once per year. |
| **Secondary NAAQS:** | Same as primary standard. |

There were no exceedances of the CO standards in 2004. The last exceedance of a standard occurred on January 7, 1998 in Ashland when an 8-hour average of 11.7 ppm was recorded. All Kentucky counties are currently in attainment of the standards for carbon monoxide.

Statewide and regional carbon monoxide levels have declined substantially since 1980, primarily due to improved emission controls on motor vehicles (see Figure 1). Due to the substantial drop in monitored levels, carbon monoxide monitoring was discontinued statewide in 2003 except for Jefferson County. This accounts for the up trend in 2004 for the statewide average as it includes only data from Jefferson County which has historically been higher than the rest of the state.

A statistical summary of carbon monoxide data collected in 2004 follows on page 8.

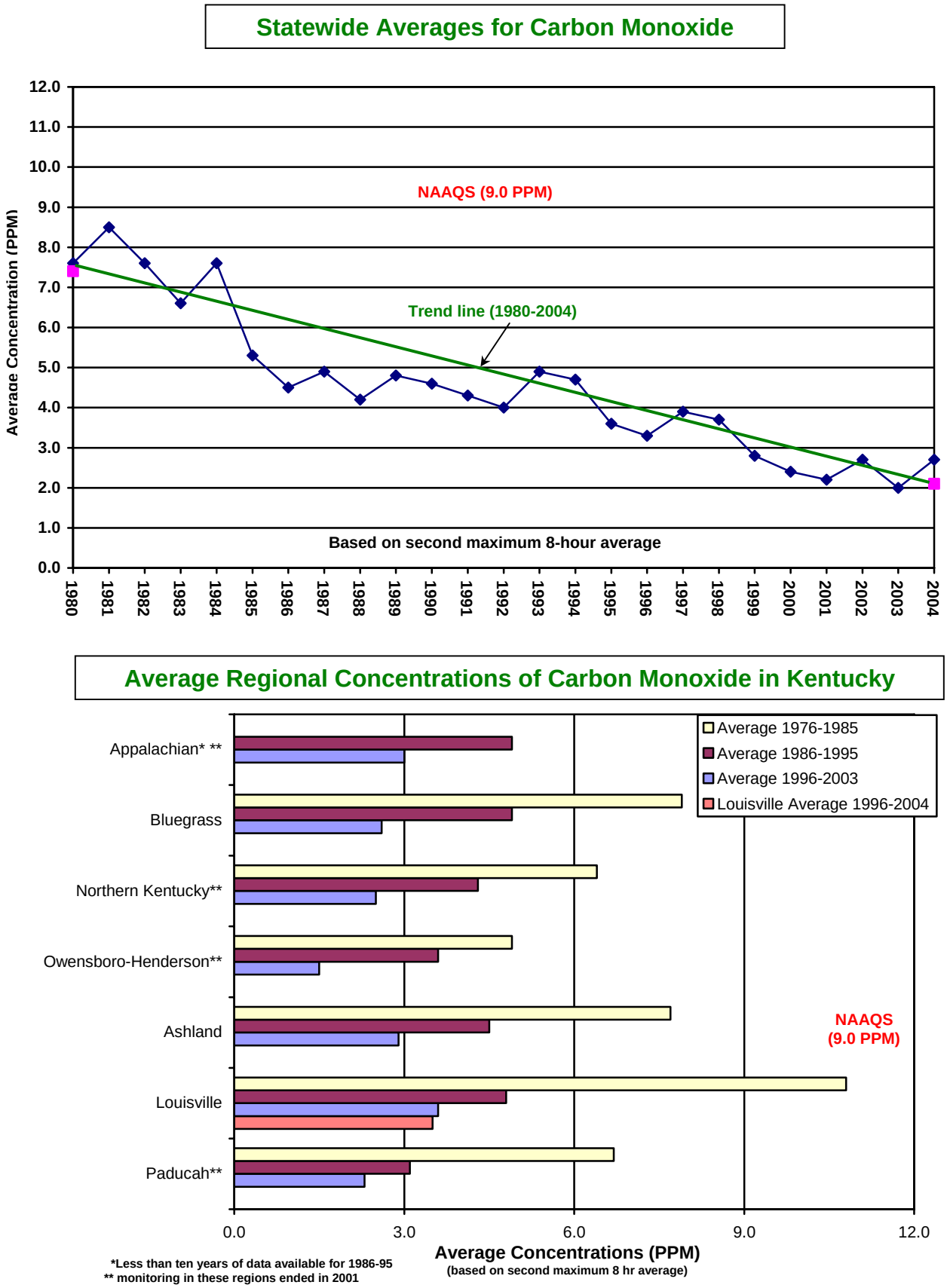
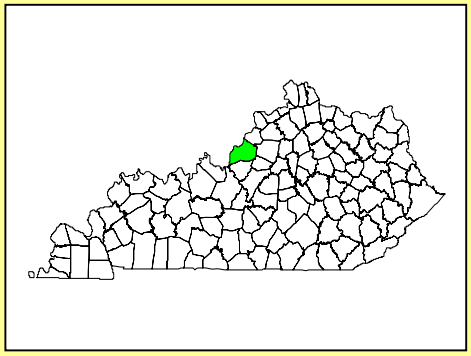



**Figure 1. Carbon Monoxide trends**

**Criteria Pollutant Summary Report - 2004**

Pollutant: **Carbon Monoxide**
Method: Instrumental/Non-Dispersive Infrared Photometry
Data Interval: Hourly
Units: Parts-per-million (PPM)



National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: 1-Hour Average 35 PPM
8-Hour Average 9 PPM
Secondary NAAQS: Same as Primary Standard

| County | Site | AIRS-ID | # Obs | 1-Hr Averages | | | 8-Hr Averages | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1st max | 2nd max | Obs> 35.0 | 1st max | 2nd max | Obs > 9.0 |
| Jefferson [1] | 3510 Goldsmith Lane Louisville | 21-111-0046 | 8549 | 5.2 | 3.3 | 0 | 2.0 | 2.0 | 0 |
| Jefferson [1] | 1735 Bardstown Road Louisville | 21-111-1019 | 8617 | 4.6 | 4.5 | 0 | 3.4 | 3.3 | 0 |

[1] Carbon monoxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

## Sulfur Dioxide

Sulfur dioxide ($SO_2$) is a colorless gas that has a pungent odor at concentrations exceeding 0.5 ppm. Sulfur dioxide is produced by the combustion of sulfur containing fuels, ore smelting, petroleum processing and the manufacture of sulfuric acid. Nationwide, coal-fired power plants are the largest sources of sulfur dioxide. Other industrial sources include petroleum refineries and paper mills.

The primary health effect of sulfur dioxide is that it aggravates pre-existing respiratory, cardiovascular and pulmonary diseases. Asthmatics, children and the elderly are especially susceptible to the effects of sulfur dioxide pollution. Sulfur dioxide can also damage the foliage of trees and agricultural crops. It can also combine with moisture in the atmosphere to form sulfuric acid ($H_2SO_4$), which is a component of acid precipitation that causes acidification of soil and water and the erosion of building surfaces. Sulfur dioxide may also be converted into sulfates; which are significant components of $PM_{2.5}$ and regional haze. Regional haze has been attributed to poor visibility at many of the vistas in our national parks including Mammoth Cave National Park in Kentucky and the Great Smoky Mountains in Tennessee.

Sulfur dioxide is measured continuously by analyzers that use the ultraviolet (UV) fluorescence method. Fluorescent analyzers irradiate an ambient air sample with ultraviolet light. Sulfur dioxide molecules absorb a portion of this energy, then re-emit the energy at a characteristic wavelength of light. The light energy emitted by the sulfur dioxide molecules is proportional to the concentration of sulfur dioxide present in the sample. A photo multiplier cell measures the light emitted and converts it to a parts per million measurement. Data from the analyzer is transmitted by telemetry for entry into an automated data storage system. In 2004 the Division for Air Quality and the Louisville Metro Air Pollution Control District operated twelve $SO_2$ monitors in Kentucky.

| | |
|---|---|
| **Primary NAAQS**: | Annual Arithmetic Mean not to exceed 0.03 ppm.<br>24-hour concentrations not to exceed 0.14 ppm more than once per year. |
| **Secondary NAAQS**: | 3-hour concentrations not to exceed 0.50 ppm more than once per year. |

There were no exceedances of any of the sulfur dioxide standards in 2004. The last exceedance of a sulfur dioxide standard occurred in November 1981 when the monitor at Louisville site 21-111-0032 recorded a 24-hour average of 0.159 ppm. Statewide and regional sulfur dioxide levels have declining trends over the past twenty years due at least in part to successful efforts of power plants to curb $SO_2$ emissions (see Figure 2).

A statistical summary of sulfur dioxide data collected in 2004 follows on page 11.

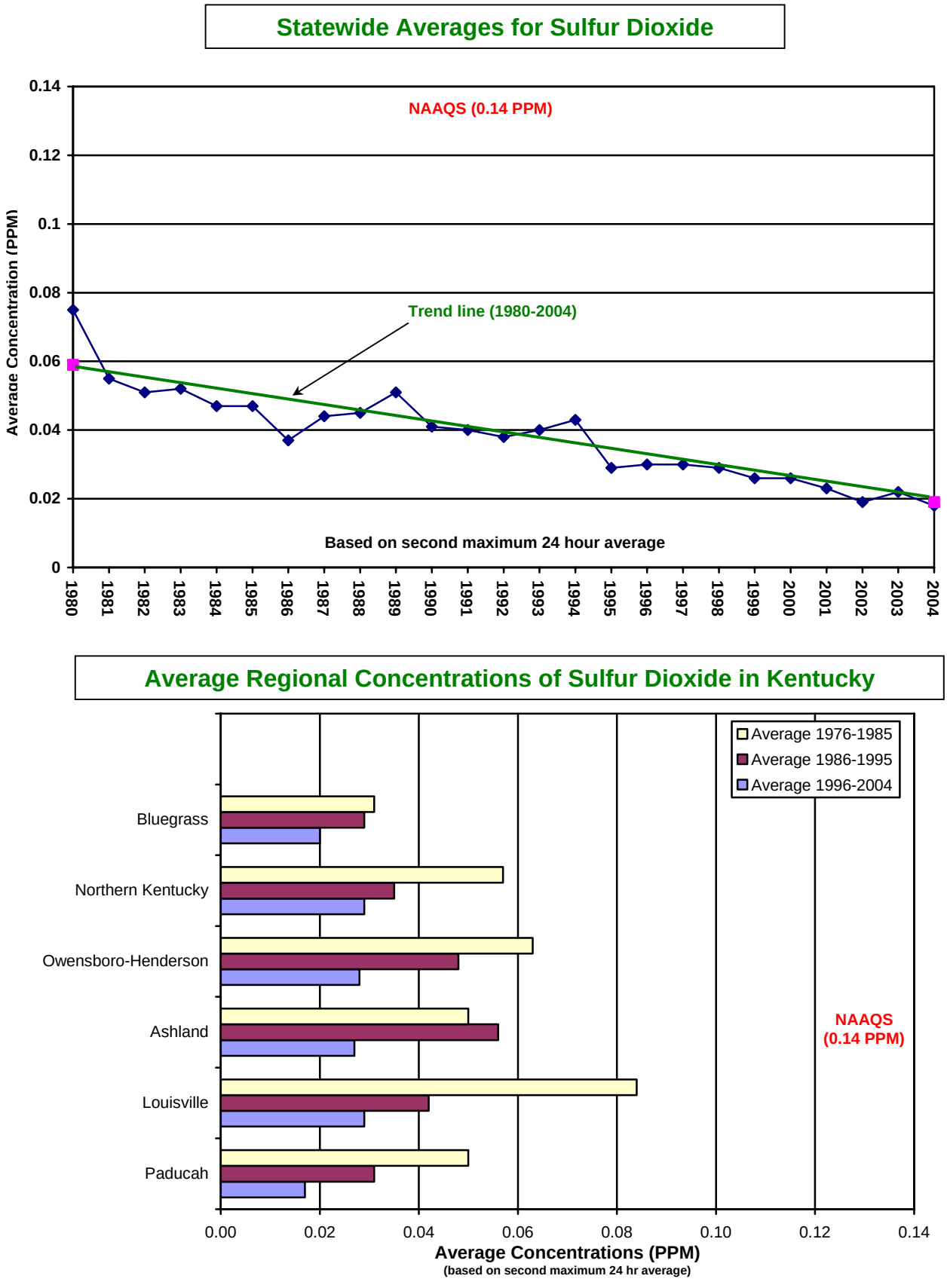


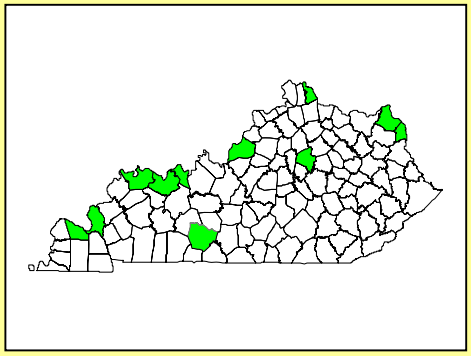

**Figure 2. Sulfur Dioxide trends**

## Criteria Pollutant Summary Report - 2004

Pollutant: **Sulfur Dioxide**
Method: Instrumental
Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

| | | |
|---|---|---|
| Primary NAAQS: | Annual Arithmetic Mean | 0.03 PPM |
| | 24-Hour Average | 0.14 PPM |
| Secondary NAAQS: | 3-Hour Average | 0.50 PPM |



| County | Site | AIRS-ID | # Obs | Annual Mean | 24-Hr Average | | | 3-Hr Average | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1st max | 2nd max | Obs> .14 | 1st max | 2nd max | Obs> .50 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | 8587 | .004 | .018 | .018 | 0 | .062 | .061 | 0 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 8300 | .005 | .025 | .024 | 0 | .095 | .094 | 0 |
| Daviess | US 60 and Pleasant Valley Rd, Owensboro | 21-059-0005 | 8691 | .005 | .024 | .020 | 0 | .075 | .074 | 0 |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | 8670 | .004 | .015 | .014 | 0 | .033 | .032 | 0 |
| Greenup | Scott & Center Streets Worthington | 21-089-0007 | 8734 | .004 | .019 | .018 | 0 | .051 | .049 | 0 |
| Hancock | 2nd & Caroline Avenue Lewisport | 21-091-0012 | 8528 | .004 | .030 | .027 | 0 | .085 | .074 | 0 |
| Henderson | Baskett Fire Dept Baskett | 21-101-0014 | 8739 | .004 | .029 | .025 | 0 | .107 | .107 | 0 |
| Jefferson[1] | 7201 Watson Lane Louisville | 21-111-0051 | 8732 | .006 | .025 | .022 | 0 | .090 | .080 | 0 |
| Jefferson[1] | 4201 Algonquin Pkwy Louisville | 21-111-1041 | 8747 | .005 | .023 | .021 | 0 | .103 | .097 | 0 |
| Livingston | 763 Bloodworth Road off KY 453 | 21-139-0004 | 8718 | .004 | .015 | .014 | 0 | .057 | .055 | 0 |
| McCracken | 2901 Powell Street Paducah | 21-145-1024 | 8731 | .002 | .012 | .011 | 0 | .028 | .024 | 0 |
| Warren | Oakland Elementary School, Oakland | 21-227-0008 | 8706 | .002 | .012 | .009 | 0 | .023 | .020 | 0 |

[1] Sulfur dioxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

## Nitrogen Dioxide

Nitrogen dioxide is a reddish brown gas that is produced during the high temperature combustion of fossil fuels. During combustion, nitrogen and oxygen are combined, or oxidized, to form a family of highly reactive gases called nitrogen oxides ($NO_x$), which includes nitrogen dioxide ($NO_2$) and nitrogen oxide (NO). In addition to the nitrogen dioxide produced during combustion, the NO produced may, in the presence of sunlight, undergo a photochemical reaction that will also form $NO_2$. The rate of reaction is dependent upon the intensity of the sunlight. Major combustion or oxidation sources that produce nitrogen dioxide include motor vehicles, power plants, incinerators, industrial boilers and some chemical processes.

The primary health effect of nitrogen dioxide is as a lung irritant, which can cause an increase in respiratory rate, a decrease in lung function and can increase the susceptibility of the respiratory system to infection. Nitrogen dioxide can also be considered detrimental to human health due to its association in the formation of ozone and the resulting health effects caused by that pollutant. Nitrogen dioxide is also a contributor to the formation of acid precipitation, which can damage plant and aquatic life and cause the deterioration of stone and masonry-type buildings and statues. Nitrogen oxides may also react with ammonia to from ammonium nitrate, a component of $PM_{2.5}$. Nitrates are also a key component in regional haze which has been attributed to poor visibility at many of our national parks.

Nitrogen dioxide is monitored continuously by analyzers that utilize the principle of photometric detection of the chemiluminescence (light) resulting from the gas phase reaction of nitric oxide and ozone. When these two gases react, light at a specific wavelength is produced. In operation, sample air is drawn into the analyzer and split into two streams. The first stream is reacted directly with ozone (which is produced by a generator in the analyzer) and the light energy produced is proportional to the NO in the sample. Since $NO_2$ does not react with ozone, the second stream of air passes through a catalytic converter that converts the $NO_2$ in the sample to NO. That stream is then reacted with ozone, which will provide a total measurement of nitrogen oxides ($NO_x$) in the sample. The assumption is that the majority of the $NO_x$ value is not $NO_2$. By subtracting the NO value obtained by the first stream from the $NO_x$ value obtained in the second stream, a $NO_2$ value is obtained. Data from the analyzer is transmitted by telemetry for entry into an automated data storage system. In 2004 the Division for Air Quality and the Louisville Metro Air Pollution Control District operated eight nitrogen dioxide monitors in Kentucky.

**Primary NAAQS**: Annual Arithmetic Mean not to exceed 0.05 ppm.

**Secondary NAAQS**: Same as primary standard.

There were no exceedances of the $NO_2$ standard in 2004 and there have been no recorded exceedances of the NAAQS since the inception of sampling in 1970. Statewide and regional nitrogen dioxide levels show steady downward trends primarily due to the use of pollution control devices on motor vehicles, power plants and industrial boilers (see Figure 3).

A statistical summary of nitrogen dioxide data collected in 2004 follows on page 14.

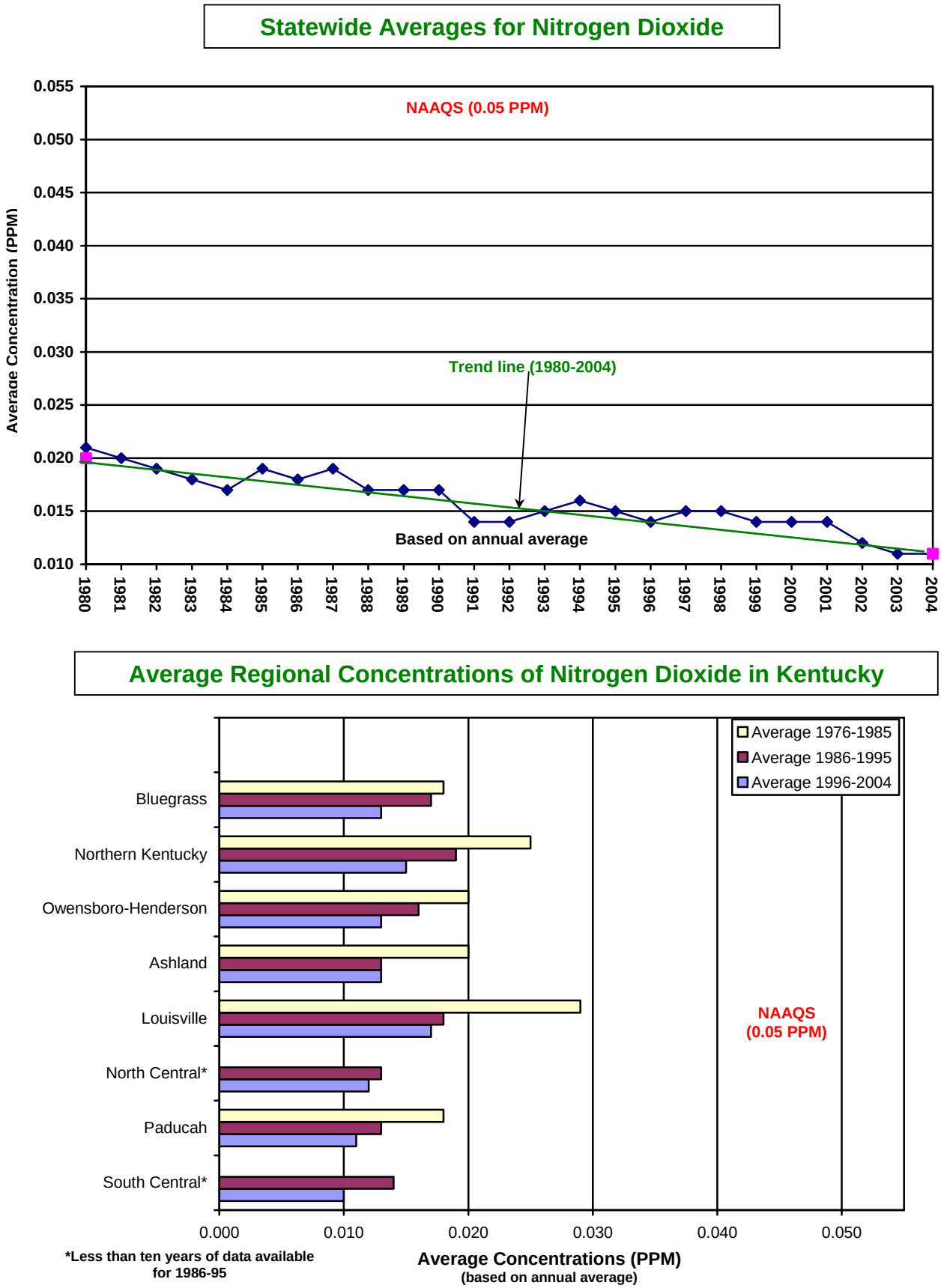



**Figure 3. Nitrogen Dioxide trends**

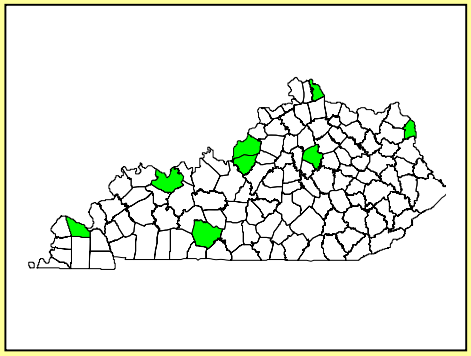
**Criteria Pollutant Summary Report - 2004**

Pollutant: **Nitrogen Dioxide**
Method: Instrumental/Gas-Phase Chemiluminescence
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: Annual Arithmetic Mean 0.05 PPM

Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | # Obs | Mean | 1-Hr Average | |
|---|---|---|---|---|---|---|
| | | | | | 1st max | 2nd max |
| Boyd | 2924 Holt Street<br>Ashland | 21-019-0017 | 8075 | .010 | .049 | .048 |
| Bullitt | 2nd & Carpenter Streets<br>Shepherdsville | 21-029-0006 | 7818 | .010 | .046 | .045 |
| Campbell | 700 Alexandria Pike<br>Fort Thomas | 21-037-0003 | 8101 | .011 | .080 | .047 |
| Daviess | US 60 and Pleasant Valley Road<br>Owensboro | 21-059-0005 | 7899 | .008 | .052 | .042 |
| Fayette | 650 Newtown Pike<br>Lexington | 21-067-0012 | 8207 | .012 | .056 | .055 |
| Jefferson[1] | 1918 Mellwood Avenue<br>Louisville | 21-111-1021 | 8450 | .017 | .062 | .059 |
| McCracken | 2901 Powell Street<br>Paducah | 21-145-1024 | 8045 | .009 | .050 | .049 |
| Warren | Oakland Elementary School<br>Oakland | 21-227-0008 | 8088 | .008 | .050 | .046 |

[1] Nitrogen dioxide monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

## Ozone

Ozone is a colorless gas that is not emitted directly into the atmosphere from sources but forms in the atmosphere from a photochemical reaction between volatile organic compounds and nitrogen oxides in the presence of sunlight. Sources of volatile organic compounds include motor vehicle exhaust, dry cleaning and paint solvents and evaporation of gasoline from storage and transfer facilities. Sources of nitrogen oxides include emissions from motor vehicles, boilers, incinerators and power plants.

In the upper atmosphere, naturally occurring stratospheric ozone (commonly called the ozone layer), shields the earth's surface from the sun's harmful ultraviolet rays. However, tropospheric or ground level ozone causes irritation of the respiratory system and is particularly harmful to those persons with asthma and circulatory problems. Ozone can also cause damage to crops and increase the deterioration of rubber, paints and fabrics.

Ozone is monitored during the period from March 1 through October 31 each year when meteorological conditions are most conducive to the formation of ozone. During this period, ozone is monitored continuously by analyzers that operate using the ultraviolet photometry method of analysis. In this method, ambient air is drawn into a sample cell and a beam of ultraviolet light is passed through it. Ozone absorbs ultraviolet light and a decrease in the intensity of the light indicates the presence of ozone. The intensity of the light is first measured with no ozone present to determine a reference value. An ambient sample is then introduced and the intensity of the resultant light is measured by an ultraviolet detector. The amount of light absorbed by the sample indicates the level of ozone present. Data from the analyzers is transmitted by telemetry for entry into an automated data storage system. In 2004 the Division for Air Quality, the National Park Service at Mammoth Cave and the Louisville Metro Air Pollution Control District operated a total of thirty ozone monitors in Kentucky.

| | |
|---|---|
| **Primary NAAQS**: | Maximum one-hour average concentration of 0.12 ppm. Average number of expected exceedances per year not to exceed 1.0 over the last three years.<br><br>Maximum 8-hour average concentration of 0.08 ppm (based on a three-year average of the annual fourth highest daily maximum 8-hour averages.) |
| **Secondary NAAQS**: | Same as primary standard. |

Although the one-hour ozone standard is written with two decimal places, actual monitoring data is recorded to three decimal places and must be rounded to two places for comparison to the standard. Therefore the standard is exceeded when a daily one-hour average is greater than or equal to 0.125 ppm. Additionally the one-hour ozone standard is based on "expected exceedances" rather than actual recorded exceedances. This takes into account periods of missing data caused by monitor malfunction, maintenance and repairs. A formula has been developed to estimate the "expected number of exceedances" that would have occurred if 100% of all possible data values had been collected. The expected number of exceedances calculated for each monitor is used to determine attainment of the one hour standard. The standard is attained when the expected number of exceedances for a monitor averaged over the last three calendar years is equal to or less than one.

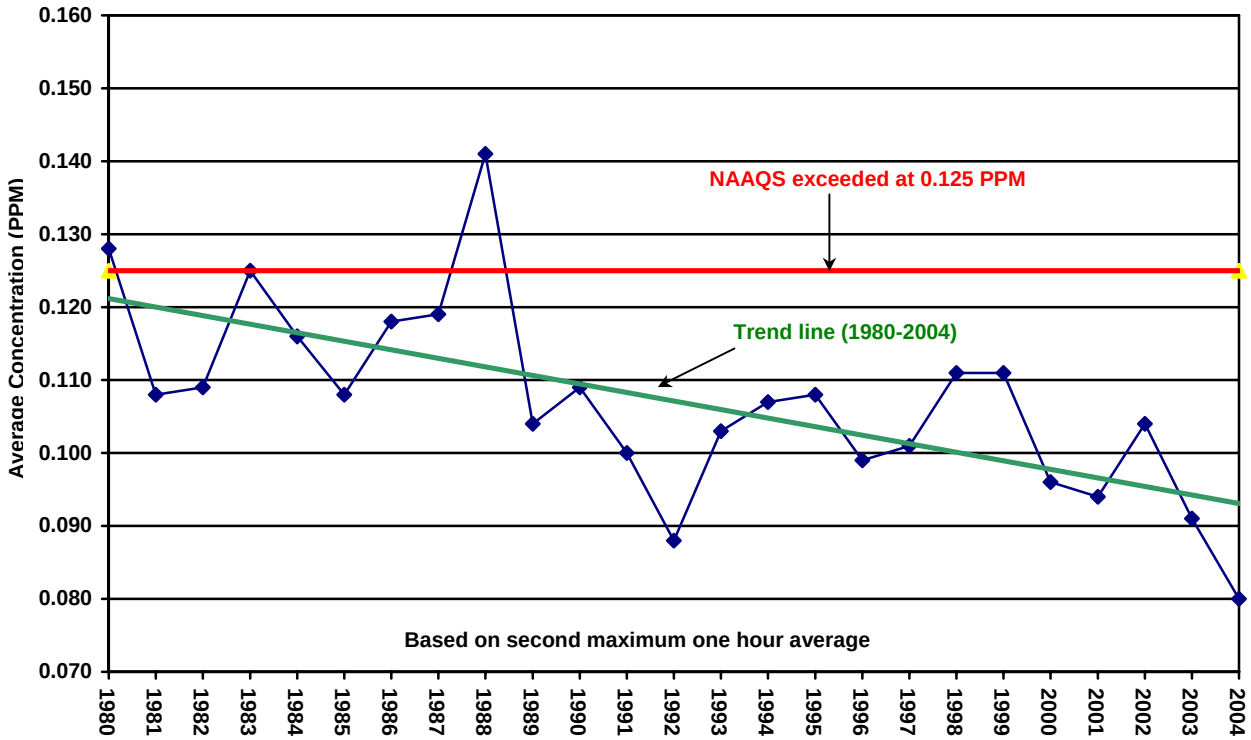
During the period 2002-2004, no monitor had an average expected number of exceedances greater than 1.0 (see one-hour ozone multi-year expected exceedances on pages 20-21).

In November 1997 the U.S. EPA adopted an eight-hour ozone standard based on scientific and medical research which indicated that extended exposure to lower levels of ozone may be as harmful as short-term exposure to elevated levels. The eight-hour standard is set at 0.08 ppm and is exceeded when an average level of ozone over an eight hour period is 0.085 ppm or greater. The standard is attained when the fourth highest daily 8-hour average for each of the three most recent years are averaged and that average is less than 0.085 ppm. Eight-hour multi-year averages for 2002-2004 can be found on pages 22-23. In 2004 there were 3 exceedances of the 8-hour standard.

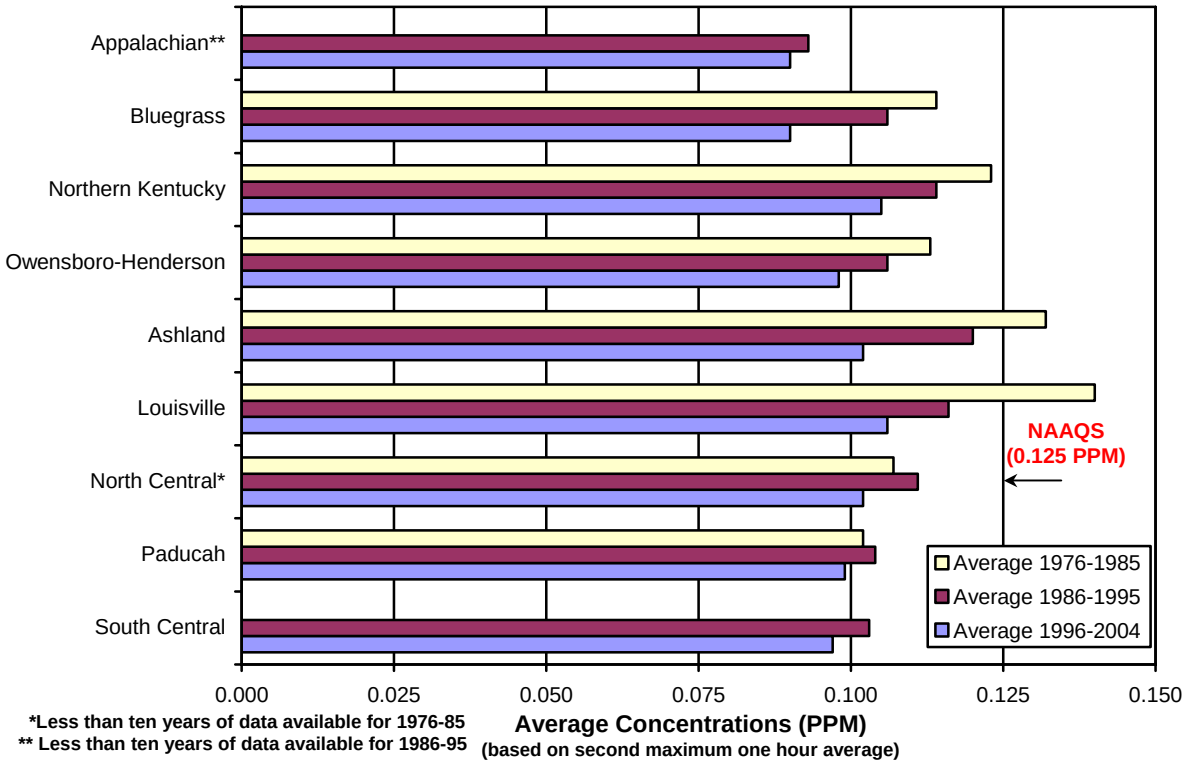
There has been a general decline in ozone levels over the past twenty-five years based on one-hour data as seen in Figure 4. This downward trend is the result of emission controls on vehicles, such as catalytic converters, and controls on industrial sources of VOC's and nitrogen oxides.

A statistical summary of one-hour and eight-hour ozone data collected in 2004 follows on pages 18-19.

## Statewide Averages for Ozone




## Average Regional Concentrations of Ozone in Kentucky




*Less than ten years of data available for 1976-85
** Less than ten years of data available for 1986-95

**Figure 4. Ozone trends**

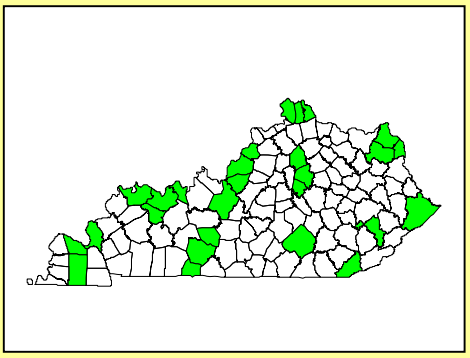
## Criteria Pollutant Summary Report - 2004

Pollutant: **Ozone**
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: 1-Hour (1 per year/3 years) 0.12 PPM
8-hour (3 year avg of 4th max.) 0.08 PPM

Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | # Obs | 1-Hr Average | | | 8-Hr Average | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Obs> 0.124 | 1st max | 2nd max | Obs> 0.084 | 1st max | 2nd max | 3rd max | 4th max |
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | 5805 | 0 | .089 | .080 | 0 | .075 | .073 | .070 | .069 |
| Boone | KY 338 & Lower River Rd, East Bend | 21-015-0003 | 5858 | 0 | .092 | .084 | 0 | .077 | .071 | .070 | .070 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | 5852 | 0 | .087 | .078 | 0 | .079 | .068 | .068 | .068 |
| Bullitt | 2nd & Carpenter St Shepherdsville | 21-029-0006 | 5763 | 1 | .127 | .085 | 1 | .102 | .078 | .070 | .068 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 5738 | 0 | .101 | .090 | 0 | .084 | .078 | .076 | .076 |
| Carter | Camp Webb Grayson Lake | 21-043-0500 | 5820 | 0 | .076 | .072 | 0 | .064 | .063 | .062 | .062 |
| Daviess | US 60 and Pleasant Valley, Owensboro | 21-059-0005 | 5853 | 0 | .081 | .078 | 0 | .074 | .068 | .067 | .066 |
| Edmonson[1] | Alfred Cook Road Mammoth Cave | 21-061-0501 | 8355 | 0 | .085 | .079 | 0 | .072 | .072 | .070 | .070 |
| Fayette | Iron Works Pike Lexington | 21-067-0001 | 5741 | 0 | .075 | .072 | 0 | .068 | .065 | .064 | .063 |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | 5722 | 0 | .075 | .075 | 0 | .068 | .066 | .064 | .063 |
| Graves | Byerly Farm on KY 1949, Symsonia | 21-083-0003 | 5865 | 0 | .083 | .074 | 0 | .073 | .070 | .067 | .066 |
| Greenup | Scott & Center St Worthington | 21-089-0007 | 5857 | 0 | .087 | .086 | 0 | .075 | .073 | .073 | .073 |
| Hancock | 2nd & Caroline Lewisport | 21-091-0012 | 5852 | 0 | .096 | .080 | 1 | .085 | .072 | .071 | .071 |
| Hardin | 801 North Miles St Elizabethtown | 21-093-0006 | 5851 | 0 | .108 | .082 | 0 | .083 | .075 | .071 | .068 |
| Henderson | Baskett Fire Dept. Baskett | 21-101-0014 | 5855 | 0 | .082 | .079 | 0 | .074 | .071 | .071 | .070 |
| Jefferson[2] | 7601 Bardstown Rd Louisville | 21-111-0027 | 5808 | 0 | .109 | .089 | 1 | .093 | .071 | .071 | .070 |
| Jefferson[2] | 7201 Watson Lane Louisville | 21-111-0051 | 5709 | 0 | .088 | .086 | 0 | .073 | .071 | .071 | .070 |
| Jefferson[2] | 1918 Mellwood Ave Louisville | 21-111-1021 | 5867 | 0 | .080 | .080 | 0 | .072 | .071 | .069 | .068 |

## Ozone Summary Report Continued

| County | Site | AIRS-ID | # Obs | 1-Hr Average | | | 8-Hr Average | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Obs> 0.124 | 1st max | 2nd max | Obs> 0.084 | 1st max | 2nd max | 3rd max | 4th max |
| Jessamine | KYDOT, Etter Drive Nicholasville | 21-113-0001 | 5718 | 0 | .078 | .077 | 0 | .073 | .070 | .066 | .065 |
| Kenton | 1401 Dixie Highway Covington | 21-117-0007 | 5626 | 0 | .099 | .085 | 0 | .081 | .076 | .075 | .073 |
| Livingston | KYDOT 811 US 60E Smithland | 21-139-0003 | 5850 | 0 | .085 | .081 | 0 | .077 | .073 | .070 | .070 |
| McCracken | 2901 Powell Street Paducah | 21-145-1024 | 5773 | 0 | .080 | .077 | 0 | .074 | .070 | .067 | .067 |
| McLean | 3962 KY 815 Guffie | 21-149-0001 | 5715 | 0 | .086 | .079 | 0 | .076 | .072 | .072 | .071 |
| Oldham | DOT Garage, 3995 Morgan Rd, Buckner | 21-185-0004 | 5822 | 0 | .089 | .085 | 0 | .078 | .077 | .076 | .076 |
| Perry | Perry Co Horse Park Hazard | 21-193-0003 | 5836 | 0 | .079 | .077 | 0 | .071 | .070 | .069 | .067 |
| Pike | 101 North Mayo Trail, Pikeville | 21-195-0002 | 5852 | 0 | .077 | .075 | 0 | .068 | .066 | .064 | .063 |
| Pulaski | Clifty Street Somerset | 21-199-0003 | 5856 | 0 | .077 | .077 | 0 | .068 | .067 | .066 | .066 |
| Scott | Fire Station, KY 32 Sadieville | 21-209-0001 | 5736 | 0 | .068 | .067 | 0 | .060 | .060 | .058 | .058 |
| Simpson | KYDOT, HWY 1008 Franklin | 21-213-0004 | 5856 | 0 | .097 | .089 | 0 | .080 | .076 | .073 | .069 |
| Warren | Oakland Elementary School, Oakland | 21-227-0008 | 5855 | 0 | .087 | .080 | 0 | .072 | .069 | .069 | .068 |

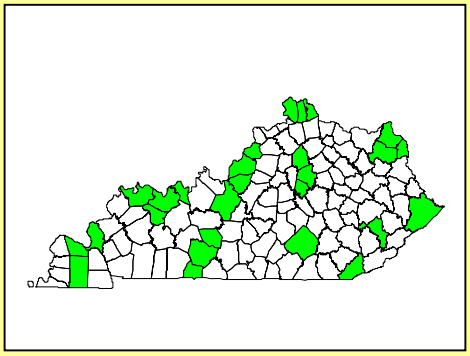
[1] Monitor operated by the National Park Service at Mammoth Cave.
[2] Ozone monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

**Criteria Pollutant Multi-year Summary Report - 2004**
**3-Year Average of One-hour Expected Exceedances**

Pollutant: **Ozone**
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: 1-Hour (1 per year/3 years) 0.12 PPM
8-Hour (3-year avg of 4th max.) 0.08 PPM
Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | 2002 | | 2003 | | 2004 | | 3 year expected avg |
|---|---|---|---|---|---|---|---|---|---|
| | | | Actual | Expect | Actual | Expect | Actual | Expect | |
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Boone | KY 338 & Lower River Road, East Bend | 21-015-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | 2 | 2.0 | 0 | 0 | 0 | 0 | 0.7 |
| Bullitt | 2nd & Carpenter Streets Shepherdsville | 21-029-0006 | 1 | 1.0 | 0 | 0 | 1 | 1.0 | 0.7 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Carter | Camp Webb Grayson Lake | 21-043-0500 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Daviess | US 60 & Pleasant Valley Road, Owensboro | 21-059-0005 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Edmonson[1] | Alfred Cook Road Mammoth Cave | 21-061-0501 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Fayette | Iron Works Pike Lexington | 21-067-0001 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Graves | Byerly Farm, KY 1949 Symsonia | 21-083-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Greenup | Scott & Center Streets Worthington | 21-089-0007 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Hancock | 2nd & Caroline Streets Lewisport | 21-091-0012 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Hardin | 801 North Miles Street Elizabethtown | 21-093-0006 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Henderson | Baskett Fire Dept Baskett | 21-101-0014 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Jefferson[2] | 7601 Bardstown Road Louisville | 21-111-0027 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Jefferson[2] | 7201 Watson Lane Louisville | 21-111-0051 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Jefferson[2] | 1918 Mellwood Ave Louisville | 21-111-1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |

## Ozone 3 Year 1-Hour Averages Continued

| County | Site | AIRS-ID | 2002 | | 2003 | | 2004 | | 3 year expected Avg |
|---|---|---|---|---|---|---|---|---|---|
| | | | Actual | Expect | Actual | Expect | Actual | Expect | |
| Jessamine | KYDOT, Etter Drive Nicholasville | 21-113-0001 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Kenton | 1401 Dixie Highway Covington | 21-117-0007 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Livingston | KYDOT, 811 US 60 East Smithland | 21-139-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| McCracken | 2901 Powell Street Paducah | 21-145-1024 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| McLean | 3962 KY 815 Guffie | 21-149-0001 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Oldham | DOT Garage, 3995 Morgan Rd, Buckner | 21-185-0004 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Perry | Perry County Horse Park Hazard | 21-193-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Pike | 101 North Mayo Trail Pikeville | 21-195-0002 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Pulaski | Clifty Street Somerset | 21-199-0003 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Scott | Fire Station on KY 32 Sadieville | 21-209-0001 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Simpson | KYDOT, HWY 1008 Franklin | 21-213-0004 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Warren | Oakland Elementary Sch Oakland | 21-227-0008 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |

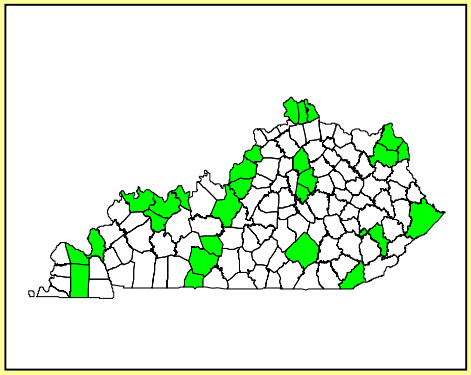
[1] Monitor operated by the National Park Service at Mammoth Cave.
[2] Ozone monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

**Criteria Pollutant Multi-year Summary Report - 2004**
**8-Hour 4th Maximum 3 Year Average**

Pollutant: **Ozone**
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: 1-Hour (1 per year/3 year) 0.12 PPM
8-Hour (3-year avg of 4th max.) 0.08 PPM
Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | 2002 4th max | 2003 4th max | 2004 4th max | 3 year Avg. 4th max |
|---|---|---|---|---|---|---|
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | .091 | .078 | .069 | .079 |
| Boone | KY 338 & Lower River Road East Bend | 21-015-0003 | .094 | .078 | .070 | .080 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | .102 | .088 | .068 | .086 |
| Bullitt | 2nd & Carpenter Streets Shepherdsville | 21-029-0006 | .091 | .072 | .068 | .077 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | .102 | .085 | .076 | .087 |
| Carter | Camp Webb Grayson Lake | 21-043-0500 | .086 | .073 | .062 | .073 |
| Daviess | US 60 & Pleasant Valley Rd Owensboro | 21-059-0005 | .086 | .069 | .066 | .073 |
| Edmonson[1] | Alfred Cook Road Mammoth Cave | 21-061-0501 | .085 | .076 | .070 | .077 |
| Fayette | Iron Works Pike Lexington | 21-067-0001 | .081 | .074 | .063 | .072 |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | .080 | .070 | .063 | .071 |
| Graves | Byerly Farm on KY 1949 Symsonia | 21-083-0003 | .092 | .073 | .066 | .077 |
| Greenup | Scott & Center Streets Worthington | 21-089-0007 | .084 | .078 | .073 | .078 |
| Hancock | 2nd & Caroline Streets Lewisport | 21-091-0012 | .093 | .077 | .071 | .080 |
| Hardin | 801 North Miles Street Elizabethtown | 21-093-0006 | .084 | .073 | .068 | .075 |
| Henderson | Baskett Fire Dept Baskett | 21-101-0014 | .087 | .078 | .070 | .078 |
| Jefferson[2] | 7601 Bardstown Road Louisville | 21-111-0027 | .085 | .072 | .070 | .078 |
| Jefferson[2] | 7201 Watson Lane Louisville | 21-111-0051 | .096 | .075 | .070 | .083 |
| Jefferson[2] | 1918 Mellwood Avenue Louisville | 21-111-1021 | .088 | .073 | .068 | .079 |

## Ozone 3 Year 8-Hour Continued

| County | Site | AIRS-ID | 2002 4th Max | 2003 4th Max | 2004 4th Max | 3 year Avg. 4th max |
|---|---|---|---|---|---|---|
| Jessamine | KYDOT, Etter Drive Nicholasville | 21-113-0001 | .085 | .071 | .065 | .073 |
| Kenton | 1401 Dixie Highway Covington | 21-117-0007 | .096 | .079 | .073 | .082 |
| Livingston | KYDOT, 811 US 60 East Smithland | 21-139-0003 | .090 | .080 | .070 | .080 |
| McCracken | 2901 Powell Street Paducah | 21-145-1024 | .086 | .076 | .067 | .076 |
| McLean | 3962 KY 815 Guffie | 21-149-0001 | .095 | .075 | .071 | .080 |
| Oldham | DOT Garage, 3995 Morgan Road, Buckner | 21-185-0004 | .091 | .082 | .076 | .083 |
| Perry | Perry County Horse Park Hazard | 21-193-0003 | .083 | .075 | .067 | .075 |
| Pike | 101 North Mayo Trail Pikeville | 21-195-0002 | .082 | .064 | .063 | .069 |
| Pulaski | Clifty Street Somerset | 21-199-0003 | .081 | .075 | .066 | .074 |
| Scott | Fire Station on KY 32 Sadieville | 21-209-0001 | .076 | .065 | .058 | .066 |
| Simpson | KYDOT, HWY 1008 Franklin | 21-213-0004 | .081 | .077 | .069 | .075 |
| Warren | Oakland Elementary School Oakland | 21-227-0008 | .090 | .076 | .068 | .078 |

[1] Monitor operated by the National Park Service at Mammoth Cave.
[2] Ozone monitors located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

## Particulate Matter - ($PM_{10}$ / $PM_{2.5}$)

Particulate matter is a broad classification of non-gaseous pollutants that consists of very fine solid particles and liquid droplets or aerosols. Particulates are produced from many sources, including utility plants, wood burning stoves, leaf burning, vehicle exhaust, incinerators, rock quarries, coal processing, smelting, construction, farming and roadways. Common forms of particulates include fly ash, soot, soil, minerals, fibers, metals, oil aerosols and tire rubber.

The primary health effects of particulates are that they aggravate respiratory and cardiovascular disease and in large amounts increase the death rates of sufferers. The elderly, children, and people with chronic lung disease are especially sensitive to particulate matter. Particulate matter can soil and damage a wide range of man-made items such as building surfaces and may damage vegetation by interfering with plant photosynthesis due to the formation of a film on leaves reducing exposure to sunlight. Particulate pollution can also produce haze, which diminishes visibility and the amount of sunlight reaching the earth.

Particulate matter is categorized according to particle diameter due to the health impacts caused by particles of differing sizes. Particles that are greater than fifty microns (50μm) in diameter rapidly settle out of the air due to gravity and pose a limited health risk. Particles that are less than fifty microns in diameter remain suspended in the air for longer periods and are classified as Total Suspended Particulates (TSP). The larger of these particles (between 10 and 50 microns) rarely penetrate deeply into the human respiratory system but are trapped and removed by the body's natural defenses. Early research on the effects of smaller or "fine particulate matter" indicated that particles ten microns or less in diameter posed the greatest risk to human health. Particulate matter ten microns or less in diameter is referred to as $PM_{10}$ and is a subset of fine particles within the TSP category. Particles in the $PM_{10}$ range are small enough to evade the body's natural defense systems and penetrate into the lungs, where tissue is damaged and the immune system is weakened.

**Primary NAAQS**: Annual Arithmetic Mean not to exceed 50 $\mu g/m^3$ (based on a three-year avg).

Maximum 24-hour concentration of 150 $\mu g/m^3$. Average number of expected exceedances per year not to exceed 1.0 over last three years.

**Secondary NAAQS**: Same as primary standard.

As a result of the research on fine particulate matter, the U. S. EPA adopted a $PM_{10}$ standard on July 1, 1987 replacing the previous TSP standard. In 2004, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated a combined network of twenty-two $PM_{10}$ samplers in Kentucky. Most $PM_{10}$ samplers are the intermittent type that operate for twenty-four hours every sixth day. These samplers operate by drawing a measured volume of air through a pre-weighed filter over a 24-hour period. Before reaching the filter the air passes through an impaction chamber where larger particles fall out of the air stream while particles smaller than ten microns pass on to the sample filter where they are collected. After completion of the sample run the filter is removed from the sampler and reweighed to determine the mass of the particulates collected. Sample

results are entered manually into a data storage system. The network also includes eight continuously operating $PM_{10}$ samplers that provide results daily. These samplers determine sample weights electronically and transmit results by telemetry for entry into an automated data storage system.

There were no exceedances of the $PM_{10}$ standards in 2004. The last $PM_{10}$ exceedance occurred on January 7, 2000 at Louisville site 21-111-0043 where a 24-hour sample of 152 $\mu g/m^3$ was collected. The only other exceedance of a $PM_{10}$ standard occurred on August 27, 1990 in Ashland where a 24-hour value of 182 $\mu g/m^3$ was collected. All Kentucky counties are currently in attainment with the $PM_{10}$ standards. Statewide and regional $PM_{10}$ levels have shown declining trends as seen in Figure 5. This downward trend is the result of controls on industrial sources of particulate matter.

A statistical summary of $PM_{10}$ data collected during 2004 follows on pages 29-30.

## $PM_{2.5}$

Medical and scientific research on the health effects of particulate matter continued after the adoption of the $PM_{10}$ standard. As a result of further research it was determined that very fine particles in the 2.5 micron size range have a more adverse effect on human health. In response to these findings the EPA adopted a $PM_{2.5}$ standard, which became effective September 16, 1997.

$PM_{2.5}$ is monitored by intermittent and continuous type samplers that collect samples over a 24-hour run cycle. While most samplers operate every third day some operate every sixth day and some every day. $PM_{2.5}$ sample collection and analysis methods are similar to those for $PM_{10}$. Sample results are entered into an electronic data storage system. In 2004, the Division for Air Quality, the National Park Service at Mammoth Cave and the Louisville Metro Air Pollution Control District operated a network of twenty-four samplers.

**Primary NAAQS**: Annual Arithmetic Mean not to exceed 15 $\mu g/m^3$ (based on a three-year avg).

24-hour concentration not to exceed 65 $\mu g/m^3$. (based on a three-year average of the annual $98^{th}$ percentiles).

**Secondary NAAQS**: Same as primary standard.

There were no exceedances of either $PM_{2.5}$ standard in 2004. Statewide $PM_{2.5}$ levels have declined steadily over the period 2000-2004 as seen in Figure 6. This downward trend appears to primarily be attributed to reductions in sulfur dioxide and particulate emissions from industrial sources. A statistical summary of 2004 $PM_{2.5}$ data appears on page 31-32. Multi-year annual averages for 2002-2004 can be found on pages 33-34.

Based on data from 2002-2004 EPA considers the following counties to be non-attainment for the annual $PM_{2.5}$ standard: Jefferson, Bullitt, Boone, Kenton, Campbell, Boyd and a portion of Lawrence. Although Jefferson County is the only county in Kentucky where the measured 3-year

annual average exceeded the standard of 15 μg/m3, the other counties listed are part of a MSA where monitors within the MSA measured violations. Bullitt County is considered part of the Louisville (Kentucky-Indiana) MSA. In the case of Boone, Kenton and Campbell monitors within the Cincinnati-Northern Kentucky MSA measured violations. In the case of Boyd and Lawrence monitors within the Huntington–Ashland MSA measured violations.

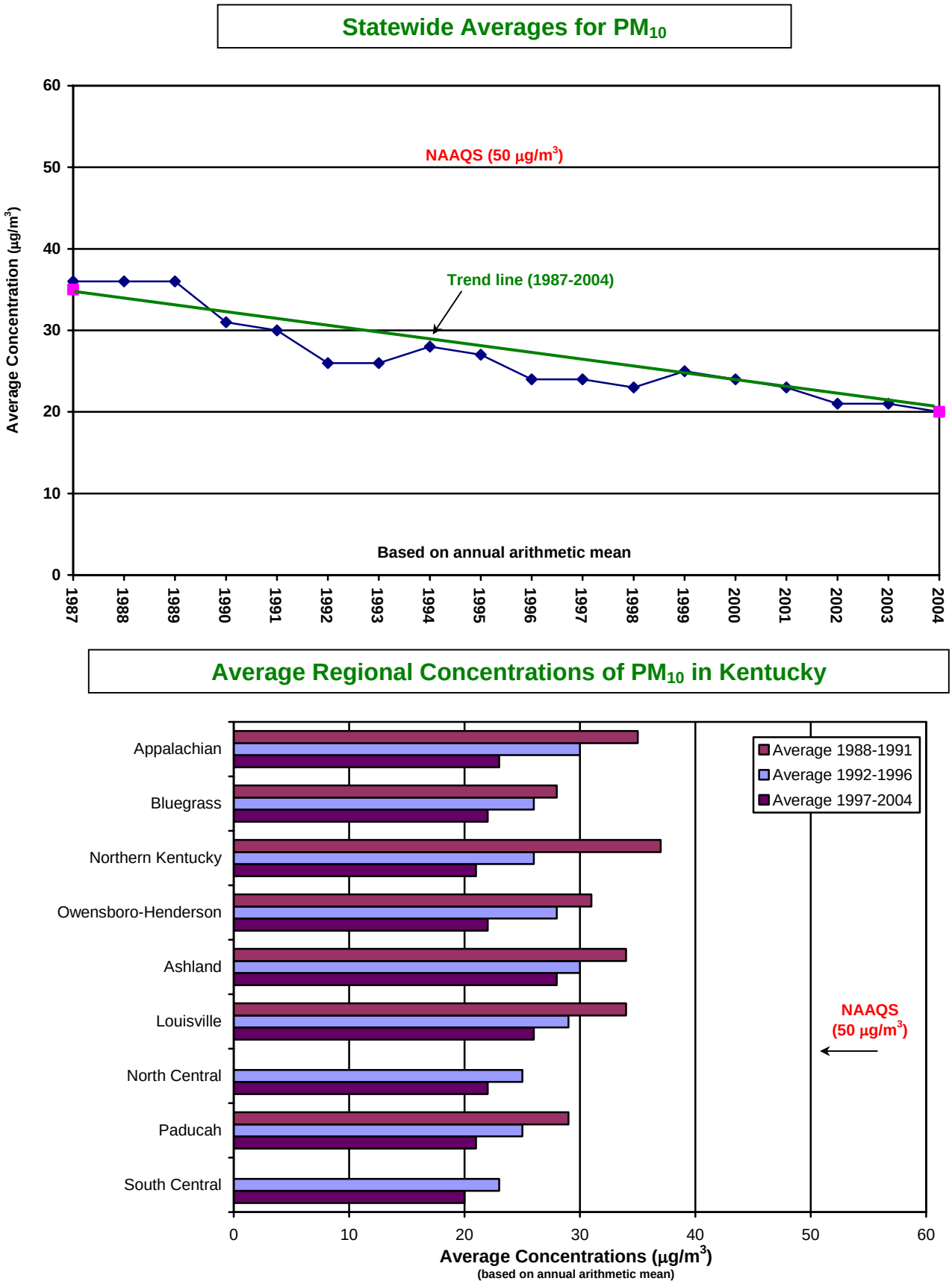



**Figure 5. $PM_{10}$ trends**

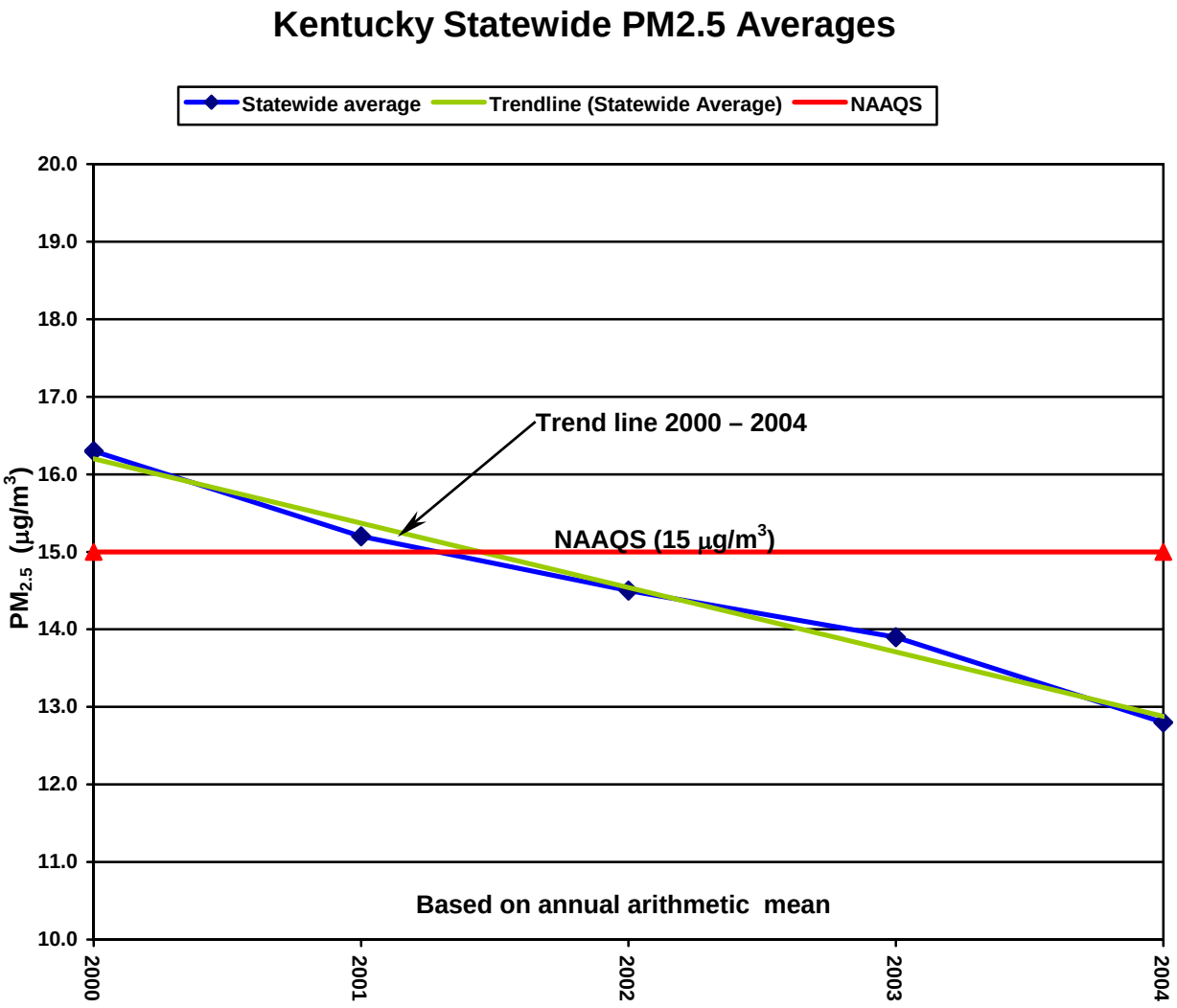



**Figure 6. $PM_{2.5}$ trends**

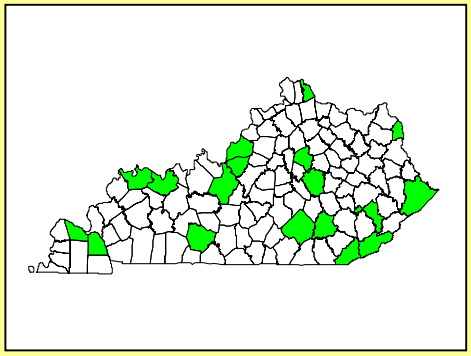
**Criteria Pollutant Summary Report - 2004**

Pollutant: **Particulate Matter $PM_{10}$**
Method: Gravimetric
Data Interval: 24-Hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: Annual Arith Mean (3yr avg) 50 $\mu g/m^3$
24-hour average 150 $\mu g/m^3$

Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | # Obs | Mean | 24-hour Average | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Obs >150 | 1st max | 2nd max | 3rd max | 4th max |
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | 61 | 21 | 0 | 44 | 38 | 36 | 36 |
| Boyd | 122 22nd Street Ashland | 21-019-0002 | 60 | 31 | 0 | 94 | 69 | 63 | 55 |
| Boyd | 2802 Louisa Street Catlettsburg | 21-019-2001 | 61 | 22 | 0 | 48 | 44 | 42 | 34 |
| Bullitt | 2nd & Carpenter Street Shepherdsville | 21-029-0006 | 59 | 23 | 0 | 96 | 48 | 43 | 40 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 351 | 18 | 0 | 54 | 50 | 49 | 43 |
| Daviess | US 60 and Pleasant Valley Rd, Owensboro | 21-059-0005 | 351 | 18 | 0 | 66 | 42 | 40 | 38 |
| Daviess | KY Wesleyan College Owensboro | 21-059-0014 | 56 | 18 | 0 | 39 | 39 | 36 | 29 |
| Fayette | 533 South Limestone Lexington | 21-067-0014 | 59 | 21 | 0 | 44 | 42 | 39 | 38 |
| Hardin | 801 North Miles Street Elizabethtown | 21-093-0006 | 59 | 18 | 0 | 42 | 39 | 36 | 32 |
| Harlan | 110 First Street Harlan | 21-095-0003 | 58 | 21 | 0 | 43 | 38 | 33 | 32 |
| Henderson | Baskett Fire Dept Baskett | 21-101-0014 | 348 | 19 | 0 | 52 | 46 | 44 | 41 |
| Jefferson[1] | 37th & Southern Ave Louisville | 21-111-0043 | 359 | 22 | 0 | 61 | 59 | 51 | 47 |
| Jefferson[1] | 1032 Beecher Avenue Louisville | 21-111-0044 | 365 | 21 | 0 | 58 | 55 | 46 | 45 |
| Laurel | London-Corbin Airport London | 21-125-0004 | 60 | 17 | 0 | 37 | 33 | 30 | 28 |
| McCracken | 342 Lone Oak Road Paducah | 21-145-1004 | 60 | 18 | 0 | 36 | 30 | 30 | 30 |
| McCracken | 2901 Powell Street Paducah | 21-145-1024 | 348 | 19 | 0 | 48 | 45 | 45 | 43 |
| Madison | Mayfield School Richmond | 21-151-0003 | 61 | 18 | 0 | 43 | 38 | 37 | 32 |
| Marshall | 24 Main Street Calvert City | 21-157-0010 | 11 | 18* | 0 | 28 | 23 | 21 | 19 |

## $PM_{10}$ Summary Report Continued

| County | Site | AIRS-ID | # Obs | Mean | 24-hour Average | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Obs >150 | 1st max | 2nd max | 3rd max | 4th max |
| Perry | Perry Co. Horse Park Hazard | 21-193-0003 | 61 | 22 | 0 | 49 | 40 | 38 | 38 |
| Pike | 101 North Mayo Trail Pikeville | 21-195-0002 | 340 | 21 | 0 | 52 | 48 | 47 | 47 |
| Pulaski | Clifty Street Somerset | 21-199-0003 | 61 | 18 | 0 | 37 | 35 | 32 | 30 |
| Warren | Oakland Elementary School, Oakland | 21-227-0008 | 345 | 16 | 0 | 39 | 37 | 37 | 36 |

* The Calvert City sampler was discontinued in March 2004; the mean does not satisfy summary criteria.

[1] $PM_{10}$ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

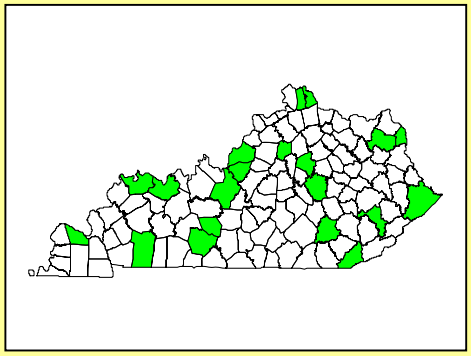
**Criteria Pollutant Summary Report - 2004**

Pollutant: **Particulate Matter $PM_{2.5}$**
Method: Gravimetric
Data Interval: 24-Hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: Annual Arithmetic Mean (3yr avg) 15 $\mu g/m^3$
24-hour (3yr avg of 98th percentile) 65 $\mu g/m^3$

Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | # Obs | Mean | 24-Hour Average | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Obs >65 | 1st max | 2nd max | 3rd max | 4th max |
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | 58 | 13.4 | 0 | 32.0 | 29.5 | 25.9 | 23.0 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | 120 | 13.3 | 0 | 30.7 | 30.4 | 30.3 | 26.7 |
| Bullitt | 2nd & Carpenter Street Shepherdsville | 21-029-0006 | 116 | 13.6 | 0 | 33.8 | 31.9 | 28.9 | 28.8 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 119 | 12.8 | 0 | 37.2 | 30.7 | 27.5 | 26.9 |
| Carter | Camp Webb Grayson Lake | 21-043-0500 | 122 | 11.1 | 0 | 28.6 | 24.6 | 24.5 | 24.1 |
| Christian | 10800 Pilot Rock Road Hopkinsville | 21-047-0006 | 106 | 11.8 | 0 | 32.7 | 28.5 | 26.2 | 25.1 |
| Daviess | KY Wesleyan College Owensboro | 21-059-0014 | 116 | 12.5 | 0 | 32.6 | 27.4 | 27.0 | 25.6 |
| Edmonson[1] | Alfred Cook Road Mammoth Cave | 21-061-0501 | 117 | 11.6 | 0 | 33.2 | 26.8 | 24.2 | 23.9 |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | 114 | 13.5 | 0 | 33.0 | 30.3 | 29.1 | 28.6 |
| Fayette | 533 South Limestone Lexington | 21-067-0014 | 121 | 14.3 | 0 | 32.5 | 30.7 | 29.2 | 29.0 |
| Franklin | 803 Schenkel Lane Frankfort | 21-073-0006 | 115 | 12.5 | 0 | 28.9 | 27.6 | 26.9 | 26.1 |
| Hardin | 801 North Miles Street Elizabethtown | 21-093-0006 | 117 | 12.2 | 0 | 30.6 | 29.7 | 27.8 | 25.3 |
| Henderson | Basket Fire Dept Baskett | 21-101-0014 | 116 | 12.1 | 0 | 27.5 | 26.1 | 25.8 | 25.0 |
| Jefferson[2] | 37th & Southern Avenue Louisville | 21-111-0043 | 342 | 14.5 | 0 | 43.7 | 42.8 | 35.1 | 33.1 |
| Jefferson[2] | 1032 Beecher Avenue Louisville | 21-111-0044 | 347 | 14.0 | 0 | 43.5 | 41.0 | 34.2 | 32.7 |
| Jefferson[2] | 850 Barret Avenue Louisville | 21-111-0048 | 109 | 13.7 | 0 | 42.7 | 30.4 | 28.8 | 28.3 |
| Jefferson[2] | 7201 Watson Lane Louisville | 21-111-0051 | 60 | 12.6 | 0 | 29.3 | 25.8 | 24.2 | 23.7 |
| Kenton | 1401 Dixie Highway Covington | 21-117-0007 | 115 | 13.4 | 0 | 38.1 | 37.4 | 29.4 | 28.2 |
| Laurel | London-Corbin Airport London | 21-125-0004 | 57 | 11.5 | 0 | 28.5 | 21.5 | 20.0 | 19.0 |

## $PM_{2.5}$ Summary Report Continued

| County | Site | AIRS-ID | # Obs | Mean | 24-hour Average | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Obs >65 | 1st max | 2nd max | 3rd max | 4th max |
| McCracken | 342 Lone Oak Road Paducah | 21-145-1004 | 117 | 11.8 | 0 | 27.7 | 27.0 | 26.5 | 26.3 |
| Madison | Mayfield School Richmond | 21-151-0003 | 111 | 13.0 | 0 | 33.7 | 28.6 | 28.4 | 27.0 |
| Perry | Perry Co Horse Park Hazard | 21-193-0003 | 61 | 11.9 | 0 | 27.9 | 24.7 | 21.0 | 19.7 |
| Pike | 101 North Mayo Trail Pikeville | 21-195-0002 | 120 | 12.3 | 0 | 36.5 | 29.7 | 28.2 | 25.4 |
| Warren | Kereiakes Park Bowling Green | 21-227-0007 | 115 | 13.1 | 0 | 34.7 | 32.8 | 31.5 | 29.2 |

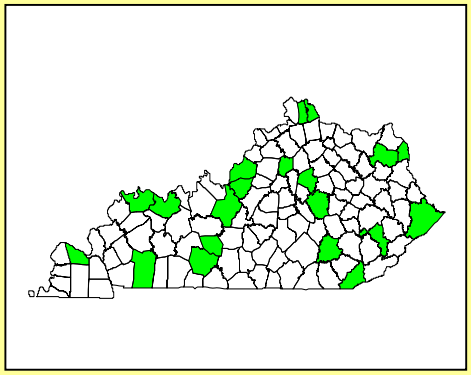
[1] Sampler operated by the National Park Service at Mammoth Cave.
[2] $PM_{2.5}$ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

**Criteria Pollutant Multi-year Summary Report - 2004**
**Annual Arithmetic Mean 3-Year Average**

Pollutant: **Particulate Matter $PM_{2.5}$**
Method: Gravimetric
Data Interval: 24-Hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: Annual Arithmetic Mean (3 yr avg) 15 $\mu g/m^3$
24-hr (3-yr avg of 98th percentile) 65 $\mu g/m^3$
Secondary NAAQS: Same as Primary Standard



| County | Site | AIRS-ID | 2002 mean | 2003 mean | 2004 mean | 3 year Avg. |
|---|---|---|---|---|---|---|
| Bell | 34th & Dorchester Middlesboro | 21-013-0002 | 14.3 | 14.2 | 13.4 | 14.0 |
| Boyd | 2924 Holt Street Ashland | 21-019-0017 | 15.5 | 13.9 | 13.3 | 14.2 |
| Bullitt | 2nd & Carpenter Streets Shepherdsville | 21-029-0006 | 14.7 | 14.4 | 13.6 | 14.2 |
| Campbell | 700 Alexandria Pike Fort Thomas | 21-037-0003 | 14.8 | 13.4 | 12.8 | 13.7 |
| Carter | Camp Webb Grayson Lake | 21-043-0500 | 12.4 | 11.4 | 11.1 | 11.6 |
| Christian | 10800 Pilot Rock Road Hopkinsville | 21-047-0006 | 13.1 | 13.9 | 11.8 | 12.9 |
| Daviess | KY Wesleyan College Owensboro | 21-059-0014 | 14.6 | 14.6 | 12.5 | 13.9 |
| Edmonson[1] | Alfred Cook Road Mammoth Cave | 21-061-0501 | - | - | 11.6 | - |
| Fayette | 650 Newtown Pike Lexington | 21-067-0012 | 15.1 | 13.8 | 13.5 | 14.1 |
| Fayette | 533 South Limestone Lexington | 21-067-0014 | 15.6 | 15.0 | 14.3 | 15.0 |
| Franklin | 803 Schenkel Lane Frankfort | 21-073-0006 | 13.7 | 13.1 | 12.5 | 13.1 |
| Hardin | 801 North Miles Street Elizabethtown | 21-093-0006 | 14.0 | 13.4 | 12.2 | 13.2 |
| Henderson | Baskett Fire Dept Baskett | 21-101-0014 | 14.2 | 13.8 | 12.1 | 13.4* |
| Jefferson[2] | 37th & Southern Avenue Louisville | 21-111-0043 | 17.2 | 16.0 | 14.5 | 15.9 |
| Jefferson[2] | 1032 Beecher Avenue Louisville | 21-111-0044 | 17.5 | 15.4 | 14.1 | 15.7 |
| Jefferson[2] | 850 Barrett Avenue Louisville | 21-111-0048 | 16.4 | 15.5 | 13.7 | 15.2 |
| Jefferson[2] | 7201 Watson Lane Louisville | 21-111-0051 | 15.7 | 14.9 | 12.6 | 14.4 |
| Kenton | 1401 Dixie Highway Covington | 21-117-0007 | 15.1 | 14.3 | 13.4 | 14.3 |
| Laurel | London-Corbin Airport London | 21-125-0004 | 13.0 | 12.1 | 11.5 | 12.2 |

## $PM_{2.5}$ Annual Arithmetic Mean 3 Year Average Continued

| County | Site | AIRS-ID | 2002 4th Max | 2003 4th Max | 2004 4th Max | 3 year Avg. 4th max |
|---|---|---|---|---|---|---|
| McCracken | 342 Lone Oak Road Paducah | 21-145-1004 | 12.6 | 13.8 | 11.8 | 12.7 |
| Madison | Mayfield School Richmond | 21-151-0003 | 13.5 | 12.9 | 13.0 | 13.1 |
| Perry | Perry County Horse Park Hazard | 21-193-0003 | 13.0 | 13.3 | 11.9 | 12.7 |
| Pike | 101 North Mayo Trail Pikeville | 21-195-0002 | 13.6 | 13.1 | 12.3 | 13.0 |
| Warren | Kereiakes Park Bowling Green | 21-227-0007 | 13.3 | 13.3 | 13.1 | 13.2 |

* This average includes data for 2002 from site 21-101-0006 where this sampler was located prior to being moved to site 21-101-0014 in 2003.

[1] Sampler operated by the National Park Service at Mammoth Cave.
[2] $PM_{2.5}$ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

## Industrial Data

Various industries within the Commonwealth of Kentucky operate air monitoring networks and subsequently report the data from these networks to the Division for Air Quality. Monitoring activity designed to measure the background levels of selected pollutants prior to construction of a proposed source or the expansion of an existing source is termed PSD (Prevention of Significant Deterioration of air quality) monitoring. This type of network is normally set up to operate for approximately one year. Monitoring designed to measure the impact of new or expanded sources on the air quality of an area is termed post-construction monitoring. A third type of monitoring is termed compliance monitoring and is usually set up around existing sources to demonstrate compliance with permit conditions and ambient air standards.

Regardless of the type of monitoring undertaken by these industrial networks, all must meet the following requirements.

- The Division must receive and approve a copy of the monitoring plan for each network prior to commencement of monitoring.
- A member of the Technical Services Branch of the Division for Air Quality must inspect the monitoring site(s) before monitoring begins to ensure that applicable siting criteria are met.
- Operators of networks with CO, $SO_2$, and $NO_2$ monitors must use gaseous standards that are traceable to National Institute of Standards and Technology (NIST) gaseous Standard Reference Materials (SRM) to generate test concentrations.
- Test concentrations of $O_3$ must be obtained in accordance with the UV photometric calibration procedure specified in 40 CFR Part 50, Appendix D, or by means of a certified ozone transfer standard.
- Flow measurements must be made with a flow measuring device that is referenced to an authoritative volume or other standard.
- All samplers and monitors used for monitoring criteria pollutants must be approved as EPA reference or equivalent methods.
- All monitors are audited once each calendar quarter by a member of the Division's Quality Assurance Section.
- Air monitoring reports from these networks are due at the Division for Air Quality no later than 90 days after the end of each calendar quarter. These air monitoring reports are to consist of the raw data from each network (usually on a 3.5" diskette), a missing data report (explaining any gaps in the data), monitor calibrations, results from the biweekly precision checks carried out on each automated analyzer, audit reports, and copies of sections of the strip charts (only when requested).

The data from each network is reviewed for completeness and accuracy and to determine if there are any exceedances of any primary or secondary pollutant standards. A letter of receipt is sent to the operator of each network when their data has been received and reviewed. If corrections are deemed necessary, the network operator is notified so the corrections can be made and the data resubmitted.

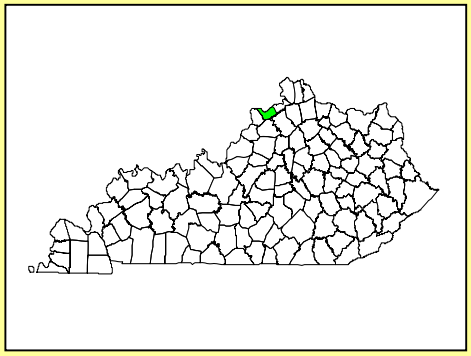
A statistical summary of industrial data collected in 2004 follows on pages 36-39.

**Industrial - Criteria Pollutant Summary Report - 2004**
**Sites Operated by Industry**

Pollutant: **Particulate Matter $PM_{10}$**
Method: Gravimetric
Data Interval: 24-Hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

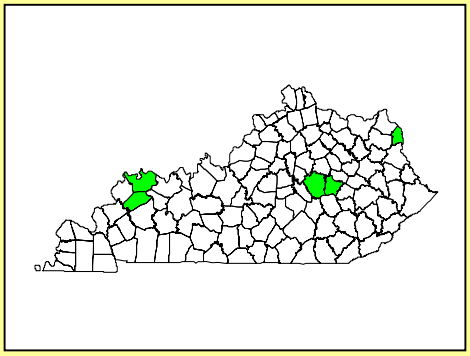
National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: Annual Arith Mean (3yr avg) 50 $\mu g/m^3$
24-hour average 150 $\mu g/m^3$
Secondary NAAQS: Same as Primary Standard



| County | Site | Facility-ID | # Obs | Annual Mean | Obs >150 | 1st max | 2nd max | 3rd max | 4th max |
|---|---|---|---|---|---|---|---|---|---|
| Carroll | US Highway 42 Ghent | North American Stainless | 50 | 24 | 0 | 54 | 49 | 43 | 42 |

**Industrial - Criteria Pollutant Summary Report - 2004**
**Sites Operated by Industry**



Pollutant: **Sulfur Dioxide**
Method: Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

| | | |
|---|---|---|
| Primary NAAQS: | Annual Arithmetic Mean | 0.03 PPM |
| | 24-Hour Average | 0.14 PPM |
| Secondary NAAQS: | 3-Hour Average | 0.50 PPM |

| County | Site | Facility-ID | # Obs | Annual Mean | 24-Hr Average | | | 3-Hr Average | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1st max | 2nd max | Obs >.14 | 1st max | 2nd max | Obs >.50 |
| Estill | 100 EK Power Ln Irvine | East Kentucky Power | 4869 | .000 | .012 | .006 | 0 | .023 | .020 | 0 |
| Henderson | US 41 & KY 2096 Sebree | Western KY Electric | 8217 | .003 | .022 | .021 | 0 | .059 | .057 | 0 |
| Henderson | KY 2097 Sebree | Western KY Electric | 8310 | .005 | .058 | .049 | 0 | .273 | .121 | 0 |
| Madison | 246 Ford Road Richmond | East Kentucky Power | 4807 | .004 | .047 | .046 | 0 | .127 | .110 | 0 |
| Webster | Bell Gibson Road | Western KY Electric | 8254 | .005 | .116 | .090 | 0 | .421 | .336 | 0 |
| Wayne, WV | Spring Brook Dr Kenova, WV | Ashland-Marathon | 8705 | .009 | .056 | .050 | 0 | .072 | .068 | 0 |
| Wayne, WV | Route 52 Neal, WV | Ashland-Marathon | 8673 | .007 | .025 | .024 | 0 | .058 | .049 | 0 |
| Wayne, WV | Big Sandy Road Neal, WV | Ashland-Marathon | 8681 | .007 | .024 | .021 | 0 | .041 | .039 | 0 |

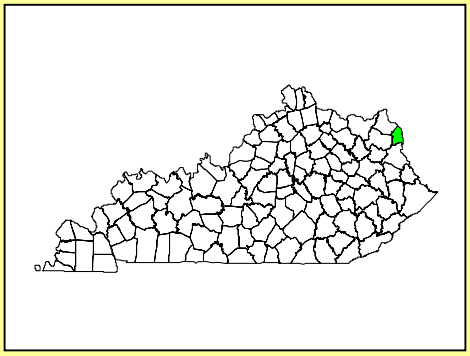
**Industrial - Criteria Pollutant Summary Report - 2004**
**Sites Operated by Industry**

Pollutant: **Nitrogen Dioxide**
Method: Instrumental/Chemiluminescence
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

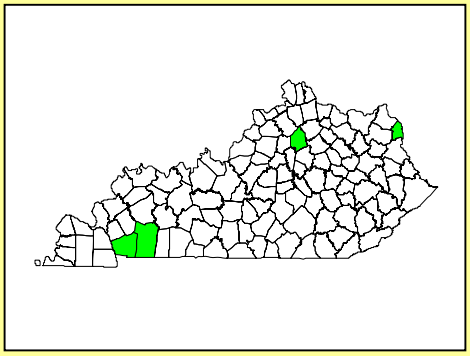
Primary NAAQS: Annual Arithmetic Mean 0.05 PPM

Secondary NAAQS: Same as Primary Standard



| County | Site | Facility-ID | # Obs | Annual Mean | 1-Hr Average | |
|---|---|---|---|---|---|---|
| | | | | | 1st max | 2nd max |
| Wayne, WV | Spring Brook Drive, Kenova, WV | Ashland-Marathon | 8611 | .015 | .077 | .075 |

**Industrial - Criteria Pollutant Summary Report - 2004**
**Sites Operated by Industry**



Pollutant: **Ozone**
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (PPM)

National Ambient Air Quality Standards (NAAQS)

Primary NAAQS: 1-Hour (1 per year/3 years) 0.12 PPM
8-Hour (3 year avg of 4th max.) 0.08 PPM
Secondary NAAQS: Same as Primary Standard

| County | Site | Facility-ID | # Obs | 1-Hr Average | | | 8-hour Average | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Obs >0.12 | 1st max | 2nd max | Obs >0.08 | 1st max | 2nd max | 3rd max | 4th max |
| Christian | 10800 Pilot Rock Rd Hopkinsville | TVA | 5806 | 0 | .093 | .085 | 0 | .079 | .077 | .074 | .074 |
| Scott | 4673 Muddy Ford Rd Oxford | Toyota | 5529 | 0 | .084 | .082 | 0 | .074 | .074 | .071 | .071 |
| Trigg | Mulberry Flat Road Land Between Lakes | TVA | 5803 | 0 | .096 | .086 | 0 | .081 | .072 | .071 | .067 |
| Wayne, WV | Spring Brook Drive Kenova, WV | Ashland-Marathon | 8737 | 0 | .086 | .080 | 0 | .079 | .073 | .070 | .068 |

## National Air Toxics Trends Network

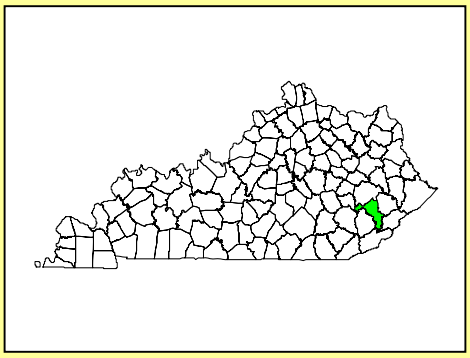
Toxic air pollutants include substances known or suspected to cause neurological, immunological, reproductive and respiratory disorders, as well as known or suspected human carcinogens. EPA's ultimate goal is to eliminate unacceptable risks of cancer and other significant health problems from exposures to air toxics emissions and to substantially reduce or eliminate adverse effects on our natural environment. To provide a basis for decision making with respect to these matters, EPA developed the National Air Toxics Trends Stations (NATTS) monitoring network. In 2003 the EPA designated the Division for Air Quality's Hazard air monitoring site part of that network. The Hazard site is in the Rural Trends Network, and along with its Urban Trends counterpart, was established to provide toxics trends data on a national basis. Data generated by these monitors are needed to understand the behavior of air toxics in the atmosphere and to develop control strategies.

The EPA has identified twenty-three hazardous air pollutants that are to be monitored in the National Air Toxics Trends study. These pollutants can be subdivided into three monitoring groups: carbonyls, metals and volatile organic compounds (VOC's). These compounds are sampled using carbonyl samplers with DNPH cartridges, high-volume $PM_{10}$ samplers and passivated SUMMA canisters. These samplers operate for 24-hours on every sixth day after which the samples are collected and sent to the Division for Environmental Services laboratory in Frankfort for analysis. The results of the laboratory analysis are sent to the Division for Air Quality where they are entered in the AQS data storage and retrieval system.

A statistical summary of the data collected in 2004 follows on page 41. Although in a rural area, the data indicates that several of the twenty-three hazardous air pollutants are present in ambient air. Considering there are no large industrial sources in the immediate area, these are the result of mobile emissions (cars, trucks, and school buses), and small local source emissions such as those from fueling stations, body shops/painting, dry cleaners, asphalt plants, etc.

## Rural Trends Toxics Network - 2004

Agency: Kentucky Division For Air Quality
Site ID: 21-193-0003
County: Perry
Location: Hazard



| Parameter | # of Samples | Units | 1st max | 2nd max | 3rd max | 4th max | Median Value |
|---|---|---|---|---|---|---|---|
| 1,3-Butadiene | 58 | ppb | ND | ND | ND | ND | - |
| Benzene | 21 | ppb | 1.07 | 0.80 | 0.78 | 0.70 | 0.68 |
| Carbon tetrachloride | 58 | ppb | ND | ND | ND | ND | - |
| Chloroform | 58 | ppb | ND | ND | ND | ND | - |
| cis-1,3-dichloropropene | 58 | ppb | 0.75 | 0.75 | ND | ND | 0.75 |
| trans-1,3-dichloropropylene | 58 | ppb | ND | ND | ND | ND | - |
| 1,2 dibromoethane | 58 | ppb | ND | ND | ND | ND | - |
| 1,2 dichloroethane | 58 | ppb | 0.22 | 0.16 | ND | ND | 0.19 |
| 1,2 dichloropropane | 58 | ppb | ND | ND | ND | ND | - |
| Methylene chloride | 58 | ppb | 1.65 | 0.61 | 0.49 | 0.46 | 0.46 |
| Tetrachloroethene | 58 | ppb | 0.15 | ND | ND | ND | 0.15 |
| 1,1,2,2 Tetrachloroethane | 58 | ppb | ND | ND | ND | ND | - |
| Trichloroethene | 58 | ppb | 0.25 | 0.23 | ND | ND | 0.24 |
| Vinyl chloride | 58 | ppb | ND | ND | ND | ND | - |
| Formaldehyde | 58 | ppb | 3.89 | 3.78 | 3.62 | 3.58 | 1.57 |
| Acetaldehyde | 53 | ppb | 1.01 | 0.96 | 0.94 | 0.89 | 0.54 |
| Arsenic | 59 | $ng/m^3$ | 6.86 | 3.46 | 3.46 | 3.03 | 1.13 |
| Beryllium | 59 | $ng/m^3$ | .26 | ND | ND | ND | - |
| Cadmium | 59 | $ng/m^3$ | 1.48 | 0.94 | 0.84 | 0.56 | 0.33 |
| Chromium | 59 | $ng/m^3$ | 1.35 | 1.25 | 0.97 | 0.89 | 0.28 |
| Lead | 59 | $ng/m^3$ | 15.0 | 8.36 | 8.35 | 8.13 | 3.44 |
| Manganese | 59 | $ng/m^3$ | 13.5 | 13.2 | 11.7 | 10.7 | 5.01 |
| Nickel | 59 | $ng/m^3$ | 4.54 | 3.90 | 2.33 | 2.25 | 0.75 |

ND - Pollutant not detected at the lowest detection limit of the analyzing instrument

## Wet Deposition

Wet deposition (sometimes referred to as "acid rain") is a classification of pollutants that are precipitation borne. Snow, sleet, hail, rain or fog can combine with pollutants in the atmosphere and fall to earth as harmful acidic compounds. Acidified rainwater may contain combinations of sulfuric and nitric acids that form when water vapor and sulfur dioxide and nitrogen oxides react. Major sources of sulfur dioxide include power plants, paper and wood pulp processing plants and facilities with coal fired boilers. Nitrogen oxides are produced primarily from the combustion of fossil fuels in the engines of cars, trucks and other vehicles and from power plant emissions.

Aquatic life appears to be most sensitive to the effects of acidic precipitation. Small changes in the pH levels of lakes and streams may prevent some fish species and other aquatic life forms from reproducing. Many insects cannot survive in acidic waters and therefore birds and mammals that depend on insects for food may suffer abnormally high mortality rates. Acidic precipitation can also alter soil chemistry and nutrient availability, in turn weakening trees and shrubs and causing them to be more vulnerable to insects, diseases and fungus infestations. Acid precipitation may also damage agricultural crops and has been blamed for deterioration of monuments and building surfaces.

Wet deposition monitoring stations operate on a weekly sampling schedule. Cumulative precipitation events occurring during a seven day period are collected in one container to represent a one-week sample. An automatic wet/dry precipitation collector is used to collect the sample. The sampler consists of two collection containers. The "wet" container is fitted with a clean plastic sample bag for collection of precipitation. The "dry" container, designed for dry particulate collection is not presently utilized for sample collection. The sampler employs a moisture sensor, which activates an electrically driven movable container lid that covers the wet container during dry periods and then moves to cover the dry container when precipitation occurs. At the end of each weekly sampling period, the wet container is removed and replaced with a new, clean container for the next sampling period. After the sample is removed, field measurements of pH and conductivity are made and recorded. The remaining sample is then shipped to Frankfort where laboratory analysis is conducted to determine levels for pH, conductivity, acidity, sulfates, nitrates, phosphates, ammonia and metal ions. In 2004, the Division for Air Quality operated one acid rain site at Grayson Lake State Park. The National Park Service at Mammoth Cave also operated a wet deposition sampler in 2004 and data from that sampler are included.

Annual pH averages for both sites have shown modest upward trends since 1985 meaning that rainfall is gradually becoming less acidic (see Figure 7). This improvement is due at least in part to successful efforts of power plants to curb sulfur dioxide and nitrogen dioxide emissions.

A statistical summary of wet deposition data collected in 2004 follows on pages 44-45.

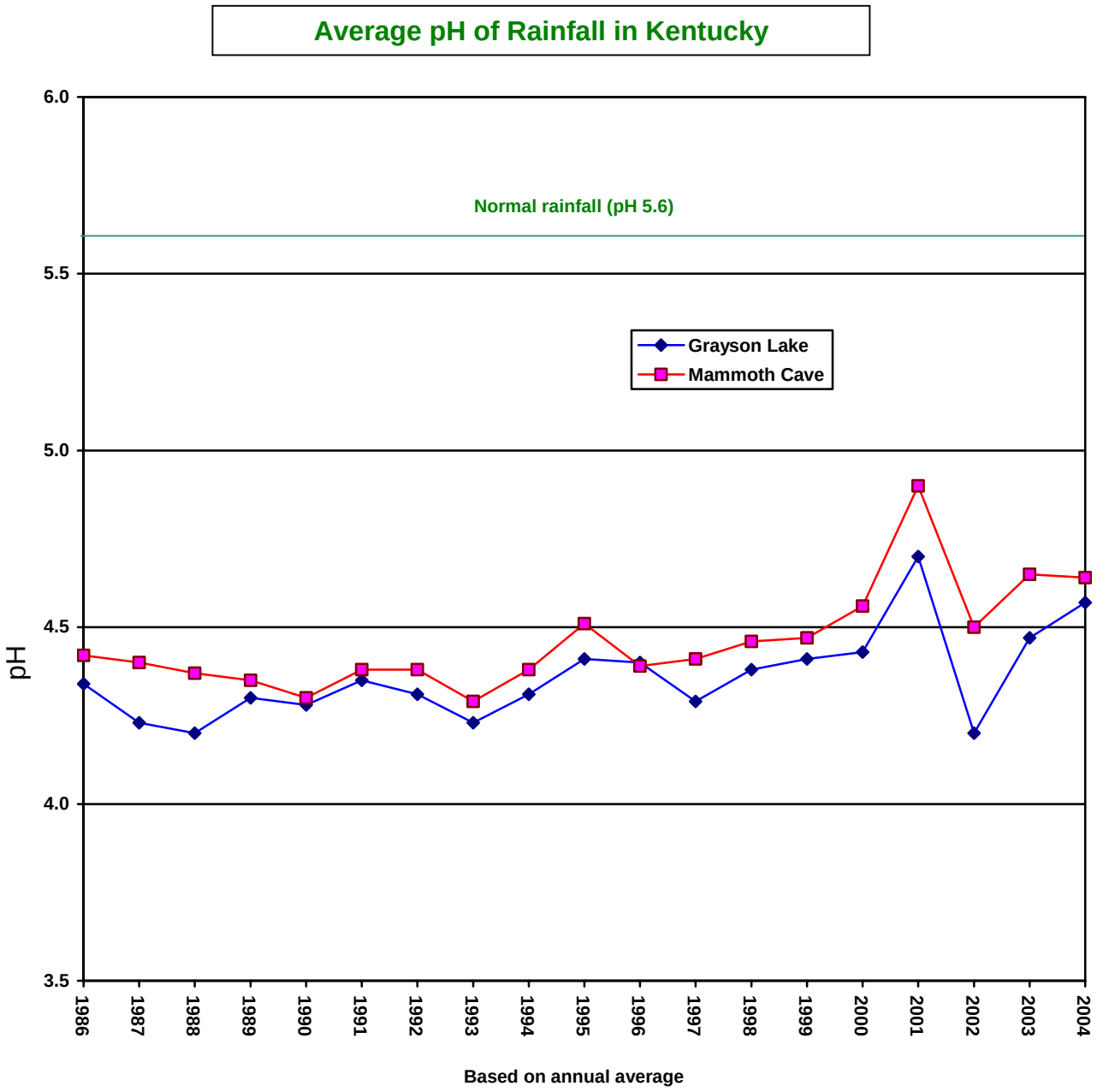


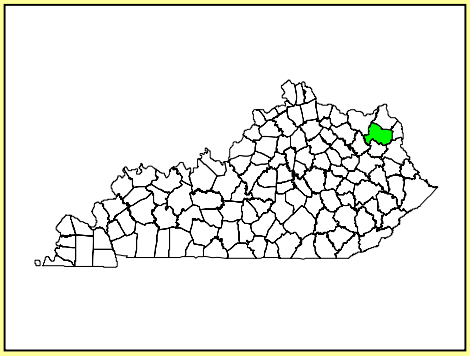

**Figure 7. pH trends**

## Wet Deposition Pollutants Summary Report - 2004

Agency: Kentucky Division for Air Quality

Site ID: 21-043-0500
County: Carter
Location: Grayson Lake
Camp Webb

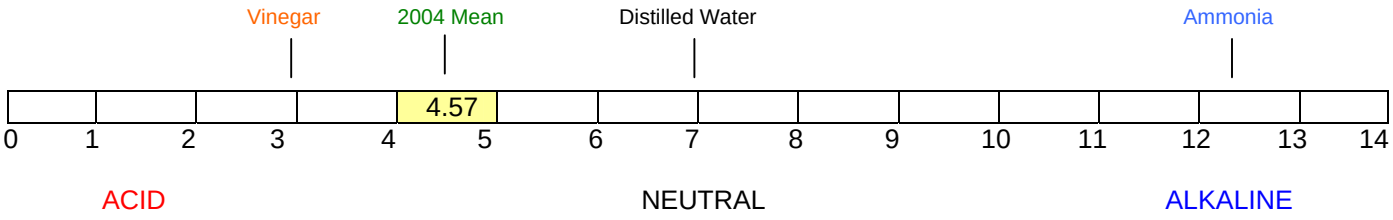
Method: Wet/Dry Collector
Laboratory Analytical



| Parameter | Units | # Obs | Arithmetic Mean | 1st Max | 2nd Max | 3rd Max | 4th Max |
|---|---|---|---|---|---|---|---|
| Acidity | Mg/L | 42 | 4.3 | 8.5 | 8.3 | 7.0 | 6.3 |
| Ammonia | Mg/L | 41 | 0.26 | 0.70 | 0.63 | 0.54 | 0.54 |
| Calcium | Mg/L | 20 | 0.34 | 1.06 | 0.85 | 0.47 | 0.43 |
| Chloride | Mg/L | 34 | 0.47 | 1.58 | 1.17 | 0.94 | 0.92 |
| Conductivity | µmho | 43 | 20.0 | 61.4 | 49.3 | 39.9 | 35.4 |
| Magnesium | Mg/L | 0 | - | - | - | - | - |
| Nitrate | Mg/L | 45 | 1.34 | 3.48 | 3.22 | 2.90 | 2.40 |
| Potassium | Mg/L | 26 | 0.40 | 0.62 | 0.55 | 0.48 | 0.48 |
| Sodium | Mg/L | 24 | 0.25 | 0.83 | 0.82 | 0.44 | 0.40 |
| Sulfate | Mg/L | 45 | 1.92 | 5.03 | 4.28 | 3.89 | 3.76 |

pH is measured on a scale ranging from zero to fourteen where neutral substances such as distilled water are around seven on the scale. The more acidic substances such as vinegar would be on the lower end of the scale while alkaline substances such as ammonia would be on the upper end of the scale. The chart below indicates where the pH measurements for 2004 at Grayson Lake fall on this scale.

### pH Scale

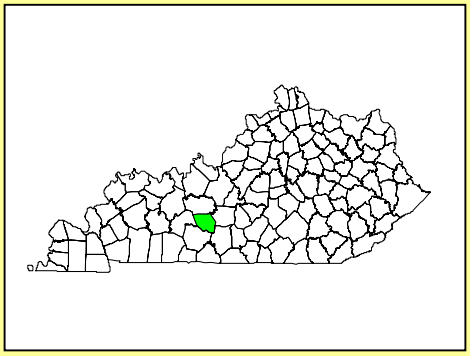


## Wet Deposition Pollutants Summary Report - 2004

Agency: National Parks Service

Site Id: 21-061-0501
County: Edmonson
Location: Mammoth Cave National Park
Alfred Cook Road

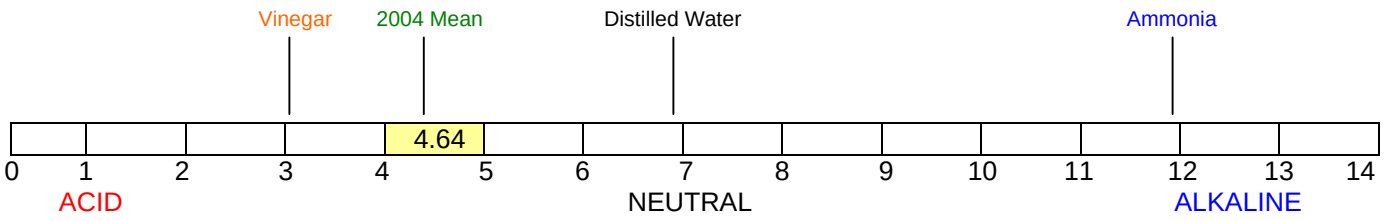
Method: Wet/Dry Collector
Laboratory Analytical



| Parameter | Units | # Obs | Arithmetic Mean | 1st Max | 2nd Max | 3rd Max | 4th Max |
|---|---|---|---|---|---|---|---|
| Acidity | Mg/L | - | - | - | - | - | - |
| Ammonia | Mg/L | 46 | 0.34 | 1.31 | 1.04 | 0.85 | 0.75 |
| Calcium | Mg/L | 47 | 0.17 | 1.28 | 0.89 | 0.71 | 0.39 |
| Chloride | Mg/L | 47 | 0.13 | 0.62 | 0.54 | 0.31 | 0.30 |
| Conductivity | µmho | 47 | 18.9 | 65.6 | 49.6 | 45.4 | 39.0 |
| Magnesium | Mg/L | 43 | 0.02 | 0.11 | 0.10 | 0.08 | 0.04 |
| Nitrate | Mg/L | 47 | 1.25 | 4.10 | 3.66 | 3.35 | 2.78 |
| Potassium | Mg/L | 47 | 0.02 | 0.13 | 0.09 | 0.07 | 0.05 |
| Sodium | Mg/L | 47 | 0.07 | 0.36 | 0.34 | 0.18 | 0.17 |
| Sulfate | Mg/L | 47 | 1.82 | 6.24 | 5.21 | 5.16 | 4.60 |

pH is measured on a scale ranging from zero to fourteen where neutral substances such as distilled water are around seven on the scale. The more acidic substances such as vinegar would be on the lower end of the scale while alkaline substances such as ammonia would be on the upper end of the scale. The chart below indicates where the pH measurements for 2004 at Mammoth Cave fall on this scale.

### pH Scale



## Speciation Charts

The promulgation of the new $PM_{2.5}$ Standards may require all future areas not meeting the Standards to reduce emissions of fine particulates and their precursors. Efficient air quality management requires knowing which sources contribute to the problem and estimating how much. However, determining $PM_{2.5}$ source contributions is very complicated due to the fact that often half or more of the $PM_{2.5}$ mass is composed of secondarily formed species therefore hiding their point of origin. In addition, $PM_{2.5}$ may remain in the atmosphere for several days enabling sources several hundred miles away to affect an area. Realizing this, EPA established the Speciation Trends Network designed to assist in identifying the compounds associated with fine particulates. The network is used to provide data on a target group of chemical species known to be significant contributors to $PM_{2.5}$ mass. The data provided by the network can be used to support several areas that include:

- Helping to implement the $PM_{2.5}$ standard by using speciated data as input to air quality modeling analyses and as indicators to track progress of controls
- Aiding the interpretation of health studies by linking effect to $PM_{2.5}$ constituents
- Understanding the effect of atmospheric constituents on visibility impairment
- Using the speciated particulate data to aid in monitoring network design and siting adjustment.

The approach to be used for chemical speciation involves both sampling and analysis components. The target group of chemical species include a list of analytes that consist of an array of cations, anions, carbon species, and trace elements. Because no one sample media is capable of providing the appropriate sample collection for all of the target analytes, each series of analytes requires sample collection on the appropriate media and utilization of the appropriate analytical techniques. Listed below are the target analytes and the analytical techniques used:

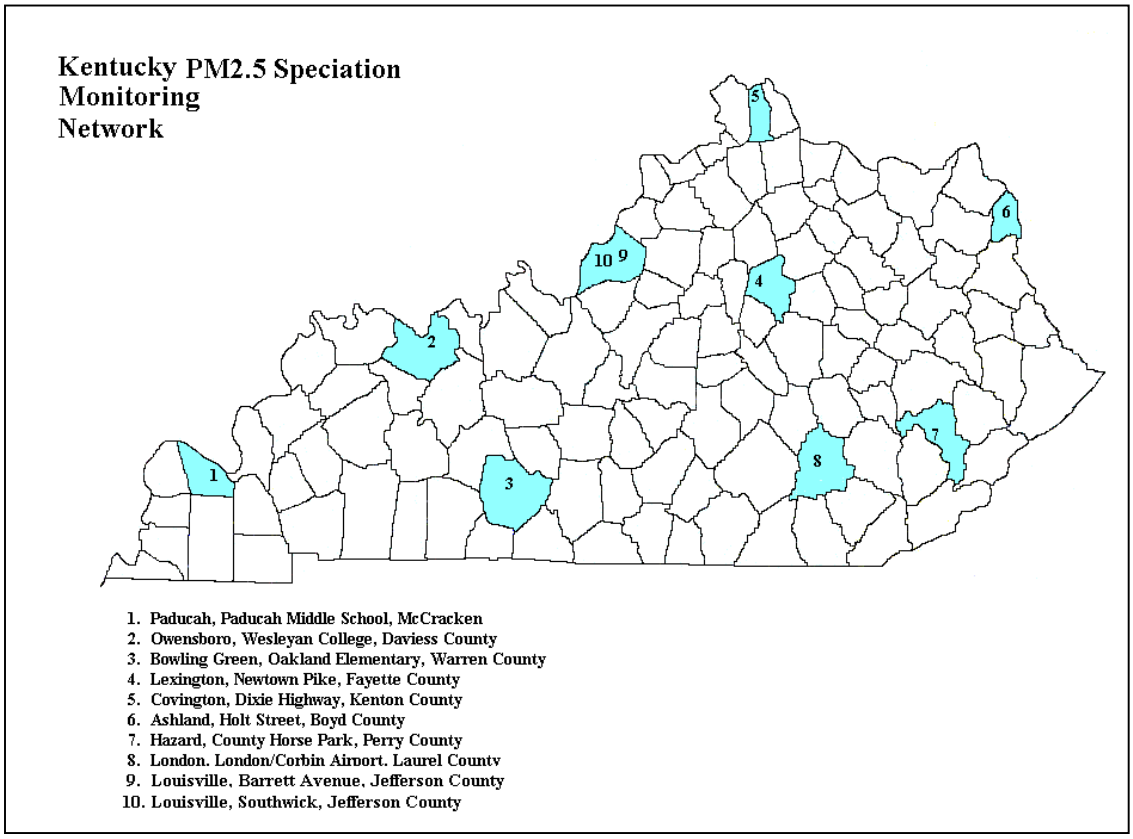
- Trace elements — X-ray fluorescence and particle induced X-ray emission
- Anion and cations — Ion chromatography
- Carbon — Controlled-combustion/thermal optical

Once analysis is complete, the analytes are grouped into the target chemical species listed below. These species in turn can be linked to source categories that ultimately can be used to assist in understanding $PM_{2.5}$ and developing control strategies needed to reduce ambient levels.

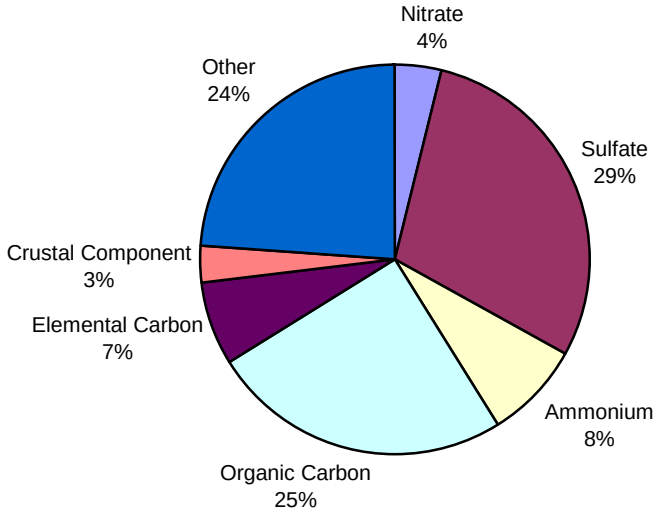
- Nitrate (total)
- Sulfate
- Ammonium
- Organic Carbon
- Elemental Carbon
- Crustal Component (trace elements, fine soil)
- Other ($PM_{2.5}$ mass unaccounted for by analytical methods)

In 2004 the Kentucky Division for Air Quality operated a network of eight Speciation Trends Network sites and the Louisville Metro Air Pollution Control District operated two. The

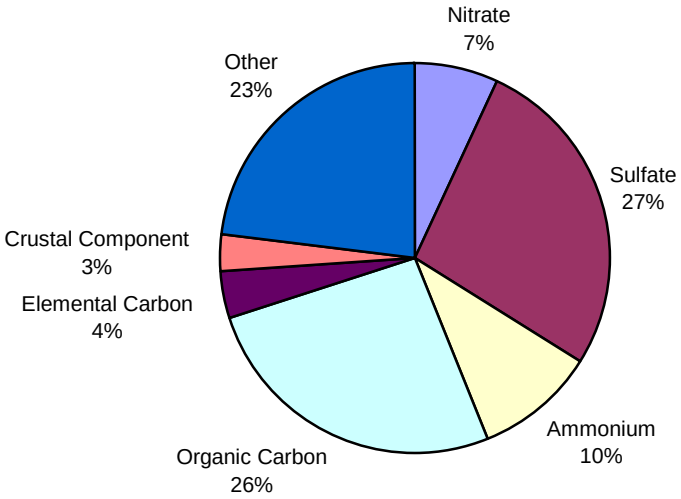
sites are strategically located to address different types of land use ranging from heavy industrial, urban, and rural. The charts on pages 48-52 provide a visual representation of speciation data collected at each site during 2004. The data suggests that sulfate and organic carbon are the primary contributors to $PM_{2.5}$ in Kentucky. Sulfates are formed from sulfur dioxide emissions with the major sources of those emissions being coal-fired power plants. Organic carbon comes from a combination of mobile and stationary combustion sources.



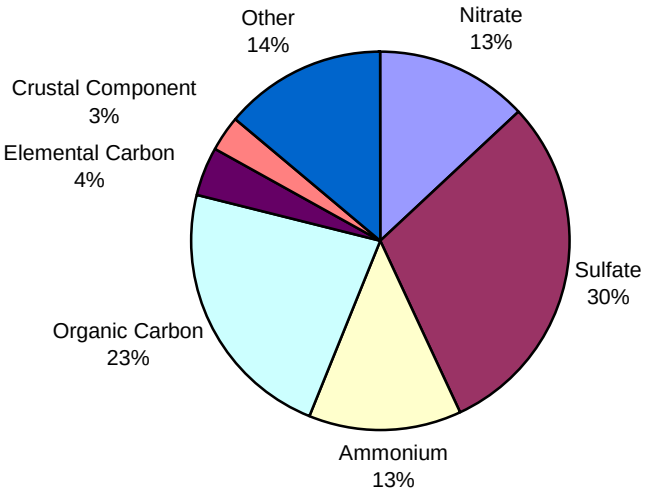
Hazard – Perry County Horse Park
AIRS Code 211930003 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



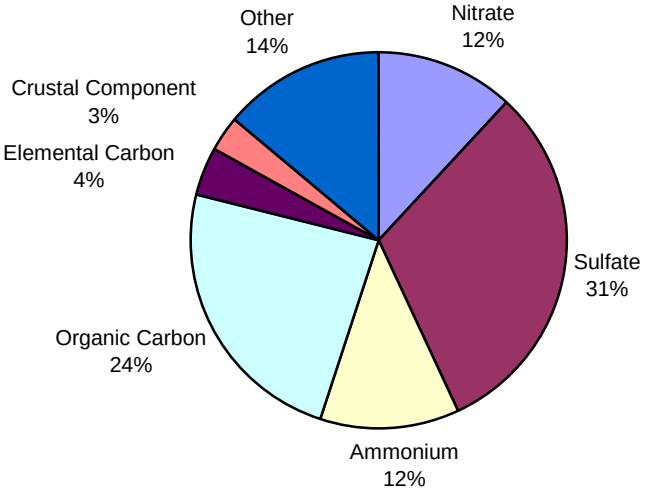

London Laurel County
AIRS Code 211250004 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



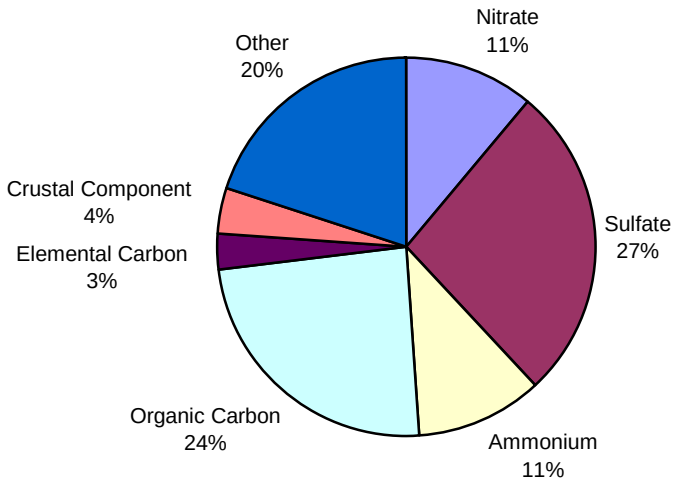
Lexington Health Department
AIRS Code 210670012 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



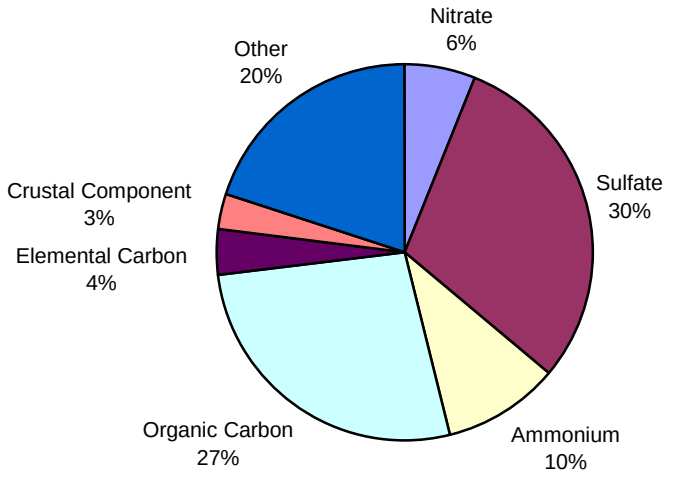

Covington – University College
AIRS Code 211170007 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



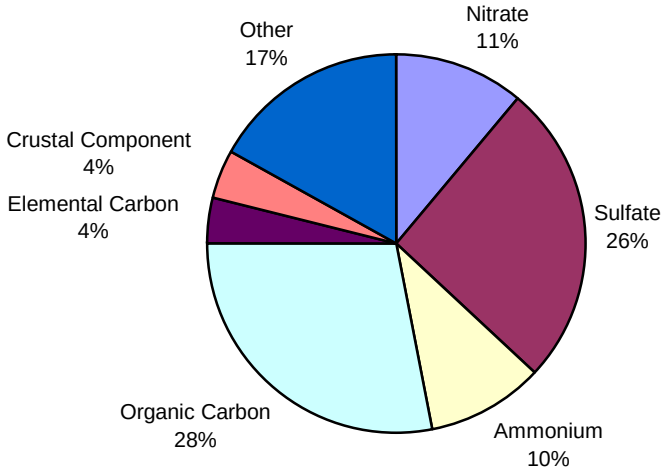
Owensboro - KY Wesleyan College
AIRS Code 210590014 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



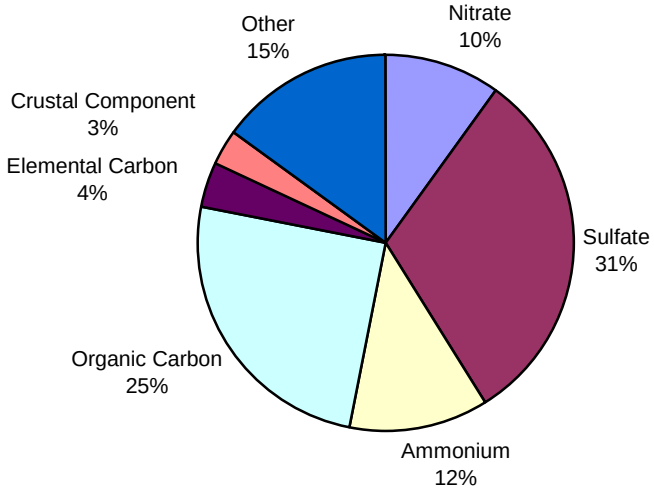

Ashland Health Department
AIRS Code 210190017 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



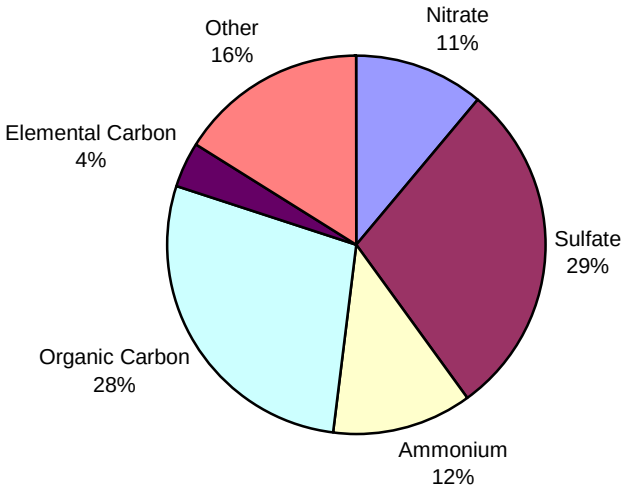
Paducah Middle School
AIRS Code 211451004 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



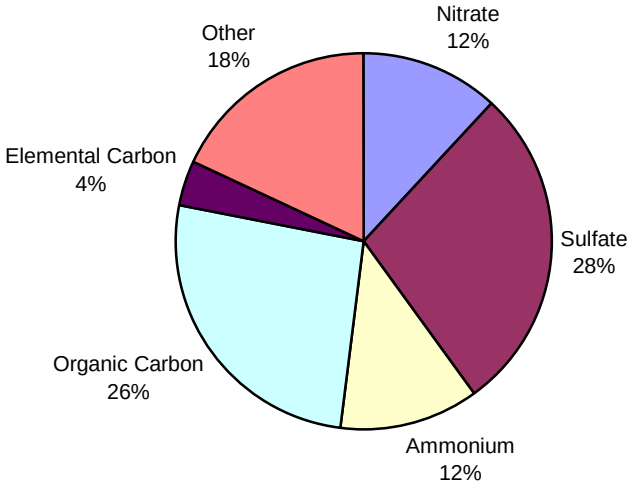

Bowling Green – Kereiakes Park
AIRS Code 212270007 POC 5 (ROUTINE)
Date(s): 1/4/04 – 12/29/04
Average Concentration (μg/m$^3$)



Southwick Community Center
AIRS Code 211110043 POC 5 (ROUTINE)
Date(s): 1/3/03 – 12/29/03
Average Concentration ($\mu g/m^3$)




LMAPCD (Barret)
AIRS Code 212270007 POC 5 (ROUTINE)
Date(s): 1/3/03 – 12/29/03
Average Concentration ($\mu g/m^3$)



## The Air Quality Index:

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health.

**How Does the AQI Work?**

Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, while an AQI value over 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy-at first for certain sensitive groups of people, then for everyone as AQI values get higher.

**Understanding the AQI**

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

| Air Quality Index (AQI) Values | Levels of Health Concern | Colors |
|---|---|---|
| *When the AQI is in this range:* | *...air quality conditions are:* | *...as symbolized by this color:* |
| **0 to 50** | **Good** | **Green** |
| **51 to 100** | **Moderate** | **Yellow** |
| **101 to 150** | **Unhealthy for Sensitive Groups** | **Orange** |
| **151 to 200** | **Unhealthy** | **Red** |
| **201 to 300** | **Very Unhealthy** | **Purple** |
| **301 to 500** | **Hazardous** | **Maroon** |

Each category corresponds to a different level of health concern. The six levels of health concern and what they mean are:

- **"Good"** The AQI value for your community is between 0 and 50. Air quality is considered satisfactory, and air pollution poses little or no risk.

- **"Moderate"** The AQI for your community is between 51 and 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a

very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.

- **"Unhealthy for Sensitive Groups"** When AQI values are between 101 and 150, members of sensitive groups may experience health effects. This means they are likely to be affected at lower levels than the general public. For example, people with lung disease are at greater risk from exposure to ozone, while people with either lung disease or heart disease are at greater risk from exposure to particle pollution. The general public is not likely to be affected when the AQI is in this range.

- **"Unhealthy"** Everyone may begin to experience health effects when AQI values are between 151 and 200. Members of sensitive groups may experience more serious health effects.

- **"Very Unhealthy"** AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.

- **"Hazardous"** AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

The map below is a summary of the air quality index values recorded for 2004.