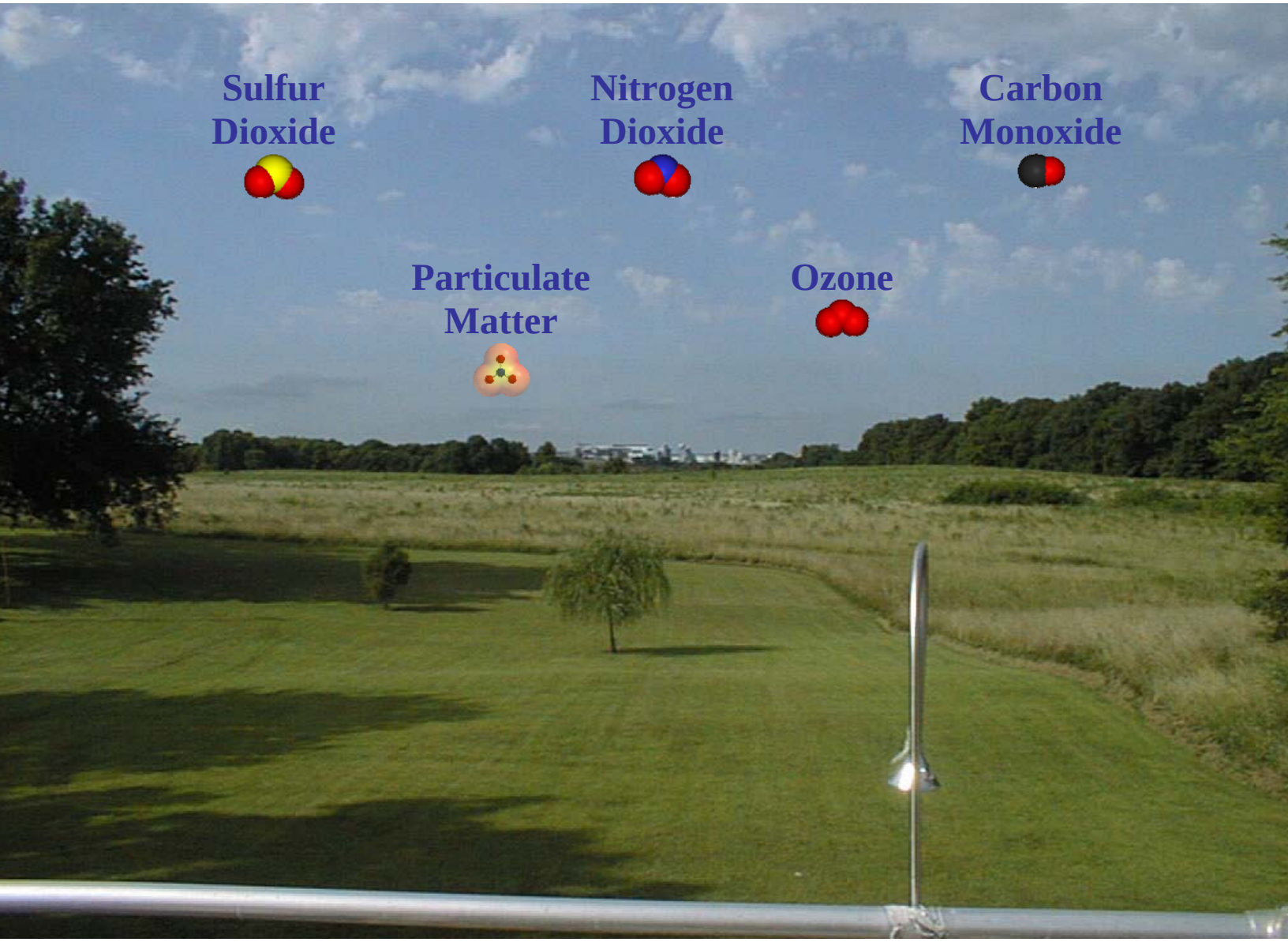
Commonwealth of Kentucky Environmental & Public Protection Cabinet
Department for Environmental Protection
Division for Air Quality 803 Schenkel Lane Frankfort, Kentucky 40601

Kentucky Ambient Air Quality Annual Report 2005

An Annual Summary of Ambient Air Monitoring Conducted in Kentucky



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Introduction

The Technical Services Branch of the Kentucky Division for Air Quality produces the Ambient Air Quality Annual Report. This report presents a summary of statistical results from monitoring outdoor concentrations of air pollutants in the Commonwealth during the calendar year 2005.

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

Since July 1967, the state has operated an air quality monitoring network. The 2005 network included 129 monitors in 37 counties (this total includes monitors operated by the Louisville Metro Air Pollution Control District, the National Park Service at Mammoth Cave and industries).

The monitoring station locations are selected with U.S. Environmental Protection Agency guidance (40 CFR 58, Appendix D) 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 visits our 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 utilized to demonstrate compliance with and/or progress made toward meeting ambient air quality standards and to identify pollution trends. The data also assists in evaluating public health impacts and the possible need to initiate emergency control procedures.

The public has access to the monitoring data through this annual report and, on a daily basis, through the Air Quality Index (AQI) message on our website: www.air.ky.gov or toll free at: 1-800-AIR-IN-KY. The AQI 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, industrial data, mercury monitoring and attainment designations 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 Andrea Keatley, Technical Services Branch, Division for Air Quality, 803 Schenkel Lane, Frankfort, KY 40601.

National Ambient Air Quality Standards (NAAQS)

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 (**Revoked June 15, 2005**)	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 (42 U.S.C. 7401-7671), 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.

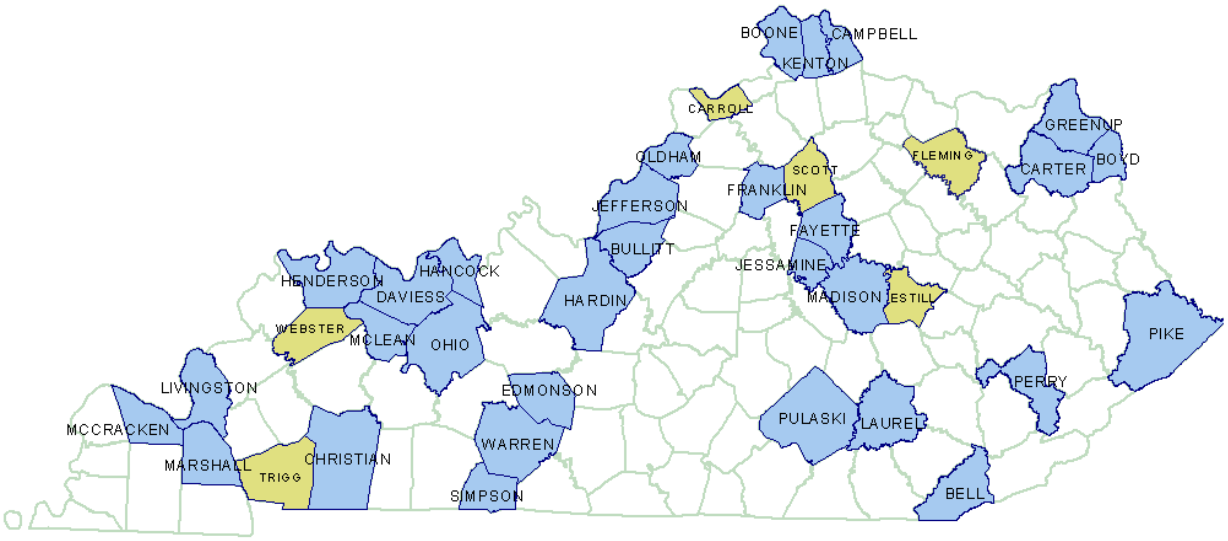
There are two standard goal levels for each of the criteria pollutants. The PRIMARY STANDARD is designed to protect the public health. The SECONDARY STANDARD is designed to protect public welfare. Welfare covers damage to plants and animals, impairment of visibility and property damage.

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 $\mu g/m^3$.

2005 Kentucky and Industrial Air Monitoring Network Counties



Pollutants

	$PM_{2.5}$	PM_{10}	SO_2	NO_2	CO	O3	AcidRn	Species	Hg	WS/WD
Bell	1	1				1				1
Boone						1			1	
Boyd	1	1	1	1		1		1		1
Bullitt	1	1		1		1				1
Campbell	1	1	1	1		1				
Carroll [3]		1		1						
Carter	1					1	1		1	1
Christian	1									
Christian [3]						1				
Daviess	1	1	1	1		1		1		1
Edmonson [1]	1					1	1			
Estill [3]			1							
Fayette	2	1	1	1		2		1		
Fleming [3]						1				
Franklin	1							1		
Greenup			1			1				
Hancock						1				
Hardin	1	1				1				
Henderson	1	1	1			1				
Henderson [3]			2							
Jefferson [2]	5	2	2	1	2	3		2		1

Pollutants

	$PM_{2.5}$	PM_{10}	SO_2	NO_2	CO	O3	AcidRn	Species	Hg	WS/WD
Jessamine						1			1	1
Kenton	1					1		1		1
Laurel	1	1						1		
Livingston			1			1			1	1
McCracken	1	2	1	1		1		1		
McLean						1				1
Madison	1	1								
Madison [3]			1							
Marshall		1								
Ohio	1		1			1			1	
Oldham						1				
Perry	1	1				1		1		1
Pike	1	1				1				
Pulaski		1				1				
Scott [3]						1				
Trigg [3]						1				
Simpson						1				1
Warren	1	1	1	1		1				
Webster [3]			1							
Wayne, WV [3]			3	1		1				

[1] Operated by the National Park Service

[2] Operated by the Louisville Metro Air Pollution Control District

[3] Industrial Air Monitoring Network

PM10 monitor installed into Marshall county during the end of 2005. There is insuficient amount of data for an annual summary

Total:	$PM_{2.5}$	PM_{10}	SO_2	NO_2	CO	O3	AcidRn	Species	Hg	WS/WD
	26	20	20	10	2	34	2	10	5	12

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, both highway and off-road vehicles such as construction equipment. Other sources include industrial processes, coal, kerosene and wood burning stoves in homes.

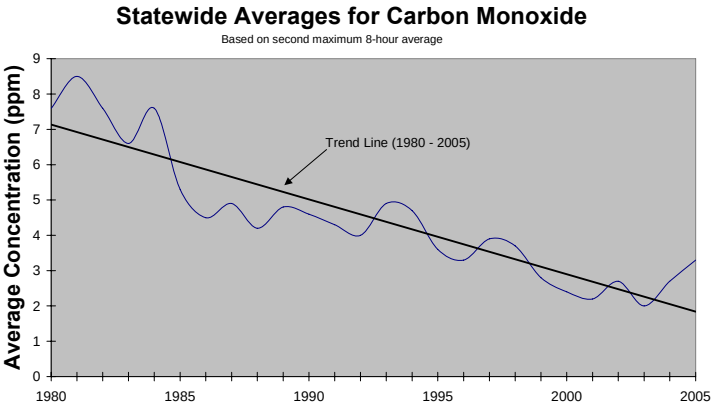
Why monitor for CO?

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. Depending on the level of exposure, CO can cause fatigue, headaches, and impaired vision and reflexes.

Unconsciousness and even death may occur at high concentrations of CO. The severity of the effects is related to the length of exposure and the level of CO concentration.

How is CO monitored?

Analyzers that operate continuously monitor carbon monoxide by 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 present in ambient air. A detector measures the difference between the sample cell beam and a duplicate beam passing through a reference cell without CO present. The difference is translated into a measurement of CO present in the ambient air. Data from the analyzer is transmitted by telemetry into an automated data storage system. In 2005, the Louisville Metro Air Pollution Control District operated two CO monitors in Jefferson County.



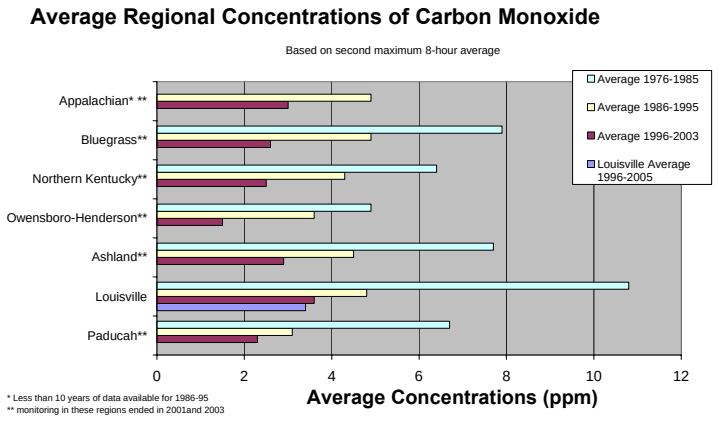


Figure 1. Carbon monoxide trends

Were there any exceedances?

There were no exceedances of the CO standards in 2005. The last exceedance of the CO 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 (see Figure 1). This decrease is primarily due to improved emission controls on motor vehicles.

Due to the substantial drop in monitored levels of CO, monitoring was discontinued statewide in 2003 except for Jefferson County. This accounts for the up trend in 2004 and 2005 for the statewide average as it includes only data from Jefferson County. Historically, Jefferson County has been higher than the rest of the state.

A statistical summary of carbon monoxide data collected in 2005 follows on this page.

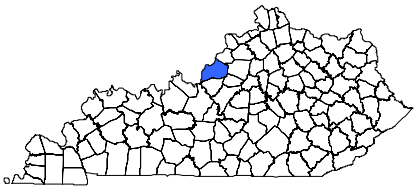
National Ambient Air Quality Standards for Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 ppm more than once per year.
1-hour average not to exceed 35 ppm more than once per year.

Secondary NAAQS: Same as primary standard.

Criteria Pollutant Summary Report – 2005

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



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	8704	2.8	2.6	0	2.1	2.0	0
Jefferson [1]	1735 Bardstown Road Louisville	21-111-1019	8614	4.1	4.0	0	2.6	2.6	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.

Why monitor for SO_2?

The primary health effect of sulfur dioxide is the aggravation of 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. Moisture in the atmosphere combined with SO_2 form sulfuric acid (H_2SO_4), which is a component of acid precipitation. Acid precipitation causes acidification of soil and water that can deteriorate plant life, animal life, and structural surfaces. Sulfur dioxide may also be converted into sulfates. Sulfates 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.

How is SO_2 monitored?

Analyzers that operate continuously monitor sulfur dioxide by using the ultraviolet (UV) fluorescence method. Fluorescent analyzers irradiate an ambient air sample with ultraviolet light. Sulfur dioxide molecules absorb a portion of this energy and 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 into an automated data storage system. In 2005, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated twelve SO_2 monitors in Kentucky.

Were there any exceedances?

There were no exceedances of any of the sulfur dioxide standards in 2005. 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 (see Figure 2).

A statistical summary of sulfur dioxide data collected in 2005 follows on the next page.

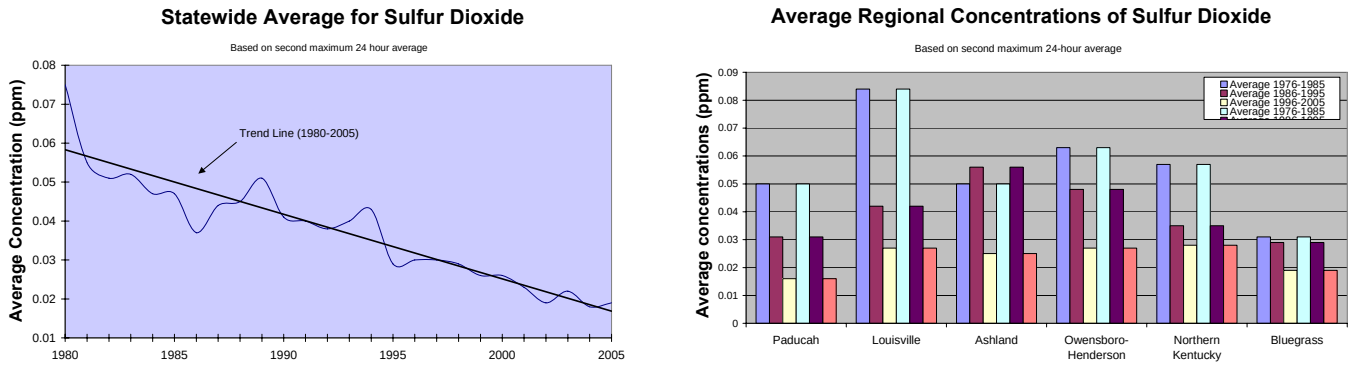


Figure 2: Sulfur dioxide trends

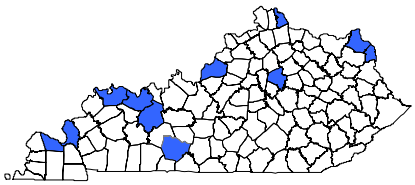
National Ambient Air Quality Standards for Sulfur Dioxide

Primary NAAQS: Annual Arithmetic Mean not to exceed 0.03 ppm.
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.

Criteria Pollutant Summary Report – 2005

Pollutant: **Sulfur Dioxide**
Method: Instrumental
Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (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	8685	.006	.024	.023	0	.056	.048	0
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	8662	.006	.032	.027	0	.118	.089	0
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	8375	.005	.026	.026	0	.065	.056	0
Fayette	650 Newtown Pike Lexington	21-067-0012	8667	.005	.015	.014	0	.030	.030	0
Greenup	Scott & Center Streets Worthington	21-089-0007	8689	.005	.025	.023	0	.058	.050	0
Henderson	Baskett Fire Dept Baskett	21-101-0014	8201	.004	.030	.022	0	.081	.080	0
Jefferson[1]	7201 Watson Lane Louisville	21-111-0051	8718	.005	.030	.018	0	.108	.062	0
Jefferson[1]	4201 Algonquin Pkwy Louisville	21-111-1041	8724	.005	.025	.023	0	.122	.107	0
Livingston	763 Bloodworth Road off KY 453	21-139-0004	8727	.006	.022	.016	0	.053	.049	0
McCracken	2901 Powell Street Paducah	21-145-1024	8687	.002	.013	.011	0	.027	.023	0
Ohio	Keytown Road Echols	21-183-0032	7863	.004	.017	.016	0	.059	.055	0
Warren	Oakland Elementary School, Oakland	21-227-0008	8703	.002	.010	.009	0	.025	.021	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 high temperature combustion. 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 NO_2 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 NO_2 include motor vehicles, power plants, incinerators, industrial boilers and some chemical processes.

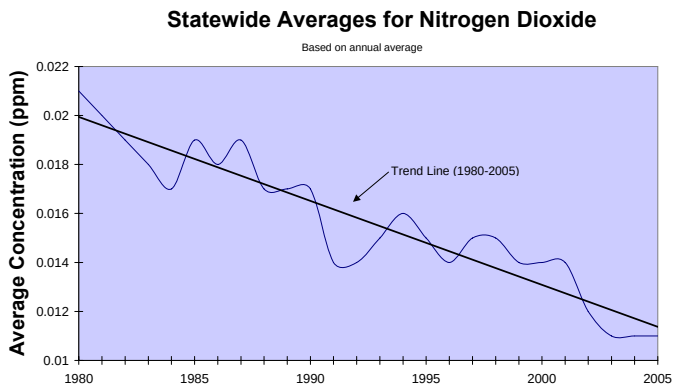
Why monitor for NO_2?

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 an increase the susceptibility of the respiratory system to infection. Nitrogen oxides are also considered detrimental to human health due to their 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 life, aquatic life, cause the deterioration of stone/masonry-type buildings and deteriorate statues. Nitrogen oxides also react with ammonia to from ammonium nitrate, a component of $PM_{2.5}$. Nitrates are also a key component in regional haze that has been attributed to poor visibility in the southeast region of the United States.

How is NO_2 monitored?

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.



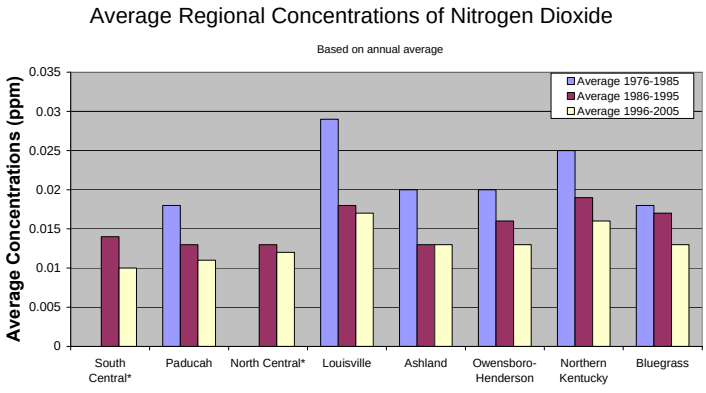


Figure 3. Nitrogen dioxide trends

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 into an automated data storage system. In 2005, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated eight nitrogen dioxide monitors in Kentucky.

Were there any exceedances?

There were no exceedances of the NO_2 standard in 2005 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 (see Figure 3) primarily due to the use of pollution control devices on motor vehicles, power plants and industrial boilers.

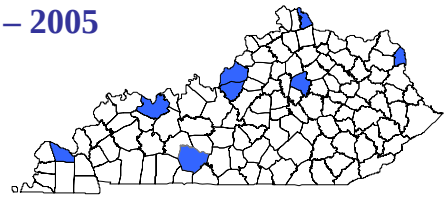
A statistical summary of nitrogen dioxide data collected in 2005 follows on this page.

National Ambient Air Quality Standards for Nitrogen Dioxide

Primary NAAQS: Annual Arithmetic Mean 0.05 ppm.

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2005



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

County	Site	AIRS-ID	# Obs	Mean	1-Hr Average	
					1st max	2nd max
Boyd	2924 Holt Street Ashland	21-019-0017	8230	.011	.045	.043
Bullitt	2nd & Carpenter Streets Shepherdsville	21-029-0006	7500	.010	.057	.055
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	8224	.011	.054	.048
Daviess	US 60 and Pleasant Valley Road Owensboro	21-059-0005	7981	.008	.040	.039
Fayette	650 Newtown Pike Lexington	21-067-0012	8164	.012	.061	.060
Jefferson[1]	1918 Mellwood Avenue Louisville	21-111-1021	8140	.017	.062	.061
McCracken	2901 Powell Street Paducah	21-145-1024	8089	.009	.059	.050
Warren	Oakland Elementary School Oakland	21-227-0008	7883	.009	.048	.048

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

Ozone

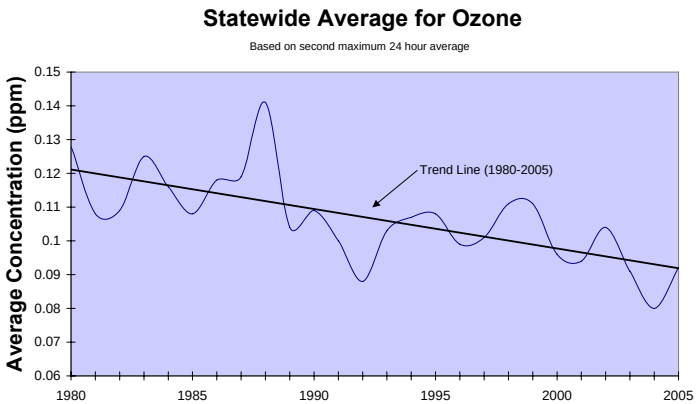
Ozone is a colorless gas that is not emitted directly into the atmosphere from sources but forms in the atmosphere from a photochemical reaction between volatile organic compounds and nitrogen oxides in the presence of sunlight. Sources of volatile organic compounds include motor vehicle exhaust, dry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

Why monitor for O_3?

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 can trigger health problems at low level exposure, cause permanent lung damage after long term exposure and damage ecosystems.

How is O_3 monitored?

Ozone is monitored from March 1 through October 31 each year when meteorological conditions are most conducive to the formation of ozone. Analyzers, which operate continuously, monitor ozone by using the ultraviolet photometry method. 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 into an automated data storage system. In 2005, the Division for Air Quality, the National Park Service at Mammoth Cave and the Louisville Metro Air Pollution Control District operated a total of twenty-nine ozone monitors in Kentucky.



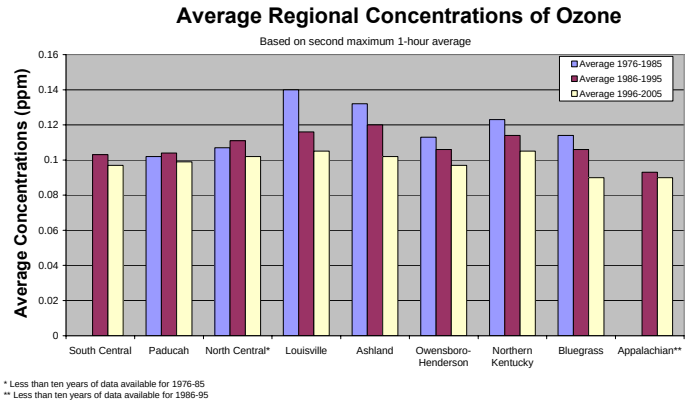


Figure 4. Ozone trends.

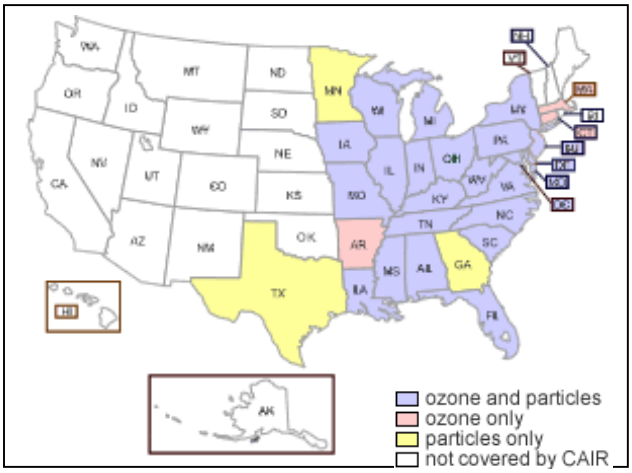
Were there any exceedances?

One year after the eight-hour ozone designations became effective, the one-hour ozone standard was revoked on June 15, 2005. All ozone exceedances for Kentucky will be based on the eight–hour standard. This will be the last annual report referencing a one-hour ozone 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. During the 2005 monitoring season, no monitor exceeded the one-hour ozone standard, see the statistical summary on pages 11-12.

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 might 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 2003-2005 can be found on pages 13-14. In 2005, there were 27 exceedances of the 8-hour standard. There are no exceedances based on the 8-hour 4th maximum 3-year average.

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. In 1997, the federal NO_x SIP Call resulted in the promulgation of 401 KAR 51:160. The 401 KAR 51:160 established regional control of NO_x emissions from large stationary internal combustion engines and large boilers and turbines used in power plants and other industrial applications. Also, on May 12, 2005, EPA finalized the Clean Air Interstate Rule (CAIR). CAIR will require the implementation of a proven cap and trade approach to reduce SO2 and NO_x emissions in 28 eastern states and the District of Columbia. By 2015, CAIR will help Kentucky reduce NO_x source emissions by 108,000 tons.



A statistical summary of one-hour and eight-hour ozone data collected in 2005 follows on pages 11-12.

VOC + NOx + Sunlight = Ozone

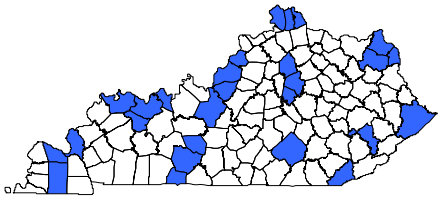
National Ambient Air Quality Standards for Ozone

Primary NAAQS: 1-Hour (1 per year/3 years) 0.12 ppm. **Revoked June 15, 2005**
8-Hour (3 year avg. of 4th max.) 0.08 ppm

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2005

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



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	.086	.086	0	.081	.078	.078	.077
Boone	KY 338 & Lower River Rd, East Bend	21-015-0003	5589	0	.096	.095	0	.082	.082	.082	.082
Boyd	2924 Holt Street Ashland	21-019-0017	5851	0	.096	.096	1	.087	.084	.083	.082
Bullitt	2nd & Carpenter St Shepherdsville	21-029-0006	5741	0	.096	.094	0	.083	.081	.081	.080
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	5853	0	.123	.110	9	.106	.097	.091	.090
Carter	Camp Webb Grayson Lake	21-043-0500	5779	0	.103	.099	1	.087	.084	.082	.081
Daviess	US 60 and Pleasant Valley, Owensboro	21-059-0005	4763	0	.100	.100	2	.087	.086	.083	.083
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	8335	0	.092	.086	0	.082	.079	.078	.075
Fayette	Iron Works Pike Lexington	21-067-0001	5853	0	.072	.069	0	.067	.064	.062	.059
Fayette	650 Newtown Pike Lexington	21-067-0012	5826	0	.095	.095	0	.080	.079	.077	.076
Greenup	Scott & Center St Worthington	21-089-0007	5855	0	.093	.092	0	.084	.080	.078	.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.

Criteria Pollutant Summary Report – 2005 Continued

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

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
Hancock	2nd & Caroline Lewisport	21-091-0012	5853	0	.095	.089	0	.078	.075	.074	.072
Hardin	801 North Miles St Elizabethtown	21-093-0006	5854	0	.093	.092	0	.083	.081	.081	.079
Henderson	Baskett Fire Dept. Baskett	21-101-0014	5828	0	.101	.090	0	.084	.081	.079	.077
Jefferson[2]	7601 Bardstown Rd Louisville	21-111-0027	5862	0	.092	.091	0	.083	.079	.079	.079
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	5865	0	.116	.115	4	.091	.086	.086	.085
Jefferson[2]	1918 Mellwood Ave Louisville	21-111-1021	5871	0	.101	.096	1	.088	.084	.076	.074
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	5859	0	.095	.093	0	.082	.079	.079	.079
Kenton	1401 Dixie Highway Covington	21-117-0007	5806	0	.108	.102	3	.091	.088	.087	.084
Livingston	KYDOT 811 US 60E Smithland	21-139-0003	5610	0	.093	.090	1	.087	.078	.075	.075
McCracken	2901 Powell Street Paducah	21-145-1024	5841	0	.091	.090	0	.082	.078	.075	.074
McLean	3962 KY 815 Guffie	21-149-0001	5732	0	.098	.088	0	.080	.078	.076	.074
Ohio	Keytown Rd. Echols	21-183-0032	5614	0	.083	.079	0	.077	.075	.075	.072
Oldham	DOT Garage, 3995 Morgan Rd, Buckner	21-185-0004	5853	0	.113	.111	4	.094	.094	.093	.089
Perry	Perry Co Horse Park Hazard	21-193-0003	5836	0	.089	.088	0	.080	.078	.076	.075
Pike	101 North Mayo Trail, Pikeville	21-195-0002	5855	0	.085	.078	0	.072	.071	.070	.069
Pulaski	Clifty Street Somerset	21-199-0003	5810	0	.085	.081	0	.078	.076	.076	.075
Simpson	KYDOT, HWY 1008 Franklin	21-213-0004	5856	0	.103	.090	1	.089	.084	.080	.079
Warren	Oakland Elementary School, Oakland	21-227-0008	5698	0	.089	.089	0	.077	.076	.076	.076

[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.

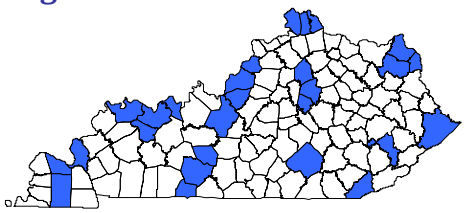
National Ambient Air Quality Standards for Ozone

Primary NAAQS: 1-Hour (1 per year/3 years) 0.12 ppm. **Revoked June 15, 2005**
8-Hour (3 year avg. of 4th max.) 0.08 ppm

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Multi-year Summary Report – 2005
8-hour 4th Maximum 3 year Average

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



County	Site	AIRS-ID	2003 4th max	2004 4th max	2005 4th max	3 year Avg. 4th max
Bell	34th & Dorchester Middlesboro	21-013-0002	.078	.069	.077	.074
Boone	KY 338 & Lower River Road East Bend	21-015-0003	.078	.070	.082	.076
Boyd	2924 Holt Street Ashland	21-019-0017	.088	.068	.082	.079
Bullitt	2nd & Carpenter Streets Shepherdsville	21-029-0006	.072	.068	.080	.073
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	.085	.076	.090	.083
Carter	Camp Webb Grayson Lake	21-043-0500	.073	.062	.081	.073
Daviess	US 60 & Pleasant Valley Rd Owensboro	21-059-0005	.069	.066	.083	.072
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	.076	.070	.075	.073
Fayette	Iron Works Pike Lexington	21-067-0001	.074	.063	.059	.065
Fayette	650 Newtown Pike Lexington	21-067-0012	.070	.063	.076	.069
Graves	Byerly Farm, KY 1949 Symsonia	21-083-0003	.073	.066	*	.077*
Greenup	Scott & Center Streets Worthington	21-089-0007	.078	.073	.078	.076
Hancock	2nd & Caroline Streets Lewisport	21-091-0012	.077	.071	.072	.073

[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.
* Monitoring discontinued after 2004. 3-year average for 2002-2004
** Monitoring started in 2005.

Criteria Pollutant Multi-year Summary Report – 2005 Continued
8-hour 4th Maximum 3 year Average

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

County	Site	AIRS-ID	2003 4th Max	2004 4th Max	2005 4th Max	3 year Avg. 4th max
Hardin	801 North Miles Street Elizabethtown	21-093-0006	.073	.068	.079	.073
Henderson	Baskett Fire Dept Baskett	21-101-0014	.078	.070	.077	.075
Jefferson[2]	7601 Bardstown Road Louisville	21-111-0027	.072	.070	.079	.073
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	.075	.070	.085	.076
Jefferson[2]	1918 Mellwood Avenue Louisville	21-111-1021	.073	.068	.074	.071
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	.071	.065	.079	.071
Kenton	1401 Dixie Highway Covington	21-117-0007	.079	.073	.084	.078
Livingston	KYDOT, 811 US 60 East Smithland	21-139-0003	.080	.070	.075	.075
McCracken	2901 Powell Street Paducah	21-145-1024	.076	.067	.074	.072
McLean	3962 KY 815 Guffie	21-149-0001	.075	.071	.074	.073
Ohio	Keytown Rd. Echols	21-183-0032			.072**	.072**
Oldham	DOT Garage, 3995 Morgan Road, Buckner	21-185-0004	.082	.076	.089	.082
Perry	Perry County Horse Park Hazard	21-193-0003	.075	.067	.075	.072
Pike	101 North Mayo Trail Pikeville	21-195-0002	.064	.063	.069	.065
Pulaski	Clifty Street Somerset	21-199-0003	.075	.066	.075	.072
Simpson	KYDOT, HWY 1008 Franklin	21-213-0004	.077	.069	.079	.075
Warren	Oakland Elementary School Oakland	21-227-0008	.076	.068	.076	.073

[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.
* Monitoring discontinued after 2004.
** Monitoring Started in 2005.

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. Particulates are also formed in the atmosphere when gases like sulfur dioxide, nitrogen oxides and volatile organic compounds are transformed by chemical reactions. Common forms of particulates include fly ash, soot, soil, minerals, fibers, metals, oil-aerosols and tire rubber.

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. 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.

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 ($PM_{2.5}$) 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.

Why monitor for PM_{10}?

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. PM_{10} also damages 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.

How is PM_{10} monitored?

Most PM_{10} samplers are the intermittent type that operates 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 into an automated data storage system. In 2005, the Division for Air Quality and the Louisville Metro Air Pollution Control District operated a

combined network of eighteen PM_{10} samplers in Kentucky.

Were there any PM_{10} exceedances?

There were no exceedances of the PM_{10} standards in 2005. 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 measured. 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 measured. 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 2005 follows on pages 17-18.

Why monitor for $PM_{2.5}$?

Particulate of 2.5 microns or smaller have the ability to penetrate into the deepest parts of the lungs causing chronic respiratory symptoms and premature deaths in the elderly with compromised immune systems. $PM_{2.5}$ also affects the environment by reducing visibility (up to 70% in some areas of the U.S.) and contributing to acid rain.

How is $PM_{2.5}$ monitored?

$PM_{2.5}$ is monitored by an intermittent type sampler. The monitors collect a sample 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 2005, 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-five samplers.

Were there any $PM_{2.5}$ exceedances?

There were no exceedances of the 24-hour $PM_{2.5}$ standard in 2005. A total of four samplers exceeded the three year average annual standard. Three samplers were in Jefferson county and one in Fayette county. Non-attainment designations were based on data collected from 2002-2004. Statewide $PM_{2.5}$ levels have declined steadily over the period 2000-2004 with a slight increase in 2005, as seen in Figure 5. This downward trend may be attributed to reductions in sulfur dioxide and particulate emissions from industrial sources. A statistical summary of 2005 $PM_{2.5}$ data appears on page 19-20. Multi-year annual averages for 2003-2005 can be found on pages 21-24.

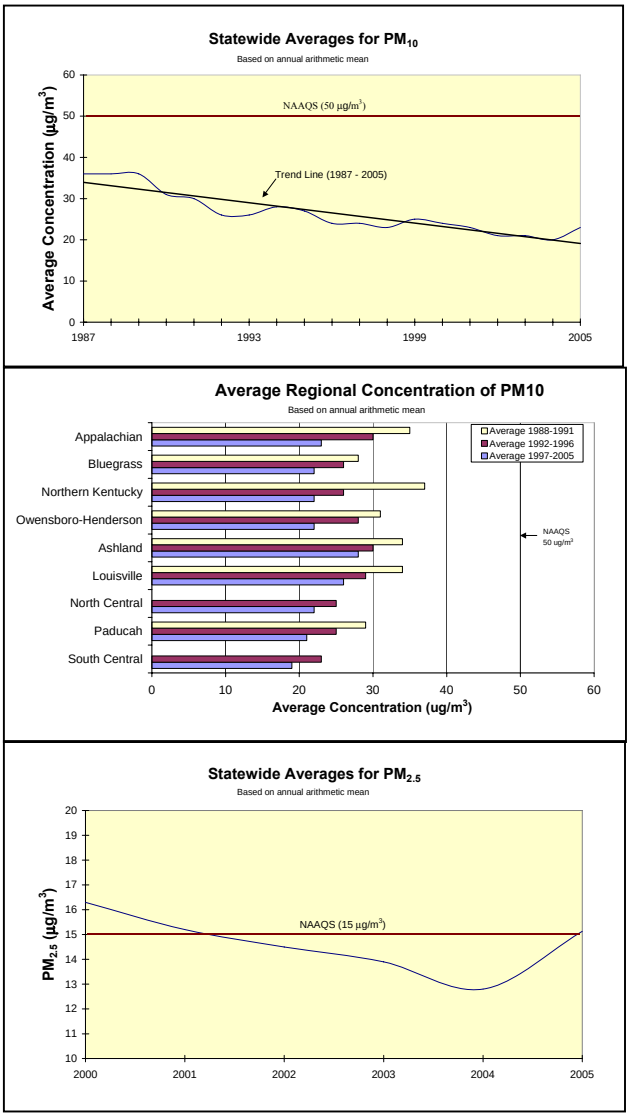


Figure 5. Particulate Matter trends.

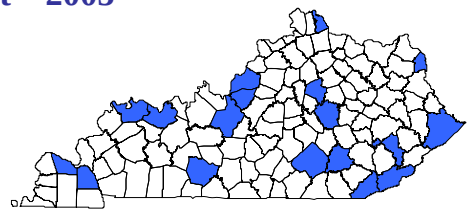
National Ambient Air Quality Standards for Particulate Matter PM_{10}

Primary NAAQS: Annual Arithmetic Mean not to exceed 50 µg/m^3 (based on a three-year avg.) Maximum 24-hour concentration of 150 µg/m^3. Average number of expected exceedances per year not to exceed 1.0 over last 3 years.

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Summary Report – 2005

Pollutant: **Particulate Matter PM_{10}**
Method: Gravimetric
Data Interval: 24-hour
Units: Micro-grams per cubic meter (µg/m^3)



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	53	23*	0	49	42	40	37
Boyd	122 22nd Street Ashland	21-019-0002	61	33	0	74	72	71	62
Bullitt	2nd & Carpenter Street Shepherdsville	21-029-0006	250	26	0	97	72	67	64
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	349	20	0	63	59	56	55
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	348	22	0	60	60	57	56
Fayette	533 South Limestone Lexington	21-067-0014	58	24	0	58	47	40	38
Hardin	801 North Miles Street Elizabethtown	21-093-0006	60	21	0	52	46	38	36
Henderson	Baskett Fire Dept Baskett	21-101-0014	344	21	0	56	54	53	53
Jefferson[1]	37th & Southern Ave Louisville	21-111-0043	8481	26	0	67	61	61	60
Jefferson[1]	1032 Beecher Avenue Louisville	21-111-0044	8680	24	0	60	59	58	58
Laurel	London-Corbin Airport London	21-125-0004	60	20	0	53	39	38	37

*Mean does not satisfy summary criteria, less than 75% data recovery during 1st quarter 2005.
[1] PM_{10} samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Criteria Pollutant Summary Report – 2005 Continued

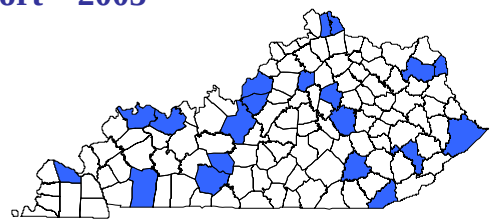
Pollutant: **Particulate Matter PM_{10}**
Method: Gravimetric
Data Interval: 24-hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

County	Site	AIRS-ID	# Obs	Mean	24-hour Average				
					Obs >150	1st max	2nd max	3rd max	4th max
McCracken	342 Lone Oak Road Paducah	21-145-1004	61	21	0	48	47	45	43
McCracken	2901 Powell Street Paducah	21-145-1024	345	23	0	67	66	66	60
Madison	Mayfield School Richmond	21-151-0003	55	21	0	53	41	38	36
Perry	Perry Co. Horse Park Hazard	21-193-0003	61	25	0	63	58	54	52
Pike	101 North Mayo Trail Pikeville	21-195-0002	331	22	0	57	52	51	50
Pulaski	Clifty Street Somerset	21-199-0003	61	20	0	54	40	37	35
Warren	Oakland Elementary School, Oakland	21-227-0008	343	19	0	55	54	53	47

*Mean does not satisfy summary criteria, less than 75% data recovery during 1st quarter 2005.
[1] PM_{10} samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

Criteria Pollutant Summary Report – 2005

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



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	55	15.0*	0	34.4	31.0	27.2	26.6
Boyd	2924 Holt Street Ashland	21-019-0017	119	16.0	0	39.0	38.1	36.1	35.5
Bullitt	2nd & Carpenter Street Shepherdsville	21-029-0006	114	16.3*	0	42.4	41.2	39.0	35.1
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	117	14.8	0	48.5	39.0	38.0	36.0
Carter	Camp Webb Grayson Lake	21-043-0500	117	13.6	0	39.8	39.6	37.2	36.4
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	119	14.0	0	44.9	41.0	35.0	34.2
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	110	15.1	0	38.9	38.6	36.7	36.6
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	119	13.6	0	34.4	33.8	33.6	32.8
Fayette	650 Newtown Pike Lexington	21-067-0012	119	15.5	0	44.1	40.8	35.6	34.7
Fayette	533 South Limestone Lexington	21-067-0014	116	16.1	0	41.0	38.2	35.4	35.1
Franklin	803 Schenkel Lane Frankfort	21-073-0006	118	14.6	0	49.1	45.7	38.0	35.5
Hardin	801 North Miles Street Elizabethtown	21-093-0006	118	14.5	0	39.6	39.5	35.1	33.2
Henderson	Baskett Fire Dept Baskett	21-101-0014	110	15.4	0	44.7	36.9	36.7	34.0
Jefferson[2]	37th & Southern Avenue Louisville	21-111-0043	340	16.7	0	48.8	47.8	45.9	44.3
Jefferson[2]	1032 Beecher Avenue Louisville	21-111-0044	332	16.5	0	48.9	44.5	43.2	43.1
Jefferson[2]	850 Barret Avenue Louisville	21-111-0048	115	16.8	0	46.4	43.6	43.2	41.6
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	59	16.5	0	39.1	36.5	30	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.
* Mean does not satisfy summary criteria. Below 75% data recovery during the 1st quarter.

Criteria Pollutant Summary Report – 2005 Continued

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

County	Site	AIRS-ID	# Obs	Mean	24-hour Average				
					Obs >65	1st max	2nd max	3rd max	4th max
Kenton	1401 Dixie Highway Covington	21-117-0007	118	15.9	0	52.7	46.8	42.1	40.4
Laurel	London-Corbin Airport London	21-125-0004	55	14.1	0	38.4	29.5	27.5	27.4
McCracken	342 Lone Oak Road Paducah	21-145-1004	119	14.0	0	39.6	37.2	37.1	36.9
Madison	Mayfield School Richmond	21-151-0003	115	15.2	0	42.3	35.2	32.6	31.7
Ohio	Keytown Rd. Echols	21-183-0032	48	14.9*	0	34.5	33.1	29.2	28.0
Perry	Perry Co. Horse Park Hazard	21-193-0003	55	13.9	0	34.6	31.4	26.4	25.8
Pike	101 North Mayo Trail Pikeville	21-195-0002	120	14.1	0	43.7	34.1	32.0	30.0
Warren	Kereiakes Park Bowling Green	21-227-0007	117	14.8	0	38.9	35.1	32.5	31.5

[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.
* Mean does not satisfy summary criteria. Below 75% data recovery during the 1st quarter.

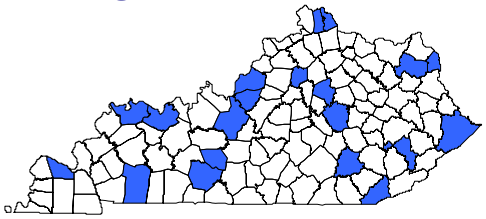
National Ambient Air Quality Standards for Particulate Matter $PM_{2.5}$

Primary NAAQS: **Annual Arithmetic Mean not to exceed 15 µg/m^3 (based on a three-year avg.)**
24-hour concentration not to exceed 65 µg/m^3. (based on a three-year average of the 98th percentiles).

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Multi-year Summary Report – 2005
Annual Arithmetic Mean 3-year average

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



County	Site	AIRS-ID	2003 mean	2004 mean	2005 mean	3 year Avg.
Bell	34th & Dorchester Middlesboro	21-013-0002	14.2	13.4	15.0*	13.8
Boyd	2924 Holt Street Ashland	21-019-0017	13.9	13.3	16.0	14.4
Bullitt	2nd & Carpenter Streets Shepherdsville	21-029-0006	14.4	13.6	16.3*	14.0
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	13.4	12.8	14.8	13.7
Carter	Camp Webb Grayson Lake	21-043-0500	11.4	11.1	13.6	12.0
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	13.9	11.8	14.0	13.2
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	14.6	12.5	15.1	14.1
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	-	11.6	13.6	-
Fayette	650 Newtown Pike Lexington	21-067-0012	13.8	13.5	15.5	14.3
Fayette	533 South Limestone Lexington	21-067-0014	15.0	14.3	16.1	15.1
Franklin	803 Schenkel Lane Frankfort	21-073-0006	13.1	12.5	14.6	13.4
Hardin	801 North Miles Street Elizabethtown	21-093-0006	13.4	12.2	14.5	13.4

[1] Sampler operated by the National Park Service at Mammoth Cave.
* Mean does not satisfy summary criteria. Below 75% data recovery during the 1st quarter.

Criteria Pollutant Multi-year Summary Report – 2005 Continued
Annual Arithmetic Mean 3-year average

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

County	Site	AIRS-ID	2003 mean	2004 mean	2005 mean	3 year Avg.
Henderson	Baskett Fire Dept Baskett	21-101-0014	13.8	12.1	15.4	13.8
Jefferson[2]	37th & Southern Avenue Louisville	21-111-0043	16.0	14.5	16.7	15.7
Jefferson[2]	1032 Beecher Avenue Louisville	21-111-0044	15.4	14.1	16.5	15.3
Jefferson[2]	850 Barrett Avenue Louisville	21-111-0048	15.5	13.7	16.8	15.3
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	14.9	12.6	16.5	14.7
Kenton	1401 Dixie Highway Covington	21-117-0007	14.3	13.4	15.9	14.5
Laurel	London-Corbin Airport London	21-125-0004	12.1	11.5	14.1	12.6
McCracken	342 Lone Oak Road Paducah	21-145-1004	13.8	11.8	14.0	13.2
Madison	Mayfield School Richmond	21-151-0003	12.9	13.0	15.2	13.7
Ohio	Keytown Rd. Echols	21-183-0032	-	-	14.9	-
Perry	Perry County Horse Park Hazard	21-193-0003	13.3	11.9	13.9	13.0
Pike	101 North Mayo Trail Pikeville	21-195-0002	13.1	12.3	14.1	13.2
Warren	Kereiakes Park Bowling Green	21-227-0007	13.3	13.1	14.8	13.7

[2] $PM2_{.5}$ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.
* Mean does not satisfy summary criteria. Below 75% data recovery during the 1st quarter.

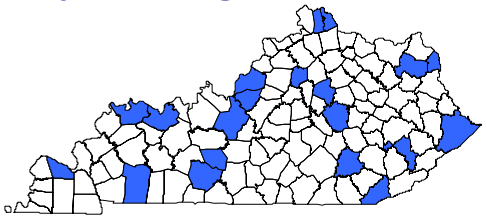
National Ambient Air Quality Standards for Particulate Matter $PM_{2.5}$

Primary NAAQS: Annual Arithmetic Mean not to exceed 15 µg/m^3 (based on a three-year avg.)
24-hour concentration not to exceed 65 µg/m^3. (based on a three-year average of the 98th percentiles).

Secondary NAAQS: Same as Primary Standard.

Criteria Pollutant Multi-year Summary Report – 2005
24-Hour Concentration 98th Percentiles 3-year average

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



County	Site	AIRS-ID	2003 mean	2004 mean	2005 mean	3 year Avg.
Bell	34th & Dorchester Middlesboro	21-013-0002	32.7	29.5	31.0	31.1
Boyd	2924 Holt Street Ashland	21-019-0017	33.8	30.3	36.1	33.4
Bullitt	2nd & Carpenter Streets Shepherdsville	21-029-0006	34.8	28.9	39.0	34.2
Campbell	700 Alexandria Pike Fort Thomas	21-037-0003	28.1	27.5	38.0	31.2
Carter	Camp Webb Grayson Lake	21-043-0500	26.7	24.5	37.2	29.5
Christian	10800 Pilot Rock Road Hopkinsville	21-047-0006	36.8	26.2	35.0	32.7
Daviess	US 60 and Pleasant Valley Rd, Owensboro	21-059-0005	36.5	27.0	36.7	33.4
Edmonson[1]	Alfred Cook Road Mammoth Cave	21-061-0501	-	24.2	33.6	-
Fayette	650 Newtown Pike Lexington	21-067-0012	28.3	29.1	35.6	31.0
Fayette	533 South Limestone Lexington	21-067-0014	29.1	29.2	35.4	31.2
Franklin	803 Schenkel Lane Frankfort	21-073-0006	30.3	26.9	38.0	31.7
Hardin	801 North Miles Street Elizabethtown	21-093-0006	32.4	27.8	35.1	31.8

[1] Sampler operated by the National Park Service at Mammoth Cave.

Criteria Pollutant Multi-year Summary Report – 2005 Continued
24-Hour Concentration 98th Percentiles 3-year average

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

County	Site	AIRS-ID	2003 mean	2004 mean	2005 mean	3 year Avg.
Henderson	Baskett Fire Dept Baskett	21-101-0014	35.8	25.8	36.7	32.8
Jefferson[2]	37th & Southern Avenue Louisville	21-111-0043	36.3	31.1	42.9	36.8
Jefferson[2]	1032 Beecher Avenue Louisville	21-111-0044	37.9	30.6	40.1	36.2
Jefferson[2]	850 Barrett Avenue Louisville	21-111-0048	35.5	28.8	43.2	35.8
Jefferson[2]	7201 Watson Lane Louisville	21-111-0051	33.0	25.8	36.5	31.8
Kenton	1401 Dixie Highway Covington	21-117-0007	30.8	29.4	42.1	34.1
Laurel	London-Corbin Airport London	21-125-0004	24.5	21.5	29.5	25.2
McCracken	342 Lone Oak Road Paducah	21-145-1004	31.0	26.5	37.1	31.5
Madison	Mayfield School Richmond	21-151-0003	28.1	28.4	32.6	29.7
Ohio	Keytown Rd. Echols	21-183-0032	-	-	34.5	-
Perry	Perry County Horse Park Hazard	21-193-0003	28.3	24.7	31.4	28.1
Pike	101 North Mayo Trail Pikeville	21-195-0002	30.5	28.2	32.0	30.2
Warren	Kereiakes Park Bowling Green	21-227-0007	30.2	31.5	32.5	31.4

[2] $PM_{2.5}$ samplers located in Jefferson County are operated by the Louisville Metro Air Pollution Control District.

$PM_{2.5}$ Speciation

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 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 groups 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.

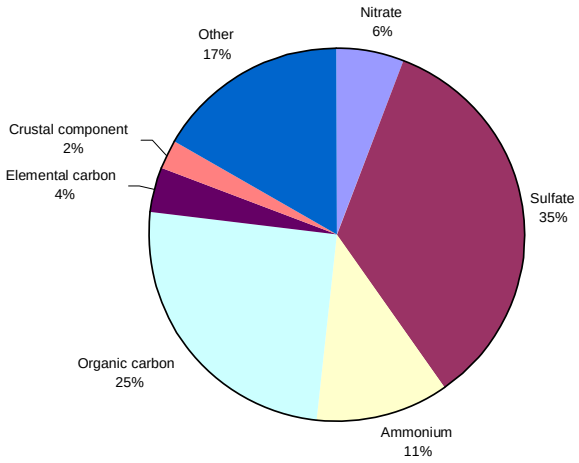
- Nitrate (total)
- Sulfate
- Ammonium
- Organic Carbon
- Elemental Carbon
- Crustal Component (trace elements, fine soil)
- Other ($PM_{2.5}$ mass unaccounted for by analytical methods)

In 2005, 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 26-30 provide a visual representation of speciation data collected at each site during 2005. 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.

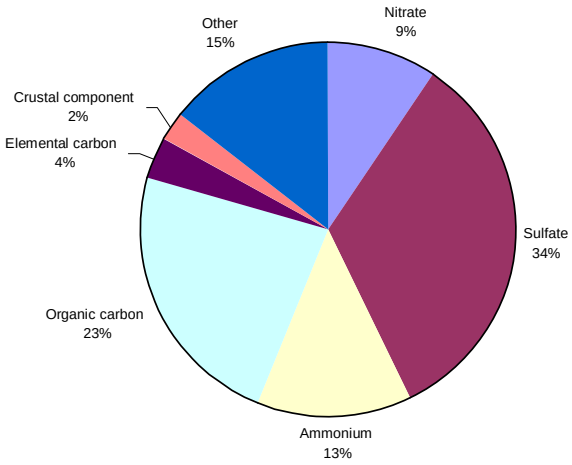
The distribution results are broken down into the following "major elements":

Nitrate (total)	**Elemental Carbon**	**Ammonium**
Sulfate	**Organic Carbon**	**Crustal Component (fine soil)**
Other		

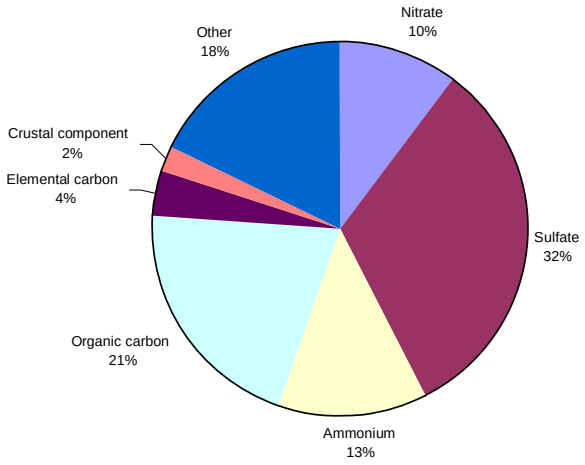
Ashland Health Department
AIRS Code 210190017 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



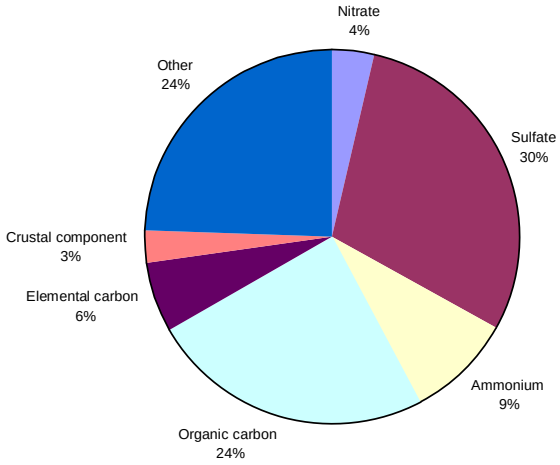
Bowling Green-Kereiakes Park
AIRS Code 212270007 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



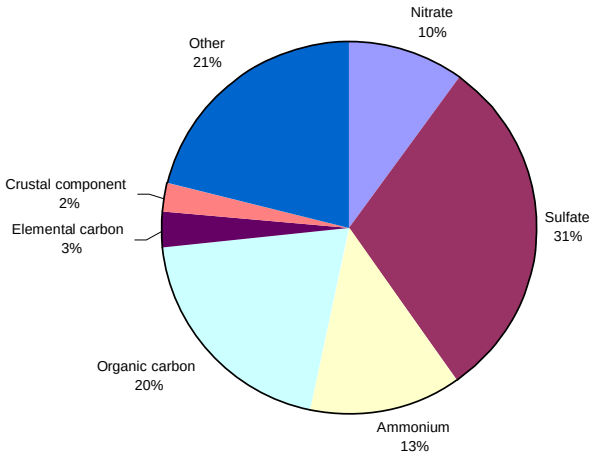
Covington - University College
AIRS Code 211170007 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/24/2005



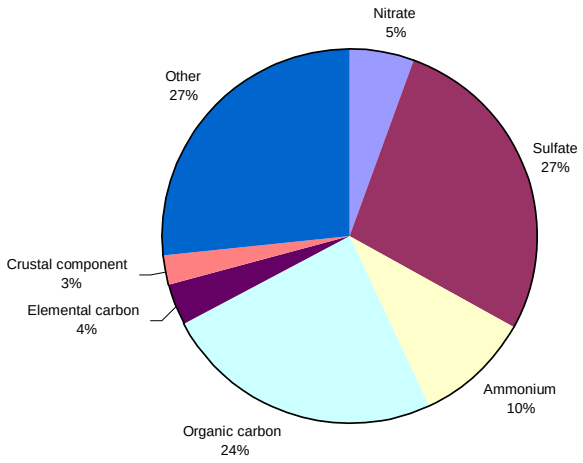
Hazard - Perry County Horse Park
AIRS Code 211930003 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



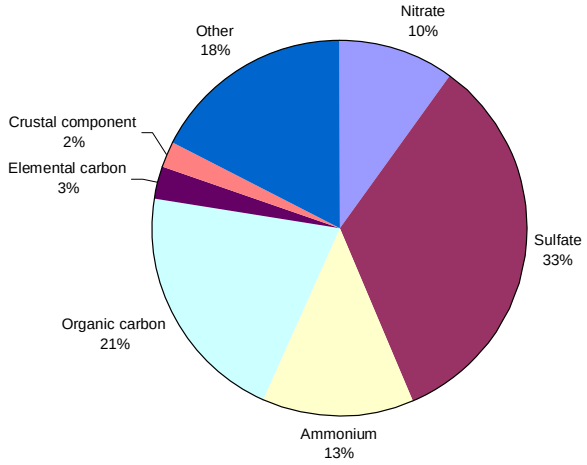
Lexington Health Department
AIRS Code 210670012 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



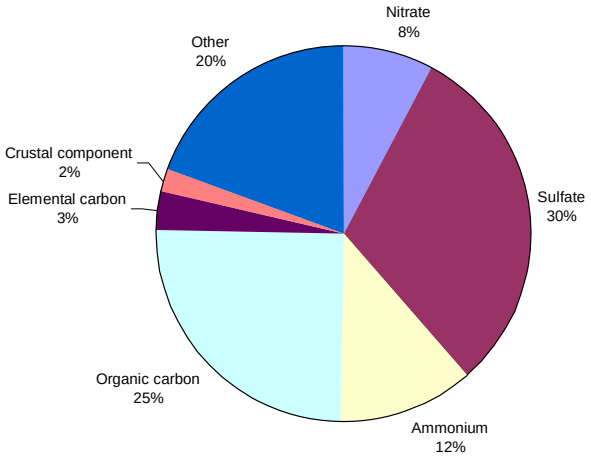
London-Laurel County
AIRS Code 211250004 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



Owensboro Primary
AIRS Code 210590005 POC 5 (ROUTINE)
Date(s): 1/10/2005 - 12/30/2005

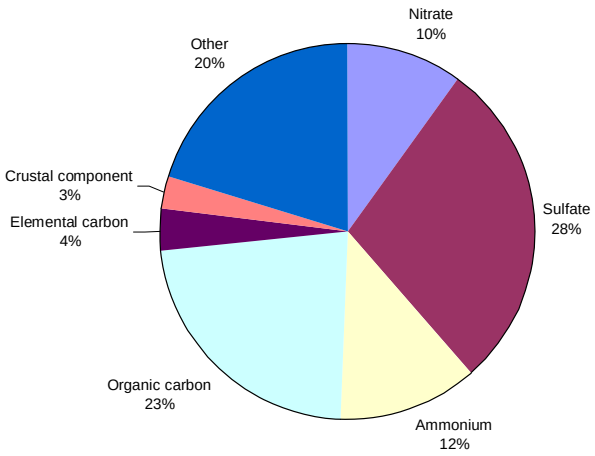


Paducah Middle School
AIRS Code 211451004 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005

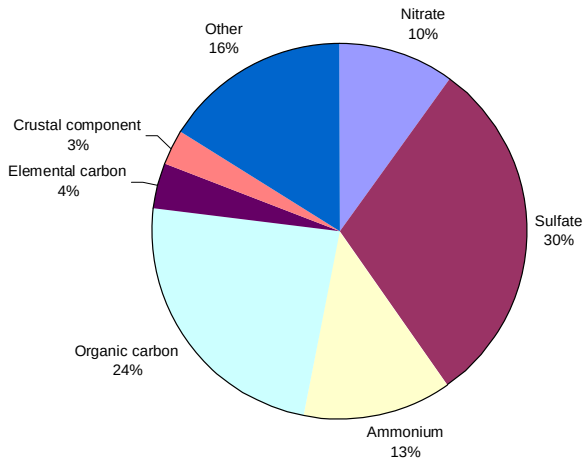


Louisville Speciation Distribution Charts

APCD (Barret)
AIRS Code 211110048 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



Southwick Community Center
AIRS Code 211110043 POC 5 (ROUTINE)
Date(s): 1/4/2005 - 12/30/2005



Nonattainment
What does it mean for Kentucky?

When the EPA classifies an area as nonattainment it means the air quality in that area does not meet the National Ambient Air Quality Standards (NAAQS). If a state does not meet the standards, a state must draft a plan on how they will improve air quality in their region.

How does nonattainment affect Kentucky?

In 2004, EPA issued a final rule designating areas not meeting the NAAQS for 8-hour ozone. Kentucky had a total of eight counties designated with a nonattainment status in 2005. The counties are Jefferson, Oldham, Bullitt, Boone, Kenton, Campbell, Boyd and Christian (see Figures 6-8). However, in January 2006, Christian county was redesignated to attainment for the 8-hour ozone National Ambient Air Quality Standard (71 FR 4047). Also in 2006, the division requested Jefferson, Bullitt, Oldham and Boyd counties to be redesignated to attainment for the 8-hour NAAQS based on the 2003-2005 ozone data demonstrating attainment.

Based on data from 2002-2004, EPA considers the following counties to be nonattainment for the annual $PM_{2.5}$ standard (see Figure 11): 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 $\mu g/m^3$, 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. Boone, Kenton and Campbell monitors are within the Cincinnati-Northern Kentucky MSA. Boyd and Lawrence monitors are within the Huntington–Ashland MSA. When looking at the 2003-2005 data set, Fayette County has an exceedance of the 3-year average at a 15.1 $\mu g/m^3$. The division is working with the Lexington Fayette County Urban Government and the University of Kentucky to devise a plan to reduce particulate matter measurements.

A portion of Boyd County, as described in 40 CFR 81.318, was designated as nonattainment for sulfur dioxide. The Division requested Boyd County to be redesignated to attainment and has been published as attainment on May 24, 2006 in 71 FR 29792.

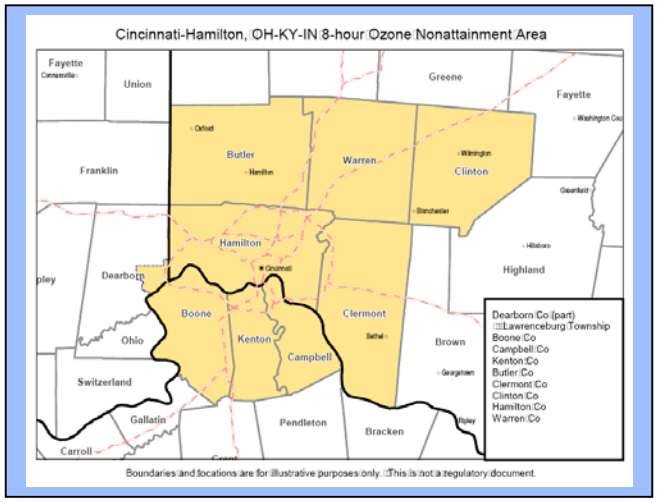


Figure 6. Boone, Kenton and Campbell counties are part of the Cincinnati-Hamilton MSA.

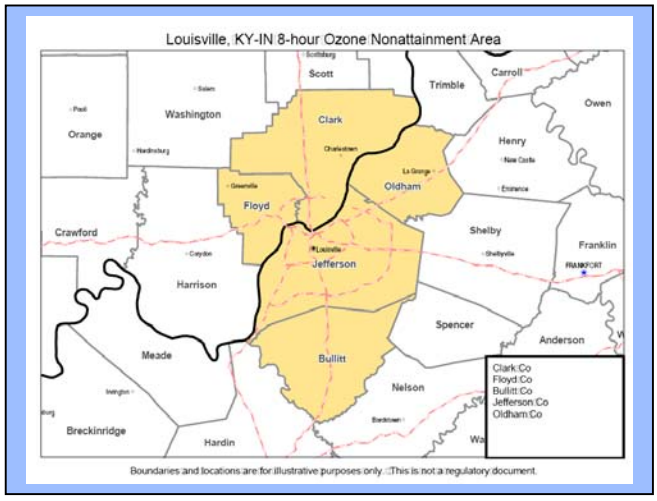
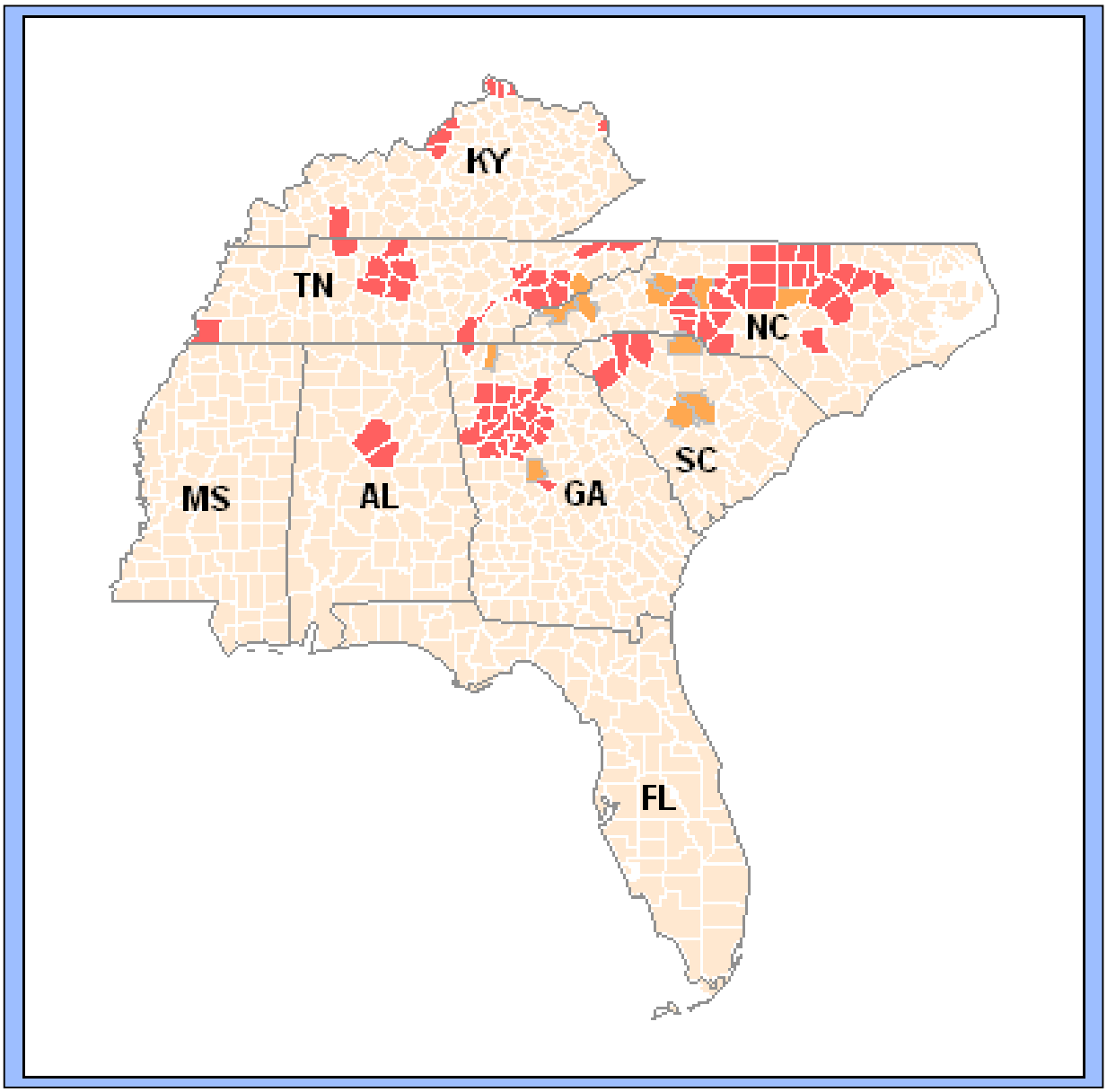
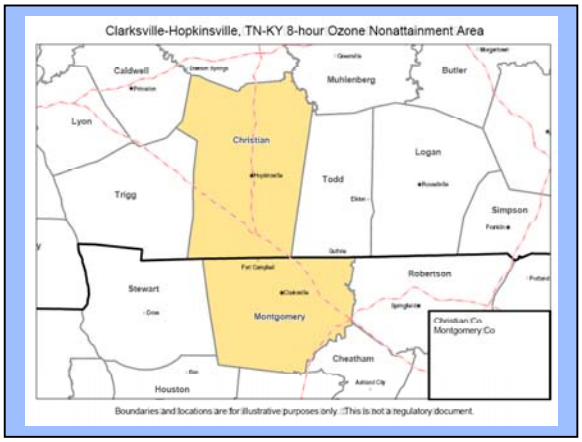


Figure 7. Bullitt, Jefferson and Oldham counties are part of the Louisville (Kentucky-Indiana) MSA.





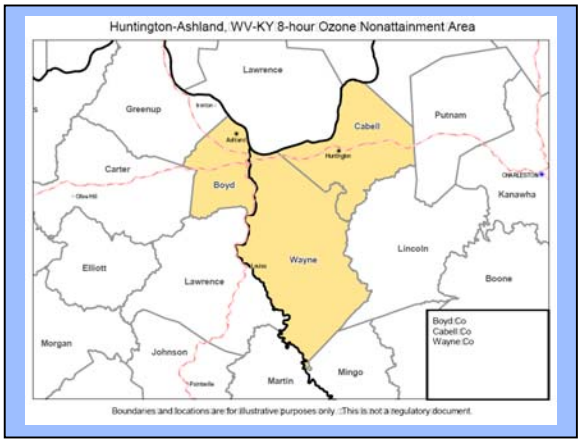


Figure 8. Top picture: EPA's Region 4 county designations of nonattainment for the 8-hour ozone NAAQS. Bottom left hand picture: As of January 2006, Christian county is redesignated as attainment. Bottom right hand picture: Boyd county is part of the Huntington-Ashland (Kentucky-West Virginia) MSA.

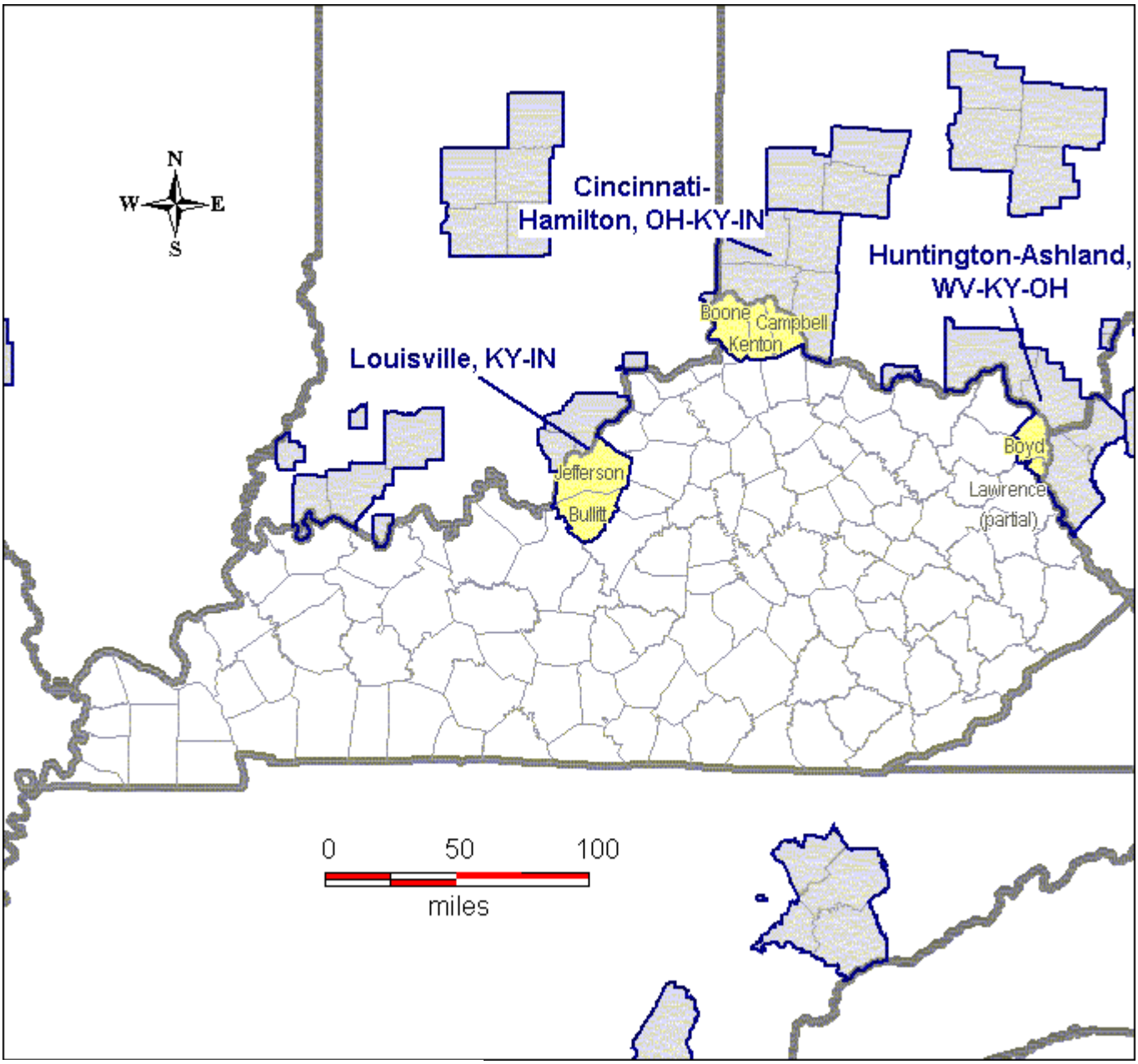


Figure 11. Kentucky PM $_{2.5}$ designation map.

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 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 industrial 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).

401 KAR 51:017 Section 2

Ambient Air Increments: In areas designated as Class I or II, increases in pollutant concentration over the baseline concentration shall be limited to the following levels:

Pollutant	Maximum Allowable Increase (Micrograms per cubic meter)
Class I	
Particulate Matter:	
PM_{10}, annual arithmetic mean	4
PM_{10}, 24-hour maximum	8
Sulfur Dioxide:	
Annual arithmetic mean	2
24-hour maximum	5
3-hour maximum	25
Nitrogen Dioxide:	
Annual arithmetic mean	2.5
Class II	
Particulate Matter:	
PM_{10}, annual arithmetic mean	17
PM_{10}, 24-hour maximum	30
Sulfur Dioxide:	
Annual arithmetic mean	20
24-hour maximum	91
3-hour maximum	512
Nitrogen Dioxide:	
Annual arithmetic mean	25

401 KAR 51:017 Section 14(8)

Emissions of sulfur dioxide from the source or modification shall not, during a day on which the other applicable maximum allowable increases are exceeded, cause or contribute to concentrations that will exceed the maximum allowable increases over the baseline concentration as specified in the following table:

Maximum Allowable Increase (Micrograms per cubic meter)		
	Terrain areas	
Period of Exposure	Low	High
24-hour maximum	36	62
3-hour maximum	130	221

401 KAR 51:017 Section 7(5)

The emissions increase of the pollutant from the new source or the net emissions increase of the pollutant from the modification will cause air quality impacts in an area, which are less than the amounts listed in the following table:

Pollutant	Air Quality Level	Averaging Time
Carbon monoxide	575 $\mu g/m^3$	8-hour average
Nitrogen dioxide	14 $\mu g/m^3$	annual average
Particulate matter	10 $\mu g/m^3$ of PM_{10}	24-hour average
Sulfur dioxide	13 $\mu g/m^3$	24-hour average
Ozone	No de minimis air quality level is provided for ozone. However, a net increase of 100 tons per year or more of volatile organic compounds subject to this administrative regulation is required to perform an ambient impact analysis including the gathering of ambient air quality data.	
Lead	0.1 $\mu g/m^3$	3-month average
Fluorides	0.25 $\mu g/m^3$	24-hour average
Hydrogen sulfide	0.2 $\mu g/m^3$	1-hour average
Total reduced sulfur	10 $\mu g/m^3$	1-hour average
Reduced sulfur compounds	10 $\mu g/m^3$	1-hour average

401 KAR 51:052 Section 3

This section shall apply only to new major stationary sources or new major modifications that will locate in designated attainment or unclassifiable areas, pursuant to 42 U.S.C. 7407(d)(1)(A)(ii) or (iii), if the source or modification will cause impacts that exceed the significance levels, as listed in the table, at a locality that does not or will not meet the national ambient air quality standards.

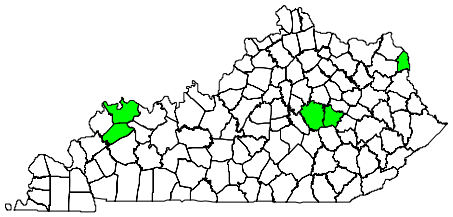
Pollutant	Annual Average	Averaging Time			
		24-Hour	8-Hour	3-Hour	1-Hour
Sulfur Dioxide	1.0 ug/m^3	5 ug/m^3	--	25 ug/m^3	--
PM_{10}	1.0 ug/m^3	5 ug/m^3	--	--	--
Nitrogen Dioxide	1.0 ug/m^3	--	--	--	--
Carbon Monoxide	--	--	0.5 mg/m^3	--	2 mg/m^3

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 2005 follows on pages 36-37.

Industrial Criteria Pollutant Summary Report – 2005

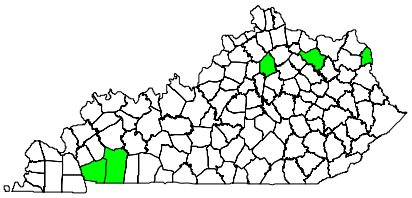
Pollutant: **Sulfur Dioxide**
Method: Instrumental
Ultra-Violet Fluorescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



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	8349	.003	.019	.019	0	.073	.069	0
Henderson	US 41 & KY 2096 Sebree	Western KY Electric	8350	.003	.022	.022	0	.075	.066	0
Henderson	KY 2097 Sebree	Western KY Electric	8160	.006	.059	.058	0	.165	.159	0
Madison	246 Ford Road Richmond	East Kentucky Power	8359	.005	.044	.043	0	.182	.128	0
Webster	Bell Gibson Road	Western KY Electric	8291	.006	.168	.164	9	.352	.330	0
Wayne, WV	Spring Brook Dr Kenova, WV	Ashland-Marathon	8678	.009	.075	.071	0	.101	.089	0
Wayne, WV	Route 52 Neal, WV	Ashland-Marathon	8622	.007	.022	.020	0	.084	.053	0
Wayne, WV	Big Sandy Road Neal, WV	Ashland-Marathon	8612	.006	.022	.022	0	.040	.035	0

Industrial Criteria Pollutant Summary Report – 2005

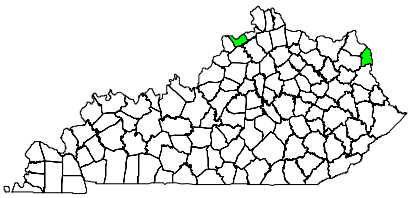
Pollutant: **Ozone**
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)



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	5801	0	.090	.088	0	.085	.080	.079	.078
Fleming	455 Industrial Drive Flemingsburg	East Kentucky Power	5482	0	.101	.100	15	.089	.089	.088	.087
Scott	4673 Muddy Ford Rd Oxford	Toyota	5435	0	.094	.094	3	.087	.086	.086	.084
Trigg	Mulberry Flat Road Land Between Lakes	TVA	5809	0	.092	.086	0	.080	.077	.075	.075
Wayne, WV	Spring Brook Drive Kenova, WV	Ashland-Marathon	8698	1	.226	.100	8	.092	.091	.090	.087

Industrial Criteria Pollutant Summary Report – 2005

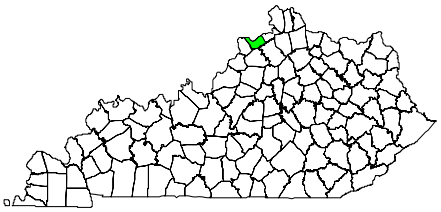
Pollutant: **Nitrogen Dioxide**
Method: Instrumental/Gas-Phase Chemiluminescence
Data Interval: Hourly
Units: Parts-per-million (ppm)



County	Site	Facility-ID	# Obs	Annual Mean	1-Hr Average	
					1st max	2nd max
Carroll	US Highway 42 Ghent	North American Stainless	8678	.012	.276	.254
Wayne, WV	Spring Brook Drive, Kenova, WV	Ashland-Marathon	8657	.015	.093	.088

Industrial Criteria Pollutant Summary Report – 2005

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



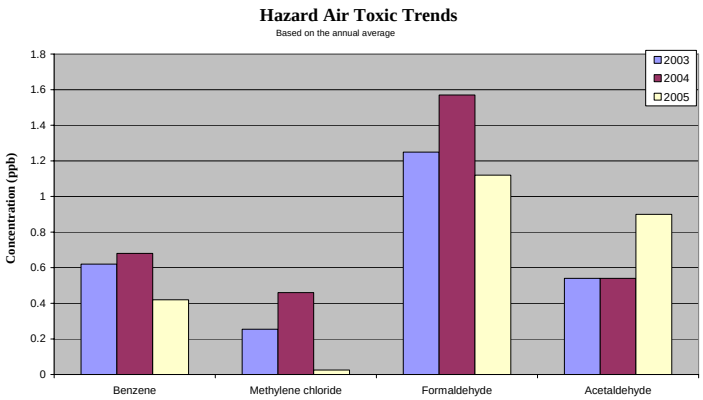
County	Site	AIRS-ID	# Obs	Mean	24-hour Average				
					Obs >150	1st max	2nd max	3rd max	4th max
Carroll	US Highway 42 Ghent	North American Stainless	56	28	0	71	55	48	47

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. The EPA's ultimate goal is to eliminate unacceptable risks of cancer, other significant health problems from exposures to air toxics emissions and to substantially reduce or eliminate adverse effect on our natural environment. To provide a basis for decision-making with respect to these matters, the 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, has been 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, low-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 2005 follows on page 39. 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.



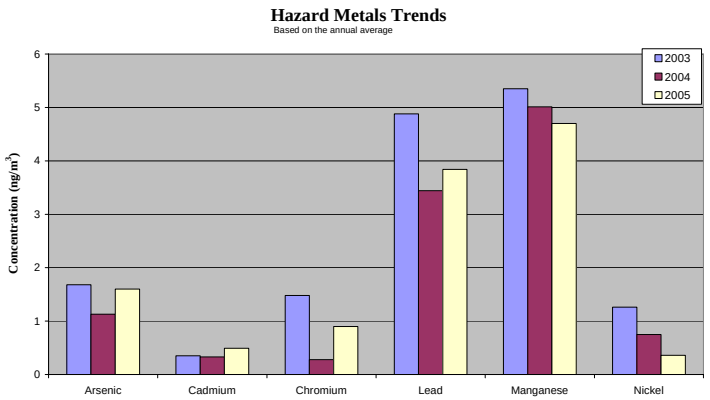
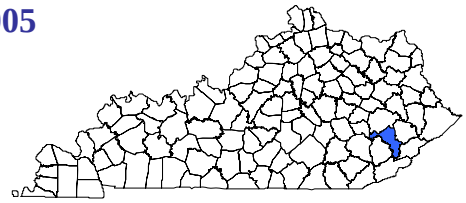


Figure 12: Hazard Rural Trends.

Kentucky Division for Air Quality
Rural Trends Toxics Network - 2005



Site Id: 21-193-0003
County: Perry
Location: Hazard, KY

Parameter	# of Samples	Units	1st max	2nd max	3rd max	4th max	Median Value
1,3-Butadiene	61	µg/m^3	ND	ND	ND	ND	-
Benzene	61	µg/m^3	2.9	1.62	1.62	1.6	1.35
Carbon tetrachloride	61	µg/m^3	1.54	1.29	-	-	1.41
Chloroform	61	µg/m^3	ND	ND	ND	ND	-
cis-1,3-dichloropropene	61	µg/m^3	ND	ND	ND	ND	-
trans-1,3-dichloropropylene	61	µg/m^3	ND	ND	ND	ND	-
Ethylene dibromide	61	µg/m^3	ND	ND	ND	ND	-
Ethylene dichloride	61	µg/m^3	ND	ND	ND	ND	-
1,2 dichloropropane	61	µg/m^3	ND	ND	ND	ND	-
Methylene chloride	61	µg/m^3	.903	.824	ND	ND	.86
Tetrachloroethene	61	µg/m^3	ND	ND	ND	ND	-
1,1,2,2 Tetrachloroethane	61	µg/m^3	ND	ND	ND	ND	-
Trichloroethene	61	µg/m^3	ND	ND	ND	ND	-
Vinyl chloride	61	µg/m^3	ND	ND	ND	ND	-
Formaldehyde	61	µg/m^3	4.98	3.94	3.84	3.73	2.02
Acetaldehyde	61	µg/m^3	2.19	2.09	1.92	1.89	1.1
Arsenic	60	ng/m^3	4.61	4.59	2.71	2.24	1.60
Beryllium	61	ng/m^3	ND	ND	ND	ND	-
Cadmium	61	ng/m^3	.711	.511	.464	.445	.49
Chromium	61	ng/m^3	2.79	2.62	2.41	2.36	.9
Lead	61	ng/m^3	16.5	13.5	9.8	8.3	3.84
Manganese	61	ng/m^3	28.5	24.3	17.5	14.4	4.7
Nickel	61	ng/m^3	.595	.575	.485	.332	.36

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.

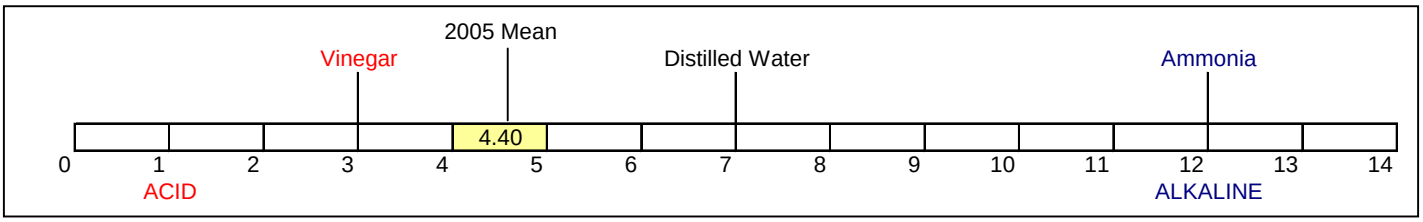
Aquatic life appears to be most sensitive to the effects of acidic precipitation. Small changes in the pH levels of lakes and streams may prevent some fish species and other aquatic life forms from reproducing. Many insects cannot survive in acidic waters; therefore, birds and mammals that depend on 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 2005, 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 2005 and data from that sampler is included.

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

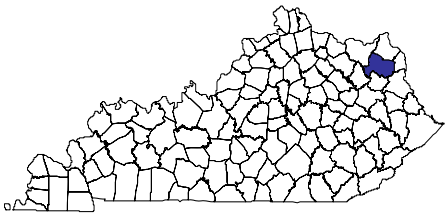
A statistical summary of wet deposition data collected in 2005 follows on pages 41-42.

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 charts on pages 38 and 39 indicate where the pH measurements for Grayson Lake and Mammoth Cave fall on the pH scale for 2005.

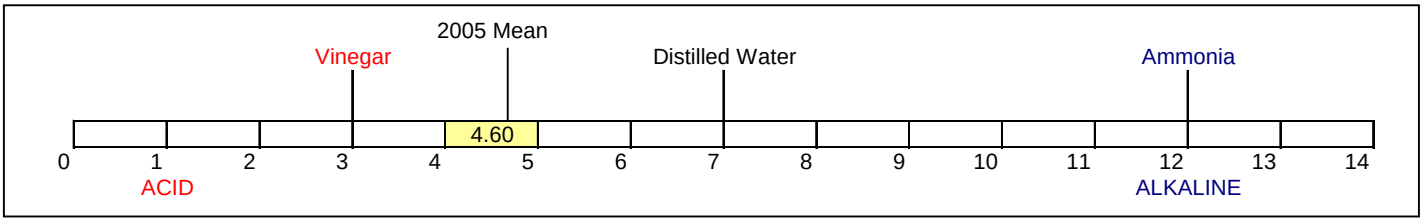


Kentucky Division for Air Quality
Wet Deposition Pollutants Summary Report - 2005

Site Id: 21-043-0500
County: Carter
Location: **Grayson Lake, KY** – Camp Webb
Method: Wet/Dry Collector, Laboratory Analytical

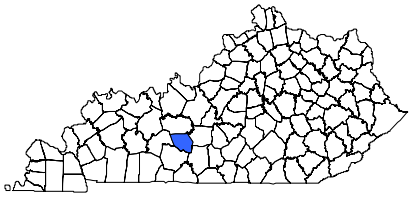


Parameter	Units	# Obs	Arithmetic Mean	1st Max	2nd Max	3rd Max	4th Max
Acidity	Mg/L	32	5.64	26.40	8.30	7.60	7.27
Ammonia	Mg/L	41	0.30	1.70	1.08	0.64	0.53
Calcium	Mg/L	24	0.31	1.44	0.55	0.47	0.44
Chloride	Mg/L	23	0.27	0.52	0.42	0.37	0.35
Conductivity	µmho	40	19.7	153.0	38.60	30.00	29.5
Magnesium	Mg/L	7	0.11	0.15	0.15	0.14	0.10
Nitrate	Mg/L	41	1.46	5.54	5.32	4.08	2.72
Potassium	Mg/L	27	0.36	0.54	0.54	0.47	0.46
Sodium	Mg/L	26	0.31	0.73	0.66	0.66	0.66
Sulfate	Mg/L	41	2.37	21.70	5.38	4.18	3.19



National Park Service
Wet Deposition Pollutants Summary Report - 2005

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	Max	90%	75%	50%
Acidity	Mg/L	-	-	-	-	-	-
Ammonium	Mg/L	44	0.31	1.01	0.62	0.47	0.22
Calcium	Mg/L	44	0.13	0.52	0.25	0.16	0.10
Chloride	Mg/L	44	0.13	0.69	0.34	0.14	0.08
Conductivity	US/cm	44	15.80	44.7	25.8	21.0	13.1
Magnesium	Mg/L	44	0.02	0.08	0.04	0.03	0.01
Nitrate	Mg/L	44	1.04	2.90	1.59	1.38	0.96
Potassium	Mg/L	44	0.03	0.09	0.07	0.03	0.02
Sodium	Mg/L	44	0.07	0.48	0.18	0.09	0.04
Sulfate	Mg/L	44	1.58	5.38	2.64	2.11	1.23

Data report from the **National Atmospheric Deposition Program/National Trends Network 2005 Annual & Seasonal Data Summary**

Mercury

Mercury (Hg) is a naturally occurring element that is found in air, water and soil. Mercury exists in several different forms: elemental, inorganic and organic. Elemental Hg is a shiny, silver-white metal that is in a liquid state at room temperature. Elemental mercury is used in thermometers, florescent lights and electrical switches. Exposed elemental mercury can become an invisible, odorless toxic gas at room temperature. Inorganic Hg compounds are mercury salts with a white powder or crystal appearance except for mercuric sulfide (cinnabar), which is red. Inorganic Hg compounds are used in fungicides, antiseptics, disinfectants, skin lightening creams and traditional medicines. Organic Hg compounds are formed when mercury combines with carbon. The most common organic mercury compound found in the environment is methylmercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish. Methylmercury is formed when inorganic mercury in the air settles into water or onto land where it can be washed into water and converted into organic mercury by microorganisms. Fish and shellfish are the main sources of methylmercury exposure to humans.

Why monitor for Hg?

Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Research has shown that most fish consumption does not cause an exposure to high levels of mercury in adults. However, it has been demonstrated that high levels of methylmercury in the bloodstream of unborn babies and young children may harm the developing nervous system. Kentucky is one of 31 states that have issued a statewide fish consumption advisory due to unsafe levels of mercury. The advisory is for women of childbearing age and children 6 years and younger.

How is Hg monitored?

Mercury is monitored in Kentucky by three different collection methods. The first collection method is wet deposition monitoring (see page 38). When a wet deposition sample is over 320 grams, there is enough sample for mercury analysis. Fifty grams or more of the excess wet deposition sample is transferred into a 250ml borosilicate glass container, five drops of hydrochloric acid is added to the sample for preservation, and shipped to Frankfort for mercury analysis. The DES laboratory performs the analysis using Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry.

The second method of collection for mercury is monitoring particulate-bound Hg. The $PM_{2.5}$ speciation monitoring network (see page 23) is the particulate-bound method currently used by the Commonwealth. Ambient air samples are collected on a 47mm Teflon filter and shipped to the Research Triangle Institute laboratory in North Carolina for analysis. The laboratory uses Energy Dispersive X-ray Fluorescence (XRF) to determine the presence of 48 species of metals and nonmetals, including Hg, in a single scan.

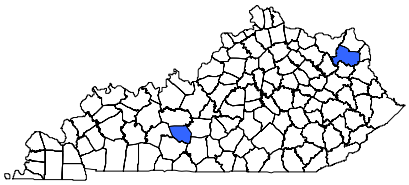
The final method of Hg collection is by the use of analyzers, which operate continuously, using Cold Vapour Atomic Fluorescence Spectrometry (CVAFS). The analyzer traps Hg vapor, from an air sample, into a cartridge containing an ultra-pure gold adsorbent. The amalgamated mercury is then thermally desorbed and detected using CVAFS.

Is Hg in the air?

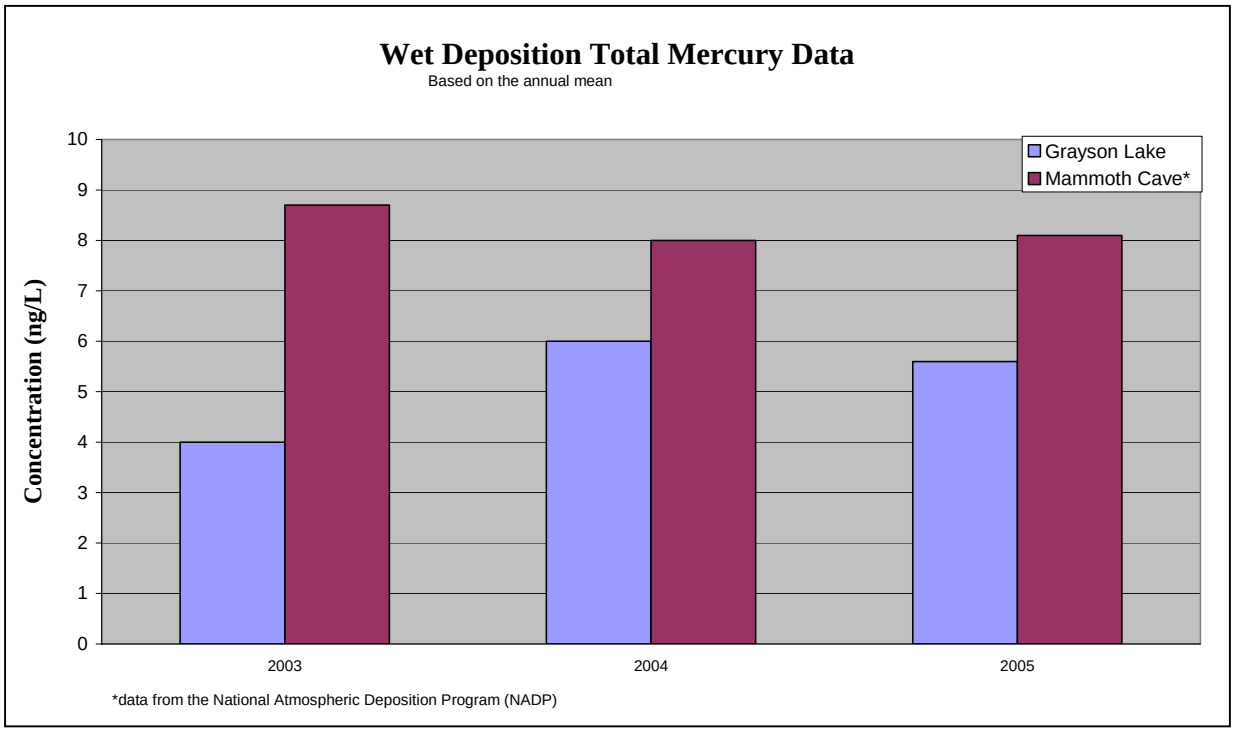
The division is measuring mercury in ambient air. The following table provides a statistical summary of particulate bound mercury. A visual representation of all monitoring methods follows on pages 44-46.

Wet Deposition Total Mercury Pollutant Summary Report 2005

Pollutant: **Mercury**
Method: Cold Vapor Atomic Fluorescence Spectrometry
Data Interval: 24-hour
Units: Nano-grams per liter (ng/L)

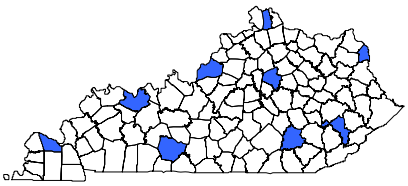


County	Site	AQS-ID	# Obs	Annual Mean	1st max	2nd max	3rd max	4th max
Carter	Camp Webb Grayson Lake	21-043-0500	26	5.6	13.0	11.1	9.6	9.0
Edmonson	Alfred Cook Road Mammoth Cave	21-059-0005	43	8.1	26.63	25.94	22.4	20.2

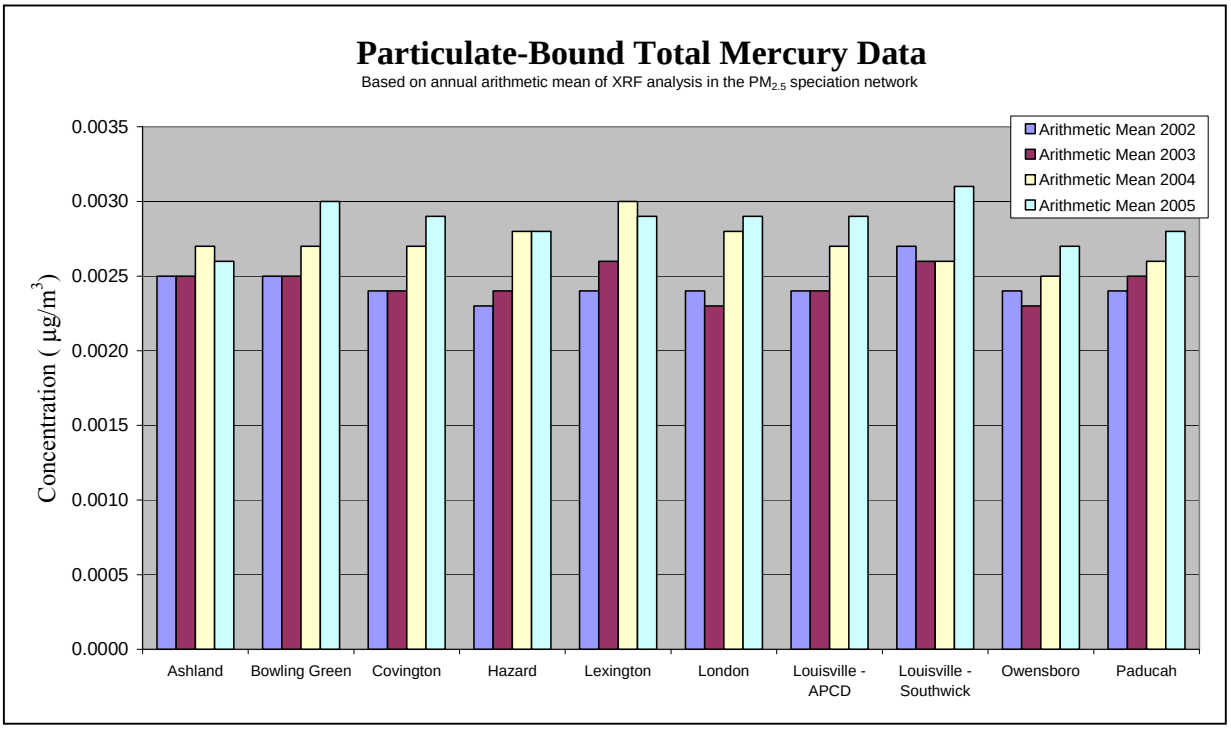


Particulate-Bound Total Mercury Pollutant Summary Report 2005

Pollutant: **Mercury**
Method: Energy Dispersive XRF
Data Interval: 24-hour
Units: Micro-grams per cubic meter ($\mu g/m^3$)

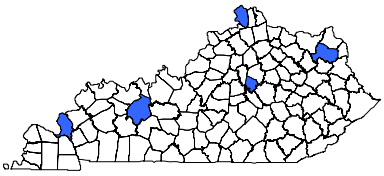


County	Site	AQS-ID	# Obs	Annual Mean	1st max	2nd max	3rd max	4th max
Boyd	2924 Holt St, FIVCO Health Dept	21-019-0017	61	.0026	.008	.006	.005	.004
Daviess	US60 & Pleasant Valley RD	21-059-0005	59	.0027	.012	.010	.008	.006
Fayette	650 Newtown Pike Fayette Co. Health	21-067-0012	59	.0029	.008	.007	.006	.006
Jefferson	37th & Southern Avenue	21-111-0043	60	.0031	.010	.009	.007	.007
Jefferson	850 Barrett Avenue	21-111-0048	59	.0025	.007	.006	.005	.005
Kenton	1401 Dixie Hwy University College	21-117-0007	59	.0029	.008	.007	.006	.006
Laurel	London Airport	21-125-0004	61	.0029	.015	.007	.006	.006
McCracken	342 Lone Oak RD Paducah Middle School	21-145-1004	60	.0028	.008	.007	.006	.006
Perry	Perry County Horse Park	21-193-0003	61	.0028	.009	.009	.008	.007
Warren	Kereiakes Park Fairview & Collett Ln	21-227-0007	60	.0030	.007	.006	.006	.006

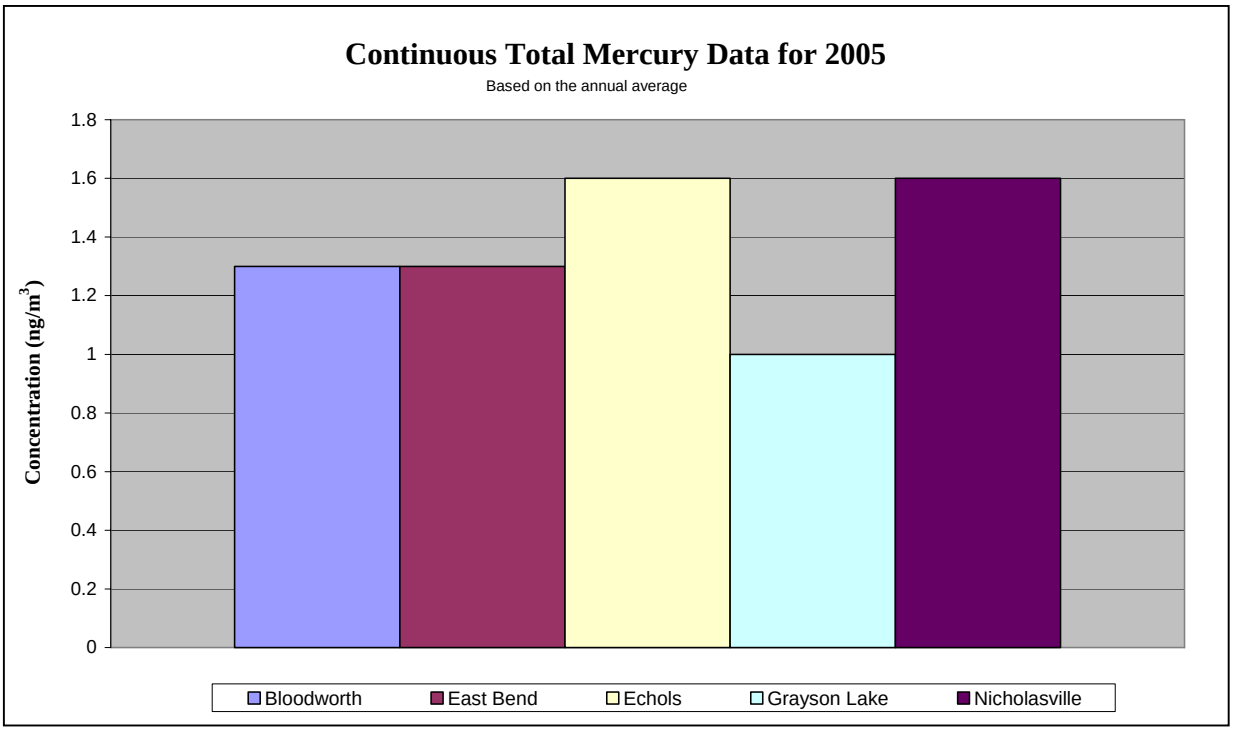


Continuous Total Mercury Pollutant Summary Report 2005

Pollutant: **Mercury**
Method: Cold Vapor Atomic Fluorescence Spectrometry
Data Interval: Hourly
Units: Nano-grams per cubic meter (ng/m^3)



County	Site	AQS-ID	# Obs	Annual Mean	1st max	2nd max	3rd max	4th max
Boone	KY 338 & Lower River Road East Bend	21-015-0003	5509	1.3	12.8	11.6	6.1	4.7
Carter	Camp Webb Grayson Lake	21-043-0500	3318	1.0	2.7	1.9	1.8	1.8
Jessamine	KYDOT, Etter Drive Nicholasville	21-113-0001	8019	1.6	7.4	6.5	5.9	5.7
Livingston	763 Bloodworth Road off KY 453	21-139-0004	4861	1.3	9.4	9.2	9.0	8.6
Ohio	Keytown Road Echols	21-183-0032	6752	1.6	3.8	3.5	3.5	3.5



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 Air Quality Index (AQI)

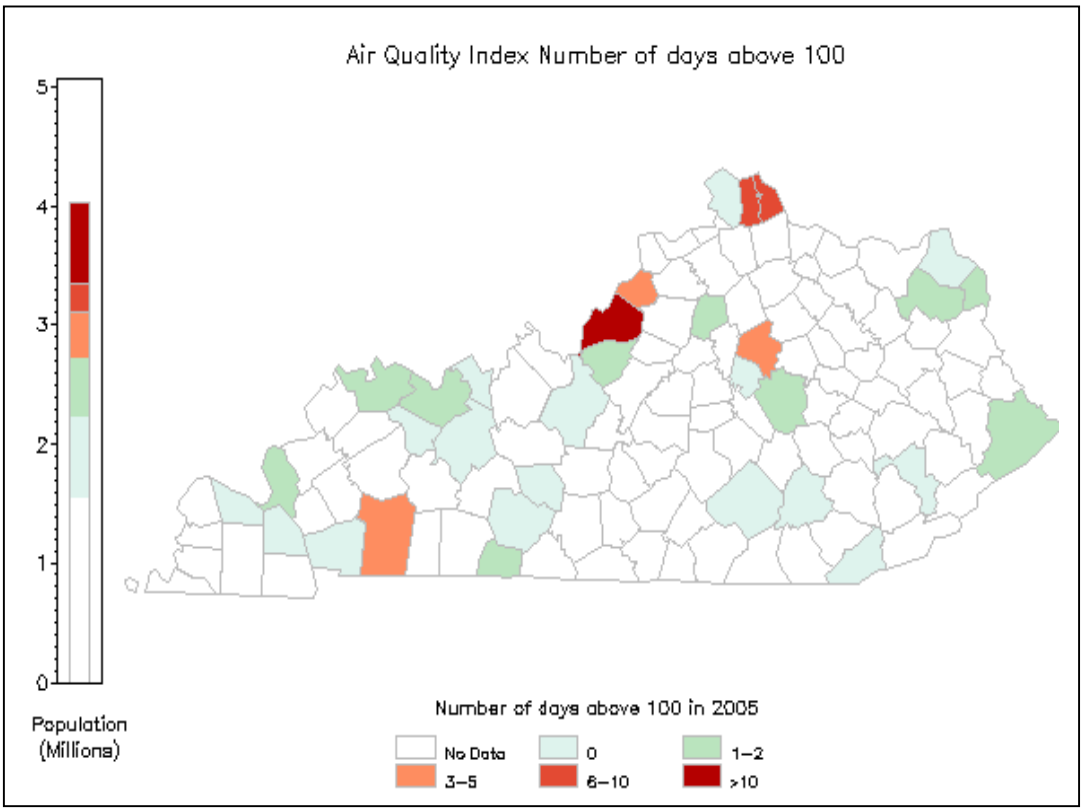
The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	**0-50**	**Air quality is considered satisfactory, and air pollution poses little or no risk.**
Moderate	**51-100**	**Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.**
Unhealthy for Sensitive Groups	**101-150**	**Members of sensitive groups may experience health effects. The general public is not likely to be affected.**
Unhealthy	**151-200**	**Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.**
Very Unhealthy	**201-300**	**Health alert: everyone may experience more serious health effects.**
Hazardous	**> 300**	**Health warnings of emergency conditions. The entire population is more likely to be affected.**

Understanding the Air Quality Index (AQI)

- **"Good"** Air pollution poses little or no risk.
- **"Moderate"** People who are unusually sensitive to ozone may experience respiratory symptoms.
- **"Unhealthy for Sensitive Groups"** 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. Members of sensitive groups may experience more serious health effects.
- **"Very Unhealthy"** Triggers a health alert, meaning everyone may experience more serious health effects.
- **"Hazardous"** Triggers 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 2005.



For Further Information

Web Sites:

http://www.epa.gov/oar/oaqps/peg_caa/pegcaain.html
The Plain English Guide to the Clean Air Act

http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm
40 CFR Chapter I – Environmental Protection Agency: Subchapter C: Parts 50-99

http://www.lrc.ky.gov/kar/TITLE401.HTM
Kentucky Administrative Regulations Title 401 Natural Resources and Environmental Protection Cabinet Department for Environmental Protection

http://www.lrc.ky.gov/KRS/224-00/CHAPTER.HTM
Kentucky Revised Statutes Chapter 224 Environmental Protection

http://www.epa.gov/air/criteria.html
National Ambient Air Quality Standards (NAAQS)

http://www.epa.gov/air/urbanair/
Six Common Air Pollutants

http://www.epa.gov/air/data/
AirData: Access to Air Pollution Data

http://nadp.sws.uiuc.edu/
National Atmospheric Deposition Program

http://www.epa.gov/air/oaqps/greenbk/index.html
EPA Green Book Nonattainment Areas for Criteria Pollutants

http://www.epa.gov/cair/
Clean Air Interstate Rule

http://www.epa.gov/cair/ky.html
Clean Air Interstate Rule – Kentucky

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