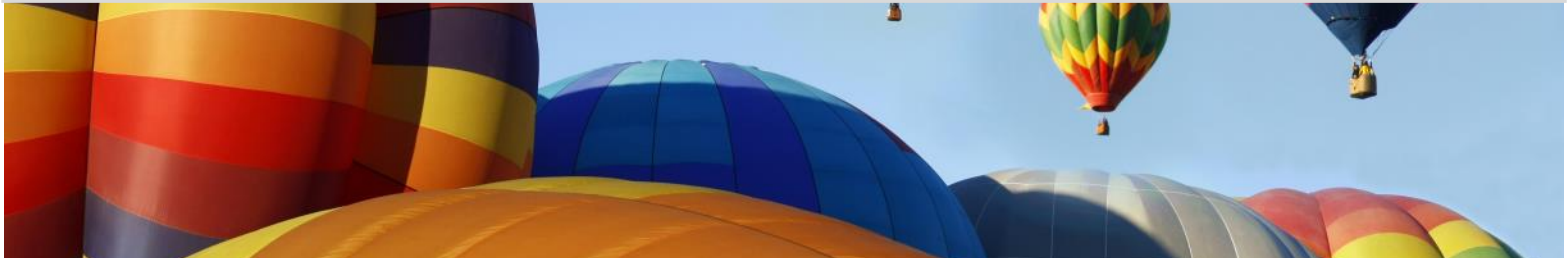
Kentucky's Air

FY2023 Annual Report

Kentucky Division for Air Quality



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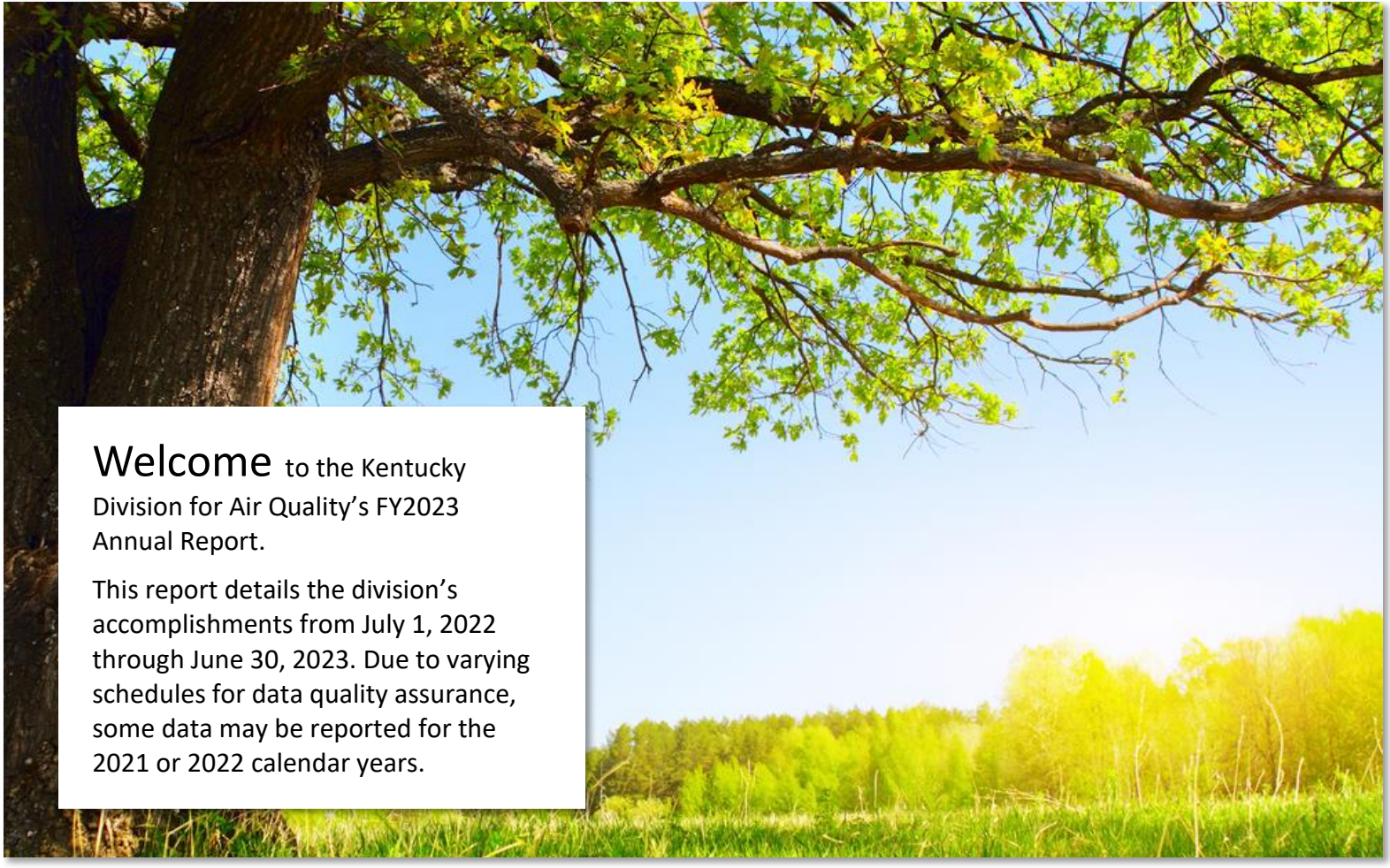


Welcome to the Kentucky Division for Air Quality's FY2023 Annual Report.

This report details the division's accomplishments from July 1, 2022 through June 30, 2023. Due to varying schedules for data quality assurance, some data may be reported for the 2021 or 2022 calendar years.

From the Director

On behalf of the Division for Air Quality (DAQ), thank you for taking the time to read our 2023 Annual Report. Within these pages, we report on key measures our dedicated staff have taken to fulfill the division's mission, function, and commitment to protecting human health and the environment.

At the time this report was being written, Kentucky was experiencing repeated waves of Canadian wildfire smoke. Ambient air monitoring instruments measured elevated levels of particulate matter and ozone across much of the commonwealth, prompting the division to issue a statewide air quality alert on June 28. Many Kentuckians experienced poor air quality in their communities for the first time in recent memory. Thankfully, the events were short-lived, but they highlighted the importance of the division's mission and one of our key strategies: Timely dissemination of accurate and useful air quality information.

A hazy sunrise was photographed on the morning of June 28, 2023. *Photo: Derek Fannin*

Air monitoring data demonstrated that six nonattainment counties — Boone, Campbell, Kenton, Jefferson, Bullitt, and Oldham — are now meeting federal clean air standards for ozone in the ambient air. The division has requested EPA to redesignate these areas as attainment. As this update is being written, EPA has posted the redesignation for Northern KY for public comment. The division is working with Louisville Metro Air Pollution

Control District to submit an exceptional event to EPA for recent wildfire-related exceedances. All remaining 114 counties are in attainment of the ozone standard.

A small area in Webster-Henderson Counties remains designated nonattainment for SO_2. The division is working with the sources to bring the area back into attainment. With the exception of this small area in Webster-Henderson counties, all areas of the commonwealth are currently in attainment for carbon monoxide, nitrogen dioxide, particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, and lead.

The division's essential work includes:

- Operation and maintenance of the air monitoring network and quality assuring air monitoring data by the Technical Services Branch;
- Issuing appropriate permits containing all applicable requirements by the Permit Review Branch;
- Developing effective regulations and control strategies by our Program Planning Branch;
- Evaluating facilities for compliance, responding to air quality complaints, and enforcing emissions limitations by the Field Operations Branch; and
- Providing education and outreach through our Environmental Education program.

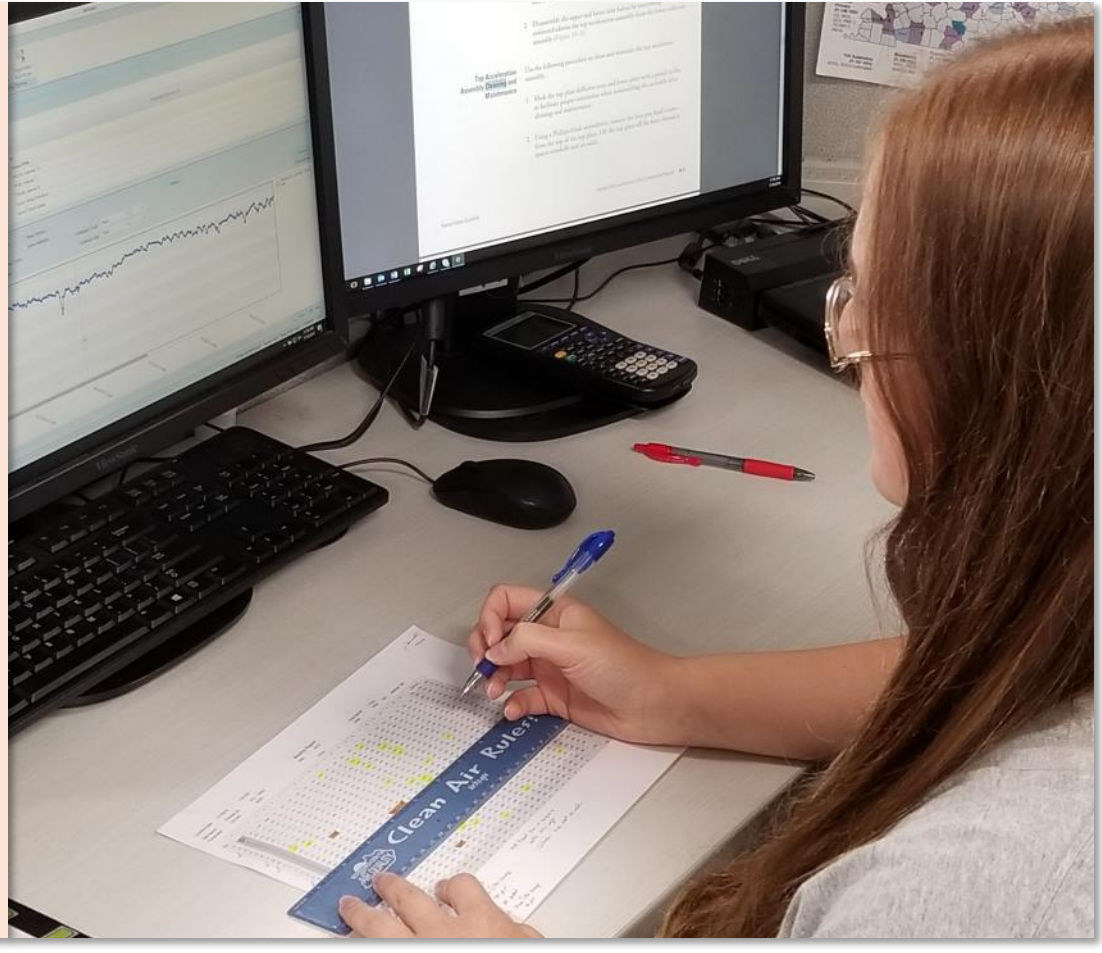
Please take a few moments to explore the good work that so many have done in our division over the past year. I hope you find this report to be informative and educational.

Michael Kennedy
Director

Our Mission

To protect human health and the environment by achieving and maintaining acceptable air quality through:

- Operation of a comprehensive air monitoring network;
- Creating effective partnerships with air pollution sources and the public;
- Timely dissemination of accurate and useful information;
- The judicious use of program resources; and
- Maintenance of a reasonable and effective compliance assurance program.



Who We Are

- A team of environmental professionals dedicated to protecting Kentucky's air quality
- 150 funded positions located in Frankfort and throughout the commonwealth in eight regional offices
- The third largest division within the Department for Environmental Protection

What We Do

- Air monitoring
- Regulation development
- Issue permits
- Respond to air quality complaints
- Ensure compliance with air quality regulations
- Education & outreach

Why We Do It

Protecting Human Health.

Human activities create air pollution. Too much air pollution is harmful to human health. That's why Congress enacted the Clean Air Act, which requires the U.S. Environmental Protection Agency (EPA) to set standards or "limits" for outdoor air pollutants. States, and sometimes local governments, are responsible for meeting those air quality standards.

Why We Do It

Protecting the Environment.

Air pollution also harms the environment. Some plants such as milkweed, tulip poplar and soybeans are sensitive to air pollution. Airborne sulfur oxide and nitrogen oxide pollution can cause acid precipitation, which in turn harms forests and aquatic organisms. Air pollution can even damage man-made structures such as buildings and monuments.

FY2023 Highlights

By the close of FY23, six counties designated nonattainment for ozone were meeting air quality standards, and EPA was considering redesignation requests. A small area in Webster and Henderson counties remained designated nonattainment for sulfur dioxide. At the end of June, Canadian wildfire smoke caused poor air quality across much of the commonwealth, prompting the division to issue a statewide air quality alert (see pg. 10 for details).

Key accomplishments for the fiscal year include:

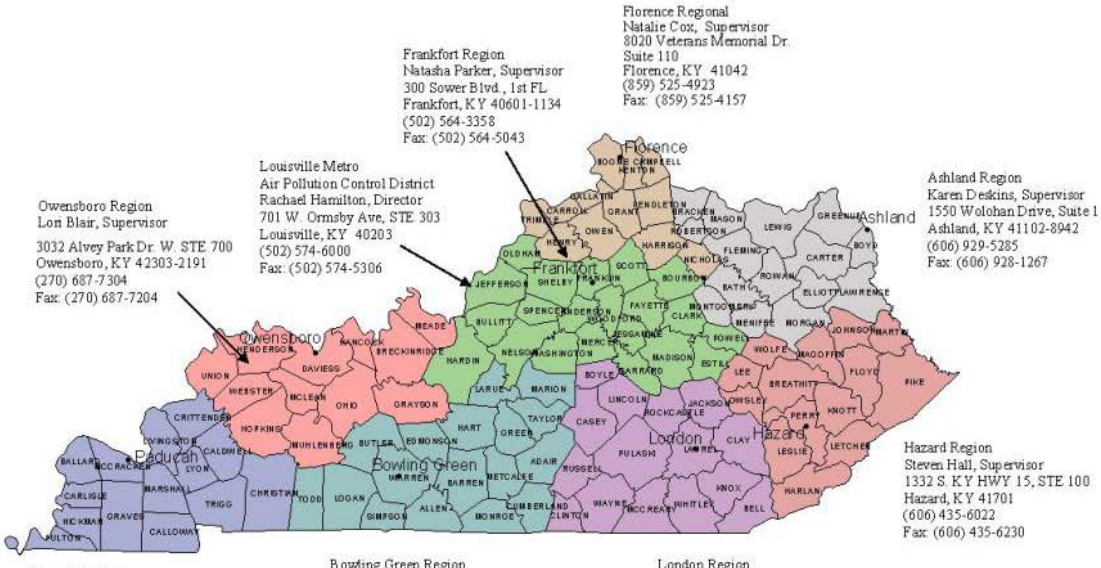
- 2,941 compliance inspections performed with a 78 percent compliance rate
- 1,546 air pollution complaints investigated

- 521 permitting actions
- 314 air permits issued
- 22 major economic development projects

- $358,123 in Clean Diesel grants awarded to six school districts
- 53 outreach programs reached 3,084 people across Kentucky

Division for Air Quality
Regional Office Boundaries

Environmental Emergency, 24-hour; (502)564-2380 or (800) 928-2380

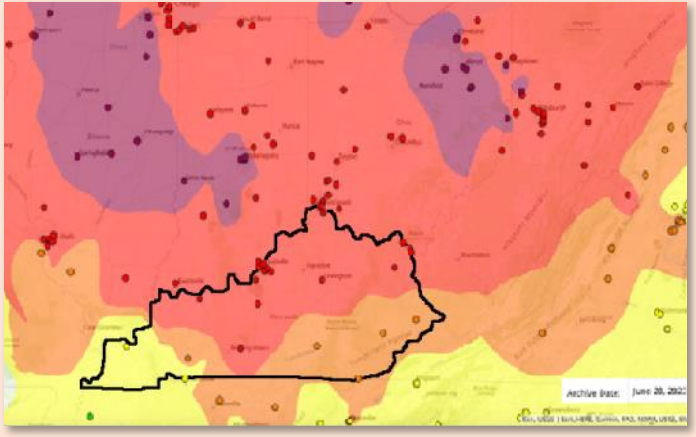


Visit the Regional Field Offices web page on our website for a complete listing of field office locations and counties served.

Canadian Wildfire Smoke Impacts Kentucky

On June 28, 2023, smoke from more than 500 Canadian wildfires drifted into Kentucky and surrounding states. As the smoke sank to ground level, air monitors began to detect high levels of particulate matter ($PM_{2.5}$) and ozone pollution. By 10 AM, most of the state was registering an Air Quality Index (AQI) in the "red", meaning air quality was unhealthy for everyone.

DAQ staff met with scientists from the National Weather Service and Kentucky Emergency Management to assess the immediate air quality outlook, and to discuss the best way to communicate about the risk of the wildfire smoke to human health. Shortly afterwards, the EEC took the unprecedented action of issuing a statewide air quality alert.



AirNow's AQI map for June 28, 2023 showed unhealthy air quality across most of the state. Purple areas to the north were even worse.

This wasn't the first time Kentucky had experienced wildfire smoke from far away. But the sheer volume of smoke, coupled with wind and air pressure conditions that pushed the smoke down to ground-level, created a much bigger impact than previous events.

Staff answered multiple phone calls throughout the two-day event from the public and media, directing people to track the real-time air quality on AirNow.gov and EPA's smoke and fire map.

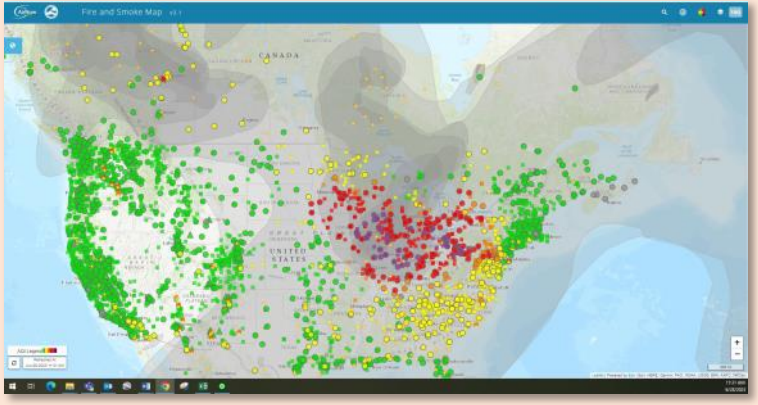
Air Quality Index	Who needs to be concerned?
Good 0-50	No need for concern
Moderate 51-100	Some people who may be unusually sensitive to air pollution
Unhealthy for Sensitive Groups 101-150	Sensitive groups include people with heart or lung disease, older adults, children, and teenagers
Unhealthy 151-200	Everyone
Very Unhealthy 201-300	Everyone
Hazardous 301-500	Everyone

The Air Quality Index (AQI)

Top: The view of northern KY & Cincinnati from DAQ's Northern KY air monitoring site on a clear day. Bottom: Smoke obscures the same view on June 28, 2023. *Photos: Chris Juilfs*

To ensure complete capture of data, DAQ suspended all planned maintenance that would have required air monitoring to be temporarily shut down. Air monitoring staff were in constant communication with DAQ's director about the changing conditions, helping the division track the smoke and weather conditions across the commonwealth.

As a result of the June 28-29 smoke, several monitors measured ozone levels far above the National Ambient Air Quality Standards (NAAQS). Exceedances such as these have the potential to contribute to a nonattainment designation by EPA, meaning an area that *was* meeting air quality standards could be determined to be failing those standards as a result of the smoke event. Along with other states and local districts that were impacted by the smoke, Kentucky is reviewing data to determine if it meets the criteria to submit an "exceptional event" request to EPA. If EPA accepts such a request, the high pollution readings would be exempted from consideration for attainment/ nonattainment determinations.



EPA's smoke and fire map on June 28, 2023 revealed multiple plumes of wildfire smoke covering the continent. The colored dots represent air quality index values, with red and purple marking the worst air quality and green the best.

Kentucky's Air Monitoring Network

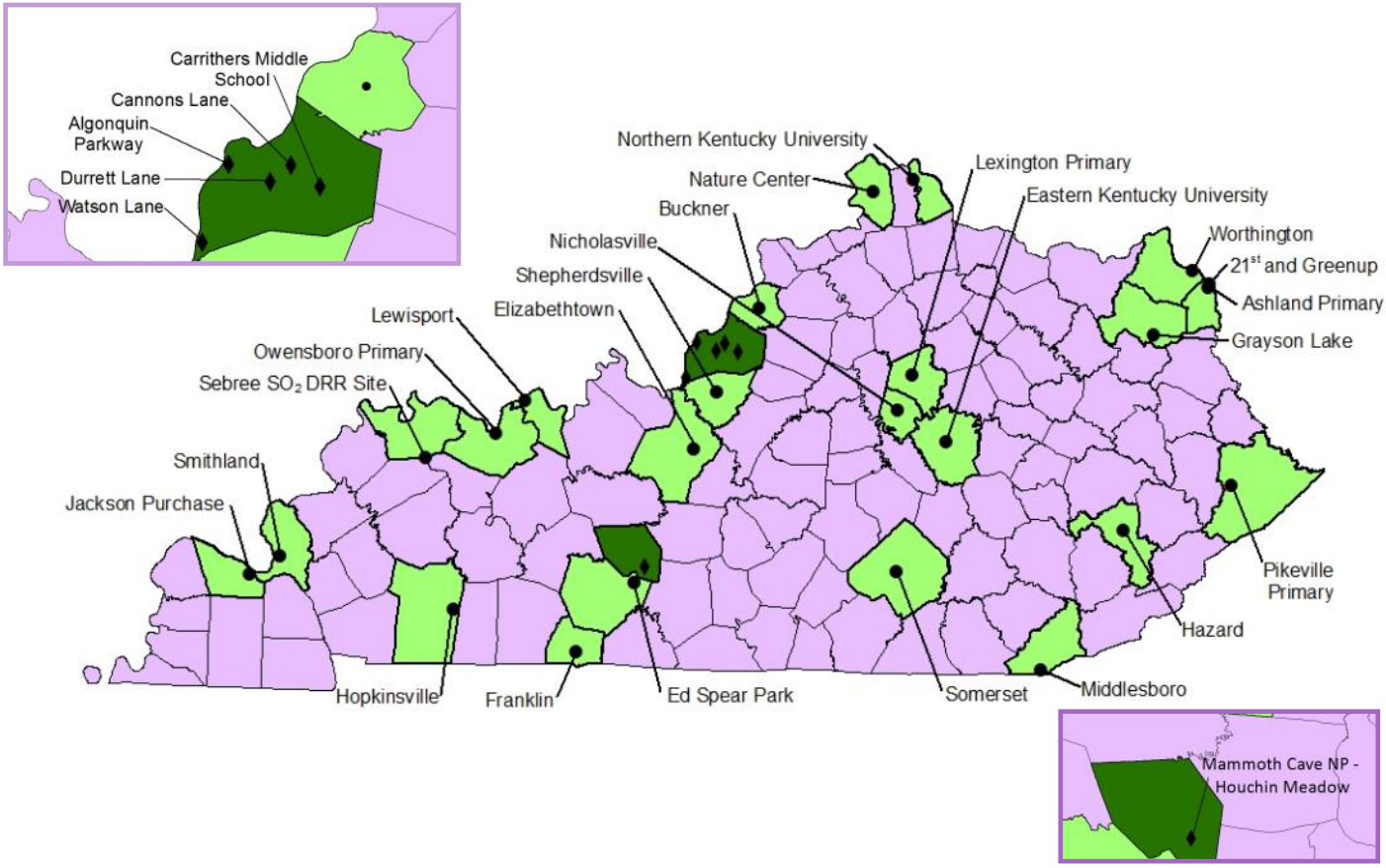
During the 2022 monitoring year, KDAQ operated 71 instruments, including 6 meteorological stations, located at 24 ambient air monitoring sites in 23 Kentucky counties. LMAPCD will operate an additional 33 instruments, including 5 meteorological stations, in Jefferson County.

When combined with the air monitoring site operated by the National Park Service (NPS) at Mammoth Cave National Park, the total ambient air monitoring network will consist of 109 instruments, including 12 meteorological stations, located at 30 sites across 25 counties of the commonwealth. While not associated with the division's air monitoring network, the EPA operates three additional CASTNET ozone monitoring stations in Kentucky, one of which was suspended in May 2022.

Locations of ambient air monitoring stations are selected in accordance with EPA regulations (40 CFR 58, Appendix D). In general, monitors are placed in densely populated areas or near point sources of pollution. The site locations are reviewed annually to ensure adequate coverage is being provided and regulatory requirements are being met. See the 2023 Kentucky Ambient Air Monitoring Network Plan for more information.

Right: An air monitoring site operator removes a filter from a particulate matter sampler. *Photo: Roberta Burnes*

2022 Ambient Air Monitoring Network Map



National Ambient Air Quality Standards

The Clean Air Act directs the U.S. Environmental Protection Agency to establish National Ambient Air Quality Standards (NAAQS) for six criteria pollutants that are considered harmful to human health and the environment. The **primary standard** is designed to protect public health. The **secondary standard** is designed to protect public welfare. Welfare includes damage to plants and animals, impairment of visibility, and property damage.

National Ambient Air Quality Standards

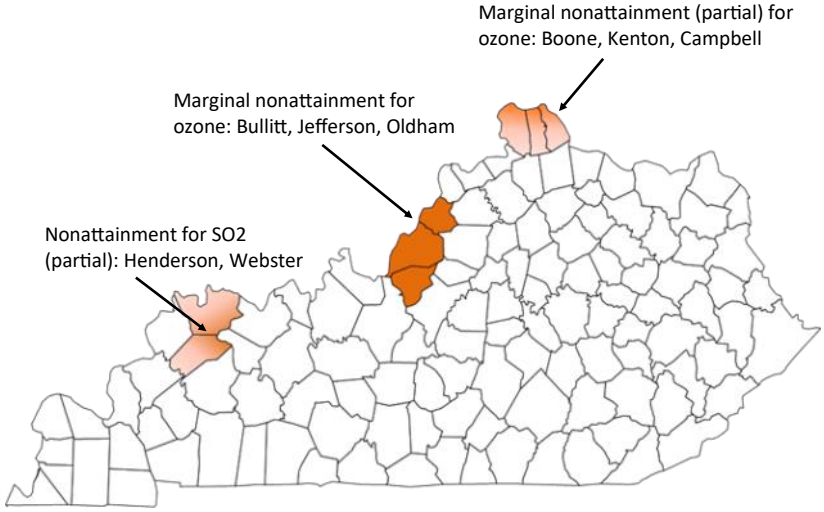
Carbon Monoxide	Primary Standard	Secondary Standard
8-Hour Average	9 ppm	none
1-Hour Average	35 ppm	none
Lead	Primary Standard	Secondary Standard
Rolling 3-Month Average	0.15 μ/m^3	Same as primary
Nitrogen Dioxide	Primary Standard	Secondary Standard
Annual Average	53 ppb	Same as primary
1-Hour Average	100 ppb	none
Particulate Matter (PM_{10})	Primary Standard	Secondary Standard
24-Hour Average	150 μ/m^3	Same as primary
Particulate Matter ($PM_{2.5}$)	Primary Standard	Secondary Standard
Annual Average	12 μ/m^3	15 μ/m^3
24-Hour Average	35 μ/m^3	Same as primary
Ozone	Primary Standard	Secondary Standard
8-Hour Average	0.070 ppm	Same as primary
Sulfur Dioxide	Primary Standard	Secondary Standard
1-Hour Average	75 ppb	none
3-Hour Average	none	0.5 ppm

Kentucky Nonattainment Areas

Effective August 3, 2018, six Kentucky counties were designated nonattainment for the 2015 ozone standard: all of Bullitt, Jefferson and Oldham counties and the northern portions of Boone, Campbell and Kenton counties. These counties and partial counties were bumped up to the designation of "moderate" nonattainment.

In September 2022, the division submitted requests to EPA to redesignate these areas as attainment. Quality-assured air monitoring data demonstrate all these areas are now meeting the National Ambient Air Quality Standard (NAAQS) for ozone. On April 18, 2023, EPA published the proposed redesignation for the Louisville area. EPA action on the northern Kentucky area submittal is forthcoming.

For the 2010 sulfur dioxide standard, portions of two Kentucky counties, Henderson and Webster, were designated nonattainment for the 2010 SO_2 standard, effective March 13, 2021. The division worked on a redesignation request for the area until the monitor picked up several exceedances that put the design value over the SO_2 standard of 75 ppb. As of the end of FY23, the division was working on an attainment plan.



During FY23, the three shaded counties in the middle of the above map were designated marginal nonattainment for the 2015 ozone standard (Bullitt, Jefferson, & Oldham counties). The northern portions of three counties in northern KY were designated marginal nonattainment for the 2015 ozone standard. Portions of the two shaded counties in western KY (Henderson and Webster) were designated nonattainment for SO_2.

Understanding the Data

This annual report contains quality-assured data collected during calendar year 2022, as well as statewide trends for each of the criteria pollutants. The data summarizes concentrations and **design values** of pollutants measured in Kentucky during the 2022 calendar year. A design value is a calculated metric that is used to determine compliance with a particular National Ambient Air Quality Standard (NAAQS). For many pollutants, a design value is calculated for each year and then averaged over a three-year period before being compared to a standard. However, some design values use alternative time intervals for calculation. For example, lead uses a 3-month rolling average and one of the primary NAAQS for nitrogen dioxide uses an annual average.

It is important to note that an exceedance of a particular pollutant is not the same as a violation of the NAAQS for that pollutant. Violations are determined according to the formula for each standard and involve the average of multiple measured values over a specific amount of time. Any data contained in this report is subject to change. The most current quality assured data set can be obtained through a Kentucky Open Records request.

Carbon Monoxide

Primary NAAQS: 8-hour average not to exceed 9 parts per million (ppm) more than once per year; 1-hour average not to exceed 35 ppm more than once per year
Secondary NAAQS: None

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

There were no exceedances of the CO standards in 2022. The last exceedance of a standard occurred on Jan. 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.

2022 Carbon Monoxide 1-Hour Averages
Method: Instrumental/Non-Dispersive Infrared Photometry
Data Interval: Hourly
Units: Parts per Million (ppm)

Station	1st Max	2nd Max
Mammoth Cave (NPS)	0.395	0.304
Cannons Lane (LMAPCD)	1.83	1.74
Durrett Lane (LMAPCD)	1.53	1.51

LMAPCD = Louisville Metro Air Pollution Control District
NPS = National Park Service

Statewide Averages for Carbon Monoxide

Statewide averages for carbon monoxide (CO) have declined substantially since 1987, primarily due to improved emission controls on motor vehicles.

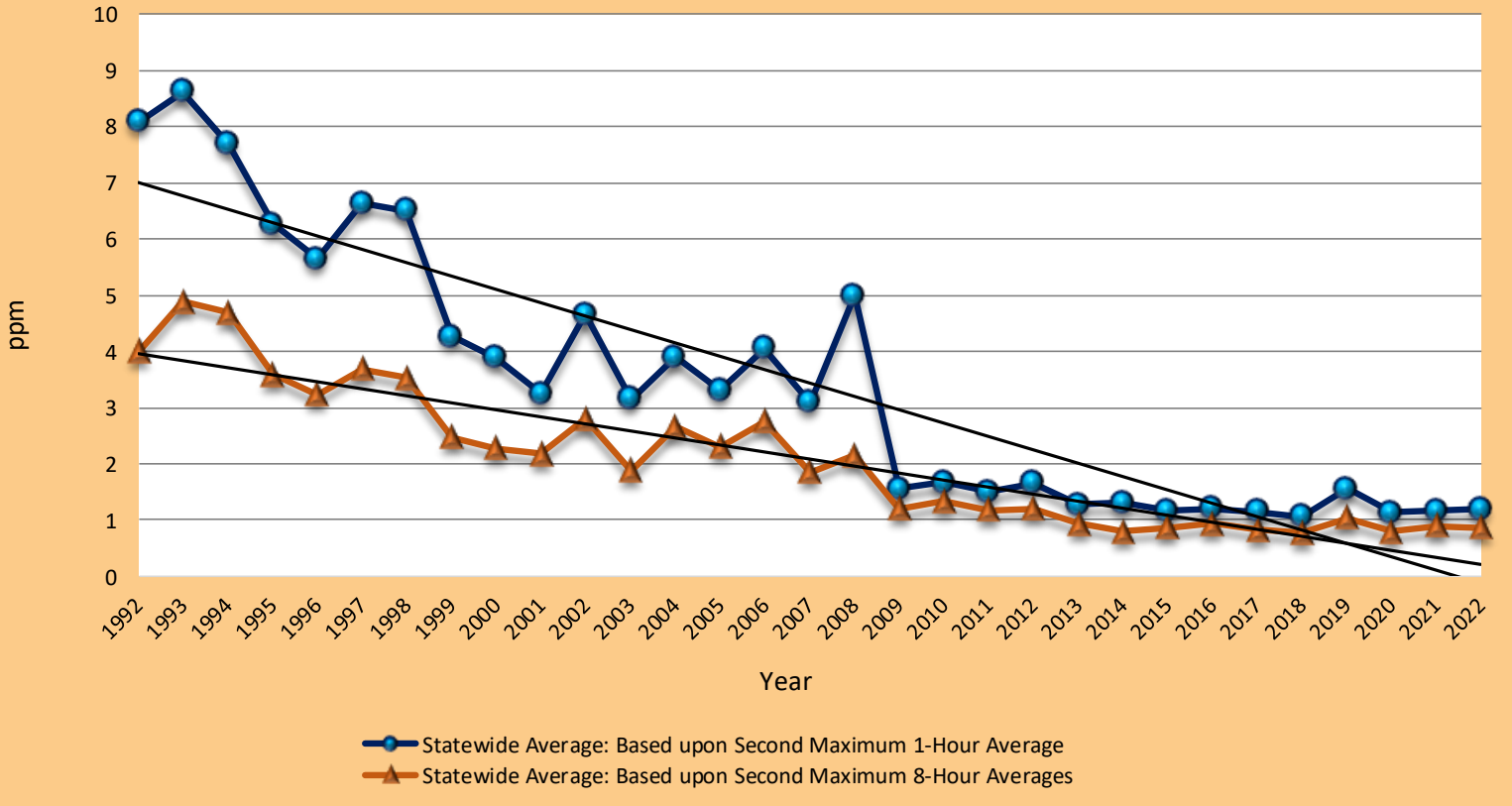
This table presents the statewide 1-hour and 8-hour averages of the second highest reading of CO from 1990 through 2022. For reference, the current 1-hour primary standard for CO is 35 parts per million (ppm) and the current 8-hour primary standard for CO is 9 ppm.

These data are graphed on the following page, with the downward trend lines marked.

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.

Year	Statewide Average (ppm) based upon Second Maximum 1-Hour Averages	Statewide Average (ppm) based upon Second Maximum 8-Hour Averages
1992	8.09	3.99
1993	8.62	4.88
1994	7.69	4.68
1995	6.26	3.58
1996	5.64	3.24
1997	6.63	3.68
1998	6.51	3.53
1999	4.27	2.47
2000	3.88	2.28
2001	3.25	2.17
2002	4.66	2.79
2003	3.15	1.88
2004	3.90	2.65
2005	3.30	2.30
2006	4.05	2.75
2007	3.10	1.85
2008	5.00	2.15
2009	1.55	1.20
2010	1.67	1.33
2011	1.50	1.17
2012	1.66	1.20
2013	1.28	0.93
2014	1.30	0.80
2015	1.16	0.87
2016	1.21	0.93
2017	1.15	0.83
2018	1.07	0.77
2019	1.56	1.03
2020	1.13	0.80
2021	1.16	0.90
2022	1.18	0.87

Statewide Averages for Carbon Monoxide



Lead

Primary NAAQS: Rolling 3-month average not to exceed 0.15 micrograms per meter squared (µg/m3)
Secondary NAAQS: Same as primary standard

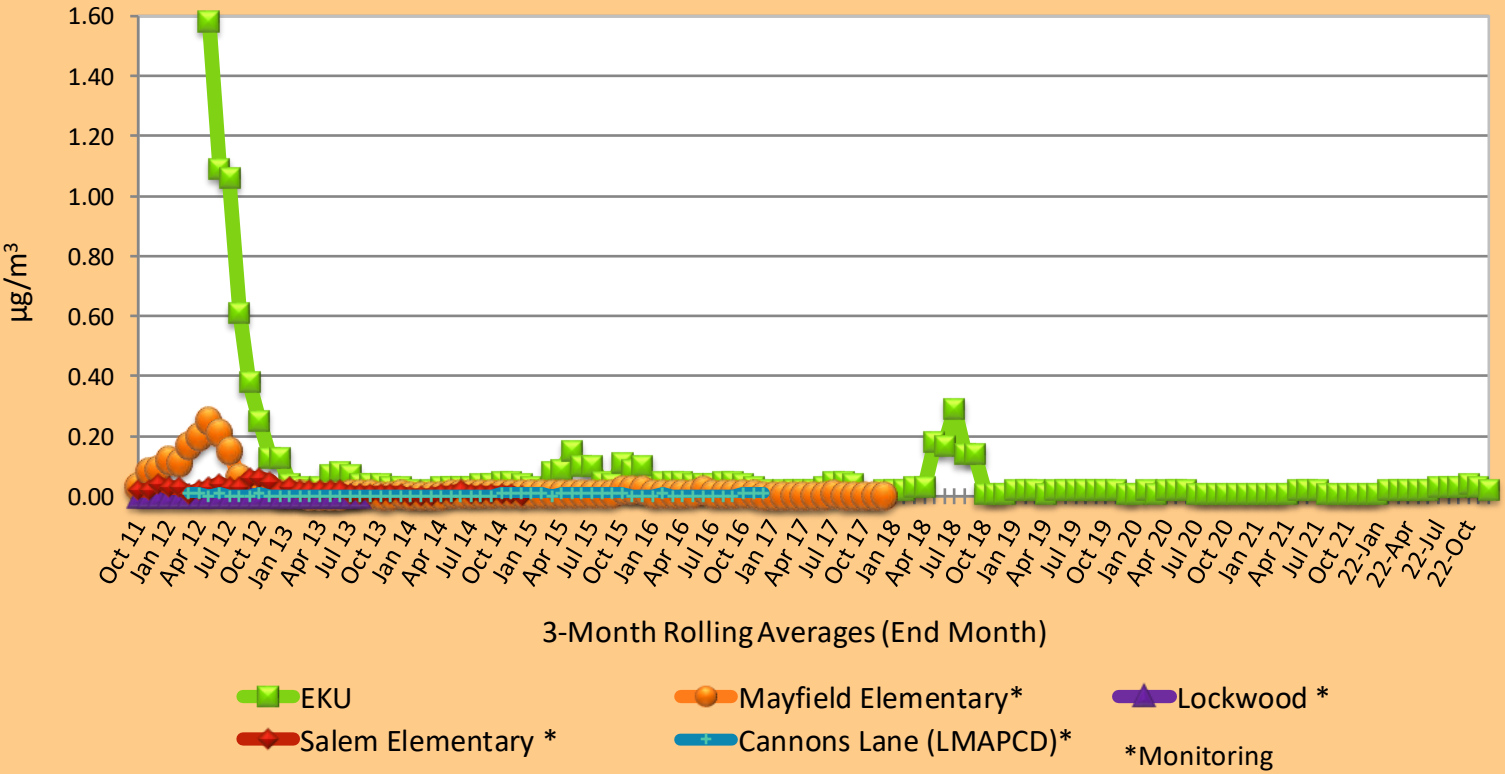
Lead is a soft, blue-gray metal that has historically been used in motor fuels, paint, plumbing and batteries. Since the 1970s when the U.S. EPA mandated the phase out of lead in gasoline, airborne lead concentrations have plummeted. By regulation, lead monitoring is now only required near major sources of lead.

In 2022, the division operated one lead monitoring site at Eastern Kentucky University. There were several exceedances of the lead NAAQS in 2012 and 2018; all were related to a compliance issue with a single stationary source.

2022 Lead Rolling Three-Month Average
Method: High Volume Sampler;
Inductively Coupled Plasma-Mass Spectroscopy
Data Interval: 24-Hour
Units: Micrograms per cubic meter ($\mu g/m^3$)

Site Name	1st Max	2nd Max	3rd Max	4th Max	Observations > 0.15
EKU	0.147	0.087	0.077	0.072	0

Three-Month Rolling Averages for Lead



Nitrogen Dioxide

Primary NAAQS:
3-year average of the 98th percentile of daily maximum one-hour averages must not exceed 100 parts per billion (ppb)

Annual arithmetic mean must not exceed 53 ppb

Secondary NAAQS: Annual arithmetic mean must not exceed 53 ppb

Nitrogen dioxide is a reddish brown gas that is produced during high-temperature combustion. During combustion, nitrogen and oxygen combine to form a family of highly reactive gases called nitrogen oxides (NOx), which include nitrogen dioxide (NO_2) and nitrogen oxide (NO). Major combustion sources that produce NO_2 include motor vehicles, power plants, incinerators, boilers, and chemical processes. NO_2 is also produced through a photochemical reaction between NO and sunlight.

There have been no recorded exceedances of an NO_2 NAAQS since the inception of sampling in 1970. All Kentucky counties are currently in attainment of the standards for nitrogen dioxide.

2022 Nitrogen Dioxide Results: Three-Year Average of 98th Percentile of Daily Maximum One-Hour Averages
Method: Chemiluminescence
Data Interval: Hourly
Units: Parts per billion (ppb)

County/Site Name	2020	2021	2022	3-Yr Avg
Boyd	27	26.2	31.2	28
Campbell	28	27.9	28.9	28
Daviess	26	28.9	30	28
Fayette	38	37.2	42.5	39*
Cannons Lane (LMAPCD)	38.4	41.4	40	40
Durrett Lane	43.7	49.5	48.2	47
McCracken	30	30.3	29.3	30*

** Incomplete data set*
LMAPCD = Louisville Metro Air Pollution Control District

Statewide Averages for Nitrogen Dioxide

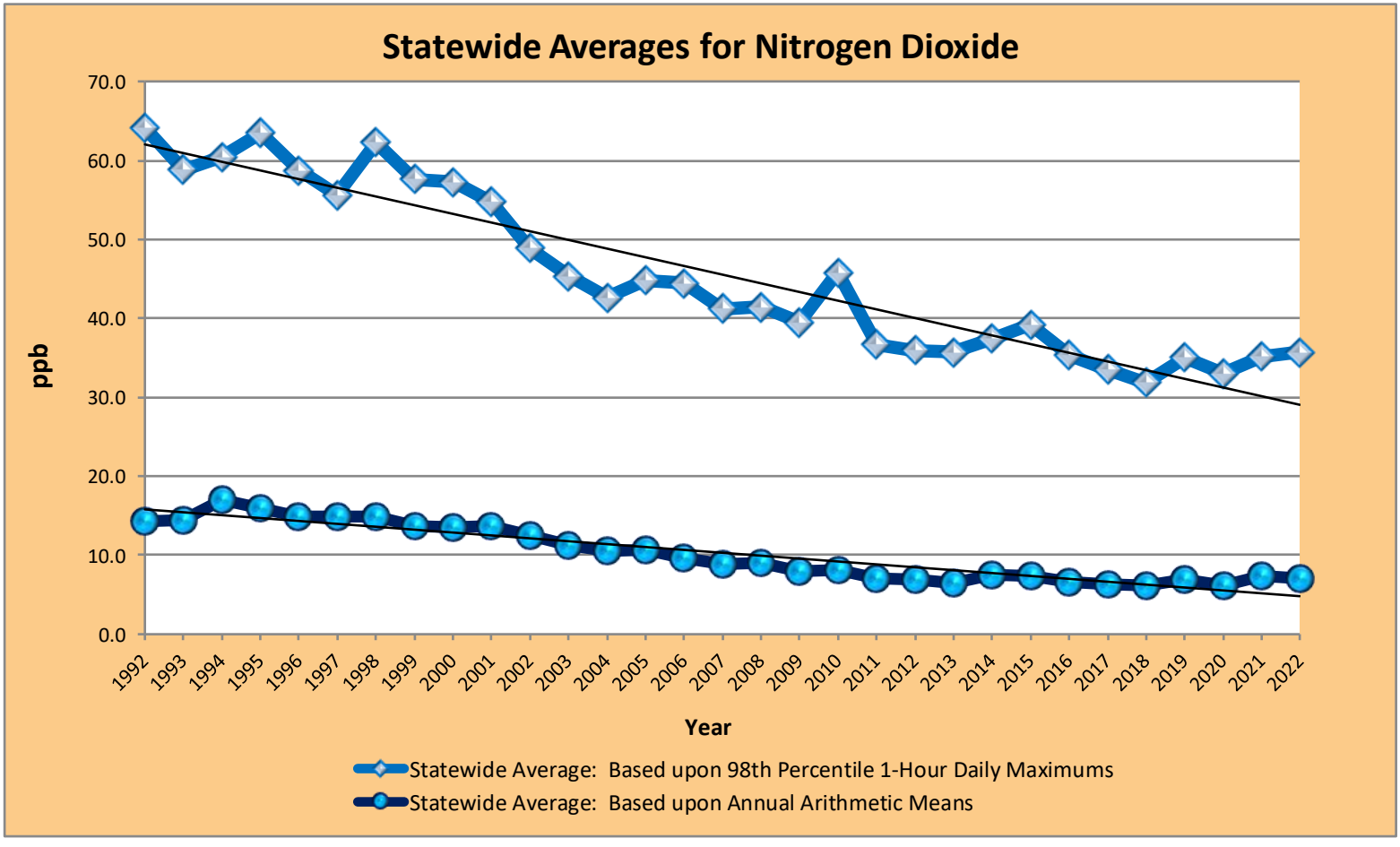
Statewide averages for nitrogen dioxide (NO_2) show a steady downward trend over the past three decades, primarily due to the installation and use of pollution control devices on motor vehicles, power plants and industrial boilers.

These tables present the statewide averages of NO_2 from 1992 through 2022. The data is represented in two different ways: A statewide average of the annual averages from each monitoring station; and the statewide average of the 98th percentile 1-hour daily maximums. For reference, the annual standard for nitrogen dioxide is 53 ppb and the 1-hour standard is 100 ppb.

The data from these tables are graphed on the following page, with the downward trend lines labeled.

Year	Statewide Average (ppb) based upon Annual Arithmetic Means	Statewide Average (ppb) based upon 98th Percentile 1-Hour Daily Maximums
1992	14.34	64.20
1993	14.40	58.85
1994	17.02	60.42
1995	15.97	63.55
1996	14.90	58.82
1997	14.88	55.64
1998	14.95	62.36
1999	13.68	57.64
2000	13.48	57.27
2001	13.72	54.77
2002	12.51	48.92
2003	11.30	45.33
2004	10.46	42.63
2005	10.72	44.88
2006	9.67	44.44
2007	8.78	41.20

Year	Statewide Average (ppb) Based upon Annual Arithmetic Means	Statewide Average (ppb) Based upon 98th Percentile 1-Hour Daily Maximums
2008	9.0	41.43
2009	7.92	39.50
2010	8.05	45.83
2011	7.04	36.68
2012	6.94	35.97
2013	6.48	35.75
2014	7.48	37.44
2015	7.35	39.17
2016	6.57	35.37
2017	6.32	33.55
2018	6.20	31.89
2019	6.88	35.06
2020	6.21	33.01
2021	7.42	35.18
2022	35.73	7.01


Statewide Averages for Nitrogen Dioxide
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
ppb
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Statewide Average: Based upon 98th Percentile 1-Hour Daily Maximums
Statewide Average: Based upon Annual Arithmetic Means

Ozone

Primary & Secondary NAAQS: 3-year average of the 4th highest daily maximum 8-hr concentration not to exceed 0.070 parts per million.

Ozone is a colorless gas that is not emitted directly into the atmosphere from sources. Instead, ozone forms in the lower atmosphere from a photochemical reaction between volatile organic compounds (VOCs) and nitrogen oxides (NOx) in the presence of sunlight.

In 2022, eight sites measured 8-hour ozone concentrations greater than 0.070 ppm. The fourth highest daily maximum 8-hour ozone concentration was above the level of the standard at the Cannons Lane (Jefferson County) site. The 2020-2022 3-year average was at or below the level of the standard for all Kentucky sites.

LMAPCD = Louisville Metro Air Pollution Control District
NPS = National Park Service
CASTNET = EPA-operated monitor

2022 Ozone Results:
3-Yr Average of 4th Highest Daily Maximum 8-Hour Concentration
Method: Ultra-Violet Photometry
Data Interval: Hourly
Units: Parts-per-million (ppm)

County/Site Name	ppm
Bell	0.056
Boone	0.066*
Boyd	0.059
Bullitt	0.064
Campbell	0.063
Cannons Lane (LMAPCD)	0.07
Carrithers Middle School (LMAPCD)	0.069
Carter	0.056
Christian	0.059
Daviess	0.064
Edmonson (NPS)	0.059
Fayette	0.063
Greenup	0.055
Hancock	0.065

County/Site Name	ppm
Hardin	0.061
Jessamine	0.062
Livingston	0.064
McCracken	0.065
Morgan (CASTNET)	0.057
Oldham	0.063
Perry	0.056
Pike	0.055
Pulaski	0.058
Simpson	0.06
Trigg (CASTNET)	0.059*
Warren	0.06
Washington (CASTNET)	0.06
Watson Lane (LMAPCD)	0.065

Statewide Averages for Ozone

Statewide averages for ozone (O_3) have generally declined since 1987. This trend is attributable to emission controls on vehicles and a regional strategy to control NOx emissions from large stationary internal combustion engines, large boilers, and turbines used in power plants and other industrial applications.

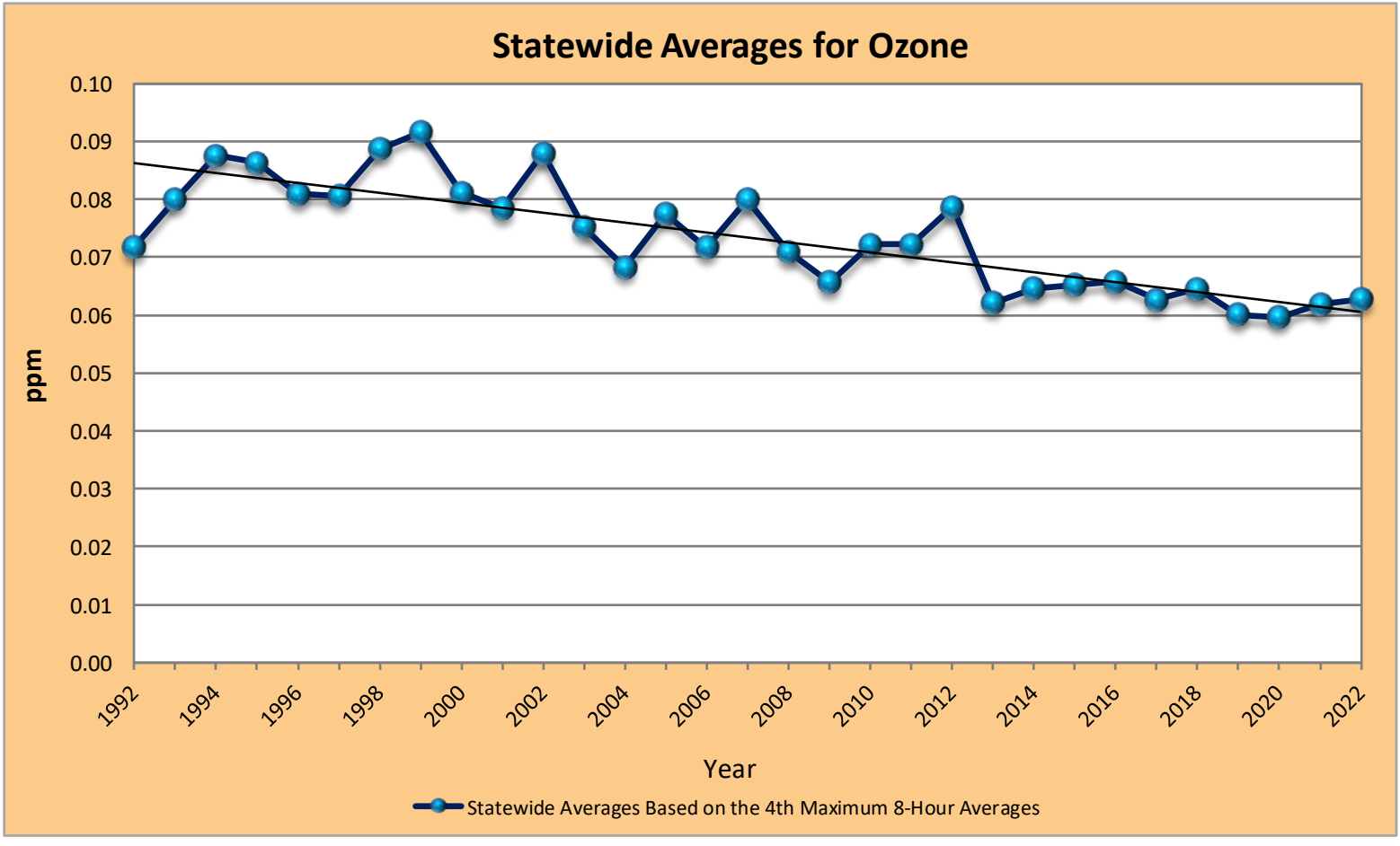
This table presents the statewide averages of ozone from 1992 through 2022. For reference, the current primary standard for ozone is a 3-year average of the 4th highest daily maximum 8-hr concentration not to exceed 0.070 ppm.

These data are graphed on the following page, with the downward trend line marked.

Year	Statewide Average: Based on Fourth Maximum 8-Hour Averages (ppm)
1992	0.072
1993	0.080
1994	0.088
1995	0.086
1996	0.081
1997	0.081
1998	0.089
1999	0.092
2000	0.081
2001	0.078
2002	0.088
2003	0.075
2004	0.068
2005	0.078
2006	0.072
2007	0.080
2008	0.071
2009	0.066
2010	0.072
2011	0.072

Year	Statewide Average: Based on Fourth Maximum 8-Hour Averages (ppm)
2012	0.079
2013	0.062
2014	0.065
2015	0.065
2016	0.066
2017	0.063
2018	0.065
2019	0.060
2020	0.060
2021	0.062
2022	0.063

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide Averages for Ozone
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
ppm
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year
Statewide Averages Based on the 4th Maximum 8-Hour Averages

Fine Particulate Matter ($PM_{2.5}$)

Primary NAAQS: 3-year average of the annual weighted mean not to exceed 12.0 micrograms per meter cubed ($\mu g/m^3$)
3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 $\mu g/m^3$

Secondary NAAQS: 3-year average of the annual weighted mean not to exceed 15.0 $\mu g/m^3$
3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 $\mu g/m^3$

Fine particulate matter ($PM_{2.5}$) is a mixture of solid particles and liquid droplets that are 2.5 microns or smaller in size. Sources include power plants, wood burning, industrial processes, and combustion. Fine particulates are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides and VOCs are transformed through chemical reactions.

There were no exceedances of the three-year 24-hour standard nor the three-year annual standard during the 2020 - 2022 averaging period. All Kentucky counties are currently in attainment for the $PM_{2.5}$ standards.

2022 $PM_{2.5}$ Results: 3-Yr Avg. of 24-Hour 98th Percentile

Method: Gravimetric
Data Interval: 24-Hour
Units: Micrograms per cubic meter ($\mu g/m^3$)

County/Site Name	$\mu g/m^3$
Bell	20
Boyd	18
Campbell	18
Carter	14
Christian	23

County/Site Name	$\mu g/m^3$
Daviess	22
Fayette	18
Hardin	19
Watson Lane (LMAPCD)	23
Cannons Lane (LMAPCD)	22
Durrett Lane (LMAPCD)	24
Carrithers M.S. (LMAPCD)	23

County/Site Name	$\mu g/m^3$
Algonquin Parkway (LMAPCD)	21
McCracken	26*
Perry	16
Pike	16
Pulaski	18
Warren	19

LMAPCD = Louisville Metro Air Pollution Control District

** Incomplete data set*

Statewide Averages for $PM_{2.5}$

This table presents the statewide averages of $PM_{2.5}$ from 2001 through 2022. The data is presented according to the two primary standards for $PM_{2.5}$:

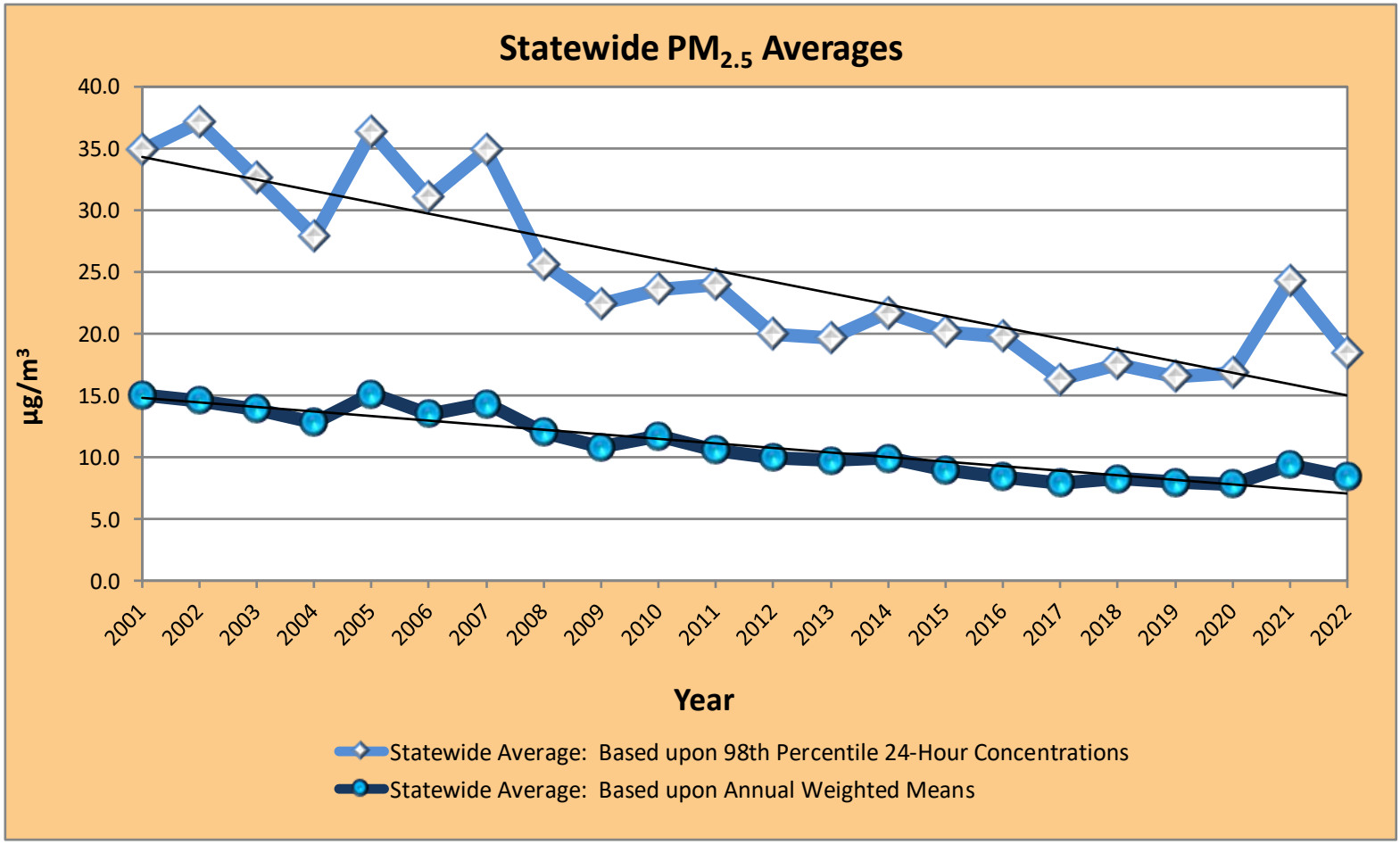
- 3-year average of the 98th percentile of 24-hour concentrations not to exceed 35 µg/m^3
- The 3-year average of the annual weighted mean, not to exceed 12.0 µg/m^3

These data are graphed on the following page, with the downward trend lines labeled.

Year	Statewide Average: Based upon 98th Percentile 24-Hour Concentrations (µg/m^3)	Statewide Average: Based upon Annual Weighted Means (µg/m^3)
2001	34.9	15.0
2002	37.1	14.6
2003	32.6	13.9
2004	27.9	12.8
2005	36.3	15.1
2006	31.0	13.5
2007	34.8	14.3
2008	25.6	12.0
2009	22.4	10.8
2010	23.6	11.7
2011	24.0	10.6
2012	20.0	9.97

Year	Statewide Average: Based upon 98th Percentile 24-Hour Concentrations (µg/m^3)	Statewide Average: Based upon Annual Weighted Means (µg/m^3)
2013	19.6	9.7
2014	21.7	9.9
2015	20.1	8.9
2016	19.8	8.4
2017	16.3	7.9
2018	17.5	8.2
2019	16.5	7.9
2020	16.8	7.8
2021	24.2	9.4
2022	18.4	8.4

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide PM2.5 Averages
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
µg/m³
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Statewide Average: Based upon 98th Percentile 24-Hour Concentrations
Statewide Average: Based upon Annual Weighted Means

Particulate Matter (PM_{10})

Primary NAAQS: Expected number of days with a maximum 24-hour concentration greater than 150 micrograms per meter cubed ($\mu g/m^3$) must be less than or equal to one, on average over three years.
Secondary NAAQS: Same as Primary Standard

Coarse particulate matter of 10 microns or less in diameter is known as PM_{10}. Common sources of PM_{10} are prescribed fires, construction activities, agricultural practices, metal recycling, and smokestacks.

There were no exceedances of the annual PM_{10} standard in 2022. The last exceedance of the standard occurred on March 22, 2012 at the Ashland site, which is located next to a metals recycler. All Kentucky counties are currently in attainment for the PM_{10} standards.

2022 PM_{10} Results: Maximum 24-Hr Concentrations ($\mu g/m^3$)
Method: Gravimetric
Data Interval: 24-Hour
Units: Micrograms per cubic meter ($\mu g/m^3$)

County/Site Name	1st Max	2nd Max	3rd Max	4th Max
Boyd	56	50	43	41
Carter	40	18	18	17
Fayette	50	27	25	23
Algonquin Parkway (LMAPCD)	59	49	48	43
Cannons Lane (LMAPCD)	76	59	52	43

LMAPCD = Louisville Metro Air Pollution Control District

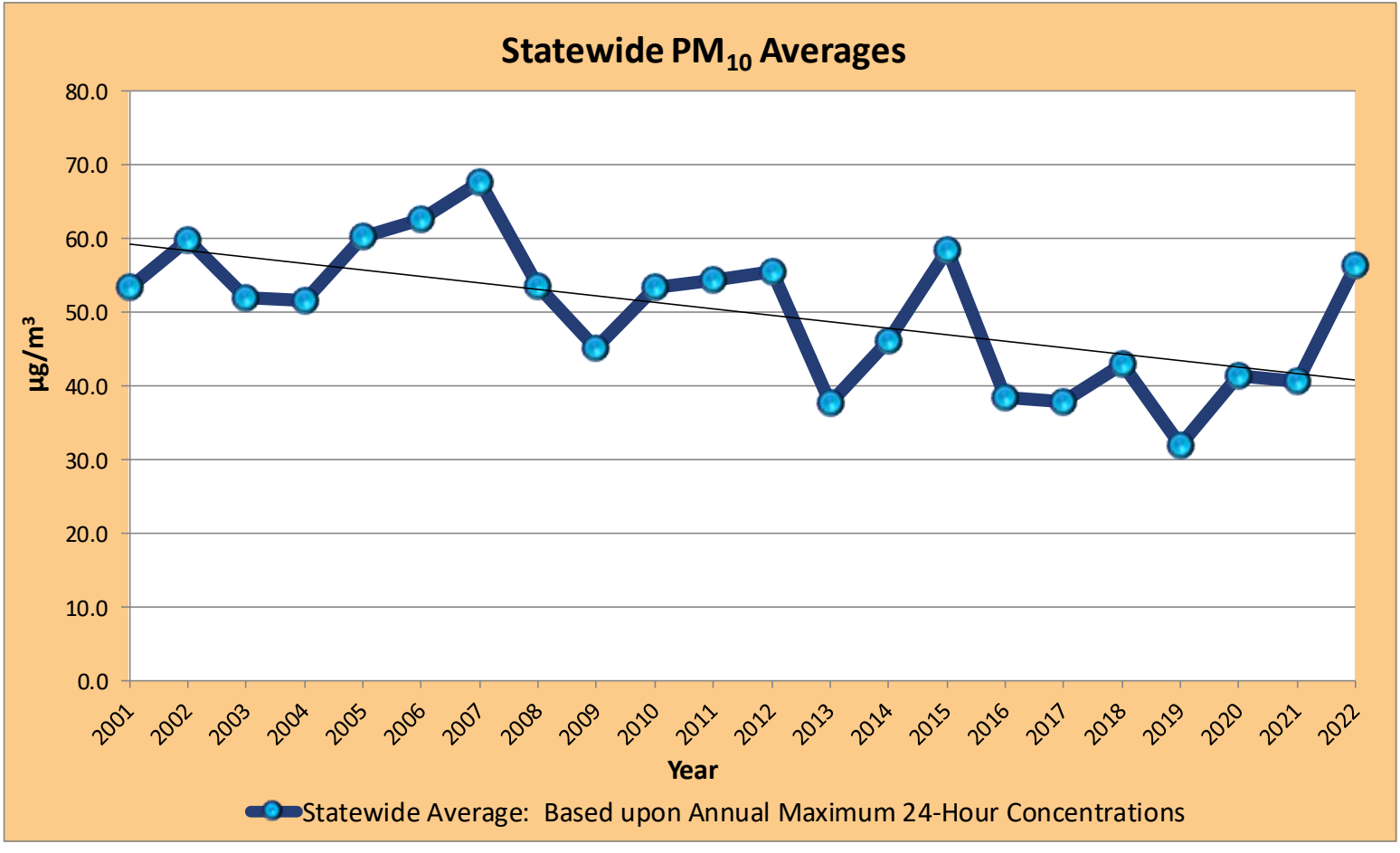
Statewide Averages for PM_{10}

Statewide and regional PM_{10} levels show declining trends over the past several decades. This decrease is largely due to the installation of pollution controls on industrial sources for particulate matter.

These tables show the statewide average of the annual maximum 24-hour concentration for PM_{10} from 1988 through 2021, measured in $\mu g/m^3$ (micrograms per cubic meter). The average is calculated using the first maximum PM10 measurement at each of five monitoring locations. PM10 levels experienced an uptick in 2022; nevertheless, all readings remained well below the NAAQS level of 150 $\mu g/m^3$. These data are graphed on the following page, with the downward trend line marked.

Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.

Year	Statewide Avg. Based upon Annual Maximum 24-Hour Concentrations ($\mu g/m^3$)
2001	53.4
2002	59.8
2003	52.0
2004	51.5
2005	60.3
2006	66.2
2007	67.7
2008	53.6
2009	45.1
2010	53.3
2011	54.3
2012	55.5
2013	37.7
2014	46.0
2015	58.5
2016	38.5
2017	37.9
2018	42.9
2019	32.0
2020	41.3
2021	40.7
2022	56.2


Statewide PM10 Averages
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
µg/m³
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Statewide Average: Based upon Annual Maximum 24-Hour Concentrations

Sulfur Dioxide (SO_2)

Primary NAAQS: 3-year average of the 99th percentile of the daily maximum 1-hour concentration not to exceed 75 ppb
Secondary NAAQS: 3-hour concentrations not to exceed 0.5 ppm (500 ppb) more than once per year

Sulfur dioxide (SO_2) is a colorless gas that has a pungent odor at concentrations exceeding 0.5 ppm. SO_2 is produced during the combustion of sulfur-containing fuels, ore smelting, petroleum processing, and the manufacturing of sulfuric acid. Nationwide, coal-fired power plants are the largest sources of SO_2.

During 2022, one site recorded 3 exceedances of the daily one-hour standard of 75 ppb. That site, located near Sebree, Kentucky, was established to characterize maximum hourly sulfur dioxide concentrations for specific stationary sources. No other exceedances were recorded in the state.

2022 Sulfur Dioxide Results: 3-Year Average of Annual Daily Maximum 1-Hr Averages (ppb)
Method: Instrumental, Ultra-Violet Fluorescence
Data Interval: Hourly

County	2020	2021	2022	3 Yr
Boyd	5	5	5.5	5
Campbell	10	9	9.9	10
Daviess	12	7	8.4	9
Edmonson (NPS)	2.2	2.7	1.9	2
Fayette	3	5.4	2.8	4
Greenup	6	8	6.6	7
Henderson (Sebree)	73	68	72.6	71
Watson Lane (LMAPCD)	14.6	12.7	11.8	13
Cannons Lane (LMAPCD)	9.1	9.1	8	9
Algonquin Parkway (LMAPCD)	5.1	4.3	4.2	5
Jessamine	3	3.3	5.4	4
McCracken	7	12	10.6	10

Units: Parts-per-billion (ppb)
LMAPCD = Louisville Metro Air Pollution Control District; NPS = National Park Service

Statewide Averages for Sulfur Dioxide

The dramatic decline of sulfur dioxide levels is one of Kentucky's biggest air quality success stories. Emission controls on coal-fired power plants, as well as the trading allowances in the federal Acid Rain Program, have directly contributed to the decline in ambient SO_2 concentrations across the region.

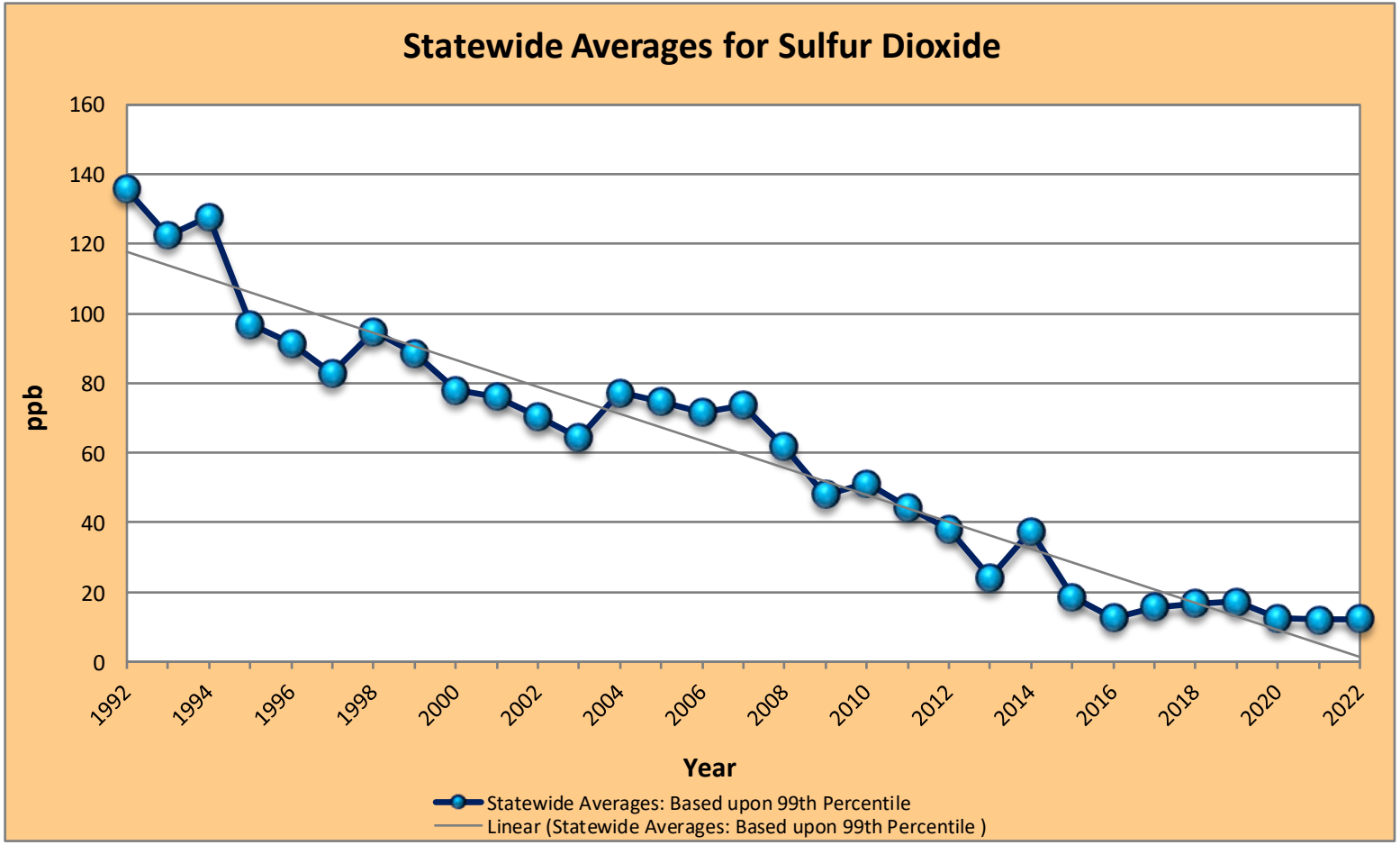
These tables show the statewide average for SO_2 from 1992 through 2022, measured in parts-per-billion (ppb). For reference, the primary standard for SO_2 is the 3-year average of the 99th percentile of the daily maximum 1-hour concentration, not to exceed 75 ppb.

These data are graphed on the following page, with the downward trend line marked.

Year	Statewide Averages: Based upon 99th Percentile (ppb)
1992	135.8
1993	122.3
1994	127.7
1995	96.8
1996	91.3
1997	82.7
1998	94.8
1999	88.7
2000	77.9
2001	76.1
2002	70.4
2003	64.4
2004	77.3
2005	74.6
2006	71.7
2007	73.6
2008	61.7
2009	47.9
2010	51.2
2011	44.4
2012	38.0
2013	24.2

Year	Statewide Averages: Based upon 99th Percentile (ppb)
2014	37.6
2015	18.7
2016	12.6
2017	15.8
2018	16.8
2019	17.3
2020	12.5
2021	12.2
2022	12.3

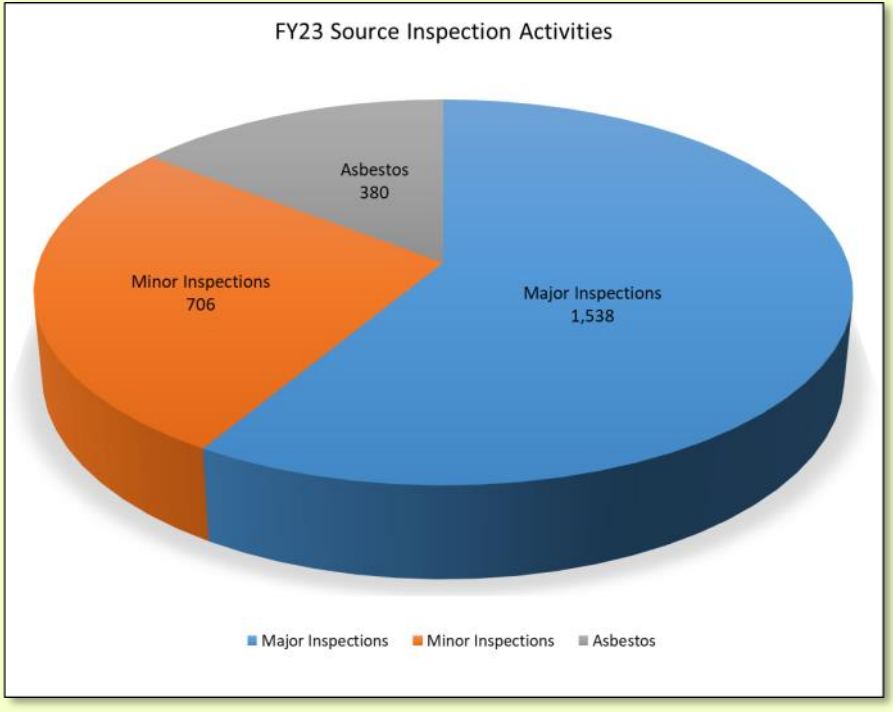
Disclaimer: These charts show generalized pollution trends through time. They do not show trends for specific sites, nor do they demonstrate attainment for any particular area. While individual pollutants may spike in certain years, overall trends show declines in pollution levels.


Statewide Averages for Sulfur Dioxide
160
140
120
100
80
60
40
20
0
ppb
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year
Statewide Averages: Based upon 99th Percentile
Linear (Statewide Averages: Based upon 99th Percentile)

Inspections

During FY23, Field Operations Branch staff completed **2,941** compliance inspections of various types at mostly permitted sources (major Title V, minor). **78 percent of inspected sources were found to be compliant**.

- Inspection activities for major and minor facilities include annual certification reviews, full compliance evaluations and partial compliance evaluations.
- Asbestos inspection activities include AHERA and NESHAP inspections.
- Inspection activities include excess emissions reviews, performance test reviews, semi-annual monitoring reviews, engineering inspections, follow-ups, infrared camera inspections, performance test observations and record reviews for all permitted facilities.

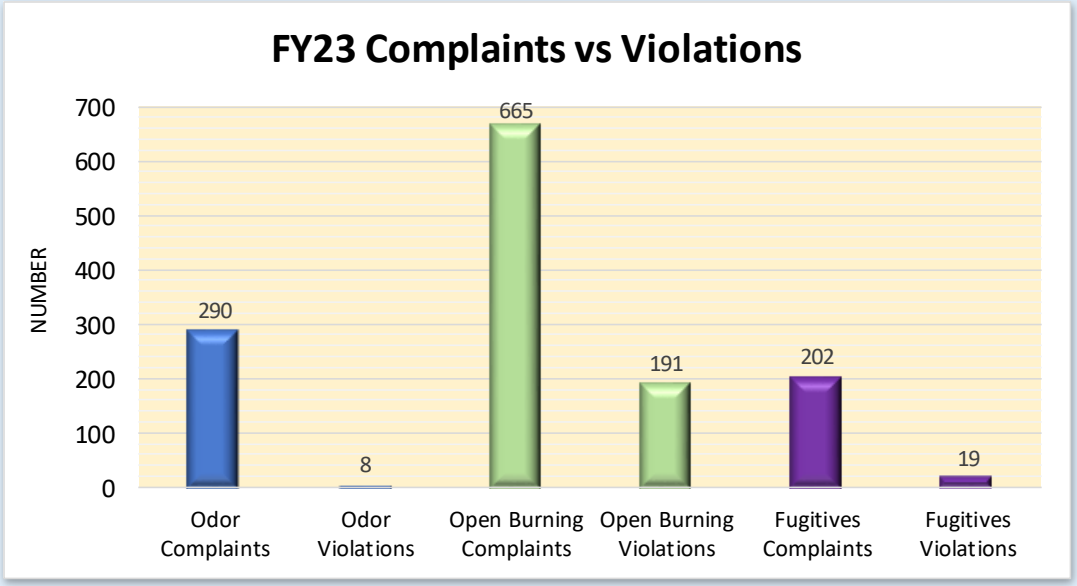


Air Pollution Complaints

During FY23, the division received a total of **1,546 complaints**. The majority of complaints were about open burning, odors, and fugitive emissions. The breakdown of complaints vs. violations follows:

- 202 complaints were about **fugitive emissions**, 19 of which resulted in notices of violation (a violation rate of nine percent).
- 290 complaints were about **odor**, of which 5 resulted in notices of violation (a violation rate of three percent).
- 665 complaints were about **open burning**, of which 212 resulted in notices of violation (a violation rate of 29 percent).

In general, an air quality complaint represents a single incident about which one or more calls have been received. For example, a single incident of tire burning may generate several citizen calls to DAQ. Those calls are counted collectively as a single complaint, since they refer to a single incident.



Program Funding

The division operates primarily on Title V (pronounced “Title Five”) emissions fees and federal grant funds. Funding under the Title V program mandated by the Clean Air Act is through air pollutant emission fees assessed to permitted air pollution sources in the state that meet specific criteria.

State statute authorizes the division to charge fees sufficient to cover the cost of implementing and carrying out the requirements of the air quality program.

During FY23, 87 percent of the division’s funding came from emissions fees under the Title V program. Another 12 percent came from federal grant funds. The remaining funding came from asbestos license application fees, tank truck permits, and proceeds from asset sales.

Emissions Inventory

The Emissions Inventory Section surveys nearly 1,200 facilities per year to determine actual air pollutant emissions for the previous calendar year. Title V fees are generated based on actual emissions in a calendar year. Sources are surveyed annually and charged a per ton fee for emissions.

The table on this page shows data for the 2021 calendar year. At the time of publication of this report, data for the 2022 calendar year was still being verified. It takes approximately nine months to verify and complete the inventory for the previous year.

Pollutant	Tons Emitted in 2021
Carbon monoxide	60,723
Nitrogen dioxide	51,465
Particulate matter 2.5	6,369
Particulate matter 10	11,542
Sulfur dioxide	54,518
Volatile organic compounds (as an ozone precursor)	55,340

Kentucky Greenhouse Gas Emissions

Because some gases have a higher warming potential than others, emissions of greenhouse gases are typically expressed in "carbon dioxide equivalent" (CO_2e) in order to allow their impacts to be directly compared. EPA's Greenhouse Reporting Rule requires reporting of greenhouse gases from sources that emit 25,000 metric tonnes or more of CO_2e per year in the U.S.

Although the division is not required to report greenhouse gas emissions on behalf of facilities, the Emissions Inventory Section collects this data when available.

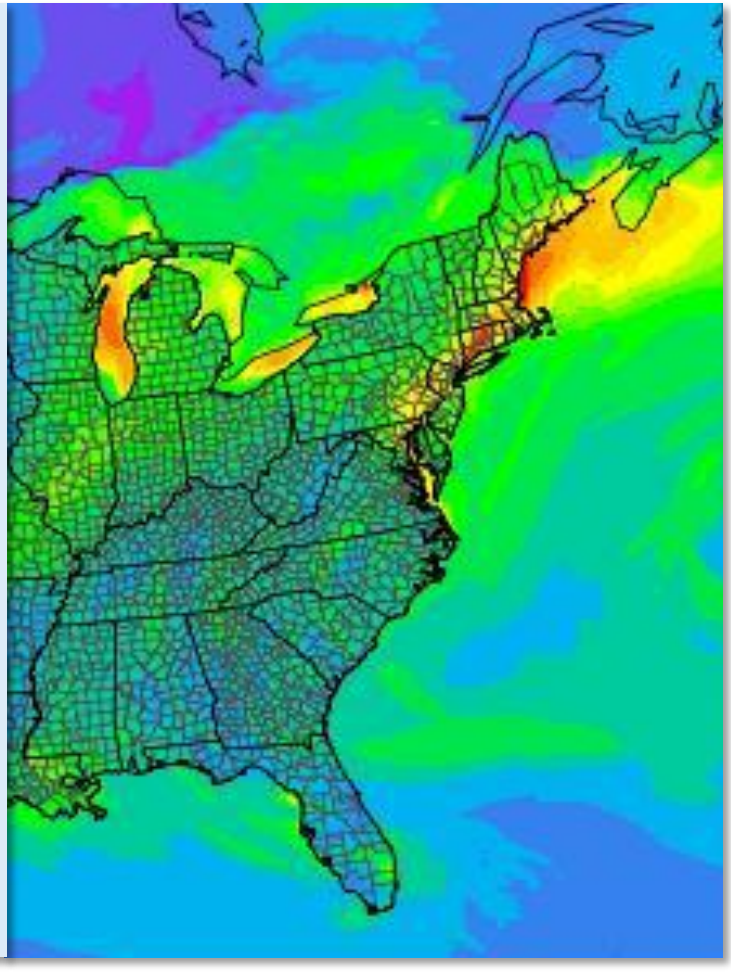
Greenhouse Gas	2017 Actual Emissions (tons)	2018 Actual Emissions (tons)	2019 Actual Emissions (tons)	2020 Actual Emissions (tons)	2021 Actual Emissions (tons)
Carbon dioxide	73,655,105	76,999,573	68,860,439	58,911,448	67,589,118
Methane	88,675	89,808	93,740	109,679	94,983
Nitrous oxide	3,190	3,369	2,788	3,156	4,071
CO2e (metric tonnes)	69,838,096	72,943,967	65,520,542	56,988,254	64,667,792
CO2e (tons)	76,983,327	80,406,960	72,224,035	62,818,800	71,284,038

Air Dispersion Modeling

Air dispersion modeling is an important tool that supports air program planning and permit review. Air modeling data is used to verify, adjust or establish limits in permits, justify permit conditions, to support the State Implementation Plan, and to protect public health and air quality.

In FY23, the following assessments and demonstrations were completed:

- 39 air toxics modeling demonstrations in compliance with 401 KAR 63:020 for affected facility applications that emit hazardous and/or toxic substances;
- 4 PSD permit application reviews in compliance with 401 KAR 51:017 and EPA's Guideline on Air Quality Models, 40 CFR Part 51, Appendix W;
- 1 lead monitoring waiver modeling demonstration for Kentucky counties;
- 1 MOVES3 (Motor Vehicle Emission Simulator) model demonstration to estimate on-road emissions to support the Henderson-Webster SO_2 nonattainment emissions inventory SIP;
- 2 Economic Development Projects—PSD evaluated.



Regional Haze

Regional haze is pollution that impairs natural visibility over a large region, including national parks, forests, and wilderness areas (known as "Class I" areas). As part of the Clean Air Act Amendments and further regulations adopted by the EPA, states must develop plans to restore natural visibility conditions in the 156 Class I areas throughout the nation by the year 2064. Kentucky's Mammoth Cave National Park is included in the list of Class I areas.

Regional haze is typically caused by sources and activities emitting fine particles and their precursors, often transported over large regions. Particles affect visibility through the scattering and absorption of light. Reducing fine particles in the atmosphere is an effective method of improving visibility.

Revisions to state plans for Regional Haze are required periodically to ensure progress is being made toward long term goals. Kentucky's draft SIP revision concentrates on reducing sulfur dioxide (SO_2) emissions from facilities shown to impact Class I areas. As of the publication of this report, the draft SIP revision was being updated to address EPA's comments on the pre-draft.

Regulation Development

During FY23, the Regulation Development Section finalized amendments to the following Kentucky Administrative Regulation:

401 KAR 63:060, *List of hazardous air pollutants, petitions process, lesser quantity designations, and source category list.* This administrative regulation was updated to include an amendment to 42 U.S.C. 7412(b) which adds 1-Bromopropane as a new hazardous air pollutant.

The section also filed the following administrative regulations:

401 KAR 51:010, *Attainment status designations.*
401 KAR 58:040, *Requirements for asbestos abatement entities.*

State Implementation Plan

During FY23, the Energy and Environment Cabinet submitted four final revisions to Kentucky's SIP:

September 6, 2022 – Request to redesignate Kentucky counties within the Louisville, KY-IN 2015 8-hour ozone nonattainment area to attainment for the NAAQS

September 21, 2022 – Request to redesignate the Kentucky counties within the Cincinnati, OH-KY 2015 8-hour ozone nonattainment area to attainment for the NAAQS

November 10, 2022 – 2010 SO_2 Data Requirements Rule Annual Report

December 2, 2022 – Adoption of amendments to 51:010, *Attainment Status Designations*

Clean Diesel Grant

The Kentucky Clean Diesel Grant Program provides financial support for projects that protect human health and improve air quality by reducing harmful emissions from diesel school buses. The division administers this program with funding provided through the federal Diesel Emissions Reduction Act (DERA).

During FY23, a total of **$358,123 was awarded** to the division through DERA. School districts in six Kentucky counties were selected to receive funding through the Kentucky Clean Diesel Grant Program. The school districts will replace a total of nine older model, diesel school buses with either new diesel, or propane buses. The new buses will emit 87 percent less particulate matter and 85 percent less nitrogen oxide pollution than the older buses they replaced.

Air Permitting

The Permit Review Branch issues air permits for industrial and commercial sources that release pollutants into the air. Air permits include information on which pollutants are being released, how much may be released, and what kinds of steps the source's owner or operator is required to take to reduce the pollution. Permits also include plans to measure and report air pollution emitted.

The Permit Review Branch is divided into several specialized sections:

- **Chemical Section** - Chemical plants (organic and inorganic), petroleum refineries, coal to liquids, bulk terminals, brake manufacturing, plastic products and resins, paper mills/pulp mills, electronic components, nonwoven fabrics, rubber products, paperboard mills, pharmaceuticals, paint and allied products, carbon and graphite products, and battery manufacturers
- **Combustion Section** - brick and tile manufacturing, charcoal manufacturing, combustion (boilers), distilleries, glass manufacturing, incineration, natural gas transmission stations, power plants, sawmills, soil remediation units, tobacco processing plants, electric utilities
- **Metallurgy Section** - primary steel and aluminum producers, mini steel mills, secondary metal plants, and various surface treatments of metals

- **Minerals Section** - Asphalt plants (portable and stationary), cement storage operations, chicken feed manufacturing plants, coal preparation plants (portable and stationary), coal tipples (portable and stationary), coal terminals, concrete block plants, edible oil plants, fertilizer operations (including blending), flour mills, grain elevators, lime manufacturing plants, limestone crushing operations (portable and stationary), limestone terminals, pet food manufacturers, pre-stress concrete plants, ready mix concrete plants, sandstone crushing operations, sand and gravel operations (portable and stationary), slag coal operations, soybean extraction plants
- **Surface Coating Section** - Automobile and light-duty trucks, beverage cans, fabric, vinyl and paper, flat wood paneling, flexible vinyl and urethane, large appliances, magnet wire, magnetic tape, metal coil, metal furniture, miscellaneous metal parts and products, plastic parts for business machines, polymeric coating, pressure sensitive tape and labels, publication rotogravure and flexography printing

Permitting Actions

The Division for Air Quality's Permit Review Branch issued new air permits or permit modifications for 22 economic development referred projects during FY23. These projects were completed in partnership with the Cabinet for Economic Development. At the close of FY23, the branch had issued 314 permits and had 253 pending applications in-house.

FY 2023 Permitting Actions

Type of Permit Action	Number
Major Permit Applications	80
Conditional Major Permit Applications	90
Minor Permit Applications	178
Registrations	133
Administrative Amendments	40

Environmental Education Outreach

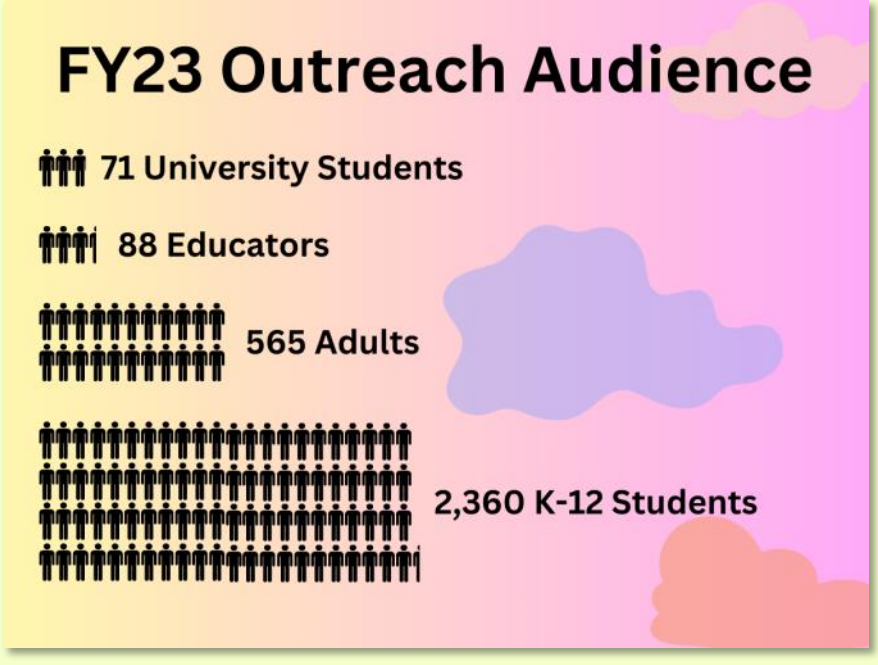
The Division for Air Quality promotes environmental stewardship and public participation through environmental education programs, resources, and community partnerships. FY23 was an especially busy and productive year for air quality outreach in Kentucky. The division's environmental education program provided virtual and in-person outreach to over 3,000 Kentuckians in schools, festivals, teacher workshops and conferences throughout the year. The division employs one full-time environmental education specialist. Other staff assist with outreach during busy times of the year.

Teacher Training

Educators presented several teacher workshops on air quality, climate change, and other environmental topics in partnership with the Kentucky Association for Environmental Education, Division of Water, and the Lexington Fayette Urban County Government's Environmental Academy for teachers.

Indoor Air Quality Education

Division staff receive numerous calls from the public about indoor air quality (IAQ) throughout the year. IAQ is not regulated in Kentucky, but the division provides educational resources to help Kentuckians learn about indoor air contaminants and control measures.



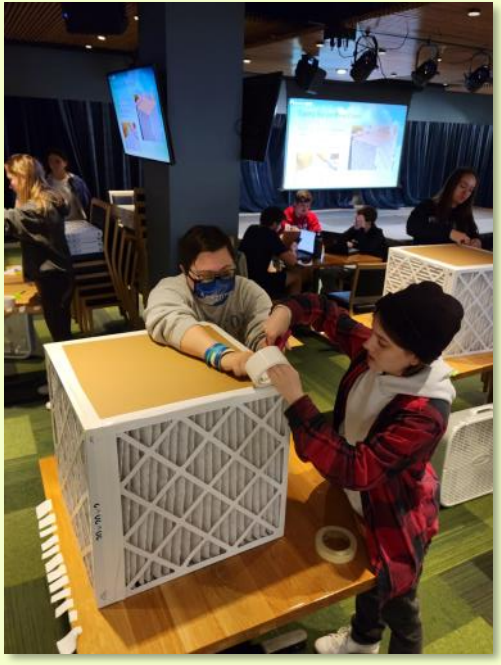
Indoor Air Quality Education (cont'd.)

In the fall of 2022, DAQ's education specialist partnered with a small group of indoor air quality advocates called the Central Kentucky Clean Air Team. The team had collected funds to build and donate indoor air cleaners to area schools, but needed help connecting with schools and providing educational outreach. From October - May, DAQ visited 16 classrooms and led students in the construction of more than three dozen Corsi -Rosenthal box air cleaners. Corsi-Rosenthal boxes have been extensively tested and found to be an affordable, effective method for removing indoor air contaminants such as particulate matter, pollen, and virus-laden aerosols.

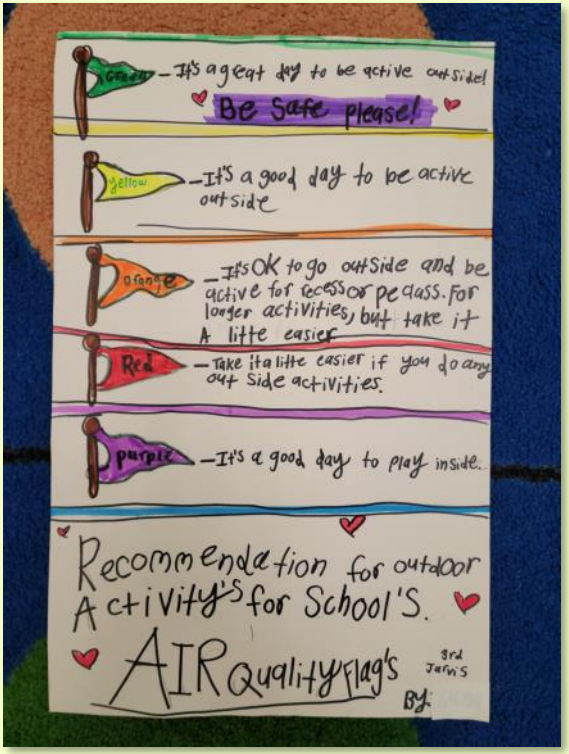
In addition to K-12 outreach, DAQ staff guest-lectured for a University of Kentucky engineering class focusing on indoor air quality, and set up a display at the annual E-Day event sponsored by the U.K. College of Engineering.

In February, DAQ and the Clean Air Team partnered with U.K.'s Center for Student Involvement to hold a Corsi-Rosenthal "Box-a-thon" event. During the event, students built two dozen Corsi-Rosenthal boxes using materials donated by the Clean Air Team. Team members delivered the boxes to area schools after the event.

Staff from DAQ and U.K.'s College of Engineering pose with two Corsi-Rosenthal boxes at UK's E-Day celebration. *Photo: U.K.*



University of Kentucky student volunteers built two dozen DIY air cleaners known as Corsi-Rosenthal boxes, which were donated to area schools. *Photo: Roberta Burnes*



(Above) Students at Cassidy Elementary learned about the air quality index and other topics during several classroom visits with DAQ staff. *Photo: Roberta Burnes*

(Right, below) DAQ educator Roberta Burnes led students at Rise STEM Academy in the construction of several indoor air cleaners for use in their classrooms. *Photos: Kirsten Delamarter*

Kentucky Division for Air Quality

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TEAM KENTUCKY
ENERGY AND ENVIRONMENT CABINET

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