

PENNSYLVANIA AIR QUALITY MONITORING 2004 ANNUAL REPORT



Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Air Quality
Division of Air Quality Monitoring
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DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY**

2004

AMBIENT AIR QUALITY MONITORING REPORT

**DIVISION OF AIR QUALITY MONITORING
400 MARKET STREET
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List of Acronyms Used in this Report

AIRS	Aerometric Information Retrieval System
AQI	Air Quality Index
AQS	Air Quality System
ATSDR	Agency for Toxic Substances and Disease Registry
BAM	Beta-Attenuation Mass (type of continuous PM _{2.5} sampler)
Be	Beryllium
CBD	Central Business District
CO	Carbon Monoxide
COPAMS	Commonwealth of Pennsylvania Air Monitoring System
DEP	Department of Environmental Protection
EPA	Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
HAPs	Hazardous Air Pollutants
H₂S	Hydrogen Sulfide
HF	Hydrogen Fluoride
IRIS	Integrated Risk Information System
Max	Maximum
MM/DD-HH	Month/Day - Hour
NAAQS	National Ambient Air Quality Standard
NARSTO	North American Research Strategy for Tropospheric Ozone
NO	Nitric Oxide
NO₂	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NPAP	National Performance Audit Program
O₃	Ozone
obs	observations
PAMS	Photochemical Assessment Monitoring Station
PAQS	Pennsylvania Air Quality Surveillance System
Pb	Lead
PM_{2.5}	Particulate Matter with aerodynamic diameter less than 2.5 micrometers
PM₁₀	Particulate Matter with aerodynamic diameter less than 10 micrometers
ppb	parts per billion
ppbC	parts per billion Carbon
ppbv	parts per billion volume
ppm	parts per million
PSI	Pollutant Standards Index
PSU	Pennsylvania State University
SO₂	Sulfur Dioxide
TSP	Total Suspended Particulate
TEOM	Tapered Element Oscillating Microbalance (type of PM _{2.5} and PM ₁₀ samplers)
µg/m³	micrograms per cubic meter (unit of flow)
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

The Department of Environmental Protection (DEP) protects the right to clean air for all Pennsylvanians as provided in Article I Section 27 of the Constitution of the Commonwealth of Pennsylvania. DEP's Bureau of Air Quality fulfills this obligation by regulating emissions from thousands of air contamination sources located at facilities such as factories, refineries, landfills, and power plants. Monitoring air quality statewide, assisting companies with compliance, requiring the installation of monitoring equipment, investigating complaints, and taking enforcement action against violators are all part of DEP's powers and duties.

As DEP continues to implement the federal Clean Air Act as Amended in 1990, the study of past and present air quality data will be a crucial component of program planning and air pollution reduction strategies. The data will allow the Department to develop a comprehensive strategy to prevent the emission of certain air contaminants.

Ambient Air Monitoring

The goals of Pennsylvania's ambient air monitoring program are to evaluate compliance with federal and state ambient air quality standards, provide real-time monitoring of air pollution episodes, develop data for trend analysis, support the development and implementation of air quality regulations, and provide information to the public on daily air quality conditions.

DEP monitors air quality in areas having high population density, high levels of expected contaminants, or a combination of both factors. The majority of the monitoring takes place in the 13 air basins of the Commonwealth. Air basins are geographic areas, usually valleys, where air tends to stagnate.

DEP does not generally monitor air quality in Allegheny and Philadelphia counties. Monitoring in these areas is performed by independent county health agencies. An exception exists in Allegheny County, where DEP has an ambient air monitoring site as part of an exhibit at the Carnegie Science Center in Pittsburgh.

Air Quality Index

An Air Quality Index (AQI) is published daily for all sites in Pennsylvania as a means of reporting air quality to the general public. The AQI reports levels of five common air contaminants -- carbon monoxide, sulfur dioxide, particulate matter (PM₁₀), particulate matter (PM_{2.5}), ozone, and nitrogen dioxide. It was developed by the U.S. Environmental Protection Agency (EPA) to standardize air pollution ratings. Real time monitoring and current AQI information is also available on DEP's website at <http://www.depweb.state.pa.us/> (DEP Keyword: Air Quality Index, Air Index).

Quality Assurance Program

DEP's Bureau of Air Quality conducts regularly scheduled performance audits and precision checks on the air monitoring equipment. Quarterly performance audits are conducted to assess data accuracy on carbon monoxide, sulfur dioxide, ozone, total suspended particulate matter (TSP), PM₁₀ suspended particulate matter, PM_{2.5} suspended particulate matter, oxides of nitrogen, nitrogen dioxide, and lead monitoring systems.

Overview of Air Quality Data

Data collected by DEP can generally be divided into two groups: particulate matter and gaseous pollutants. DEP monitors health-based National Ambient Air Quality Standards (NAAQS) as well as several Pennsylvania ambient air quality standards for contaminants such as beryllium and hydrogen sulfide.

Total Suspended Particulate and PM₁₀ and PM_{2.5} Suspended Particulate Matter

Particulate matter is the solid or liquid matter formed by smoke, dust, fly ash, or condensing vapors that can be suspended in the air for long periods of time. Particulate emissions result primarily from industrial processes and fuel

combustion. The smaller particles can be breathed deeply into the lungs where they can aggravate or cause respiratory ailments or carry other pollutants into the lungs.

The federal ambient air quality standard for particulate matter was revised to reflect the adverse health effects of particulate matter less than 10 microns in size (PM₁₀). PM₁₀ measurements have replaced the total suspended particulate (TSP) standard because many of the larger particles measured in TSP do not penetrate the lungs and have little health effect. PM₁₀ measurements appear to represent all of the particulate emissions from transportation sources and most of the emissions in the other traditional categories. Thus, there is no federal or state air quality standard for TSP. In July 1997, EPA revised the standard for particulate matter by adding a standard for fine particulates that are less than 2.5 micrometers in diameter (PM_{2.5}). Although legal challenges to the PM_{2.5} standard had initially left it unenforceable, a March 26, 2002 appellate court decision rejected all challenges and EPA has developed guidance to implement the new standard.

The annual mean composite of all areas of the Commonwealth has demonstrated a 38 percent improvement in TSP levels over the last 10 years. There were no sites in the Commonwealth that exceeded the former annual or 24-hour air quality standard in 2004.

Average PM₁₀ levels have improved 25 percent over the last 10 years. There were no sites in the Commonwealth that exceeded the ambient air quality standards in 2004.

With only six complete years of PM_{2.5} data collected, no trend information is available. Six of the Federal Reference Method (FRM) monitoring sites exceeded the annual air quality standard, and none of the FRM sites exceeded the 24-hour air quality standard in 2004.

Sulfates

The atmosphere contains two types of sulfates: primary and secondary. Primary sulfates are emitted directly into the atmosphere from industrial processes. Secondary sulfates are formed in the atmosphere from other sulfur-containing compounds under mechanisms that involve photochemical processes.

Studies have shown significant correlation between high sulfate levels and illness. Sulfates also reduce visibility and contribute to acid rain. The high level

of sulfates during the summer is due to sulfate formation in sunlight. Sulfates continue to be a problem in Pennsylvania.

There are currently no long- or short-term air quality standards for sulfates.

Lead

Lead is a metal that is highly toxic when ingested or inhaled. It is a suspected carcinogen of the lungs and kidneys and has adverse effects on cardiovascular, nervous and renal systems. Lead is emitted into the atmosphere by industrial processes.

Lead levels in the Commonwealth have met the federal standards for at least the past 10 years. Since lead was removed from gasoline, relatively few improvements now are seen in air basins that have no lead industrial sources.

Nitrates

Nitrates are particulate compounds that form in the atmosphere from the oxidation of nitrogen gases emitted from fuel combustion sources. They represent a significant portion of the finer particulate that can be inhaled into the lungs and which affect visibility.

Levels of nitrates are relatively constant across the Commonwealth. There are no long- or short-term air quality standards for nitrates.

Sulfur Dioxide

Sulfur dioxide is a gaseous pollutant that is emitted primarily by industrial furnaces or power plants burning coal or oil containing sulfur. Health problems caused by high exposures to sulfur dioxide include impairment of breathing and respiratory illnesses. Sulfur dioxide damages trees, plants and agricultural crops and is a precursor to acid rain.

All sites met the air quality standards for sulfur dioxide. In general, sulfur dioxide levels have improved slightly or remained the same over the last 10-year period.

The 2004 averages continue to be below 50 percent of the annual ambient air quality standard.

Ground-Level Ozone

Ground-Level Ozone, or photochemical smog, is not emitted into the atmosphere as ozone, but

rather is formed by reactions of other pollutants. The primary pollutants entering into this reaction -- volatile organic compounds (VOCs) and oxides of nitrogen (NO_x) -- create ozone in the presence of sunlight. Ozone is a strong irritant to the eyes and upper respiratory system and also damages crops.

Ground-Level Ozone levels fluctuate depending on weather conditions. Ozone levels are consistently higher during the summer months, with the ozone monitoring season (April 1 to Oct. 31). Since 1995, daily maximum 1-hour ozone levels have improved so that the majority of counties in Pennsylvania are meeting the air quality standard. The improvements that are seen in ozone concentrations can be attributed in part to controls on VOCs and gasoline volatility. Ozone concentrations (using all monitors in Pennsylvania) did not exceed the 1-hour daily air quality standard in 2004, but the 8-hour daily maximum level of 84 parts per billion (ppb) was exceeded on 14 days during 2004.

Oxides of Nitrogen

Oxides of nitrogen (NO_x) are a class of pollutants formed when fuel is burned at a very high temperature. They are predominately emitted from vehicles. Although there is no air quality standard for NO_x, the level of this pollutant is of concern due to its role in the formation of ground-level ozone and acid rain.

Nitrogen Dioxide

Nitrogen dioxide is a highly toxic, reddish brown gas that is created primarily from fuel combustion in industrial sources and vehicles. It creates an odorous haze that causes eye and sinus irritation, blocks natural sunlight and reduces visibility. It can severely irritate respiratory illnesses. Nitrogen dioxide contributes to the creation of acid rain and adversely impacts forests and other ecosystems.

No sites in Pennsylvania exceeded the annual air quality standard for nitrogen dioxide in 2004. Nitrogen dioxide levels have improved 19 percent on average over the last 10 years.

Carbon Monoxide

Carbon monoxide is a poisonous gas that, when introduced into the bloodstream, inhibits the delivery of oxygen to body tissue. Exposure creates a severe health risk to individuals with cardiovascular disease. The largest man-made source of carbon monoxide is motor vehicle emissions. This pollutant is a health concern in

areas of high traffic density or near industrial sources.

All DEP sites in the Commonwealth have met the federal air quality standards for carbon monoxide for at least the last 10 years. Carbon monoxide levels have seen a long-term improvement of 57 percent from levels in 1995.

For additional information about Pennsylvania's air quality programs, visit the DEP website <http://www.depweb.state.pa.us/> (DEP Keyword: Air, Air Pollution, Air Quality, Clean Air).

Acid Rain

The DEP, under cooperative agreement with the Pennsylvania State University, has maintained the Pennsylvania Atmospheric Deposition Monitoring Network (PADMN) since 1981. The purpose of this program is to determine how much acid rain is falling in Pennsylvania for environmental assessment purposes. Parameters monitored include pH, sulfate, nitrate, ammonium, chloride, calcium, magnesium, potassium, sodium, and specific conductance. Starting in 1997, measurements of the amount of mercury in rain were made as part of the National Atmospheric Deposition Program – Mercury Deposition Network (NADP – MDN).

Eighteen acid rain monitoring sites are currently in operation in Pennsylvania. Included in this network are nine acid rain and six mercury monitoring sites supported by the DEP. The remaining sites are supported by the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) and various other agencies.

The annual Acid Rain Report can be found on the web at the following address: <http://www.depweb.state.pa.us/> (DEP Keyword: Acid Rain)

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INTRODUCTION

The goals of the ambient air monitoring program in Pennsylvania are to determine compliance with federal and state ambient air quality standards, provide real-time monitoring of air pollution episodes, provide data for trend analysis, evaluate regulations and planning, and provide public information daily on air quality.

Three agencies conduct air quality monitoring to evaluate compliance with air quality standards in Pennsylvania: DEP, the Allegheny County Health Department, and the Philadelphia Department of Health Air Management Services.

This report contains summaries of the air quality data collected by DEP's Bureau of Air Quality during the 2004 calendar year. Data from Philadelphia or Allegheny counties can be obtained by contacting those agencies directly. Mailing addresses and telephone numbers for all three agencies are listed in Appendix B.

The monitoring strategy of DEP places monitors in areas having high population density and/or high levels of contaminants. The majority of all monitoring efforts take place in the "air basins" of the Commonwealth. These "air basins" are defined in 25 Pa. Code § 121.1 and consist of the following geographical areas:

- Allegheny County Air Basin
- Allentown - Bethlehem - Easton Air Basin
- Erie Air Basin
- Harrisburg Air Basin
- Johnstown Air Basin
- Lancaster Air Basin
- Lower Beaver Valley Air Basin
- Monongahela Valley Air Basin
- Reading Air Basin
- Scranton, Wilkes-Barre Air Basin
- Southeast Pennsylvania Air Basin
- Upper Beaver Valley Air Basin
- York Air Basin

Air monitoring surveillance is conducted in the 13 air basins. The Allegheny County Health Department conducts the majority of the air quality monitoring in the Allegheny County Air Basin. The Philadelphia Department of Public Health, Air Management Services, which is located in the Southeast Pennsylvania Air Basin, conducts air monitoring only for the Philadelphia County portion

of the air basin. In addition to the aforementioned 13 air basins, DEP conducts surveillance in three non-air basin areas: Altoona, Montoursville, and Farrell. DEP also performs monitoring in Allegheny County at the Carnegie Science Center in Pittsburgh as part of an air quality exhibit.

DEP operates two air monitoring networks in the Commonwealth: the Pennsylvania Air Quality Surveillance System (PAQSS) for high volume particulate sampling and the Commonwealth of Pennsylvania Air Monitoring System (COPAMS) for continuous pollutant sampling.

In July 1997, EPA revised the primary standard for particulate matter by adding standards for fine particulates (particulates less than 2.5 micrometers in diameter – $PM_{2.5}$). The increased resources needed to implement and operate the $PM_{2.5}$ monitors resulted in significant cuts to the PAQSS network. The remaining sites were chosen to support needed lead monitoring. The discrete total suspended particulate network consists of eight monitoring sites. Each site sampled total suspended particulate matter (TSP) on a schedule of once every six days. Selected filters are also analyzed for sulfates, nitrates, and lead. In addition, discrete sampling is also conducted at four sites for suspended particulate matter of 10 microns or less in size (PM_{10}) in 2004. No additional analysis is performed on the PM_{10} sample filters. The 2004 $PM_{2.5}$ monitoring network consists of 24 discrete $PM_{2.5}$ sites along with 10 continuous $PM_{2.5}$ monitoring sites.

The COPAMS network is a totally automatic, microprocessor-controlled system that consists of 51 remote stations throughout the Commonwealth. Dial-up telephone lines used by a central computer system collect the raw data from these remote stations every hour. Each station measures selected parameters such as sulfur dioxide, hydrogen sulfide, ozone, carbon monoxide, nitrogen dioxide, oxides of nitrogen, continuous PM_{10} , continuous $PM_{2.5}$, wind speed, wind direction (vector averaged and sigma theta), ambient temperature, and solar radiation.

The sampling locations for DEP's air monitoring sites and the pollutants monitored at each site are listed in Appendix C.

In addition to the normal air monitoring surveillance conducted by DEP, two cooperative monitoring efforts continued this year. DEP has renewed a cooperative agreement with Pennsylvania State University's (PSU) Department of Plant Pathology to conduct ozone monitoring in five remote areas. The collected ozone data will be used to determine possible effects to forests and crops and assess ozone transport in rural Pennsylvania. The sites are located in the Moshannon State Forest, Clearfield County; Tiadaghton State Forest, Lycoming County; near Gleason, Tioga County; at the Department of Conservation and Natural Resources Penn Nursery, Centre County; and in State College, Centre County.