

Environmental Health

Safe Drinking Water

Passed in 1974, the Safe Drinking Water Act (SDWA) gave the U.S. Environmental Protection Agency (EPA) authority to establish the Public Water System Supervision (PWSS) Program. With amendments to the SDWA passed in 1986, the EPA set national limits on levels of both organic and inorganic drinking water contaminants intended to ensure its safety for human consumption. These limits are known as maximum contaminant levels (MCLs). For some contaminants, EPA established treatment techniques in lieu of MCLs, in order to control unacceptable levels of contaminants in drinking water.

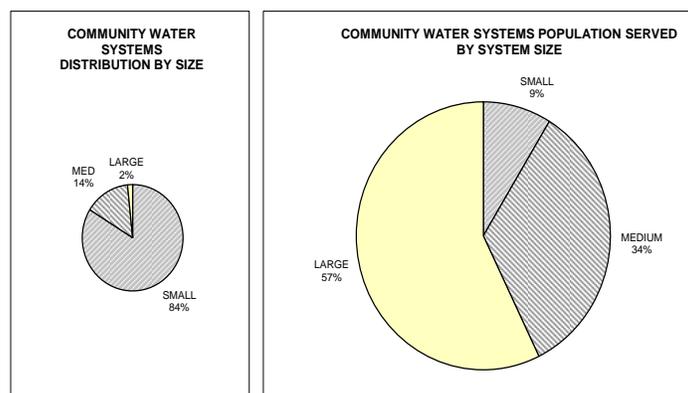
The EPA's regulations also establish how often public water systems must monitor their water for contaminants and report their findings. Generally, water systems that serve a greater number of persons must monitor and report on water quality more often. In addition, the EPA requires public water systems to monitor for unregulated contaminants, to provide data for future regulatory development. Finally, the EPA requires public water systems to notify the public of regulatory violations. The 1996 amendments require the notification to include a clear and understandable explanation of the nature of the violation, its potential adverse health effects, steps that the public water system is undertaking to correct the violation and alternative water supplies during the violation.

In Pennsylvania, drinking water was first regulated in 1905 through the Public Water Supply Law, in response to widespread disease outbreaks that were attributed to microbiological contamination of public water supplies. Approximately 1,200 systems were regulated under the law, and they had to monitor and report on about 20 contaminants for which the U.S. Public Health Service had established drinking water standards. Public water supplies were regulated under this law for nearly 80 years, until 1984 a new wave of disease outbreaks, caused by Giardia in the water system, led to the establishment of better authorities for protecting public health.

The SDWA allows states and territories to seek EPA approval to administer their own PWSS programs. The Pennsylvania Safe Drinking Water Act was signed into law in 1984 and, in 1985, was awarded primacy (approval to self-operate) under the SDWA. The Pennsylvania Department of Environmental Protection (DEP)'s Bureau of Water Standards and Facility Regulation administered the PWSS program in 2011. Under the 1905 Public Water Supply Law, Pennsylvania led the nation in waterborne disease outbreaks, averaging about 8 to 10 each year. Today, DEP regulates nearly 9,300 public water systems serving over 10 million people. Through the improved water quality regulation of the 1984 Act, waterborne disease outbreaks are now a very rare occurrence in the state's public water systems.

Figure 8.1 Pennsylvania Water Systems and Population Served by Size Category, Pennsylvania, 2011¹

	NUMBER OF PWSs			POPULATION SERVED		
	CWS	NTNC	TNC	CWS	NTNC	TNC
SMALL	1,708	1,087	5,898	933,259	389,901	739,049
MEDIUM	296	12	6	3,657,473	68,584	26,100
LARGE	33	0	0	6,137,291	0	0
TOTAL	2,037	1,099	5,904	10,728,023	458,485	765,149



Note: CWS = Community water system; NTNS = Non-transient non-community; TNC = Transient non-community

National and State Goals

The majority of public water systems treat their water, as necessary, to ensure that their customers receive safe drinking water. Contaminants may enter drinking water before, during, or after treatment. Sources of contaminants include:

Before Treatment

- Bacteria, viruses, or protozoa from human or animal sources
- Turbidity in water, caused by suspended matter such as clay, silt and microscopic organisms
- Inadequately treated wastewater, sanitary sewer overflows, leaking sewer lines, malfunctioning septic systems
- Defective storage tanks
- Leaking hazardous landfills, ponds, or pits
- Pesticides, fertilizers, other agricultural run-off
- Run-off from oil-slicked or salt-treated highways
- Underground injection of hazardous wastes
- Underground storage tanks
- Naturally-occurring metals, such as arsenic and cadmium
- Decay products of naturally-occurring radionuclides, such as radon, radium and uranium
- Industrial chemicals, such as solvents

During Treatment

- Treatment malfunction or chemical overfeed
- By-products of disinfectants, such as trihalomethanes and haloacetic acids

After Treatment

- Lead, copper, asbestos and other materials from corroding pipes
- Microbes and sediments entering through leaking pipes or water line breaks
- Improper connections with other systems, or cross-connections with non-potable water
- Permeation of contaminants through certain pipe materials

In addition to these special efforts to improve the microbiological safety of drinking water, the Pennsylvania DEP currently regulates 97 primary contaminants and 15 secondary contaminants, up from about 20 in 1984. Regulations are set for 16 inorganic contaminants, 5 radionuclides, turbidity, 8 microbial contaminants or indicator organisms, 3 disinfectants, 11 disinfection byproducts and 53 organic contaminants. Primary MCLs have been set for 87 contaminants, secondary MCLs have been set for 15 contaminants and 10 contaminants have required treatment techniques.

Healthy People 2020

The U.S. Department of Health and Human Services established two Healthy People 2020 goals related to drinking water: increase of the proportion of persons served by community water systems who receive a supply of drinking water that meets the regulations of the State Drinking Water Act to 91 percent, and reduce waterborne disease outbreaks arising from water intended for drinking among persons served by community water systems to two outbreaks per year.

As of 2008, the national rate of persons who received drinking water in accord with the State Drinking Water Act was 92 percent.² In Pennsylvania, the rate was 95 percent.³ However, there were seven outbreaks of waterborne disease per year across the U.S. between 1999 and 2008.⁴ From 2006 to 2009, Pennsylvania had no outbreaks of waterborne disease, among water processed by a water system.⁵

General Statistics

Data in the federal Safe Drinking Water Information System (SDWIS) may differ from the data in this report, due to reporting differences. The DEP transmits violation data from the Pennsylvania Drinking Water Information System (PADWIS) several times a year; data in PADWIS and SDWIS may not match if data are extracted on different dates.

In the following snapshot of drinking water systems in Pennsylvania, data marked with an asterisk(*) are from June 2012.

- Total population: 12,742,886
- Population served by individual wells: 16 percent
- Population served by Community Water Systems: 84 percent
- Drainage basin used as sources by Public Water Systems: 95 of 104 (Major river basins include the Delaware, Susquehanna, Potomac and Ohio)
- Ground water basins: 478
- Population served by Source Water Protection programs: 78 percent
- CWS ground water sources have had Surface Water Identification Protocol evaluation: 97 percent*
- Confirmed waterborne disease outbreaks in 2011: 4
- On-site assessment (inspections) were performed: 2,103
- Population served by CWSs with surface-water sources or ground water under the direct influence of surface water received filtered water: 99.93 percent*
- Surface water systems that have optimized filtration treatment: 73 percent
- Filter Plant Performance evaluations in 2011: 55
- Population served by CWSs protected by optimized corrosion control: 97 percent*
- Children at day cares and schools with own water supply, protected by optimized corrosion control treatment: 93 percent*
- Population served by CWSs protected from nitrate/nitrite: >99.92 percent*
- Population served by CWSs protected from carcinogenic contaminants: >98 percent*

Intervention Strategies

Waterborne Disease Outbreaks

The DEP is responsible for ensuring that public water systems deliver a safe and reliable water supply to state residents through efficiently operated facilities. Water systems that derive some or all of their drinking water from surface water sources, including Groundwater Under Direct Influence of Surface Water (GUDI), serve more than 8.4 million state residents, as well as millions of visitors to the state. Therefore, state officials have great interest in the potential for waterborne disease associated with surface water.

Between 1971 and 1980, Pennsylvania reported 20 percent of all waterborne disease outbreaks in the U.S., more than any other state. Since 1979, eight documented waterborne outbreaks of giardiasis and one of cryptosporidiosis have occurred in the state, causing illness and costing families, businesses and local and state governments millions of dollars. While the more significant outbreaks occurred in communities that were served unfiltered surface or GUDI-source water, the adoption of PA's mandatory surface water filtration regulation has shifted the focus to filtration facilities that use these waters.

For Pennsylvania residents, the bottom line is that reported waterborne disease incidence has declined sharply. In fact, the state's incidence of waterborne disease outbreaks associated with public drinking water has been at an all-time low. According to the Pennsylvania Department of Health, no waterborne disease outbreaks related to drinking water were reported in the state between 2007 and 2009. During 2010, the Department of Health reported two Legionella outbreaks and in 2011 it reported four such outbreaks, affecting 22 persons, causing 11 hospitalizations and one death. The potable water supply was the probably source of Legionella in all of these cases. (Note that waterborne disease outbreaks related to non-potable water sources such as swimming and bathing facilities are not included in this report.)

Reporting shortfalls: Waterborne disease outbreaks may be underreported. Not all are recognized, investigated and reported to federal agencies. The U.S. Centers for Disease Control and Prevention (CDC) reports incidents, but their documentation is typically a few years out of date, as the agency analyzes and compiles data from all 50 states.

By comparison, information the DEP receives from the state Department of Health is more current. The sensitivity of the disease surveillance system is affected by the following factors: the size of the outbreak, severity of disease caused by the outbreak, public awareness of the outbreak, routine laboratory testing for organisms, requirements for reporting cases of diseases, and resources available to the local health departments for surveillance and investigations of probable outbreaks. The surveillance system probably underreports the true number of outbreaks as a result. The state's disease detection, investigation and reporting system are being improved through cooperative efforts of local public health agencies, DEP and the state Department of Health.

Filtration practices: Reduction in waterborne disease outbreaks in Pennsylvania over the past 22 years is due in part to the state's filtration requirements. When Pennsylvania adopted filtration regulations in March of 1989, 231 public water systems were drawing from unfiltered surface water sources. Over time, most have ultimately filtered or abandoned the sources; the number of surface and GUDI filtration plants has increased from 204 to 356, and only 13 unfiltered surface and GUDI systems remain. The Surface Water Treatment Rule has been revised several times to increase public health protection. Most recently the Long-Term 2 Surface Water Treatment Rule (LT2SWTR) is being implemented to increase the public's protection from disease associated with cryptosporidium and other disease-causing microorganisms in drinking water.

To ensure Pennsylvania's filtration plants provide maximum health protection, the DEP has developed the Filter Plant Performance Evaluation Program (FPPEP), Partnership for Safe Water Program, and the Area Wide Optimization Program. These programs are a cooperative effort to ensure that filtration plant workers optimize the removal of disease-causing organisms at their facilities.

Pesticides in wells: The Pennsylvania Department of Agriculture conducts well water sampling to test for the presence and levels of 57 pesticides registered under the EPA's Insecticide, Fungicide, and Rodenticide Act that may affect ground waters. Since 1993, about 600 wells have been tested; only three have been reported as having pesticide contaminants exceeding the regulation's action level (1/3 of the EPA's MCL or HAL standards). All were associated with point-source contamination. Sample wells have been selected from across the range of state geologic formations, with emphasis on settings of greatest vulnerability and cropping patterns. None of the tested wells associated with agricultural pesticide applications has shown levels of pesticide approaching the action level. Data from resampling of the wells every 10 years has shown a gradual decline in levels of pesticide active ingredients in the groundwater. In 2013, water in one well exceeds regulatory standards; testing of neighboring wells shows the contamination to be isolated.

Lead in drinking water: Water coolers and home plumbing systems have long been identified as primary sources of lead in drinking water. Under the Lead and Copper Rule, the DEP is working with public water systems to reduce lead exposure by setting guidelines for the water that ensure it won't be as corrosive to home plumbing pipes.

Additionally, the DEP oversees the Pennsylvania Plumbing System Lead Ban and Notification Act (Lead Ban Act, 1991) which bans the sale or use of materials not "lead-free" for plumbing systems in the state, sets standards for lead-levels in solder products and clarifies which solders can be used in plumbing, to minimize risk of lead contamination in the water.

Lead Ban surveillance involves locating hardware stores, home centers and other retail facilities in which solder is sold (e.g., electronics, craft and auto parts stores) and educating these facilities, as well as solder wholesalers and manufacturers, of the provisions of the Act. Lead Ban Act surveillance activities are conducted by summer interns; over 15 years of program data show this to be an effective method of educating business owners about the requirements, resulting in a significant reduction in the available of banned solder products, as well as the number of facilities out-of-compliance.

In 2011,

- 230 stores were surveyed; 176 of these sold solder
- 175 of 176 (99 percent) sold lead-free solder
- 139 of 176 (79 percent) sold **only** lead-free solder
- 24 of 176 (13.6 percent) were in violation of the PA Lead Ban Act, 3 by selling banned solder and 21 by selling restricted solder in the plumbing section

Monitoring/Reporting Requirements

All public water systems are required to supply drinking water that meets the primary and secondary MCLs. At a minimum, all must conduct routine monitoring for total coliform bacteria, nitrate and nitrite; if using a surface water source, systems must also monitor for other microbiological contaminants. In addition, Community Water Systems (CWSs) and Nontransient Noncommunity Water Systems (NTNCWSs) must monitor for other chemicals and radiological contaminants.

The DEP may require any public water system to conduct additional monitoring if there is reason to believe the system is not in compliance with the MCLs, Maximum Residual Disinfectant Levels (MRDLs), or Treatment Technique (TT) requirements. In addition to MCL, MRDL and TT violations, the DEP monitors and reports on violations in monitoring and reporting, such as taking fewer samples than required or failing to submit results during a compliance period.

Variations and Exemptions

Variations and exemptions to specific requirements of the Safe Drinking Water Act may be granted under certain circumstances. Occasionally, a public water system cannot meet the MCL due to the characteristics of the raw water sources, and no alternate sources are available. In such cases, the public water system can receive a variance if it has installed and is using the best available technology, treatment techniques or other means that the EPA determines to be available. The state must find that the variance will not result in an unreasonable health risk, and it must prescribe a schedule under which the public water system will come into compliance. No variations or exemptions were in effect for any Pennsylvania public water system in 2011.

Table 8.1 Compliance Action Summary, Pennsylvania, 2011⁶

Action	Number
Compliance notices and NOVs	6,624
Consent and administrative orders	170
Consent assessments	8
Boil water advisories (CWSs)	44
Boil water advisories (non-CWSs)	111
Civil penalties collected	\$330,597.78

Note: Compliance actions in this table are counted only once for each contaminant group for a public water system on a given date.

Consumer Confidence Reports and Public Notifications

Community water systems are required to prepare annual reports to ensure that customers are aware of the quality of the water supplied to them. In addition, public water systems are required to issue public notifications in response to a violation of an MCL, MRDL, or TT requirement; for monitoring/reporting violations; and for other emergency situations. Public notices must contain minimum elements, including a description of the violation, recommendations for actions consumers should take, and information about when the supplier expects to return to compliance. A system can incur a violation for failure to issue a complete notice; 3,226 public notification violations occurred in 2011.

Regulation Development

No new regulations were promulgated in 2011. The DEP continues to provide training, outreach and compliance assistance for the Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR), Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), Groundwater Rule (GWR), and Lead and Copper Short Term Revisions Rule (LCRSTR) regulations.

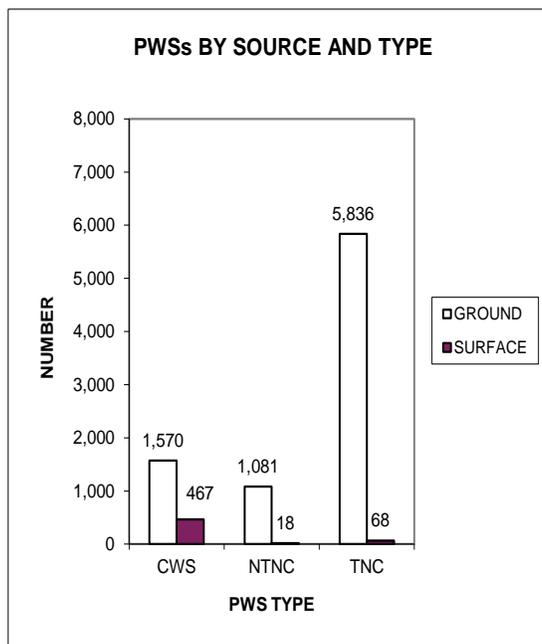
The Unregulated Contaminant Monitoring Rule 1 (UCMR 2) is a direct federal implementation rule that establishes a monitoring program to gather occurrence data on unregulated contaminants. All public water systems serving more than 10,000 persons, as well as a representative sample of those serving fewer than 10,000 persons were required to conduct monitoring for 10 "List 1" contaminants. All PWSs serving more than 100,000 persons, and select PWSs serving

fewer than 100,000 persons, were required to conduct monitoring for 15 “List 2” contaminants. In Pennsylvania, 197 PWSs participated in this surveillance between January 2008 and December 2010.

During 2011, the DEP supported the UCMR 2 program by assisting PWSs with using the national database; communicating the system’s monitoring requirements and schedule; and sending out reminder letters to the three systems that did complete the required monitoring.

Figure 8.2 Public Water Systems by Source and System Type, Pennsylvania, 2011⁷

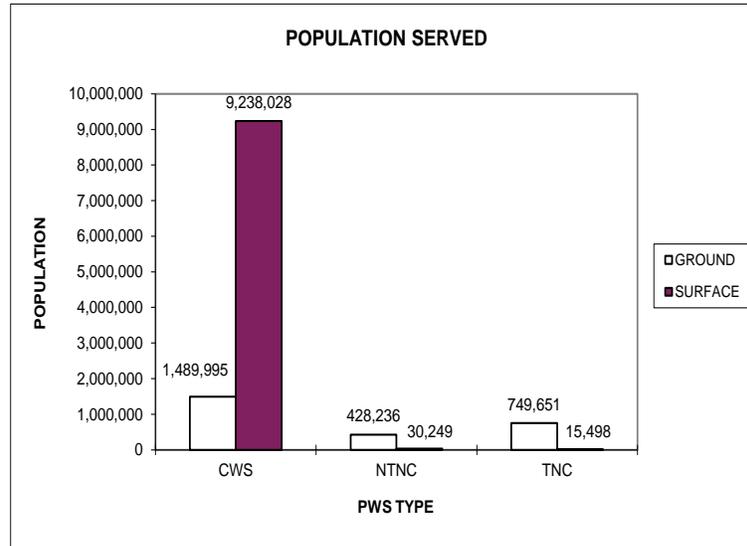
	CWS		NTNC		TNC		TOTAL	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
GROUND	1,570	77.1%	1,081	98.4%	5,836	98.8%	8,487	93.9%
SURFACE	467	22.9%	18	1.6%	68	1.2%	553	6.1%
TOTAL	2,037	100.0%	1,099	100.0%	5,904	100.0%	9,040	100.0%



Note: CWS = Community water system; NTNS = Non-transient non-community; TNC = Transient non-community

Figure 8.3 Public Water Systems, Users by Source Type, Pennsylvania, 2011⁸

	POP SERVED BY SOURCE AND SYSTEM TYPE							
	CWS		NTNC		TNC		TOTAL	
	POPL SERVED	PER CENT	POPL SERVED	PER CENT	POPL SERVED	PER CENT	POPL SERVED	PER CENT
GROUND	1,489,995	13.9%	428,236	93.4%	749,651	98.0%	2,667,882	22.3%
SURFACE	9,238,028	86.1%	30,249	6.6%	15,498	2.0%	9,283,775	77.7%
TOTAL	10,728,023	100.0%	458,485	100.0%	765,149	100.0%	11,951,657	100.0%



Note: CWS = Community water system; NTNS = Non-transient non-community; TNC = Transient non-community

Endnotes

¹ PA Department of Environmental Protection. (2013). *Pennsylvania public water system compliance report for 2011*.

Retrieved from

http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/2011%20Annual%20Compliance%20Report_Final.pdf

² Healthy People 2020. Water Quality, Objective EH-4. Retrieved from

<http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=12>

³ Pennsylvania Department of Health, Bureau of Health Statistics and Research. (2010). *Healthy People 2020, state data set and data sources files, EH-4*. Retrieved from

<http://www.portal.state.pa.us/portal/server.pt?open=512&objID=14136&mode=2>

⁴ Healthy People 2020. Water Quality, Objective EH-5. Retrieved from

<http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=12>

⁵ Pennsylvania Department of Health, Bureau of Health Statistics and Research. (2010). *Healthy People 2020, state data set and data sources files, EH-5*. Retrieved from

<http://www.portal.state.pa.us/portal/server.pt?open=512&objID=14136&mode=2>

⁶ PA Department of Environmental Protection. (2011). *PA public water system compliance report for 2011*.
http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/2011%20Annual%20Compliance%20Report_Final.pdf

⁷ PA Department of Environmental Protection. *PA public water system compliance report for 2011*.
http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/2011%20Annual%20Compliance%20Report_Final.pdf

⁸ PA Department of Environmental Protection. *PA public water system compliance report for 2011*.
http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/DrinkingWaterPortalFiles/2011%20Annual%20Compliance%20Report_Final.pdf

Environmental Pesticide Exposure

In Pennsylvania, the Pittsburgh Poison Center (PPC) and Children’s Hospital of Philadelphia (CHOP) serve as poison centers. In the west and east, respectively, these organizations provide 24-hour information and assistance to residents, support resolution of exposure incidents, and answer general, non-emergency questions about toxic substances in and around the home and workplace. Cases handled by PPC and CHOP are included in the American Association of Poison Control Centers National Poison Data System, the source for data in this report.

This information serves as an indicator of pesticide exposure, but should not be interpreted as a complete picture of pesticide exposure in Pennsylvania. For the data available, this report clarifies exposure by chemical family, pesticide type, age group of exposed person, treatment received and health effects.

Exposure by Type

Data from 2011 show 3,321 reported exposures to pesticide, 772 more cases than the 2,549 reported in 2010. Pesticides can be divided into seven general classifications, as shown in Table 8.2

Table 8.2 Pesticide Exposures by Chemical Classification, Pennsylvania, 2011¹

Chemical Classification	Exposures	Percent (%) of All Exposures
Insecticides	2,139	64.41%
Rodenticides	407	12.26%
Herbicides	274	8.25%
Moth Repellents	147	4.43%
Fungicides	31	0.93%
Fumigants	3	0.9%
Miscellaneous pesticides	320	9.64%

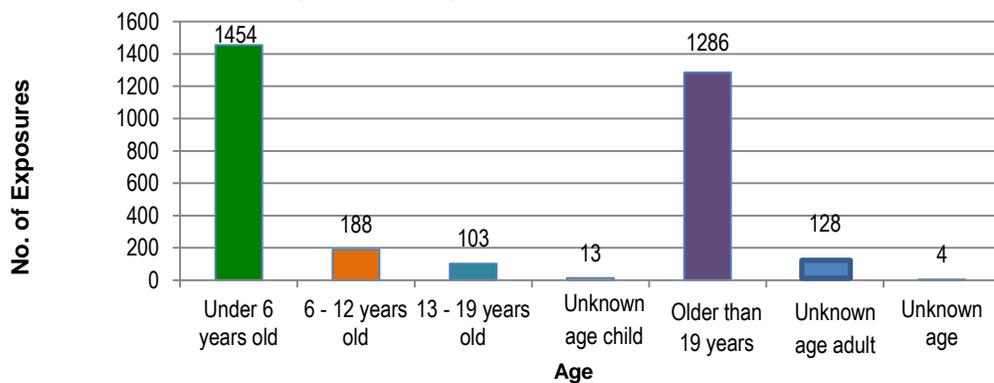
For insecticide exposures, pyrethroids accounted for 899 of the contacts, followed by insect repellents (248), pyrethrins (196), organophosphates (101) and carbamates (89). Pyrethroids are the general insecticides most widely-used by the general public. Long-acting anticoagulant rodenticides were identified in 306 of the 407 cases. Glyphosate tops the herbicide list with 123 reported exposures, followed by chlorophenoxy (57), triazine (19) and diquat (16) formulations, respectively. For moth repellents, 80 unidentified formulations generated calls, followed by 57 Naphthalene moth repellent products. The “miscellaneous” category includes borates and boric acid pesticides (excluding other, non-pesticide uses), with 291 reports accounting for 8.76% of all reported exposures.

Exposure by Age

Data on cases of pesticide exposure involving children are presented in the following age groups: 0 to 5 years, ages 6 to 12 and 13 to 19 years of age. Data for a small subset (13) of children whose ages were unknown is also included. Reports from those over age 19 are considered to be adults; a small subset of adults whose ages were unknown is also included. Intentional (56) and occupational (33) reports are not included in the analysis.

Pesticide exposures involving children younger than 6 years of age were responsible for 46.7 percent of calls received in 2011.

Figure 8.4 Pesticide Exposures by Age, Pennsylvania, 2011²



Exposure by Age and Pesticide Classification

At 57.9 percent of all pesticide contacts, insecticide exposures are the leading type for all age groups. The percentage of calls related to rodenticide exposure among children younger than six years of age is noteworthy, as these exposures are related directly to bait placement and product storage. Persons may have exposure to more than one chemical classification and will be counted more than once in the table below.

Table 8.3 Pesticide Exposures by Age and Pesticide Classification, Pennsylvania, 2011³

Chemical Classification	Under 6 Years	6 to 12 Years	13 to 19 Years	Adult
Insecticides	582	98	74	1,048
Insect repellents	132	50	6	52
Rodenticides	332	13	5	47
Herbicides	63	12	5	160
Moth Repellents	79	7	8	48
Fungicides	8	2	1	16
Fumigants	0	0	0	2
Miscellaneous pesticides	258	6	4	34
TOTAL EXPOSURES	1,454	188	103	1,407

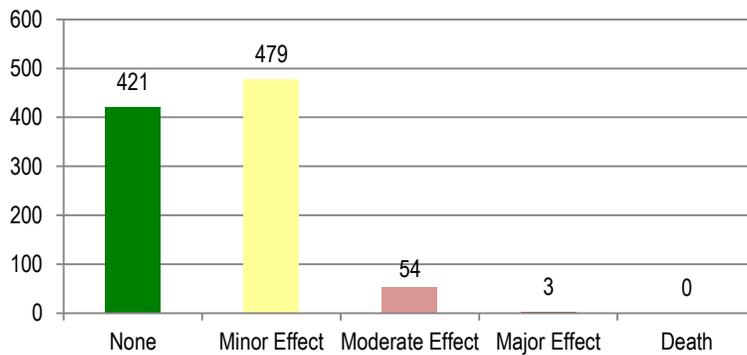
Treatment of Exposure

Data available from the poison control centers indicate the level of health care required for the exposure, ranging from “no treatment required” to “home treatment” to “treatment required at a Health Care Facility (HCF).” In 2011, of the 3,321 calls Pennsylvania centers reported, 63 of affected persons had a reaction but did not seek treatment at a HCF, and 467 were treated at a HCF.

Medical Outcome

Since 71.2 percent of cases (2,364) were determined to be “innocuous in nature,” follow up contacts were not made. Data reported here is based on those cases for which a follow up inquiry was completed. Using the definitions established by the American Association of Poison Control Centers, 44 percent reported the exposure had “no adverse” effect, 50 percent reported a “minor” effect, 5.6 percent reported a “moderate” effect and 0.3 percent reported a “major” effect. No deaths were reported.

Figure 8.5 Medical Outcomes of Pesticide Exposures with Follow Up Calls, Pennsylvania, 2011



Resource

Richards, K., Harvey, J., & Davis, L. (2012). 2011 Pesticide Exposures in Pennsylvania. Retrieved from <http://extension.psu.edu/pesticide-education/applicators/fact-sheets/other-fact-sheets/2011-pesticide-exposures-in-pennsylvania/view>

Endnotes

¹ Richards, K., Harvey, J., and Davis, L. (2012). *2011 Pesticide exposures in Pennsylvania*. Retrieved from <http://extension.psu.edu/pesticide-education/applicators/fact-sheets/other-fact-sheets/2011-pesticide-exposures-in-pennsylvania/view>

² Richards, K., Harvey, J., and Davis, L. (2012). *2011 Pesticide exposures in Pennsylvania*. Retrieved from <http://extension.psu.edu/pesticide-education/applicators/fact-sheets/other-fact-sheets/2011-pesticide-exposures-in-pennsylvania/view>

³ Richards, K., Harvey, J., and Davis, L. (2012). *2011 Pesticide exposures in Pennsylvania*. Retrieved from <http://extension.psu.edu/pesticide-education/applicators/fact-sheets/other-fact-sheets/2011-pesticide-exposures-in-pennsylvania/view>

Air Quality

The right to clean air is set forth in Article I Section 27 of the constitution of the commonwealth of Pennsylvania, and it is protected by the Department of Environmental Protection (DEP). The DEP's Bureau of Air Quality fulfills this obligation by regulating emissions from thousands of sources of air contaminants, including factories, refineries, landfills and power plants. Monitoring air quality statewide, assisting companies with compliance, requiring the installation of monitoring equipment, investigating complaints, enforcing regulations and addressing violations are all part of DEP's responsibilities.

Data are collected from 177 air quality monitors in 63 sites across Pennsylvania. These provide information about the six air pollutants regulated by the U.S. Environmental Protection Agency (EPA): ozone (O₃), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), particulate matter (PM) and lead (Pb). DEP also collects data from two additional air toxics monitoring sites: a mercury vapor monitor in Lancaster and a Photochemical Assessment Monitoring Station (PAMS) in Arendtsville.

National and State Goals

The U.S. EPA has established health-based National Ambient Air Quality Standards (NAAQS) for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter (PM_{2.5} and PM₁₀) and lead. Pennsylvania has adopted and incorporated all of these standards by reference.

Primary standards protect against adverse health effects, while secondary standards protect against effects on environmental welfare, including damage to crops, vegetation and buildings, as well as decreased visibility. These standards are periodically revised; the most current standards are online at <http://www.epa.gov/air/criteria.html>.

Table 8.4 National Ambient Air Quality Standards (NAAQS), 2011¹

Pollutant <i>[final rule cite]</i>	Primary/ Secondary	Averaging Time	Level	Form	
Carbon Monoxide <i>[76 FR 54294, Aug 31, 2011]</i>	Primary	8-hour 1-hour	9 ppm 35 ppm	Not to be exceeded more than once per year	
Lead <i>[73 FR 66964, Nov 12, 2008]</i>	Primary and Secondary	Rolling 3 month average	<u>0.15 µg/m³</u> ^a	Not to be exceeded	
Nitrogen Dioxide <i>[75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]</i>	Primary	1-hour	100 ppb	98th percentile, averaged over 3 years	
	Primary and Secondary	Annual	<u>53 ppb</u> ^b	Annual mean	
Ozone <i>[73 FR 16436, Mar 27, 2008]</i>	Primary and secondary	8-hour	<u>0.075 ppm</u> ^c	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years	
Particle Pollution <i>[71 FR 61144, Oct 17, 2006]</i>	PM_{2.5}	primary and secondary	Annual 24-hour	15 µg/m ³ 35 µg/m ³	annual mean, averaged over 3 years 98th percentile, averaged over 3 years
	PM₁₀	primary and secondary	24-hour	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide <i>[75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]</i>	primary secondary	1-hour 3-hour	<u>75 ppb</u> ^d 0.5 ppm	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years Not to be exceeded more than once per year	

Notes: (a) Final rule signed October 15, 2008; the 1978 lead standard (1.5 µg/m³ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, but areas designated as nonattainment for the 1978 standard have it remain in effect until implementation plans to attain or maintain the 2008 standards are approved; (b) The official level of the annual NO₂ standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard; (c) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1; (d) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO₂ standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Ground-Level Ozone

Pennsylvania's ozone monitoring season runs from April 1 to October 31 each year. Although ground-level ozone levels can fluctuate according to meteorological conditions, they are consistently higher during the summer months, when increased sunlight and warm temperatures amplify ozone formation.

Figure 8.6 shows the fourth highest daily maximum running 8-hour O₃ concentrations, and figure 8.7 shows the second highest daily maximum 1-hour O₃ concentration, by county, for all DEP ozone monitoring sites in 2011. Ten counties within DEP's jurisdiction had a fourth highest daily maximum that exceeded the standard in 2011. No counties contained a site that exceeded the former 1-hour NAAQS. Figures 8.8 and 8.9 show annual trends in those parameters from 2002 through 2011.

Figure 8.6 Fourth-Highest Maximum Daily 8-Hour Ozone Concentrations, DEP-Monitored Counties, Pennsylvania, 2011²

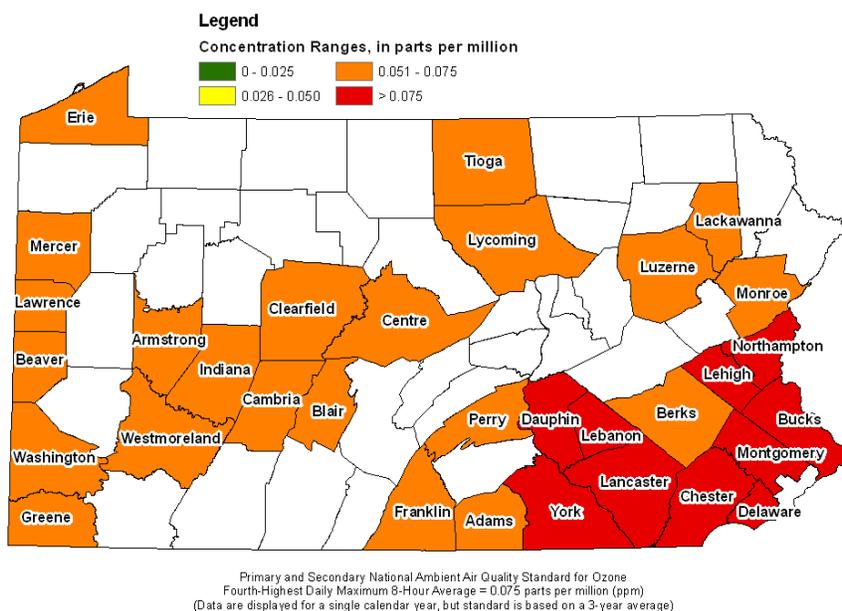


Figure 8.7 Second-Highest Maximum Daily 1-Hour Ozone Concentrations, DEP-Monitored Counties, Pennsylvania, 2011³

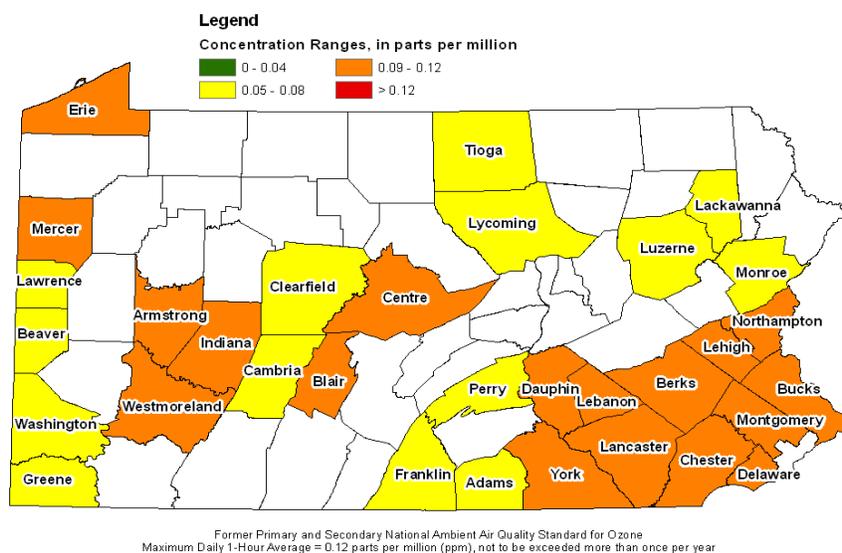
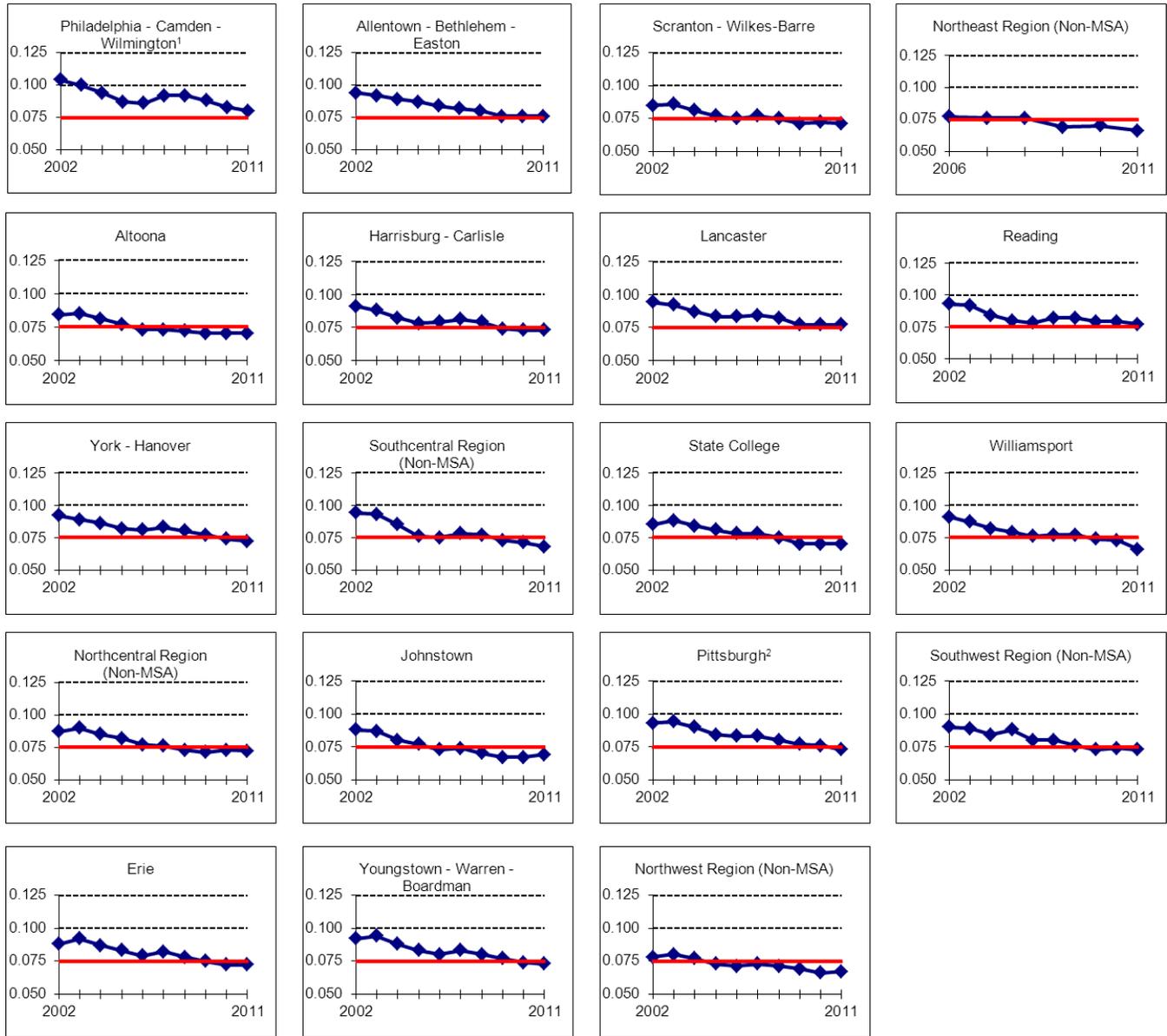
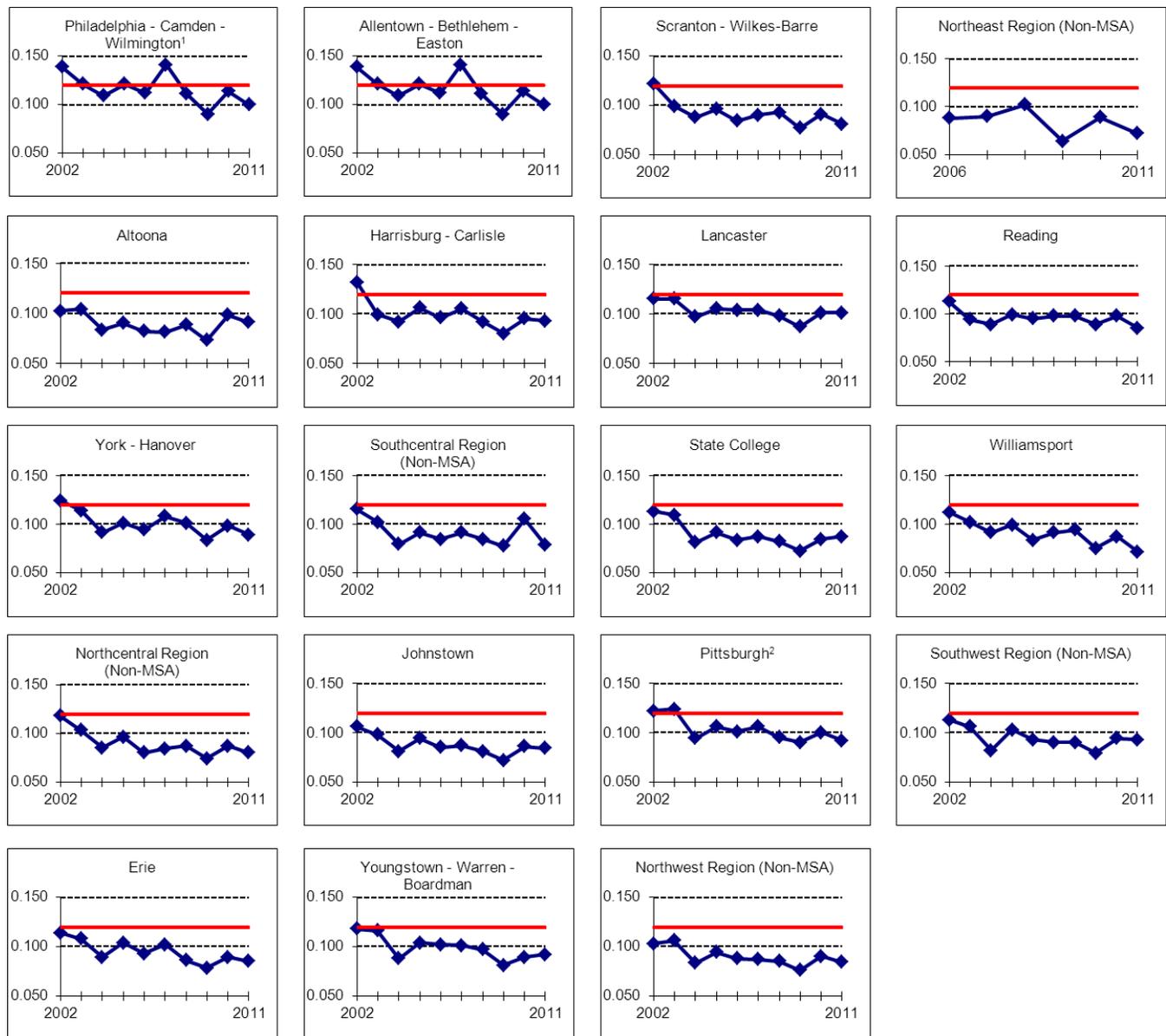


Figure 8.8 Trends in Fourth-Highest Maximum Daily 8-Hour Ozone Concentrations, Averages in Parts Per Million, DEP-Monitored MSA Regions, Pennsylvania, 2011⁴



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

Figure 8.9 Trends in Second-Highest Maximum Daily 1-Hour Ozone Concentrations, Averages in Parts Per Million, DEP-Monitored MSA Regions, Pennsylvania, 2011⁵



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

PM_{2.5} Particulate Matter

Citing current scientific evidence about significant adverse effects of particulate matter on human health, the EPA tightened the primary (human health-based) PM_{2.5} standard on December 18, 2006. The PM_{2.5} national ambient air quality standard (NAAQS) at the 24-hour level was lowered from 65 to 35 micrograms per cubic meter. The PM_{2.5} 24-hour standard is based on the 98th percentile value (the concentration below which 98 percent of 24-hour averages fall) of all 24-hour values over a calendar year. The annual mean standard of 15 micrograms per cubic meter was not adjusted. Secondary (environmental welfare-based) standard levels are identical to the primary standards for PM_{2.5}.

The 2011 PM_{2.5} monitoring network consisted of 26 monitoring sites, including 25 FEM continuous monitors and 11 FRM manual method monitors. In addition, PM_{2.5} samples were collected for constituent analysis from 13 speciation sites.

Figure 8.10 shows the PM_{2.5} annual mean and 24-hour maximum 98th percentile by county for 2011. Although many counties in southeastern and western Pennsylvania contained sites with concentration maximums close to national standard levels, no county registered an annual mean or 98th percentile 24-hour concentration average exceeding the level of the PM_{2.5} NAAQS in 2011. Figures 8.12 and 8.13 show the annual trends of those parameters from 2002 through 2011.

Figure 8.10 Annual Mean Concentrations of PM_{2.5}, DEP-Monitored Counties, Pennsylvania, 2011

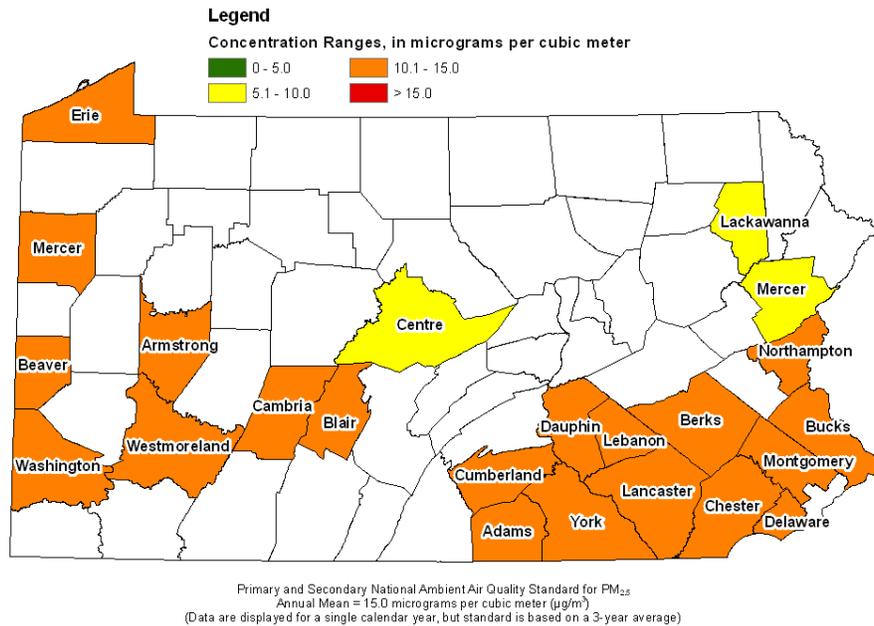


Figure 8.11 98th Percentiles of 24-Hour PM_{2.5} Concentrations, DEP-Monitored Counties, Pennsylvania, 2011

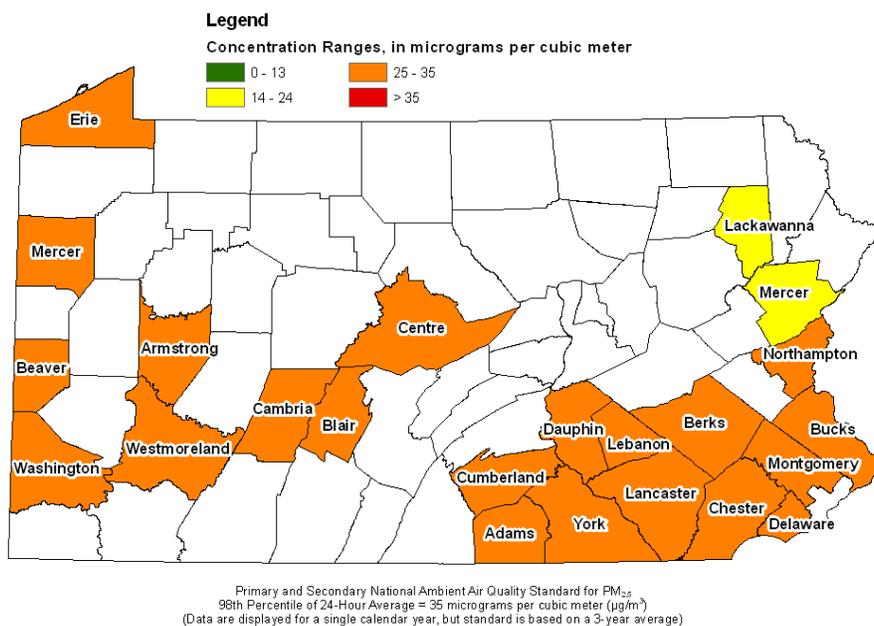
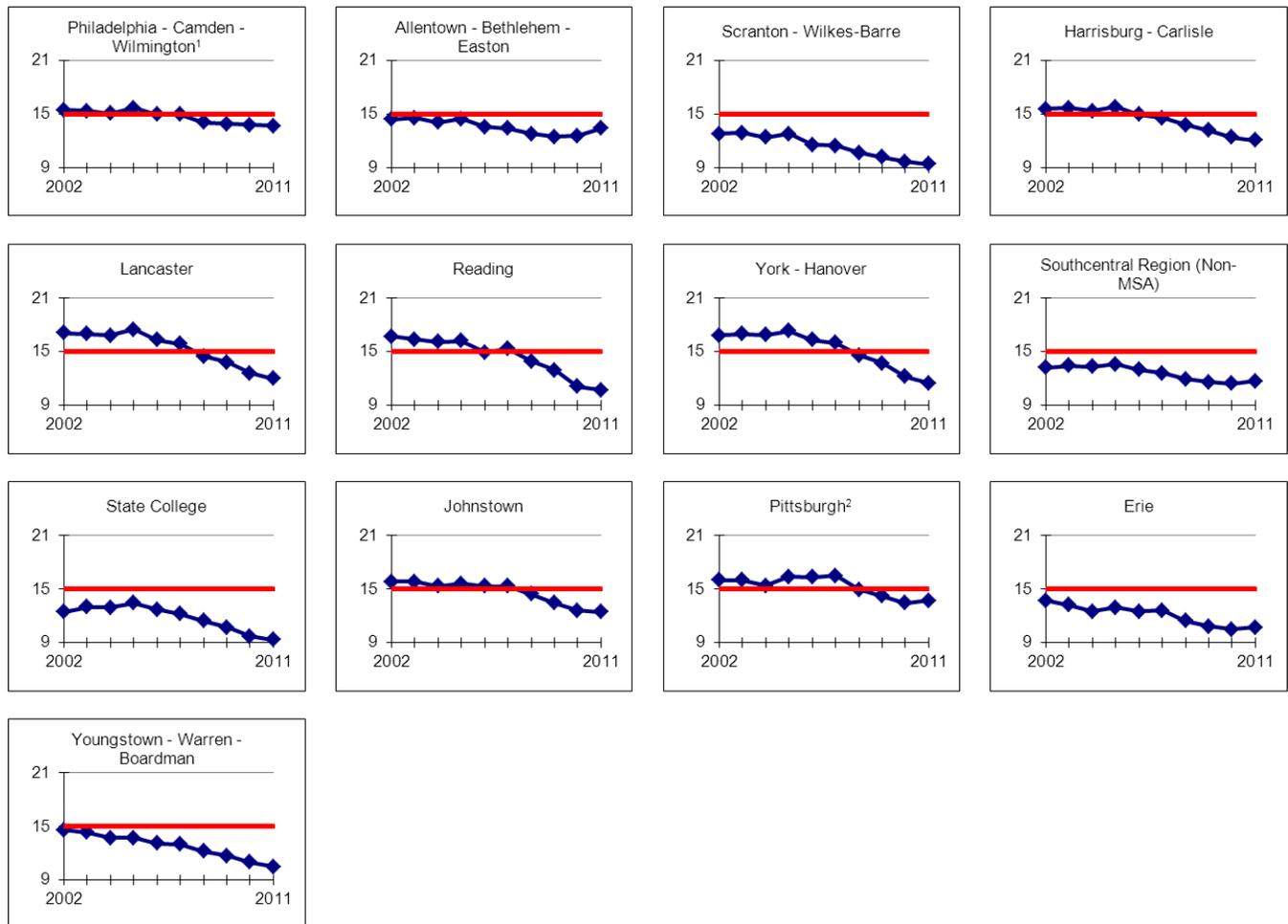
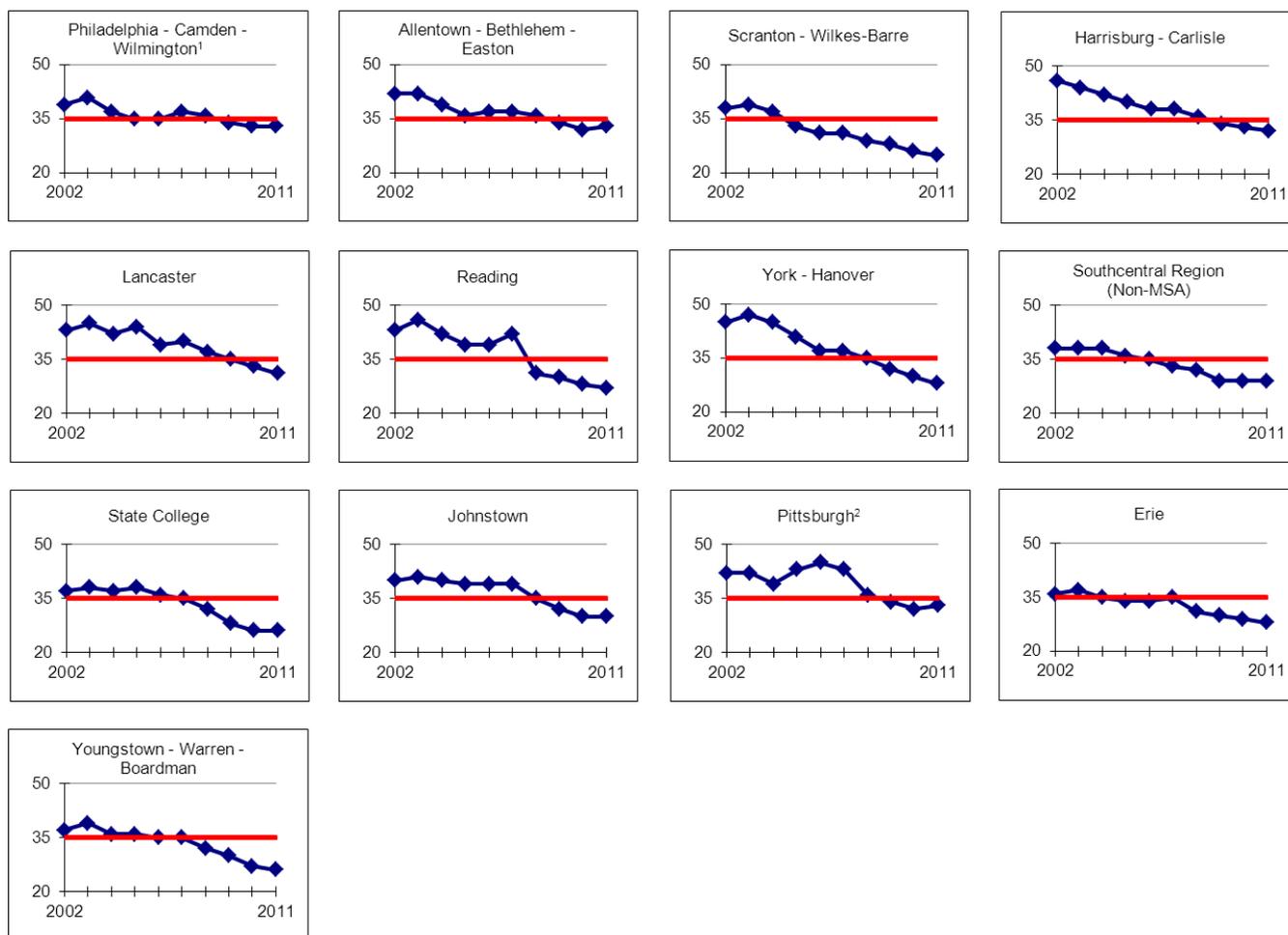


Figure 8.12 Trends in Three-Year Averages of Annual Means for PM_{2.5} Concentrations, DEP-Monitored MSA Regions, Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

Figure 8.13 Trends in Three-Year Averages of 98th Percentile 24-Hour PM_{2.5} Concentrations, DEP-Monitored MSA Regions, Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

PM₁₀ Particulate Matter

On October 17, 2006, the EPA revised the national ambient air quality standard (NAAQS) for particulate matter less than or equal to 10 micrometers in diameter (PM₁₀). Citing the lack of evidence linking health problems and long-term exposure to inhalable coarse particle pollution, EPA revoked the annual PM₁₀ primary (human health-based) and secondary (environmental welfare-based) standard, while implementing a tightened fine particulate (PM_{2.5}) standard. The 24-hour PM₁₀ air quality standard was not changed and remains at 150 micrograms per cubic meter, not to be exceeded more than once per year, as both a primary and secondary standard.

The 2011 DEP PM₁₀ monitoring network consisted of 15 sites. All sites met the NAAQS for PM₁₀ in 2011.

Figure 8.14 shows the second highest daily PM₁₀ 24-hour maximums and annual means, by county in 2011. No monitored county contained sites exceeding the level of the PM₁₀ NAAQS.

Twenty-four-hour average historical trends for individual MSA and non-MSA regions are shown in Figure 8.15. All regions remained under the 24-hour NAAQS for PM₁₀ in 2011.

Figure 8.14 Second-Highest Maximum Daily 24-Hour PM₁₀ Concentrations, DEP-Monitored Counties, Pennsylvania, 2011

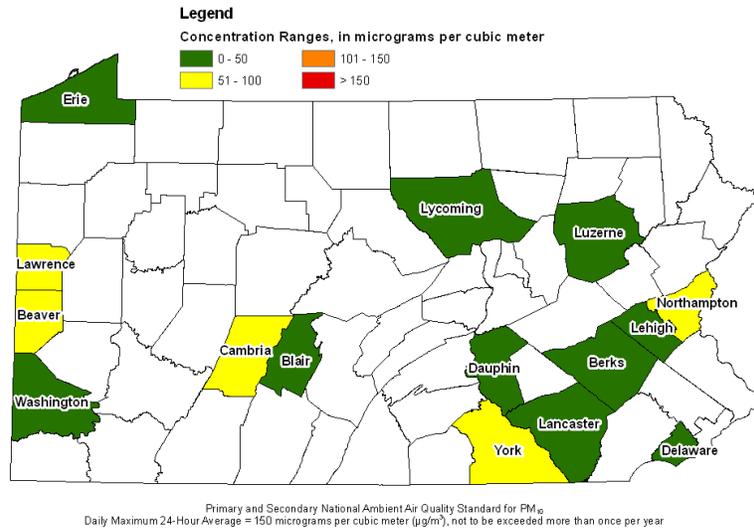
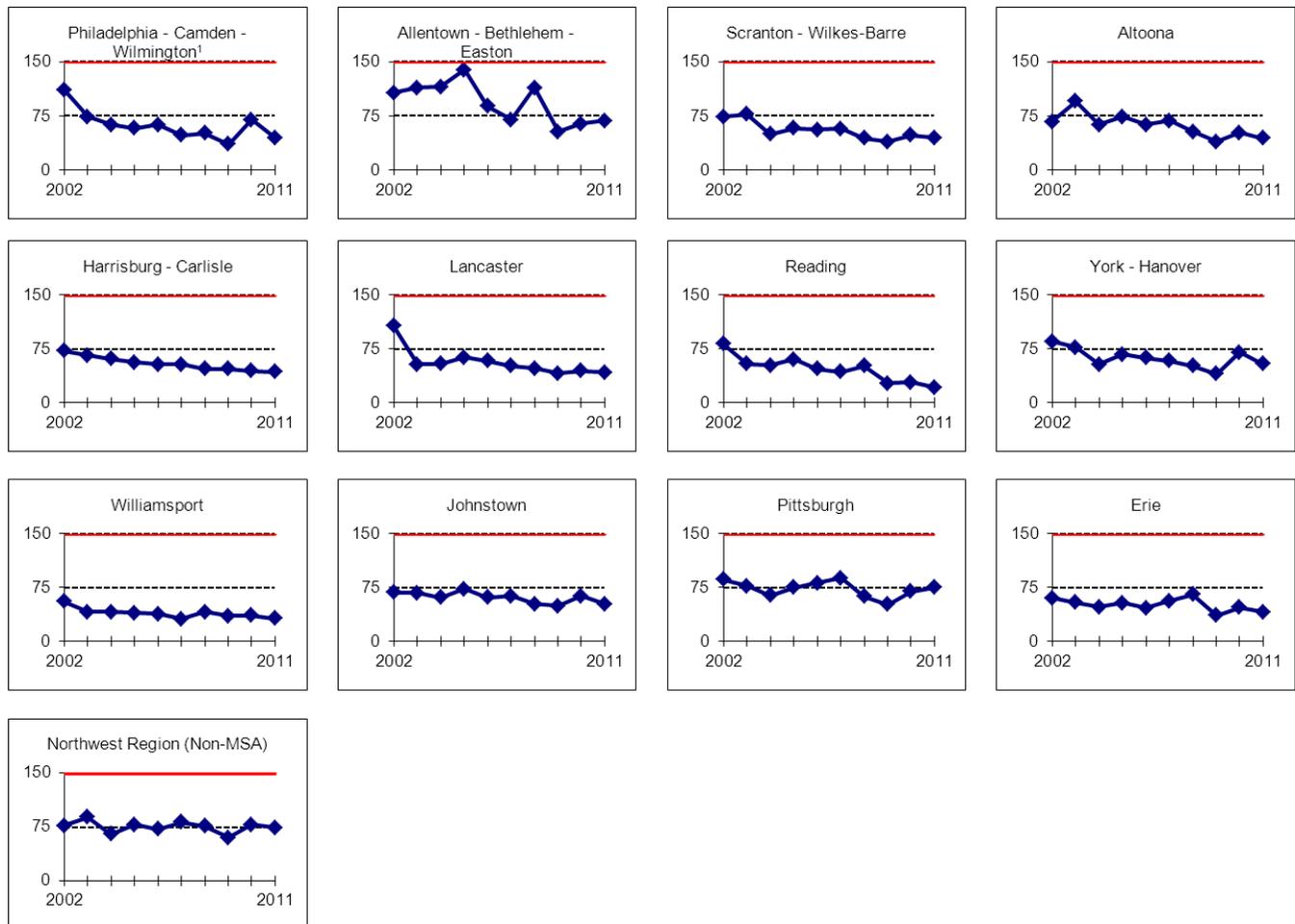


Figure 8.15 Trends in Second-Highest Maximum Daily 24-Hour PM₁₀ Concentrations, MSA Regions, Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

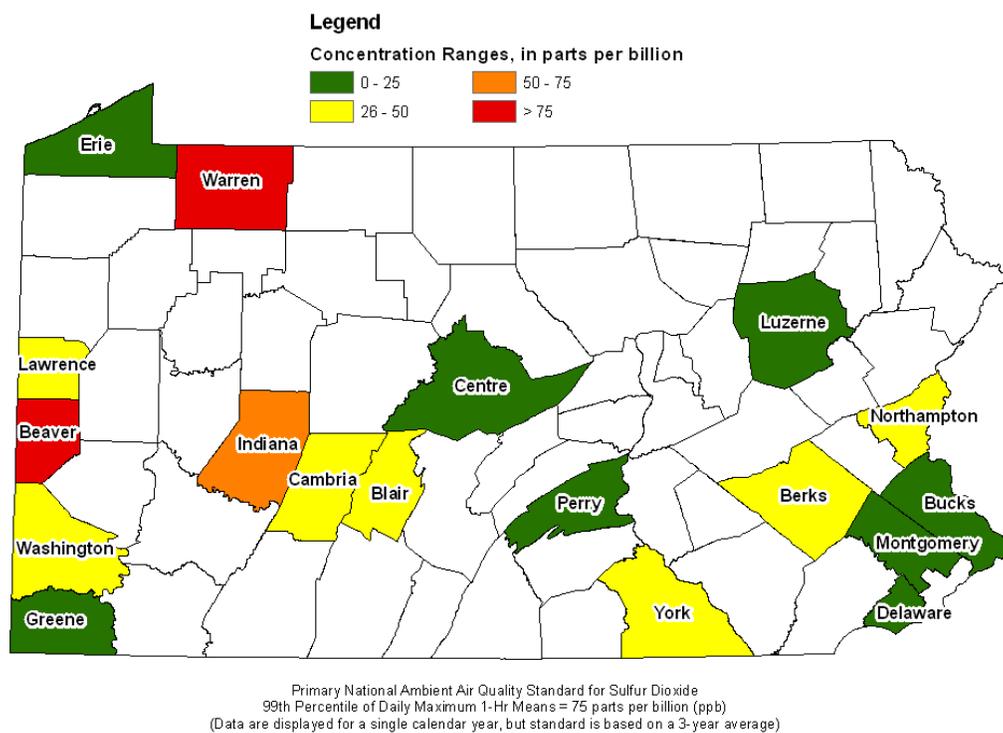
Sulfur Dioxide

Effective August 23, 2010, the EPA strengthened the primary sulfur dioxide (SO₂) standard to improve public health protection from adverse respiratory effects associated with breathing SO₂, such as bronchoconstriction and hospitalization for respiratory illness, particularly for at-risk populations including children, the elderly and people with asthma. After evaluating scientific evidence and finding a stronger link between detrimental health effects and exposure to high short-term SO₂ concentrations (rather than long-term SO₂ exposure), the EPA established a new 1-hour primary NAAQS and revoked the annual and 24-hour primary NAAQS. The secondary standard was not revised at that time, however EPA indicated in the final rule that it will undertake an assessment of the secondary SO₂ standard, jointly with the secondary NO₂ standard, under a separate review.

The current national ambient air quality standards (NAAQS) for SO₂ consist of one primary standard (human health-based) and one secondary standard (environmental welfare-based). The primary standard is a 1-hour average of 75 parts per billion (ppb), based on the 3-year average of 99th percentile values (the concentration below which 99 percent of 1-hour averages fall) of all daily maximum 1-hour values over a calendar year. The secondary standard is 0.5 ppm based on a 3-hour block average. The secondary standard may not be exceeded more than once per year.

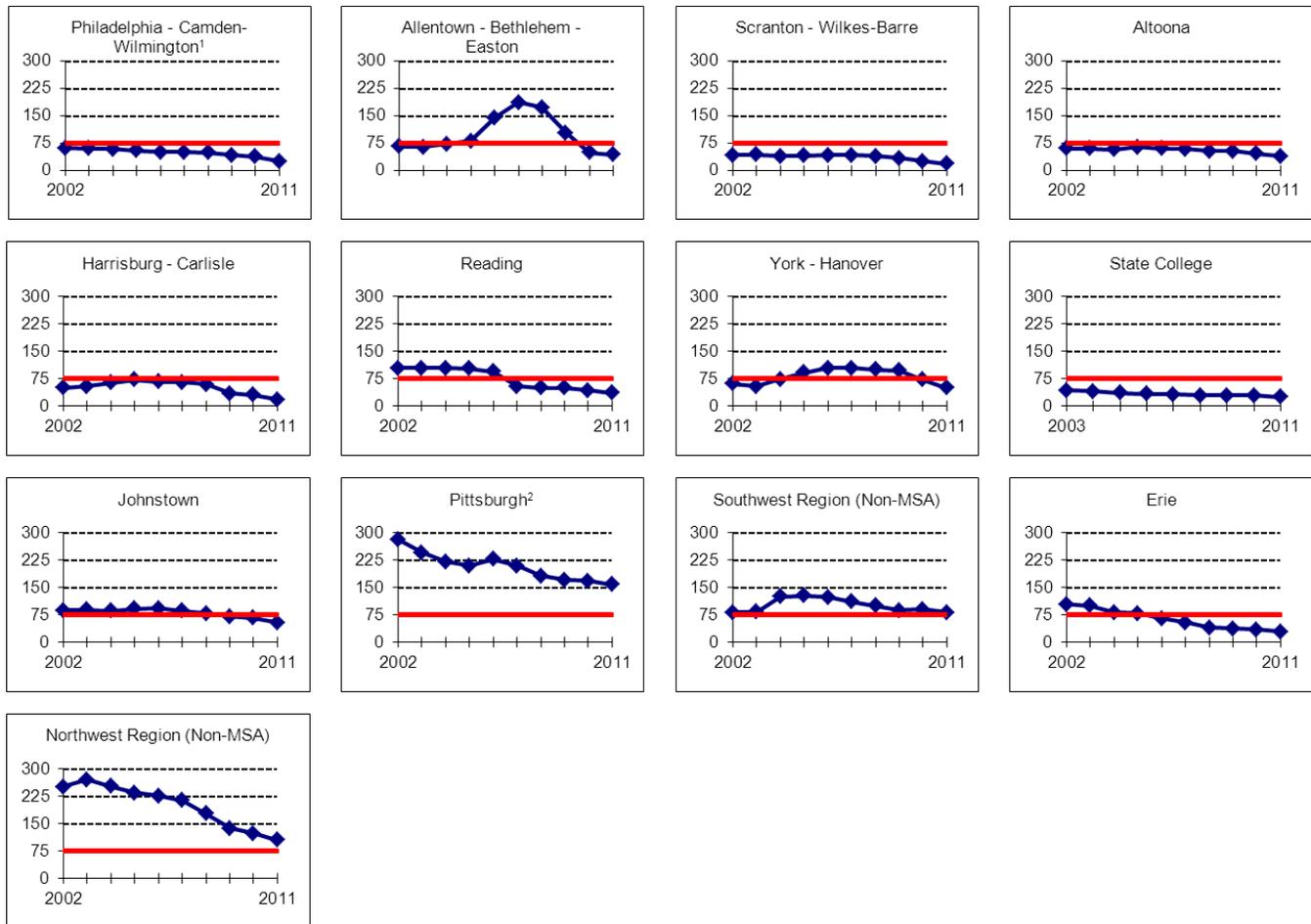
Figure 8.16 shows the 99th percentile daily maximum 1-hour sulfur dioxide concentration in 2011, by county. Two counties, Beaver and Warren, contained sites exceeding the level of the current SO₂ air quality primary standard.

Figure 8.16 99th Percentiles of 1-Hour Sulfur Dioxide Concentrations, DEP-Monitored Counties, Pennsylvania, 2011



Trends for individual MSA and non-MSA regions are shown in Figure 8.17, using three-year averages of 99th percentile daily maximum 1-hour concentrations. Data points above the solid red line represent averages in excess of the annual NAAQS for sulfur dioxide.

Figure 8.17 Trends in Three-Year Averages of 99th Percentile 1-Hour Sulfur Dioxide Concentrations, DEP-Monitored MSA Regions, Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

Nitrogen Dioxide/Oxides of Nitrogen

Effective April 12, 2010, EPA strengthened the primary nitrogen dioxide (NO₂) standard to improve public health protection from adverse respiratory effects associated with breathing NO₂, such as increased asthma symptoms, greater difficulty controlling asthma, and hospitalization for respiratory illness, particularly for sensitive populations including children, the elderly and asthmatics. After evaluating scientific evidence linking detrimental health effects with exposure to high short-term NO₂ concentrations, EPA established a new 1-hour primary NAAQS, while retaining the previous annual primary NAAQS. The secondary standard was not revised, although the EPA indicated in the final rule that it will undertake an assessment of the secondary NO₂ standard, jointly with the secondary SO₂ standard, under a separate review.

The current national ambient air quality standards (NAAQS) for NO₂ consist of two primary standards (human health-based) and one secondary standard (environmental welfare-based). The annual primary standard is 53 parts per billion (ppb), based on an annual mean. The 1-hour primary standard is 100 parts per billion (ppb). The 1-hour primary standard is based on the 3-year average of 98th percentile values (the concentration below which 98 percent of 1-hour averages fall) of all daily maximum 1-hour values over a calendar year. The secondary standard is 0.53 parts per million (ppm) based on an annual mean.

The 2011 DEP nitrogen dioxide (NO₂) monitoring network consisted of 16 sites.

Figure 8.18 shows the annual mean concentrations, and figure 8.19 shows the 98th percentile daily maximum 1-hour nitrogen dioxide concentration in 2011. No county exceeded the level of the current NO₂ air quality primary standards.

Figure 8.18 Annual Mean Concentrations of Nitrogen Dioxide, DEP-Monitored Counties, Pennsylvania, 2011

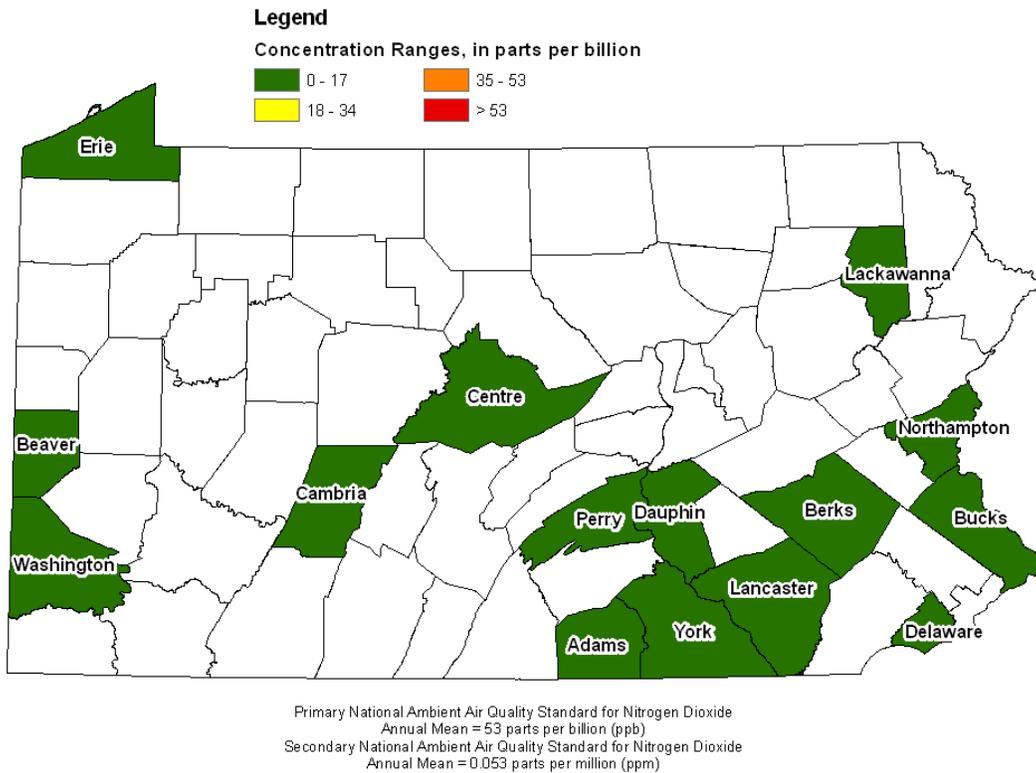
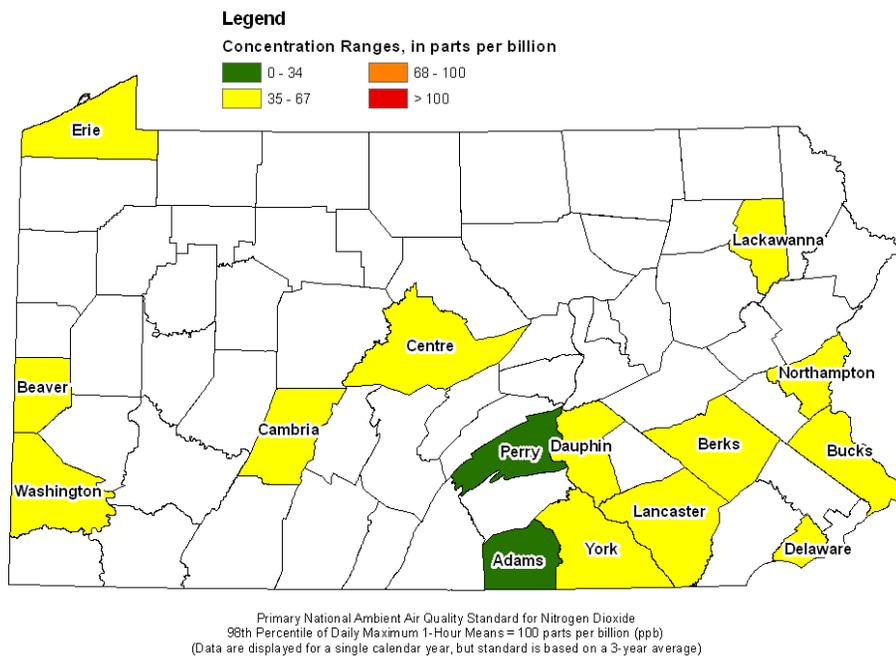
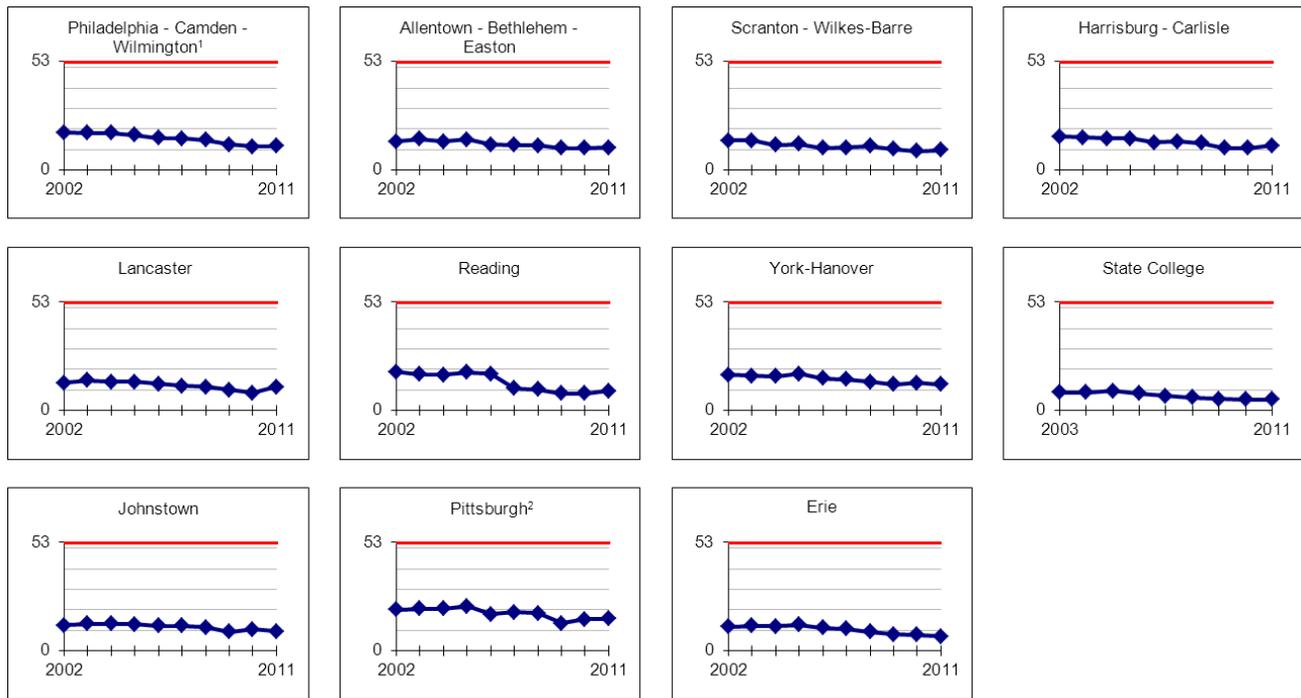


Figure 8.19 98th Percentiles of 1-Hour Nitrogen Dioxide Concentrations, DEP-Monitored Counties, Pennsylvania, 2011



Trends for nitrogen dioxide levels in individual MSAs and non-MSA regions are shown in figure 8.20. All regions remain consistently below the NO₂ NAAQS.

Figure 8.20 Trends in Nitrogen Dioxide Concentrations, DEP-Monitored MSA Regions Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

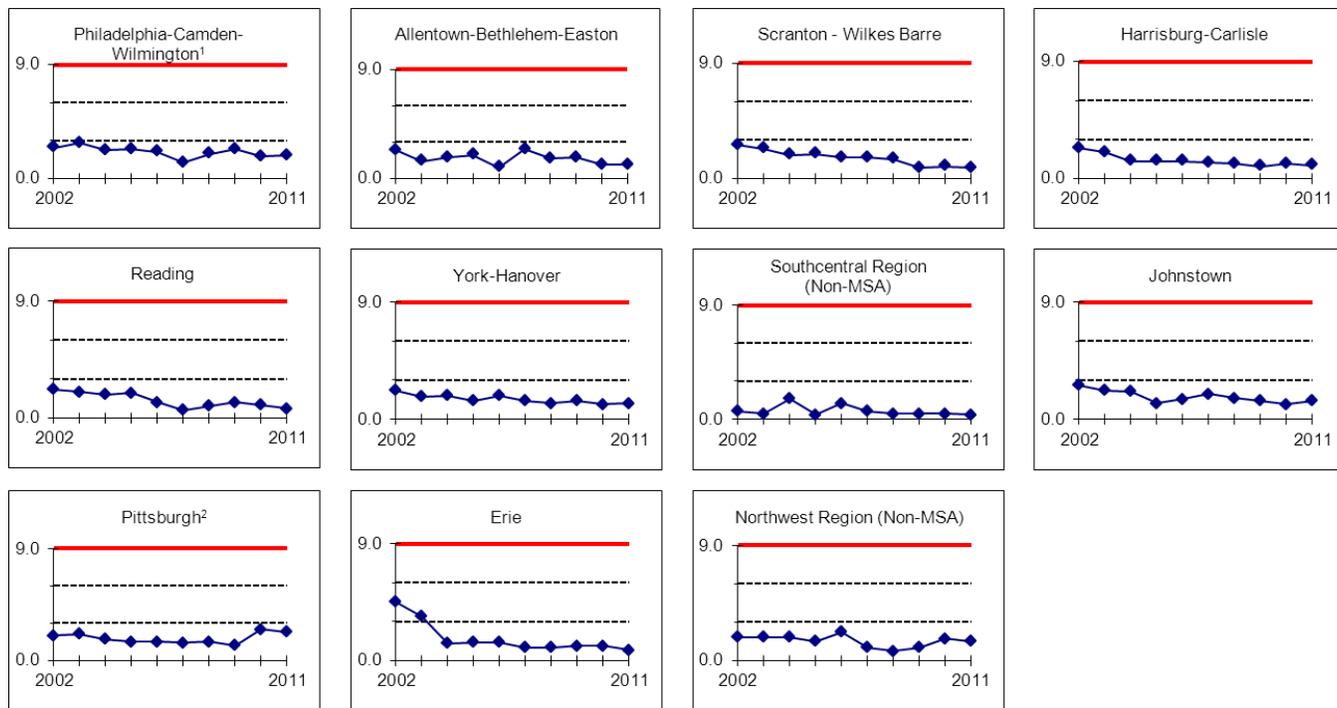
Carbon Monoxide

The national ambient air quality standard (NAAQS) for carbon monoxide (CO) consisted of two primary (human health-based) standards. In September 1985, the EPA revoked the previous secondary (environmental welfare-based) standards, citing studies that showed no effects on environmental welfare could be expected at levels found in ambient air at the time of review. The EPA did not revise the primary standard at that time, and it is 9 parts per million (ppm) based on an 8-hour maximum and 35 ppm based on a 1-hour maximum. To meet the standard, neither criterion may be exceeded more than once per year.

The 2011 DEP monitoring network for CO consisted of 12 sites. Carbon monoxide levels have improved 39 percent since 2002 and have remained well below one-third of the CO NAAQS during the past 10 years.

Annual mean historical trends for carbon monoxide are shown for individual MSA and non-MSA regions in Figure 8.21. Data points above the solid red line represent levels that exceed the annual NAAQS for carbon monoxide. All regions have followed the statewide trend, remaining consistently below the CO NAAQS.

Figure 8.21 Second-Highest Maximum 8-Hour Running Mean, Ten-Year Trends in Carbon Monoxide, DEP-Monitored MSA Regions, Pennsylvania, 2002 to 2011



Note: ¹Excludes monitors in Philadelphia County maintained by Philadelphia Department of Public Health, Air Management Services; ²Excludes monitors in Allegheny County maintained by Allegheny Health Department

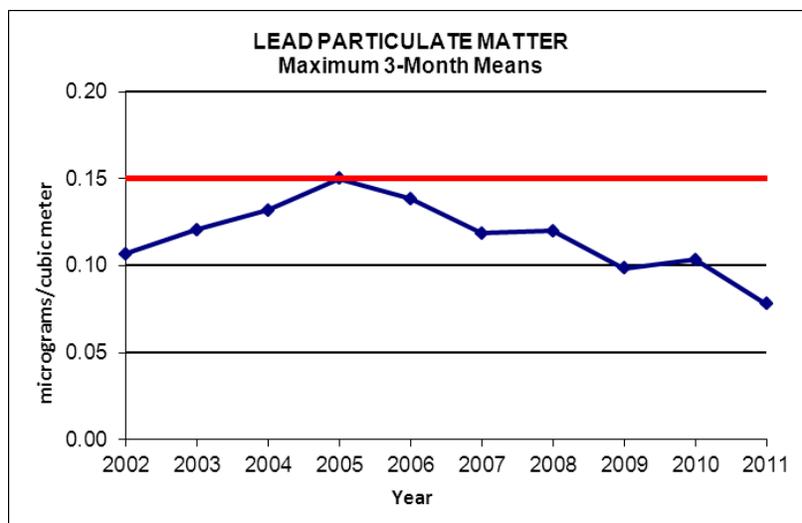
Lead

Effective January 12, 2009, the EPA strengthened the primary lead standard to provide increased protection for children and other at-risk populations against an array of adverse health effects related to lead exposure, including neurological effects in children, especially neurocognitive and neurobehavioral effects. The secondary standard (environmental welfare-based) was set identical to the primary (human health-based) standard. The current primary and secondary national ambient air quality standard (NAAQS) for lead is 0.15 micrograms per cubic meter, based on a maximum 3-month average of 24-hour concentration averages, during a 3-year period. This revision represented a ten-fold strengthening of the lead NAAQS over the previous level of 1.5 micrograms per cubic meter, which had been unchanged since 1978. Lead levels in ambient air concentrations improved dramatically once lead was removed from gasoline in the mid-1970s. Ambient air concentrations of lead remain consistently low, although they can be affected by local influences.

In addition to strengthening the standard, the EPA also revised monitoring requirements. Effective January 1, 2010, monitoring agencies are required to employ a source-based approach in their lead-monitoring practices. The EPA requires air monitoring agencies to conduct lead monitoring sites near lead sources that have or are expected to exceed the NAAQS, as well as near lead sources with lead emissions greater than or equal to one ton or more per year, to measure the maximum concentration.

Figure 8.22 shows the statewide composite average of the maximum 3-month average concentration from 2002 to 2011. Data points above the solid red line represent levels above the 3-month NAAQS for lead. In general, as a statewide average, considering data from both the previous network sites and the sites established in 2010, lead concentration levels decreased 27 percent over the past 10 years.

Figure 8.22 Trend in Maximum 3-Month Average of 24-Hour Mean Lead Concentrations, DEP Monitors Statewide, Pennsylvania, 2002 to 2011



Intervention Strategies

Air Quality Index—The primary tool used by the DEP and numerous other state and local agencies for measuring and reporting on health effects of six primary air pollutants: ozone (O₃), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), suspended particulate matter 10 microns or less in size (PM₁₀) and suspended particulate matter 2.5 microns or less (PM_{2.5}). The AQI is also used widely for public air quality forecasting purposes.

The AQI has been in use since October 1999, when the EPA established it to replace the former Pollutant Standards Index (PSI). The AQI reflects updated health information considered in the 1997 EPA revisions of the air quality standards for ground-level ozone (smog) and fine particulate matter. The revised index ensures consistency between current science on the health effects of air pollutants and means of sharing air quality and health information with the public.

The AQI is used extensively by the DEP; hourly updates are available at <http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/aqi.htm>.

AQI values are calculated based on concentration breakpoints specific to individual criteria for pollutant and sample time. Specifically, the AQI for an area is based on the “critical pollutant,” meaning the pollutant associated with the highest AQI obtained from all monitored pollutants in the area. The AQI scale is divided into categories associated with health messages, as indicated in Table 8.5.

Table 8.5 Air Quality Index (AQI) Scale

	Value	Air Quality
	Green 0 to 50	Good
	Yellow 51 to 100	Moderate
	Orange 101 to 150	Unhealthy for Sensitive Groups elderly persons; children; persons with asthma, other respiratory ailments, or heart conditions
	Red 151 to 200	Unhealthy
	Purple 201 to 300	Very Unhealthy
	Maroon > 300	Hazardous

AQI breakpoints are periodically revised by the EPA to reflect revised NAAQS. For 2011 data, the most recent revisions occurred in July 2011. The pollutant concentration breakpoints for the AQI are shown in Table 8.6.

Table 8.6 Breakpoints for the Air Quality Index

These breakpoints ...							equal these AQIs	
O ₃ 8-hour (ppm)	O ₃ 1-hour ⁽¹⁾ (ppm)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	CO (ppm)	SO ₂ 1-hour (ppm)	NO ₂ 1-hour (ppm)	AQI	Category
0.000-0.059		0.0-15.4	0-54	0.0-4.4	0-0.035	0-0.053	0-50	Good
0.060-0.075		15.5-40.4	55-154	4.5-9.4	0.036-0.075	0.054-0.100	51-100	Moderate
0.076-0.095	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.076-0.185	0.101-0.360	101-150	Unhealthy for Sensitive Groups
0.096-0.115	0.165-0.204	⁽³⁾ 65.5-150.4	255-354	12.5-15.4	⁽⁴⁾ 0.186-0.304	0.361-0.64	151-200	Unhealthy
0.116-0.374	0.205-0.404	⁽³⁾ 150.5-250.4	355-424	15.5-30.4	⁽⁴⁾ 0.305-0.604	0.65-1.24	201-300	Very Unhealthy
⁽²⁾	0.405-0.504	⁽³⁾ 250.5-350.4	425-504	30.5-40.4	⁽⁴⁾ 0.605-0.804	1.25-1.64	301-400	Hazardous
⁽²⁾	0.505-0.604	⁽³⁾ 350.5-500.4	505-604	40.5-50.4	⁽⁴⁾ 0.805-1.004	1.65-2.04	401-500	Hazardous

Note: (1) Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated and the greater of the two values reported. (2) 8-hour ozone values do not define higher AQI values (>300). AQI values of 301 or greater are calculated with 1-hour ozone concentrations. (3) If a different SHL for PM_{2.5} is promulgated, these numbers will change accordingly. (4) 1-hour SO₂ values do not define higher AQI values (>200). AQI values of 201 or greater are calculated with 24-hour SO₂ concentrations.

Resources

Detailed annual reports of air quality are available from the DEP at <http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/aqreport.htm>.

Endnotes

¹ United States Environmental Protection Agency. Retrieved from <http://www.epa.gov/air/criteria.html>.

² Pennsylvania Department of Environmental Protection. Retrieved from http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968

³ Pennsylvania Department of Environmental Protection. Retrieved from http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968

⁴ Pennsylvania Department of Environmental Protection. Retrieved from http://www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968

⁵ Pennsylvania Department of Environmental Protection. Retrieved from <http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/aqi.htm>

Children’s Environmental Health

When health and safety hazards are present in a home, they can profoundly affect the health of the occupants, particularly the most vulnerable of them, such as children and seniors. By eliminating hazards such as mold, pests, lead dust, bare wires and dust mites, a home can be made safer and healthier for its occupants. Some home conditions contribute to the development or exacerbation of asthma (e.g., mold, milder, dust mites, pests and pet dander). When these allergens are reduced or eliminated, thereby reducing asthma triggers, children typically have fewer and milder asthmatic episodes. Other home conditions that can lead to illness or injury are safety hazards, carbon monoxide and radon.

Asthma

In 2010, asthma led to 21,061 inpatient hospitalizations in Pennsylvania, about 16.6 per 10,000 population. The rate for children under five years of age was highest of any age group, with 44.8 per 10,000 population.¹ Asthma triggers such as mold, mildew and dust mites continue to disproportionately affect the most vulnerable populations living in the oldest Pennsylvania housing.

Accidents

In 2008, non-motor vehicle accidents for children aged 14 and younger caused 4,620 non-fatal injuries in Pennsylvania, a rate of 201.7 per 100,000 population.^{2,3}

Lead

Exposure to lead paint and the dust it creates over time can lead to serious health or developmental issues, including loss of IQ, attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD), seizures, coma and even death. Traditionally, interventions have involved providing information to families and children, testing at-risk children, and providing follow-up services and medical treatment. Recent efforts have focused on prevention through addressing hazards in the home.

In 2011, in Pennsylvania, 1,950 children tested for lead were confirmed to have elevated blood lead levels (EBLLs) of 10µg/dL or greater⁴ Between 2008 and 2011, the number of children aged 0 to 6 who were tested for lead increased by 8.7 percent; at the same time, the percent of children with confirmed elevated blood lead levels (EBLLs) of 10µg/dL or greater decreased by 34.9 percent. During that same time period, the geometric mean blood level for children tested in this age group decreased by 13.8 percent.⁵

Figure 8.23 Children < 72 Months of Age Tested for Lead, Pennsylvania, 2008 to 2011⁶

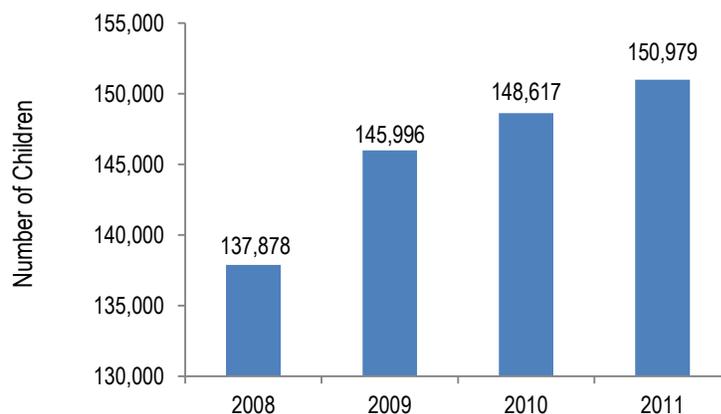


Figure 8.24 Children < 72 Months of Age with Elevated Blood Lead Levels of $\geq 10\mu\text{g}/\text{dL}$, Pennsylvania, 2008 to 2011⁷

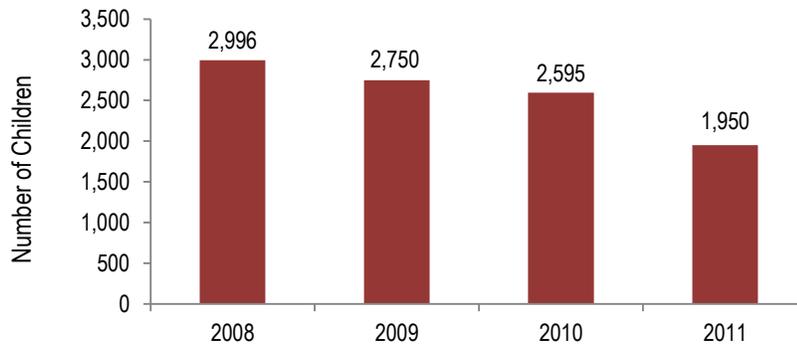


Figure 8.25 Mean Blood Lead Levels of Children < 72 Months of Age Tested for Lead Exposure, Pennsylvania, 2008 to 2011⁸

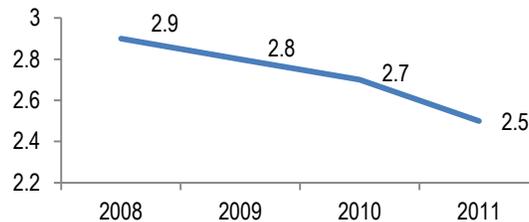
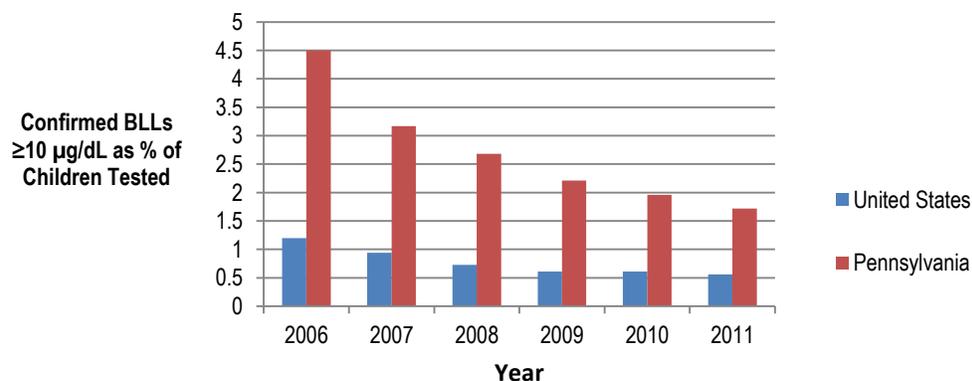


Figure 8.26 Elevated Blood Lead Levels, Children < 72 Months of Age, Pennsylvania and United States, 2006 to 2011⁹



Nationwide, the risk of childhood lead poisoning has decreased over the last ten years, due in large part to the phase-out of lead paint and leaded gasoline, as well as recalls of some products that contain lead.^{10,11}

In 1999, the Centers for Disease Control and Prevention (CDC) reported that 5.0 percent of children younger than 6 years of age who underwent blood testing for lead had blood lead levels of $10\mu\text{g}/\text{dL}$ or greater. By 2011, this figure had dropped to 0.6 percent. Of the 24,258,220 children nationwide who were tested for lead poisoning in 2011, 192,229 had

blood lead levels of ≥ 10 $\mu\text{g}/\text{dL}$.¹² Still, more than 200,000 had blood lead levels ≥ 5 $\mu\text{g}/\text{dL}$; the CDC estimates that “there are approximately half a million U.S. children aged 1 to 5 with BLLs above 5 $\mu\text{g}/\text{dL}$.”

In response to research showing that there is no safe level of lead exposure for children, the CDC in 2012 ceased use of the term “lead level of concern” and lowered its reference level to 5 $\mu\text{g}/\text{dL}$.¹³ Although the agency stated that it hoped the new value would “enable more children to be identified as having been exposed to lead, allowing parents, doctors, public health officials and communities to take action earlier to reduce the child’s future exposure to lead,” the budget for lead prevention was cut from \$29 million to \$2 million nationwide,¹⁴ at the same time.

Lack of available funding inhibits the CDC from implementing suggested lead poisoning prevention activities, and state and local Childhood Lead Poisoning Prevention programs have been defunded.¹²

States with childhood lead poisoning surveillance programs have seen a decrease in childhood lead poisoning between 1997 and 2011. However, childhood lead poisoning continues to be a problem.^{10,11,12} In 2011, Pennsylvania had the highest percent of tested children with blood lead levels ≥ 10 $\mu\text{g}/\text{dL}$, at 1.7 percent.¹⁰

At the same time, more than 25 U.S. states reported 270 or more cases of children younger than 72 months old with blood lead levels ≥ 5 $\mu\text{g}/\text{dL}$. Many states had 5,000 children or more with blood lead levels ≥ 5 $\mu\text{g}/\text{dL}$. Iowa had the highest number of children younger than 72 months old with blood lead levels ≥ 5 $\mu\text{g}/\text{dL}$, at 30,852 cases.

Age and Sex

Lead testing efforts in Pennsylvania have focused on children younger than seven, especially those aged one and two. In 2011, nearly 150,979 children younger than seven, 15 percent of this population, were tested for lead. By comparison, about 25.4 percent of the state’s one and two year olds were tested, about 71,463 children.¹⁵ More than 87 percent of persons tested for lead in Pennsylvania were younger than 16 years old.¹⁶

Race and Ethnicity

Among children younger than seven tested for lead in 2011, 1.3 percent had a confirmed EBLL. Among blacks, the rate was 2.8 percent; among whites, 1.8 percent; and among Asians, 1.2 percent. However, due to difficulties in collecting data on race and ethnicity, more than 50 percent of confirmed EBLL results were reported with a race/ethnicity indicator of “other” or “unknown.”¹⁷ This prevents any meaningful analysis of race data with regard to lead testing.

Income and Education

These statistics are not tracked for lead, but they are tracked for persons who receive Medical Assistance (MA). According to PA-NEDSS data, in 2011, children receiving MA had a confirmed EBLL rate of 1.7 percent. This is roughly twice the rate of those not receiving MA (.8 percent).¹⁸

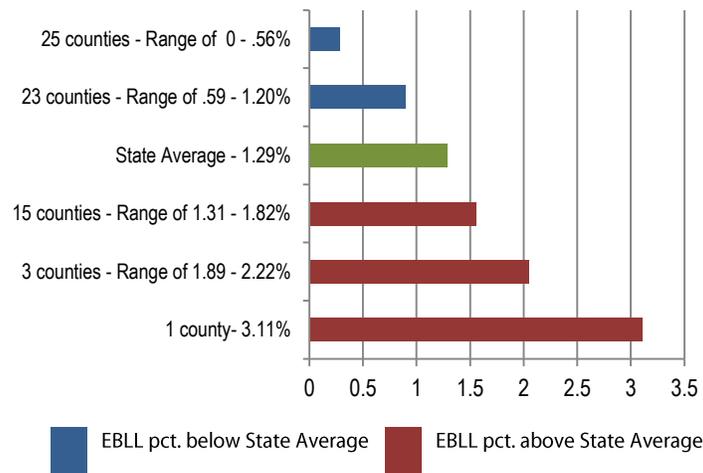
Geographic Variation

In Pennsylvania, confirmed EBLLs for children younger than seven years of age, by county, range from 0 percent (six counties) to 3.1 percent (one county). In all, 19 of Pennsylvania’s 67 counties reported a confirmed EBLL rate above the state figure of 1.3 percent.

Table 8.7 Ranges of Confirmed Elevated Blood Lead Levels Among Children < 7 Years of Age by MSA Regions, Pennsylvania, 2011

Percent (%)	Counties
3.1	Berks
1.9 to 2.2	Lancaster, Warren, Mercer
1.3 to 1.8	York, Philadelphia, Lackawanna, Dauphin, Blair, Lebanon, Cameron, Erie, Schuylkill, Crawford, Northumberland, Cambria, Snyder, Venango, Luzerne
.6 to 1.2	Washington, Adams, McKean, Juniata, Lycoming, Wyoming, Bedford, Montgomery, Allegheny, Armstrong, Huntingdon, Lehigh, Delaware, Westmoreland, Somerset, Butler, Perry, Susquehanna, Chester, Columbia, Northampton, Carbon, Union
0 to .6	Mifflin, Montour, Jefferson, Fulton, Fayette, Clinton, Indiana, Wayne, Beaver, Franklin, Cumberland, Bradford, Potter, Centre, Clearfield, Lawrence, Monroe, Bucks, Tioga, Clarion, Elk, Forest, Greene, Pike, Sullivan

Figure 8.27 Distribution of Confirmed Elevated Blood Lead Levels by County, Pennsylvania, 2011¹⁹



Cost Analysis

High lead levels can cause multiple and irreversible health and developmental problems, including learning disabilities, ADHD, mental retardation, stunted growth, seizures, coma and death. Even low levels of lead exposure can lower a child's IQ, and recent research points to significant neurologic damage at very low levels of exposure.²⁰

Treatment costs—Children with EBLLs can require chelation, follow-up testing, case management and other forms of additional support. In addition, lower IQ can lead to special education services, lower the likelihood of high school and/or college graduation, lower lifetime earnings, and significantly increase the risk of future criminal activity. Some estimates suggest that on a national level, the cost of treating children younger than age six for lead poisoning would be between \$11 billion and \$53 billion. Estimates for the cost of lead paint hazard control for this group are about \$1 billion to \$11 billion. However, as a result of lessened employment prospects, children untreated are estimated to suffer lost lifetime earnings of between \$165 billion and \$233 billion, collectively.²¹

Risk Factors

Housing

Pennsylvania's diverse landscape of rural and urban communities includes some of the oldest housing in the nation; the state ranks fifth in both the percent of homes built before 1950 and the percent of homes built before 1978.²² (Note that to determine the number of homes built before 1978, the decade of homes built between 1970 and 1979 was reduced by 20 percent (representing the two years out of 10, 1978 and 1979 that were not before 1978). Lead paint was not banned until 1978; therefore, many of Pennsylvania's homes hold potentially hazardous sources of lead exposure. When the lead paint in these older homes deteriorates, lead dust is created. Lead absorption is a significant risk, in part due to children's frequent hand-to-mouth activity.

Income

Families with lower incomes tend to live in homes with more structural issues, which can lead to pest infestations, reduced indoor air quality and increased risk of asthma. They also tend to have a greater chance of deteriorating lead paint, increasing the risk for lead poisoning. Children in households with incomes below 200 percent of the federal poverty level are at increased risk of having higher-than-average lead exposures.²³

Intervention Strategies

In recent years, CDC and other federal agencies have been supporting a transition to a Healthy Homes approach in order to increase the cost effectiveness and efficiency of interventions instead of addressing multiple health and safety hazards individually. The Healthy Homes approach identifies and addresses housing hazards comprehensively in order to reduce the risk of housing-related illnesses or injuries, such as asthma, lead poisoning, respiratory infections, trips or falls, and accidental poisoning. Addressing hazards proactively in a holistic manner is less intrusive to families and produces better health outcomes than waiting until after an accident or illness has occurred to intervene. In light of CDC's recommendations that no level of lead exposure has been determined to be safe or harmless, and the effects of lead poisoning appear to be irreversible, the Department of Health is committed to conducting primary prevention of childhood lead poisoning through its Lead Hazard Control and Healthy Homes Programs.²⁴ The Department of Health receives federal funds to conduct lead hazard control and Healthy Homes activities in areas throughout the state. Program services include home risk assessments or inspections to identify lead paint or other health and safety concerns, providing education to families to reduce their risk of exposure, conducting interim controls to make homes lead-safe and providing supplies, materials, or direct remediation to reduce other risks.

Housing codes and regulations can be applied to ensure safe and healthy housing for residents. Although Pennsylvania does not have statewide regulations for lead paint hazards, many cities and municipalities have housing ordinances or property maintenance codes that apply to this concern. Department of Health programs work with regulatory agencies within their jurisdictions to make referrals or enforce regulations that affect health or safety, including peeling or chipping paint, mold or moisture problems, pest infestations, or maintenance issues.

In Pennsylvania, laboratories are mandated to report all blood lead test results to the Department of Health. The Department uses blood lead report data to identify trends in blood lead testing and incidence of elevated blood lead levels. Data is also used to identify areas of the state with higher incidence rates of lead poisoning in order to target program services.

Endnotes

¹ Pennsylvania Department of Health. (2012) *2012 Asthma hospitalization fact sheet*. Retrieved from www.portal.state.pa.us/portal/portal/.../2012_asthma_burden_report_pdf

² Pennsylvania Department of Health, Bureau of Health Promotion and Risk Reduction. (2008) *Injuries in Pennsylvania 2008*, p.68.

- ³ Pennsylvania Health Care Cost Containment Council. (2010) *Inpatient discharge data, 2008*. [Data File]. Retrieved from <http://www.phc4.org/>
- ⁴ Pennsylvania Department of Health. (2010). *2010 Childhood Lead Poisoning Prevention Program (CLPPP) surveillance annual report*, p.7. Unless otherwise cited, the source for lead testing information is Pennsylvania National Electronic Disease Surveillance System (PA NEDSS) as of May 7, 2012. Retrieved from <http://www.health.state.pa.us/lead>
- ⁵ Pennsylvania Department of Health. (2010). *2010 Childhood Lead Poisoning Prevention Program (CLPPP) surveillance annual report*, p.12. Retrieved from <http://www.health.state.pa.us/lead>
- ⁶ Pennsylvania Department of Health. (2012). *Pennsylvania National Electronic Disease Surveillance System. (PA NEDSS)* [Data File]. Retrieved from <https://www.nedss.state.pa.us/nedss/default.aspx>
- ⁷ Pennsylvania Department of Health. (2012). *Pennsylvania National Electronic Disease Surveillance System. (PA NEDSS)* [Data File]. Retrieved from <https://www.nedss.state.pa.us/nedss/default.aspx>
- ⁸ Pennsylvania Department of Health. (2012). *Pennsylvania National Electronic Disease Surveillance System. (PA NEDSS)* [Data File]. Retrieved from <https://www.nedss.state.pa.us/nedss/default.aspx>
- ⁹ Centers for Disease Control's National Surveillance Data. (2012). *Number of children tested and confirmed EBLLS by state, year, and BLL group, children < 72 months old* . Retrieved from <http://www.cdc.gov/nceh/lead/data/StateConfirmedByYear1997-2011.htm>
- ¹⁰ Centers for Disease Control and Prevention. (2012). *All lead recalls*. Retrieved from <http://www.cdc.gov/nceh/lead/Recalls/allhazards.htm>
- ¹¹ Centers for Disease Control and Prevention. (2000). *Eliminating childhood lead poisoning: a federal strategy targeting lead paint hazards*. Retrieved from <http://www.cdc.gov/nceh/lead/about/fedstrategy2000.pdf>
- ¹² Centers for Disease Control and Prevention. (2013). *Number of children tested and confirmed EBLLs by state, year, and BLL group, children < 72 months old*. Retrieved from <http://www.cdc.gov/nceh/lead/data/StateConfirmedByYear1997-2011.htm>
- ¹³ Centers for Disease Control and Prevention. (2013). *Lead: what do parents need to know to protect their children?* Retrieved from http://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm
- ¹⁴ Centers for Disease Control and Prevention. (2013). *CDC response to advisory committee on childhood lead poisoning prevention recommendations in "low level lead exposure harms children: a renewed call of primary prevention"*. Retrieved from http://www.nchh.org/Portals/0/Contents/CDC_Response_Lead_Exposure_Recs.pdf
- ¹⁵ Pennsylvania Department of Health. (2010) *Childhood Lead Poisoning Prevention Program (CLPPP) surveillance annual report*. p 9. Retrieved from <http://www.health.state.pa.us/lead>
- ¹⁶ Pennsylvania Department of Health. (2010) *Childhood Lead Poisoning Prevention Program (CLPPP) surveillance annual report*. p 61. Retrieved from <http://www.health.state.pa.us/lead>
- ¹⁷ Pennsylvania Department of Health. (2010) *Childhood Lead Poisoning Prevention Program (CLPPP) surveillance annual report*. p 3. Retrieved from <http://www.health.state.pa.us/lead>
- ¹⁸ Pennsylvania Department of Health. (2011) *Pennsylvania National Electronic Disease Surveillance System. (PA NEDSS)* [Data File]. Retrieved from <https://www.nedss.state.pa.us/nedss/default.aspx>
- ¹⁹ Pennsylvania Department of Health. (2011). *Pennsylvania National Electronic Disease Surveillance System. (PA NEDSS)* [Data File]. Retrieved from <https://www.nedss.state.pa.us/nedss/default.aspx>
- ²⁰ Gould, Elise. (2009). Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. *Environmental Health Perspectives*, July 2009;116:1162-1164.

²¹ Gould, Elise. (2009). Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. *Environmental Health Perspectives*, July 2009, 1162,1164.

²² U.S. Census Bureau. (2010). *American Community Survey, table B25034*. [Data File]. Retrieved from http://www.census.gov/acs/www/data_documentation/data_main/

²³ Gould, Elise. (2009) Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. *Environmental Health Perspectives*, July 2009, 1162-63.

²⁴ CDC Advisory Committee on Childhood Lead Poisoning Prevention. (2012). *Low level lead exposure harms children: a renewed call for primary prevention*. Retrieved from http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_010412.pdf

Arsenic in Groundwater

Arsenic is an odorless and tasteless semi-metallic, naturally occurring mineral found in the environment. It enters drinking water supplies from natural deposits in the earth, or from agricultural and industrial practices. Sources of contamination include erosion of natural deposits, runoff from orchards and runoff from glass and electronic production wastes.¹ Arsenic combines with inorganic or organic substances to form many different compounds. Inorganic arsenic compounds are found in soils, sediments and groundwater; they also occur as a result of mining, ore smelting. Organic arsenic compounds are found mainly in fish and shellfish. In the past, inorganic forms of arsenic were used in pesticides and paint pigments. They were also used as wood preservatives and in the treatment of a variety of ailments. Today, usage of arsenic-containing pesticides and wood preservatives is restricted. People are most likely to be exposed to inorganic arsenic through drinking water or, to a lesser extent, through various foods. Levels of naturally occurring arsenic vary regionally.²

The concentration of arsenic in natural surface and groundwater is typically about one part in a billion parts of water (1 ppb), but it may exceed 1,000 ppb in contaminated areas or where arsenic levels in soil are high. Groundwater is far more likely than surface water to contain high levels of arsenic. Surveys of U.S. drinking water indicate that about 80 percent of water supplies have less than 2 ppb of arsenic, but 2 percent of supplies exceed 20 ppb of arsenic. In June 2001, the EPA lowered the acceptable limit for arsenic in drinking water from 50 to 10 ppb, based on a 1996 amendment to the Safe Drinking Water Act.³

In Pennsylvania, arsenic is most common in shallow glacial and shale-sandstone type aquifers, particularly those containing pyrite minerals. Arsenic can also result from human activities. Geologic conditions such as fractures and chemical factors of ground water (e.g., low oxygen, extreme pH, salinity) can cause arsenic to leach from rocks, become mobile and contaminate wells distant from the source. Groundwater with arsenic levels elevated to more than four micrograms per liter can be found in scattered locations throughout Pennsylvania.

Eight percent of more than 5,000 wells tested across Pennsylvania contain groundwater with levels of arsenic at or above federal standards for public drinking water. An additional 12 percent also show elevated levels of arsenic, although they do not currently exceed the standards. These findings, along with maps depicting areas in the state most likely to have elevated levels of arsenic in groundwater, are part of a recently released U.S. Geological Survey (USGS) study, conducted in cooperation with the Pennsylvania Departments of Health and Environmental Protection.

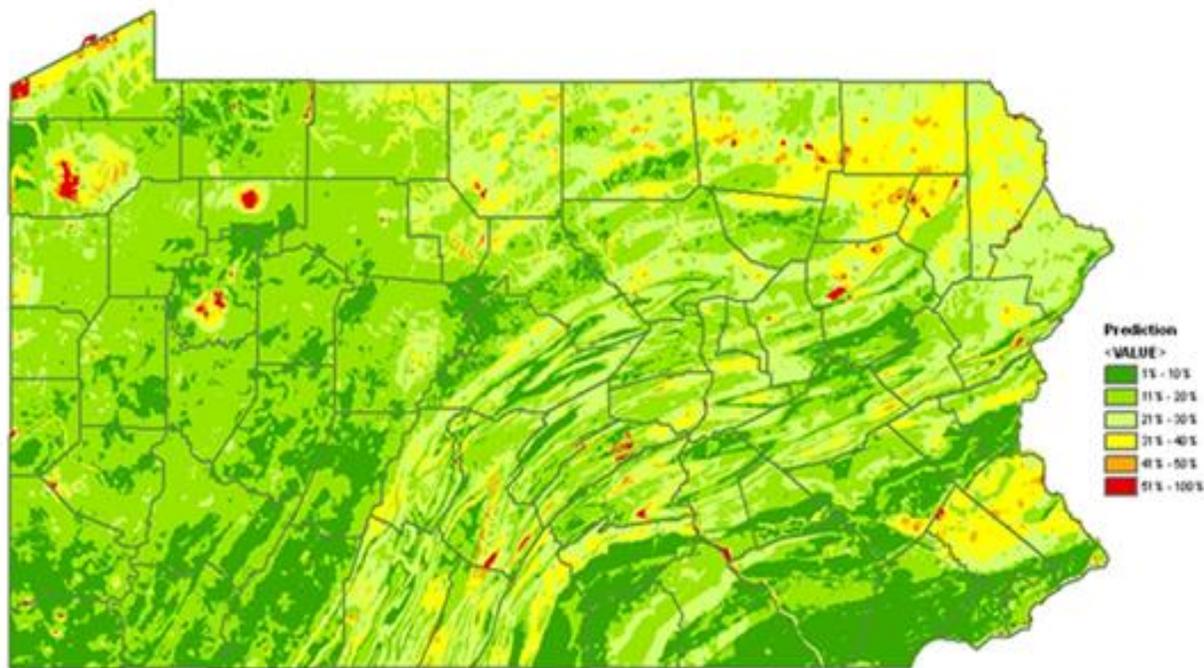
The results of this study highlight the importance of testing and treating private well water. While public water supplies are treated to ensure that water reaching the taps of households meets federal drinking water standards, private wells are unregulated in Pennsylvania, and owners are responsible for testing and treating their own water.

USGS scientists in Pennsylvania compiled data collected between 1969 and 2007 from industrial, public and private wells. Arsenic levels, along with other groundwater quality and environmental factors were used to generate regional and statewide maps that predict the probability of elevated arsenic. The study examined groundwater from carbonate, crystalline and shale/sandstone bedrock aquifers and shallow glacial sediment aquifers. Similar maps have been produced for other states. The Pennsylvania Department of Health plans to use the maps as an educational tool to inform health professionals of the possibility of elevated arsenic in drinking water wells and to help improve the health of residents, particularly in rural communities.

Arsenic in drinking water has been linked to several types of cancer, reproductive problems, diabetes, weakened immune system and developmental delays in children. Chronic consumption of water contaminated with arsenic can cause non-cancer effects, including thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhea, numbness in hands and feet, partial paralysis and blindness.⁴ Measurement of arsenic in urine is the most reliable means of detecting arsenic exposures experienced within the last several days.⁵

Arsenic levels can be reduced or eliminated in tap water through treatment. Private well owners can find testing and other information on the Pennsylvania Department of Environmental Protection Arsenic in Drinking Water website.

Figure 8.28 Arsenic Probability Map, Pennsylvania⁶



Resources

Water Technology—<http://www.watertechnonline.com/articles/166443-tests-of-over-5000-private-wells-in-pa-show-high-levels-of-arsenic-in-groundwater>

Endnotes

¹ US Environmental Protection Agency. (2013). *Arsenic in drinking water*. Retrieved from <http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm>

² US Centers for Disease Control and Prevention. *Factsheet – arsenic*. Retrieved from http://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

³ Agency for Toxic Substances & Disease Registry, Section 1.3. Retrieved from <http://www.atsdr.cdc.gov/phs/phs.asp?id=18&tid=3>

⁴ US Environmental Protection Agency. (2013). *Arsenic in drinking water*. Retrieved from <http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm>

⁵ Agency for Toxic Substances & Disease Registry, Section 1.8. Retrieved from <http://www.atsdr.cdc.gov/phs/phs.asp?id=18&tid=3>

⁶ U.S. Geological Survey. (2013). Retrieved from <http://pubs.usgs.gov/sir/2012/5257/>