2017 Carbon Monoxide Summary

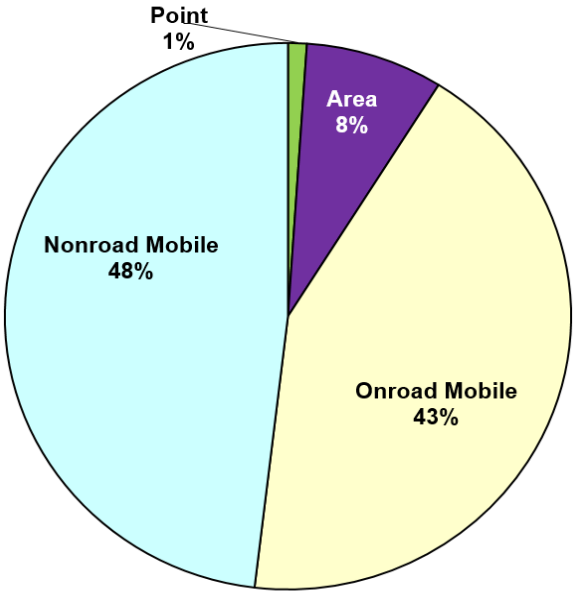
New Jersey Department of Environmental Protection

SOURCES

Carbon monoxide (CO) is a colorless, odorless gas formed when carbon in fuels is not burned completely. The main source of outdoor CO is exhaust from internal combustion engines, primarily on-road vehicles, as well as non-road vehicles, generators, construction equipment, boats and other types of mobile sources. 50% of all CO emissions nationwide are attributable to mobile sources, and over 90% in New Jersey. Significant amounts of CO are also emitted from fuel combustion in boilers and incinerators, natural sources such as forest fires, and various industrial processes. A pie chart estimating the contribution of different categories of CO sources in New Jersey in 2017 is shown in Figure 8-1.

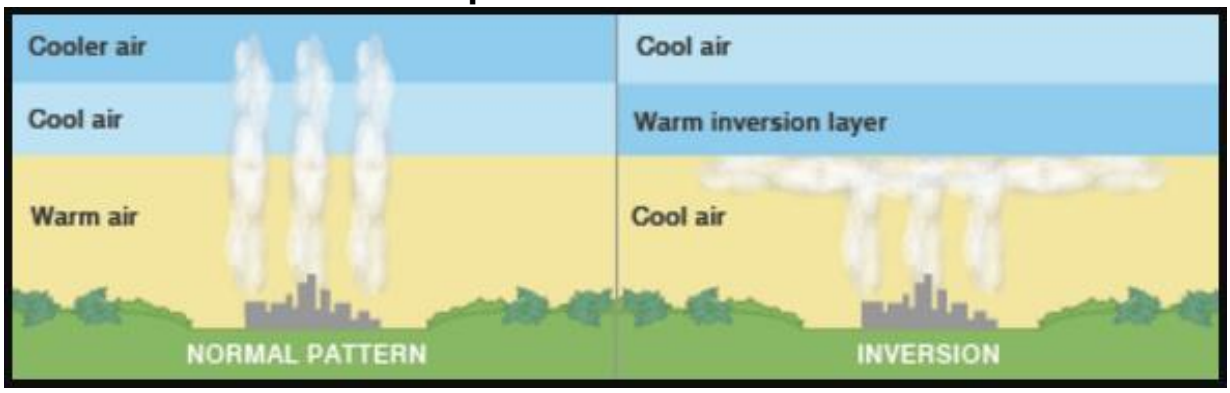
Outdoor concentrations of CO can rise during atmospheric inversions. This phenomenon occurs when cooler air is trapped beneath a layer of warmer air, which often occurs overnight. The inversion acts like a lid, preventing pollution from mixing in the atmosphere and effectively trapping it close to the ground (see Figure 8-2). This can allow CO to accumulate at ground-level.

Figure 8-1
2017 New Jersey 2017 Carbon Monoxide Projected Emissions



Inventory Source: MARAMA 2017 BETA2

Figure 8-2
Effect of Atmospheric Inversion on Pollution Levels



https://kisialevelgeography.files.wordpress.com/2014/06/44875197_thermal_inversion466x135.gif

Figure 8-3 shows that CO concentrations are slightly higher in the winter, probably because inversions are more frequent during the winter months. Also, high CO levels often coincide with morning and afternoon rush hours. This diurnal variation is displayed in Figure 8-4.

Figure 8-3
2017 Carbon Monoxide Concentrations in New Jersey
Monthly Variation
Parts per Million (ppm)

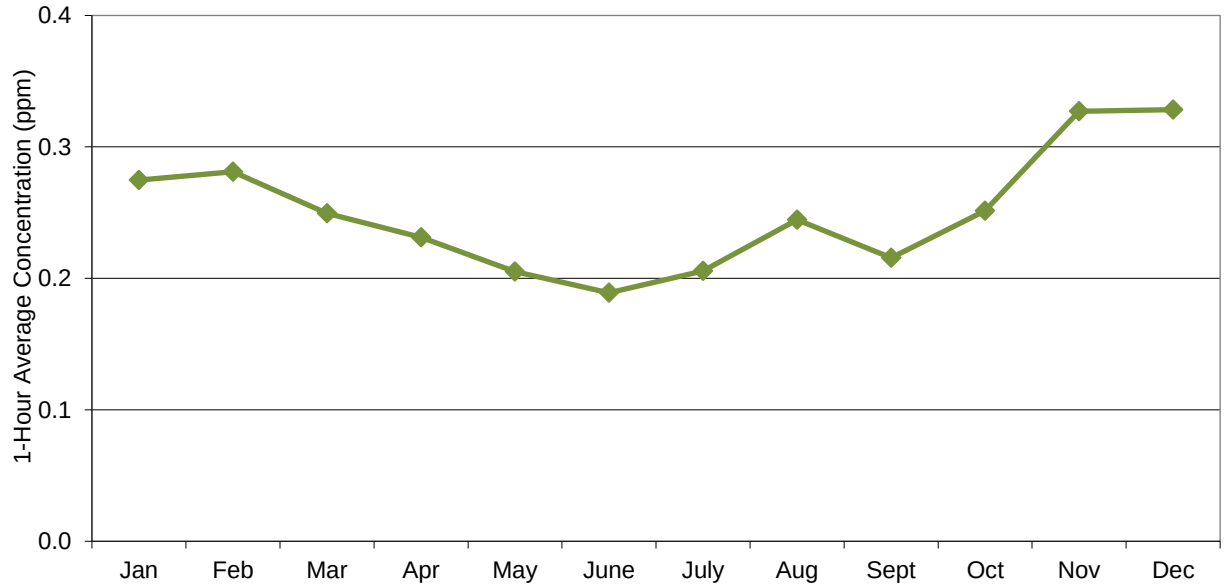
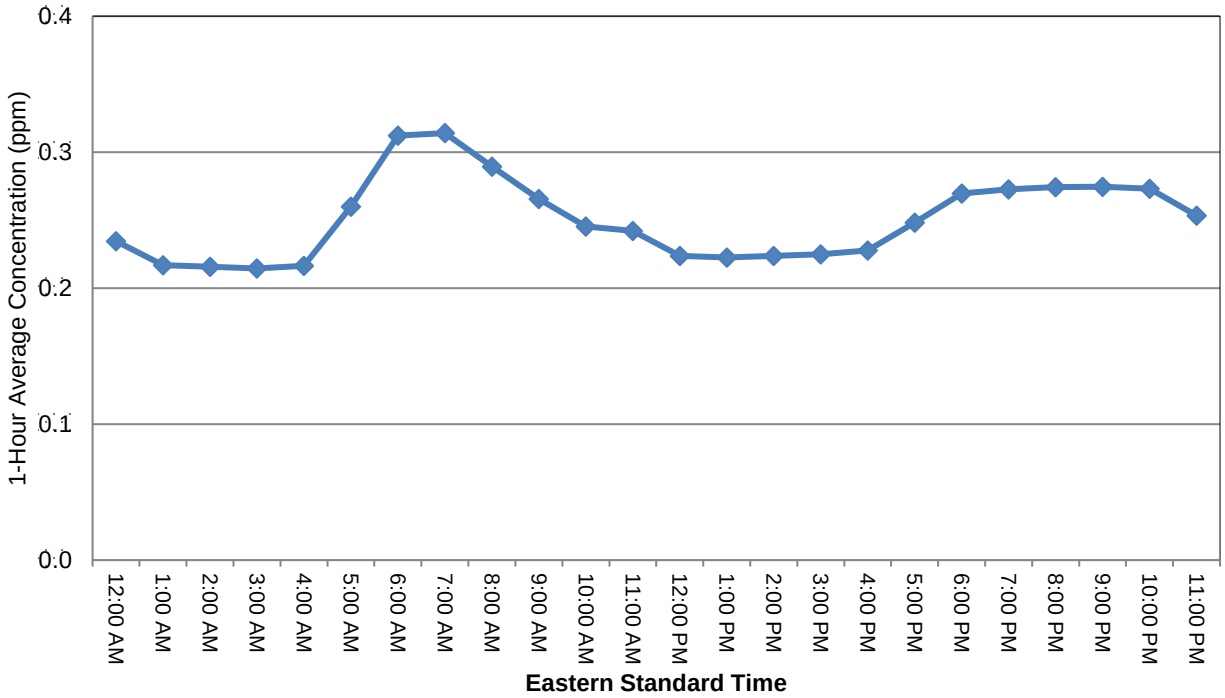


Figure 8-4
2017 Carbon Monoxide Concentrations in New Jersey
Hourly Variation
Parts per Million (ppm)



HEALTH EFFECTS

Carbon monoxide reduces the oxygen-carrying capacity of blood, therefore reducing the distribution of oxygen to organs like the heart and brain. The most common symptoms of exposure to high concentrations of carbon monoxide are headaches and nausea. Exposure to extremely high concentrations, usually resulting from combustion exhaust accumulating in enclosed indoor spaces, can be life-threatening. Such high levels of CO are not likely to occur outdoors. The health threat from exposure to outdoor CO is most serious for those who suffer from cardiovascular disease. For a person with heart disease, a single exposure to CO at low levels may reduce that individual's ability to exercise and may cause chest pain (angina).

AMBIENT AIR QUALITY STANDARDS

National Ambient Air Quality Standards (NAAQS) are established for the entire U.S. Primary standards are set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. For carbon monoxide, there are currently two primary, or health-based, NAAQS: a 1-hour standard of 35 parts per million (ppm), and an 8-hour standard of 9 ppm. These levels are not to be exceeded more than once in any calendar year. Therefore, the design value, or the actual statistical value that determines compliance with the NAAQS, is the second-highest 1-hour and 8-hour value in a given year. There are no national secondary, or welfare-based, standards for CO at this time. New Jersey also has standards for CO, and they are equivalent to the NAAQS even though they have different units (milligrams per cubic meter as opposed to parts per million). Also, the 8-hour state standard is based on a running average, not to be exceeded more than once in a 12-month period. The state has set secondary standards for CO at the same level as the primary standards. The standards are all summarized in Table 8-1.

Table 8-1
National and New Jersey Ambient Air Quality Standards for Carbon Monoxide
Parts per Million (ppm)
Milligrams per Cubic Meter (mg/m3)

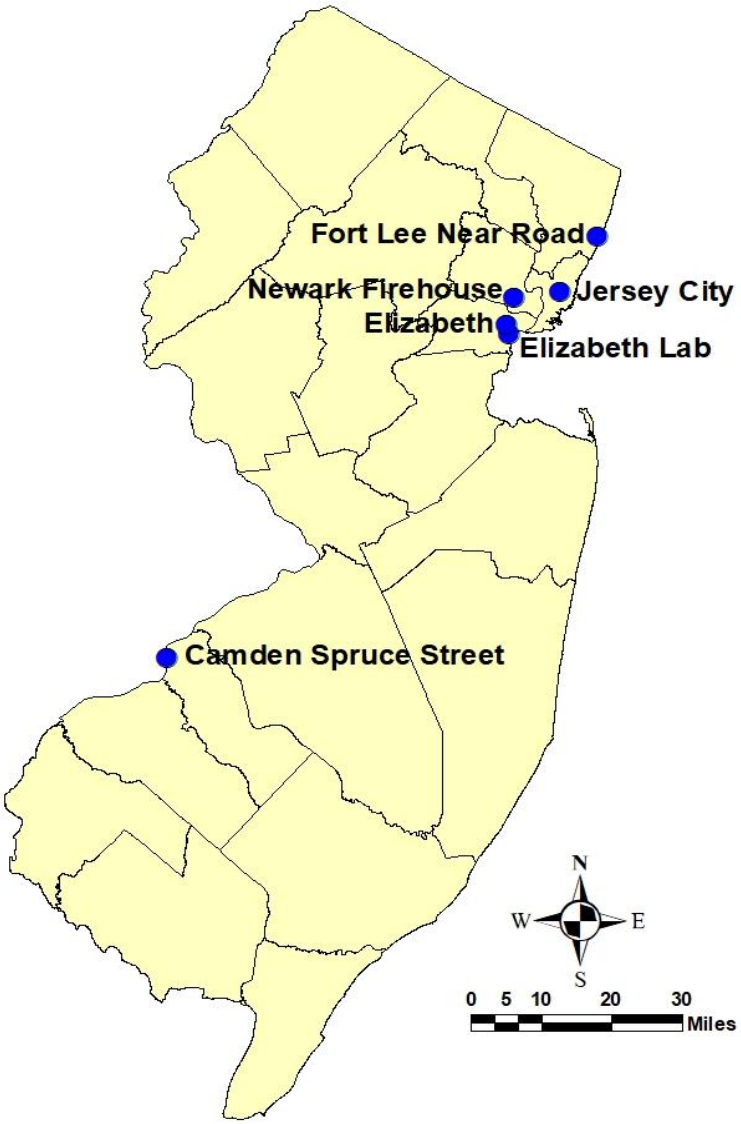
Averaging Period	Type	National [a]	New Jersey [b]
1-Hour	Primary	35 ppm	40 mg/m^3 (35 ppm)
1-Hour	Secondary	----	40 mg/m^3 (35 ppm)
8-Hours	Primary	9 ppm	10 mg/m^3 (9 ppm)
8-Hours	Secondary	----	10 mg/m^3 (9 ppm)

[a] Not to be exceeded more than once in a calendar year.
[b] Not to be exceeded more than once in any consecutive 12-month period.

CO Monitoring Network

The New Jersey Department of Environmental Protection (NJDEP) operated six CO monitoring stations in 2017. These sites are shown in the map in Figure 8-5. The Newark Firehouse station is part of the U.S. Environmental Protection Agency's (USEPA) National Core Multipollutant Monitoring Network (NCore). It measures and reports CO concentrations at trace levels, down to a hundredth of a ppm (0.00 ppm). The other stations are Camden Spruce Street, Elizabeth, Elizabeth Lab, Fort Lee Near Road, and Jersey City.

Figure 8-5
2017 Carbon Monoxide Monitoring Network



CO Levels in 2017

There were no exceedances of any CO standards at any of the New Jersey monitoring sites during 2017. The maximum 1-hour average CO concentration recorded in 2017 was 2.4 ppm, at the Elizabeth station. The highest 8-hour average CO concentration recorded was 1.8 ppm, at the Camden Spruce Street, Elizabeth, and Elizabeth Lab stations. Summaries of the 2017 data are provided in Table 8-2, and Figures 8-6 and 8-7.

Table 8-2
2017 Carbon Monoxide Concentrations in New Jersey
1-Hour and 8-Hour Averages
Parts per Million (ppm)

Monitoring Site	1-Hour Average Concentrations		8-Hour Average Concentrations	
	Highest	2nd-Highest	Highest	2nd-Highest*
Camden Spruce St.	2.2	2.0	1.8	1.4
Elizabeth	2.4	2.3	1.8	1.6
Elizabeth Lab	2.1	1.9	1.8	1.3
Fort Lee Near Rd.	1.3	1.2	1.0	0.9
Jersey City	2.0	1.7	1.1	1.1
Newark Firehouse	2.33	2.17	1.4	1.4

*Non-overlapping 8-hour periods

Figure 8-6
2017 Carbon Monoxide Concentrations in New Jersey
1-Hour Averages
Parts per Million (ppm)

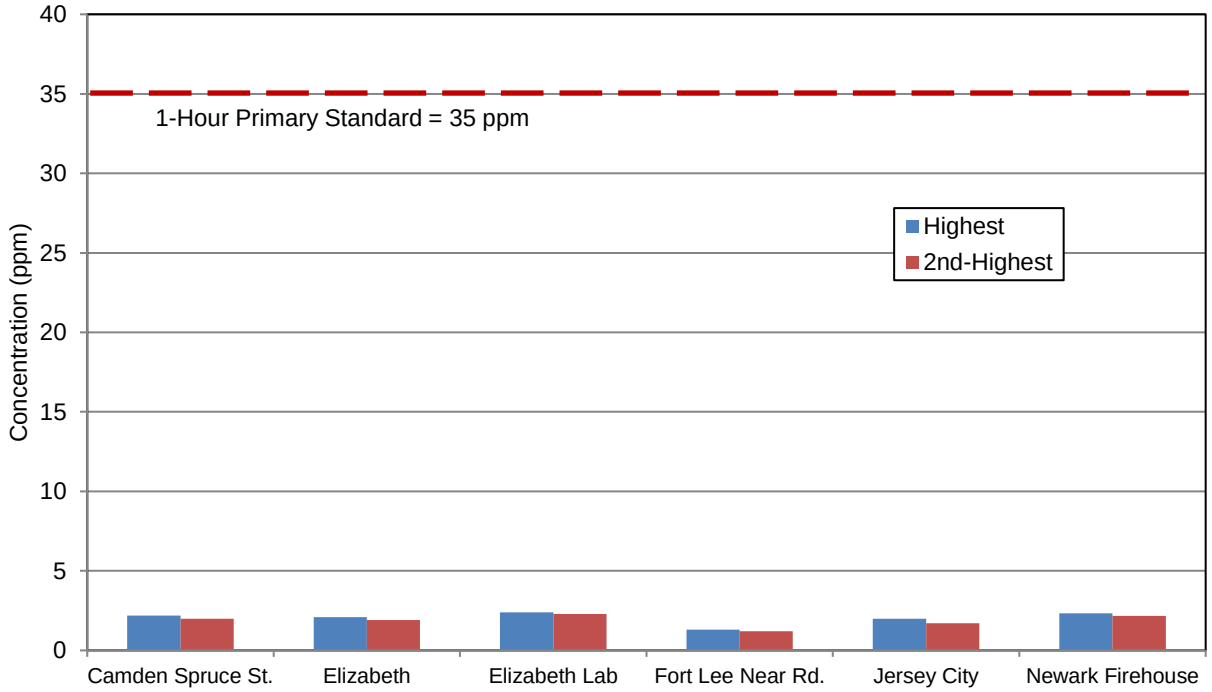
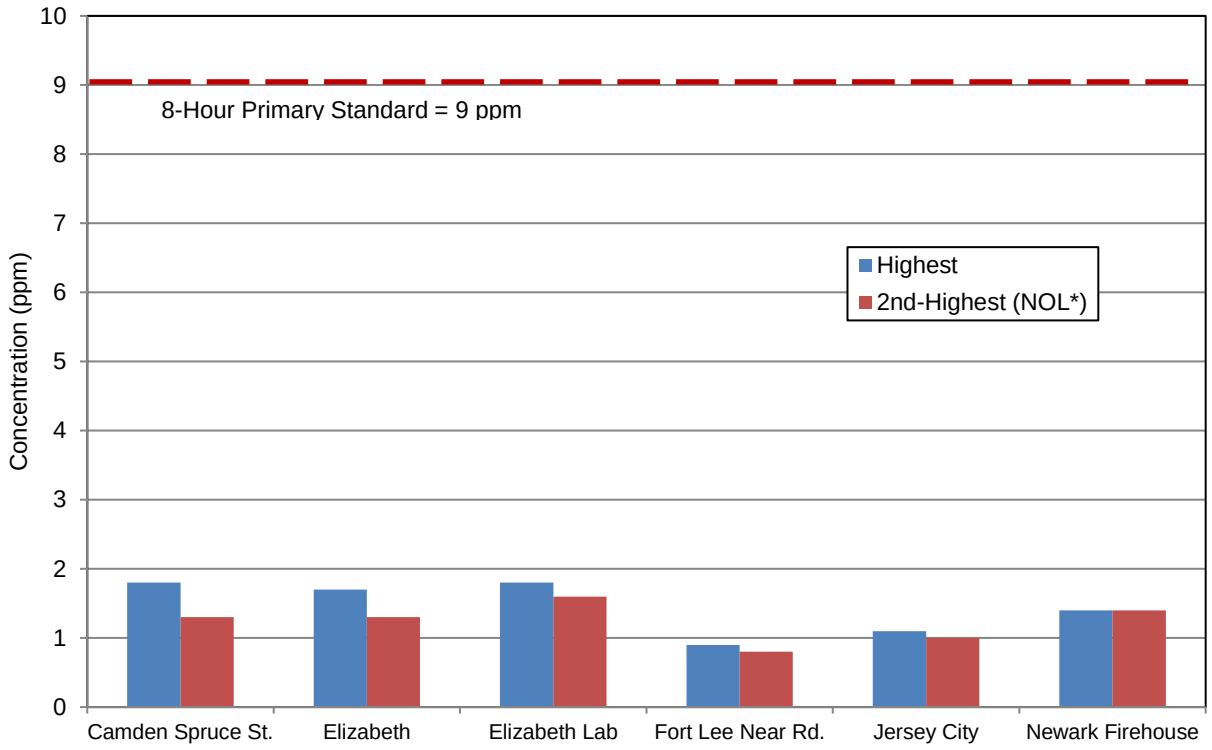


Figure 8-7
2017 Carbon Monoxide Concentrations in New Jersey
8-Hour Averages
Parts per Million (ppm)



*Non-overlapping 8-hour periods

CO Trends

Carbon monoxide levels in outdoor air have improved dramatically over the past two-and-a-half decades. Figures 8-8 and 8-9 present the trends in CO levels since 1990. The graphs actually show the second-highest 1-hour and 8-hour values recorded, because those are the design values that determine if the NAAQS are being met (one exceedance per site is allowed each year). The entire state was officially declared to have attained the CO standards as of August 23, 2002. Years ago, unhealthy levels of CO were recorded on a regular basis. The reduction in CO levels is due primarily to cleaner-running cars and other vehicles, which are by far the largest source of this pollutant outdoors. The last violation of the 8-hour NAAQS was in 1994.

Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2017
Statewide 2nd-Highest 1-Hour Average Concentrations
Parts per Million (ppm)

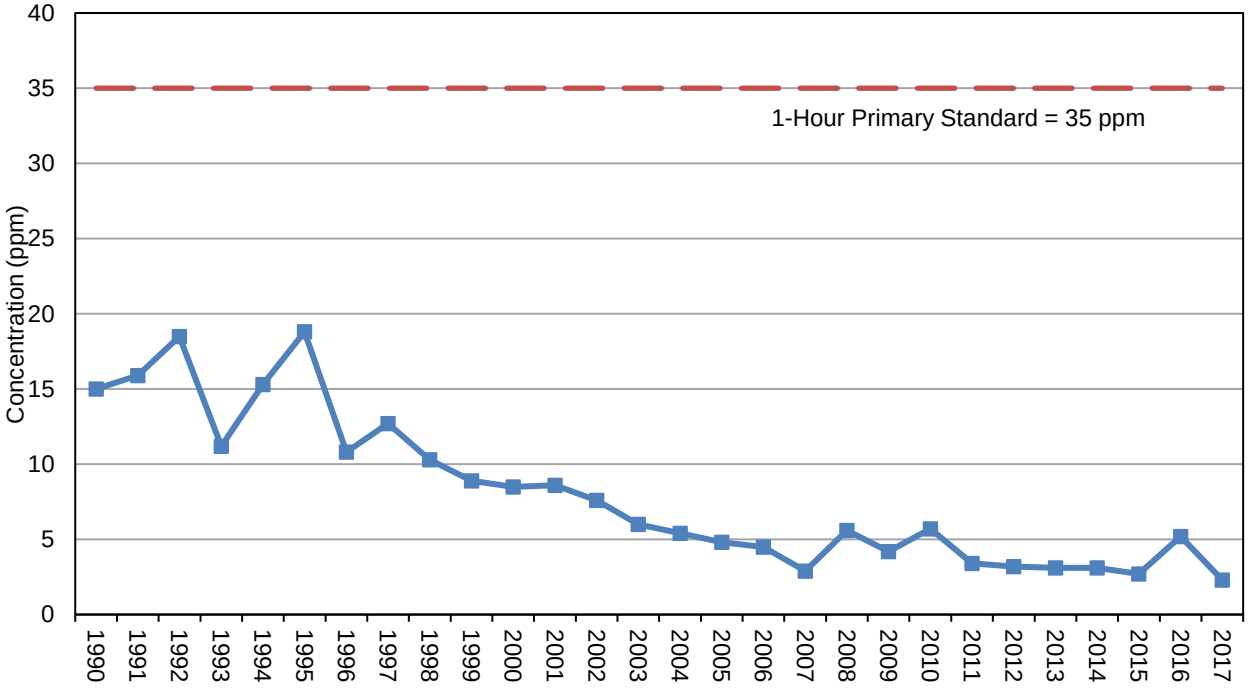
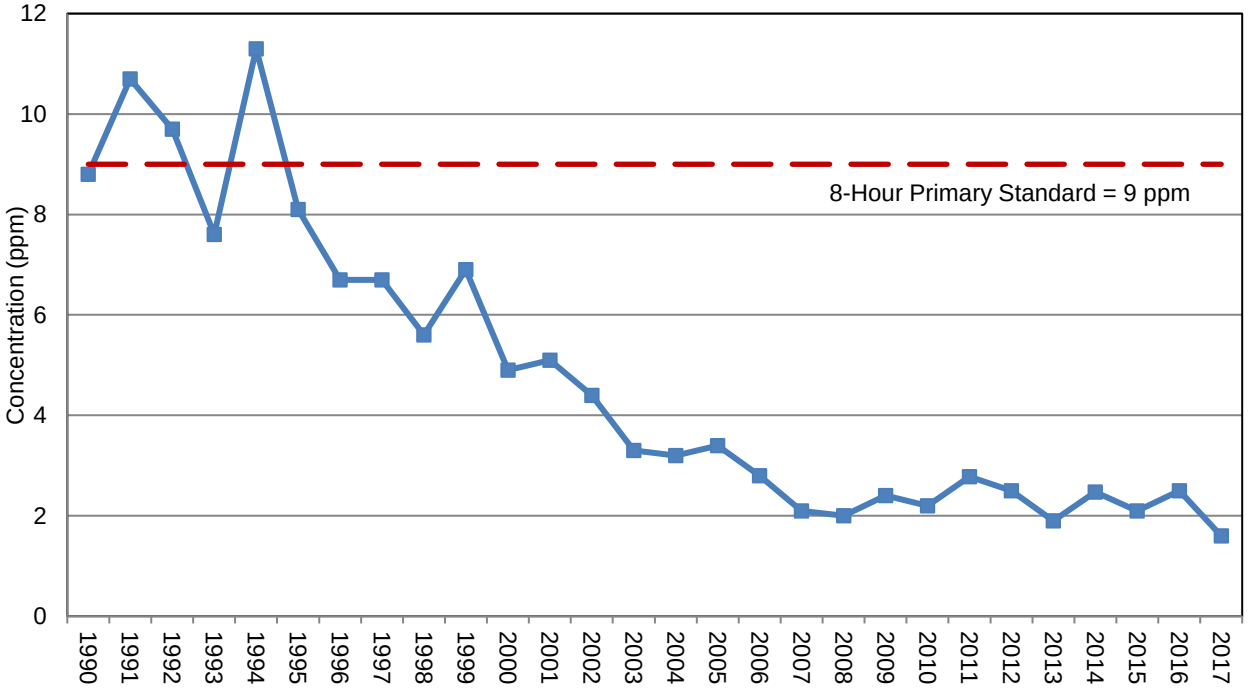


Figure 8-8
Carbon Monoxide Design Value Trend in New Jersey, 1990-2017
Statewide 2nd Highest 8-Hour Average Concentrations
Parts per Million (ppm)



REFERENCES

New Jersey Department of Environmental Protection, Bureau of Evaluation and Planning. *New Jersey Air Emission Inventories*. www.state.nj.us/dep/baqp/inventory.html . Accessed 6/14/18.

U.S. Environmental Protection Agency (USEPA). *Carbon Monoxide (CO) Pollution in Outdoor Air*. **WWW.EPA.GOV/CO-POLLUTION**. Accessed 6/14/18.

USEPA. *Air Trends: Carbon Monoxide Trends*. www.epa.gov/air-trends/carbon-monoxide-trends. Accessed 6/14/18.

USEPA. *Table of Historical Carbon Monoxide (CO) National Ambient Air Quality Standards (NAAQS)*. www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed: 6/14/18.