



2011 Sulfur Dioxide Summary

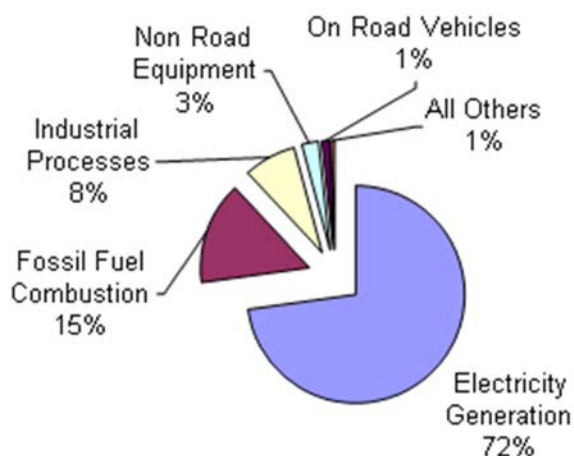
New Jersey Department of Environmental Protection

NATURE AND SOURCES

Sulfur dioxide (SO₂) is a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO₂ gases can be formed when fuels containing sulfur are burned, or when gasoline is extracted from oil. Most of the sulfur dioxide released into the air comes from electric utilities, especially those that burn coal with high sulfur content. Sulfur is found in raw materials such as crude oil, coal, and ores that contain metals such as aluminum, copper, zinc, lead and iron. Industrial facilities that derive their products from these materials may also release SO₂. A pie chart summarizing the major sources of SO₂ is shown in Figure 1.

Figure 4 (page 6) shows that SO₂ concentrations in New Jersey are generally higher in the winter than in the summer due to higher emissions from space heating and other sources, but peak SO₂ daily levels can occur any time during the year. As shown in Figure 5 (page 6), SO₂ levels tend to peak in mid to late morning as emissions accumulate prior to being more effectively dispersed when wind speeds increase and atmospheric mixing increases later in the day.

Figure 1
National Summary
SO₂ Emissions by Source Category



SOURCE: USEPA WEBSITE
[HTTP://WWW.EPA.GOV/AIR/EMISSIONS/SO2.HTM](http://www.epa.gov/air/emissions/so2.htm)
2005 data.

HEALTH AND ENVIRONMENTAL EFFECTS

Sulfur dioxide causes irritation of the mucous membranes. This is probably the result of the action of sulfurous acid that is formed when the highly soluble SO₂ dissolves at the surface of the membranes. Groups that are especially susceptible to the harmful health effects of SO₂ include children, the elderly, and people with heart or lung disorders such as asthma. When SO₂ concentrations in the air become elevated, people belonging to these sensitive groups and those who are active outdoors may have trouble breathing. The International Agency for Research on Cancer (IARC) evaluated SO₂ and based on available information, determined that no conclusion can be made as to the carcinogenicity of SO₂ to human beings (IARC, 1992).

Sulfur dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people and the environment. Sulfate particles are the major cause of reduced visibility in the eastern United States. SO₂ can also react with other substances in the air to form acids that fall to the earth in rain and snow. Better known as acid rain, this acidic precipitation can damage forests and crops, can make lakes and streams too acidic for fish, and eventually can speed up the decay of building materials and paints.

STANDARDS

From 1971 through June 2010, the National Ambient Air Quality Standards (NAAQS) for SO₂ were revised three times. In June 2010, based on its review of the air quality standard for oxides of sulfur (as measured by SO₂), the United States Environmental Protection Agency (USEPA) established a new 1-hour NAAQS for SO₂ at a level of 75 parts per billion (ppb). This new standard is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations (Federal Register, 2010). The 1971 SO₂ standards remain in effect until one year after an area is designated for the 2010 standard. In areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved (USEPA, 2010). The 1971 standards include an annual average health standard of 0.03 parts per million (ppm). This is based on a calendar year average of continuously monitored levels. There is also a 24-hour average health based standard of 0.14 ppm which is not to be exceeded more than once a year, and a secondary (welfare based) 3-hour average concentration standard of 0.5 ppm that is also not to be exceeded more than once per year.

New Jersey also has state air quality standards for SO₂. They are similar to the Federal standards but are expressed in micrograms per cubic meter (µg/m³) instead of ppm, and are based on rolling averages rather than block averages. This means the State's primary 12-month standard is based on any twelve-month average recorded during two consecutive years, while the Federal standard is based solely on the calendar year (block) average. The State also has secondary 12-month, 24-hour, and 3-hour average standards. Table 1 summarizes the NAAQS and the New Jersey Ambient Air Quality Standards (NJAAQS) for SO₂.

Table 1
National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide
Parts Per Million (ppm), Parts Per Billion (ppb)
Micrograms Per Cubic Meter (µg/m³)

Averaging Period	Type	New Jersey	National^a
12 – month average	Primary	80 µg/m ³ (0.03 ppm)	0.03 ppm
12 – month average	Secondary	60 µg/m ³ (0.02 ppm)	---
24 – hour average	Primary	365 µg/m ³ (0.14 ppm)	0.14 ppm
24 – hour average	Secondary	260 µg/m ³ (0.10 ppm)	---
3 – hour average	Secondary	1300 µg/m ³ (0.5 ppm)	0.5 ppm
1 – hour average ^b	Primary	---	75 ppb

^a – National standards are block averages rather than moving averages.

^b – Final rule signed June 2, 2010 and effective on August 23, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hr average at each monitor within an area must not exceed 75 ppb.

MONITORING LOCATIONS

The state monitored SO₂ levels at 8 locations in 2011. These sites are shown in Figure 2. In 2010, the NJDEP submitted a section 126 petition showing emissions from the Portland Generating Station, located in Pennsylvania, significantly contribute to nonattainment or interfere with maintenance of the 1-hour SO₂ NAAQS. In support of this petition, NJDEP has been monitoring SO₂ concentrations in Columbia, Warren County (Figure 8, page 8) since September 23, 2010.

SO₂ LEVELS IN 2011

In 2011, 27 exceedences of the 1-hour standard were recorded at the Columbia WMA site. The highest 99th percentile of the 1-hour daily maximum concentration for 2011 was recorded at Columbia WMA (125 ppb). While this value is high, it does not violate the Federal standard because 3 years of data are necessary to determine violations. Attainment or non-attainment with the new 1-hour standard will be determined beginning in October 2013, when enough data has been collected to determine if the standard has been violated. Two sites (Newark and Columbia WMA) do not have sufficient data to compare with the 1-hour standard. Of the remaining 6 sites with adequate data capture, the Elizabeth Lab location had the highest 1-hour average at 32 ppb.

None of the other monitoring sites recorded violations of the primary or secondary SO₂ standards during 2011. The maximum 12-month average concentration recorded was 0.0022 ppm at the Newark site. The maximum 24-hour average level recorded was 0.027 ppm at the Columbia WMA site. The highest 3-hour average recorded was 0.107 ppm at the Columbia WMA site. Summaries of the 2011 data are provided in Tables 2, 3, 4 (pages 4 and 5),

Figure 2
2011 Sulfur Dioxide
Monitoring Network

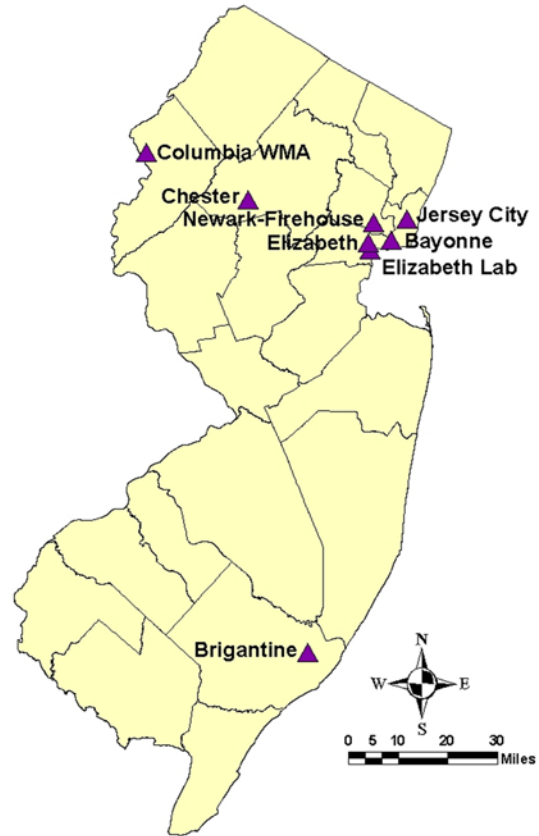


Table 2
2011 Sulfur Dioxide Data
3-Year Average of 99th Percentile
of Daily Maximum 1-Hour Average
Parts Per Billion (ppb)

Location	99th Percentile of Daily Maximum			3 – Year Average
	2009	2010	2011	2009 - 2011
Bayonne	33	26	27	29
Brigantine	14.0	9.8	7.2	10.3
Chester	29	26	25	27
Columbia WMA ^a	---	183	125	---
Elizabeth	22	11	15	16
Elizabeth Lab	34	30	32	32
Jersey City	22	19	22	21
Newark Firehouse ^b	---	18.0	18.9	---

^a – Columbia WMA site started in September 2010.

^b – Newark Firehouse site started in July 2009.

Table 3
2011 Sulfur Dioxide Data
3-Hour and Annual Averages
Parts Per Million (ppm)

Monitoring Sites	3-Hour Average Maximum	3-Hour Average 2 nd Highest ^a	12-Month Average Maximum	Calendar Year Average
Bayonne	0.027	0.021	0.002	0.002
Brigantine	0.0093	0.0076	0.0009	0.0006
Chester	0.052	0.036	0.001	0.000
Columbia WMA	0.107	0.096	0.002	0.002
Elizabeth	0.014	0.012	0.001	0.001
Elizabeth Lab	0.040	0.029	0.001	0.001
Jersey City	0.022	0.020	0.002	0.002
Newark Firehouse	0.0212	0.0193	0.0022	0.0020

^a – Based on non-overlapping 3 – hour moving averages.

**Table 4
2011 Sulfur Dioxide Data
24-Hour and Daily Averages
Parts Per Million (ppm)**

Monitoring Sites	24-Hour Average Maximum	24-Hour Average 2nd Highest ^a	Daily Average Maximum	Daily Average 2nd Highest
Bayonne	0.012	0.009	0.009	0.009
Brigantine	0.0042	0.0041	0.0041	0.0038
Chester	0.013	0.010	0.010	0.010
Columbia WMA	0.027	0.020	0.023	0.019
Elizabeth	0.007	0.005	0.005	0.005
Elizabeth Lab	0.013	0.010	0.011	0.009
Jersey City	0.013	0.012	0.011	0.011
Newark Firehouse	0.0097	0.0091	0.0090	0.0080

^a – Based on non-overlapping 24 – hour moving averages.

**Figure 3
Sulfur Dioxide – New Jersey
2011 – 3 Year Design Value
Parts Per Billion (ppb)**

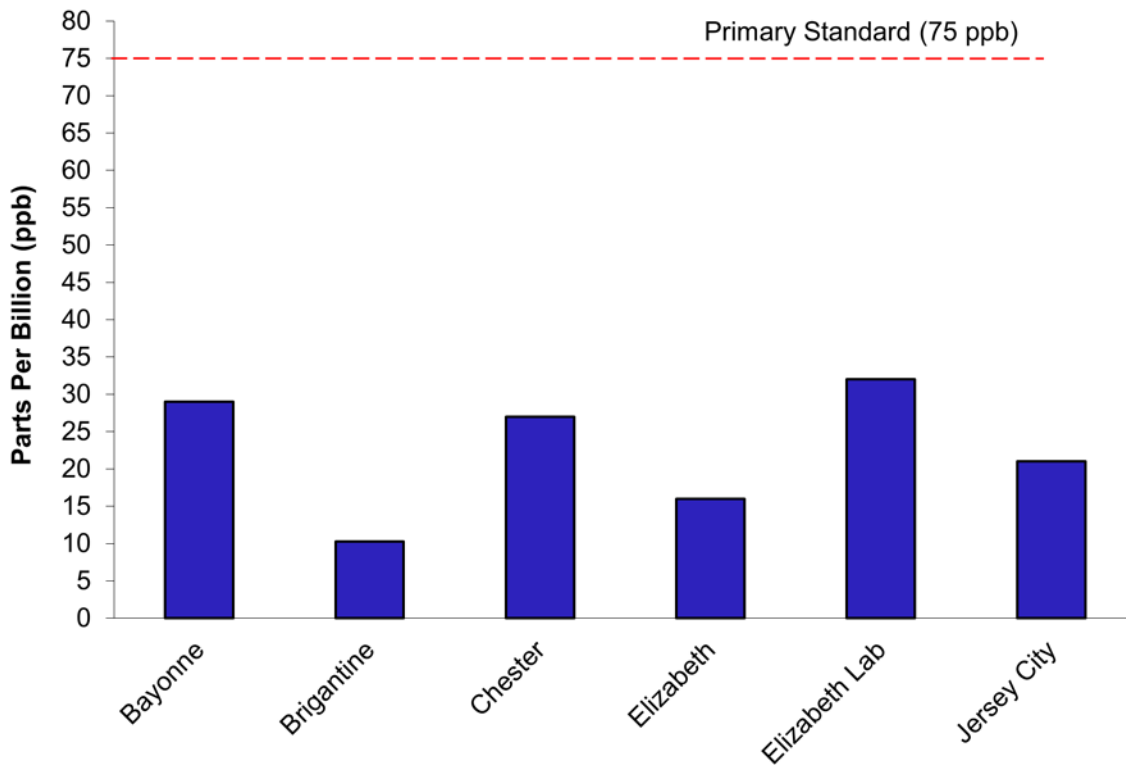


Figure 4
Sulfur Dioxide – New Jersey
2011 Monthly Variation
Parts Per Million (ppm)

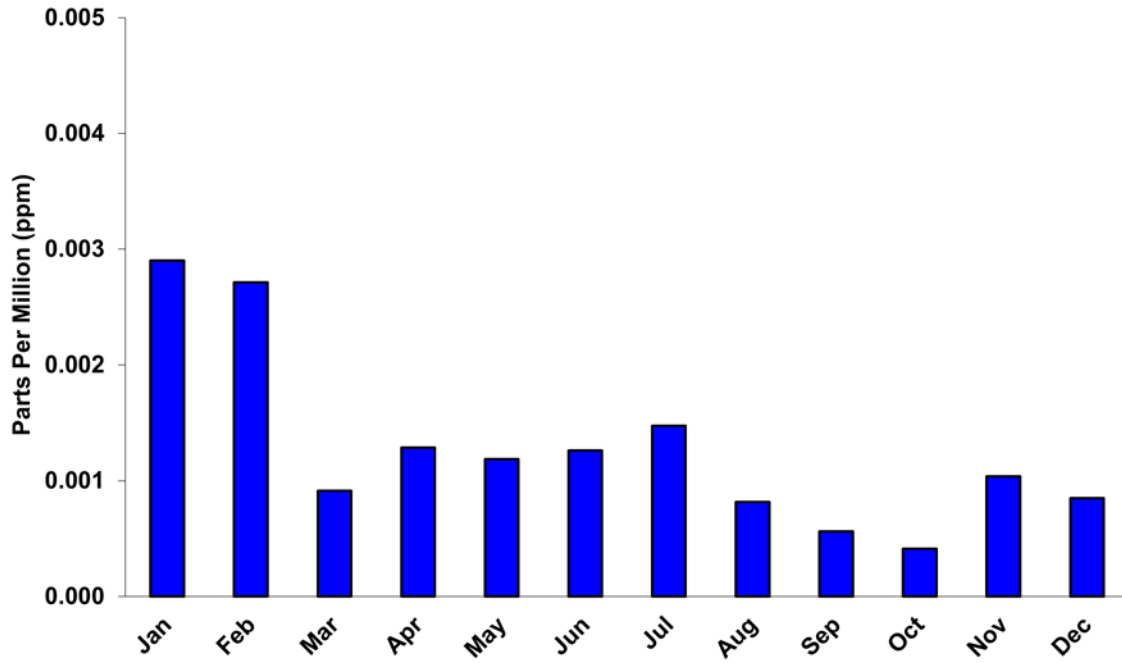


Figure 5
Sulfur Dioxide – New Jersey
2011 Hourly Variation
Parts Per Million (ppm)

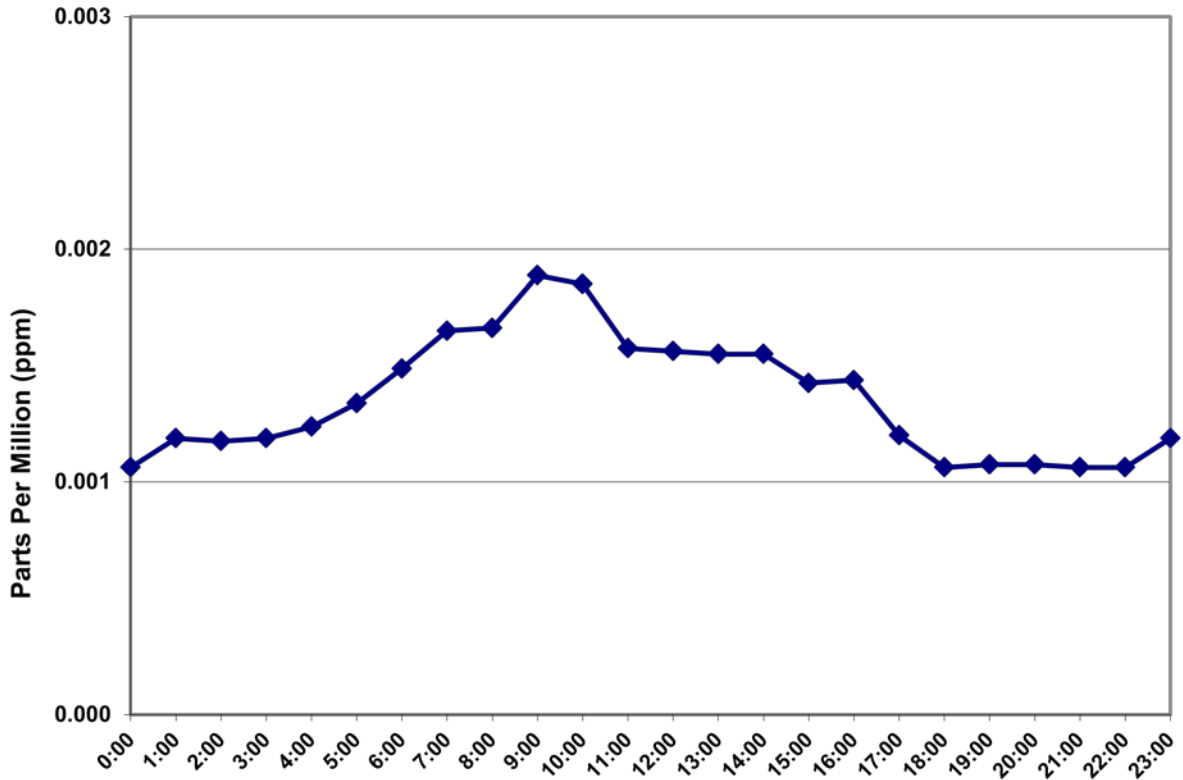


Figure 6
2011 Sulfur Dioxide Concentrations
Highest and 2nd Highest 24-Hour Averages
Parts Per Million (ppm)

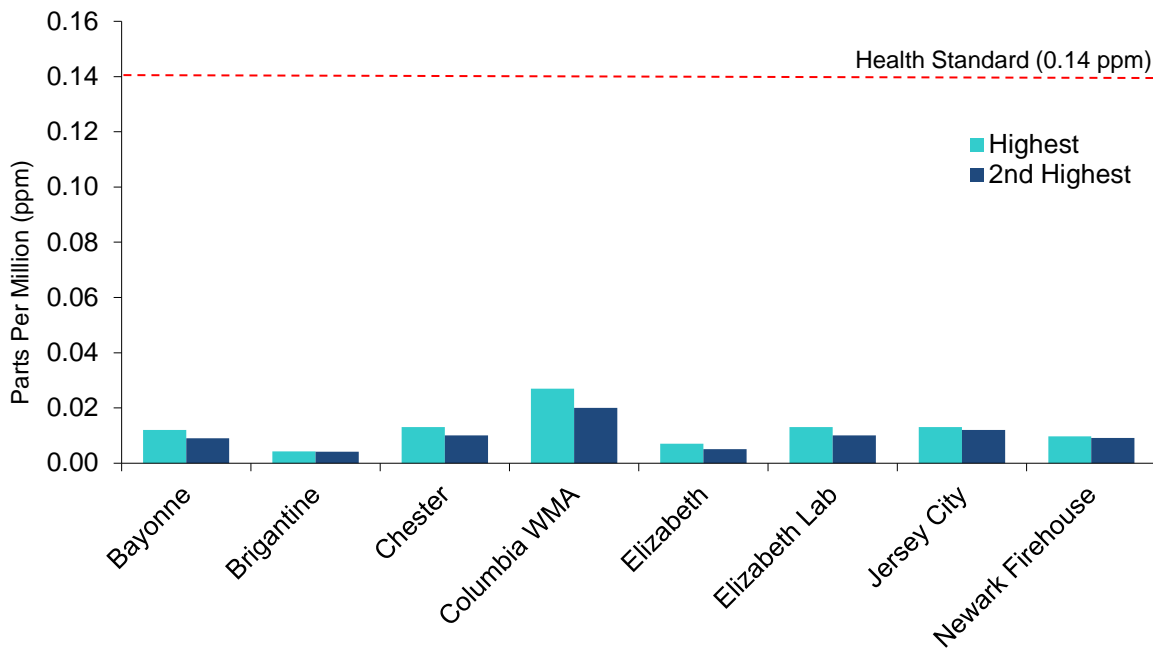
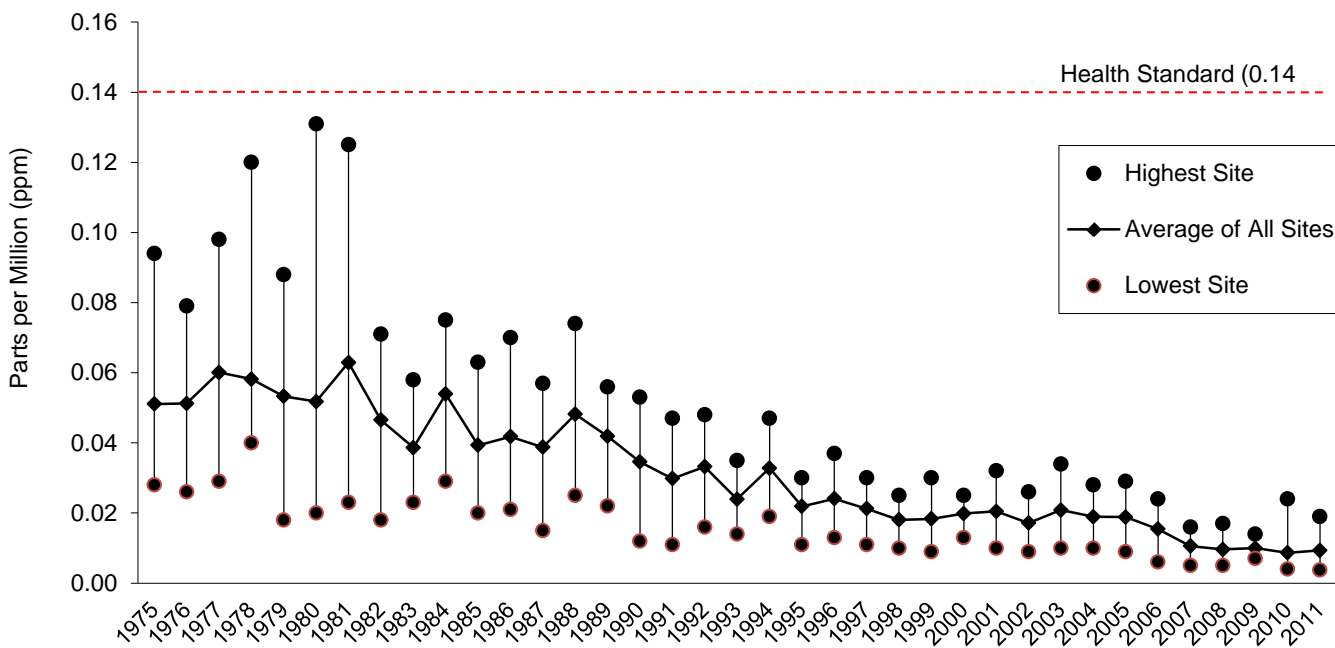


Figure 7
1975 - 2011 Sulfur Dioxide Concentrations
Second Highest Daily Average
Parts Per Million (ppm)

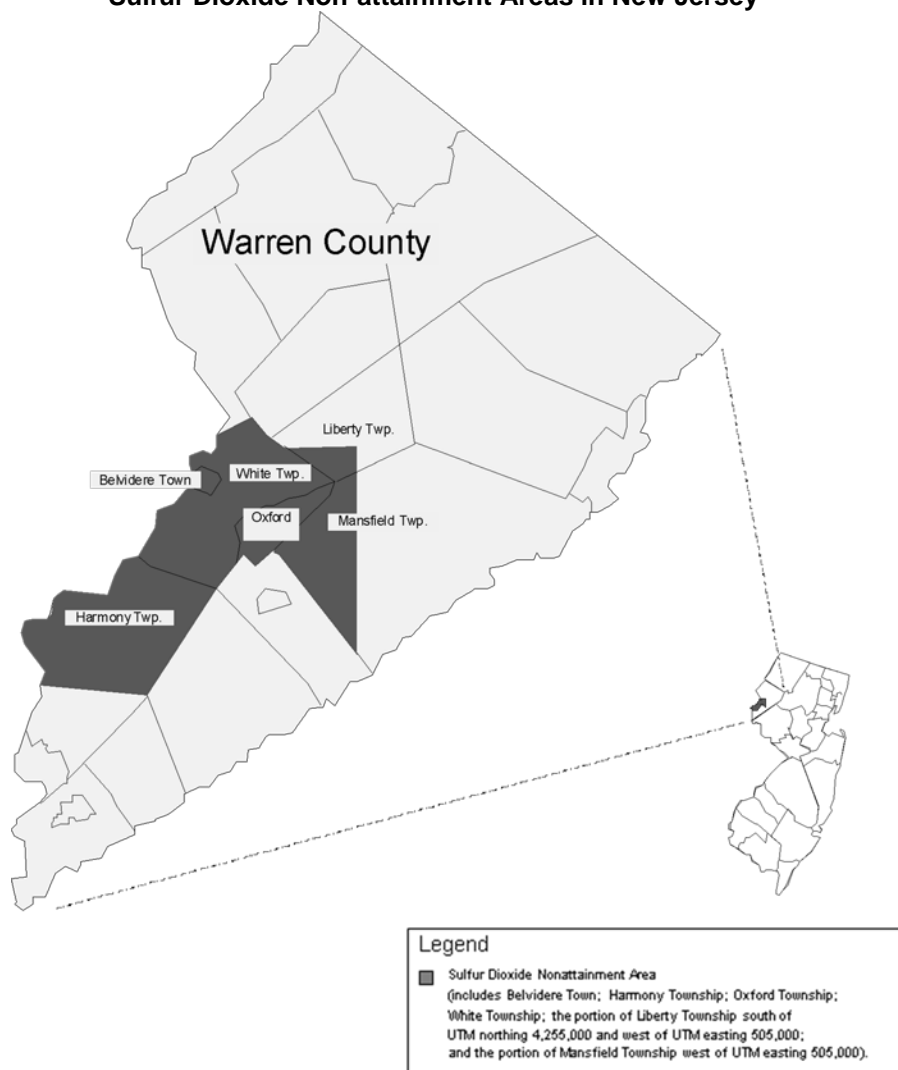


TRENDS

Since the implementation of Federal regulations requiring the use of lower sulfur fuels nationwide, SO₂ concentrations have improved significantly. The last time an exceedence of the 3-hour, 24-hour, or 12-month NAAQS for SO₂ was recorded in the state was in 1980. Although exceedences of the 1-hour standard were measured at Columbia WMA, it does not violate the Federal standard because 3 years of data are necessary to determine violations. A trend graph of SO₂ levels showing the daily average concentrations recorded since 1975 from the highest, average, and lowest of all sites is shown in Figure 7 (page 7). The graph uses the second highest daily average, as this is the value that determines if the national health standard is being met (one exceedence per site is allowed each year).

There is still a small area of New Jersey that is classified as a non-attainment area for SO₂. This is the result of air quality modeling studies that predicted non-attainment of the standard within a small area of Warren County. The area is shown in Figure 8. In June 2011, New Jersey petitioned the USEPA to take action against the Portland Power Plant in Pennsylvania as a larger area of New Jersey is being influenced by SO₂ emissions from the plant. This area includes all of Warren County and portions of Sussex, Somerset, and Hunterdon counties. A detailed map of the affected areas can be found at <http://www.state.nj.us/dep/baqp/docs/SO2%20package.pdf>.

Figure 8
Sulfur Dioxide Non-attainment Areas in New Jersey



*Nonattainment of the National Primary (Health) and Secondary (Welfare) Standards

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