2004

AIR QUALITY SUMMARY

STATE OF RHODE ISLAND

Department of Environmental Management
Office of Air Resources

Rhode Island Department of Health
Air Pollution Laboratory

INTRODUCTION

Ambient air quality has been monitored at a network of stations in the State of Rhode Island since 1968. The monitoring network is operated and maintained by the Rhode Island Department of Environmental Management (RI DEM) Office of Air Resources (OAR) and by the Rhode Island Department of Health (RI HEALTH) Air Pollution Laboratory via an interagency contract agreement. The ambient air quality data collected are entered quarterly in the U.S. Environmental Protection Agency's (USEPA's) Aerometric Information Retrieval System (AIRS).

PURPOSE

Monitoring data collected are used for the following purposes:

1. Determining whether the State is in attainment of national and State ambient air quality standards;
2. Tracking progress toward meeting national and State ambient air quality standards for which the State is in nonattainment;
3. Documenting maintenance of air quality standards for which the State is in attainment;
4. Providing a daily report of air quality and a forecast for the next day's air quality with appropriate health warnings, when required;
5. Providing real-time data for regional air quality maps;
6. Identifying pollution patterns and trends;
7. Assessing health and welfare effects and land use and transportation plans and evaluating the effectiveness of abatement strategies and enforcement of control regulations; and,
8. Activating emergency control procedures intended to prevent air pollution episodes.

This summary of 2004 ambient air quality data is intended to be used to provide general information about air quality in Rhode Island and as a source of statistics necessary to support modeling studies and other air quality analyses.

AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT

The USEPA has set National Ambient Air Quality Standards (NAAQS) for six air pollutants: lead (Pb), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and particulate matter (PM). Pollutants with adopted NAAQS are referred to as "criteria pollutants."

There are two types of NAAQS; primary NAAQS are designed to protect human health and secondary NAAQS are designed to protect the environment, property and aesthetics. The derivations of the NAAQS, as well as background information about the sources, chemistry and deleterious effects of the criteria pollutants, are documented in the USEPA's air quality criteria documents.

The NAAQS promulgated to date are listed in Table 1. In July 1997, the USEPA promulgated a NAAQS for particulate matter with diameters less than or equal to 2.5 micrometers (PM-2.5) and modified the standards for ozone and particulate matter with diameters less than or equal to 10 micrometers (PM-10). The State of Rhode Island has not as yet adopted those standards, but has adopted all NAAQS promulgated prior to 1997.

Areas that do not meet air quality standards are called nonattainment areas. The Clean Air Act (CAA) requires each state with a nonattainment area to submit and implement a State Implementation Plan (SIP) which documents the measures that the State will take to come into attainment with the standard. The entire State of Rhode Island is a nonattainment area for ozone. The State is in attainment of the NAAQS for the other criteria pollutants.

The State of Rhode Island is classified as a serious nonattainment area for ozone, and, as such, was required by the Clean Air Act Amendments of 1990 to reduce emissions of ozone precursors and to attain the ozone NAAQS by 1999. To this end, the State has adopted a variety of regulations limiting emissions of two classes of ozone precursors, volatile organic compounds and nitrogen oxides, from industrial and commercial sources such as surface coating facilities, power plants and gasoline stations, as well as from mobile sources (motor vehicles). Although these measures have reduced ozone levels, the State has still not attained the NAAQS for that pollutant. Since Rhode Island’s air quality is substantially affected by transport of pollutants into the State, further reductions in emissions in upwind states will be necessary for Rhode Island to become an attainment area for ozone.

TABLE 1: NATIONAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT	AVERAGING TIME	PRIMARY STANDARD	SECONADARY STANDARD
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.03 ppm 80 μg/m³	None
	24-Hour	0.14 ppm 365 μg/m³	None
	3-Hour	None	0.50 ppm 1300 μg/m³
Carbon Monoxide (CO)	8-Hour	9 ppm 10 mg/m³	Same as Primary Standard
	1-Hour	35 ppm 40 mg/m³	Same as Primary Standard
Ozone (O_3)	1-Hour[A]	0.12 ppm 235 μg/m³	Same as Primary Standard
	8-Hour[B]	0.08 ppm 157 μg/m³	Same as Primary Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm 100 μg/m³	Same as Primary Standard
Particulate Matter $\leq$10 micrometers (PM-10)	Annual Arithmetic Mean[C]	50 μg/m³	Same as Primary Standard
	24-Hour[D]	150 μg/m³	Same as Primary Standard
Particulate Matter $\leq$ 2.5 micrometers (PM-2.5)	Annual Arithmetic Mean[E]	15 μg/m³	Same as Primary Standard
	24-Hour[F]	65 μg/m³	Same as Primary Standard
Lead (Pb)	Calendar Quarter Arithmetic Mean	1.5 μg/m³	Same as Primary Standard

Primary standards protect against adverse health effects. **Secondary standards** protect against welfare effects such as damage to crops, vegetation, and buildings.

SO2 and CO standards must not be exceeded more than once a year.

[A] To attain the 1-hour O_3 standard, the daily maximum 1-hour average concentration must not exceed 0.12 ppm more than 3 times in 3 consecutive years.

[B] To attain the 8-hour O_3 standard, the fourth-highest daily maximum 8-hour average each year, averaged over 3 consecutive years must not exceed 0.08 ppm. The 8-hour standard was adopted in July 1997.

[C] To attain the PM-10 annual standard, the arithmetic average of the 24-hour samples for a 1-year period, averaged over 3 consecutive years, must not exceed 50 μg/m³.

[D] To attain the PM-10 24-hour standard, the 99th percentile of the distribution of the 24-hour concentrations for a period of 1 year, averaged over 3 years, must not exceed 150 μg/m³.

[E] To attain the PM-2.5 annual standard, the 3-year average of the annual arithmetic mean of the 24-hour concentration must not exceed 15.0 μg/m³.

[F] To attain the PM-2.5 24-hour standard, the 98th percentile of the distribution of the 24-hour concentrations for a period of 1 year, averaged over 3 years, must not exceed 65 μg/m³.

μg/m³ = micrograms per cubic meter; **ppm** = parts per million; **mg/m³** = milligrams per cubic meter

RHODE ISLAND AMBIENT AIR QUALITY MONITORING NETWORK

During 2004, RI DEM and RI HEALTH monitored the ambient air levels of all of the criteria pollutants except for lead. The State discontinued lead monitoring in 1992 because airborne lead concentrations in the State had been substantially lower than the NAAQS for that pollutant since 1986, when lead was removed from gasoline.

Monitoring was also conducted for nitrogen oxides (NOx), volatile organic compounds (VOCs) and carbonyls in 2004. Those pollutants are ozone precursors which react in the atmosphere to form ground-level ozone, a criteria pollutant. In addition, some of the VOCs and carbonyls monitored are air toxics; exposure to those substances is associated with cancer and other serious health effects.

The locations of the criteria pollutant and air toxics monitoring sites are shown in Figures 1- 4. Table 2 lists the parameters measured and the sampling methods employed at each of those sites.

Figure 1
Air Quality Monitoring Network (2004)
Continous Monitors
Site Locations

Figure 2
PM-10 Air Pollution Monitoring Network
(2004)
Site Locations

Figure 3
PM-2.5 Air Pollution Monitoring Network
(2004)
Site Locations

Figure 4
Air Toxics Monitoring Network (2004)
Site Locations

TABLE 2: MONITORING SITES

Site Location	AIRS Code	UTM East	UTM North	Parameter Measured	Method Of Sampling	EPA Method Designation
Vernon Trailer Vernon Street Pawtucket	440070026	302.5	4638.4	PM-2.5	Lo Vol	Reference
				PM-10s	Hi Vol	Reference
				VOCs	Canisters, GC/MS	Reference
Johnson & Wales 111 Dorrance Street Providence	440070027	299.2	4633.8	PM-10	Hi Vol	Reference
Hallmark Building 695 Eddy Street Providence	440070028	299.2	4633.8	PM-2.5	Lo Vol	Reference
Brown University 10 Prospect Street Providence	440070012	300.2	4633.0	Oxides of Nitrogen	Chemiluminescence	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				Sulfur Dioxide	Simulated Fluorescence	Equivalent
Case Mead Building 76 Dorrance Street Providence	440071009	299.7	4632.8	Carbon Monoxide	Gas Filter Correlation	Equivalent
USEPA Laboratory 27 Tarzwell Drive Narragansett	440090007	273.4	4610.4	Ozone	U.V. Photometric	Reference
				PM-2.5	Lo Vol	Reference
				PM-2.5	Beta Attenuation/Cont	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Temperature	Spot Reading	N/A
Francis School 64 Bourne Avenue E. Providence	440071010	303.9	4634.5	Oxides of Nitrogen	Chemiluminescence	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				VOCs	Canisters, GC/MS	Reference
				Carbon Monoxide	Gas Filter Correlation	Equivalent
				Ozone	U.V. Photometric	Reference
				PM-2.5	Lo Vol	Reference
				PM-2.5	TEOM/Continuous	N/A
				Speciated PM-2.5	Speciation Monitor	N/A
				Carbonyls	HPLC Cartridges	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Barometric Pressure	Barometer	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
				Solar Radiation	Pyranometric	N/A
				UV Radiation	UV Photometric	N/A
				Precipitation	Bucket/Continuous	N/A

Site Location	AIRS Code	UTM East	UTM North	Parameter Measured	Method Of Sampling	EPA Method Designation
Urban League 212 Prairie Avenue Providence	440070022	299.4	4631.1	PM-2.5	Lo Vol	Reference
				PM-2.5	TEOM/Continuous	N/A
				PM-2.5	Beta Attenuation/Cont	N/A
				Speciated PM-2.5	Speciation Monitor	N/A
				PM-10/Metals	Hi Vol	Reference
				VOCs	Canisters, GC/MS	Reference
				Carbonyls	HPLC Cartridges	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
Alton Jones Campus Victory Highway West Greenwich	440030002	273.4	4610.4	Ozone	U.V. Photometric	Reference
				Nitrogen Dioxide	Chemiluminescence	Reference
				Oxides Of Nitrogen	Chemiluminescence	Reference
				VOCs	Canisters, GC/MS	Reference
				PM-10	Hi Vol	Reference
				PM-2.5	Lo Vol	Reference
				PM-2.5	Beta Attenuation/Cont	N/A
				Wind Speed	Anemometer	N/A
				Wind Direction	Wind Vane	N/A
				Barometric Pressure	Barometer	N/A
				Temperature	Spot Reading	N/A
				Relative Humidity	Plastic Film	N/A
				Solar Radiation	Pyranometric	N/A

AIR QUALITY INDEX

In 1976, the USEPA developed the Pollutant Standards Index (PSI), a readily understandable way of communicating monitored air pollutant concentrations and associated health implications to the public. In June 2000, the USEPA updated the index and renamed it the Air Quality Index (AQI). The AQI converts monitored ambient concentrations of criteria pollutants to a scale of 0 to 500. For all pollutants except for PM-2.5, an AQI level of 100 means that the monitored concentration is at the level of the short-term standard for the pollutant. Monitored levels just above the standard (AQI of 101 –150) are characterized as “unhealthy for sensitive groups” and higher levels (AQI of 151-200) are characterized as “unhealthy” by the USEPA. To avoid any confusion that might result from the interpretation of the term “sensitive group”, Rhode Island describes all AQI levels between 100 and 200 as “unhealthy” in its health advisories.

For PM-2.5, the USEPA has determined that levels below the one-hour standard of 65 $\mu g/m^3$ may cause health effects in sensitive individuals. Therefore, for that pollutant, EPA’s “unhealthy for sensitive groups” category (AQI of 101-150) represents concentrations in the range of 40 – 64 $\mu g/m^3$, which is below the standard, while all concentrations at and above the standard are characterized as “unhealthy.”

AQI subindices are calculated every day for the highest 8-hour average concentrations of ozone and CO and for the 24-hour average concentration of SO_2 recorded during the 24-hour period ending at 8:00 AM on that day. The highest of the subindices is then reported as the AQI for that date. During the summer, the AQI is based on the ozone subindex, while during the cooler months the AQI is based on CO or SO_2.

Rhode Island DEM reports the AQI to the local news media, accompanied by an easily understood descriptor word. A forecast for the next day’s pollutant levels, consisting only of a descriptor word, is also reported.

The Rhode Island AQI descriptors are as follows:

AQI	Descriptor
0 to 50	Good
51 to 100	Moderate
101 to 200	Unhealthy

201-300	Very Unhealthy

Pollutant levels measured at five monitoring sites were used for AQI reporting in 2004. The AQI pollutants measured at those sites are as follows:

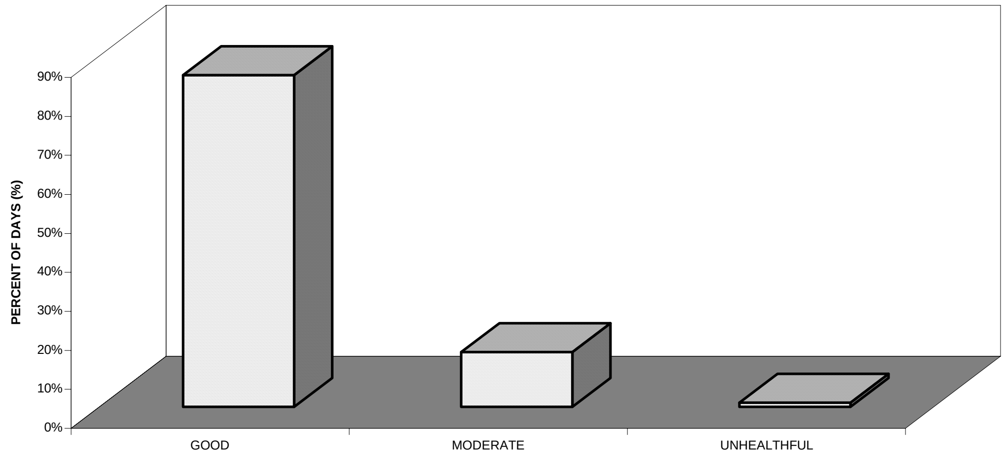
Site Location	**AQI Pollutants Monitored**
76 Dorrance Street, Providence	carbon monoxide, sulfur dioxide
Brown University, 10 Prospect Street, Providence	sulfur dioxide
Myron Francis School 64 Bourne Avenue, E. Providence	ozone
Alton Jones Campus of URI W. Greenwich	ozone
USEPA Research Laboratory 72 Tarzwell Drive, Narragansett	ozone

Note that nitrogen dioxide concentrations are not used to calculate the AQI because there is no short-term air quality standard for that pollutant. PM-10 levels are also not used, because the monitoring results for those pollutants are not available the day after the samples are taken. RI DEM has begun to operate continuous PM-2.5 instruments and, has begun using the data from those monitors to include PM-2.5 in the AQI calculations.

In 2004, the AQI in Rhode Island was good on 85% of the reporting days, moderate on 14%, and unhealthful on 1% (see Figure V). The daily AQI and forecast are printed in the weather section of the Providence Journal. During the ozone season, (April through

September), a daily air quality report is also available on the OAR hotline at 401-222-2808 and at DEM's web site at http://www.state.ri.us/dem/programs/benviron/air/ozone.htm. Additional information on the AQI and the health effects associated with various index levels is available from the OAR.

Figure V
Air Quality Index (AQI)
2004 Air Quality Levels



2004 AIR QUALITY SUMMARY

The weather in the summer of 2004 was cool and dry and, as a result, the ozone concentrations were lower than those that occurred during the hot summer of 2003. The 8-hour ozone standard was exceeded on ten days in 2004, as compared to seventeen days in 2003. Ambient concentrations of the other criteria pollutants continued to stay below the National Ambient Air Quality Standards (NAAQS).

A more detailed discussion of the properties of the criteria pollutants, the concentrations of pollutants measured in 2004 and ambient air quality trends follows.

CARBON MONOXIDE (CO)

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed by the incomplete combustion of fuels by motor vehicles, aircraft, boilers, power plants, incinerators, industrial processes and other fuel-burning sources. Elevated CO levels are often found in downtown areas with heavy traffic and poor dispersion characteristics.

By binding to the hemoglobin in blood, CO reduces the amount of oxygen that is delivered to the body's organs and tissues. CO exposure is most dangerous to those who suffer from cardiovascular disease. Healthy individuals are also affected at higher levels of exposure. Exposure to elevated CO levels can cause shortness of breath, chest pain, headaches, confusion, visual impairment, reduced work capacity, reduced coordination, poor learning ability, and difficulty in performing complex tasks.

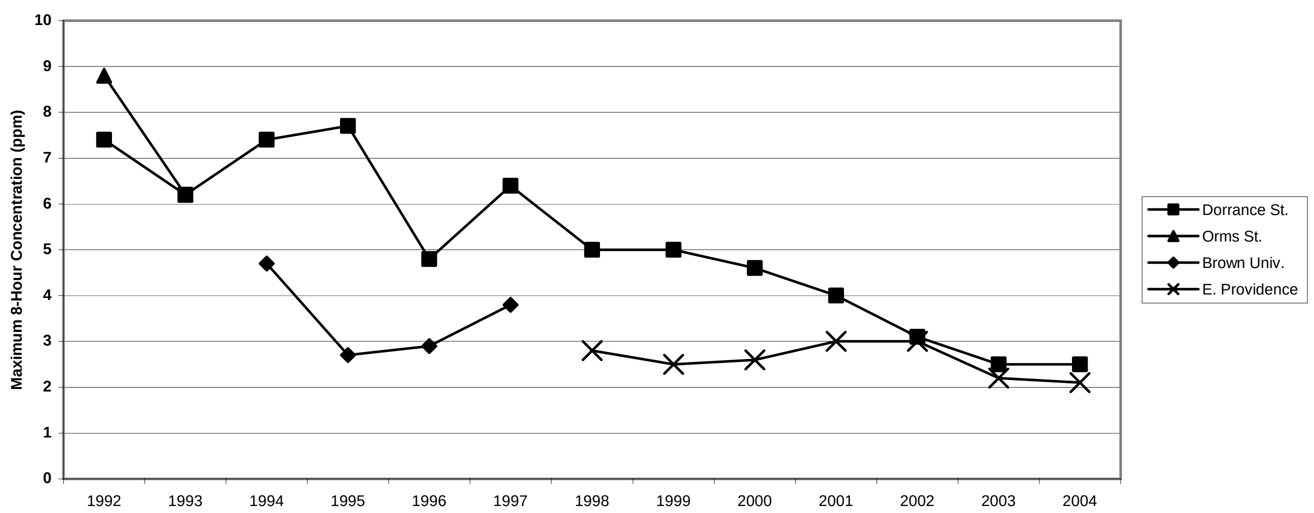
The primary and secondary NAAQS for CO are the same, 9 ppm as an 8-hour average and 35 ppm as a 1-hour average. In 2004, no exceedances of the NAAQS were recorded at either of the two carbon monoxide monitoring sites in the State. The Dorrance Street site, which is located in downtown Providence, reported the highest CO concentrations, which were 28% and 13% of the 8-hour and 1-hour NAAQS respectively, (See Table 3).

Figure VI shows CO trends in Rhode Island between 1993 and 2004. Maximum yearly CO concentrations at the Dorrance Street site, the only site that operated continuously since 1990, decreased in that period. The CO concentration at that site was slightly lower in 2004 than in 2003. The CO levels at the East Providence site remained roughly constant between 1998 and 2002 but decreased in 2003 and 2004. Previously, the CO levels at the Dorrance Street site were significantly higher than those in East Providence but, due to the steady drop in the levels measured at the Dorrance Street site, the CO levels at the two sites have been similar since 2002.

Table 3 Carbon Monoxide (CO) Levels Measured in Rhode Island in 2004 (ppm)

	1-Hour Values (NAAQS is 35 ppm)				8-Hour Values (NAAQS is 9 ppm)		
Stations	# of Observations	1st Maximum	2nd Maximum	# of Exceedances	1st Maximum	2hd Maximum	# of Exceedances
Francis School 64 Bourne Ave. E. Providence	8,135	4.2	2.4	0	2.1	1.7	0
76 Dorrance St. Providence	8,441	3.7	3.5	0	2.5	2.5	0
Totals				0			0

Figure VI
CARBON MONOXIDE (CO)
Maximum 8-Hour Concentrations
Standard = 9 ppm



LEAD (Pb)

Lead is no longer monitored as a criteria pollutant in the State because, since the removal of lead from gasoline, airborne lead concentrations in the State have been substantially lower than the NAAQS. There are no major stationary sources of lead in the State.

Lead can enter the body through inhalation of lead dust or fumes and by ingestion of lead paint chips and lead-contaminated dust, water, soil, or food. Lead accumulates in blood, bone, and soft tissue. Fetuses and small children are particularly susceptible to the toxic effects of lead, which include brain damage, behavioral alterations, decreased intelligence and slowed growth. At higher levels, exposure to lead can damage the kidneys, liver, and nervous system, and cause reproductive disorders and anemia. The USEPA's health-based NAAQS for lead is 1.5 $\mu g/m^3$ as a three-month average.

Lead is one of the metals monitored in respirable particulate matter (PM-10) at the Urban League site in Providence as part of the National Air Toxics Trends Sites (NATTS) network. Lead in PM-10 was also monitored as part of a one-year special toxics study at the Bridgham School in the Olneyville section of Providence beginning in March 2004. Since monitoring for metals at the Olneyville will continue until March 2005, the results of the metals monitoring at that site will be reported in the 2005 Air Quality Data Summary.

In addition, the national PM-2.5 Speciation program measured lead, as well as a number of other parameters, in fine particulate matter (PM-2.5) at the Urban League and East Providence sites in 2004. PM-2.5 speciation monitoring was discontinued at the East Providence site in May 2004 and, at that time, the frequency of speciation monitoring at the Urban League site was increased from one 24-hour sample every sixth day to one 24-hour sample every third day.

At the Urban League site, the mean lead concentration in PM-10 was 0.00501 $\mu g/m^3$ in 2004, while the mean lead concentration in PM-2.5 was approximately half as high, 0.00276 $\mu g/m^3$.

NITROGEN DIOXIDE (NO_2) and OXIDES of NITROGEN (NOx)

Nitrogen dioxide (NO_2) belongs to a family of highly reactive gases called oxides of nitrogen (NOx). NOx forms when fuel is burned at high temperatures, and is found in the exhuast emitted by motor vehicles and stationary sources such as power plants and industrial boilers. A suffocating, brownish gas, NO_2 is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates.

Breathing air with elevated NO_2 levels irritates the lungs and lowers the body's resistance to respiratory infections such as influenza. Continued or frequent exposure to high concentrations of NO_2 may cause an increased incidence of acute respiratory illness in children. Emissions of NO_2, as well as other oxides of nitrogen (NOx), contribute to the formation of ground level ozone and to other adverse environmental effects, such as acid rain and the eutrophication of coastal waters.

In 2004, Rhode Island monitored NO_2 and NOx at three sites. The East Providence and West Greenwich NO_2/ NOx monitors are located at Photochemical Assessment Monitoring Sites (PAMS). The PAMS network is designed to track the movement of ozone and its precursors (like NOx) through the region, so NOx monitoring at those locations is required only during June, July and August, when ozone levels tend to be highest. In keeping with that requirement, the NO_2/ NOx monitors in West Greenwich and East Providence were operated from June through August in 2004. The third site, which is located at Brown University in Providence, operated throughout the year.

The NAAQS for NO_2 is 0.053 ppm as an annual arithmetic mean. The NAAQS has not been exceeded in Rhode Island since monitoring for NO_2 began in 1980. In 2004, the annual arithmetic mean at the Brown University site was 0.018 ppm, or 34% of the NAAQS. There is no NAAQS for NOx. 2004 NO_2 and NOx levels are summarized in Tables 4 and 5, respectively.

As can be seen in Figure VII, NO_2 and NOx levels in the State have declined over the past ten years. NO_2 and NOx levels were both lower in 2004 than they were in 2003 and in previous years.

Table 4 Nitrogen Dioxide (NO_2) Levels Measured in Rhode Island in 2004 (ppm)

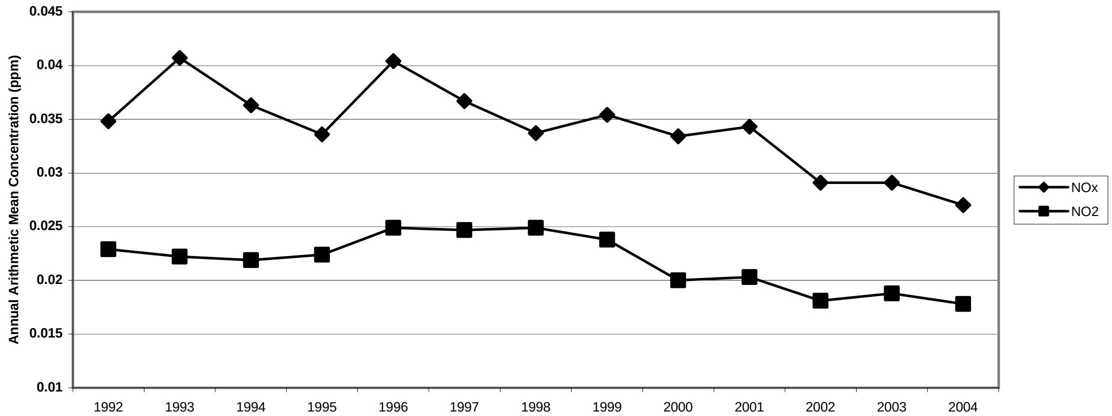
Stations	1-hour Values			Annual Mean (NAAQS = 0.053 ppm)	
	# of Observations	1st Maximum	2nd Maximum	Observed Mean	# of Exceedances
Alton Jones W. Greenwich	819	0.010	0.009	N/A*	N/A
Brown University 10 Prospect St. Providence	7,602	0.058	0.054	0.018	0
Francis School 64 Bourne Ave. E. Providence	1,872	0.035	0.035	N/A*	N/A
Total					0

Table 5 Concentrations of Oxides of Nitrogen (NOx) Measured in Rhode Island in 2004 (ppm)

Stations	1-hour Values			Annual Mean
	# of Observations	1st Maximum	2nd Maximum	
Alton Jones W. Greenwich	819	0.013	0.011	N/A*
Brown University 10 Prospect St. Providence	7,602	0.390	0.385	0.0270
Francis School 65 Bourne Ave. E. Providence	1,872	0.070	0.053	N/A*

* N/A = Not applicable. The W. Greenwich and E. Providence NO_2/NOx monitors are operated only in June, July and August. Since those monitors do not operate for the whole year, annual means cannot be calculated for those sites. Note that, due to equipment malfunction, the W. Greenwich NO_2/NOx monitor operated only from June 1 – July 13 in 2004.

Figure VII
NITROGEN DIOXIDE (NO_2) and OXIDES OF NITROGEN (NOx)
Annual Average Concentrations at Brown University, Providence Site
NO_2 Standard = 0.053 ppm



OZONE (O_3)

Ozone (O_3) is a photochemical oxidant which is the major component of smog. Elevated concentrations of ground level ozone are a major health and environmental concern. Ozone is formed in the atmosphere when hydrocarbons and oxides of nitrogen (NOx) emitted by mobile and stationary sources react in the presence of elevated temperatures and sunlight.

Because airborne hydrocarbons and NOx can be transported over long distances before being converted to ozone, sources emitting those pollutants in states upwind of Rhode Island contribute to the State's ozone problem. Ozone levels in Rhode Island generally are highest on hot sunny summer days when the winds are from the west or southwest. Based on the one-hour average NAAQS for ozone, Rhode Island is classified as a serious nonattainment area.

People exposed to elevated ozone levels experience eye, nose and throat irritation; coughing; chest pain; shortness of breath; decreased lung function; headache; and fatigue. Repeated exposures can increase susceptibility to respiratory infection and lung inflammation, and can aggravate preexisting respiratory diseases, such as asthma. Long-term exposures can cause irreversible changes in the lungs, leading to chronic respiratory illnesses such as emphysema and chronic bronchitis and to premature aging of the lungs.

Children, who are frequently active outside during the summertime when ozone levels are at their highest, are at a high risk for ozone related effects. Adults who work or exercise outside and people with respiratory and heart diseases are also at an increased risk. Elevated ozone levels also reduce agricultural and commercial forest yields; reduce the growth and survivability rates of tree seedlings; increase tree and plant susceptibility to disease, pests and other environmental stresses; and have long-term effects on forests and ecosystems.

After a lengthy scientific review which included an extensive external review process, the USEPA determined in 1997 that the one-hour average ozone NAAQS, 0.12 ppm, was not sufficiently stringent to protect public health and the environment. In response to this determination, the USEPA promulgated a new ozone NAAQS of 0.08 ppm as an 8-hour average in July 1997.

In 2004, three ozone monitors were operated in the State during the ozone season (April - September). The locations of those monitors are listed in Table 2 and displayed in Figure I. The 1-hour ozone NAAQS was exceeded at the Narragansett and W. Greenwich monitors on one day in 2004; no exceedances of the 1-hour standard were recorded at the E. Providence site in 2004. The highest 1-hour concentration of the year, 0.136 ppm, was recorded in Narragansett and is 113% of the corresponding NAAQS.

A monitor is in violation of the 1-hour ozone NAAQS if the fourth highest maximum daily 1-hour concentration in a three-year period is greater than or equal to 0.125 ppm. The fourth highest 1-hour concentration during the 2002 – 2004 periods was 0.121 ppm at the West Greenwich site, 0.115 at the East Providence site and 0.120 ppm at Narragansett.

The 8-hour ozone NAAQS was exceeded at one or more of the Rhode Island sites on four days in 2004, May 11^{th} and 12^{th} and June 8^{th} and 9th. Exceedances were recorded at the Narragansett site on all four days and at the W. Greenwich and E. Providence sites on the two June days. The highest 8-hour concentration recorded, at the Narragansett site, was 0.110 ppm, 138% of the NAAQS. 2004 ozone levels are summarized in Table 6a and 6b.

A monitor is in violation of the 8-hour ozone NAAQS if the average of the fourth highest daily maximum 8-hour concentrations for each year in a three-year period is greater than or equal to 0.085 ppm. During the 2002 – 2004 periods, these values were 0.087 ppm at the West Greenwich site, 0.084 at the East Providence site and 0.090 ppm at Narragansett. Therefore, two of the three Rhode Island monitors violated the 8-hour NAAQS for ozone during that time period.

Figure VIII shows the number of days that the 1-hour ozone standard was exceeded during each year since 1990 at each monitoring site. Due to decreased emissions of ozone precursors in Rhode Island and upwind states, the number of exceedances recorded per year decreased significantly in the early 1990s. Since 1992, the number of one-hour exceedances at each site has fluctuated in the range of zero to three days per year, depending largely on weather conditions.

Similarly, since a decline in the early 1990's, there has been no clear trend in the number of days per year that the 8-hour ozone standard is exceeded in the State, as can be seen in Figure IX. As with the one-hour levels, 8-hour ozone concentrations in any given year are significantly influenced by the weather patterns that occur during the summer of that year. Since the summer of 2004 was cool and dry, the number of 8-hour exceedances in 2004 was lower than during the hot summers of 2001 and 2002.

Table 6a One-Hour Average Ozone Levels Measured in Rhode Island in 2004(ppm) (NAAQS = 0.12 ppm)

Stations	# of Observations	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	# of Exceedances
Alton Jones W. Greenwich	177	0.131	0.118	0.103	0.093	1
Francis School 10 Prospect St. E. Providence	176	0.115	0.113	0.092	0.091	0
EPA Laboratory 27 Tarzwell Dr. Narragansett	181	0.136	0.111	0.110	0.100	1
Total						2

Table 6b Eight-Hour Average Ozone Levels Measured in Rhode Island in 2004(ppm) (NAAQS = 0.08 ppm)

Stations	# of Observations	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	# of Exceedances
Alton Jones W. Greenwich	174	0.103	0.095	0.081	0.080	2
Francis School 10 Prospect St. E. Providence	168	0.094	0.093	0.080	0.077	2
EPA Laboratory 27 Tarzwell Dr. Narragansett	180	0.110	0.097	0.095	0.086	4
Total						8

Figure VIII
OZONE (O_3)
Exceedances of the One-Hour Standard
One-Hour Standard = 0.12 ppm

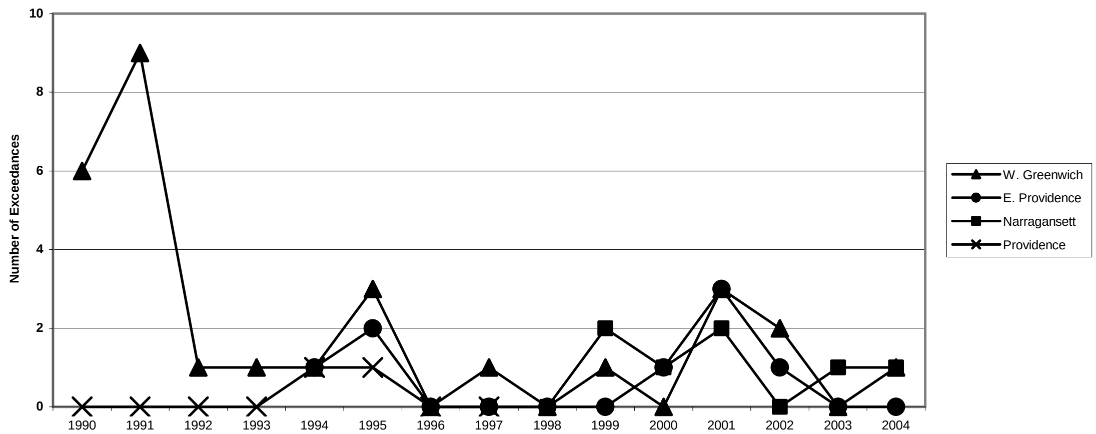
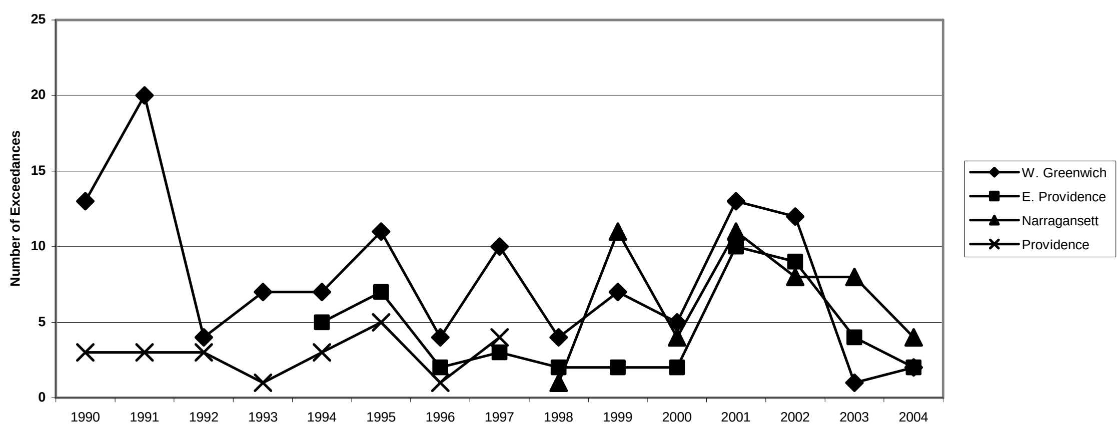


Figure IX
OZONE (O3)
Exceedances of the 8-Hour Standard
8-Hour Standard = 0.08 ppm



PARTICULATE MATTER

Airborne particulate matter (PM) is generated by the operation of mobile and stationary sources, including diesel trucks, wood stoves, power plants, and industrial processes, as well as by natural and human activities. PM is both emitted directly from sources and formed in the atmosphere by chemical reactions of gaseous pollutants. The chemical and physical compositions of airborne particles vary widely.

The NAAQS for PM focus on small particles, because inhaled small particles can travel to the lower regions of the respiratory tract and are therefore associated with significant health effects. The PM-10 standard regulates particles with diameters of 10 micrometers (one-seventh the width of a human hair) or less and the PM-2.5 or fine particulate standard, which was promulgated in July 1997, regulates particles with diameters equal to or smaller than 2.5 micrometers.

Exposure to PM has been linked to a variety of health effects, including coughing, difficult or painful breathing, chronic bronchitis, aggravated asthma, increased respiratory-related hospital admissions and emergency room visits, and premature death. The elderly, children, and people with heart or lung diseases like emphysema, bronchitis and asthma are at particular risk for those effects. Airborne PM also impairs visibility and can soil and damage materials.

Rhode Island has monitored PM-10 since 1985 and PM-2.5 since 1999.

PM-10

In 2004, Rhode Island operated a network of four PM-10 monitoring sites: the Johnson and Wales library on Dorrance Street in downtown Providence; Vernon Street, Pawtucket, adjacent to Route I-95*;* the Urban League building in urban South Providence and the Alton Jones campus of the University of Rhode Island in West Greenwich, a background rural site. The monitor that was located at a site on Fountain Street in downtown Providence was moved to the nearby Johnson and Wales site at the end of 2003 due to the planned demolition of the Fountain Street building.

The Urban League site is a National Air Toxic Trends (NATTS) site; PM-10 samples collected at that site are also analyzed for several metals. Rhode Island also collected PM-10 samples at the Bridgham School on Westminster Street in Providence beginning in March 2004. These samples were collected as part of a one-year toxics study at that site and were also analyzed for metals.

The NAAQS for PM-10 are 150 $\mu g/m^3$ as a 24-hour average and 50 $\mu g/m^3$ as an annual arithmetic mean. As is shown in Table 7a, Rhode Island PM-10 levels in 2004, as in previous years, did not exceed those standards. The maximum 24-hour PM-10 concentration in 2004, which was measured at the Urban League site, was 35% of the NAAQS, and the maximum annual average PM-10 concentration, which was at the Vernon Street site, was 42% of the corresponding NAAQS.

Figure X shows the annual average PM-10 levels measured in the past ten years. The highest PM-10 levels measured each year through 2001were at the Allens Avenue site, which was located immediately adjacent to Route I-95 in Providence. That site reflected worst-case levels and was not representative of neighborhood exposures. Monitoring at the Allens Avenue site was discontinued in 2002 due to extensive construction and demolition activity in the area associated with a highway relocation project. Since the discontinuation of the Allens Avenue site, the monitor at the Vernon Street site, which is located near Rte. I-95 in Pawtucket, consistently records the highest annual mean PM-10 levels in the State, The annual mean PM-10 concentrations at the Vernon Street site in 2004, as in the two previous years, was approximately 3 ug/m^3 higher than at the other urban sites and approximately double that at the rural W. Greenwich site.

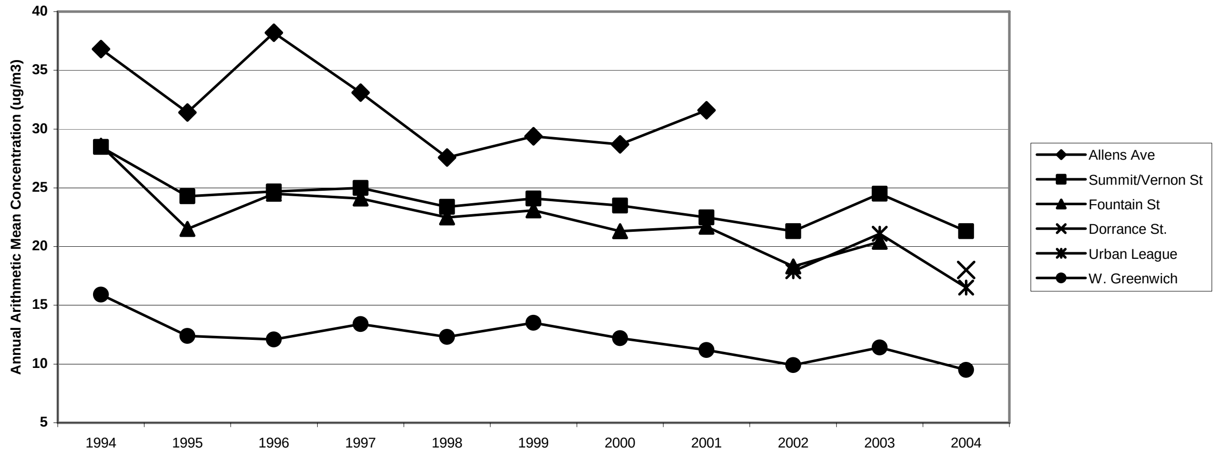
The average PM-10 concentrations at the Rhode Island sites show a slight downward trend over the past ten years. In 2003, the mean levels at all sites were higher than in the previous year, but in 2004 the mean levels again decreased.

Table 7a PM–10 Concentrations in Rhode Island in 2004(ug/m3)
NAAQS = 150 ug/m3 (24-hour average), 50 ug/m3 (annual mean)

Stations	24-hour Values						Annual Mean
	# Of Observations.	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	# of Exceedances	
Bridgham School Providence	48	50	42	31	29	0	N/A*
Vernon St. Pawtucket	61	50	45	43	41	0	21
Alton Jones W. Greenwich	59	38	24	24	23	0	10
212 Prairie Ave. Providence	60	53	37	30	30	0	17
111 Dorrance St. Providence Totals	56	50	37	35	31	0	18
						0	

* Since PM-10 samples were not collected at this site in January and February of 2004, an annual average could not be calculated.

Figure X
PARTICULATE MATTER (PM-10)
Annual Average Concentrations
Standard = 50 ug/m^3



FINE PARTICULATE MATTER (PM-2.5)

As discussed above, an NAAQS for PM-2.5 was promulgated in July 1997. In 1999, RI DEM began operating a network of PM-2.5 monitors to determine whether Rhode Island is in compliance with those standards.

PM-2.5 was measured at four sites in the State in 2004. Urban core sites, which reflect population exposure in urban areas, are located at the Urban League building on Prairie Avenue in Providence; at a trailer on Vernon Street in Pawtucket, adjacent to Route 95; on the roof of a building on Eddy Street in Providence and at a trailer adjacent to the Francis School in East Providence, which is downwind of the Providence metropolitan area. A background/transport rural site is located at the Alton Jones campus of the University of Rhode Island in West Greenwich. The W. Greenwich, Pawtucket, and Urban League sites are also PM-10 sites.

Rhode Island also operates continuous PM-2.5 monitors at four sites - a TEOM continuous PM2.5 monitor at the East Providence site, a TEOM and a Beta Attenuation Monitor (BAM) at the Urban League site, a BAM at the West Greenwich site and, beginning in October 2004, a BAM at the USEPA laboratory in Narragansett, a coastal site where ozone is also measured. The continuous instrumentation does not produce data that are identical to those produced by the filter-based Federal Reference Method (FRM), and, thus, these data cannot be used for determining compliance with the NAAQS. However, the continuous monitors provide vital real-time data which are used for forecasting PM-2.5 levels, for issuing health alerts and for tracking PM-2.5 levels.

Rhode Island also began operating PM2.5 speciation samplers at the East Providence and Urban League sites in June 2002. In May 2004, the East Providence speciation site was discontinued and the frequency of collection of speciated PM-10 samples at the Urban League site was increased from one in six days to a one in three day schedule. Speciation monitors provide valuable data on the composition of PM2.5 which are useful for identifying the sources and for characterizing the toxicity of this pollutant.

As can be seen in Table 7b, the average concentration at the Eddy Street site in 2004, 12.2 $\mu g/m^3$, was higher than at the other sites, probably due to the motor vehicle traffic downtown. The levels at the rural site in W. Greenwich were lower than those at the urban sites, but the difference was not as substantial as was the case with PM-10.

The short-term NAAQS for PM-2.5 is 65 $\mu g/m^3$ as a 24-hour average. As can be seen in Table 7b, PM-2.5 concentrations in Rhode Island in 2004 did not exceed the 24-hour average NAAQS at any of the sites. The highest 24-hour level of PM-2.5 was 41 $\mu g/m^3$, which was recorded at the Urban League site on June 8, 2004.

It is generally accepted by members of the scientific and regulatory communities, including the USEPA, that exposure to concentrations of PM-2.5 concentrations substantially below the standard can cause health effects. In its Air Quality Index Reporting rule, discussed above, the USEPA classifies 24-hour average PM-2.5 levels between 40 and 64 $\mu g/m^3$ as “unhealthy for sensitive groups,” even though those levels are below the corresponding standard. Groups sensitive to PM-2.5 health effects include children, the elderly, and people with heart or respiratory disease. Other experts have recommended reducing the 24-hour PM-2.5 NAAQS to an even lower level. In 2004, PM-2.5 concentrations above 40 $\mu g/m^3$ were recorded in Rhode Island on one day and levels above 30 $\mu g/m^3$ were recorded on 7 days. Levels were generally highest during the summer months, although elevated levels occasionally also occurred in the colder months.

Note that on the day in 2004 that the PM-2.5 level was in the USEPA’s “unhealthy for sensitive groups” range, the ozone levels were also elevated. Therefore, Rhode Island residents were exposed to elevated levels of two potent respiratory irritants on that day.

In December 2004, the USEPA designated the entire State of Rhode Island as an attainment area for the PM-2.5 NAAQS. As can been seen in Figure XI, annual average PM-2.5 concentrations at the Rhode Island sites have been consistently lower than the annual average NAAQS since measurement of that pollutant began. The 24-hour concentrations measured at all sites have also consistently been below the short-term PM-2.5 standard.

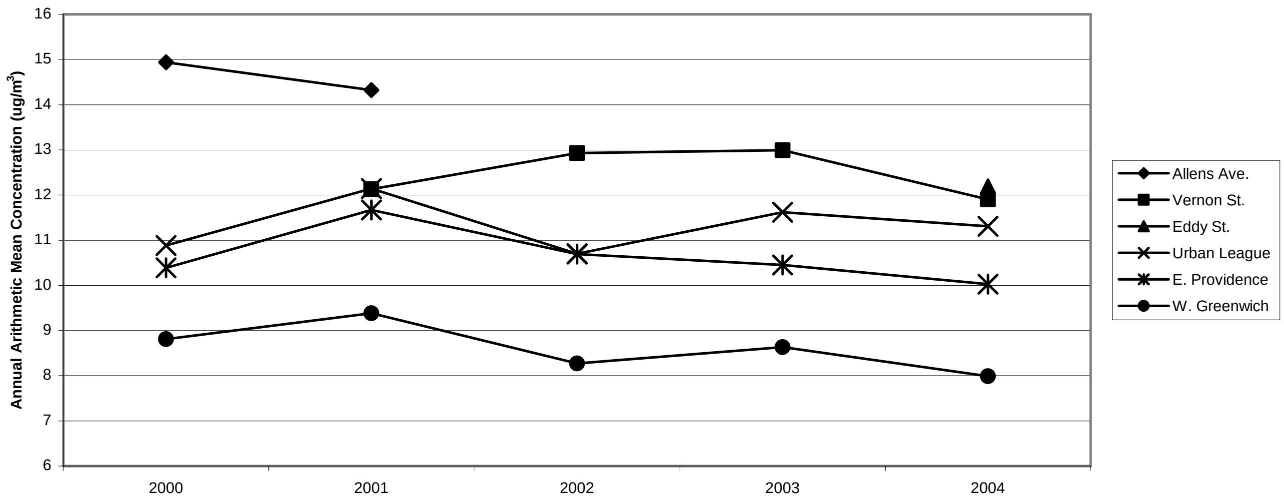
The annual average PM-2.5 levels measured in 2000 and 2001 at a site on Allens Avenue in Providence were higher than at the other sites and almost as high as the annual average NAAQS level. However, since that monitor was located beside the highway in an area that was not accessible to the public, the PM-2.5 levels measured at that site were not appropriate for determining compliance with the NAAQS. Monitoring at the Allens Avenue site was discontinued in 2002 due to massive construction and demolition activity in the area and that monitor was relocated at the beginning of 2004 to the Eddy Street site, which is at a location in the same area that is representative of population exposure. The average PM-2.5 concentration at the Eddy Street site in 2004 was similar to that at the Vernon Street site and was below the corresponding NAAQS.

Table 7b PM-2.5 Concentrations in Rhode Island in 2004 (ug/m3)
NAAQS = 65 ug/m3 (24-hour average), 15ug/m3 (annual mean)

Stations	24-hour Values							Annual Mean
	# Of Observations.	1st Maximum	2nd Maximum	3rd Maximum	4th Maximum	98th Percentile	# of Exceedances	
Francis School E. Providence	293	35	32	30	30	28	0	10.0
Vernon St Pawtucket	110	34	32	29	27	29	0	11.9
Alton Jones W. Greenwich	97	31	28	26	22	28	0	8.0*
Prairie Avenue Providence	294	37	34	33	31	31	0	11.3
695 Eddy St Providence	102	41	34	27	27	27	0	12.2
Totals							0	

*Data capture at this one site was insufficient for calculating an accurate annual mean.

Figure XI
FINE PARTICULATE MATTER (PM-2.5)
Annual Average Concentrations
Stamdard = 15 ug/m^3



SULFUR DIOXIDE (SO2)

Sulfur dioxide (SO_2) is emitted primarily by sources burning fossil fuels to produce heat or electricity. Exposures to high concentrations of SO_2 cause respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease such as bronchitis or emphysema are most susceptible to the adverse health effects of SO_2.

SO_2 combines with water in the atmosphere to form sulfates, which can cause acidification of lakes and streams, accelerated corrosion of buildings and monuments, reduced visibility, and adverse health effects.

The primary (health-based) NAAQS for SO_2 are 0.03 ppm as an annual arithmetic mean and 0.14 ppm as a 24-hour average. The USEPA has also set a secondary NAAQS for SO_2, 0.50 ppm as a three- hour average, to protect the environment, property, and aesthetics.

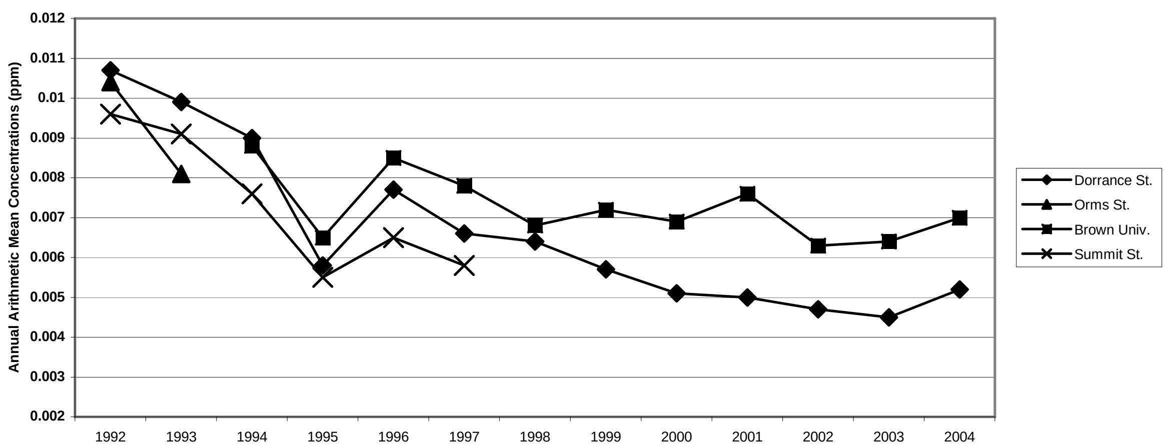
The State of Rhode Island has been in compliance with these standards since 1975. In 2004, SO_2 was monitored at two sites, Brown University and Dorrrance Street, both in Providence. The highest SO_2 concentrations measured in 2004 in the State, recorded at the Brown University monitor, were 23% of the annual NAAQS, 17% of the 24-hour standard, and 8% of the 3-hour standard. (See Table 8).

Figure XII shows annual arithmetic mean concentrations of SO_2 at Rhode Island monitoring sites between 1992 and 2004. Annual mean SO_2 concentrations decreased during that time period. However, average SO_2 concentrations at both sites were a little higher than those of 2003.

Table 8 Rhode Island 2004 Sulfur Dioxide (SO_2) Levels

Stations	1-Hour Values			3-Hour Values (NAAQS = 0.50 ppm)			24-hour Values (NAAQS = 0.14 ppm)			Annual Mean
	# of Observations	1st Max.	2nd Max.	1st Max.	2nd Max.	# of Exceedances	1st Max.	2nd Max.	# of Exceedances	(NAAQS = 0.03 ppm)
Brown Univer. 10 Prospect St. Providence	8,083	0.060	0.047	0.041	0.037	0	0.024	0.024	0	0.007
76 Dorrance St. Providence	8,436	0.061	0.044	0.035	0.034	0	0.021	0.018	0	0.005
Totals						0			0	

Figure XII
SULFUR DIOXIDE (SO_2)
Annual Average Concentrations
Standard = 0.03 ppm



PHOTOCHEMICAL ASSESSMENT MONITORING STATIONS (PAMS)

Although ground-level ozone concentrations in Rhode Island have decreased over the past ten years, the State, as well as much of the rest of the Northeast, continues to violate the one-hour and eight-hour ozone NAAQS.

Ground level ozone is a regional problem; ozone precursors (NOx and VOCs) emitted in one state can contribute to elevated ozone levels in states that are many miles downwind. The photochemical reactions involved in ozone formation are influenced by a number of factors, including the relative concentrations of various precursor chemicals in the atmosphere and a variety of meteorological parameters. Therefore, identifying emissions control strategies that effectively reduce ozone levels in nonattainment areas is a complex task.

In order to obtain ambient air quality data useful for evaluating such strategies, the Clean Air Act Amendments of 1990 (CAAA) required serious, severe and extreme ozone nonattainment areas to establish enhanced monitoring networks for ozone and ozone precursors. In response to that mandate, the USEPA promulgated rules in 1993 that required the establishment of a network of Photochemical Assessment Monitoring Stations (PAMS) to measure ozone, NOx, VOCs (including carbonyls), and meteorological parameters in nonattainment areas.

Rhode Island's PAMS network consists of four sites: one Type 1 site, one Type 2 site, one Type 3 site and one Type 4 site. Type 1 sites are located upwind of nonattainment areas and are used to measure concentrations of pollutants in the area. Type 2 sites are located immediately downwind of the area of maximum precursor emissions, which in Rhode Island is the Providence metropolitan area. Type 3 sites are located 10-30 miles downwind of the urban area, and are used to track the movement of precursor pollutants and the resulting formation of ozone. Type 4 sites are located further downwind, and are used to track pollutants leaving the area.

Two of Rhode Island's PAMS sites are located within the State boundaries; the Type 1 site at the Alton Jones campus of the University of Rhode Island in W. Greenwich and the Type 2 site at the Francis School in East Providence. Due to the proximity of the Providence metropolitan area to the Massachusetts border, the Type 3 and 4 sites are located in Massachusetts. In 2004, those sites were located on the Blue Hill in Milton, Massachusetts and in Truro, Massachusetts, respectively. At the W. Greenwich Type I PAMS site, 24-hour samples VOC are collected every sixth day year round. In 2004, eight three-hour VOC samples per day were collected at that site on three days in July during an ozone episode. At the Type 2 site in East Providence, eight three-hour VOC samples are collected daily and eight three-hour carbonyl samples are collected every third day during June, July and August, while 24-hour VOC and carbonyl samples are collected every sixth day year round. The two sites in Massachusetts collect eight three-hour VOC samples every day during June, July and August.

VOC samples are analyzed for approximately 56 substances which are ozone precursors and/or air toxics. The carbonyl samples are analyzed for formaldehyde, acetaldehyde and acetone. The PAMS sites also measure ozone, NOx and surface meteorological conditions during the summer months. PAMS monitoring began at the East Providence site in 1994 and at the West Greenwich site in 1995.

The data from the Rhode Island PAMS sites, combined with results from similar sites in the other states, are being used to identify sources of ozone precursors, to track migration of those pollutants, to determine the concentrations of various toxic air pollutants in the region, to track changes in ambient levels over time, and to verify the inputs and results of regional ozone modeling.

AIR TOXICS

Many of the substances measured at the PAMS sites are air toxics in addition to being ozone precursors. Since the PAMS sites have been operated for a decade, data from those sites provide useful information about trends in air toxics concentrations. In addition, RI DEM began operating an air toxics monitoring site in May 2001 that became a National Air Toxics Trends Site (NATTS) in 2002. That site is located at the Urban League building in Providence, an urban residential area that is not immediately impacted by localized industrial or commercial sources. In addition to VOCs and carbonyls, PM-10, PM-10 metals, PM-2.5 and speciated PM-2.5 are also monitored at that site. In 2004, VOCs were also monitored at two other sites in Rhode Island: at the Vernon Street, Pawtucket site, adjacent to I-95, and, as part of a one-year study, at the Bridgham School on Westminster Street in the Olneyville area of Providence, an urban residential area adjacent to industrial sources.

Benzene, a constituent of gasoline which causes leukemia in humans, is one of the toxics measured in the VOC samples. The average benzene concentrations measured at the PAMS and toxics sites for the years 1995 –2004 are displayed in Figure XIII. Benzene levels dropped sharply between 1995 and 1996, probably because of the implementation of rules requiring the sale of reformulated gasoline with reduced benzene content in late 1995. In the succeeding years, ambient benzene levels have continued to show a downward trend. This trend continued in 2004.

Due to the ubiquitous nature of motor vehicle traffic, benzene, as well as other gasoline constituents and components of motor vehicle exhaust, such as the carcinogen 1, 3-butadiene, are present in the ambient air throughout the State. However, the average concentrations of those pollutants are higher in urban and highly trafficked areas than in more rural areas of the State. As can be seen in Figure XIV, the mean concentration of benzene in 2004 at the suburban E. Providence site was twice as high as at the rural site in W. Greenwich. The average benzene concentrations at the two Providence sites were nearly three times higher than at the rural site and the level at the Pawtucket site, which is in a residential area next to the highway, was almost four times that at the rural site.

Intrastate variations in concentrations were even more substantial for 1, 3-butadiene. The 2004 average 1, 3-butadiene concentration at the E. Providence site was approximately 2.5 times that in W. Greenwich. Concentrations of 1, 3-butadiene at the Providence sites were 4 – 5 times higher and at the Pawtucket site more than 7 times higher than at the rural site in W. Greenwich.

Similarly, as shown in Figure XV, the concentrations of the industrial/commercial chlorinated cleaning solvents trichloroethylene and perchloroethylene were substantially higher in the urban locations than at the rural site. The average trichloroethylene concentration in 2004 at the Olneyville site was 140 times higher than at the W. Greenwich site. Average trichloroethylene levels at the Vernon Street, Urban League and E. Providence sites were 55, 45 and 23 times that in W. Greenwich, respectively.

The intrastate differences between levels of perchloroethylene at the rural and urban sites were less dramatic than for trichloroethylene but were still substantial. Average perchloroethylene levels at the three urban sites (Olneyville, Vernon St. and Urban League) in 2004 were approximately equal and were five times that at the W. Greenwich site, while the average concentration in E. Providence was approximately four times that in W. Greenwich.

Average ambient concentrations of the carbonyl compounds formaldehyde and acetaldehyde at the East Providence site for 1995 –2004 and at the Urban League site for 2002- 2004 are displayed in Figure XVI. Carbonyls are emitted by combustion sources but, like ozone, substantial amounts of carbonyls are also formed by photochemical reactions in the atmosphere. Therefore, carbonyl levels tend to be highest in the summer and average carbonyl concentrations in years with hot summers tend to be higher than in cooler years. This may explain the observation that levels of both formaldehyde and acetaldehyde were lower in 2004 than in the hotter years of 2001 and 2002.

The average formaldehyde levels at the Urban League site in 2003 and 2004 were slightly higher than at the E. Providence site, while average acetaldehyde sites were similar at the two sites. Formaldehyde and acetaldehyde, which are classified as probable human carcinogens, were also measured at the Olneyville site for a one-year period beginning in March 2004. The results of those measurements will be reported in the 2005 Air Quality Data Summary.

The mean concentrations of five metals measured in PM-10 at the Urban League NATTS site are listed in Table 9. Also listed in that table are health benchmarks for those metals, which are based on considerations of cancer risk. The mean cadmium level was substantially (93%) lower than the health benchmark for that substance. The mean concentrations of arsenic and lead were also somewhat (50% and 40%, respectively) lower than the corresponding health benchmarks. Note, however, that the means calculated for arsenic and cadmium have a greater degree of uncertainty because the levels of those substances were, on most days, lower than the level that could be detected by the sampling/analytical method used.

The mean concentration of nickel measured was 30% higher than the corresponding health benchmark. Airborne nickel is generated by the combustion of fossil fuel by stationary and mobile sources, by incineration of metal-containing materials and by certain industrial processes. The mean concentration of total chromium was nearly eight times the health benchmark for hexavalent chromium, the most toxic form of chromium; however, it is not known at this time how much of the total chromium measured is in the toxic hexavalent form. In 2005, RI DEM will begin to sample for hexavalent, as well as for total chromium.

Table 9 Rhode Island 2004 Metals Levels in PM-10

	2004 Mean ($\mu g/m^3$)	Health Benchmark ($\mu g/m^3$)	Mean/Benchmark
Arsenic	0.00009*	0.0002	0.5*
Cadmium	0.00004*	0.0006	0.07*
Chromium	0.00062	0.00008**	7.8**
Lead	0.0050	0.008	0.6
Nickel	0.0051	0.004	1.3

*59 of the 60 measurements of arsenic and cadmium were below the method detection limits for the method used to measure concentrations of those substances. This increases the uncertainty of the mean concentrations calculated for those substances.
**The chromium mean concentration is for total chromium, while the health benchmark is for the most toxic form of chromium, the hexavalent form. It is likely that most of the chromium present in the ambient air is not in the hexavalent form, so the actual mean/benchmark ratio is probably significantly lower. Beginning in 2005, hexavalent chromium, as well as total chromium, will be measured at the Urban League site.

Figure XIII
BENZENE
Annual Average Concentrations

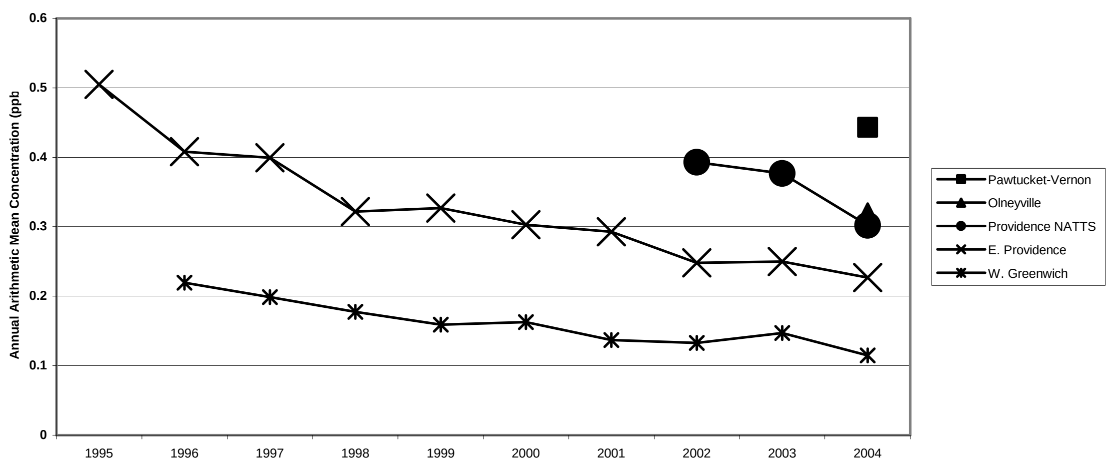


Figure XIV
MOBILE SOURCE TOXIC VOLATILE ORGANICS
2004 Annual Mean Concentrations

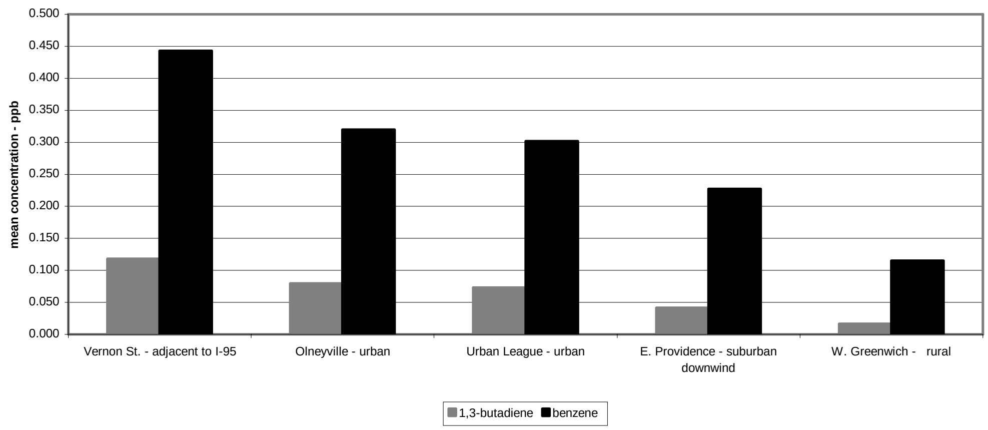


Figure XV CHLORINATED SOLVENTS
2004 Annual Mean Concentrations (ppb)

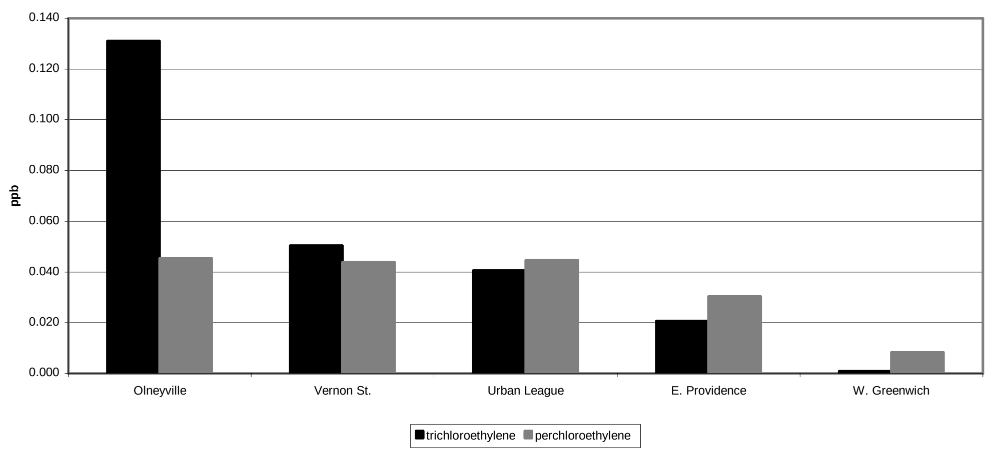
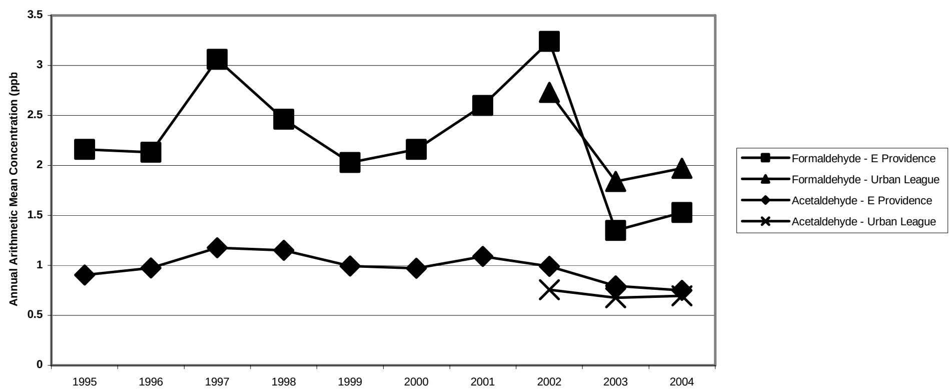


Figure XVI
CARBONYLS
Annual Average Concentrations



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