1991

STATE OF CONNECTICUT
ANNUAL AIR QUALITY SUMMARY

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I. INTRODUCTION

The 1991 Air Quality Summary of ambient air quality in Connecticut is a compilation of all air pollutant measurements made at the Department of Environmental Protection (DEP) air monitoring network sites.

A. OVERVIEW OF AIR POLLUTANT CONCENTRATIONS IN CONNECTICUT

The assessment of ambient air quality in Connecticut is made by comparing the measured concentrations of a pollutant to each of two Federal air quality standards. The first is the primary standard which is established to protect public health with an adequate margin of safety. The second is the secondary standard which is established to protect plants and animals and to prevent economic damage. The specific air quality standards are listed in Table 1-1 along with the time and data constraints imposed on each.

The following section briefly describes the status of Connecticut's air quality for the year 1991. More detailed discussions of each of the six pollutants are provided in subsequent sections of this Air Quality Summary.

1. PARTICULATE MATTER (PM_{10})

Revision of the Particulate Matter Standard - In 1971, the federal Environmental Protection Agency (EPA) promulgated primary and secondary national ambient air quality standards for particulate matter, measured as total suspended particulates or "TSP." The primary standards were set at 260 $\mu g/m^3$, 24-hour average not to be exceeded more than once per year, and 75 $\mu g/m^3$, annual geometric mean. The secondary standard was set at 150 $\mu g/m^3$, 24-hour average not to be exceeded more than once per year. These standards were adopted by the state of Connecticut in 1972.

In accordance with sections 108 and 109 of the Clean Air Act, EPA has reviewed and revised the health and welfare criteria upon which these primary and secondary particulate matter standards were based. EPA found that a size-specific indicator for primary standards representing small particles was warranted and that it should include particles of diameter less than or equal to a nominal 10 micrometers "cut point." Such a standard would place substantially greater emphasis on controlling small particles than does a TSP indicator, but would not completely exclude larger particles from all control.

On March 20, 1984, EPA proposed changes in the standards for particulate matter based on its review and revision of the health and welfare criteria. On July 1, 1987, EPA announced its final decisions regarding these changes. They include: (1) replacing TSP as the indicator for particulate matter for the ambient standards with a new indicator that includes only those particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}); (2) replacing the 24-hour primary TSP standard with a 24-hour PM_{10} standard of 150 $\mu g/m^3$ with no more than one expected exceedance per year; (3) replacing the annual primary TSP standard with a PM_{10} standard of 50 $\mu g/m^3$, expected annual arithmetic mean; and (4) replacing the secondary TSP standard with 24-hour and annual PM_{10} standards that are identical in all respects to the primary standards. The state of Connecticut is in the process of adopting these standards.

Compliance Assessment - Measured PM_{10} concentrations during 1991 did not exceed the 50 μg/m^3 level of the primary and secondary annual standards or the 150 μg/m^3 level of the primary and secondary 24-hour standards at any site. Futhermore, the 24-hour standards were not violated because the "expected number of exceedances" for the most recent 3 years at each site did not exceed one per year. The annual standards were also not violated because the "expected annual mean" for the most recent 3 years at each site did not exceed 50 μg/m^3.

2. SULFUR DIOXIDE (SO_2)

Compliance Assessment - None of the air quality standards for sulfur dioxide were exceeded in Connecticut in 1991. Measured concentrations were below the 80 μg/m^3 primary annual standard, the 365 μg/m^3 primary 24-hour standard, and the 1300 μg/m^3 secondary 3-hour standard at all monitoring sites.

3. OZONE (O_3)

National Ambient Air Quality Standard (NAAQS) - On February 8, 1979, the U.S. Environmental Protection Agency (EPA) established an ambient air quality standard for ozone of 0.12 ppm for a one-hour average. That level is not to be exceeded more than once per year. Furthermore, in order to determine compliance with the 0.12 ppm ozone standard, EPA directs the states to record the number of daily exceedances of 0.12 ppm at a given monitoring site over a consecutive 3-year period and then calculate the average number of daily exceedances for this interval. If the resulting average value is less than or equal to 1.0, (that is, if the fourth highest daily value in a consecutive 3-year period is less than or equal to 0.12 ppm), the ozone standard is considered to be attained. The definition of the pollutant was also changed, along with the numerical value of the standard, partly because the instruments used to measure photochemical oxidants in the air really measure only ozone. Ozone is one of a group of chemicals which are formed photochemically in the air and are called photochemical oxidants. In the past, the two terms have often been used interchangeably. This Air Quality Summary uses the term "ozone" in conjunction with the new NAAQS to reflect the changes in both the numerical value of the NAAQS and the definition of the pollutant.

Compliance Assessment - The primary 1-hour ozone standard was frequently exceeded at all eleven DEP ozone monitoring sites in 1991 (see Table 1-2). Consequently, the standard was violated at those sites.

4. NITROGEN DIOXIDE (NO_2)

Compliance Assessment - The annual average NO_2 standard of 100 μg/m^3 was not exceeded at any site in Connecticut in 1991.

5. CARBON MONOXIDE (CO)

Compliance Assessment - The primary eight-hour standard of 9 ppm was exceeded at one of the five carbon monoxide monitoring sites in Connecticut during 1991. The standard was exceeded once at Hartford 017 (see Table 1-2). Since two exceedances at a particular site are required for the standard to be violated, this means that the eight-hour standard was not violated at any of the sites.

There were no exceedances and, therefore, no violations of the primary one-hour standard of 35 ppm at any carbon monoxide monitoring site in Connecticut in 1991.

6. LEAD (Pb)

Compliance Assessment - The primary and secondary ambient air quality standard for lead is 1.5 $\mu g/m^3$, maximum arithmetic mean averaged over three consecutive calendar months. As has been the case since 1980, the lead standard was not exceeded at any site in Connecticut during 1991.

B. AIR MONITORING NETWORK

A computerized Air Monitoring Network consisting of an IBM System 7 computer and numerous telemetered monitoring sites has operated in Connecticut for several years. In 1985, this data acquisition system was modernized by installing new data loggers at the monitoring sites and replacing the dedicated IBM System 7 computer with a non-dedicated Data General Eclipse MV10000 computer, which was replaced in 1988 with a MV15000 model. This essentially improved both data accuracy and data capture. As many as 13 measurement parameters are transmitted from a site via telephone lines to the Data General unit located in the DEP Hartford office. The data are then compiled three times daily into 24-hour summaries. The telemetered sites are located in the towns of Bridgeport (3), Danbury, East Hartford (2), East Haven, Enfield, Greenwich, Groton (2), Hartford (3), Madison, Mansfield, Middletown, New Haven (3), Stafford, Stamford (2), Stratford, Torrington and Waterbury.

Continuously measured parameters include the pollutants sulfur dioxide, particulates (measured as PM_{10}), carbon monoxide, nitrous oxide, total nitrogen oxides and ozone. Meteorological data consists of wind speed and direction, wind horizontal sigma, temperature, precipitation, barometric pressure and dew point.

The real-time capabilities of the telemetry network have enabled the Air Monitoring Unit to report the Pollutant Standards Index for a number of towns on a daily basis while continuously keeping a close watch for high pollution levels which may occur during adverse weather conditions.

The complete monitoring network used in 1991 consisted of the following:

31	Particulate matter (PM_{10}) hi-vol samplers
4	Particulate matter (PM_{10}) analyzers
5	Lead lo-vol samplers
13	Sulfur dioxide analyzers
11	Ozone analyzers
3	Nitrogen dioxide analyzers
5	Carbon monoxide analyzers

A complete description of all permanent air monitoring sites in Connecticut operated by DEP in 1991 is available from the Department of Environmental Protection, Bureau of Air Management, Monitoring and Radiation Division, State Office Building, Hartford, Connecticut, 06106.

C. POLLUTANT STANDARDS INDEX

The Pollutant Standards Index (PSI) is a daily air quality index recommended for common use in state and local agencies by the U.S. Environmental Protection Agency. Starting on November 15, 1976, Connecticut began reporting the PSI on a 7-day basis, but is currently reporting the PSI on a 5-day basis (i.e., with predictions for the weekends). The PSI incorporates three pollutants : sulfur dioxide, PM_{10} and ozone. The index converts each air pollutant concentration into a normalized number where the National Ambient Air Quality Standard for each pollutant corresponds to PSI = 100 and the Significant Harm Level corresponds to PSI = 500.

Figure 1-1 shows the breakdown of index values for the commonly reported pollutants (PM_{10}, SO_2, and O_3) in Connecticut. For the winter of 1991, Connecticut reported the PM_{10} PSI for the towns of Ansonia, Bridgeport, Danbury, East Hartford, Greenwich, Groton, Hartford, Meriden, Milford, Naugatuck, New Britain, New Haven, Norwalk, Norwich, Putnam, Stamford, Torrington, Wallingford, Waterbury and Willimantic; and reported the sulfur dioxide PSI for the towns of Bridgeport, Danbury, East Hartford, East Haven, Enfield, Greenwich, Groton, Hartford, Mansfield, New Haven, Stamford, and Waterbury. For the summer, the ozone PSI was reported for the towns of Bridgeport, Danbury, East Hartford, Greenwich, Groton, Madison, Middletown, New Haven, Stafford, Stratford and Torrington. Each day, the pollutant with the highest PSI value of all the pollutants being monitored is reported for each town, along with the dimensionless PSI number and a descriptor label to characterize the daily air quality. A descriptor label of each subsequent day's forecast is also included.

A telephone recording of the PSI is taped each afternoon at approximately 3 PM, five days a week, and can be heard by dialing 566-3449. Predictions for weekends are included on the Friday recordings. For answers to specific questions, you can call a DEP representative at 566-3310 . The PSI information, as well as health effects information, is also available to the public during weekdays from the American Lung Association of Connecticut in East Hartford. The number there is 289-5401 or 1-800-992-2263.

D. QUALITY ASSURANCE

Quality Assurance requirements for State and Local Air Monitoring Stations (SLAMS) and the National Air Monitoring Stations (NAMS), as part of the SLAMS network, are specified by the code of Federal Regulations, Title 40, Part 58, Appendix A.

The regulations were enacted to provide a consistent approach to Quality Assurance activities across the country so that ambient data with a defined precision and accuracy is produced.

A Quality Assurance program was initiated in Connecticut with written procedures covering, but not limited to, the following:

Equipment procurement
Equipment installation
Equipment calibration
Equipment operation
Sample analysis
Maintenance checks
Performance audits
Data handling
Data quality assessment

Quality assurance procedures for the above activities were fully operational on January 1, 1981 for all NAMS monitoring sites. On January 1, 1983 the above procedures were fully operational for all SLAMS monitoring sites.

Data precision and accuracy values are reported in the form of 95% probability limits as defined by equations found in Appendix A of the Federal regulations cited above.

1. **PRECISION**

Precision is a measure of data repeatability (grouping) and is determined as follows:

a. **Manual Samplers** (PM_{10})

A second (co-located) PM_{10} hi-vol sampler is placed alongside a regular PM_{10} network sampler and operated concurrently. The concentration values from the co-located hi-vol sampler are compared to the network sampler and precision values are generated from the comparison.

b. **Manual Samplers** (Lead)

A second (co-located) hi-vol sampler is placed alongside a regular network hi-vol sampler and operated concurrently. The concentration values from the co-located hi-vol sampler are compared to those from the network sampler, and precision values are generated from the comparison.

c. **Automated Analyzers** (SO_2, O_3, CO and NO_2)

All NAMS and SLAMS analyzers are challenged with a low level pollutant concentration a minimum of once every two weeks: 0.08 to 0.10 ppm for SO_2, O_3 and NO_2, and 8 to 10 ppm for CO. The comparison of analyzer response to input concentration is used to generate automated analyzer precision values.

2. **ACCURACY**

Accuracy is an estimate of the closeness of a measured value to a known value and is determined in the following manner:

a. **Manual Methods** (PM_{10})

Accuracy for PM_{10} is assessed by auditing the flow measurement phase of the sampling method. In Connecticut, this is accomplished by attaching a secondary standard calibrated orifice to the hi-vol inlet and comparing the flow rates. A minimum of 25% of the PM_{10} network samplers is audited each quarter.

b. **Manual Methods** (Lead)

Accuracy for lead is assessed by analyzing spiked samples and comparing the known spiked-sample concentrations with the measured concentrations. Accuracy measurements are obtained each quarter.

c. **Automated Analyzers** (SO_2, O_3, CO and NO_2)

Automated analyzer data accuracy is determined by challenging each analyzer with three predetermined concentration levels (four for NO_2). Each quarter, accuracy values are calculated for approximately 25% of the analyzers in a pollutant sampling network, at each concentration level. The results for each concentration of a particular pollutant are used to assess automated analyzer accuracy. The audit concentration levels are as follows:

SO_2, O_3, and NO_2 (PPM)	CO (PPM)
0.03 to 0.08	3 to 8
0.15 to 0.20	15 to 20
0.35 to 0.45	35 to 45
0.80 to 0.90 (NO_2 only)	

TABLE 1-1

ASSESSMENT OF AMBIENT AIR QUALITY

POLLUTANT	SAMPLING PERIOD	DATA REDUCTION	STATISTICAL BASE	AMBIENT AIR QUALITY STANDARDS			
				PRIMARY		SECONDARY	
				μg/m³	ppm	μg/m³	ppm
Particulates (PM_{10})[a]	24 Hours (every sixth day)	24-Hour Average	Annual Arithmetic Mean[b]	50[c]		50[c]	
			24-Hour Average	150[d]		150[d]	
Sulfur Oxides (measured as sulfur dioxide)	Continuous	1-Hour Average	Annual Arithmetic Mean[e]	80	0.03		
			24-Hour Average[e]	365[f]	0.14[f]		
			3-Hour Average[e]			1300[f]	
Nitrogen Dioxide	Continuous	1-Hour Average	Annual Arithmetic Mean[e]	100	0.05	100	0.05
Ozone	Continuous	1-Hour Average	1-Hour Average	235[g]	0.12[g]	235[g]	0.12[g]
Lead	24 Hours (every sixth day)	Monthly Composite	Weighted 3-Month Average[h]	1.5		1.5	
Carbon Monoxide	Continuous	1-Hour Average	8-Hour Average[e]	10[f,i]	9[f]	10[f,i]	9[f]
			1-Hour Average	40[f]	35[f]	40[f]	35[f]

[a] Particulate matter with an aerodynamic diameter not greater than a nominal 10 micrometers.

[b] EPA assessment criteria require 4 calendar quarters of data per year and at least 75% of the scheduled samples per calendar quarter in each of the most recent 3 years.

[c] The "expected annual mean" for the most recent 3 years.

[d] The "expected number of exceedances" per calendar year should be less than or equal to one, for the most recent 3 years.

[e] EPA assessment criteria require at least 75% of the possible data to compute a valid average. For the annual mean, 9 months of data are required, and each calendar quarter must have at least 2 months of data. Furthermore, a valid month must have at least 21 days of data, and a valid day must have at least 18 hours of data.

[f] Not to be exceeded more than once per year.

[g] Daily maximum not to be exceeded more than an average of once per year in three years at a site.

[h] State of Connecticut assessment criteria require at least 75% of the scheduled samples to compute a valid average.

[i] Units are mg/m³, not μg/m³.

TABLE 1-2

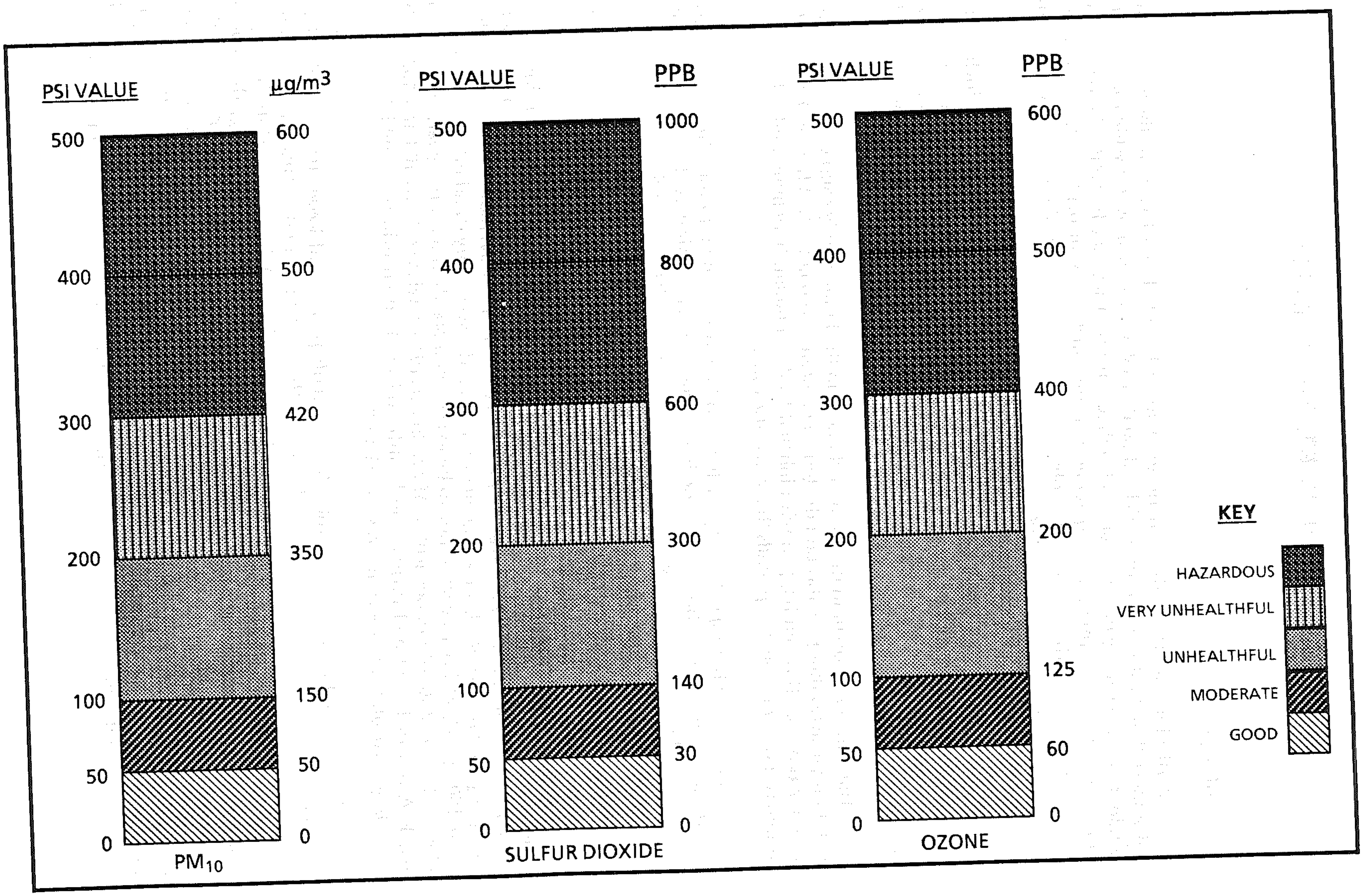
AIR QUALITY STANDARDS EXCEEDED IN CONNECTICUT IN 1991 BASED ON MEASURED CONCENTRATIONS

		OZONE		CARBON MONOXIDE	
		Level Exceeding 1-Hour Standard		Level Exceeding 8-Hour Standard	
TOWN	SITE	Highest Observed Level (ppm)	Number of Days Standard Exceeded	Highest Observed Level 8-Hour / 1-Hour (ppm)	Number of Times Standard Exceeded
Bridgeport	013	0.149	6	-	-
Danbury	123	0.153	6	-	-
East Hartford	003	0.155	4	-	-
Greenwich	017	0.161	9	-	-
Groton	008	0.169	8	-	-
Hartford	017	-	-	12.2 / 20.6	1
Madison	002	0.193	17	-	-
Middletown	007	0.170	8	-	-
New Haven	123	0.161	7	-	-
Stafford	001	0.165	2	-	-
Stratford	007	0.157	10	-	-
Torrington	006	0.133	2	-	-

N.B. A dash "-" means that the pollutant is not monitored at the site.

FIGURE 1-1

POLLUTANT STANDARDS INDEX



II. PARTICULATE MATTER

HEALTH EFFECTS

Particulate matter is the generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles originate from a variety of stationary and mobile sources. They may be emitted directly or formed in the atmosphere by transformations of gaseous emissions such as sulfur oxides, nitrogen oxides, and volatile organic substances. The chemical and physical properties of particulate matter vary greatly with time, region, meteorology and source category.

The major effects associated with high exposures to particulate matter include reduced lung function; interference with respiratory mechanics; aggravation or potentiation of existing respiratory and cardiovascular disease, such as chronic bronchitis and emphysema; increased susceptibility to infection; interference with clearance and other host defense mechanisms; damage to lung tissues; carcinogenesis and mortality.

Harm may also occur in the form of changes in the human body caused by chemical reactions with pollution particles that pass through the lung membranes to poison the blood or be carried by the blood to other organs. This can happen with inhaled lead, cadmium, beryllium, and other metals, and with certain complex organic compounds that can cause cancer.

Population subgroups that appear likely to be most sensitive to the effects of particulate matter include individuals with chronic obstructive pulmonary or cardiovascular disease, individuals with influenza, asthmatics, the elderly, children, smokers, and mouth or oronasal breathers.

REVISION OF THE PARTICULATE MATTER STANDARD

In 1971, the federal Environmental Protection Agency (EPA) promulgated primary and secondary national ambient air quality standards for particulate matter, measured as total suspended particulates or "TSP." The primary standards were set at 260 $\mu g/m^3$, 24-hour average not to be exceeded more than once per year, and 75 $\mu g/m^3$, annual geometric mean. The secondary standard, also measured as TSP, was set at 150 $\mu g/m^3$, 24-hour average not to be exceeded more than once per year. These standards were adopted by the state of Connecticut in 1972. In accordance with sections 108 and 109 of the Clean Air Act, EPA has reviewed and revised the health and welfare criteria upon which these primary and secondary particulate matter standards were based.

The TSP standard directs control efforts towards particles of lower risk to health because of its inclusion of large particles which can dominate the measured mass concentration, but which are deposited only in the extrathoracic region. Smaller particles penetrate furthest in the respiratory tract, settling in the tracheobronchial region and in the deepest portion of the lung, the alveolar region. Available evidence demonstrates that the risk of adverse health effects associated with deposition of typical ambient fine and coarse particles in the thorax are markedly greater than those associated with deposition in the extrathoracic region. EPA found that a size-specific indicator for primary standards representing small particles was warranted and that it should include particles of diameter less than or equal to a nominal 10 micrometers "cut point." Such a standard would place substantially greater emphasis on controlling smaller particles than does a TSP indicator, but would not completely exclude larger particles from all control.

On March 20, 1984, EPA proposed changes in the standards for particulate matter based on its review and revision of the health and welfare criteria. On July 1, 1987, EPA announced its final decisions regarding these changes. They include: (1) replacing TSP as the indicator for particulate matter for the ambient standards with a new indicator that includes only those particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}); (2) replacing the 24-hour primary TSP standard with a 24-hour PM_{10} standard of 150 $\mu g/m^3$ with no more than one expected exceedance per year; (3) replacing the annual primary TSP standard with a PM_{10} standard of 50 $\mu g/m^3$, expected annual arithmetic mean; and (4) replacing the secondary TSP standard with 24-hour and annual PM_{10} standards that are identical in all respects to the primary standards. The state of Connecticut is in the process of adopting these standards.

CONCLUSIONS

Measured PM_{10} concentrations during 1991 did not exceed the 50 $\mu g/m^3$ level of the primary and secondary annual standards or the 150 $\mu g/m^3$ level of the primary and secondary 24-hour standards at any site. Furthermore, the 24-hour standards were not violated because the "expected number of exceedances" for the most recent 3 years at each site did not exceed one per year. The annual standards were also not violated anywhere because the "expected annual mean" for the most recent 3 years at each site did not exceed 50 $\mu g/m^3$.

SAMPLE COLLECTION AND ANALYSIS

PM_{10} Sampler - Before 1988, Connecticut's particulate sampling network was comprised of standard high-volume (hi-vol) samplers, whose function was to measure TSP. With the promulgation of a PM_{10} standard, hi-vol samplers were needed that could screen out most particles larger than 10 microns. The samplers also had to be omnidirectional and have a constant inlet velocity so that wind direction and speed would not affect the amount of material collected.

In anticipation of a PM_{10} standard being promulgated, Connecticut installed a small number of PM_{10} samplers in 1985. The samplers, manufactured by Sierra-Andersen, were the first PM_{10} samplers on the market. These early samplers were found to have relatively high maintenance requirements and to be biased towards particles larger than 10 microns. To remedy these problems, the samplers were physically modified after 1986. In 1987, PM_{10} samplers by Wedding & Associates came on the market. These samplers replaced the Andersen samplers in the sampling network in 1988. The Wedding samplers have demonstrated lower maintenance requirements and greater precision (repeatability) and accuracy than the Andersen samplers they replaced.

The PM_{10} samplers, like the standard hi-vol samplers, operate from midnight to midnight (standard time) at least every sixth day at all sites. However, PM_{10} samplers use quartz fiber filters instead of fiberglass filters, in order to eliminate sulfate artifact formation. And the matter collected on the filter is analyzed only for weight and sulfates at the present time. The air flow is recorded during sampling. The weight in micrograms (μg) divided by the volume of air in standard cubic meters (m^3) yields the PM_{10} concentration for the day in micrograms per cubic meter.

High Volume Sampler (Hi-vol) - The high volume sampler resembles a vacuum cleaner in its operation, with an 8" X 10" piece of fiberglass filter paper replacing the vacuum bag. Hi-vols are equipped with retractable lids in order to eliminate the passive sampling error. The sampler normally operates every sixth day (midnight to midnight, standard time).

Low Volume Sampler (Lo-vol) - The low volume sampler is a 30-day continuous sampler. It is enclosed in a shelter similar to a hi-vol, uses the same fiberglass filter paper, but operates at an air sampling flow rate approximately one-tenth that used by a standard hi-vol (i.e., 4 cfm as opposed to 40-

60 cfm). The air flow through the lo-vol is measured by a temperature compensating dry gas meter. The lo-vol measurement is essentially an average for the 30-day sampling interval. The Department did not operate any lo-vol samplers in 1991.

The matter collected on the filters is analyzed for weight in the case of the PM_{10} samplers and for both weight and chemical composition in the case of the hi-vol samplers. The chemical composition of the suspended particulate matter is determined at each hi-vol site as follows. Two standardized strips of every filter are cut out and prepared for two different analyses. In the first analysis, a sample is digested in acid and the resulting solution is analyzed for metals by means of an atomic absorption spectrophotometer. The results are reported for each individual metal in $\mu g/m^3$. In the second analysis, a sample is dissolved in water, filtered and the resulting solution is analyzed by means of wet chemistry techniques to determine the concentration of certain water soluble components. The results are reported for each individual constituent of the water soluble fraction in $\mu g/m^3$.

DISCUSSION OF DATA

Monitoring Network - In 1991, 31 PM_{10} samplers were operated in Connecticut (see Figure 2-1). It should be noted that this total includes one sampler for site New Haven 018 when, in fact, there are five samplers at the site, which are operated seqentially in order to facilitate a daily sampling schedule.

As part of the 1991 network for monitoring the airborne concentrations of lead, five hi-vol samplers were used to gather information on the chemical composition of TSP in the state. These samplers were Bridgeport 010, East Hartford 004, Hartford 016, New Haven 018 and Waterbury 123.

Precision and Accuracy - Precision checks were conducted at three PM_{10} sampling sites which had co-located samplers. On the basis of 166 precision checks, the 95% probability limits for precision ranged from -6% to +11%. Accuracy is based on air flow through the monitor. The 95% probability limits for accuracy, based on 38 audits conducted on the PM_{10} monitoring system network, ranged from -1% to +8%. (See section I.D. of this Air Quality Summary for a discussion of precision and accuracy.)

Annual Averages - The Federal EPA has established minimum sampling criteria (see Table 1-1) for use in determining compliance with the primary and secondary annual NAAQS for PM_{10}. A site must have 75% of the scheduled samples in each calendar quarter for the the most recent 3 years. Using the EPA criteria, one finds that a determination of attainment or nonattainment of the 50 $\mu g/m^3$ primary and secondary annual standards could be reached at 27 of the 31 PM_{10} monitoring sites in Connecticut in 1991. These 27 sites proved to be in attainment of the annual standards. A determination of attainment or nonattainment could not be reached at Darien 001, Meriden 002, New Britain 012 and New London 004, where there were insufficient data at each site in at least one calendar quarter during the most recent three years. Nevertheless, given the 95 percent confidence limits about the annual mean at these sites (see Table 2-1), it is likely that attainment was achieved.

A summary of annual average PM_{10} data for 1989 -1991 is presented in Table 2-1. This table also includes an indication of whether the aforementioned EPA minimum sampling criteria were met at each site for each year. If the sampling was insufficient to meet the EPA criteria, an asterisk appears next to the number of samples.

Statistical Projections - The statistical projections presented in Table 2-1 are prepared by a DEP computer program which analyzes data from all sites operated by DEP. Input to the program includes the site location, the year, the number of samples (usually a maximum of 61), the annual arithmetic and geometric mean concentrations, and the arithmetic and geometric standard deviations. For each site, the program lists the input, calculates the 95% confidence limits about the annual arithmetic mean, and predicts the number of days in each year that the level of the primary and secondary 24-hour standards (150 $\mu g/m^3$) would have been exceeded if sampling had been conducted every day. For comparison,

Table 2-1 also shows the number of days at each site when the level of the primary and secondary 24-hour standards was actually exceeded, as demonstrated by actual measurements at the site.

The statistical predictions of the number of days that would have seen an exceedance of the level of the 24-hour standards are based on the assumption of a lognormal distribution of the data. They indicate that more frequent PM_{10} sampling in 1989 at New Haven 018 might have resulted in an exceedance of the 24-hour standards.

Because manpower and economic limitations dictate that PM_{10} sampling for particulate matter cannot be conducted every day, a degree of uncertainty is introduced as to whether the air quality at a site has either met or exceeded the level of the annual standards. This uncertainty can be expressed by means of a statistic called a confidence limit. Assuming a normal distribution of the pollutant data, 95% confidence limits were calculated about the annual arithmetic mean at each site. For example (see Table 2-1), at Bridgeport 014 in 1989, 59 samples were analyzed and an arithmetic mean of 36.5 $\mu g/m^3$ was then calculated. The columns labeled "95-PCT-LIMITS" show the lower and upper limits of the 95% confidence interval to be 33.0 and 40.0 $\mu g/m^3$, respectively. This means that, if sampling were done every day, there is a 95% chance that the true arithmetic mean would fall between these limits. Since the upper 95% limit is less than 50 $\mu g/m^3$, one can be confident that the level of the annual standards was not exceeded at the site. However, if the upper 95% limit were greater, and the lower limit less, than 50 $\mu g/m^3$, then one could not be confident that the standard was not exceeded at the site. And if both the upper and lower 95% limits were greater than 50 $\mu g/m^3$, then one could assume that the level of the standards was indeed exceeded sometime during the year. These three possibilities are illustrated in Figure 2-2.

Table 2-2 summarizes the statistical predictions from Table 2-1 regarding compliance with the level of the annual air quality standards, using the 95% confidence limit criteria. The table shows that the level of the primary and secondary annual standards was probably achieved at the 30 sites that met the minimum sampling criteria in 1991. The results for the years 1989 and 1990 are also tabulated.

It should be noted that the above discussion of statistics does not affect the actual determination of attainment or nonattainment of the PM_{10} standards. The promulgated regulations specify the requirements for making an attainment determination. Those requirements, mentioned in a limited way in Table 1-1, address the projection of exceedances and the calculation and use of arithmetic means in ways that are different from the foregoing discussion.

24-Hour Averages - Figure 2-3 presents the maximum 24-hour concentrations recorded at each site. There were no PM_{10} concentrations at any site that exceeded the 150 $\mu g/m^3$ level of the primary and secondary 24-hour standards in 1991.

Table 2-3 summarizes the statistical predictions from Table 2-1 regarding the number of sites that would have seen PM_{10} concentrations exceeding the level of the 24-hour standards, if sampling had been conducted every day. In 1991, there was no such site. The results for 1989 and 1990 are also given. In all cases, results are presented only for those sites that met the minimum sampling criteria for the year.

A determination of actual compliance with the primary and secondary 24-hour standards can be made for a site only when the minimum sampling criteria are met in each calendar quarter for the most recent 3 years. Based on these criteria, compliance was achieved at 27 of the 31 sites in 1991. A determination of compliance could not be made for Darien 001, Meriden 002, New Britain 012 and New London 004 because there were insufficient data at each site in at least one calendar quarter during the most recent three years. But based upon the data that is available, it is highly improbable that an exceedance would have occurred at any of these four sites.

Hi-vol Averages - Quarterly and annual averages of the chemical components from the hi-vol TSP/lead monitors have been computed for 1991 and are presented in Table 2-4.

10 High Days with Wind Data - Table 2-5 lists the 10 highest 24-hour average PM_{10} readings with the dates of occurrence for each PM_{10} hi-vol site in Connecticut which complied with EPA's minimum sampling criteria during 1991. This table also shows the average wind conditions which occurred on each of these dates. The resultant wind direction (DIR, in compass degrees clockwise from true north) and velocity (VEL, in mph), the average wind speed (SPD, in mph), and the ratio between the velocity and the speed are presented for each of four National Weather Service stations located in or near Connecticut. The resultant wind direction and velocity are vector quantities and are computed from the individual wind direction and speed readings in each day. The closer the wind speed ratio is to 1.000, the more persistent the wind. It should be noted that the Connecticut stations have local influences which change the speed and shift the direction of the near-surface air flow (e.g., the Bradley Field air flow is channeled north-south by the Connecticut River Valley and the Bridgeport air flow is frequently subject to sea breezes).

On a statewide basis, this table shows that approximately 43% of the high PM_{10} days occur with winds out of the southwest quadrant and most of those days have relatively persistent winds. This relationship between southwest winds and high particulate levels has historically been more prevalent in southwestern Connecticut. However, many of the maximum levels at some urban sites do not occur with southwest winds, indicating that these sites are possibly influenced by local sources or transport from different out-of-state sources. As noted above, a large scale southwesterly air flow is often diverted into a southerly flow up the Connecticut River Valley. At sites in the Connecticut River Valley, many of the highest PM_{10} days occur when the winds at Bradley Airport are from the south.

Trends - Any attempt to assess statewide trends in air pollution levels must account for the tendency of local changes to obscure the statewide pattern. In order to reach some statistically valid conclusions concerning trends in pollutant levels in Connecticut, the DEP has applied a statistical test called a paired *t* test (referred to hereafter as the *t* test) to the annual average data for PM_{10}.

The *t* test is a parametric test which can ascertain a statistically significant change in the statewide annual average pollutant concentration in Connecticut. The *t* test makes it possible to overcome the trend analysis problems which arise due to the changes in the number and location of monitoring sites from year-to-year, as well as problems associated with making equitable comparisons among sites. The annual mean pollutant concentrations for consecutive years are compared at each site, and the difference is noted. There is no inter-site comparison. The mean and the standard deviation of the differences are used to calculate a *t* statistic, which is employed to determine the statistical significance of the apparent statewide change in pollutant level. For example, if a high proportion of sites experience an increase and/or if the magnitude of the increases at several sites is of much greater importance than the magnitude of the decreases at other sites, the *t* test will show that the increase was statistically significant for those two years.

The results of the *t* test for PM_{10} are presented in Table 2-6 . The analyses were performed only on data computed for sites at which the EPA's minimum sampling criteria were met. The first three columns of Table 2-6 show the years of data that were paired, the number of sites, and the average of the geometric mean pollutant concentrations at the sites in each year. The remaining columns show the average and standard deviation of the differences of the paired year means at each site, as well as the statistical significance of any change in the statewide pollutant average. The significance of a change is indicated by an arrow for each confidence limit, and is also given numerically as the number of chances in 10,000 that the change in the statewide PM_{10} level was not significant. For example, the statewide annual average for PM_{10} decreased between 1986 and 1987 from 37.7 to 34.0. This change represented a significant decrease at the 95% confidence level, but it did not represent a significant change at the 99% confidence level. The "probability that change is not significant" is given as 0.0148, meaning that there are only 148 chances in 10,000 that the apparent decrease in PM_{10} levels between 1986 and 1987 did not occur. The results of the *t* test show that the year-to-year PM_{10} levels in Connecticut apparently remained unchanged from 1985 to 1989, except for a decrease at the 95% confidence level from 1986 to 1987. However, there was a significant decrease in statewide PM_{10} levels from 1989 to 1990, and a significant increase from 1990 to 1991. The reader is advised that the results should be interpreted with caution when the number of paired sites is small, as is the case with the 1985-1989 data.

These trend analyses do not account for the uncertainty associated with the individual annual mean computed for each PM_{10} site. Most particulate sampling is conducted only every sixth day, producing a maximum possible total of 61 samples per year. Therefore, the *t* test really compares averages of the sampled concentrations, not actual annual averages. However, the every-sixth-day sampling schedule is believed to be sufficient to produce representative annual averages. The every-sixth-day schedule for particulate sampling began in 1971.

Significant changes in annual PM_{10} levels can be caused by a number of things. Among these are simple changes of weather, particularly the wind; changes in annual fuel use associated with conservation efforts or heating demand; the frequency of precipitation events, which wash out particulates from the atmosphere; changes in average wind speed, since higher winds result in greater dilution of emissions; and a change in the frequency of southwesterly winds, which affect the amount of particulate matter transported into Connecticut from the New York City metropolitan area and from other sources of emissions located to the southwest.

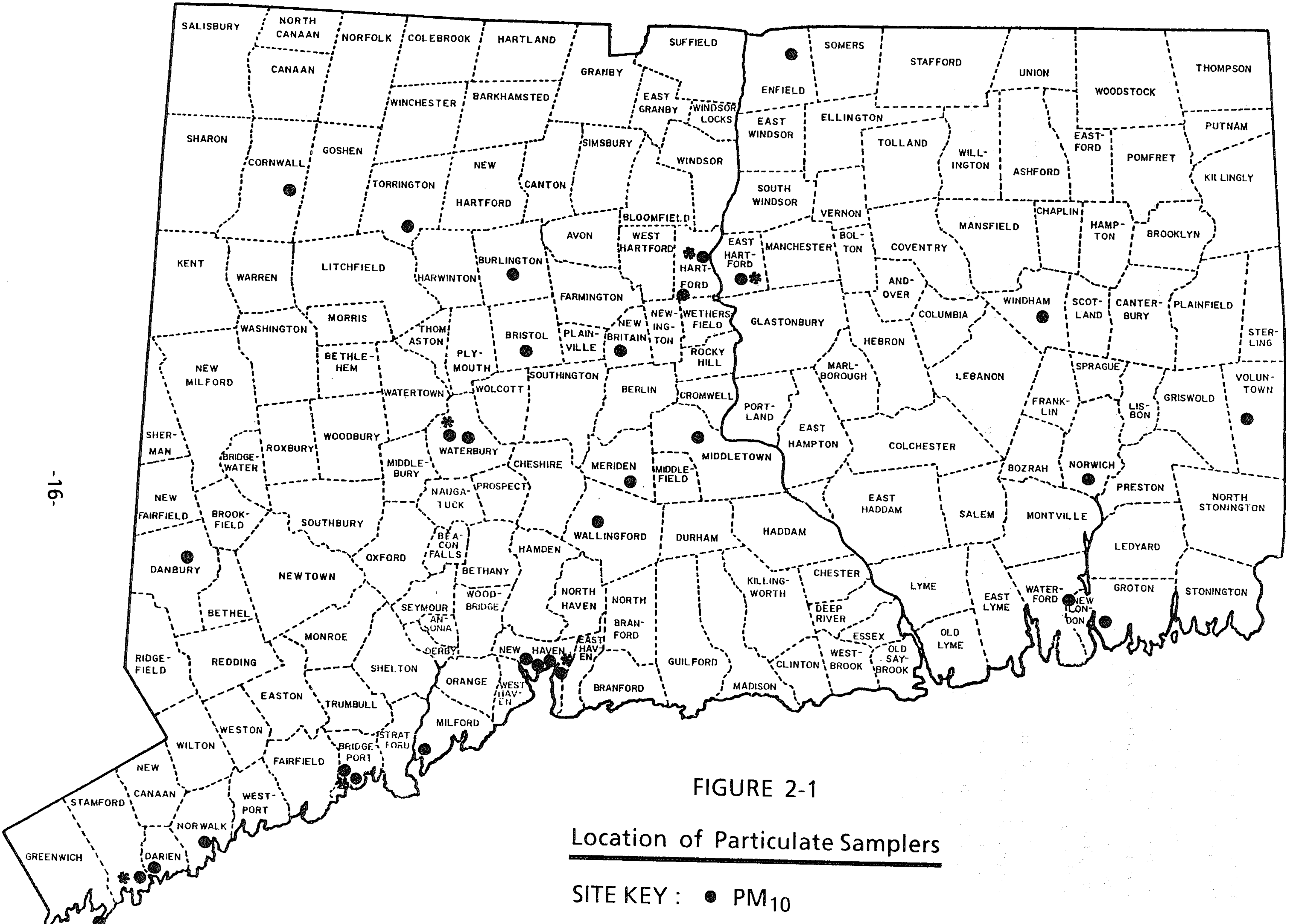


FIGURE 2-1

Location of Particulate Samplers

SITE KEY : ● PM_{10}

✱ TSP

TABLE 2-1

1989-1991 PM10 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 150 UG/M3	MEASURED DAYS OVER 150 UG/M3
ANSONIA	004	1989	58	25.3	22.5	28.1	11.597		
ANSONIA	004	1990	30*	21.1	16.6	25.7	12.780		
BERLIN	002	1989	59	22.4	19.9	24.9	10.325		
BERLIN	002	1990	55	18.8	16.3	21.2	9.800		
BRIDGEPORT	010	1989	57	27.3	24.2	30.4	12.843		
BRIDGEPORT	010	1990	59	25.0	21.6	28.4	14.198		
BRIDGEPORT	010	1991	55	27.7	24.4	31.0	13.236		
BRIDGEPORT	013	1989	57	26.9	23.6	30.1	13.412		
BRIDGEPORT	013	1990	58	24.6	21.3	27.8	13.451		
BRIDGEPORT	014	1989	59	36.5	33.0	40.0	14.737		
BRIDGEPORT	014	1990	59	32.6	29.1	36.2	14.881		
BRIDGEPORT	014	1991	55	33.3	29.8	36.9	14.349		
BRISTOL	001	1989	60	22.9	20.5	25.2	9.936		
BRISTOL	001	1990	60	20.1	17.7	22.5	10.058		
BRISTOL	001	1991	58	22.6	20.0	25.2	10.696		
BURLINGTON	001	1989	59	15.2	13.5	16.9	7.171		
BURLINGTON	001	1990	59	14.8	12.7	16.8	8.573		
BURLINGTON	001	1991	58	16.9	14.3	19.5	10.727		
CORNWALL	005	1989	60	15.1	13.1	17.1	8.587		
CORNWALL	005	1990	58	16.0	13.4	18.7	10.949		
CORNWALL	005	1991	58	17.4	14.5	20.4	12.191		
DANBURY	123	1989	57	25.4	22.6	28.3	11.743		
DANBURY	123	1990	60	22.1	19.4	24.7	11.272		
DANBURY	123	1991	56	25.6	22.5	28.7	12.534		
DARIEN	001	1989	45*	28.7	25.0	32.4	13.200		
DARIEN	001	1990	58	31.0	27.6	34.3	13.869		
DARIEN	001	1991	56	35.3	29.9	40.8	22.068		

* THE NUMBER OF SAMPLES IS INSUFFICIENT TO COMPLY WITH THE MINIMUM SAMPLING CRITERIA.

TABLE 2-1, CONTINUED

1989-1991 PM10 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 150 UG/M3	MEASURED DAYS OVER 150 UG/M3
EAST HARTFORD	004	1989	59	25.8	22.9	28.8	12.329		
EAST HARTFORD	004	1990	59	21.8	18.9	24.7	12.030		
EAST HARTFORD	004	1991	56	25.8	22.7	28.9	12.409		
ENFIELD	005	1989	58	19.6	17.5	21.8	8.784		
ENFIELD	005	1990	58	16.6	14.5	18.7	8.763		
ENFIELD	005	1991	59	20.2	17.7	22.8	10.634		
GREENWICH	017	1989	56	21.4	18.7	24.1	11.003		
GREENWICH	017	1990	57	20.4	17.5	23.3	11.953		
GREENWICH	017	1991	58	24.7	21.6	27.8	12.971		
GROTON	006	1989	59	20.0	17.7	22.3	9.689		
GROTON	006	1990	56	18.8	16.1	21.4	10.730		
GROTON	006	1991	58	21.9	18.6	25.3	13.888		
HADDAM	002	1989	59	18.5	16.4	20.5	8.468		
HADDAM	002	1990	53*	16.6	14.3	18.8	8.751		
HARTFORD	013	1989	57	23.3	20.8	25.8	10.299		
HARTFORD	013	1990	59	20.7	18.2	23.2	10.526		
HARTFORD	013	1991	59	22.3	19.7	24.8	10.762		
HARTFORD	014	1989	58	24.4	21.4	27.4	12.352		
HARTFORD	014	1990	55	21.6	18.8	24.4	11.331		
HARTFORD	015	1989	59	29.5	26.6	32.3	11.918		
HARTFORD	015	1990	58	24.9	22.0	27.8	11.864		
HARTFORD	015	1991	57	27.8	24.9	30.7	11.824		
HARTFORD	018	1989	60	28.0	25.1	30.9	12.232		
HARTFORD	018	1990	60	24.1	21.1	27.0	12.684		
MANCHESTER	001	1989	58	21.2	18.8	23.5	9.687		
MANCHESTER	001	1990	55	19.1	16.5	21.6	10.404		

* THE NUMBER OF SAMPLES IS INSUFFICIENT TO COMPLY WITH THE MINIMUM SAMPLING CRITERIA.

TABLE 2-1, CONTINUED

1989-1991 PM10 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 150 UG/M3	MEASURED DAYS OVER 150 UG/M3
MERIDEN	002	1989	48*	24.3	21.4	27.2	10.722		
MERIDEN	002	1990	37*	21.4	18.0	24.8	10.792		
MERIDEN	002	1991	57	24.8	21.9	27.7	11.952		
MIDDLETOWN	003	1989	57	23.2	20.4	25.9	11.154		
MIDDLETOWN	003	1990	58	20.5	18.0	23.0	10.360		
MIDDLETOWN	003	1991	55	25.1	22.3	28.0	11.425		
MILFORD	010	1989	58	22.0	19.6	24.4	9.861		
MILFORD	010	1990	58	21.2	18.5	23.9	11.180		
MILFORD	010	1991	57	22.9	19.7	26.0	12.920		
NAUGATUCK	001	1989	60	26.4	23.5	29.2	12.146		
NAUGATUCK	001	1990	56	23.4	20.3	26.5	12.583		
NEW BRITAIN	012	1989	61	24.2	21.5	26.9	11.676		
NEW BRITAIN	012	1990	58	21.3	18.6	24.0	11.223		
NEW BRITAIN	012	1991	56*	23.6	20.6	26.6	12.180		
NEW HAVEN	013	1989	57	24.9	22.4	27.3	10.140		
NEW HAVEN	013	1990	60	23.7	20.8	26.5	12.172		
NEW HAVEN	013	1991	55	26.4	23.0	29.9	13.961		
NEW HAVEN	018	1989	351	44.1	43.7	44.5	20.213	1	
NEW HAVEN	018	1990	349	40.6	40.2	41.1	19.749		
NEW HAVEN	018	1991	350	40.1	39.7	40.5	17.930		
NEW HAVEN	020	1989	59	28.8	26.0	31.6	11.659		
NEW HAVEN	020	1990	60	26.5	23.6	29.4	12.392		
NEW HAVEN	020	1991	59	30.4	27.4	33.4	12.539		
NEW HAVEN	123	1989	59	27.9	25.1	30.6	11.561		
NEW HAVEN	123	1990	55	26.7	23.3	30.1	13.549		
NEW HAVEN	123	1991	58	29.9	25.8	34.0	16.940		

* THE NUMBER OF SAMPLES IS INSUFFICIENT TO COMPLY WITH THE MINIMUM SAMPLING CRITERIA.

TABLE 2-1, CONTINUED

1989-1991 PM10 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 150 UG/M3	MEASURED DAYS OVER 150 UG/M3
NEW LONDON	004	1989	42*	21.7	18.6	24.8	10.615		
NEW LONDON	004	1990	58	20.6	18.1	23.0	10.210		
NEW LONDON	004	1991	58	23.4	20.4	26.3	12.194		
NORWALK	014	1989	57	37.4	33.7	41.0	14.853		
NORWALK	014	1990	59	38.7	34.7	42.6	16.628		
NORWALK	014	1991	56	38.4	34.8	42.0	14.636		
NORWICH	002	1989	60	23.5	21.0	25.9	10.509		
NORWICH	002	1990	59	20.7	18.2	23.2	10.378		
NORWICH	002	1991	58	23.6	20.8	26.5	11.813		
OLD SAYBROOK	005	1989	59	23.2	20.6	25.8	10.856		
PUTNAM	002	1989	59	20.2	18.0	22.4	9.224		
PUTNAM	002	1990	49*	19.2	16.6	21.8	9.623		
STAMFORD	001	1989	59	26.0	23.0	29.0	12.567		
STAMFORD	001	1990	59	24.0	20.8	27.2	13.461		
STAMFORD	001	1991	58	28.6	25.2	31.9	13.780		
STRATFORD	005	1989	60	25.0	22.4	27.7	11.300		
STRATFORD	005	1990	55	24.3	20.8	27.7	13.678		
TORRINGTON	001	1989	60	22.9	20.4	25.4	10.474		
TORRINGTON	001	1990	59	19.5	16.9	22.1	10.923		
TORRINGTON	001	1991	57	22.5	19.6	25.3	11.656		
VOLUNTOWN	001	1989	56	15.3	13.4	17.3	7.947		
VOLUNTOWN	001	1990	60	14.3	12.4	16.3	8.292		
VOLUNTOWN	001	1991	55	16.2	13.6	18.8	10.433		
WALLINGFORD	006	1989	58	22.2	19.9	24.5	9.510		
WALLINGFORD	006	1990	53	19.5	16.8	22.1	10.291		
WALLINGFORD	006	1991	56	23.2	20.2	26.1	11.964		

* THE NUMBER OF SAMPLES IS INSUFFICIENT TO COMPLY WITH THE MINIMUM SAMPLING CRITERIA.

TABLE 2-1, CONTINUED

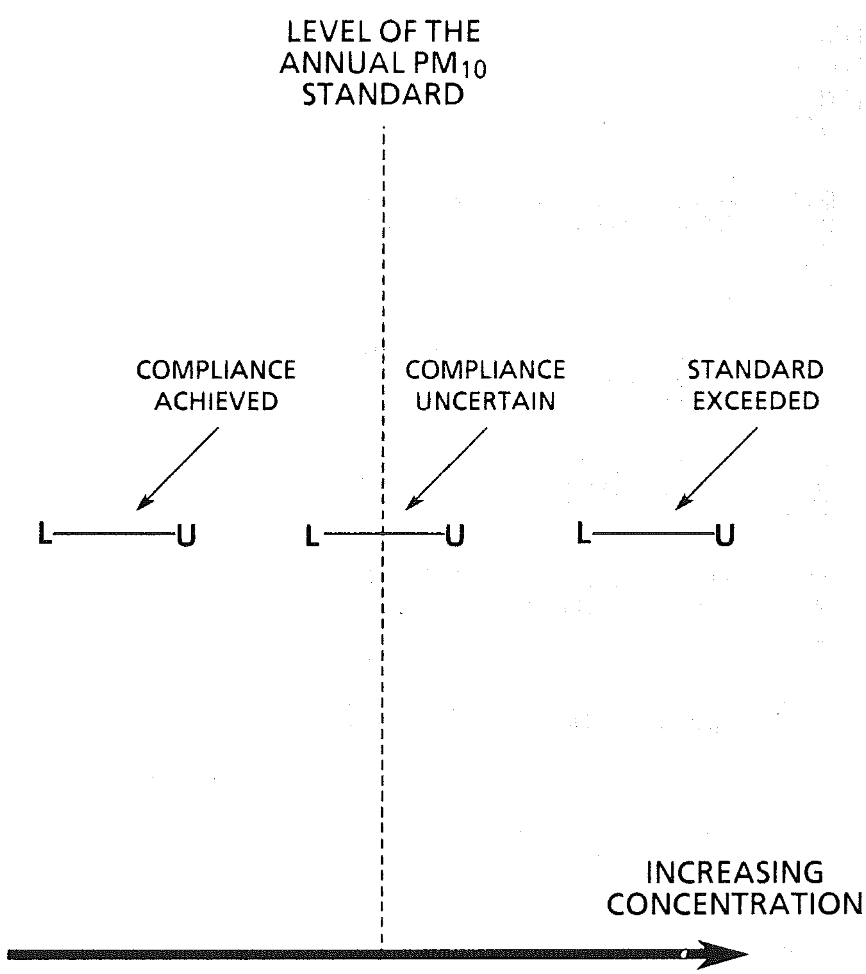
1989-1991 PM10 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 150 UG/M3	MEASURED DAYS OVER 150 UG/M3
WATERBURY	007	1989	57	28.3	24.8	31.7	14.142		
WATERBURY	007	1990	59	25.6	22.1	29.1	14.752		
WATERBURY	007	1991	59	27.0	23.8	30.2	13.538		
WATERBURY	123	1989	59	33.0	29.1	36.9	16.235		
WATERBURY	123	1990	59	32.4	28.4	36.4	16.652		
WATERBURY	123	1991	57	28.9	25.5	32.2	13.581		
WATERFORD	001	1989	58	17.5	15.5	19.5	8.309		
WATERFORD	001	1990	55	18.4	15.7	21.0	10.669		
WEST HAVEN	003	1989	60	27.9	25.3	30.5	11.109		
WEST HAVEN	003	1990	57	26.8	24.0	29.6	11.570		
WILLIMANTIC	002	1989	60	21.0	18.8	23.2	9.174		
WILLIMANTIC	002	1990	60	18.5	16.3	20.7	9.318		
WILLIMANTIC	002	1991	59	23.1	20.4	25.7	11.027		

* THE NUMBER OF SAMPLES IS INSUFFICIENT TO COMPLY WITH THE MINIMUM SAMPLING CRITERIA.

FIGURE 2-2

COMPLIANCE WITH THE LEVEL OF THE ANNUAL PM10 STANDARDS USING 95% CONFIDENCE LIMITS ABOUT THE ANNUAL ARITHMETIC MEAN CONCENTRATION



L = The lower limit of the 95% confidence interval about the annual arithmetic mean concentration.

U = The upper limit of the 95% confidence interval about the annual arithmetic mean concentration.

TABLE 2-2

STATISTICALLY PREDICTED NUMBER OF SITES IN COMPLIANCE WITH THE LEVEL OF THE ANNUAL PM10 STANDARDS*

	COMPLIANCE ACHIEVED	COMPLIANCE UNCERTAIN	STANDARD EXCEEDED
1985	2	0	0
1986	4	0	1
1987	4	0	1
1988	3	0	0
1989	40	0	0
1990	39	0	0
1991	30	0	0

* Using 95% confidence limits about the arithmetic mean concentration at only those sites which had sufficient data to satisfy the minimum sampling criteria for the year.

FIGURE 2-3

1991 MAXIMUM 24-HOUR PM10 CONCENTRATIONS

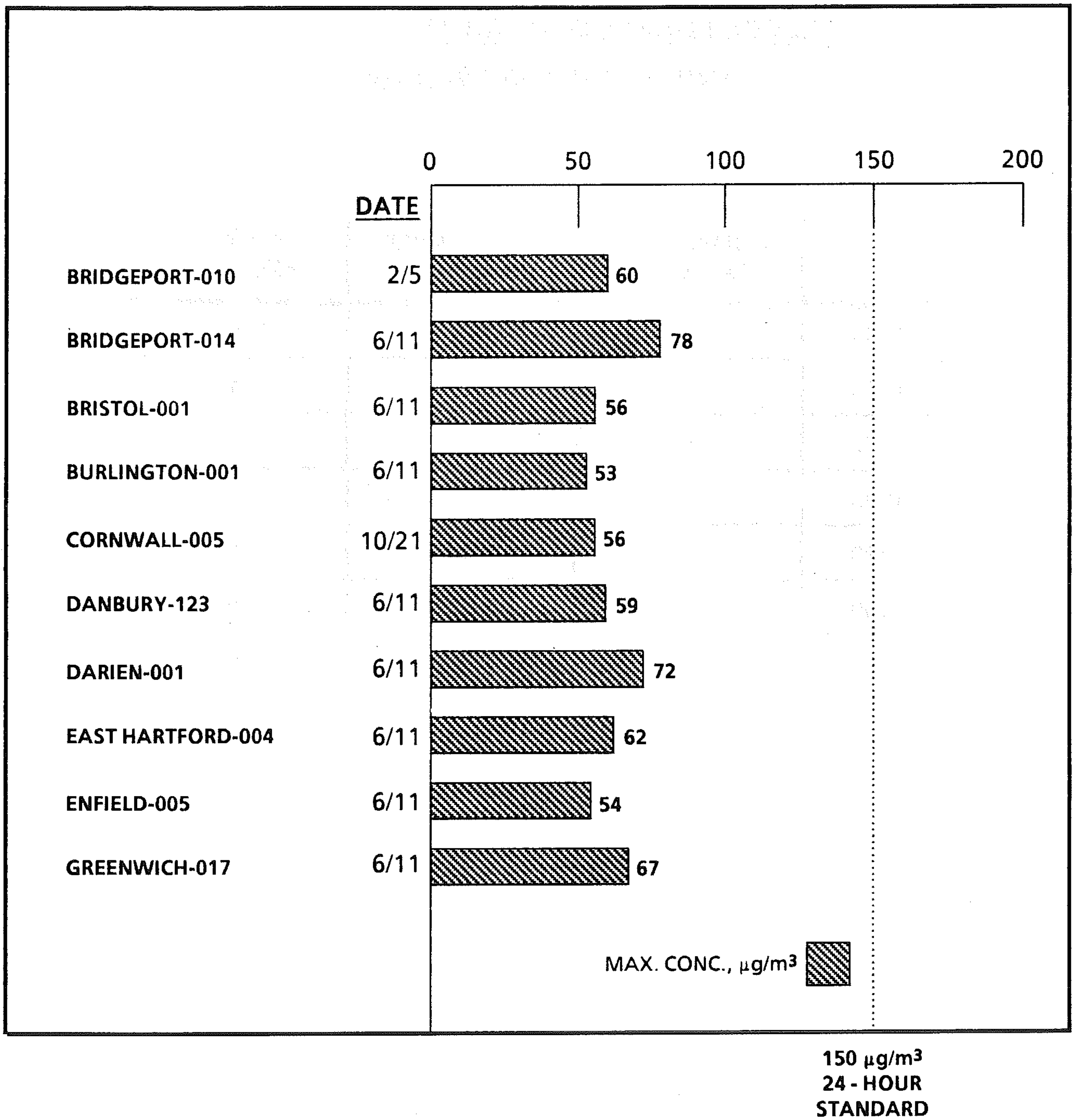
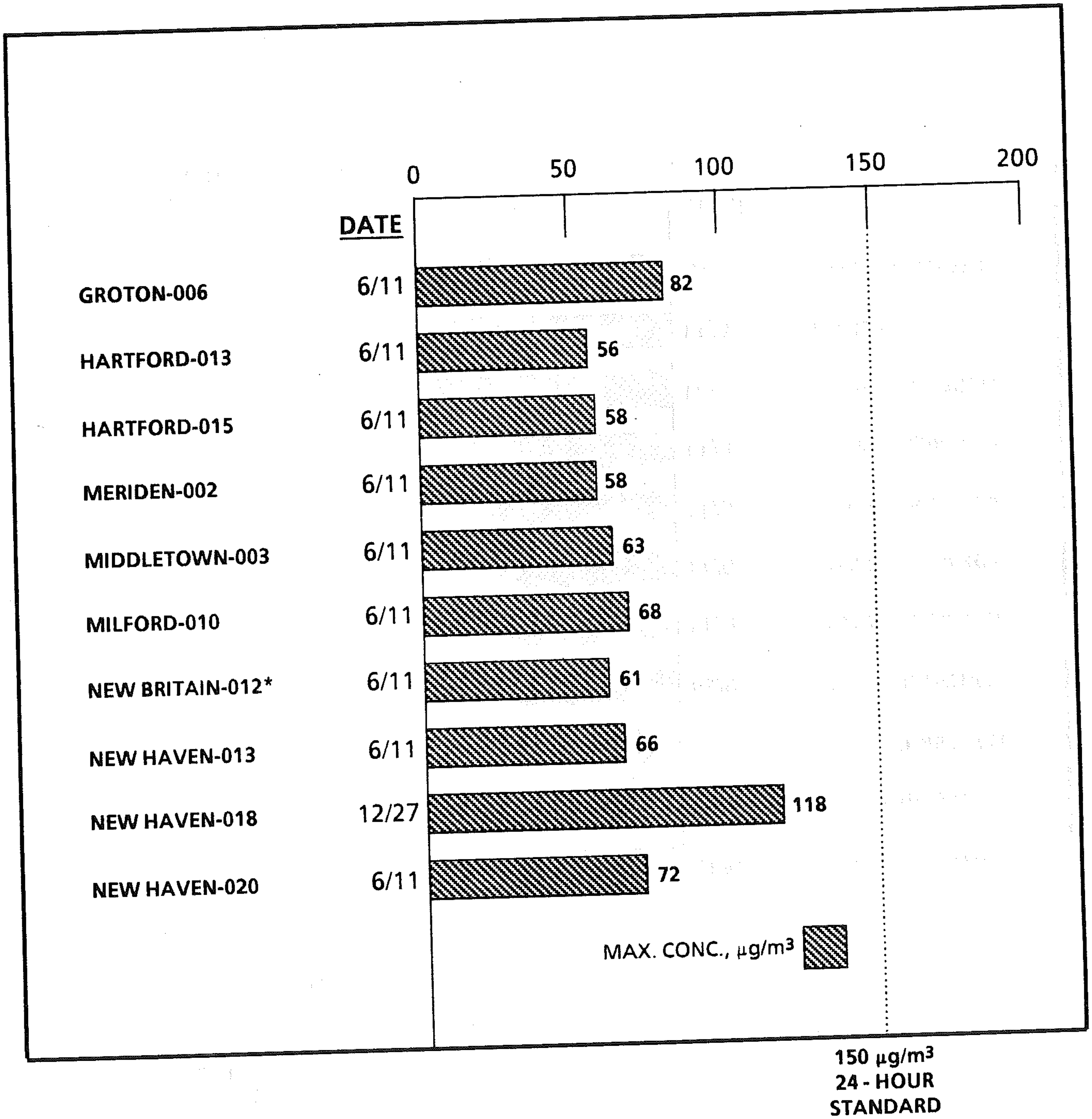


FIGURE 2-3, continued

1991 MAXIMUM 24-HOUR PM10 CONCENTRATIONS



* The site has insufficient data to satisfy the minimum sampling criteria.

FIGURE 2-3, continued

1991 MAXIMUM 24-HOUR PM10 CONCENTRATIONS

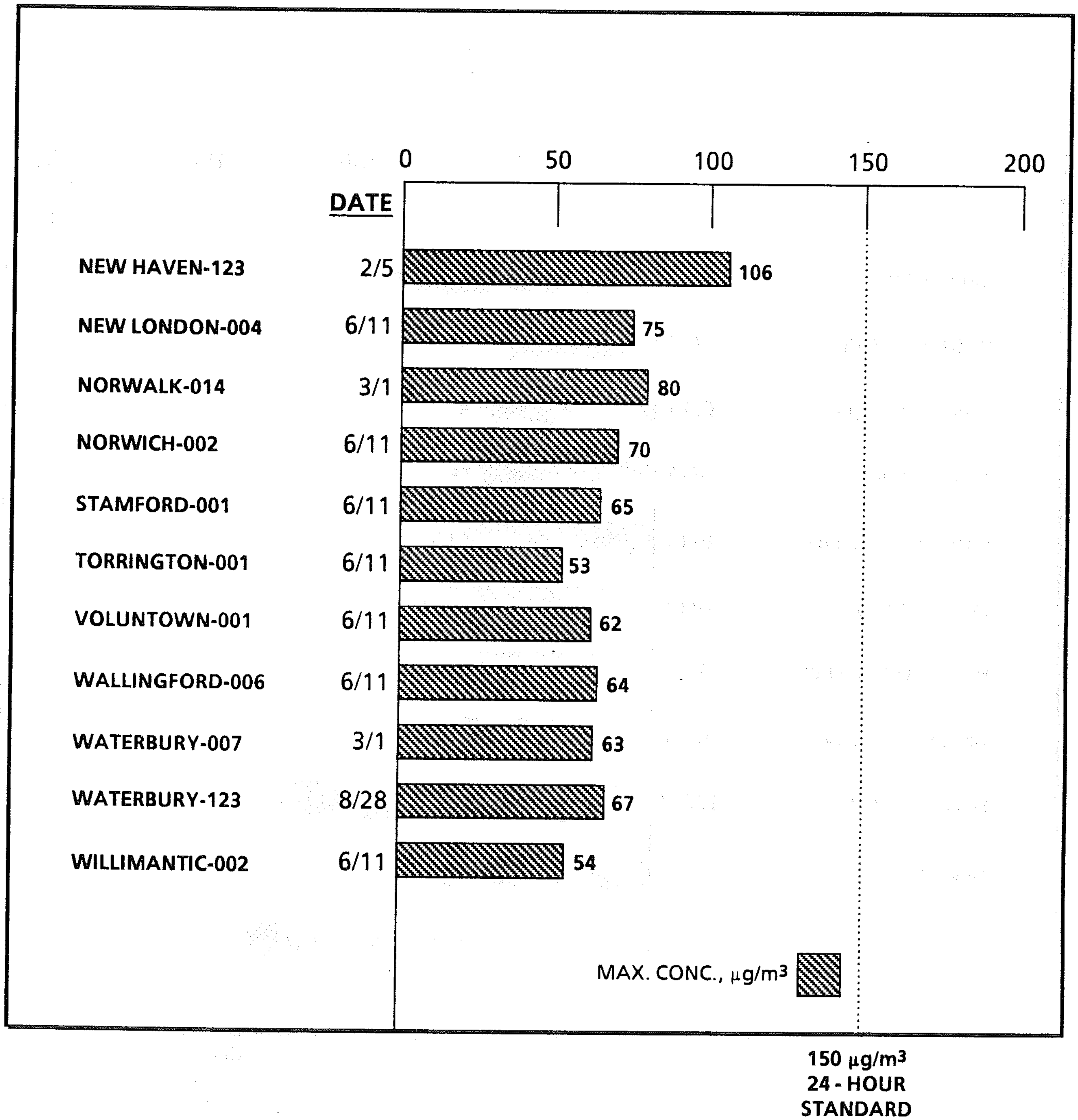


TABLE 2-3

SUMMARY OF THE STATISTICALLY PREDICTED NUMBER OF PM10 SITES EXCEEDING THE LEVEL OF THE 24-HOUR STANDARDS

		SITES WITH ≧ 1 DAY EXCEEDING 150 μg/m^3	
YEAR	NO. OF SITES[1]	No. of Sites	Percentage of All Sites
1985	2	0	0%
1986	5	2	40%
1987	5	1	20%
1988	3	1	33%
1989	40	1	3%
1990	39	0	0%
1991	30	0	0%

1 Only those sites are used which had sufficient data to satisfy the minimum sampling criteria.

TABLE 2-4

QUARTERLY CHEMICAL CHARACTERIZATION OF 1991 HI-VOL TSP

TOWN	AREA	SITE
BRIDGEPORT	**0060**	**010**

	QUARTERLY AVG				ANNUAL AVG
	1ST	2ND	3RD	4TH	
METALS (ng/m^3)					
BERYLLIUM	<.1	<.1	<.1	<.1	<.1
CADMIUM	1.4	0.4	1.6	0.7	1.0
CHROMIUM	5	9	3	<1	4[a]
COPPER	110	150	90	460	200
IRON	800	940	650	20	600
LEAD	20	30	20	60	30
MANGANESE	116	13	9	7	36
NICKEL	14	19	6	1	10
VANADIUM	20	280	10	30	80
ZINC	50	80	30	30	50
WATER SOLUBLES (ng/m^3)					
NITRATE	3250	3910	4940	3770	3990
SULFATE	8840	10410	11040	8970	9790
AMMONIUM	200	160	310	230	230
TSP (µg/m^3)	42	49	49	43	46
SAMPLE COUNT	13[b]	13	14	13[c]	

[a] The average was calculated using one half of the detectable limit in the 4th quarter.
[b] The sample count for sulfate and TSP is 14.
[c] The sample count for sulfate and TSP is 15.

TABLE 2-4, CONTINUED

QUARTERLY CHEMICAL CHARACTERIZATION OF 1991 HI-VOL TSP

TOWN	AREA	SITE
EAST HARTFORD	0220	004

	QUARTERLY AVG				ANNUAL AVG
	1ST	2ND	3RD	4TH	
METALS (ng/m^3)					
BERYLLIUM	<.1	<.1	<.1	<.1	<.1
CADMIUM	1.5	0.2	1.9	1.1	1.1
CHROMIUM	5	3	3	3	4
COPPER	200	300	540	250	310
IRON	700	850	640	410	660
LEAD	10	40	10	10	20
MANGANESE	12	10	10	6	10
NICKEL	16	8	8	12	11
VANADIUM	20	100	10	10	40
ZINC	30	30	40	40	30
WATER SOLUBLES (ng/m^3)					
NITRATE	2600	3480	3240	3460	3180
SULFATE	8900	10700	11590	8080	9720
AMMONIUM	80	200	330	260	210
TSP (µg/m^3)	41	45	48	39	43
SAMPLE COUNT	15	15	10	13	

TABLE 2-4, CONTINUED

QUARTERLY CHEMICAL CHARACTERIZATION OF 1991 HI-VOL TSP

TOWN	AREA	SITE
HARTFORD	**0420**	**016**

	QUARTERLY AVG				ANNUAL AVG
	1ST	2ND	3RD	4TH	
METALS (ng/m3)					
BERYLLIUM	<.1	<.1	<.1	<.1	<.1
CADMIUM	0.9	0.3	0.6	1.1	0.7
CHROMIUM	6	5	2	5	4
COPPER	40	50	60	50	50
IRON	1450	920	690	1190	1060
LEAD	20	30	20	30	30
MANGANESE	19	14	10	16	15
NICKEL	12	8	6	10	9
VANADIUM	10	130	10	20	40
ZINC	60	40	20	60	50
WATER SOLUBLES (ng/m3)					
NITRATE	3140	3540	3720	3810	3560
SULFATE	9290	11040	10000	8530	9720
AMMONIUM	150	410	430	380	350
TSP (µg/m3)	64	66	64	66	65
SAMPLE COUNT	14	15	15	15	

TABLE 2-4, CONTINUED

QUARTERLY CHEMICAL CHARACTERIZATION OF 1991 HI-VOL TSP

TOWN	AREA	SITE
NEW HAVEN	0700	018

	QUARTERLY AVG				ANNUAL AVG
	1ST	2ND	3RD	4TH	
METALS (ng/m^3)					
BERYLLIUM	<.1	<.1	<.1	<.1	<.1
CADMIUM	2.3	0.2	1.0	1.3	1.2
CHROMIUM	8	9	6	6	7
COPPER	120	150	140	130	140
IRON	4660	5350	1280	3840	3700
LEAD	60	90	50	70	70
MANGANESE	43	71	31	45	47
NICKEL	20	16	12	16	16
VANADIUM	40	390	20	30	120
ZINC	150	150	110	180	150
WATER SOLUBLES (ng/m^3)					
NITRATE	2660	4170	4280	3930	3810
SULFATE	8400	13070	9390	9130	10060
AMMONIUM	220	730	280	310	390
TSP ($\mu g/m^3$)	144	155	119	119	134
SAMPLE COUNT	12	14	15	13	

TABLE 2-4, CONTINUED

QUARTERLY CHEMICAL CHARACTERIZATION OF 1991 HI-VOL TSP

TOWN	AREA	SITE
WATERBURY	**1240**	**123**

	QUARTERLY AVG				ANNUAL AVG
	1ST	2ND	3RD	4TH	
METALS (ng/m3)					
BERYLLIUM	<.1	<.1	<.1	<.1	<.1
CADMIUM	1.9	0.2	2.2	1.7	1.5
CHROMIUM	19	10	16	21	17
COPPER	330	630	300	160	360
IRON	1220	1790	3160	1330	1810
LEAD	20	100	720	140	220
MANGANESE	24	31	25	171	65
NICKEL	10	7	8	11	9
VANADIUM	20	150	10	20	50
ZINC	70	150	210	150	140
WATER SOLUBLES (ng/m3)					
NITRATE	2750	2910	3180	3280	3020
SULFATE	8580	9890	9750	7880	8990
AMMONIUM	280	300	190	180	240
TSP (µg/m3)	76	76	64	58	69
SAMPLE COUNT	15	15	12	15	

TABLE 2-5

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)		RANK	1	2	3	4	5	6	7	8	9	10
BRIDGEPORT-010 (0055)		PM10	60	56	52	51	50	49	49	46	46	45
		DATE	2/ 5/91	6/29/91	11/20/91	7/17/91	8/16/91	8/28/91	5/24/91	6/17/91	7/23/91	1/30/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	300	240	250	280	260	240	90	250	230
		VEL (MPH)	5.7	7.1	10.6	11.6	5.6	6.9	9.1	2.8	8.1	2.4
		SPD (MPH)	7.6	9.5	11.9	13.9	7.5	8.6	10.1	8.6	10.4	3.2
		RATIO	0.747	0.746	0.891	0.832	0.746	0.800	0.904	0.323	0.779	0.764
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	270	330	180	270	260	270	200	60	210	80
		VEL (MPH)	2.7	7.1	8.7	5.8	4.9	4.1	8.5	3.1	7.0	.8
		SPD (MPH)	5.3	9.2	9.6	8.5	7.6	6.0	10.5	6.6	10.6	4.6
		RATIO	0.501	0.769	0.903	0.686	0.638	0.686	0.808	0.475	0.659	0.164
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	240	260	240	250	260	250	250	110	270	160
		VEL (MPH)	5.2	2.5	9.0	7.2	5.8	5.0	6.3	4.6	6.5	.3
		SPD (MPH)	5.5	3.9	9.1	7.3	6.3	5.2	6.5	4.9	7.5	2.2
		RATIO	0.950	0.653	0.992	0.984	0.913	0.961	0.977	0.945	0.867	0.137
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	280	320	240	280	280	280	260	70	260	240
		VEL (MPH)	7.3	6.0	9.7	9.8	8.2	8.4	9.0	4.5	9.1	3.6
		SPD (MPH)	7.6	8.1	9.9	9.9	8.5	8.6	9.3	4.6	9.3	5.6
		RATIO	0.953	0.741	0.973	0.983	0.969	0.979	0.968	0.978	0.969	0.636
BRIDGEPORT-014 (0055)		PM10	78	64	63	61	59	53	51	51	49	48
		DATE	6/11/91	6/29/91	2/ 5/91	1/24/91	3/ 1/91	1/30/91	8/16/91	11/20/91	8/28/91	5/24/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	300	250	280	150	230	280	240	260	240
		VEL (MPH)	7.5	7.1	5.7	10.9	4.0	2.4	5.6	10.6	6.9	9.1
		SPD (MPH)	10.2	9.5	7.6	13.1	4.5	3.2	7.5	11.9	8.6	10.1
		RATIO	0.734	0.746	0.747	0.833	0.892	0.764	0.746	0.891	0.800	0.904
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	330	270	290	190	80	260	180	270	200
		VEL (MPH)	6.6	7.1	2.7	8.7	6.9	.8	4.9	8.7	4.1	8.5
		SPD (MPH)	9.1	9.2	5.3	10.5	7.2	4.6	7.6	9.6	6.0	10.5
		RATIO	0.729	0.769	0.501	0.830	0.962	0.164	0.638	0.903	0.686	0.808
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	260	240	300	170	160	260	240	250	250
		VEL (MPH)	5.7	2.5	5.2	9.4	2.4	.3	5.8	9.0	5.0	6.3
		SPD (MPH)	5.9	3.9	5.5	10.1	3.5	2.2	6.3	9.1	5.2	6.5
		RATIO	0.959	0.653	0.950	0.937	0.698	0.137	0.913	0.992	0.961	0.977
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	320	280	290	240	240	280	240	280	260
		VEL (MPH)	5.8	6.0	7.3	9.6	8.0	3.6	8.2	9.7	8.4	9.0
		SPD (MPH)	6.5	8.1	7.6	10.2	8.2	5.6	8.5	9.9	8.6	9.3
		RATIO	0.898	0.741	0.953	0.945	0.980	0.636	0.969	0.973	0.979	0.968
BRISTOL-001 (0058)		PM10	56	49	40	40	40	39	38	36	35	35
		DATE	6/11/91	8/28/91	7/23/91	3/ 1/91	6/29/91	12/26/91	5/24/91	11/20/91	12/ 8/91	7/17/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	260	250	150	300	190	240	240	220	250
		VEL (MPH)	7.5	6.9	8.1	4.0	7.1	2.2	9.1	10.6	3.3	11.6
		SPD (MPH)	10.2	8.6	10.4	4.5	9.5	5.0	10.1	11.9	5.5	13.9
		RATIO	0.734	0.800	0.779	0.892	0.746	0.436	0.904	0.891	0.604	0.832
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	270	210	190	330	190	200	180	200	270
		VEL (MPH)	6.6	4.1	7.0	6.9	7.1	3.7	8.5	8.7	2.8	5.8
		SPD (MPH)	9.1	6.0	10.6	7.2	9.2	7.3	10.5	9.6	6.2	8.5
		RATIO	0.729	0.686	0.659	0.962	0.769	0.509	0.808	0.903	0.455	0.686

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	260	250	270	170	260	250	250	240	170	250
BRIDGEPORT	VEL (MPH)	5.7	5.0	6.5	2.4	2.5	2.8	6.3	9.0	2.3	7.2
	SPD (MPH)	5.9	5.2	7.5	3.5	3.9	3.2	6.5	9.1	4.5	7.3
	RATIO	0.959	0.961	0.867	0.698	0.653	0.888	0.977	0.992	0.519	0.984
METEOROLOGICAL SITE	DIR (DEG)	270	280	260	240	320	250	260	240	240	280
WORCESTER	VEL (MPH)	5.8	8.4	9.1	8.0	6.0	4.8	9.0	9.7	2.0	9.8
	SPD (MPH)	6.5	8.6	9.3	8.2	8.1	6.3	9.3	9.9	4.5	9.9
	RATIO	0.898	0.979	0.969	0.980	0.741	0.756	0.968	0.973	0.453	0.983
BURLINGTON-001 (0058)	PM10	53	51	40	36	35	31	30	28	28	27
	DATE	6/11/91	8/28/91	5/24/91	7/23/91	6/29/91	5/12/91	8/16/91	3/ 1/91	7/17/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	240	250	300	280	280	150	250	220
NEWARK	VEL (MPH)	7.5	6.9	9.1	8.1	7.1	8.6	5.6	4.0	11.6	3.3
	SPD (MPH)	10.2	8.6	10.1	10.4	9.5	11.2	7.5	4.5	13.9	5.5
	RATIO	0.734	0.800	0.904	0.779	0.746	0.766	0.746	0.892	0.832	0.604
METEOROLOGICAL SITE	DIR (DEG)	250	270	200	210	330	290	260	190	270	200
BRADLEY	VEL (MPH)	6.6	4.1	8.5	7.0	7.1	9.2	4.9	6.9	5.8	2.8
	SPD (MPH)	9.1	6.0	10.5	10.6	9.2	11.5	7.6	7.2	8.5	6.2
	RATIO	0.729	0.686	0.808	0.659	0.769	0.802	0.638	0.962	0.686	0.455
METEOROLOGICAL SITE	DIR (DEG)	260	250	250	270	260	280	260	170	250	170
BRIDGEPORT	VEL (MPH)	5.7	5.0	6.3	6.5	2.5	5.9	5.8	2.4	7.2	2.3
	SPD (MPH)	5.9	5.2	6.5	7.5	3.9	6.6	6.3	3.5	7.3	4.5
	RATIO	0.959	0.961	0.977	0.867	0.653	0.897	0.913	0.698	0.984	0.519
METEOROLOGICAL SITE	DIR (DEG)	270	280	260	260	320	280	280	240	280	240
WORCESTER	VEL (MPH)	5.8	8.4	9.0	9.1	6.0	9.4	8.2	8.0	9.8	2.0
	SPD (MPH)	6.5	8.6	9.3	9.3	8.1	9.9	8.5	8.2	9.9	4.5
	RATIO	0.898	0.979	0.968	0.969	0.741	0.951	0.969	0.980	0.983	0.453
CORNWALL-005 (0058)	PM10	56	51	47	40	36	35	34	32	31	30
	DATE	10/21/91	6/11/91	8/28/91	5/24/91	6/29/91	7/23/91	5/12/91	7/17/91	8/16/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	170	250	260	240	300	250	280	250	280	220
NEWARK	VEL (MPH)	4.4	7.5	6.9	9.1	7.1	8.1	8.6	11.6	5.6	3.3
	SPD (MPH)	5.8	10.2	8.6	10.1	9.5	10.4	11.2	13.9	7.5	5.5
	RATIO	0.766	0.734	0.800	0.904	0.746	0.779	0.766	0.832	0.746	0.604
METEOROLOGICAL SITE	DIR (DEG)	190	250	270	200	330	210	290	270	260	200
BRADLEY	VEL (MPH)	5.7	6.6	4.1	8.5	7.1	7.0	9.2	5.8	4.9	2.8
	SPD (MPH)	7.6	9.1	6.0	10.5	9.2	10.6	11.5	8.5	7.6	6.2
	RATIO	0.749	0.729	0.686	0.808	0.769	0.659	0.802	0.686	0.638	0.455
METEOROLOGICAL SITE	DIR (DEG)	200	260	250	250	260	270	280	250	260	170
BRIDGEPORT	VEL (MPH)	3.0	5.7	5.0	6.3	2.5	6.5	5.9	7.2	5.8	2.3
	SPD (MPH)	4.7	5.9	5.2	6.5	3.9	7.5	6.6	7.3	6.3	4.5
	RATIO	0.623	0.959	0.961	0.977	0.653	0.867	0.897	0.984	0.913	0.519
METEOROLOGICAL SITE	DIR (DEG)	220	270	280	260	320	260	280	280	280	240
WORCESTER	VEL (MPH)	5.2	5.8	8.4	9.0	6.0	9.1	9.4	9.8	8.2	2.0
	SPD (MPH)	5.5	6.5	8.6	9.3	8.1	9.3	9.9	9.9	8.5	4.5
	RATIO	0.956	0.898	0.979	0.968	0.741	0.969	0.951	0.983	0.969	0.453

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)		RANK	1	2	3	4	5	6	7	8	9	10
DANBURY-123 (0056)		PM10	59	53	50	47	45	44	43	42	40	37
		DATE	6/11/91	2/ 5/91	8/28/91	3/ 1/91	7/17/91	6/29/91	11/20/91	5/24/91	7/23/91	1/30/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	250	260	150	250	300	240	240	250	230
		VEL (MPH)	7.5	5.7	6.9	4.0	11.6	7.1	10.6	9.1	8.1	2.4
		SPD (MPH)	10.2	7.6	8.6	4.5	13.9	9.5	11.9	10.1	10.4	3.2
		RATIO	0.734	0.747	0.800	0.892	0.832	0.746	0.891	0.904	0.779	0.764
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	270	270	190	270	330	180	200	210	80
		VEL (MPH)	6.6	2.7	4.1	6.9	5.8	7.1	8.7	8.5	7.0	.8
		SPD (MPH)	9.1	5.3	6.0	7.2	8.5	9.2	9.6	10.5	10.6	4.6
		RATIO	0.729	0.501	0.686	0.962	0.686	0.769	0.903	0.808	0.659	0.164
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	240	250	170	250	260	240	250	270	160
		VEL (MPH)	5.7	5.2	5.0	2.4	7.2	2.5	9.0	6.3	6.5	.3
		SPD (MPH)	5.9	5.5	5.2	3.5	7.3	3.9	9.1	6.5	7.5	2.2
		RATIO	0.959	0.950	0.961	0.698	0.984	0.653	0.992	0.977	0.867	0.137
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	280	280	240	280	320	240	260	260	240
		VEL (MPH)	5.8	7.3	8.4	8.0	9.8	6.0	9.7	9.0	9.1	3.6
		SPD (MPH)	6.5	7.6	8.6	8.2	9.9	8.1	9.9	9.3	9.3	5.6
		RATIO	0.898	0.953	0.979	0.980	0.983	0.741	0.973	0.968	0.969	0.636
DARIEN-001 (0055)		PM10	72	55	55	53	53	52	52	51	49	48
		DATE	6/11/91	5/24/91	7/17/91	11/20/91	6/29/91	3/ 1/91	7/23/91	8/16/91	2/ 5/91	12/20/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	240	250	240	300	150	250	280	250	310
		VEL (MPH)	7.5	9.1	11.6	10.6	7.1	4.0	8.1	5.6	5.7	7.6
		SPD (MPH)	10.2	10.1	13.9	11.9	9.5	4.5	10.4	7.5	7.6	9.9
		RATIO	0.734	0.904	0.832	0.891	0.746	0.892	0.779	0.746	0.747	0.764
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	200	270	180	330	190	210	260	270	350
		VEL (MPH)	6.6	8.5	5.8	8.7	7.1	6.9	7.0	4.9	2.7	3.9
		SPD (MPH)	9.1	10.5	8.5	9.6	9.2	7.2	10.6	7.6	5.3	6.5
		RATIO	0.729	0.808	0.686	0.903	0.769	0.962	0.659	0.638	0.501	0.602
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	250	250	240	260	170	270	260	240	320
		VEL (MPH)	5.7	6.3	7.2	9.0	2.5	2.4	6.5	5.8	5.2	6.6
		SPD (MPH)	5.9	6.5	7.3	9.1	3.9	3.5	7.5	6.3	5.5	7.5
		RATIO	0.959	0.977	0.984	0.992	0.653	0.698	0.867	0.913	0.950	0.877
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	260	280	240	320	240	260	280	280	300
		VEL (MPH)	5.8	9.0	9.8	9.7	6.0	8.0	9.1	8.2	7.3	8.5
		SPD (MPH)	6.5	9.3	9.9	9.9	8.1	8.2	9.3	8.5	7.6	8.6
		RATIO	0.898	0.968	0.983	0.973	0.741	0.980	0.969	0.969	0.953	0.989
EAST HARTFORD-004 (0056)		PM10	62	58	55	47	45	41	41	39	39	38
		DATE	6/11/91	8/28/91	1/30/91	6/29/91	11/20/91	8/16/91	12/20/91	3/ 1/91	5/24/91	2/ 5/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	260	230	300	240	280	310	150	240	250
		VEL (MPH)	7.5	6.9	2.4	7.1	10.6	5.6	7.6	4.0	9.1	5.7
		SPD (MPH)	10.2	8.6	3.2	9.5	11.9	7.5	9.9	4.5	10.1	7.6
		RATIO	0.734	0.800	0.764	0.746	0.891	0.746	0.764	0.892	0.904	0.747
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	270	80	330	180	260	350	190	200	270
		VEL (MPH)	6.6	4.1	.8	7.1	8.7	4.9	3.9	6.9	8.5	2.7
		SPD (MPH)	9.1	6.0	4.6	9.2	9.6	7.6	6.5	7.2	10.5	5.3
		RATIO	0.729	0.686	0.164	0.769	0.903	0.638	0.602	0.962	0.808	0.501

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	260	250	160	260	240	260	320	170	250	240
BRIDGEPORT	VEL (MPH)	5.7	5.0	.3	2.5	9.0	5.8	6.6	2.4	6.3	5.2
	SPD (MPH)	5.9	5.2	2.2	3.9	9.1	6.3	7.5	3.5	6.5	5.5
	RATIO	0.959	0.961	0.137	0.653	0.992	0.913	0.877	0.698	0.977	0.950
METEOROLOGICAL SITE	DIR (DEG)	270	280	240	320	240	280	300	240	260	280
WORCESTER	VEL (MPH)	5.8	8.4	3.6	6.0	9.7	8.2	8.5	8.0	9.0	7.3
	SPD (MPH)	6.5	8.6	5.6	8.1	9.9	8.5	8.6	8.2	9.3	7.6
	RATIO	0.898	0.979	0.636	0.741	0.973	0.969	0.989	0.980	0.968	0.953
ENFIELD-005 (0059)	PM10	54	51	41	39	36	36	35	32	31	31
	DATE	6/11/91	8/28/91	6/29/91	7/23/91	11/20/91	5/24/91	8/16/91	5/12/91	3/ 1/91	10/27/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	300	250	240	240	280	280	150	200
NEWARK	VEL (MPH)	7.5	6.9	7.1	8.1	10.6	9.1	5.6	8.6	4.0	3.5
	SPD (MPH)	10.2	8.6	9.5	10.4	11.9	10.1	7.5	11.2	4.5	4.0
	RATIO	0.734	0.800	0.746	0.779	0.891	0.904	0.746	0.766	0.892	0.880
METEOROLOGICAL SITE	DIR (DEG)	250	270	330	210	180	200	260	290	190	190
BRADLEY	VEL (MPH)	6.6	4.1	7.1	7.0	8.7	8.5	4.9	9.2	6.9	6.7
	SPD (MPH)	9.1	6.0	9.2	10.6	9.6	10.5	7.6	11.5	7.2	8.9
	RATIO	0.729	0.686	0.769	0.659	0.903	0.808	0.638	0.802	0.962	0.756
METEOROLOGICAL SITE	DIR (DEG)	260	250	260	270	240	250	260	280	170	240
BRIDGEPORT	VEL (MPH)	5.7	5.0	2.5	6.5	9.0	6.3	5.8	5.9	2.4	5.7
	SPD (MPH)	5.9	5.2	3.9	7.5	9.1	6.5	6.3	6.6	3.5	6.5
	RATIO	0.959	0.961	0.653	0.867	0.992	0.977	0.913	0.897	0.698	0.882
METEOROLOGICAL SITE	DIR (DEG)	270	280	320	260	240	260	280	280	240	250
WORCESTER	VEL (MPH)	5.8	8.4	6.0	9.1	9.7	9.0	8.2	9.4	8.0	10.5
	SPD (MPH)	6.5	8.6	8.1	9.3	9.9	9.3	8.5	9.9	8.2	10.6
	RATIO	0.898	0.979	0.741	0.969	0.973	0.968	0.969	0.951	0.980	0.986
GREENWICH-017 (0058)	PM10	67	48	48	47	45	43	43	43	41	40
	DATE	6/11/91	7/23/91	7/17/91	8/16/91	11/20/91	5/24/91	8/28/91	2/ 5/91	12/ 8/91	3/ 1/91
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	280	240	240	260	250	220	150
NEWARK	VEL (MPH)	7.5	8.1	11.6	5.6	10.6	9.1	6.9	5.7	3.3	4.0
	SPD (MPH)	10.2	10.4	13.9	7.5	11.9	10.1	8.6	7.6	5.5	4.5
	RATIO	0.734	0.779	0.832	0.746	0.891	0.904	0.800	0.747	0.604	0.892
METEOROLOGICAL SITE	DIR (DEG)	250	210	270	260	180	200	270	270	200	190
BRADLEY	VEL (MPH)	6.6	7.0	5.8	4.9	8.7	8.5	4.1	2.7	2.8	6.9
	SPD (MPH)	9.1	10.6	8.5	7.6	9.6	10.5	6.0	5.3	6.2	7.2
	RATIO	0.729	0.659	0.686	0.638	0.903	0.808	0.686	0.501	0.455	0.962
METEOROLOGICAL SITE	DIR (DEG)	260	270	250	260	240	250	250	240	170	170
BRIDGEPORT	VEL (MPH)	5.7	6.5	7.2	5.8	9.0	6.3	5.0	5.2	2.3	2.4
	SPD (MPH)	5.9	7.5	7.3	6.3	9.1	6.5	5.2	5.5	4.5	3.5
	RATIO	0.959	0.867	0.984	0.913	0.992	0.977	0.961	0.950	0.519	0.698
METEOROLOGICAL SITE	DIR (DEG)	270	260	280	280	240	260	280	280	240	240
WORCESTER	VEL (MPH)	5.8	9.1	9.8	8.2	9.7	9.0	8.4	7.3	2.0	8.0
	SPD (MPH)	6.5	9.3	9.9	8.5	9.9	9.3	8.6	7.6	4.5	8.2
	RATIO	0.898	0.969	0.983	0.969	0.973	0.968	0.979	0.953	0.453	0.980

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
GROTON-006 (0058)	PM10	82	59	55	53	52	35	33	32	32	31
	DATE	6/11/91	8/16/91	8/28/91	6/29/91	7/17/91	12/ 8/91	8/22/91	11/ 8/91	11/20/91	6/17/91
METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	280	260	300	250	220	250	30	240	90
	VEL (MPH)	7.5	5.6	6.9	7.1	11.6	3.3	7.3	10.8	10.6	2.8
	SPD (MPH)	10.2	7.5	8.6	9.5	13.9	5.5	8.2	10.9	11.9	8.6
	RATIO	0.734	0.746	0.800	0.746	0.832	0.604	0.888	0.985	0.891	0.323
METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	260	270	330	270	200	230	10	180	60
	VEL (MPH)	6.6	4.9	4.1	7.1	5.8	2.8	3.8	8.6	8.7	3.1
	SPD (MPH)	9.1	7.6	6.0	9.2	8.5	6.2	5.0	8.9	9.6	6.6
	RATIO	0.729	0.638	0.686	0.769	0.686	0.455	0.747	0.960	0.903	0.475
METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	260	250	260	250	170	260	20	240	110
	VEL (MPH)	5.7	5.8	5.0	2.5	7.2	2.3	5.6	8.4	9.0	4.6
	SPD (MPH)	5.9	6.3	5.2	3.9	7.3	4.5	5.9	8.6	9.1	4.9
	RATIO	0.959	0.913	0.961	0.653	0.984	0.519	0.943	0.976	0.992	0.945
METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	280	280	320	280	240	260	360	240	70
	VEL (MPH)	5.8	8.2	8.4	6.0	9.8	2.0	6.0	5.8	9.7	4.5
	SPD (MPH)	6.5	8.5	8.6	8.1	9.9	4.5	6.3	6.0	9.9	4.6
	RATIO	0.898	0.969	0.979	0.741	0.983	0.453	0.956	0.964	0.973	0.978
HARTFORD-013 (0059)	PM10	56	51	41	41	37	37	36	36	35	32
	DATE	6/11/91	8/28/91	11/20/91	6/29/91	7/17/91	3/ 1/91	5/24/91	7/23/91	1/30/91	2/ 5/91
METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	260	240	300	250	150	240	250	230	250
	VEL (MPH)	7.5	6.9	10.6	7.1	11.6	4.0	9.1	8.1	2.4	5.7
	SPD (MPH)	10.2	8.6	11.9	9.5	13.9	4.5	10.1	10.4	3.2	7.6
	RATIO	0.734	0.800	0.891	0.746	0.832	0.892	0.904	0.779	0.764	0.747
METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	270	180	330	270	190	200	210	80	270
	VEL (MPH)	6.6	4.1	8.7	7.1	5.8	6.9	8.5	7.0	.8	2.7
	SPD (MPH)	9.1	6.0	9.6	9.2	8.5	7.2	10.5	10.6	4.6	5.3
	RATIO	0.729	0.686	0.903	0.769	0.686	0.962	0.808	0.659	0.164	0.501
METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	250	240	260	250	170	250	270	160	240
	VEL (MPH)	5.7	5.0	9.0	2.5	7.2	2.4	6.3	6.5	.3	5.2
	SPD (MPH)	5.9	5.2	9.1	3.9	7.3	3.5	6.5	7.5	2.2	5.5
	RATIO	0.959	0.961	0.992	0.653	0.984	0.698	0.977	0.867	0.137	0.950
METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	280	240	320	280	240	260	260	240	280
	VEL (MPH)	5.8	8.4	9.7	6.0	9.8	8.0	9.0	9.1	3.6	7.3
	SPD (MPH)	6.5	8.6	9.9	8.1	9.9	8.2	9.3	9.3	5.6	7.6
	RATIO	0.898	0.979	0.973	0.741	0.983	0.980	0.968	0.969	0.636	0.953
HARTFORD-015 (0057)	PM10	58	55	53	49	46	45	44	40	40	39
	DATE	6/11/91	8/28/91	12/20/91	2/ 5/91	1/30/91	3/ 1/91	7/17/91	8/16/91	11/20/91	7/23/91
METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	260	310	250	230	150	250	280	240	250
	VEL (MPH)	7.5	6.9	7.6	5.7	2.4	4.0	11.6	5.6	10.6	8.1
	SPD (MPH)	10.2	8.6	9.9	7.6	3.2	4.5	13.9	7.5	11.9	10.4
	RATIO	0.734	0.800	0.764	0.747	0.764	0.892	0.832	0.746	0.891	0.779
METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	270	350	270	80	190	270	260	180	210
	VEL (MPH)	6.6	4.1	3.9	2.7	.8	6.9	5.8	4.9	8.7	7.0
	SPD (MPH)	9.1	6.0	6.5	5.3	4.6	7.2	8.5	7.6	9.6	10.6
	RATIO	0.729	0.686	0.602	0.501	0.164	0.962	0.686	0.638	0.903	0.659

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	260	250	320	240	160	170	250	260	240	270
BRIDGEPORT	VEL (MPH)	5.7	5.0	6.6	5.2	.3	2.4	7.2	5.8	9.0	6.5
	SPD (MPH)	5.9	5.2	7.5	5.5	2.2	3.5	7.3	6.3	9.1	7.5
	RATIO	0.959	0.961	0.877	0.950	0.137	0.698	0.984	0.913	0.992	0.867
METEOROLOGICAL SITE	DIR (DEG)	270	280	300	280	240	240	280	280	240	260
WORCESTER	VEL (MPH)	5.8	8.4	8.5	7.3	3.6	8.0	9.8	8.2	9.7	9.1
	SPD (MPH)	6.5	8.6	8.6	7.6	5.6	8.2	9.9	8.5	9.9	9.3
	RATIO	0.898	0.979	0.989	0.953	0.636	0.980	0.983	0.969	0.973	0.969
MERIDEN-002 (0057)	PM10	58	50	48	47	46	46	39	37	37	36
	DATE	6/11/91	8/28/91	2/ 5/91	3/ 1/91	11/20/91	7/17/91	7/23/91	8/16/91	6/29/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	250	150	240	250	250	280	300	220
NEWARK	VEL (MPH)	7.5	6.9	5.7	4.0	10.6	11.6	8.1	5.6	7.1	3.3
	SPD (MPH)	10.2	8.6	7.6	4.5	11.9	13.9	10.4	7.5	9.5	5.5
	RATIO	0.734	0.800	0.747	0.892	0.891	0.832	0.779	0.746	0.746	0.604
METEOROLOGICAL SITE	DIR (DEG)	250	270	270	190	180	270	210	260	330	200
BRADLEY	VEL (MPH)	6.6	4.1	2.7	6.9	8.7	5.8	7.0	4.9	7.1	2.8
	SPD (MPH)	9.1	6.0	5.3	7.2	9.6	8.5	10.6	7.6	9.2	6.2
	RATIO	0.729	0.686	0.501	0.962	0.903	0.686	0.659	0.638	0.769	0.455
METEOROLOGICAL SITE	DIR (DEG)	260	250	240	170	240	250	270	260	260	170
BRIDGEPORT	VEL (MPH)	5.7	5.0	5.2	2.4	9.0	7.2	6.5	5.8	2.5	2.3
	SPD (MPH)	5.9	5.2	5.5	3.5	9.1	7.3	7.5	6.3	3.9	4.5
	RATIO	0.959	0.961	0.950	0.698	0.992	0.984	0.867	0.913	0.653	0.519
METEOROLOGICAL SITE	DIR (DEG)	270	280	280	240	240	280	260	280	320	240
WORCESTER	VEL (MPH)	5.8	8.4	7.3	8.0	9.7	9.8	9.1	8.2	6.0	2.0
	SPD (MPH)	6.5	8.6	7.6	8.2	9.9	9.9	9.3	8.5	8.1	4.5
	RATIO	0.898	0.979	0.953	0.980	0.973	0.983	0.969	0.969	0.741	0.453
MIDDLETOWN-003 (0055)	PM10	63	51	45	43	42	39	39	38	37	36
	DATE	6/11/91	8/28/91	6/29/91	7/23/91	7/17/91	11/20/91	11/ 8/91	8/16/91	2/ 5/91	5/24/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	300	250	250	240	30	280	250	240
NEWARK	VEL (MPH)	7.5	6.9	7.1	8.1	11.6	10.6	10.8	5.6	5.7	9.1
	SPD (MPH)	10.2	8.6	9.5	10.4	13.9	11.9	10.9	7.5	7.6	10.1
	RATIO	0.734	0.800	0.746	0.779	0.832	0.891	0.985	0.746	0.747	0.904
METEOROLOGICAL SITE	DIR (DEG)	250	270	330	210	270	180	10	260	270	200
BRADLEY	VEL (MPH)	6.6	4.1	7.1	7.0	5.8	8.7	8.6	4.9	2.7	8.5
	SPD (MPH)	9.1	6.0	9.2	10.6	8.5	9.6	8.9	7.6	5.3	10.5
	RATIO	0.729	0.686	0.769	0.659	0.686	0.903	0.960	0.638	0.501	0.808
METEOROLOGICAL SITE	DIR (DEG)	260	250	260	270	250	240	20	260	240	250
BRIDGEPORT	VEL (MPH)	5.7	5.0	2.5	6.5	7.2	9.0	8.4	5.8	5.2	6.3
	SPD (MPH)	5.9	5.2	3.9	7.5	7.3	9.1	8.6	6.3	5.5	6.5
	RATIO	0.959	0.961	0.653	0.867	0.984	0.992	0.976	0.913	0.950	0.977
METEOROLOGICAL SITE	DIR (DEG)	270	280	320	260	280	240	360	280	280	260
WORCESTER	VEL (MPH)	5.8	8.4	6.0	9.1	9.8	9.7	5.8	8.2	7.3	9.0
	SPD (MPH)	6.5	8.6	8.1	9.3	9.9	9.9	6.0	8.5	7.6	9.3
	RATIO	0.898	0.979	0.741	0.969	0.983	0.973	0.964	0.969	0.953	0.968

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
MILFORD-010 (0057)	PM10	68	54	44	44	43	43	40	40	39	36
	DATE	6/11/91	6/29/91	8/16/91	7/23/91	8/28/91	7/17/91	5/24/91	11/20/91	2/ 5/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	250	300	280	250	260	250	240	240	250	220
NEWARK	VEL (MPH)	7.5	7.1	5.6	8.1	6.9	11.6	9.1	10.6	5.7	3.3
	SPD (MPH)	10.2	9.5	7.5	10.4	8.6	13.9	10.1	11.9	7.6	5.5
	RATIO	0.734	0.746	0.746	0.779	0.800	0.832	0.904	0.891	0.747	0.604
METEOROLOGICAL SITE	DIR (DEG)	250	330	260	210	270	270	200	180	270	200
BRADLEY	VEL (MPH)	6.6	7.1	4.9	7.0	4.1	5.8	8.5	8.7	2.7	2.8
	SPD (MPH)	9.1	9.2	7.6	10.6	6.0	8.5	10.5	9.6	5.3	6.2
	RATIO	0.729	0.769	0.638	0.659	0.686	0.686	0.808	0.903	0.501	0.455
METEOROLOGICAL SITE	DIR (DEG)	260	260	260	270	250	250	250	240	240	170
BRIDGEPORT	VEL (MPH)	5.7	2.5	5.8	6.5	5.0	7.2	6.3	9.0	5.2	2.3
	SPD (MPH)	5.9	3.9	6.3	7.5	5.2	7.3	6.5	9.1	5.5	4.5
	RATIO	0.959	0.653	0.913	0.867	0.961	0.984	0.977	0.992	0.950	0.519
METEOROLOGICAL SITE	DIR (DEG)	270	320	280	260	280	280	260	240	280	240
WORCESTER	VEL (MPH)	5.8	6.0	8.2	9.1	8.4	9.8	9.0	9.7	7.3	2.0
	SPD (MPH)	6.5	8.1	8.5	9.3	8.6	9.9	9.3	9.9	7.6	4.5
	RATIO	0.898	0.741	0.969	0.969	0.979	0.983	0.968	0.973	0.953	0.453
NEW HAVEN-013 (0055)	PM10	66	66	58	55	47	46	45	45	42	40
	DATE	6/11/91	6/29/91	6/17/91	2/ 5/91	8/28/91	7/23/91	7/17/91	3/ 1/91	12/ 8/91	5/24/91
METEOROLOGICAL SITE	DIR (DEG)	250	300	90	250	260	250	250	150	220	240
NEWARK	VEL (MPH)	7.5	7.1	2.8	5.7	6.9	8.1	11.6	4.0	3.3	9.1
	SPD (MPH)	10.2	9.5	8.6	7.6	8.6	10.4	13.9	4.5	5.5	10.1
	RATIO	0.734	0.746	0.323	0.747	0.800	0.779	0.832	0.892	0.604	0.904
METEOROLOGICAL SITE	DIR (DEG)	250	330	60	270	270	210	270	190	200	200
BRADLEY	VEL (MPH)	6.6	7.1	3.1	2.7	4.1	7.0	5.8	6.9	2.8	8.5
	SPD (MPH)	9.1	9.2	6.6	5.3	6.0	10.6	8.5	7.2	6.2	10.5
	RATIO	0.729	0.769	0.475	0.501	0.686	0.659	0.686	0.962	0.455	0.808
METEOROLOGICAL SITE	DIR (DEG)	260	260	110	240	250	270	250	170	170	250
BRIDGEPORT	VEL (MPH)	5.7	2.5	4.6	5.2	5.0	6.5	7.2	2.4	2.3	6.3
	SPD (MPH)	5.9	3.9	4.9	5.5	5.2	7.5	7.3	3.5	4.5	6.5
	RATIO	0.959	0.653	0.945	0.950	0.961	0.867	0.984	0.698	0.519	0.977
METEOROLOGICAL SITE	DIR (DEG)	270	320	70	280	280	260	280	240	240	260
WORCESTER	VEL (MPH)	5.8	6.0	4.5	7.3	8.4	9.1	9.8	8.0	2.0	9.0
	SPD (MPH)	6.5	8.1	4.6	7.6	8.6	9.3	9.9	8.2	4.5	9.3
	RATIO	0.898	0.741	0.978	0.953	0.979	0.969	0.983	0.980	0.453	0.968
NEW HAVEN-018 (0350)	PM10	118	112	108	108	103	100	93	92	87	83
	DATE	12/27/91	11/24/91	2/ 4/91	2/ 5/91	1/15/91	8/24/91	4/ 8/91	6/11/91	7/18/91	8/31/91
METEOROLOGICAL SITE	DIR (DEG)	340	280	270	250	140	70	230	250	260	330
NEWARK	VEL (MPH)	6.9	6.9	4.6	5.7	.8	4.8	8.1	7.5	8.7	10.5
	SPD (MPH)	8.5	9.9	7.0	7.6	3.3	6.8	10.8	10.2	10.5	11.5
	RATIO	0.814	0.699	0.658	0.747	0.249	0.714	0.749	0.734	0.830	0.910
METEOROLOGICAL SITE	DIR (DEG)	330	360	260	270	200	20	240	250	260	340
BRADLEY	VEL (MPH)	5.4	4.4	6.6	2.7	1.2	7.3	7.8	6.6	3.8	7.9
	SPD (MPH)	7.0	6.5	9.5	5.3	2.9	9.5	9.8	9.1	5.0	9.1
	RATIO	0.769	0.676	0.697	0.501	0.420	0.766	0.803	0.729	0.759	0.875

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	330	80	240	240	90	110	250	260	240	350
BRIDGEPORT	VEL (MPH)	5.6	5.2	5.1	5.2	3.0	4.6	6.2	5.7	5.7	5.8
	SPD (MPH)	6.5	10.4	5.2	5.5	3.6	5.8	6.3	5.9	6.0	7.2
	RATIO	0.862	0.499	0.987	0.950	0.823	0.805	0.975	0.959	0.944	0.800
METEOROLOGICAL SITE	DIR (DEG)	310	30	270	280	250	80	270	270	270	310
WORCESTER	VEL (MPH)	7.4	3.5	6.2	7.3	3.8	4.7	7.7	5.8	7.6	9.6
	SPD (MPH)	8.2	6.3	6.3	7.6	4.5	5.3	8.1	6.5	8.1	11.2
	RATIO	0.899	0.556	0.982	0.953	0.847	0.875	0.954	0.898	0.940	0.858
NEW HAVEN-020 (0059)	PM10	72	55	52	51	51	51	49	44	44	43
	DATE	6/11/91	8/28/91	3/ 1/91	8/16/91	2/ 5/91	6/29/91	7/17/91	7/23/91	12/ 8/91	7/29/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	150	280	250	300	250	250	220	40
NEWARK	VEL (MPH)	7.5	6.9	4.0	5.6	5.7	7.1	11.6	8.1	3.3	4.3
	SPD (MPH)	10.2	8.6	4.5	7.5	7.6	9.5	13.9	10.4	5.5	5.0
	RATIO	0.734	0.800	0.892	0.746	0.747	0.746	0.832	0.779	0.604	0.857
METEOROLOGICAL SITE	DIR (DEG)	250	270	190	260	270	330	270	210	200	40
BRADLEY	VEL (MPH)	6.6	4.1	6.9	4.9	2.7	7.1	5.8	7.0	2.8	2.6
	SPD (MPH)	9.1	6.0	7.2	7.6	5.3	9.2	8.5	10.6	6.2	6.0
	RATIO	0.729	0.686	0.962	0.638	0.501	0.769	0.686	0.659	0.455	0.426
METEOROLOGICAL SITE	DIR (DEG)	260	250	170	260	240	260	250	270	170	70
BRIDGEPORT	VEL (MPH)	5.7	5.0	2.4	5.8	5.2	2.5	7.2	6.5	2.3	4.1
	SPD (MPH)	5.9	5.2	3.5	6.3	5.5	3.9	7.3	7.5	4.5	4.3
	RATIO	0.959	0.961	0.698	0.913	0.950	0.653	0.984	0.867	0.519	0.949
METEOROLOGICAL SITE	DIR (DEG)	270	280	240	280	280	320	280	260	240	70
WORCESTER	VEL (MPH)	5.8	8.4	8.0	8.2	7.3	6.0	9.8	9.1	2.0	3.1
	SPD (MPH)	6.5	8.6	8.2	8.5	7.6	8.1	9.9	9.3	4.5	3.9
	RATIO	0.898	0.979	0.980	0.969	0.953	0.741	0.983	0.969	0.453	0.793
NEW HAVEN-123 (0058)	PM10	106	60	58	57	55	55	53	51	50	47
	DATE	2/ 5/91	3/ 1/91	6/11/91	11/20/91	1/30/91	8/28/91	6/29/91	6/17/91	7/17/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	250	150	250	240	230	260	300	90	250	220
NEWARK	VEL (MPH)	5.7	4.0	7.5	10.6	2.4	6.9	7.1	2.8	11.6	3.3
	SPD (MPH)	7.6	4.5	10.2	11.9	3.2	8.6	9.5	8.6	13.9	5.5
	RATIO	0.747	0.892	0.734	0.891	0.764	0.800	0.746	0.323	0.832	0.604
METEOROLOGICAL SITE	DIR (DEG)	270	190	250	180	80	270	330	60	270	200
BRADLEY	VEL (MPH)	2.7	6.9	6.6	8.7	.8	4.1	7.1	3.1	5.8	2.8
	SPD (MPH)	5.3	7.2	9.1	9.6	4.6	6.0	9.2	6.6	8.5	6.2
	RATIO	0.501	0.962	0.729	0.903	0.164	0.686	0.769	0.475	0.686	0.455
METEOROLOGICAL SITE	DIR (DEG)	240	170	260	240	160	250	260	110	250	170
BRIDGEPORT	VEL (MPH)	5.2	2.4	5.7	9.0	.3	5.0	2.5	4.6	7.2	2.3
	SPD (MPH)	5.5	3.5	5.9	9.1	2.2	5.2	3.9	4.9	7.3	4.5
	RATIO	0.950	0.698	0.959	0.992	0.137	0.961	0.653	0.945	0.984	0.519
METEOROLOGICAL SITE	DIR (DEG)	280	240	270	240	240	280	320	70	280	240
WORCESTER	VEL (MPH)	7.3	8.0	5.8	9.7	3.6	8.4	6.0	4.5	9.8	2.0
	SPD (MPH)	7.6	8.2	6.5	9.9	5.6	8.6	8.1	4.6	9.9	4.5
	RATIO	0.953	0.980	0.898	0.973	0.636	0.979	0.741	0.978	0.983	0.453

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)		RANK	1	2	3	4	5	6	7	8	9	10
NEW LONDON-004 (0058)		PM10	75	49	49	48	43	37	37	36	36	35
		DATE	6/11/91	6/29/91	8/16/91	7/23/91	8/28/91	2/ 5/91	7/17/91	12/ 8/91	3/ 1/91	6/17/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	300	280	250	260	250	250	220	150	90
		VEL (MPH)	7.5	7.1	5.6	8.1	6.9	5.7	11.6	3.3	4.0	2.8
		SPD (MPH)	10.2	9.5	7.5	10.4	8.6	7.6	13.9	5.5	4.5	8.6
		RATIO	0.734	0.746	0.746	0.779	0.800	0.747	0.832	0.604	0.892	0.323
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	330	260	210	270	270	270	200	190	60
		VEL (MPH)	6.6	7.1	4.9	7.0	4.1	2.7	5.8	2.8	6.9	3.1
		SPD (MPH)	9.1	9.2	7.6	10.6	6.0	5.3	8.5	6.2	7.2	6.6
		RATIO	0.729	0.769	0.638	0.659	0.686	0.501	0.686	0.455	0.962	0.475
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	260	260	270	250	240	250	170	170	110
		VEL (MPH)	5.7	2.5	5.8	6.5	5.0	5.2	7.2	2.3	2.4	4.6
		SPD (MPH)	5.9	3.9	6.3	7.5	5.2	5.5	7.3	4.5	3.5	4.9
		RATIO	0.959	0.653	0.913	0.867	0.961	0.950	0.984	0.519	0.698	0.945
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	320	280	260	280	280	280	240	240	70
		VEL (MPH)	5.8	6.0	8.2	9.1	8.4	7.3	9.8	2.0	8.0	4.5
		SPD (MPH)	6.5	8.1	8.5	9.3	8.6	7.6	9.9	4.5	8.2	4.6
		RATIO	0.898	0.741	0.969	0.969	0.979	0.953	0.983	0.453	0.980	0.978
NORWALK-014 (0056)		PM10	80	77	68	66	60	58	58	56	56	55
		DATE	3/ 1/91	6/11/91	2/ 5/91	1/30/91	7/17/91	8/16/91	6/29/91	5/24/91	12/20/91	8/28/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	150	250	250	230	250	280	300	240	310	260
		VEL (MPH)	4.0	7.5	5.7	2.4	11.6	5.6	7.1	9.1	7.6	6.9
		SPD (MPH)	4.5	10.2	7.6	3.2	13.9	7.5	9.5	10.1	9.9	8.6
		RATIO	0.892	0.734	0.747	0.764	0.832	0.746	0.746	0.904	0.764	0.800
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	190	250	270	80	270	260	330	200	350	270
		VEL (MPH)	6.9	6.6	2.7	.8	5.8	4.9	7.1	8.5	3.9	4.1
		SPD (MPH)	7.2	9.1	5.3	4.6	8.5	7.6	9.2	10.5	6.5	6.0
		RATIO	0.962	0.729	0.501	0.164	0.686	0.638	0.769	0.808	0.602	0.686
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	170	260	240	160	250	260	260	250	320	250
		VEL (MPH)	2.4	5.7	5.2	.3	7.2	5.8	2.5	6.3	6.6	5.0
		SPD (MPH)	3.5	5.9	5.5	2.2	7.3	6.3	3.9	6.5	7.5	5.2
		RATIO	0.698	0.959	0.950	0.137	0.984	0.913	0.653	0.977	0.877	0.961
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	240	270	280	240	280	280	320	260	300	280
		VEL (MPH)	8.0	5.8	7.3	3.6	9.8	8.2	6.0	9.0	8.5	8.4
		SPD (MPH)	8.2	6.5	7.6	5.6	9.9	8.5	8.1	9.3	8.6	8.6
		RATIO	0.980	0.898	0.953	0.636	0.983	0.969	0.741	0.968	0.989	0.979
NORWICH-002 (0058)		PM10	70	48	45	44	44	43	38	38	38	36
		DATE	6/11/91	6/29/91	8/28/91	8/16/91	1/30/91	7/23/91	2/ 5/91	3/ 1/91	7/17/91	12/ 8/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	300	260	280	230	250	250	150	250	220
		VEL (MPH)	7.5	7.1	6.9	5.6	2.4	8.1	5.7	4.0	11.6	3.3
		SPD (MPH)	10.2	9.5	8.6	7.5	3.2	10.4	7.6	4.5	13.9	5.5
		RATIO	0.734	0.746	0.800	0.746	0.764	0.779	0.747	0.892	0.832	0.604
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	330	270	260	80	210	270	190	270	200
		VEL (MPH)	6.6	7.1	4.1	4.9	.8	7.0	2.7	6.9	5.8	2.8
		SPD (MPH)	9.1	9.2	6.0	7.6	4.6	10.6	5.3	7.2	8.5	6.2
		RATIO	0.729	0.769	0.686	0.638	0.164	0.659	0.501	0.962	0.686	0.455

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	260	260	250	260	160	270	240	170	250	170
BRIDGEPORT	VEL (MPH)	5.7	2.5	5.0	5.8	.3	6.5	5.2	2.4	7.2	2.3
	SPD (MPH)	5.9	3.9	5.2	6.3	2.2	7.5	5.5	3.5	7.3	4.5
	RATIO	0.959	0.653	0.961	0.913	0.137	0.867	0.950	0.698	0.984	0.519
METEOROLOGICAL SITE	DIR (DEG)	270	320	280	280	240	260	280	240	280	240
WORCESTER	VEL (MPH)	5.8	6.0	8.4	8.2	3.6	9.1	7.3	8.0	9.8	2.0
	SPD (MPH)	6.5	8.1	8.6	8.5	5.6	9.3	7.6	8.2	9.9	4.5
	RATIO	0.898	0.741	0.979	0.969	0.636	0.969	0.953	0.980	0.983	0.453
STAMFORD-001 (0058)	PM10	65	56	54	52	52	52	50	50	46	46
	DATE	6/11/91	3/ 1/91	1/30/91	6/29/91	7/23/91	7/17/91	5/24/91	2/ 5/91	12/ 8/91	11/20/91
METEOROLOGICAL SITE	DIR (DEG)	250	150	230	300	250	250	240	250	220	240
NEWARK	VEL (MPH)	7.5	4.0	2.4	7.1	8.1	11.6	9.1	5.7	3.3	10.6
	SPD (MPH)	10.2	4.5	3.2	9.5	10.4	13.9	10.1	7.6	5.5	11.9
	RATIO	0.734	0.892	0.764	0.746	0.779	0.832	0.904	0.747	0.604	0.891
METEOROLOGICAL SITE	DIR (DEG)	250	190	80	330	210	270	200	270	200	180
BRADLEY	VEL (MPH)	6.6	6.9	.8	7.1	7.0	5.8	8.5	2.7	2.8	8.7
	SPD (MPH)	9.1	7.2	4.6	9.2	10.6	8.5	10.5	5.3	6.2	9.6
	RATIO	0.729	0.962	0.164	0.769	0.659	0.686	0.808	0.501	0.455	0.903
METEOROLOGICAL SITE	DIR (DEG)	260	170	160	260	270	250	250	240	170	240
BRIDGEPORT	VEL (MPH)	5.7	2.4	.3	2.5	6.5	7.2	6.3	5.2	2.3	9.0
	SPD (MPH)	5.9	3.5	2.2	3.9	7.5	7.3	6.5	5.5	4.5	9.1
	RATIO	0.959	0.698	0.137	0.653	0.867	0.984	0.977	0.950	0.519	0.992
METEOROLOGICAL SITE	DIR (DEG)	270	240	240	320	260	280	260	280	240	240
WORCESTER	VEL (MPH)	5.8	8.0	3.6	6.0	9.1	9.8	9.0	7.3	2.0	9.7
	SPD (MPH)	6.5	8.2	5.6	8.1	9.3	9.9	9.3	7.6	4.5	9.9
	RATIO	0.898	0.980	0.636	0.741	0.969	0.983	0.968	0.953	0.453	0.973
TORRINGTON-001 (0057)	PM10	53	52	49	47	43	40	37	36	35	35
	DATE	6/11/91	3/ 1/91	2/ 5/91	8/28/91	12/ 8/91	7/23/91	6/29/91	5/24/91	11/20/91	1/30/91
METEOROLOGICAL SITE	DIR (DEG)	250	150	250	260	220	250	300	240	240	230
NEWARK	VEL (MPH)	7.5	4.0	5.7	6.9	3.3	8.1	7.1	9.1	10.6	2.4
	SPD (MPH)	10.2	4.5	7.6	8.6	5.5	10.4	9.5	10.1	11.9	3.2
	RATIO	0.734	0.892	0.747	0.800	0.604	0.779	0.746	0.904	0.891	0.764
METEOROLOGICAL SITE	DIR (DEG)	250	190	270	270	200	210	330	200	180	80
BRADLEY	VEL (MPH)	6.6	6.9	2.7	4.1	2.8	7.0	7.1	8.5	8.7	.8
	SPD (MPH)	9.1	7.2	5.3	6.0	6.2	10.6	9.2	10.5	9.6	4.6
	RATIO	0.729	0.962	0.501	0.686	0.455	0.659	0.769	0.808	0.903	0.164
METEOROLOGICAL SITE	DIR (DEG)	260	170	240	250	170	270	260	250	240	160
BRIDGEPORT	VEL (MPH)	5.7	2.4	5.2	5.0	2.3	6.5	2.5	6.3	9.0	.3
	SPD (MPH)	5.9	3.5	5.5	5.2	4.5	7.5	3.9	6.5	9.1	2.2
	RATIO	0.959	0.698	0.950	0.961	0.519	0.867	0.653	0.977	0.992	0.137
METEOROLOGICAL SITE	DIR (DEG)	270	240	280	280	240	260	320	260	240	240
WORCESTER	VEL (MPH)	5.8	8.0	7.3	8.4	2.0	9.1	6.0	9.0	9.7	3.6
	SPD (MPH)	6.5	8.2	7.6	8.6	4.5	9.3	8.1	9.3	9.9	5.6
	RATIO	0.898	0.980	0.953	0.979	0.453	0.969	0.741	0.968	0.973	0.636

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
VOLUNTOWN-001 (0055)	PM10	62	42	40	40	32	27	26	24	23	23
	DATE	6/11/91	6/29/91	7/23/91	8/28/91	7/17/91	5/12/91	5/24/91	11/ 8/91	6/17/91	12/ 8/91
METEOROLOGICAL SITE	DIR (DEG)	250	300	250	260	250	280	240	30	90	220
NEWARK	VEL (MPH)	7.5	7.1	8.1	6.9	11.6	8.6	9.1	10.8	2.8	3.3
	SPD (MPH)	10.2	9.5	10.4	8.6	13.9	11.2	10.1	10.9	8.6	5.5
	RATIO	0.734	0.746	0.779	0.800	0.832	0.766	0.904	0.985	0.323	0.604
METEOROLOGICAL SITE	DIR (DEG)	250	330	210	270	270	290	200	10	60	200
BRADLEY	VEL (MPH)	6.6	7.1	7.0	4.1	5.8	9.2	8.5	8.6	3.1	2.8
	SPD (MPH)	9.1	9.2	10.6	6.0	8.5	11.5	10.5	8.9	6.6	6.2
	RATIO	0.729	0.769	0.659	0.686	0.686	0.802	0.808	0.960	0.475	0.455
METEOROLOGICAL SITE	DIR (DEG)	260	260	270	250	250	280	250	20	110	170
BRIDGEPORT	VEL (MPH)	5.7	2.5	6.5	5.0	7.2	5.9	6.3	8.4	4.6	2.3
	SPD (MPH)	5.9	3.9	7.5	5.2	7.3	6.6	6.5	8.6	4.9	4.5
	RATIO	0.959	0.653	0.867	0.961	0.984	0.897	0.977	0.976	0.945	0.519
METEOROLOGICAL SITE	DIR (DEG)	270	320	260	280	280	280	260	360	70	240
WORCESTER	VEL (MPH)	5.8	6.0	9.1	8.4	9.8	9.4	9.0	5.8	4.5	2.0
	SPD (MPH)	6.5	8.1	9.3	8.6	9.9	9.9	9.3	6.0	4.6	4.5
	RATIO	0.898	0.741	0.969	0.979	0.983	0.951	0.968	0.964	0.978	0.453
WALLINGFORD-006 (0056)	PM10	64	51	50	47	42	42	39	35	32	31
	DATE	6/11/91	11/20/91	8/28/91	6/29/91	7/23/91	8/16/91	7/17/91	12/ 8/91	2/ 5/91	1/30/91
METEOROLOGICAL SITE	DIR (DEG)	250	240	260	300	250	280	250	220	250	230
NEWARK	VEL (MPH)	7.5	10.6	6.9	7.1	8.1	5.6	11.6	3.3	5.7	2.4
	SPD (MPH)	10.2	11.9	8.6	9.5	10.4	7.5	13.9	5.5	7.6	3.2
	RATIO	0.734	0.891	0.800	0.746	0.779	0.746	0.832	0.604	0.747	0.764
METEOROLOGICAL SITE	DIR (DEG)	250	180	270	330	210	260	270	200	270	80
BRADLEY	VEL (MPH)	6.6	8.7	4.1	7.1	7.0	4.9	5.8	2.8	2.7	.8
	SPD (MPH)	9.1	9.6	6.0	9.2	10.6	7.6	8.5	6.2	5.3	4.6
	RATIO	0.729	0.903	0.686	0.769	0.659	0.638	0.686	0.455	0.501	0.164
METEOROLOGICAL SITE	DIR (DEG)	260	240	250	260	270	260	250	170	240	160
BRIDGEPORT	VEL (MPH)	5.7	9.0	5.0	2.5	6.5	5.8	7.2	2.3	5.2	.3
	SPD (MPH)	5.9	9.1	5.2	3.9	7.5	6.3	7.3	4.5	5.5	2.2
	RATIO	0.959	0.992	0.961	0.653	0.867	0.913	0.984	0.519	0.950	0.137
METEOROLOGICAL SITE	DIR (DEG)	270	240	280	320	260	280	280	240	280	240
WORCESTER	VEL (MPH)	5.8	9.7	8.4	6.0	9.1	8.2	9.8	2.0	7.3	3.6
	SPD (MPH)	6.5	9.9	8.6	8.1	9.3	8.5	9.9	4.5	7.6	5.6
	RATIO	0.898	0.973	0.979	0.741	0.969	0.969	0.983	0.453	0.953	0.636
WATERBURY-007 (0059)	PM10	63	62	57	53	53	49	44	40	39	39
	DATE	3/ 1/91	8/28/91	2/ 5/91	1/30/91	12/ 8/91	11/20/91	5/24/91	7/23/91	7/17/91	8/16/91
METEOROLOGICAL SITE	DIR (DEG)	150	260	250	230	220	240	240	250	250	280
NEWARK	VEL (MPH)	4.0	6.9	5.7	2.4	3.3	10.6	9.1	8.1	11.6	5.6
	SPD (MPH)	4.5	8.6	7.6	3.2	5.5	11.9	10.1	10.4	13.9	7.5
	RATIO	0.892	0.800	0.747	0.764	0.604	0.891	0.904	0.779	0.832	0.746
METEOROLOGICAL SITE	DIR (DEG)	190	270	270	80	200	180	200	210	270	260
BRADLEY	VEL (MPH)	6.9	4.1	2.7	.8	2.8	8.7	8.5	7.0	5.8	4.9
	SPD (MPH)	7.2	6.0	5.3	4.6	6.2	9.6	10.5	10.6	8.5	7.6
	RATIO	0.962	0.686	0.501	0.164	0.455	0.903	0.808	0.659	0.686	0.638

TABLE 2-5, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE PM10 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	170	250	240	160	170	240	250	270	250	260
	VEL (MPH)	2.4	5.0	5.2	.3	2.3	9.0	6.3	6.5	7.2	5.8
	SPD (MPH)	3.5	5.2	5.5	2.2	4.5	9.1	6.5	7.5	7.3	6.3
	RATIO	0.698	0.961	0.950	0.137	0.519	0.992	0.977	0.867	0.984	0.913
METEOROLOGICAL SITE WORCESTER	DIR (DEG)	240	280	280	240	240	240	260	260	280	280
	VEL (MPH)	8.0	8.4	7.3	3.6	2.0	9.7	9.0	9.1	9.8	8.2
	SPD (MPH)	8.2	8.6	7.6	5.6	4.5	9.9	9.3	9.3	9.9	8.5
	RATIO	0.980	0.979	0.953	0.636	0.453	0.973	0.968	0.969	0.983	0.969
WATERBURY-123 (0057)	PM10	67	61	60	56	54	47	46	46	44	41
	DATE	8/28/91	3/ 1/91	6/11/91	1/30/91	2/ 5/91	11/20/91	12/ 8/91	12/20/91	7/17/91	10/ 3/91
METEOROLOGICAL SITE NEWARK	DIR (DEG)	260	150	250	230	250	240	220	310	250	250
	VEL (MPH)	6.9	4.0	7.5	2.4	5.7	10.6	3.3	7.6	11.6	1.8
	SPD (MPH)	8.6	4.5	10.2	3.2	7.6	11.9	5.5	9.9	13.9	4.7
	RATIO	0.800	0.892	0.734	0.764	0.747	0.891	0.604	0.764	0.832	0.373
METEOROLOGICAL SITE BRADLEY	DIR (DEG)	270	190	250	80	270	180	200	350	270	190
	VEL (MPH)	4.1	6.9	6.6	.8	2.7	8.7	2.8	3.9	5.8	1.3
	SPD (MPH)	6.0	7.2	9.1	4.6	5.3	9.6	6.2	6.5	8.5	4.3
	RATIO	0.686	0.962	0.729	0.164	0.501	0.903	0.455	0.602	0.686	0.313
METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	250	170	260	160	240	240	170	320	250	110
	VEL (MPH)	5.0	2.4	5.7	.3	5.2	9.0	2.3	6.6	7.2	1.0
	SPD (MPH)	5.2	3.5	5.9	2.2	5.5	9.1	4.5	7.5	7.3	3.6
	RATIO	0.961	0.698	0.959	0.137	0.950	0.992	0.519	0.877	0.984	0.288
METEOROLOGICAL SITE WORCESTER	DIR (DEG)	280	240	270	240	280	240	240	300	280	230
	VEL (MPH)	8.4	8.0	5.8	3.6	7.3	9.7	2.0	8.5	9.8	4.9
	SPD (MPH)	8.6	8.2	6.5	5.6	7.6	9.9	4.5	8.6	9.9	5.0
	RATIO	0.979	0.980	0.898	0.636	0.953	0.973	0.453	0.989	0.983	0.968
WILLIMANTIC-002 (0059)	PM10	54	48	44	44	43	42	38	36	36	35
	DATE	6/11/91	3/ 1/91	8/28/91	6/29/91	9/15/91	2/ 5/91	1/30/91	7/23/91	12/ 8/91	11/20/91
METEOROLOGICAL SITE NEWARK	DIR (DEG)	250	150	260	300	210	250	230	250	220	240
	VEL (MPH)	7.5	4.0	6.9	7.1	1.9	5.7	2.4	8.1	3.3	10.6
	SPD (MPH)	10.2	4.5	8.6	9.5	5.3	7.6	3.2	10.4	5.5	11.9
	RATIO	0.734	0.892	0.800	0.746	0.363	0.747	0.764	0.779	0.604	0.891
METEOROLOGICAL SITE BRADLEY	DIR (DEG)	250	190	270	330	200	270	80	210	200	180
	VEL (MPH)	6.6	6.9	4.1	7.1	4.1	2.7	.8	7.0	2.8	8.7
	SPD (MPH)	9.1	7.2	6.0	9.2	5.0	5.3	4.6	10.6	6.2	9.6
	RATIO	0.729	0.962	0.686	0.769	0.815	0.501	0.164	0.659	0.455	0.903
METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	260	170	250	260	150	240	160	270	170	240
	VEL (MPH)	5.7	2.4	5.0	2.5	2.2	5.2	.3	6.5	2.3	9.0
	SPD (MPH)	5.9	3.5	5.2	3.9	5.0	5.5	2.2	7.5	4.5	9.1
	RATIO	0.959	0.698	0.961	0.653	0.440	0.950	0.137	0.867	0.519	0.992
METEOROLOGICAL SITE WORCESTER	DIR (DEG)	270	240	280	320	210	280	240	260	240	240
	VEL (MPH)	5.8	8.0	8.4	6.0	6.7	7.3	3.6	9.1	2.0	9.7
	SPD (MPH)	6.5	8.2	8.6	8.1	7.5	7.6	5.6	9.3	4.5	9.9
	RATIO	0.898	0.980	0.979	0.741	0.894	0.953	0.636	0.969	0.453	0.973

TABLE 2-6

PM10 TRENDS: 1985-1991

(PAIRED *t* TEST)

PAIRED YEARS	AVERAGE OF ANNUAL GEOMETRIC MEANS (µg/m³)	NO. OF SITES[1]	DIFFERENCES OF THE PAIRED YEAR MEANS		SIGNIFICANCE LEVEL[1]		
					TREND AT		PROBABILITY THAT CHANGE IS NOT SIGNIFICANT
			AVG.	STD. DEV.	95% LEVEL	99% LEVEL	
85 86	36.3 35.2	2 2	-1.10	0.57	N.C.	N.C.	0.2220
86 87	37.7 34.0	5 5	-3.72	2.03	↓	N.C.	0.0148
87 88	37.8 32.3	3 3	-5.50	4.20	N.C.	N.C.	0.1514
88 89	32.3 31.9	3 3	-0.40	0.87	N.C.	N.C.	0.4808
89 90	22.4 20.1	37 37	-2.38	1.35	↓	↓	0.0001
90 91	20.5 23.0	29 29	2.45	1.54	↑	↑	0.0001

Key to Symbols : ↓ = Significant downward trend
↑ = Significant upward trend
N.C. = No significant change

[1] When the number of paired sites is small, the results should be interpreted with caution.

III. SULFUR DIOXIDE

HEALTH EFFECTS

Sulfur oxides are heavy, pungent, yellowish gases that come from the burning of sulfur-containing fuel, mainly coal and oil-derived fuels, and also from the smelting of metals and from certain industrial processes. They have a distinctive odor. Sulfur dioxide (SO_2) comprises about 95 percent of these gases, so scientists use a test for SO_2 alone as a measure of all sulfur oxides.

Exposure to high levels of sulfur oxides can cause an obstruction of breathing that doctors call "pulmonary flow resistance." The amount of breathing obstruction has a direct relation to the amount of sulfur compounds in the air. Moreover, the effect of sulfur pollution is enhanced by the presence of other pollutants, especially particulates and oxidants. The action of two or more pollutants is synergistic: each pollutant augments the other and the combined effect is greater than the sum of the effects that each alone would have.

Many types of respiratory disease are associated with sulfur oxides: coughs and colds, asthma, bronchitis, and emphysema. Some researchers believe that the harm is due not only to the sulfur oxide gases but also to other sulfur compounds that accompany the oxides.

CONCLUSIONS

Sulfur dioxide concentrations in 1991 did not exceed any federal primary or secondary standards. Measured concentrations were substantially below the 365 $\mu g/m^3$ primary 24-hour standard and well below both the 80 $\mu g/m^3$ primary annual standard and the 1300 $\mu g/m^3$ secondary 3-hour standard.

METHOD OF MEASUREMENT

The DEP Air Monitoring Unit used the pulsed fluorescence method (TECo instruments) to continuously measure sulfur dioxide levels at all 13 sites in 1991.

DISCUSSION OF DATA

Monitoring Network - Thirteen continuous SO_2 monitors were used to record data in 12 towns during 1991 (see Figure 3-1):

Bridgeport 012
Bridgeport 013
Danbury 123
East Hartford 006
East Haven 003
Enfield 005
Greenwich 017
Groton 007
Hartford 018
Mansfield 003
New Haven 123
Stamford 123
Waterbury 123

All of these sites telemetered their data to the central computer in Hartford three times each day (i.e., at 0700, 1400, and 2400 hours local time).

Precision and Accuracy - 502 precision checks were made on SO_2 monitors in 1991, yielding 95% probability limits ranging from -5% to +6%. Accuracy is determined by introducing a known amount of SO_2 into each of the monitors. Three different concentration levels are tested: low, medium, and high. The 95% probability limits for accuracy based on 15 audits were: low, -5% to +6%; medium, -5% to +3%; and high, -5% to +3%.

Annual Averages - SO_2 levels were below the primary annual standard of 80 $\mu g/m^3$ at all sites in 1991 (see Table 3-1). The annual average SO_2 levels decreased at 6 of the 12 monitoring sites that had sufficient data in both 1990 and 1991 to produce valid annual averages. The largest decrease was 3 $\mu g/m^3$, which occurred at New Haven 123. Four sites experienced increases in the annual average. The largest increase was 4 $\mu g/m^3$, which occurred at Greenwich 017. No change in the annual average was evident at East Haven 003 and Hartford 018.

Statistical Projections - A statistical analysis of the sulfur dioxide data is presented in Table 3-2. This analysis is produced by a DEP computer program and provides information to compensate for any loss of data caused by instrumentation problems. The format of Table 3-2 is the same as that used to present the statistical projections for particulate matter (see Table 2-1). Since the statistical projections are made for the 24-hour standard, the hourly SO_2 data are first converted to 24-hour block averages. These 24-hour "samples" form the basis for the annual arithmetic and geometric means and the arithmetic and geometric standard deviations employed by the DEP computer program to make the statistical projections and calculate the 95% confidence limits.

The monitored data indicate that there were no violations of the primary 24-hour SO_2 standard at any site in Connecticut in the last three years. The statistical projections confirm that no days exceeding the primary 24-hour standard of 365 $\mu g/m^3$ would have occurred during this period at any site, if sampling were complete.

The annual averages in Table 3-2 differ slightly from those in Table 3-1 due to the manner in which they were derived. The averages in Table 3-1 are based on the available hourly readings, while those in Table 3-2 are based on valid calendar day 24-hour averages. (At least 18 hourly readings are required to produce a valid 24-hour average.)

24-Hour Averages - Figure 3-2 presents the first and second high calendar day average concentrations recorded at each monitoring site in 1991. No site recorded SO_2 levels in excess of the 24-hour primary standard of 365 $\mu g/m^3$. Second high calendar day SO_2 average concentrations increased at 7 of the 12 monitoring sites that had adequate data in both 1990 and 1991. The increases ranged from 1 $\mu g/m^3$ at Danbury 123 to 16 $\mu g/m^3$ at Bridgeport 013. Decreases in the second high concentrations occurred at 5 sites and ranged from 3 $\mu g/m^3$ at Greenwich 017 to 32 $\mu g/m^3$ at East Hartford 003.

Current EPA policy bases compliance with the primary 24-hour SO_2 standard on calendar day averages. Assessment of compliance is based on the second highest calendar day average in the year. Running averages are averages computed for the 24-hour periods ending at every hour. If running averages were used, assessment of compliance would be based on the value of the second highest of the two highest non-overlapping 24-hour periods in the year. There has been some contention over which average is the more appropriate one on which to base compliance. Table 3-3 contains the two highest 24-hour SO_2 readings at each site in terms of both the running averages and the calendar day averages. The first high 24-hour running averages are all larger than the first high calendar day averages except at Danbury 123, Groton 007 and New Haven 123 where they are the same. The differences vary in magnitude up to 18 $\mu g/m^3$, which occurred at Enfield 005.

3-Hour Averages - Figure 3-3 presents the first and second high 3-hour concentrations recorded at each monitoring site. Measured SO_2 concentrations were far below the federal secondary 3-hour standard of 1300 $\mu g/m^3$ at all DEP monitoring sites in 1991. Of the 12 sites that had a sufficient quantity of data in both 1990 and 1991, 6 had lower second high concentrations in 1991. The decreases ranged from 7 µg/m³ at Enfield 005 to 116 µg/m³ at East Haven 003. Stamford 123 and New Haven 123 had second high concentrations in 1991 that were higher than 1990 by 7 µg/m³ and 112 µg/m³, respectively. East Hartford 006, Greenwich 017 and Hartford 018 experienced no changes in their second high concentrations.

10-High Days with Wind Data - Table 3-4 lists the ten highest 24-hour calendar day SO_2 averages and the dates of occurrence for each SO_2 site in Connecticut in 1991. Only the 12 sites were used which had sufficient data to produce a valid annual average. The table also shows the average wind conditions that occurred on each of these dates. (The origin and use of these wind data are described in the discussion of Table 2-5 in the particulate matter section of this Air Quality Summary.)

Once again, as with particulate matter, many (i.e., 46%) of the highest SO_2 days occurred with winds out of the southwest quadrant, and most of these days had relatively persistent winds. This relationship is caused, at least in part, by SO_2 transport, but any transport is limited by the chemical instability of SO_2. In the atmosphere, SO_2 reacts with other gases to produce, among other things, sulfate particulates. Therefore, SO_2 is not likely to be transported very long distances. Previous studies conducted by the DEP have shown that, during periods of southwest winds, levels of SO_2 in Connecticut decrease with distance from the New York City metropolitan area. This relationship tends to support the transport hypothesis. On the other hand, these studies also revealed that certain meteorological parameters, most notably mixing height and wind speed, are more conducive to high SO_2 levels on days when there are southwesterly winds than on other days.

The data in Table 3-4 also suggest another reason for high SO_2 levels. Approximately 86% of the tabulated days occurred during the winter, and 13% occurred in late autumn. This phenomenon can be attributed to the fact that more fuel oil is burned during cold weather resulting in greater SO_2 emissions.

In summary, high levels of SO_2 in Connecticut seem to be caused by a number of related factors. First, Connecticut experiences its highest SO_2 levels during the late fall and winter months, when there is an increased amount of fuel combustion. Second, the New York City metropolitan area, a large emission source, is located to the southwest of Connecticut, and southwest winds occur relatively often in this region in comparison to other wind directions. Also, adverse meteorological conditions are often associated with southwest winds. The net effect is that during the colder months when a persistent southwesterly wind occurs, an air mass picks up increased amounts of SO_2 over the New York City metropolitan area and transports this SO_2 into Connecticut, where the SO_2 levels are already relatively high. In addition, relatively low mixing heights are associated with warm air advection (i.e., southwest wind flow), which inhibits vertical mixing and contributes to the enhanced SO_2 concentrations.

The levels of transported SO_2 eventually decline with increasing distance from New York City, as the SO_2 is dispersed and as it slowly reacts to produce sulfate particulates. These sulfate particulates may fall to the ground in either a dry state (dry deposition) or in a wet state after combination with water droplets (wet deposition or "acid rain").

Trends - The SO_2 trend analysis results are summarized in Figure 3-4 and Table 3-5. (For a discussion of the paired *t* test used in Table 3-5, see the discussion of Table 2-6 in the particulate matter section of this Air Quality Summary.)

The long-term trend of SO_2 concentrations is shown in graphical form in Figure 3-4. An improvement in SO_2 levels is demonstrated by the decrease over time of concentrations in excess of 30 µg/m³. The year-to-year trends in ambient SO_2 levels are illustrated in Table 3-5 and show significant decreases from 1982 to 1983 and from 1989 to 1990.

The results of the paired *t* test indicate that sulfur dioxide levels in 1991 were not significantly different from those in 1990 (see Table 3-5). The apparent increase in annual average SO_2 levels from 1990 to 1991 were not judged to be statistically significant at the 95% and 99% confidence levels.

Year-to-year changes in SO_2 levels may be attributable to year-to-year fluctuations in meteorology, or changes in fuel use due to fuel price fluctuations and/or increased fuel efficiency (i.e., 'tighter' buildings). Temperature can be an important factor in determining SO_2 emissions. This is normally reflected in the number of "degree days" -- a measure of the heating/cooling requirement. As the number of degree days of heating and cooling increases, the amount of fuel that must be burned to heat and cool buildings also increases. Consequently, as more fuel is burned, the emissions of sulfur dioxide are proportionately increased. There was approximately a 5.1% increase in degree days of heating and cooling for Connecticut from 1990 to 1991, as measured at Bradley International Airport, Windsor Locks. The concomitant increase in annual average SO_2 levels was approximately 5.3%.

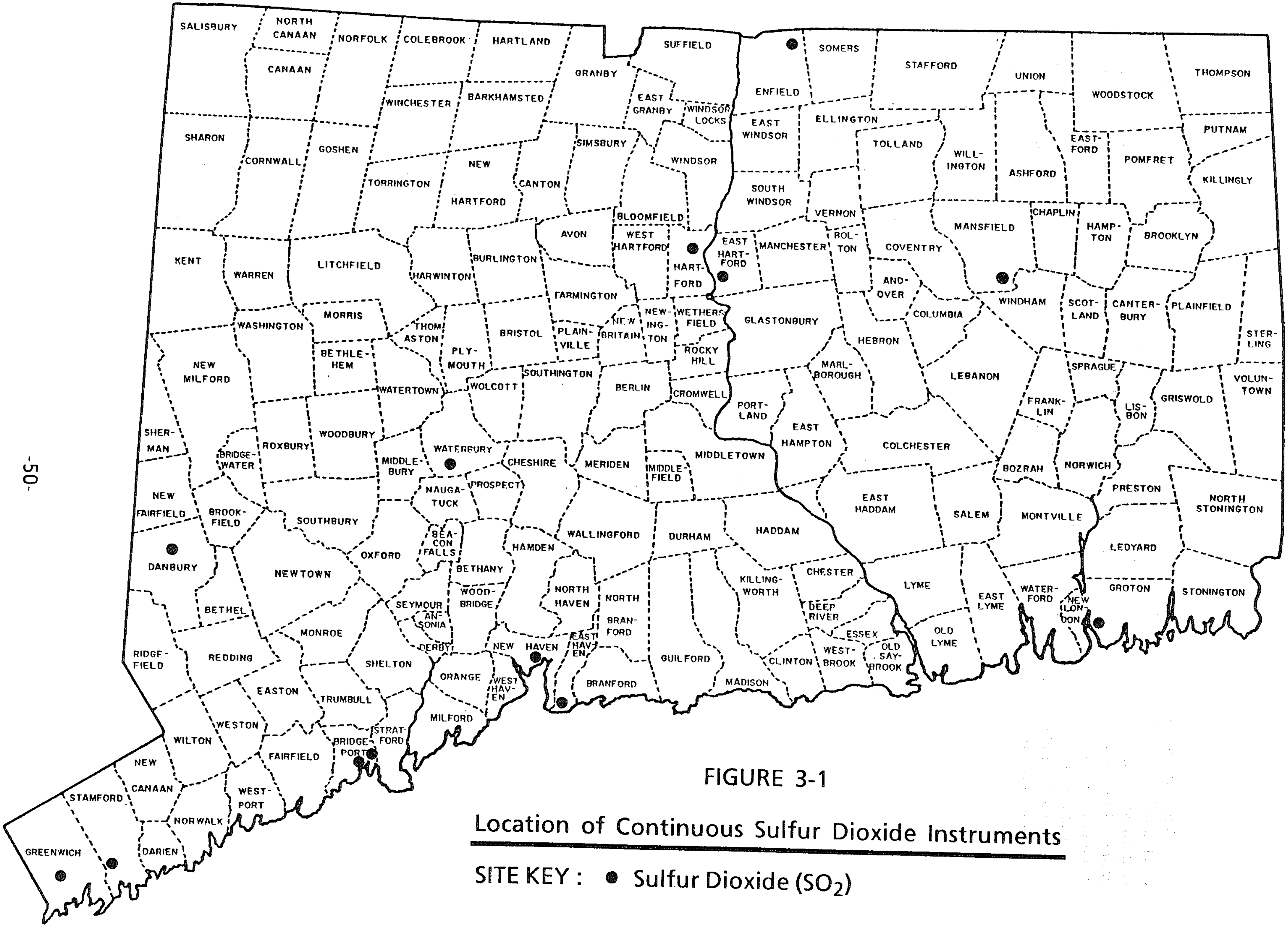


FIGURE 3-1

Location of Continuous Sulfur Dioxide Instruments

SITE KEY : ● Sulfur Dioxide (SO_2)

TABLE 3-1

1991 ANNUAL ARITHMETIC AVERAGES OF SULFUR DIOXIDE

(PRIMARY STANDARD: 80 µg/m3)

TOWN-SITE	SITE NAME	ANNUAL AVG (µg/m3)
Bridgeport 012	Edison School	32
Bridgeport 013	Congress Street	23
Danbury 123	Western CT State University	20
East Hartford 006	High Street	23
East Haven 003	Animal Shelter	19
Enfield 005	Department of Corrections	15
Greenwich 017	Greenwich Point Park	16
Groton 007	Fire Headquarters	19
Hartford 018	Sheldon Street	24
Mansfield 003	Dept. of Transportation	11*
New Haven 123	State Street	33
Stamford 123	Health Department	26
Waterbury 123	Bank Street	23

* A valid annual average cannot be calculated because the site has insufficient data to satisfy the minimum sampling criteria.

TABLE 3-2

1989-1991 SO2 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 365 UG/M3
BRIDGEPORT	012	1989	362	35.8	35.5	36.0	26.908	
BRIDGEPORT	012	1990	358	32.9	32.5	33.3	27.329	
BRIDGEPORT	012	1991	363	32.0	31.9	32.2	22.387	
BRIDGEPORT	013	1989	348	26.0	25.5	26.4	19.517	
BRIDGEPORT	013	1990	362	25.5	25.3	25.7	20.468	
BRIDGEPORT	013	1991	345	23.4	22.9	23.8	18.108	
DANBURY	123	1989	362	22.1	21.9	22.2	17.365	
DANBURY	123	1990	345	19.4	19.0	19.8	16.290	
DANBURY	123	1991	358	19.7	19.5	19.9	13.741	
EAST HARTFORD	005	1989	152*	26.6	24.0	29.2	21.299	
EAST HARTFORD	006	1989	139*	27.5	24.7	30.2	21.076	
EAST HARTFORD	006	1990	364	21.0	20.9	21.1	17.149	
EAST HARTFORD	006	1991	354	23.1	22.8	23.4	16.843	
EAST HAVEN	003	1989	349	22.2	21.7	22.7	22.662	
EAST HAVEN	003	1990	365	18.8	18.8	18.8	16.076	
EAST HAVEN	003	1991	363	19.4	19.3	19.5	16.553	
ENFIELD	005	1989	356	17.4	17.2	17.7	13.374	
ENFIELD	005	1990	352	15.6	15.3	15.8	11.994	
ENFIELD	005	1991	361	14.5	14.4	14.6	10.755	
GREENWICH	017	1989	360	15.8	15.7	16.0	13.551	
GREENWICH	017	1990	364	12.5	12.4	12.6	10.371	
GREENWICH	017	1991	354	16.1	15.9	16.3	11.217	
GROTON	007	1989	341	19.9	19.6	20.2	12.749	
GROTON	007	1990	357	20.4	20.1	20.6	14.369	
GROTON	007	1991	335	18.9	18.5	19.2	12.339	

* THE QUANTITY OF DATA IS NOT SUFFICIENT FOR REPRESENTATIVE ANNUAL STATISTICS.

N.B. THE ARITHMETIC MEAN AND STANDARD DEVIATION HAVE UNITS OF MICROGRAMS PER CUBIC METER.

TABLE 3-2, CONTINUED

1989-1991 SO2 ANNUAL AVERAGES AND STATISTICAL PROJECTIONS

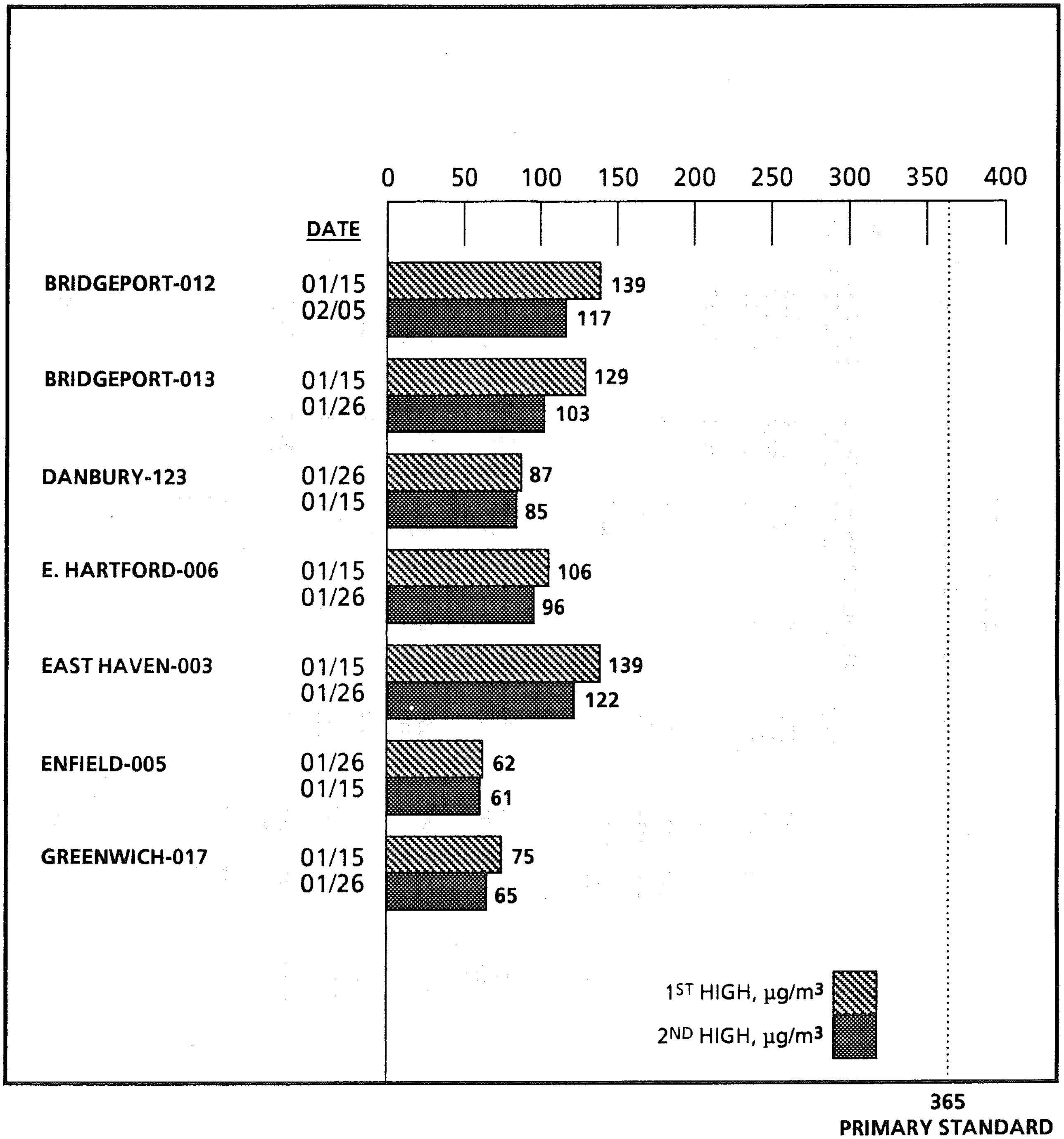
TOWN NAME	SITE	YEAR	SAMPLES	ARITHMETIC MEAN	95-PCT-LIMITS LOWER	95-PCT-LIMITS UPPER	STANDARD DEVIATION	PREDICTED DAYS OVER 365 UG/M3
HARTFORD	018	1989	339	27.5	26.9	28.0	19.595	
HARTFORD	018	1990	362	24.2	24.0	24.4	18.618	
HARTFORD	018	1991	348	23.7	23.3	24.1	16.998	
MANSFIELD	003	1991	294*	10.5	10.1	10.9	7.686	
MILFORD	010	1989	323	25.5	24.7	26.3	22.218	
MILFORD	010	1990	283	23.3	22.2	24.4	20.582	
NEW BRITAIN	011	1989	355	23.9	23.6	24.3	21.577	
NEW BRITAIN	011	1990	316	21.2	20.4	21.9	18.814	
NEW HAVEN	017	1989	249*	29.5	27.5	31.4	27.983	
NEW HAVEN	123	1989	345	41.1	40.2	42.0	35.953	
NEW HAVEN	123	1990	353	35.7	35.2	36.2	27.077	
NEW HAVEN	123	1991	355	33.3	32.8	33.7	29.708	
STAMFORD	025	1989	357	28.2	27.8	28.5	22.593	
STAMFORD	025	1990	315	21.9	21.0	22.7	20.806	
STAMFORD	123	1989	364	25.1	25.0	25.2	22.175	
STAMFORD	123	1990	354	23.1	22.8	23.5	19.813	
STAMFORD	123	1991	358	26.2	25.9	26.5	21.775	
WATERBURY	008	1989	360	29.9	29.5	30.2	29.408	
WATERBURY	008	1990	317	22.3	21.4	23.2	22.754	
WATERBURY	123	1989	341	25.4	24.8	26.0	21.647	
WATERBURY	123	1990	358	24.9	24.7	25.2	17.648	
WATERBURY	123	1991	356	22.9	22.6	23.1	15.782	

* THE QUANTITY OF DATA IS NOT SUFFICIENT FOR REPRESENTATIVE ANNUAL STATISTICS.

N.B. THE ARITHMETIC MEAN AND STANDARD DEVIATION HAVE UNITS OF MICROGRAMS PER CUBIC METER.

FIGURE 3-2

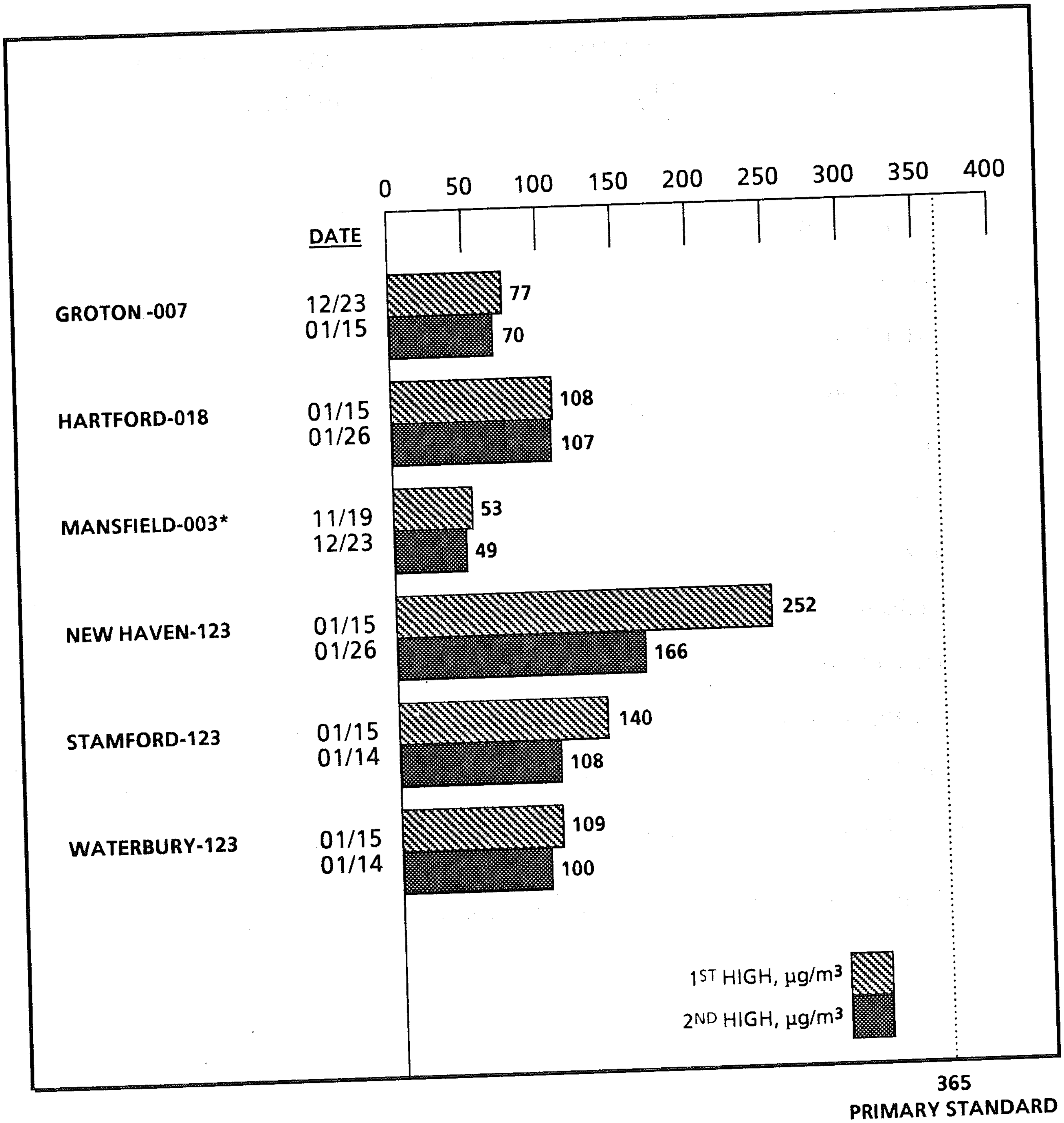
1991 MAXIMUM CALENDAR DAY AVERAGE SO2 CONCENTRATIONS



N.B. When a listed concentration occurs more than once at a site, the earliest date of occurrence is given first.

FIGURE 3-2, CONTINUED

1991 MAXIMUM CALENDAR DAY AVERAGE SO2 CONCENTRATIONS



* The site has insufficient data to satisfy the minimum sampling criteria for a valid annual average.

N.B. When a listed concentration occurs more than once at a site, the earliest date of occurrence is given first.

TABLE 3-3

COMPARISONS OF FIRST AND SECOND HIGH CALENDAR DAY AND 24-HOUR RUNNING SO2 AVERAGES FOR 1991

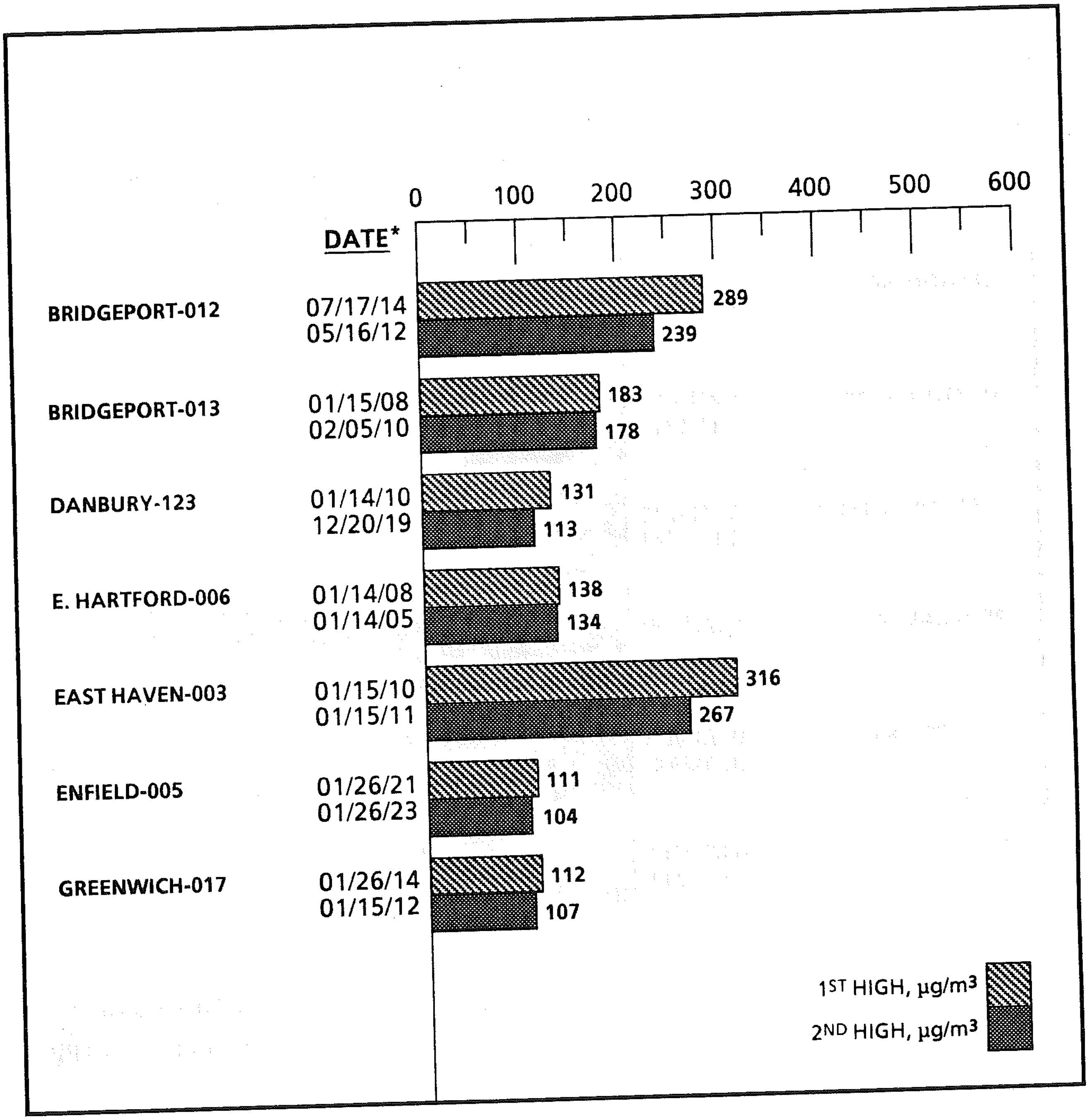
SITE	FIRST HIGH AVERAGE		SECOND HIGH AVERAGE	
	RUNNING 24-HOUR	CALENDAR DAY	RUNNING 24-HOUR	CALENDAR DAY
Bridgeport-012	152	139	117	117
Bridgeport-013	138	129	117	103
Danbury-123	87	87	87	85
E. Hartford-006	107	106	102	96
East Haven-003	151	139	129	122
Enfield-005	80	62	73	61
Greenwich-017	76	75	69	65
Groton-007	77	77	71	70
Hartford-018	110	108	109	107
Mansfield-003*	55	53	51	49
New Haven-123	252	252	190	166
Stamford-123	145	140	120	108
Waterbury-123	115	109	104	100

* The site has insufficient data to satisfy the minimum sampling criteria for a valid annual average.

N.B. The averages have units of $\mu g/m^3$.

FIGURE 3-3

1991 MAXIMUM 3-HOUR RUNNING AVERAGE SO2 CONCENTRATIONS



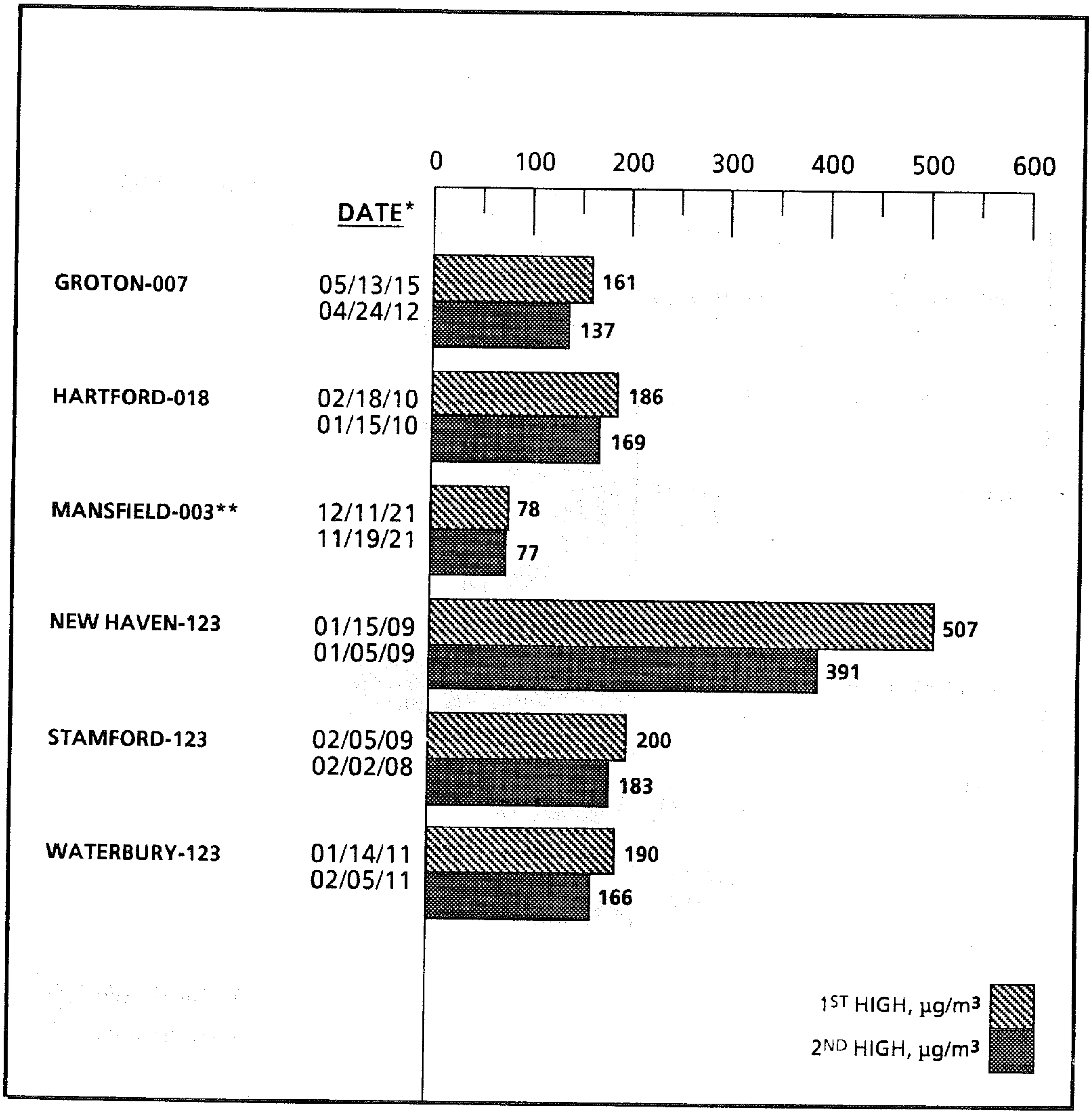
* The date is the month/day/ending hour of occurrence.

N.B. When a listed concentration occurs more than once at a site, the earliest date of occurrence is given first.

Secondary standard = 1300 µg/m^3.

FIGURE 3-3, CONTINUED

1991 MAXIMUM 3-HOUR RUNNING AVERAGE SO2 CONCENTRATIONS



* The date is the month/day/ending hour of occurrence.

** The site has insufficient data to satisfy the minimum sampling criteria for a valid annual average.

N.B. When a listed concentration occurs more than once at a site, the earliest date of occurrence is given first.

Secondary standard = 1300 $\mu g/m^3$.

TABLE 3-4

1991 TEN HIGHEST 24-HOUR AVERAGE SO2 DAYS WITH WIND DATA UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)		RANK	1	2	3	4	5	6	7	8	9	10
BRIDGEPORT-012 (0363)		SO2	139	117	108	106	105	101	94	94	93	88
		DATE	1/15/91	2/ 5/91	7/17/91	1/26/91	1/23/91	1/14/91	2/13/91	1/29/91	2/21/91	2/ 4/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	140	250	250	210	210	220	50	130	240	270
		VEL (MPH)	.8	5.7	11.6	5.8	8.9	5.4	1.6	2.7	6.1	4.6
		SPD (MPH)	3.3	7.6	13.9	7.2	10.2	6.3	6.3	4.3	8.1	7.0
		RATIO	0.249	0.747	0.832	0.802	0.868	0.850	0.252	0.625	0.763	0.658
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	200	270	270	200	200	200	50	160	230	260
		VEL (MPH)	1.2	2.7	5.8	4.4	7.6	2.8	2.7	1.4	4.5	6.6
		SPD (MPH)	2.9	5.3	8.5	5.5	8.3	5.8	4.0	5.2	9.3	9.5
		RATIO	0.420	0.501	0.686	0.813	0.913	0.487	0.662	0.263	0.487	0.697
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	90	240	250	250	240	280	130	180	260	240
		VEL (MPH)	3.0	5.2	7.2	5.3	10.7	4.4	4.3	2.6	4.7	5.1
		SPD (MPH)	3.6	5.5	7.3	6.6	10.8	5.2	5.9	3.9	5.0	5.2
		RATIO	0.823	0.950	0.984	0.802	0.996	0.848	0.735	0.661	0.932	0.987
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	250	280	280	250	230	250	150	250	270	270
		VEL (MPH)	3.8	7.3	9.8	6.3	10.3	6.4	3.1	4.4	7.8	6.2
		SPD (MPH)	4.5	7.6	9.9	6.6	10.4	7.3	4.6	5.3	8.1	6.3
		RATIO	0.847	0.953	0.983	0.948	0.997	0.870	0.667	0.830	0.974	0.982
BRIDGEPORT-013 (0345)		SO2	129	103	96	95	85	82	80	79	78	73
		DATE	1/15/91	1/26/91	1/29/91	1/14/91	2/ 5/91	1/ 5/91	2/ 2/91	1/23/91	2/13/91	12/28/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	140	210	130	220	250	220	230	210	50	240
		VEL (MPH)	.8	5.8	2.7	5.4	5.7	3.2	8.7	8.9	1.6	4.9
		SPD (MPH)	3.3	7.2	4.3	6.3	7.6	5.2	9.8	10.2	6.3	5.9
		RATIO	0.249	0.802	0.625	0.850	0.747	0.620	0.887	0.868	0.252	0.831
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	200	200	160	200	270	190	200	200	50	230
		VEL (MPH)	1.2	4.4	1.4	2.8	2.7	4.0	8.3	7.6	2.7	2.6
		SPD (MPH)	2.9	5.5	5.2	5.8	5.3	6.6	10.2	8.3	4.0	6.9
		RATIO	0.420	0.813	0.263	0.487	0.501	0.610	0.817	0.913	0.662	0.374
	METEOROLOGICAL SITE BRIDGEPORT	DIR (DEG)	90	250	180	280	240	360	260	240	130	270
		VEL (MPH)	3.0	5.3	2.6	4.4	5.2	.8	7.2	10.7	4.3	6.1
		SPD (MPH)	3.6	6.6	3.9	5.2	5.5	2.9	7.3	10.8	5.9	6.6
		RATIO	0.823	0.802	0.661	0.848	0.950	0.268	0.977	0.996	0.735	0.918
	METEOROLOGICAL SITE WORCESTER	DIR (DEG)	250	250	250	250	280	250	250	230	150	280
		VEL (MPH)	3.8	6.3	4.4	6.4	7.3	6.0	12.4	10.3	3.1	11.4
		SPD (MPH)	4.5	6.6	5.3	7.3	7.6	6.5	12.5	10.4	4.6	12.2
		RATIO	0.847	0.948	0.830	0.870	0.953	0.925	0.994	0.997	0.667	0.929
DANBURY-123 (0358)		SO2	87	85	77	67	66	63	61	60	58	53
		DATE	1/26/91	1/15/91	1/14/91	1/23/91	2/ 5/91	1/ 5/91	12/20/91	1/29/91	12/23/91	2/ 2/91
	METEOROLOGICAL SITE NEWARK	DIR (DEG)	210	140	220	210	250	220	310	130	250	230
		VEL (MPH)	5.8	.8	5.4	8.9	5.7	3.2	7.6	2.7	5.7	8.7
		SPD (MPH)	7.2	3.3	6.3	10.2	7.6	5.2	9.9	4.3	7.9	9.8
		RATIO	0.802	0.249	0.850	0.868	0.747	0.620	0.764	0.625	0.724	0.887
	METEOROLOGICAL SITE BRADLEY	DIR (DEG)	200	200	200	200	270	190	350	160	200	200
		VEL (MPH)	4.4	1.2	2.8	7.6	2.7	4.0	3.9	1.4	2.5	8.3
		SPD (MPH)	5.5	2.9	5.8	8.3	5.3	6.6	6.5	5.2	6.5	10.2
		RATIO	0.813	0.420	0.487	0.913	0.501	0.610	0.602	0.263	0.388	0.817

TABLE 3-4, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE SO2 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	250	90	280	240	240	360	320	180	280	260
BRIDGEPORT	VEL (MPH)	5.3	3.0	4.4	10.7	5.2	.8	6.6	2.6	8.1	7.2
	SPD (MPH)	6.6	3.6	5.2	10.8	5.5	2.9	7.5	3.9	8.3	7.3
	RATIO	0.802	0.823	0.848	0.996	0.950	0.268	0.877	0.661	0.972	0.977
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	230	280	250	300	250	260	250
WORCESTER	VEL (MPH)	6.3	3.8	6.4	10.3	7.3	6.0	8.5	4.4	7.7	12.4
	SPD (MPH)	6.6	4.5	7.3	10.4	7.6	6.5	8.6	5.3	7.9	12.5
	RATIO	0.948	0.847	0.870	0.997	0.953	0.925	0.989	0.830	0.970	0.994
EAST HARTFORD-006 (0354)	SO2	106	96	92	83	76	71	71	69	68	67
	DATE	1/15/91	1/26/91	1/14/91	3/11/91	11/ 6/91	2/ 5/91	1/27/91	1/23/91	11/18/91	2/18/91
METEOROLOGICAL SITE	DIR (DEG)	140	210	220	330	220	250	240	210	240	40
NEWARK	VEL (MPH)	.8	5.8	5.4	15.9	2.4	5.7	6.6	8.9	2.7	4.5
	SPD (MPH)	3.3	7.2	6.3	16.4	5.3	7.6	9.3	10.2	5.3	5.2
	RATIO	0.249	0.802	0.850	0.973	0.454	0.747	0.712	0.868	0.499	0.873
METEOROLOGICAL SITE	DIR (DEG)	200	200	200	330	180	270	220	200	140	350
BRADLEY	VEL (MPH)	1.2	4.4	2.8	13.8	4.1	2.7	7.4	7.6	2.4	2.1
	SPD (MPH)	2.9	5.5	5.8	14.2	4.7	5.3	8.6	8.3	5.0	3.7
	RATIO	0.420	0.813	0.487	0.970	0.870	0.501	0.855	0.913	0.477	0.566
METEOROLOGICAL SITE	DIR (DEG)	90	250	280	360	230	240	260	240	280	110
BRIDGEPORT	VEL (MPH)	3.0	5.3	4.4	14.1	2.1	5.2	7.8	10.7	6.0	8.9
	SPD (MPH)	3.6	6.6	5.2	14.1	4.9	5.5	9.1	10.8	6.3	9.3
	RATIO	0.823	0.802	0.848	0.998	0.439	0.950	0.864	0.996	0.950	0.954
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	340	210	280	260	230	300	120
WORCESTER	VEL (MPH)	3.8	6.3	6.4	9.9	3.7	7.3	7.3	10.3	6.3	1.7
	SPD (MPH)	4.5	6.6	7.3	10.1	4.2	7.6	7.6	10.4	7.3	3.6
	RATIO	0.847	0.948	0.870	0.985	0.877	0.953	0.964	0.997	0.861	0.475
EAST HAVEN-003 (0363)	SO2	139	122	79	71	68	67	66	65	64	64
	DATE	1/15/91	1/26/91	1/14/91	11/ 7/91	1/ 5/91	2/ 9/91	1/29/91	12/23/91	2/ 5/91	1/23/91
METEOROLOGICAL SITE	DIR (DEG)	140	210	220	30	220	330	130	250	250	210
NEWARK	VEL (MPH)	.8	5.8	5.4	5.1	3.2	8.4	2.7	5.7	5.7	8.9
	SPD (MPH)	3.3	7.2	6.3	5.3	5.2	8.9	4.3	7.9	7.6	10.2
	RATIO	0.249	0.802	0.850	0.960	0.620	0.945	0.625	0.724	0.747	0.868
METEOROLOGICAL SITE	DIR (DEG)	200	200	200	350	190	310	160	200	270	200
BRADLEY	VEL (MPH)	1.2	4.4	2.8	4.4	4.0	6.6	1.4	2.5	2.7	7.6
	SPD (MPH)	2.9	5.5	5.8	4.9	6.6	6.8	5.2	6.5	5.3	8.3
	RATIO	0.420	0.813	0.487	0.893	0.610	0.981	0.263	0.388	0.501	0.913
METEOROLOGICAL SITE	DIR (DEG)	90	250	280	30	360	350	180	280	240	240
BRIDGEPORT	VEL (MPH)	3.0	5.3	4.4	4.0	.8	5.9	2.6	8.1	5.2	10.7
	SPD (MPH)	3.6	6.6	5.2	4.5	2.9	6.9	3.9	8.3	5.5	10.8
	RATIO	0.823	0.802	0.848	0.888	0.268	0.850	0.661	0.972	0.950	0.996
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	50	250	310	250	260	280	230
WORCESTER	VEL (MPH)	3.8	6.3	6.4	2.8	6.0	8.6	4.4	7.7	7.3	10.3
	SPD (MPH)	4.5	6.6	7.3	3.9	6.5	8.6	5.3	7.9	7.6	10.4
	RATIO	0.847	0.948	0.870	0.729	0.925	0.993	0.830	0.970	0.953	0.997

TABLE 3-4, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE SO2 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)		RANK	1	2	3	4	5	6	7	8	9	10
ENFIELD-005 (0361)		SO2	62	61	60	56	52	50	48	45	43	43
		DATE	1/26/91	1/15/91	11/19/91	12/23/91	1/27/91	1/14/91	11/20/91	2/19/91	12/12/91	1/23/91
METEOROLOGICAL SITE	NEWARK	DIR (DEG)	210	140	230	250	240	220	240	40	120	210
		VEL (MPH)	5.8	.8	5.4	5.7	6.6	5.4	10.6	2.6	2.8	8.9
		SPD (MPH)	7.2	3.3	7.2	7.9	9.3	6.3	11.9	3.7	4.5	10.2
		RATIO	0.802	0.249	0.757	0.724	0.712	0.850	0.891	0.694	0.631	0.868
METEOROLOGICAL SITE	BRADLEY	DIR (DEG)	200	200	170	200	220	200	180	70	240	200
		VEL (MPH)	4.4	1.2	4.7	2.5	7.4	2.8	8.7	.4	1.5	7.6
		SPD (MPH)	5.5	2.9	7.3	6.5	8.6	5.8	9.6	4.6	7.6	8.3
		RATIO	0.813	0.420	0.636	0.388	0.855	0.487	0.903	0.085	0.192	0.913
METEOROLOGICAL SITE	BRIDGEPORT	DIR (DEG)	250	90	260	280	260	280	240	70	130	240
		VEL (MPH)	5.3	3.0	6.6	8.1	7.8	4.4	9.0	2.9	4.0	10.7
		SPD (MPH)	6.6	3.6	7.0	8.3	9.1	5.2	9.1	3.0	5.0	10.8
		RATIO	0.802	0.823	0.943	0.972	0.864	0.848	0.992	0.970	0.786	0.996
METEOROLOGICAL SITE	WORCESTER	DIR (DEG)	250	250	270	260	260	250	240	240	170	230
		VEL (MPH)	6.3	3.8	9.6	7.7	7.3	6.4	9.7	1.5	3.1	10.3
		SPD (MPH)	6.6	4.5	9.9	7.9	7.6	7.3	9.9	4.5	4.9	10.4
		RATIO	0.948	0.847	0.967	0.970	0.964	0.870	0.973	0.343	0.627	0.997
GREENWICH-017 (0354)		SO2	75	65	59	55	54	54	49	48	48	46
		DATE	1/15/91	1/26/91	2/ 5/91	2/13/91	11/19/91	1/29/91	1/14/91	11/ 7/91	11/28/91	12/23/91
METEOROLOGICAL SITE	NEWARK	DIR (DEG)	140	210	250	50	230	130	220	30	240	250
		VEL (MPH)	.8	5.8	5.7	1.6	5.4	2.7	5.4	5.1	6.1	5.7
		SPD (MPH)	3.3	7.2	7.6	6.3	7.2	4.3	6.3	5.3	7.6	7.9
		RATIO	0.249	0.802	0.747	0.252	0.757	0.625	0.850	0.960	0.802	0.724
METEOROLOGICAL SITE	BRADLEY	DIR (DEG)	200	200	270	50	170	160	200	350	220	200
		VEL (MPH)	1.2	4.4	2.7	2.7	4.7	1.4	2.8	4.4	7.5	2.5
		SPD (MPH)	2.9	5.5	5.3	4.0	7.3	5.2	5.8	4.9	9.8	6.5
		RATIO	0.420	0.813	0.501	0.662	0.636	0.263	0.487	0.893	0.770	0.388
METEOROLOGICAL SITE	BRIDGEPORT	DIR (DEG)	90	250	240	130	260	180	280	30	260	280
		VEL (MPH)	3.0	5.3	5.2	4.3	6.6	2.6	4.4	4.0	11.3	8.1
		SPD (MPH)	3.6	6.6	5.5	5.9	7.0	3.9	5.2	4.5	11.6	8.3
		RATIO	0.823	0.802	0.950	0.735	0.943	0.661	0.848	0.888	0.968	0.972
METEOROLOGICAL SITE	WORCESTER	DIR (DEG)	250	250	280	150	270	250	250	50	250	260
		VEL (MPH)	3.8	6.3	7.3	3.1	9.6	4.4	6.4	2.8	9.7	7.7
		SPD (MPH)	4.5	6.6	7.6	4.6	9.9	5.3	7.3	3.9	9.8	7.9
		RATIO	0.847	0.948	0.953	0.667	0.967	0.830	0.870	0.729	0.990	0.970
GROTON-007 (0335)		SO2	77	70	69	67	61	57	49	49	48	47
		DATE	12/23/91	1/15/91	1/26/91	2/ 5/91	1/29/91	2/ 4/91	4/24/91	11/19/91	12/ 8/91	1/ 2/91
METEOROLOGICAL SITE	NEWARK	DIR (DEG)	250	140	210	250	130	270	50	230	220	310
		VEL (MPH)	5.7	.8	5.8	5.7	2.7	4.6	2.3	5.4	3.3	1.7
		SPD (MPH)	7.9	3.3	7.2	7.6	4.3	7.0	5.5	7.2	5.5	4.5
		RATIO	0.724	0.249	0.802	0.747	0.625	0.658	0.422	0.757	0.604	0.379
METEOROLOGICAL SITE	BRADLEY	DIR (DEG)	200	200	200	270	160	260	210	170	200	300
		VEL (MPH)	2.5	1.2	4.4	2.7	1.4	6.6	4.0	4.7	2.8	1.8
		SPD (MPH)	6.5	2.9	5.5	5.3	5.2	9.5	6.6	7.3	6.2	5.2
		RATIO	0.388	0.420	0.813	0.501	0.263	0.697	0.602	0.636	0.455	0.353

TABLE 3-4, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE SO2 DAYS WITH WIND DATA

UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	280	90	250	240	180	240	130	260	170	290
BRIDGEPORT	VEL (MPH)	8.1	3.0	5.3	5.2	2.6	5.1	2.1	6.6	2.3	3.2
	SPD (MPH)	8.3	3.6	6.6	5.5	3.9	5.2	3.2	7.0	4.5	4.3
	RATIO	0.972	0.823	0.802	0.950	0.661	0.987	0.661	0.943	0.519	0.745
METEOROLOGICAL SITE	DIR (DEG)	260	250	250	280	250	270	190	270	240	260
WORCESTER	VEL (MPH)	7.7	3.8	6.3	7.3	4.4	6.2	3.5	9.6	2.0	7.5
	SPD (MPH)	7.9	4.5	6.6	7.6	5.3	6.3	4.9	9.9	4.5	7.8
	RATIO	0.970	0.847	0.948	0.953	0.830	0.982	0.712	0.967	0.453	0.967
HARTFORD-018 (0348)	SO2	108	107	89	86	80	77	76	74	71	66
	DATE	1/15/91	1/26/91	1/14/91	1/29/91	2/ 5/91	1/27/91	1/23/91	2/18/91	11/19/91	12/23/91
METEOROLOGICAL SITE	DIR (DEG)	140	210	220	130	250	240	210	40	230	250
NEWARK	VEL (MPH)	.8	5.8	5.4	2.7	5.7	6.6	8.9	4.5	5.4	5.7
	SPD (MPH)	3.3	7.2	6.3	4.3	7.6	9.3	10.2	5.2	7.2	7.9
	RATIO	0.249	0.802	0.850	0.625	0.747	0.712	0.868	0.873	0.757	0.724
METEOROLOGICAL SITE	DIR (DEG)	200	200	200	160	270	220	200	350	170	200
BRADLEY	VEL (MPH)	1.2	4.4	2.8	1.4	2.7	7.4	7.6	2.1	4.7	2.5
	SPD (MPH)	2.9	5.5	5.8	5.2	5.3	8.6	8.3	3.7	7.3	6.5
	RATIO	0.420	0.813	0.487	0.263	0.501	0.855	0.913	0.566	0.636	0.388
METEOROLOGICAL SITE	DIR (DEG)	90	250	280	180	240	260	240	110	260	280
BRIDGEPORT	VEL (MPH)	3.0	5.3	4.4	2.6	5.2	7.8	10.7	8.9	6.6	8.1
	SPD (MPH)	3.6	6.6	5.2	3.9	5.5	9.1	10.8	9.3	7.0	8.3
	RATIO	0.823	0.802	0.848	0.661	0.950	0.864	0.996	0.954	0.943	0.972
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	250	280	260	230	120	270	260
WORCESTER	VEL (MPH)	3.8	6.3	6.4	4.4	7.3	7.3	10.3	1.7	9.6	7.7
	SPD (MPH)	4.5	6.6	7.3	5.3	7.6	7.6	10.4	3.6	9.9	7.9
	RATIO	0.847	0.948	0.870	0.830	0.953	0.964	0.997	0.475	0.967	0.970
NEW HAVEN-123 (0355)	SO2	252	166	149	141	140	128	124	124	122	119
	DATE	1/15/91	1/26/91	1/29/91	1/14/91	1/ 5/91	2/ 2/91	1/ 2/91	2/ 5/91	1/23/91	12/28/91
METEOROLOGICAL SITE	DIR (DEG)	140	210	130	220	220	230	310	250	210	240
NEWARK	VEL (MPH)	.8	5.8	2.7	5.4	3.2	8.7	1.7	5.7	8.9	4.9
	SPD (MPH)	3.3	7.2	4.3	6.3	5.2	9.8	4.5	7.6	10.2	5.9
	RATIO	0.249	0.802	0.625	0.850	0.620	0.887	0.379	0.747	0.868	0.831
METEOROLOGICAL SITE	DIR (DEG)	200	200	160	200	190	200	300	270	200	230
BRADLEY	VEL (MPH)	1.2	4.4	1.4	2.8	4.0	8.3	1.8	2.7	7.6	2.6
	SPD (MPH)	2.9	5.5	5.2	5.8	6.6	10.2	5.2	5.3	8.3	6.9
	RATIO	0.420	0.813	0.263	0.487	0.610	0.817	0.353	0.501	0.913	0.374
METEOROLOGICAL SITE	DIR (DEG)	90	250	180	280	360	260	290	240	240	270
BRIDGEPORT	VEL (MPH)	3.0	5.3	2.6	4.4	.8	7.2	3.2	5.2	10.7	6.1
	SPD (MPH)	3.6	6.6	3.9	5.2	2.9	7.3	4.3	5.5	10.8	6.6
	RATIO	0.823	0.802	0.661	0.848	0.268	0.977	0.745	0.950	0.996	0.918
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	250	250	250	260	280	230	280
WORCESTER	VEL (MPH)	3.8	6.3	4.4	6.4	6.0	12.4	7.5	7.3	10.3	11.4
	SPD (MPH)	4.5	6.6	5.3	7.3	6.5	12.5	7.8	7.6	10.4	12.2
	RATIO	0.847	0.948	0.830	0.870	0.925	0.994	0.967	0.953	0.997	0.929

TABLE 3-4, CONTINUED

1991 TEN HIGHEST 24-HOUR AVERAGE SO2 DAYS WITH WIND DATA

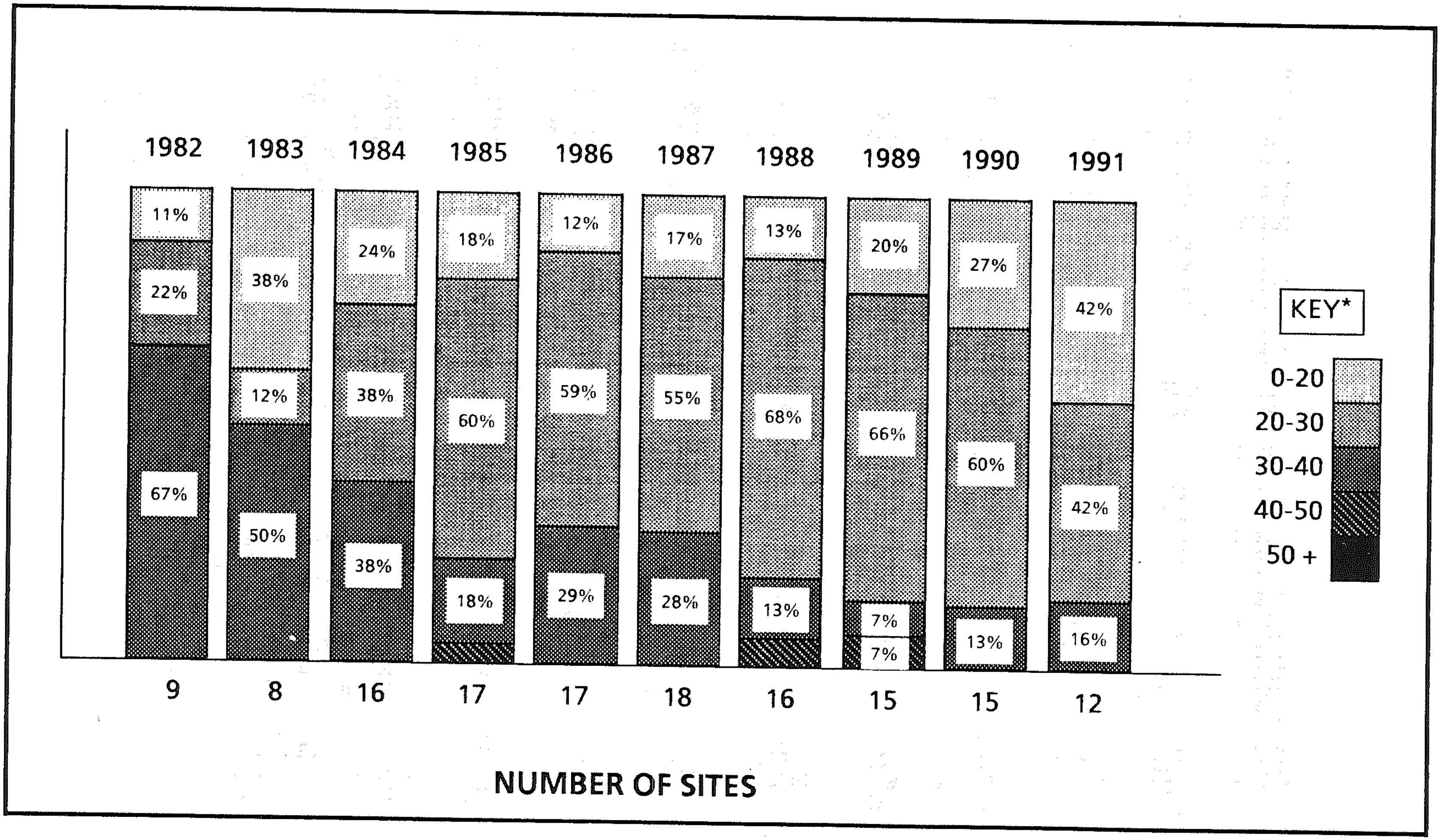
UNITS : MICROGRAMS PER CUBIC METER

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
STAMFORD-123 (0358)	SO2	140	108	106	106	105	98	95	89	86	82
	DATE	1/15/91	1/14/91	2/ 2/91	1/26/91	2/ 5/91	1/29/91	2/13/91	1/ 2/91	1/23/91	2/ 4/91
METEOROLOGICAL SITE	DIR (DEG)	140	220	230	210	250	130	50	310	210	270
NEWARK	VEL (MPH)	.8	5.4	8.7	5.8	5.7	2.7	1.6	1.7	8.9	4.6
	SPD (MPH)	3.3	6.3	9.8	7.2	7.6	4.3	6.3	4.5	10.2	7.0
	RATIO	0.249	0.850	0.887	0.802	0.747	0.625	0.252	0.379	0.868	0.658
METEOROLOGICAL SITE	DIR (DEG)	200	200	200	200	270	160	50	300	200	260
BRADLEY	VEL (MPH)	1.2	2.8	8.3	4.4	2.7	1.4	2.7	1.8	7.6	6.6
	SPD (MPH)	2.9	5.8	10.2	5.5	5.3	5.2	4.0	5.2	8.3	9.5
	RATIO	0.420	0.487	0.817	0.813	0.501	0.263	0.662	0.353	0.913	0.697
METEOROLOGICAL SITE	DIR (DEG)	90	280	260	250	240	180	130	290	240	240
BRIDGEPORT	VEL (MPH)	3.0	4.4	7.2	5.3	5.2	2.6	4.3	3.2	10.7	5.1
	SPD (MPH)	3.6	5.2	7.3	6.6	5.5	3.9	5.9	4.3	10.8	5.2
	RATIO	0.823	0.848	0.977	0.802	0.950	0.661	0.735	0.745	0.996	0.987
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	250	280	250	150	260	230	270
WORCESTER	VEL (MPH)	3.8	6.4	12.4	6.3	7.3	4.4	3.1	7.5	10.3	6.2
	SPD (MPH)	4.5	7.3	12.5	6.6	7.6	5.3	4.6	7.8	10.4	6.3
	RATIO	0.847	0.870	0.994	0.948	0.953	0.830	0.667	0.967	0.997	0.982
WATERBURY-123 (0356)	SO2	109	100	89	80	75	70	68	67	65	65
	DATE	1/15/91	1/14/91	1/26/91	11/19/91	1/29/91	1/ 5/91	2/ 5/91	12/28/91	12/23/91	1/27/91
METEOROLOGICAL SITE	DIR (DEG)	140	220	210	230	130	220	250	240	250	240
NEWARK	VEL (MPH)	.8	5.4	5.8	5.4	2.7	3.2	5.7	4.9	5.7	6.6
	SPD (MPH)	3.3	6.3	7.2	7.2	4.3	5.2	7.6	5.9	7.9	9.3
	RATIO	0.249	0.850	0.802	0.757	0.625	0.620	0.747	0.831	0.724	0.712
METEOROLOGICAL SITE	DIR (DEG)	200	200	200	170	160	190	270	230	200	220
BRADLEY	VEL (MPH)	1.2	2.8	4.4	4.7	1.4	4.0	2.7	2.6	2.5	7.4
	SPD (MPH)	2.9	5.8	5.5	7.3	5.2	6.6	5.3	6.9	6.5	8.6
	RATIO	0.420	0.487	0.813	0.636	0.263	0.610	0.501	0.374	0.388	0.855
METEOROLOGICAL SITE	DIR (DEG)	90	280	250	260	180	360	240	270	280	260
BRIDGEPORT	VEL (MPH)	3.0	4.4	5.3	6.6	2.6	.8	5.2	6.1	8.1	7.8
	SPD (MPH)	3.6	5.2	6.6	7.0	3.9	2.9	5.5	6.6	8.3	9.1
	RATIO	0.823	0.848	0.802	0.943	0.661	0.268	0.950	0.918	0.972	0.864
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	270	250	250	280	280	260	260
WORCESTER	VEL (MPH)	3.8	6.4	6.3	9.6	4.4	6.0	7.3	11.4	7.7	7.3
	SPD (MPH)	4.5	7.3	6.6	9.9	5.3	6.5	7.6	12.2	7.9	7.6
	RATIO	0.847	0.870	0.948	0.967	0.830	0.925	0.953	0.929	0.970	0.964

FIGURE 3-4

SULFUR DIOXIDE TREND FROM CONTINUOUS DATA

"PERCENT OF SITES WITHIN EACH RANGE"



PRIMARY ANNUAL STANDARD = 80 µg/m³

* ANNUAL ARITHMETIC MEAN (µg/m³)

TABLE 3-5

SO2 TRENDS FROM CONTINUOUS DATA: 1982-1991
(PAIRED *t* TEST)

PAIRED YEARS	AVERAGE OF ANNUAL GEOMETRIC MEANS (μg/m3)	NO. OF SITES	DIFFERENCES OF THE PAIRED YEAR MEANS		SIGNIFICANCE LEVEL		
					TREND AT		PROBABILITY THAT CHANGE IS NOT SIGNIFICANT
			AVG.	STD. DEV.	95% LEVEL	99% LEVEL	
82 83	20.0 18.1	8 8	-1.96	0.79	↓	↓	0.0002
83 84	18.1 18.2	8 8	0.11	3.20	N.C.	N.C.	0.9237
84 85	16.4 16.5	15 15	0.04	3.51	N.C.	N.C.	0.9654
85 86	14.6 15.5	16 16	0.86	3.76	N.C.	N.C.	0.3772
86 87	15.6 16.1	16 16	0.47	2.65	N.C.	N.C.	0.4899
87 88	16.5 16.4	15 15	-0.13	3.06	N.C.	N.C.	0.8784
88 89	15.8 16.3	14 14	0.51	1.51	N.C.	N.C.	0.2245
89 90	16.7 14.7	14 14	-2.03	2.01	↓	↓	0.0023
90 91	14.9 15.7	12 12	0.77	0.63	N.C.	N.C.	0.2486

Key to Symbols : ↓ = Significant downward trend
↑ = Significant upward trend
N.C. = No significant change

IV. OZONE

HEALTH EFFECTS

Ozone is a highly reactive form of oxygen and the principal component of modern smog. Until recently, EPA called this type of pollution "photochemical oxidants." The name has been changed to ozone because ozone is the only oxidant actually measured and is the most plentiful.

Ozone and other oxidants -- including peroxyacetal nitrates (PAN), formaldehyde and peroxides -- are not usually emitted into the air directly. They are formed by chemical reactions in the air from two other pollutants: hydrocarbons and nitrogen oxides. Energy from sunlight is needed for these chemical reactions. This accounts for the term photochemical smog and the daily variation in ozone levels, which increase during the day and decrease at night.

Ozone is a pungent gas with a faintly bluish color. It irritates the mucous membranes of the respiratory system, causing coughing, choking and impaired lung function. It aggravates chronic respiratory diseases like asthma and bronchitis and is believed capable of hastening the death, by pneumonia, of persons in already weakened health. PAN and the other oxidants that accompany ozone are powerful eye irritants.

NATIONAL AMBIENT AIR QUALITY STANDARD

On February 8, 1979 the EPA established a national ambient air quality standard (NAAQS) for ozone of 0.12 ppm for a one-hour average. Compliance with this standard is determined by summing the number of days at each monitoring site over a consecutive three-year period when the 1-hour standard is exceeded and then computing the average number of exceedances over this interval. If the resulting average value is less than or equal to 1.0 (that is, if the fourth highest daily value in a consecutive three-year period is less than or equal to 0.12 ppm) the ozone standard is considered attained at the site. This standard replaces the old photochemical oxidant Standard of 0.08 ppm. The definition of the pollutant was changed along with the numerical value of the standard, partly because the instruments used to measure photochemical oxidants in the air really measure only ozone. Ozone is one of a group of chemicals which are formed photochemically in the air and are called photochemical oxidants. In the past, the two terms have often been used interchangeably. This Air Quality Summary uses the term "ozone" in conjunction with the NAAQS to reflect the change in both the numerical value of the NAAQS and the definition of the pollutant.

The EPA defines the ozone standard to two decimal places. Therefore, the standard is considered exceeded when a level of 0.13 ppm is reached. However, since the DEP still measures ozone levels to three decimal places, any one-hour average ozone reading which equals or is greater than 0.125 ppm is considered an exceedance of the 0.12 ppm standard in Connecticut. This interpretation of the ozone standard differs from the one used by the DEP before 1982, when a one-hour ozone concentration of 0.121 ppm was considered an exceedance of the standard.

CONCLUSIONS

As in past years, Connecticut experienced very high concentrations of ozone in the summer months of 1991. Levels in excess of the one-hour NAAQS of 0.12 ppm were frequently recorded at all eleven monitoring sites. No site experienced levels greater than 0.20 ppm in 1991, compared to one site in 1989 and none in 1990. All the sites except Torrington 006 operated in both 1990 and 1991.

The incidence of ozone concentrations in excess of the 1-hour 0.12 ppm standard was significantly higher in 1991 than in 1990 (see Table 4-1). There was a total of 195 exceedances in 1991 and 96 exceedances in 1990 at the ten monitoring sites that operated in both years. This represents an increase in the frequency of such exceedances from 2.4 per 1000 sampling hours in 1990 to 4.1 per 1000 sampling hours in 1991: a 71% increase. The actual number of hours when the ozone standard was exceeded in the state increased markedly from 59 in 1990 to 196 in 1991.

The number of site-days on which the ozone monitors experienced ozone levels in excess of the 1-hour standard increased from 43 in 1990 to 77 in 1991 at the ten monitoring sites that operated in both years (see Table 4-2). This represents an increase in the frequency of such occurrences from 2.2 per 100 sampling days in 1990 to 3.8 per 100 sampling days in 1991: a 73% increase. The actual number of days on which the ozone standard was exceeded in the state increased from 13 in 1990 to 24 in 1991.

The yearly changes in ozone concentrations can be attributed primarily to year-to-year variations in regional weather conditions, especially wind direction, temperature and the amount of sunlight. A large portion of the peak ozone concentrations in Connecticut is caused by the transport of ozone and/or precursors (i.e., hydrocarbons and nitrogen oxides) from the New York City area and other points to the west and southwest. Therefore, an increase in the frequency of winds out of the southwest would help to explain the increase in the number of ozone exceedances from 1990 to 1991. However, the percentage of southwest winds during the "ozone season" was 38% in both 1990 and 1991, as is shown by the wind roses from Newark (Figures 4-1 and 4-2). The magnitude of high ozone levels can be partly associated with yearly variations in temperature, since ozone production is greatest at high temperatures and in strong sunlight. The summer season's daily high temperatures were significantly higher in 1991 than in 1990. This is demonstrated by the number of days exceeding 90° F which increased from four in 1990 to seventeen in 1991 at Sikorsky Airport in Bridgeport, and from fourteen in 1990 to thirty-one in 1991 at Bradley International Airport. The incidence of high ozone levels is dependent on the percentage of possible sunshine, since sunlight is essential to the creation of ozone. According to National Weather Service local climatological data recorded at Bradley Airport, the percentage of sunshine increased from 52% in 1990 to 63% in 1991 for the months May through September. The average for these summer months at Bradley is usually 60%. Of the three meteorological parameters, the variation in temperature and the percentage of possible sunshine can be seen as contributors to the increase in ozone levels from 1990 to 1991.

The meteorological influences notwithstanding, additional and important factors contributing to the decrease in ozone concentrations in 1991 are the continuing efforts of the EPA and the state Department of Environmental Protection to control the emissions of nitrogen oxides and hydrocarbons. Newer automobiles continue to be less polluting and the use of lower vapor pressure gasoline in the summer months, which was initiated in 1989, is a major effective control strategy.

METHOD OF MEASUREMENT

The DEP Air Monitoring Unit uses UV photometry to measure and record instantaneous concentrations of ozone continuously by means of a UV absorption technique. Properly calibrated, instruments of this type are shown to be remarkably reliable and stable.

DISCUSSION OF DATA

Monitoring Network - In order to gather information which will further the understanding of ozone production and transport, and to provide real-time data for the daily Pollutant Standards Index, DEP operated a state-wide ozone monitoring network consisting of four types of sites in 1991 (see Figure 4-3):

Urban	- East Hartford, Middletown
Advection from Southwest	- Greenwich, Groton, Madison, Stratford
Urban and advection from Southwest	- Bridgeport, Danbury, New Haven
Rural	- Stafford, Torrington

Precision and Accuracy - The ozone monitors had a total of 231 precision checks during 1991. The resulting 95% probability limits were -9% to +6%. Accuracy is determined by introducing a known amount of ozone into each of the monitors. Three different concentration levels are tested: low, medium, and high. The 95% probability limits, based on 12 audits conducted on the monitoring system, were: low, -2% to +17%; medium, -5% to +8%; and high, -5% to +6%.

1-Hour Average - The 1-hour ozone standard was exceeded at all the DEP monitoring sites in 1991. Of the ten sites that were in operation in both 1990 and 1991, four sites had high concentrations that were lower in 1991, and six sites had high concentrations that were higher in 1991. Seven of the sites had higher second high concentrations in 1991, and three sites had lower second high concentrations.

The number of hours when the ozone standard was exceeded at each site during the summertime "ozone season" is presented in Table 4-1. The number of days on which the 1-hour standard was exceeded at each site is presented in Table 4-2. Figure 4-4 shows the year's high and second high concentrations at each site.

10 High Days with Wind Data - Table 4-3 lists the ten highest 1-hour ozone averages and their dates of occurrence for each ozone site in 1991. The wind data associated with these high readings are also presented. (See the discussion of Table 2-5 in the particulate matter section of this Air Quality Summary for a description of the origin and use of these wind data.)

Most (i.e., 75%) of the tabulated high ozone levels occurred on days with winds out of the southwest. This is due to the special features of a southwest wind blowing over Connecticut. The first feature is that, during the summer, southwest winds are usually accompanied by high temperatures and bright sunshine, which are important to the production of ozone. The second feature of a southwest wind is that it will transport precursor emissions from New York City and other urban areas to the southwest of Connecticut. It is the combination of these factors that often produces unhealthful ozone levels in Connecticut.

There are also many instances of high ozone levels on non-southwest wind days. This suggests that pollution control programs currently being implemented in this state are needed to protect the public health of Connecticut's citizenry on days when Connecticut is responsible for its own pollution.

Trends - Ozone trends can be illustrated in a number of ways using various statistics: daily mean concentration, daily maximum concentration, number of hourly exceedances, number of daily exceedances, etc. Each has its merits. The daily maximum ozone concentration is used here as the basis for a trend analysis because (1) it represents a more robust dataset than hourly or daily exceedances, and (2) a maximum concentration is more relevant to the NAAQS for ozone.

Figure 4-5 shows the unweighted average of the annual means of the maximum daily concentrations at ten ozone sites from 1982 to 1991. There is a lot of variation in the statistic from one year to the next. The importance of meteorology in the formation of ozone explains much of this variation. However, unless the effect of meteorology can be factored out, one cannot judge the effect of emission control measures on ozone production. A regression line through the data in Figure 4-5 would trend down, but the reason for this would not be evident.

The effect of meteorology on an ozone trend can be diminished by multiple year averaging. Periods of multiple years exhibit much less meteorological variability than do single years, and a trend analysis based on multiple years should more clearly reveal the effect of emission controls on ambient ozone concentrations. Figure 4-6 illustrates five year averages of the data that is presented in Figure 4-5. It is evident that the ozone trend, freed from meteorological effects, is down over the past seven years.

TABLE 4-1

NUMBER OF HOURS WHEN THE 1-HOUR OZONE STANDARD WAS EXCEEDED IN 1991

SITE	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	THIS YEAR	LAST YEAR
Bridgeport 013	0	0	2	8	1	0	0	11	5
Danbury 123	0	1	1	7	1	0	0	10	9
E. Hartford 003	0	0	2	3	4	0	0	9	7
Greenwich 017	0	0	10	6	4	0	0	20	15
Groton 008	0	0	6	11	1	1	0	19	16
Madison 002	0	1	18	14	8	2	0	43	24
Middletown 007	0	1	7	17	4	0	0	29	6
New Haven 123	0	0	5	10	1	0	0	16	0
Stafford 001	0	0	0	5	3	0	0	8	8
Stratford 007	0	0	13	12	5	0	0	30	6
Torrington 006	0	0	0	1	2	0	0	3	n/a[a]
TOTAL SITE HOURS	0	3	64	94	34	3	0	198	96

[a] The Torrington 006 monitoring site did not exist in 1990.

TABLE 4-2

NUMBER OF DAYS WHEN THE 1-HOUR OZONE STANDARD WAS EXCEEDED IN 1991

SITE	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	THIS YEAR	LAST YEAR
Bridgeport 013	0	0	1	4	1	0	0	6	3
Danbury 123	0	1	1	3	1	0	0	6	4
E. Hartford 003	0	0	1	1	2	0	0	4	4
Greenwich 017	0	0	3	3	3	0	0	9	7
Groton 008	0	0	2	4	1	1	0	8	6
Madison 002	0	1	7	5	3	1	0	17	7
Middletown 007	0	1	2	4	1	0	0	8	3
New Haven 123	0	0	2	4	1	0	0	7	0
Stafford 001	0	0	0	1	1	0	0	2	5
Stratford 007	0	0	5	3	2	0	0	10	4
Torrington 006	0	0	0	1	1	0	0	2	n/a[a]
TOTAL SITE DAYS	0	3	24	33	17	2	0	79	43

[a] The Torrington 006 monitoring site did not exist in 1990.

FIGURE 4-1

WIND ROSE FOR APRIL - OCTOBER 1990
NEWARK INTERNATIONAL AIRPORT
NEWARK, NEW JERSEY

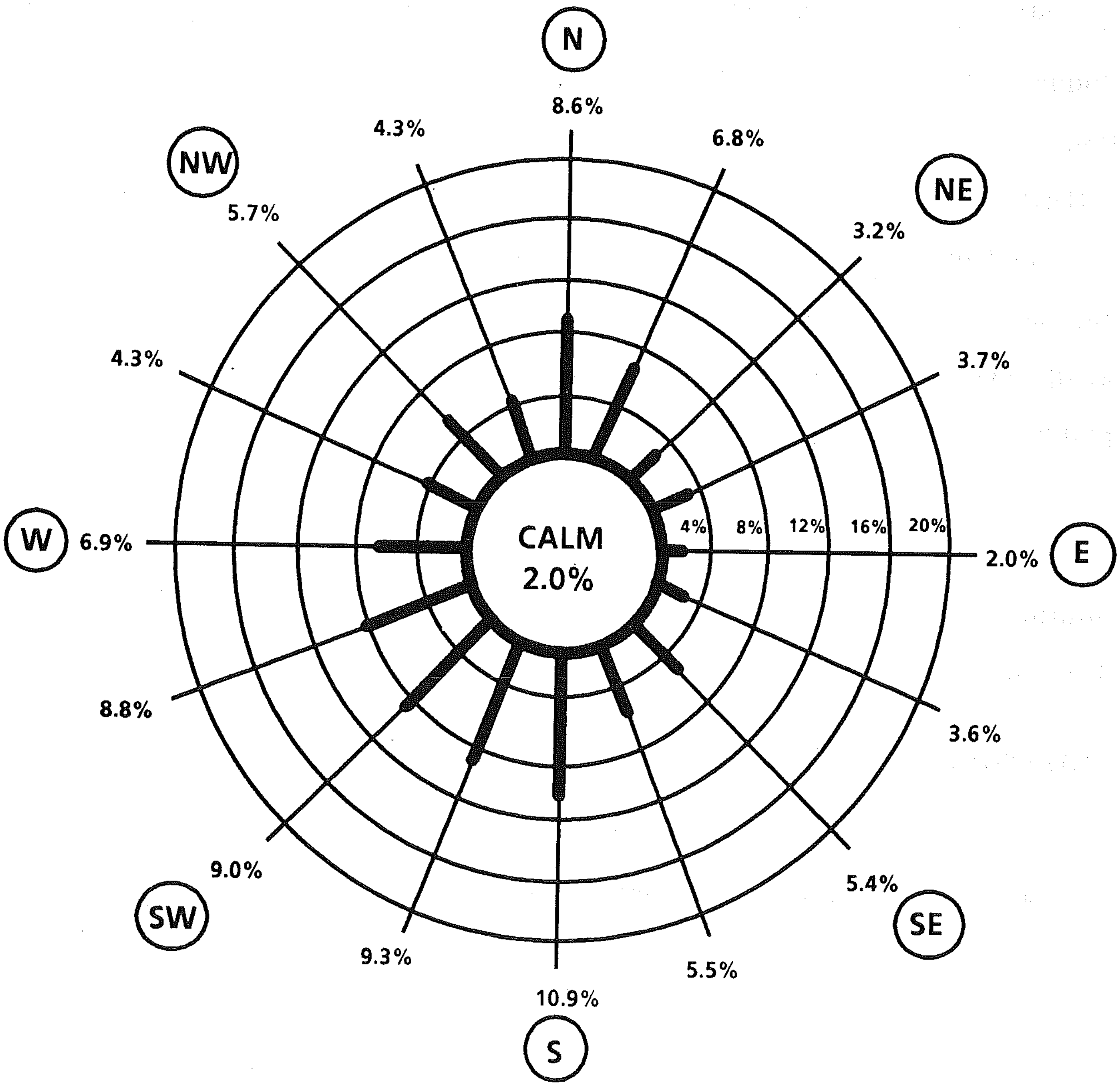
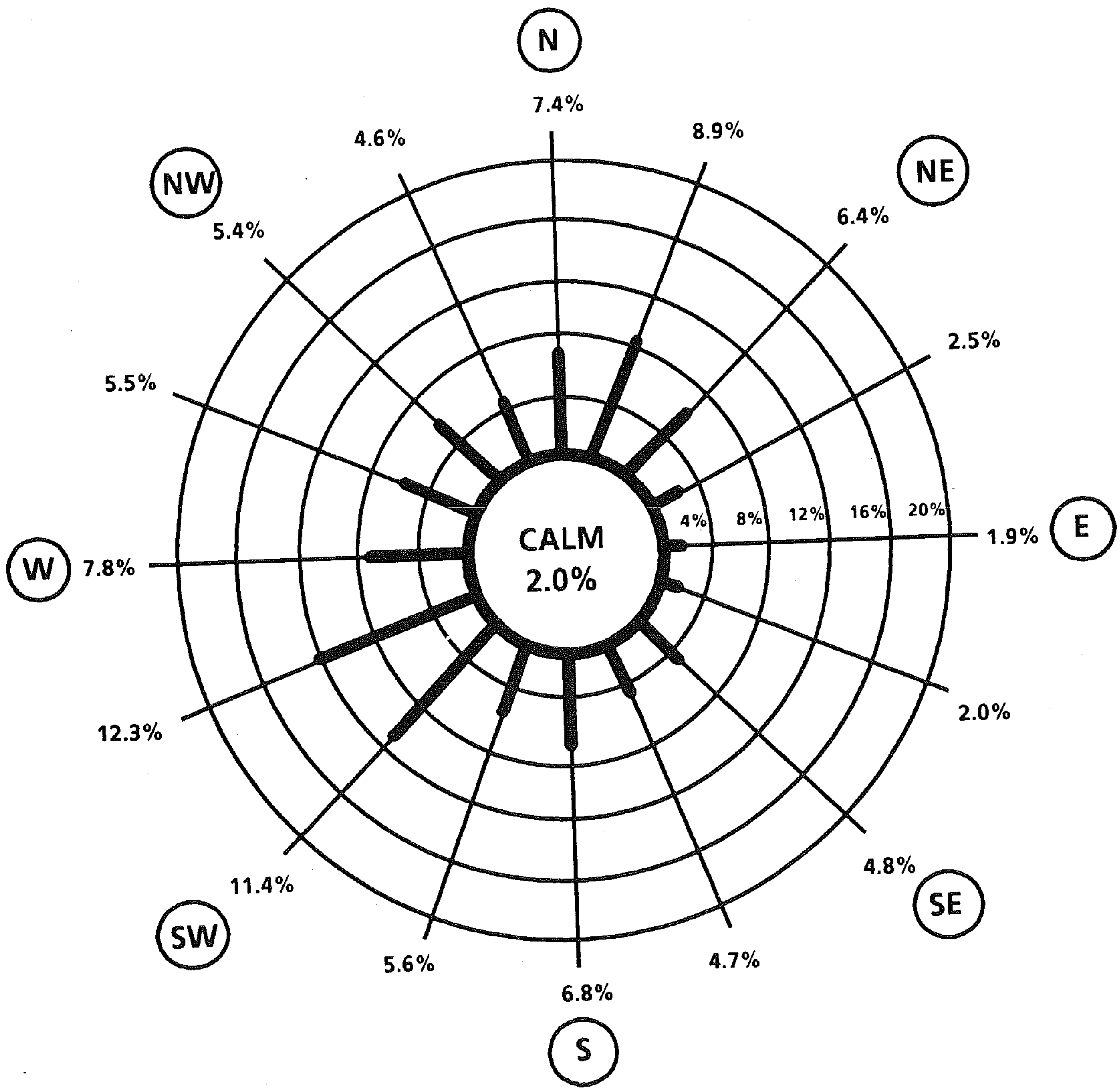


FIGURE 4-2

WIND ROSE FOR APRIL - OCTOBER 1991
NEWARK INTERNATIONAL AIRPORT
NEWARK, NEW JERSEY



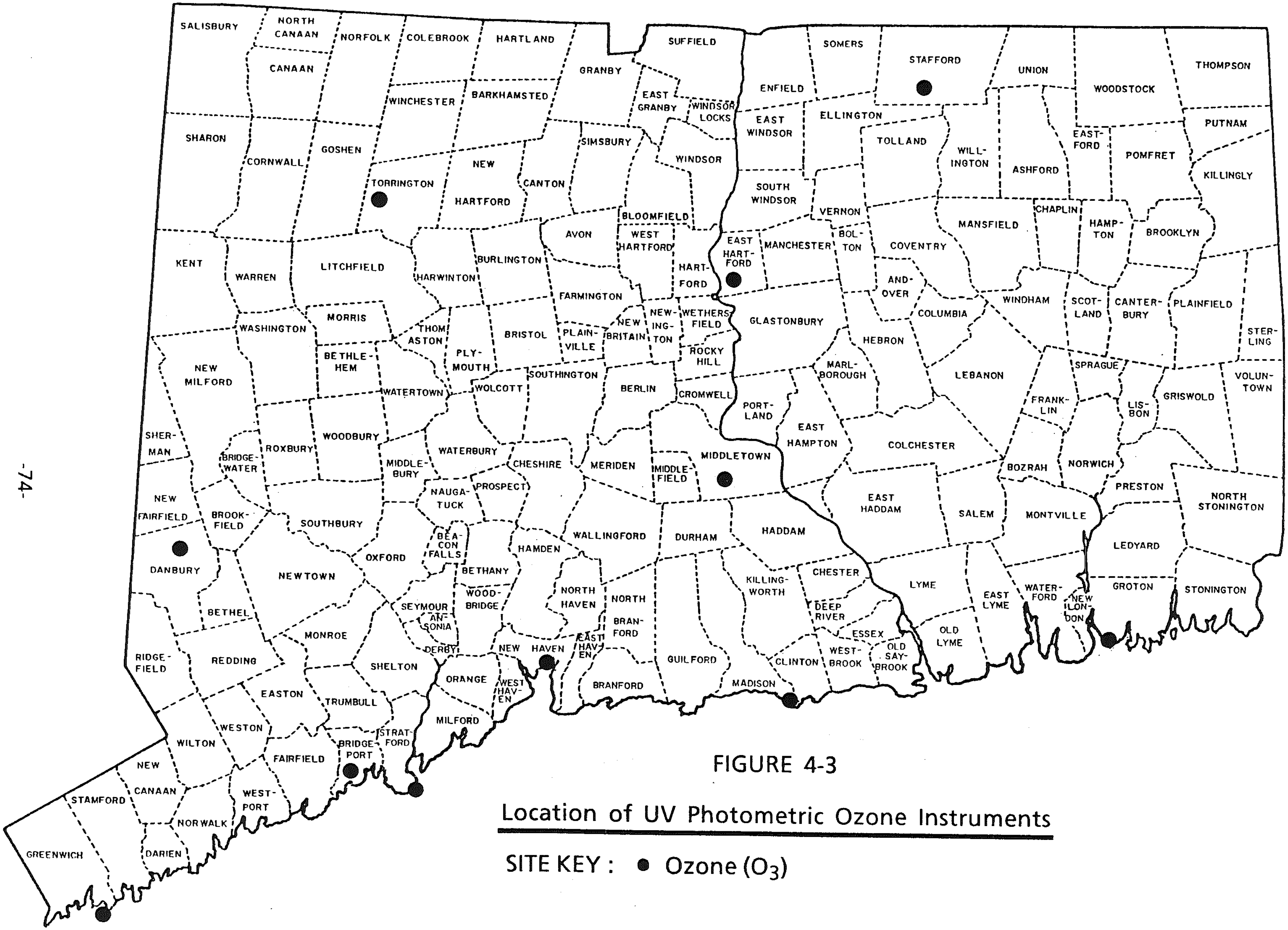


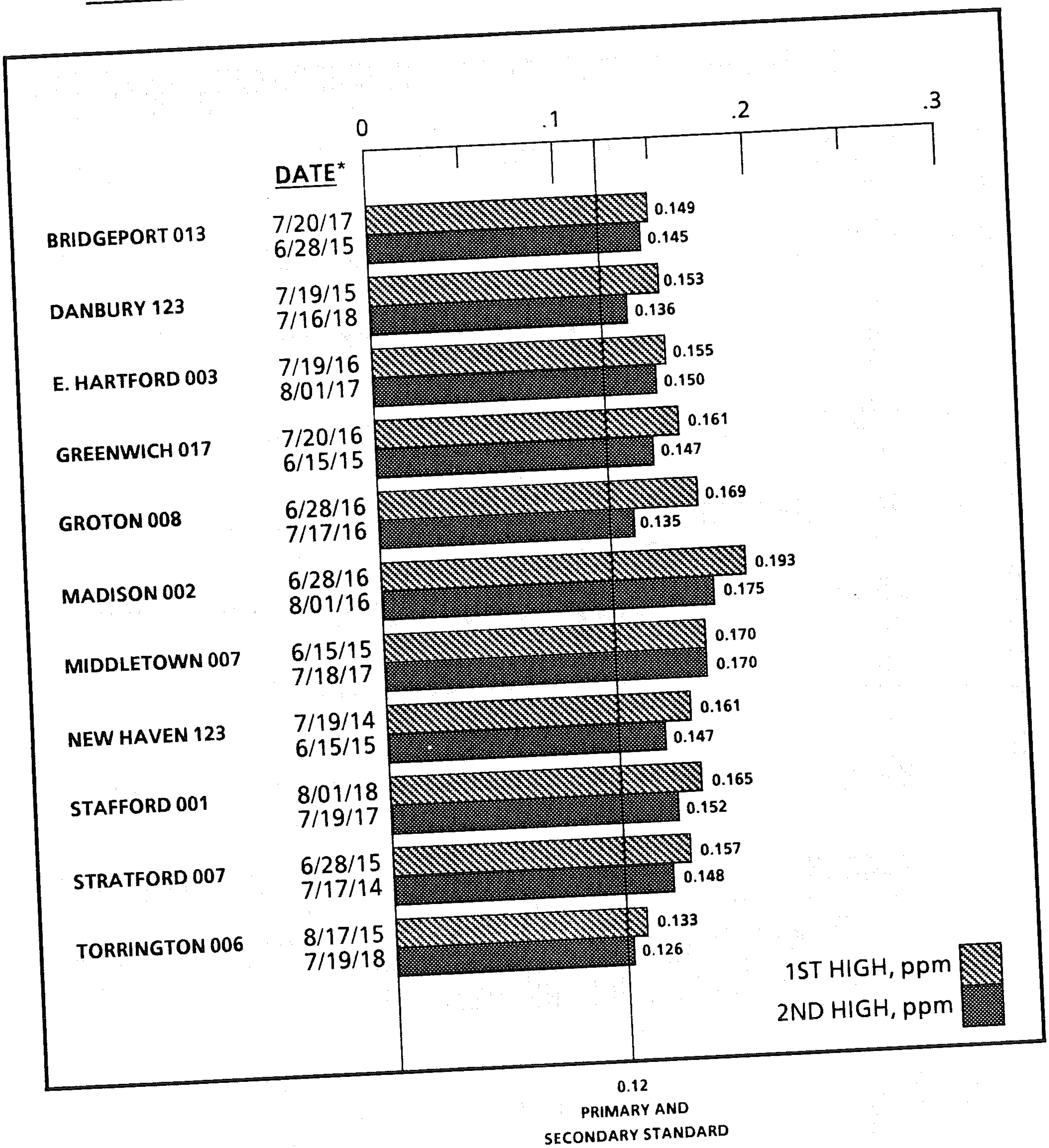
FIGURE 4-3

Location of UV Photometric Ozone Instruments

SITE KEY : ● Ozone (O_3)

FIGURE 4-4

1ST AND 2ND HIGH 1-HOUR OZONE CONCENTRATIONS IN 1991



* The date is the month/day/ending hour (standard time) of occurrence.

N.B. To be consistent with the requirements of the NAAQS for ozone, only the highest hourly concentration per day per site is considered.

TABLE 4-3

1991 TEN HIGHEST 1-HOUR AVERAGE OZONE DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
BRIDGEPORT-013 (4686)	OZONE	.149	.145	.134	.128	.125	.125	.120	.110	.107	.103
	DATE	7/20/91	6/28/91	7/18/91	7/19/91	8/14/91	7/17/91	8/30/91	8/ 1/91	8/17/91	6/11/91
METEOROLOGICAL SITE	DIR (DEG)	270	260	260	250	240	250	210	250	210	250
NEWARK	VEL (MPH)	5.4	9.2	8.7	1.2	6.4	11.6	3.5	7.9	7.9	7.5
	SPD (MPH)	8.1	11.1	10.5	9.5	8.9	13.9	4.6	8.8	10.2	10.2
	RATIO	0.676	0.830	0.830	0.132	0.722	0.832	0.766	0.904	0.776	0.734
METEOROLOGICAL SITE	DIR (DEG)	280	240	260	200	230	270	210	210	200	250
BRADLEY	VEL (MPH)	4.9	7.1	3.8	5.5	3.9	5.8	3.5	8.4	7.5	6.6
	SPD (MPH)	6.0	9.6	5.0	7.5	5.8	8.5	6.9	8.8	9.5	9.1
	RATIO	0.808	0.740	0.759	0.734	0.671	0.686	0.512	0.956	0.795	0.729
METEOROLOGICAL SITE	DIR (DEG)	250	270	240	240	230	250	250	240	230	260
BRIDGEPORT	VEL (MPH)	4.6	7.2	5.7	4.6	4.0	7.2	2.6	4.3	6.1	5.7
	SPD (MPH)	4.6	7.3	6.0	4.7	4.2	7.3	3.9	5.3	6.3	5.9
	RATIO	0.990	0.983	0.944	0.969	0.958	0.984	0.659	0.811	0.961	0.959
METEOROLOGICAL SITE	DIR (DEG)	290	270	270	240	290	280	280	230	230	270
WORCESTER	VEL (MPH)	6.8	11.1	7.6	5.0	6.2	9.8	5.7	6.2	8.6	5.8
	SPD (MPH)	6.9	11.4	8.1	5.6	6.5	9.9	6.3	6.5	8.8	6.5
	RATIO	0.984	0.980	0.940	0.889	0.959	0.983	0.900	0.962	0.986	0.898
DANBURY-123 (4856)	OZONE	.153	.136	.135	.135	.130	.127	.123	.122	.118	.115
	DATE	7/19/91	7/16/91	7/18/91	5/27/91	6/15/91	8/17/91	6/27/91	8/30/91	5/16/91	7/17/91
METEOROLOGICAL SITE	DIR (DEG)	250	260	260	120	240	210	250	210	230	250
NEWARK	VEL (MPH)	1.2	5.0	8.7	2.1	8.4	7.9	8.6	3.5	7.5	11.6
	SPD (MPH)	9.5	8.9	10.5	6.5	9.6	10.2	10.4	4.6	8.9	13.9
	RATIO	0.132	0.556	0.830	0.324	0.871	0.776	0.829	0.766	0.844	0.832
METEOROLOGICAL SITE	DIR (DEG)	200	240	260	180	210	200	230	210	210	270
BRADLEY	VEL (MPH)	5.5	4.4	3.8	4.5	7.1	7.5	4.4	3.5	7.4	5.8
	SPD (MPH)	7.5	6.2	5.0	8.8	9.3	9.5	7.2	6.9	9.1	8.5
	RATIO	0.734	0.715	0.759	0.516	0.761	0.795	0.610	0.512	0.821	0.686
METEOROLOGICAL SITE	DIR (DEG)	240	220	240	220	250	230	260	250	240	250
BRIDGEPORT	VEL (MPH)	4.6	3.6	5.7	1.6	5.7	6.1	6.7	2.6	4.2	7.2
	SPD (MPH)	4.7	4.2	6.0	2.7	5.9	6.3	6.9	3.9	4.5	7.3
	RATIO	0.969	0.860	0.944	0.594	0.959	0.961	0.975	0.659	0.934	0.984
METEOROLOGICAL SITE	DIR (DEG)	240	270	270	260	250	230	290	280	250	280
WORCESTER	VEL (MPH)	5.0	6.9	7.6	3.8	6.9	8.6	8.2	5.7	6.4	9.8
	SPD (MPH)	5.6	7.6	8.1	6.2	8.6	8.8	8.6	6.3	7.2	9.9
	RATIO	0.889	0.910	0.940	0.609	0.795	0.986	0.952	0.900	0.894	0.983
EAST HARTFORD-003 (4853)	OZONE	.155	.150	.146	.137	.123	.118	.116	.115	.113	.107
	DATE	7/19/91	8/ 1/91	6/15/91	8/17/91	5/27/91	5/16/91	7/18/91	6/16/91	6/25/91	8/18/91
METEOROLOGICAL SITE	DIR (DEG)	250	250	240	210	120	230	260	250	220	220
NEWARK	VEL (MPH)	1.2	7.9	8.4	7.9	2.1	7.5	8.7	7.5	6.7	7.0
	SPD (MPH)	9.5	8.8	9.6	10.2	6.5	8.9	10.5	8.8	9.3	9.9
	RATIO	0.132	0.904	0.871	0.776	0.324	0.844	0.830	0.860	0.717	0.708
METEOROLOGICAL SITE	DIR (DEG)	200	210	210	200	180	210	260	190	210	220
BRADLEY	VEL (MPH)	5.5	8.4	7.1	7.5	4.5	7.4	3.8	1.8	3.7	5.6
	SPD (MPH)	7.5	8.8	9.3	9.5	8.8	9.1	5.0	7.2	6.2	8.6
	RATIO	0.734	0.956	0.761	0.795	0.516	0.821	0.759	0.248	0.604	0.648

TABLE 4-3, CONTINUED

1991 TEN HIGHEST 1-HOUR AVERAGE OZONE DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	240	240	250	230	220	240	240	250	230	220
BRIDGEPORT	VEL (MPH)	4.6	4.3	5.7	6.1	1.6	4.2	5.7	3.6	4.1	7.4
	SPD (MPH)	4.7	5.3	5.9	6.3	2.7	4.5	6.0	3.6	4.7	7.5
	RATIO	0.969	0.811	0.959	0.961	0.594	0.934	0.944	0.997	0.865	0.984
METEOROLOGICAL SITE	DIR (DEG)	240	230	250	230	260	250	270	90	310	230
WORCESTER	VEL (MPH)	5.0	6.2	6.9	8.6	3.8	6.4	7.6	3.0	3.7	7.9
	SPD (MPH)	5.6	6.5	8.6	8.8	6.2	7.2	8.1	5.0	4.7	8.2
	RATIO	0.889	0.962	0.795	0.986	0.609	0.894	0.940	0.600	0.787	0.963
GREENWICH-017 (4861)	OZONE	.161	.147	.143	.141	.135	.134	.129	.127	.127	.121
	DATE	7/20/91	6/15/91	8/30/91	6/28/91	7/18/91	8/ 1/91	8/23/91	6/16/91	7/17/91	8/28/91
METEOROLOGICAL SITE	DIR (DEG)	270	240	210	260	260	250	280	250	250	260
NEWARK	VEL (MPH)	5.4	8.4	3.5	9.2	8.7	7.9	4.3	7.5	11.6	6.9
	SPD (MPH)	8.1	9.6	4.6	11.1	10.5	8.8	8.3	8.8	13.9	8.6
	RATIO	0.676	0.871	0.766	0.830	0.830	0.904	0.511	0.860	0.832	0.800
METEOROLOGICAL SITE	DIR (DEG)	280	210	210	240	260	210	270	190	270	270
BRADLEY	VEL (MPH)	4.9	7.1	3.5	7.1	3.8	8.4	1.9	1.8	5.8	4.1
	SPD (MPH)	6.0	9.3	6.9	9.6	5.0	8.8	5.6	7.2	8.5	6.0
	RATIO	0.808	0.761	0.512	0.740	0.759	0.956	0.337	0.248	0.686	0.686
METEOROLOGICAL SITE	DIR (DEG)	250	250	250	270	240	240	250	250	250	250
BRIDGEPORT	VEL (MPH)	4.6	5.7	2.6	7.2	5.7	4.3	4.7	3.6	7.2	5.0
	SPD (MPH)	4.6	5.9	3.9	7.3	6.0	5.3	5.0	3.6	7.3	5.2
	RATIO	0.990	0.959	0.659	0.983	0.944	0.811	0.944	0.997	0.984	0.961
METEOROLOGICAL SITE	DIR (DEG)	290	250	280	270	270	230	300	90	280	280
WORCESTER	VEL (MPH)	6.8	6.9	5.7	11.1	7.6	6.2	5.9	3.0	9.8	8.4
	SPD (MPH)	6.9	8.6	6.3	11.4	8.1	6.5	6.5	5.0	9.9	8.6
	RATIO	0.984	0.795	0.900	0.980	0.940	0.962	0.912	0.600	0.983	0.979
GROTON-008 (4794)	OZONE	.169	.135	.135	.135	.131	.131	.128	.127	.119	.117
	DATE	6/28/91	7/21/91	7/18/91	7/17/91	6/11/91	7/23/91	8/ 2/91	9/17/91	8/27/91	6/26/91
METEOROLOGICAL SITE	DIR (DEG)	260	280	260	250	250	250	270	260	250	240
NEWARK	VEL (MPH)	9.2	4.7	8.7	11.6	7.5	8.1	6.7	8.4	6.5	8.0
	SPD (MPH)	11.1	6.5	10.5	13.9	10.2	10.4	9.6	11.4	7.9	10.6
	RATIO	0.830	0.725	0.830	0.832	0.734	0.779	0.697	0.742	0.818	0.753
METEOROLOGICAL SITE	DIR (DEG)	240	320	260	270	250	210	280	280	210	240
BRADLEY	VEL (MPH)	7.1	6.9	3.8	5.8	6.6	7.0	8.3	4.6	5.5	6.2
	SPD (MPH)	9.6	9.2	5.0	8.5	9.1	10.6	9.9	7.5	7.9	8.5
	RATIO	0.740	0.753	0.759	0.686	0.729	0.659	0.836	0.618	0.692	0.729
METEOROLOGICAL SITE	DIR (DEG)	270	260	240	250	260	270	260	250	250	260
BRIDGEPORT	VEL (MPH)	7.2	2.8	5.7	7.2	5.7	6.5	5.6	6.4	6.5	6.8
	SPD (MPH)	7.3	4.3	6.0	7.3	5.9	7.5	5.8	6.6	6.8	6.9
	RATIO	0.983	0.657	0.944	0.984	0.959	0.867	0.978	0.965	0.961	0.992
METEOROLOGICAL SITE	DIR (DEG)	270	290	270	280	270	260	280	260	250	270
WORCESTER	VEL (MPH)	11.1	7.8	7.6	9.8	5.8	9.1	5.9	8.1	8.8	8.8
	SPD (MPH)	11.4	7.9	8.1	9.9	6.5	9.3	6.5	8.2	8.9	9.5
	RATIO	0.980	0.982	0.940	0.983	0.898	0.969	0.918	0.993	0.991	0.922

TABLE 4-3, CONTINUED

1991 TEN HIGHEST 1-HOUR AVERAGE OZONE DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
MADISON-002 (4812)	OZONE	.193	.175	.174	.158	.151	.150	.145	.144	.142	.137
	DATE	6/28/91	8/ 1/91	7/18/91	6/11/91	7/17/91	6/16/91	7/20/91	6/15/91	8/30/91	8/ 2/91
METEOROLOGICAL SITE	DIR (DEG)	260	250	260	250	250	250	270	240	210	270
NEWARK	VEL (MPH)	9.2	7.9	8.7	7.5	11.6	7.5	5.4	8.4	3.5	6.7
	SPD (MPH)	11.1	8.8	10.5	10.2	13.9	8.8	8.1	9.6	4.6	9.6
	RATIO	0.830	0.904	0.830	0.734	0.832	0.860	0.676	0.871	0.766	0.697
METEOROLOGICAL SITE	DIR (DEG)	240	210	260	250	270	190	280	210	210	280
BRADLEY	VEL (MPH)	7.1	8.4	3.8	6.6	5.8	1.8	4.9	7.1	3.5	8.3
	SPD (MPH)	9.6	8.8	5.0	9.1	8.5	7.2	6.0	9.3	6.9	9.9
	RATIO	0.740	0.956	0.759	0.729	0.686	0.248	0.808	0.761	0.512	0.836
METEOROLOGICAL SITE	DIR (DEG)	270	240	240	260	250	250	250	250	250	260
BRIDGEPORT	VEL (MPH)	7.2	4.3	5.7	5.7	7.2	3.6	4.6	5.7	2.6	5.6
	SPD (MPH)	7.3	5.3	6.0	5.9	7.3	3.6	4.6	5.9	3.9	5.8
	RATIO	0.983	0.811	0.944	0.959	0.984	0.997	0.990	0.959	0.659	0.978
METEOROLOGICAL SITE	DIR (DEG)	270	230	270	270	280	90	290	250	280	280
WORCESTER	VEL (MPH)	11.1	6.2	7.6	5.8	9.8	3.0	6.8	6.9	5.7	5.9
	SPD (MPH)	11.4	6.5	8.1	6.5	9.9	5.0	6.9	8.6	6.3	6.5
	RATIO	0.980	0.962	0.940	0.898	0.983	0.600	0.984	0.795	0.900	0.918
MIDDLETOWN-007 (4888)	OZONE	.170	.170	.155	.151	.147	.140	.129	.126	.124	.122
	DATE	6/15/91	7/18/91	7/17/91	8/ 1/91	7/19/91	7/20/91	5/16/91	6/25/91	6/11/91	6/26/91
METEOROLOGICAL SITE	DIR (DEG)	240	260	250	250	250	270	230	220	250	240
NEWARK	VEL (MPH)	8.4	8.7	11.6	7.9	1.2	5.4	7.5	6.7	7.5	8.0
	SPD (MPH)	9.6	10.5	13.9	8.8	9.5	8.1	8.9	9.3	10.2	10.6
	RATIO	0.871	0.830	0.832	0.904	0.132	0.676	0.844	0.717	0.734	0.753
METEOROLOGICAL SITE	DIR (DEG)	210	260	270	210	200	280	210	210	250	240
BRADLEY	VEL (MPH)	7.1	3.8	5.8	8.4	5.5	4.9	7.4	3.7	6.6	6.2
	SPD (MPH)	9.3	5.0	8.5	8.8	7.5	6.0	9.1	6.2	9.1	8.5
	RATIO	0.761	0.759	0.686	0.956	0.734	0.808	0.821	0.604	0.729	0.729
METEOROLOGICAL SITE	DIR (DEG)	250	240	250	240	240	250	240	230	260	260
BRIDGEPORT	VEL (MPH)	5.7	5.7	7.2	4.3	4.6	4.6	4.2	4.1	5.7	6.8
	SPD (MPH)	5.9	6.0	7.3	5.3	4.7	4.6	4.5	4.7	5.9	6.9
	RATIO	0.959	0.944	0.984	0.811	0.969	0.990	0.934	0.865	0.959	0.992
METEOROLOGICAL SITE	DIR (DEG)	250	270	280	230	240	290	250	310	270	270
WORCESTER	VEL (MPH)	6.9	7.6	9.8	6.2	5.0	6.8	6.4	3.7	5.8	8.8
	SPD (MPH)	8.6	8.1	9.9	6.5	5.6	6.9	7.2	4.7	6.5	9.5
	RATIO	0.795	0.940	0.983	0.962	0.889	0.984	0.894	0.787	0.898	0.922
NEW HAVEN-123 (4703)	OZONE	.161	.147	.143	.136	.135	.133	.129	.121	.113	.106
	DATE	7/19/91	6/15/91	7/18/91	8/ 1/91	6/28/91	7/20/91	7/17/91	6/16/91	8/14/91	8/30/91
METEOROLOGICAL SITE	DIR (DEG)	250	240	260	250	260	270	250	250	240	210
NEWARK	VEL (MPH)	1.2	8.4	8.7	7.9	9.2	5.4	11.6	7.5	6.4	3.5
	SPD (MPH)	9.5	9.6	10.5	8.8	11.1	8.1	13.9	8.8	8.9	4.6
	RATIO	0.132	0.871	0.830	0.904	0.830	0.676	0.832	0.860	0.722	0.766
METEOROLOGICAL SITE	DIR (DEG)	200	210	260	210	240	280	270	190	230	210
BRADLEY	VEL (MPH)	5.5	7.1	3.8	8.4	7.1	4.9	5.8	1.8	3.9	3.5
	SPD (MPH)	7.5	9.3	5.0	8.8	9.6	6.0	8.5	7.2	5.8	6.9
	RATIO	0.734	0.761	0.759	0.956	0.740	0.808	0.686	0.248	0.671	0.512

TABLE 4-3, CONTINUED

1991 TEN HIGHEST 1-HOUR AVERAGE OZONE DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	240	250	240	240	270	250	250	250	230	250
BRIDGEPORT	VEL (MPH)	4.6	5.7	5.7	4.3	7.2	4.6	7.2	3.6	4.0	2.6
	SPD (MPH)	4.7	5.9	6.0	5.3	7.3	4.6	7.3	3.6	4.2	3.9
	RATIO	0.969	0.959	0.944	0.811	0.983	0.990	0.984	0.997	0.958	0.659
METEOROLOGICAL SITE	DIR (DEG)	240	250	270	230	270	290	280	90	290	280
WORCESTER	VEL (MPH)	5.0	6.9	7.6	6.2	11.1	6.8	9.8	3.0	6.2	5.7
	SPD (MPH)	5.6	8.6	8.1	6.5	11.4	6.9	9.9	5.0	6.5	6.3
	RATIO	0.889	0.795	0.940	0.962	0.980	0.984	0.983	0.600	0.959	0.900
STAFFORD-001 (4865)	OZONE	.165	.152	.122	.120	.119	.114	.102	.098	.096	.092
	DATE	8/ 1/91	7/19/91	8/17/91	5/16/91	6/15/91	7/18/91	8/27/91	5/24/91	8/30/91	7/20/91
METEOROLOGICAL SITE	DIR (DEG)	250	250	210	230	240	260	250	240	210	270
NEWARK	VEL (MPH)	7.9	1.2	7.9	7.5	8.4	8.7	6.5	9.1	3.5	5.4
	SPD (MPH)	8.8	9.5	10.2	8.9	9.6	10.5	7.9	10.1	4.6	8.1
	RATIO	0.904	0.132	0.776	0.844	0.871	0.830	0.818	0.904	0.766	0.676
METEOROLOGICAL SITE	DIR (DEG)	210	200	200	210	210	260	210	200	210	280
BRADLEY	VEL (MPH)	8.4	5.5	7.5	7.4	7.1	3.8	5.5	8.5	3.5	4.9
	SPD (MPH)	8.8	7.5	9.5	9.1	9.3	5.0	7.9	10.5	6.9	6.0
	RATIO	0.956	0.734	0.795	0.821	0.761	0.759	0.692	0.808	0.512	0.808
METEOROLOGICAL SITE	DIR (DEG)	240	240	230	240	250	240	250	250	250	250
BRIDGEPORT	VEL (MPH)	4.3	4.6	6.1	4.2	5.7	5.7	6.5	6.3	2.6	4.6
	SPD (MPH)	5.3	4.7	6.3	4.5	5.9	6.0	6.8	6.5	3.9	4.6
	RATIO	0.811	0.969	0.961	0.934	0.959	0.944	0.961	0.977	0.659	0.990
METEOROLOGICAL SITE	DIR (DEG)	230	240	230	250	250	270	250	260	280	290
WORCESTER	VEL (MPH)	6.2	5.0	8.6	6.4	6.9	7.6	8.8	9.0	5.7	6.8
	SPD (MPH)	6.5	5.6	8.8	7.2	8.6	8.1	8.9	9.3	6.3	6.9
	RATIO	0.962	0.889	0.986	0.894	0.795	0.940	0.991	0.968	0.900	0.984
STRATFORD-007 (4750)	OZONE	.157	.148	.148	.146	.144	.141	.141	.137	.133	.131
	DATE	6/28/91	7/17/91	7/18/91	6/11/91	8/30/91	6/15/91	6/16/91	7/20/91	8/ 1/91	6/10/91
METEOROLOGICAL SITE	DIR (DEG)	260	250	260	250	210	240	250	270	250	260
NEWARK	VEL (MPH)	9.2	11.6	8.7	7.5	3.5	8.4	7.5	5.4	7.9	7.2
	SPD (MPH)	11.1	13.9	10.5	10.2	4.6	9.6	8.8	8.1	8.8	8.1
	RATIO	0.830	0.832	0.830	0.734	0.766	0.871	0.860	0.676	0.904	0.895
METEOROLOGICAL SITE	DIR (DEG)	240	270	260	250	210	210	190	280	210	230
BRADLEY	VEL (MPH)	7.1	5.8	3.8	6.6	3.5	7.1	1.8	4.9	8.4	5.4
	SPD (MPH)	9.6	8.5	5.0	9.1	6.9	9.3	7.2	6.0	8.8	9.5
	RATIO	0.740	0.686	0.759	0.729	0.512	0.761	0.248	0.808	0.956	0.564
METEOROLOGICAL SITE	DIR (DEG)	270	250	240	260	250	250	250	250	240	240
BRIDGEPORT	VEL (MPH)	7.2	7.2	5.7	5.7	2.6	5.7	3.6	4.6	4.3	4.5
	SPD (MPH)	7.3	7.3	6.0	5.9	3.9	5.9	3.6	4.6	5.3	4.6
	RATIO	0.983	0.984	0.944	0.959	0.659	0.959	0.997	0.990	0.811	0.975
METEOROLOGICAL SITE	DIR (DEG)	270	280	270	270	280	250	90	290	230	270
WORCESTER	VEL (MPH)	11.1	9.8	7.6	5.8	5.7	6.9	3.0	6.8	6.2	7.0
	SPD (MPH)	11.4	9.9	8.1	6.5	6.3	8.6	5.0	6.9	6.5	7.2
	RATIO	0.980	0.983	0.940	0.898	0.900	0.795	0.600	0.984	0.962	0.979

TABLE 4-3, CONTINUED

1991 TEN HIGHEST 1-HOUR AVERAGE OZONE DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
TORRINGTON-006 (4821)	OZONE	.133	.126	.114	.114	.113	.108	.106	.105	.103	.100
	DATE	8/17/91	7/19/91	5/16/91	7/18/91	6/15/91	7/20/91	6/28/91	8/ 1/91	7/16/91	8/30/91
METEOROLOGICAL SITE	DIR (DEG)	210	250	230	260	240	270	260	250	260	210
NEWARK	VEL (MPH)	7.9	1.2	7.5	8.7	8.4	5.4	9.2	7.9	5.0	3.5
	SPD (MPH)	10.2	9.5	8.9	10.5	9.6	8.1	11.1	8.8	8.9	4.6
	RATIO	0.776	0.132	0.844	0.830	0.871	0.676	0.830	0.904	0.556	0.766
METEOROLOGICAL SITE	DIR (DEG)	200	200	210	260	210	280	240	210	240	210
BRADLEY	VEL (MPH)	7.5	5.5	7.4	3.8	7.1	4.9	7.1	8.4	4.4	3.5
	SPD (MPH)	9.5	7.5	9.1	5.0	9.3	6.0	9.6	8.8	6.2	6.9
	RATIO	0.795	0.734	0.821	0.759	0.761	0.808	0.740	0.956	0.715	0.512
METEOROLOGICAL SITE	DIR (DEG)	230	240	240	240	250	250	270	240	220	250
BRIDGEPORT	VEL (MPH)	6.1	4.6	4.2	5.7	5.7	4.6	7.2	4.3	3.6	2.6
	SPD (MPH)	6.3	4.7	4.5	6.0	5.9	4.6	7.3	5.3	4.2	3.9
	RATIO	0.961	0.969	0.934	0.944	0.959	0.990	0.983	0.811	0.860	0.659
METEOROLOGICAL SITE	DIR (DEG)	230	240	250	270	250	290	270	230	270	280
WORCESTER	VEL (MPH)	8.6	5.0	6.4	7.6	6.9	6.8	11.1	6.2	6.9	5.7
	SPD (MPH)	8.8	5.6	7.2	8.1	8.6	6.9	11.4	6.5	7.6	6.3
	RATIO	0.986	0.889	0.894	0.940	0.795	0.984	0.980	0.962	0.910	0.900

FIGURE 4-5

AVERAGES OF THE ANNUAL MEAN DAILY MAXIMUM OZONE CONCENTRATIONS AT TEN SITES

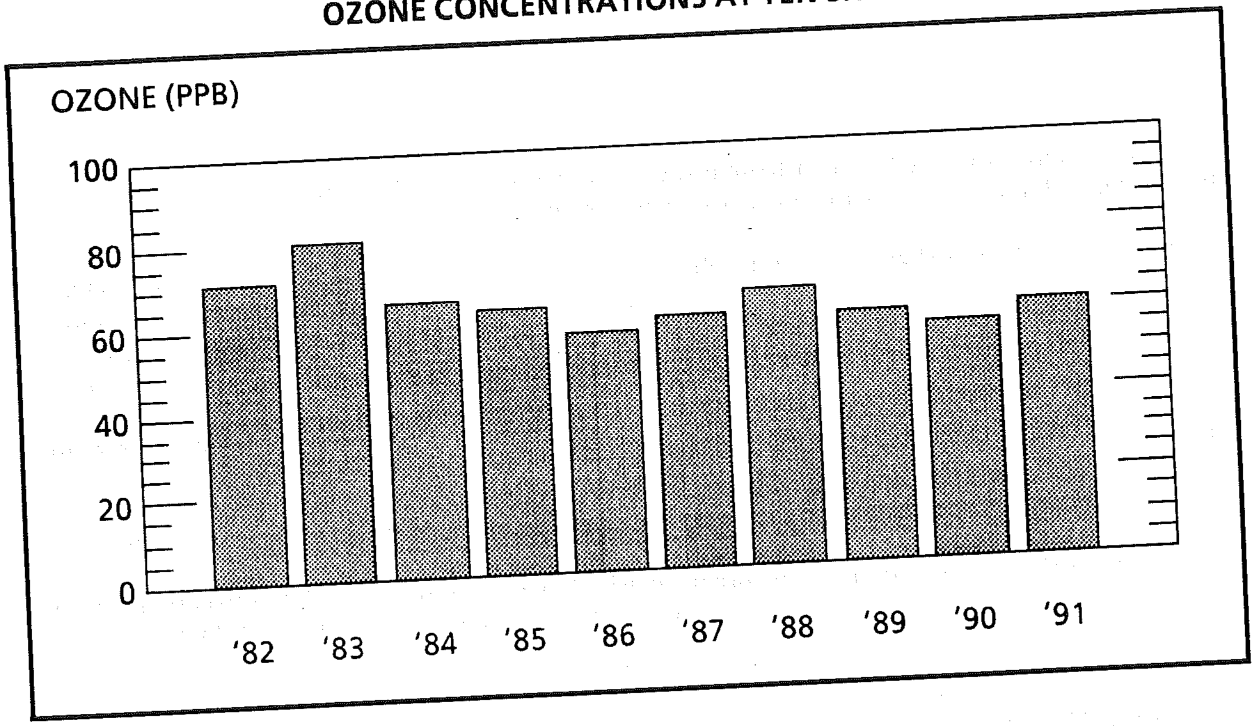
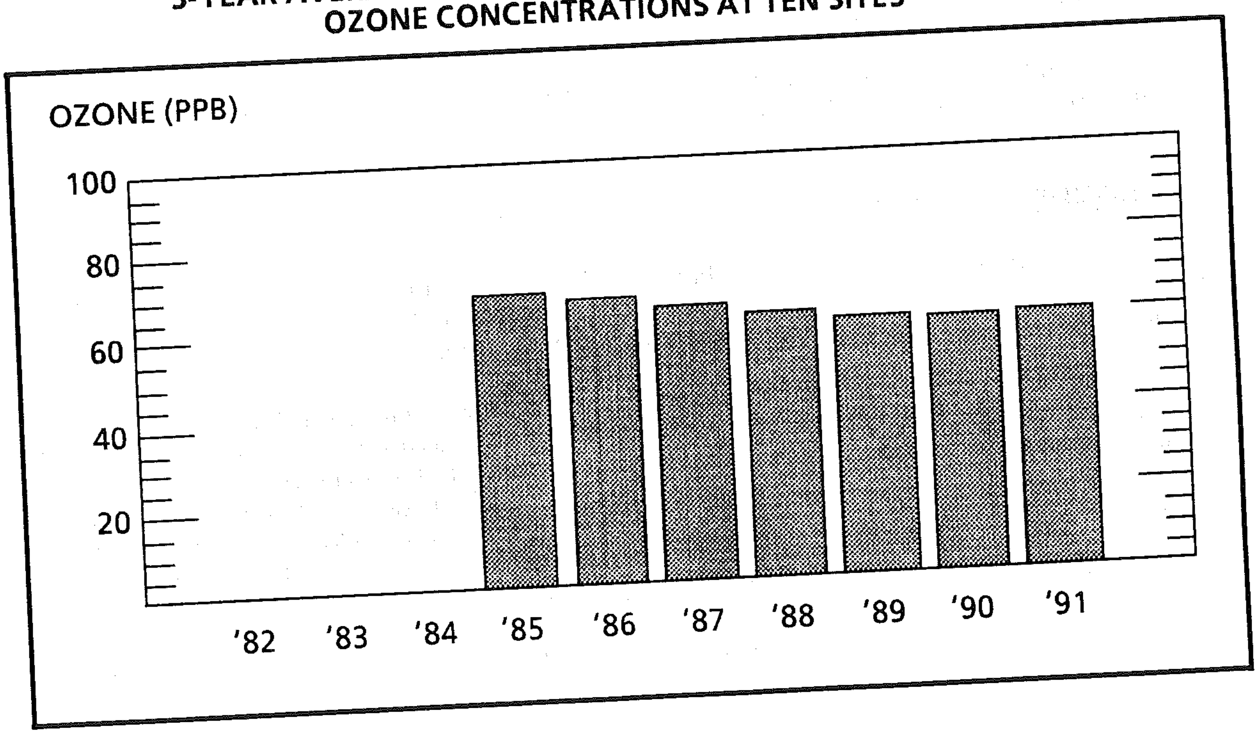


FIGURE 4-6

5-YEAR AVERAGES OF THE ANNUAL MEAN DAILY MAXIMUM OZONE CONCENTRATIONS AT TEN SITES



V. NITROGEN DIOXIDE

HEALTH EFFECTS

Nitrogen dioxide (NO_2) is a toxic gas with a characteristic pungent odor and a reddish-orange-brown color. It is highly oxidizing and extremely corrosive.

The presence of NO_2 in the atmosphere is accounted for by the oxidation of nitric oxide (NO) to NO_2 by means of reactions with various chemical species, principally ozone, hydroperoxyl radicals and organic peroxyl radicals. Large amounts of NO are emitted into the air by high temperature combustion processes. Industrial furnaces, power plants and motor vehicles are the primary sources of NO emissions.

Exposure to NO_2 is believed to increase the risks of acute respiratory disease and susceptibility to chronic respiratory infection. NO_2 also contributes to heart, lung, liver and kidney damage. At high concentrations, this pollutant can be fatal. At lower levels of 25 to 100 parts per million, it can cause acute bronchitis and pneumonia. Occasional exposure to low levels of NO_2 can irritate the eyes and skin.

Other effects of nitrogen dioxide are its toxicity to vegetation and its ability to combine with water vapor to form nitric acid. Furthermore, NO_2 is an essential ingredient, along with hydrocarbons, in the formation of ozone.

CONCLUSIONS

Nitrogen dioxide (NO_2) concentrations at all monitoring sites did not violate the NAAQS for NO_2 in 1991. The annual arithmetic mean NO_2 concentration at each site was well below the federal standard of 100 $\mu g/m^3$. The highest annual mean was 52 $\mu g/m^3$ which occurred at the New Haven 123 site.

SAMPLE COLLECTION AND ANALYSIS

The DEP Air Monitoring Unit used continuous electronic analyzers employing the chemiluminescent reference method to continuously monitor NO_2 levels.

DISCUSSION OF DATA

Monitoring Network - There were three nitrogen dioxide monitoring sites in 1991 (see Figure 5-1). The sites -- Bridgeport 013, East Hartford 003 and New Haven 123 -- were located in three urban areas near major expressways in order to obtain maximum NO_2 readings.

Precision and Accuracy - Fifty-three precision checks were made on the NO_2 monitors in 1991, yielding 95% probability limits ranging from -13% to +14%. Accuracy is determined by introducing a known amount of NO_2 into each of the monitors. Four audits for accuracy were conducted on the monitoring network in 1991. Four different concentration levels were tested on each monitor: low, low/medium, medium/high and high. The 95% probability limits for the low level test ranged from -3% to +10%; those for the low/medium level test ranged from -4% to +6%; those for the medium/high level test ranged from -3% to +3%; and those for the high level test ranged from -9% to +6%.

Annual Averages - The annual average NO_2 standard of 100 $\mu g/m^3$ was not exceeded in 1991 at any site in Connecticut (see Table 5-1). In 1991, all three sites had sufficient data to compute valid arithmetic means. This permits comparisons with the 1989 and 1990 annual averages. Notwithstanding an increase from 1989 to 1990 at East Hartford and New Haven, the annual average NO_2 concentrations decreased at all three sites between 1989 and 1991.

Statistical Projections - The format of Table 5-1 is the same as that used to present the particulate matter and sulfur dioxide data, except that for NO_2 there are no 24-hour standards and, therefore, no projections of violations are possible. However, Table 5-1 gives the annual arithmetic mean of the hourly NO_2 concentrations in order to allow direct comparison to the annual NO_2 standard. The 95% confidence limits about the arithmetic mean for each site demonstrate that it is unlikely that any site exceeded the primary annual standard of 100 $\mu g/m^3$ in 1991.

10-High Days with Wind Data - Table 5-2 presents for each site the ten days in 1991 when the highest hourly NO_2 readings occurred, along with the associated wind conditions for each day. (See the discussion of Table 2-5 in the particulate matter section for a description of the origin and use of the wind data.)

According to National Weather Service local climatological data recorded at Bradley Airport, 18 of the 21 days listed in the table had at least 50% of the possible sunshine. This is interpreted to confirm the importance of photochemical oxidation in the formation of NO_2.

Using the National Weather Service data from the Bridgeport meteorological site for Bridgeport 013 and New Haven 123, and using the data from Bradley for East Hartford 003, one finds that over 63% of the days have persistent winds out of the southwest. This is not unexpected given the fact that the NO_2 sites were deliberately located to the north and east of major expressways and interchanges, which are major sources of nitrogen oxide emissions. Moreover, high NO_2 levels coincident with southwest winds confirm the importance of pollution transport into Connecticut from the southwest.

Trends - The weighted average of the annual NO_2 concentrations at the three monitoring sites is illustrated in Figure 5-2. The year-to-year trend appears to be down through 1987, up in 1988 and down until 1991, when levels rose again.

Given the importance of meteorology -- sunlight, in general, and southwest winds in Connecticut, in particular -- on the formation of NO_2, a trend might best be illustrated by the averaging of data over multiple years. As was the case with ozone, a trend based on multiple years of data should diminish the effect of meteorology and, thereby, reveal the effect of nitrogen oxide and hydrocarbon emission controls on ambient concentrations of NO_2. Figure 5-3 shows that the 3-year average NO_2 concentration, unlinked from meteorology, has been trending downward over the past seven years.

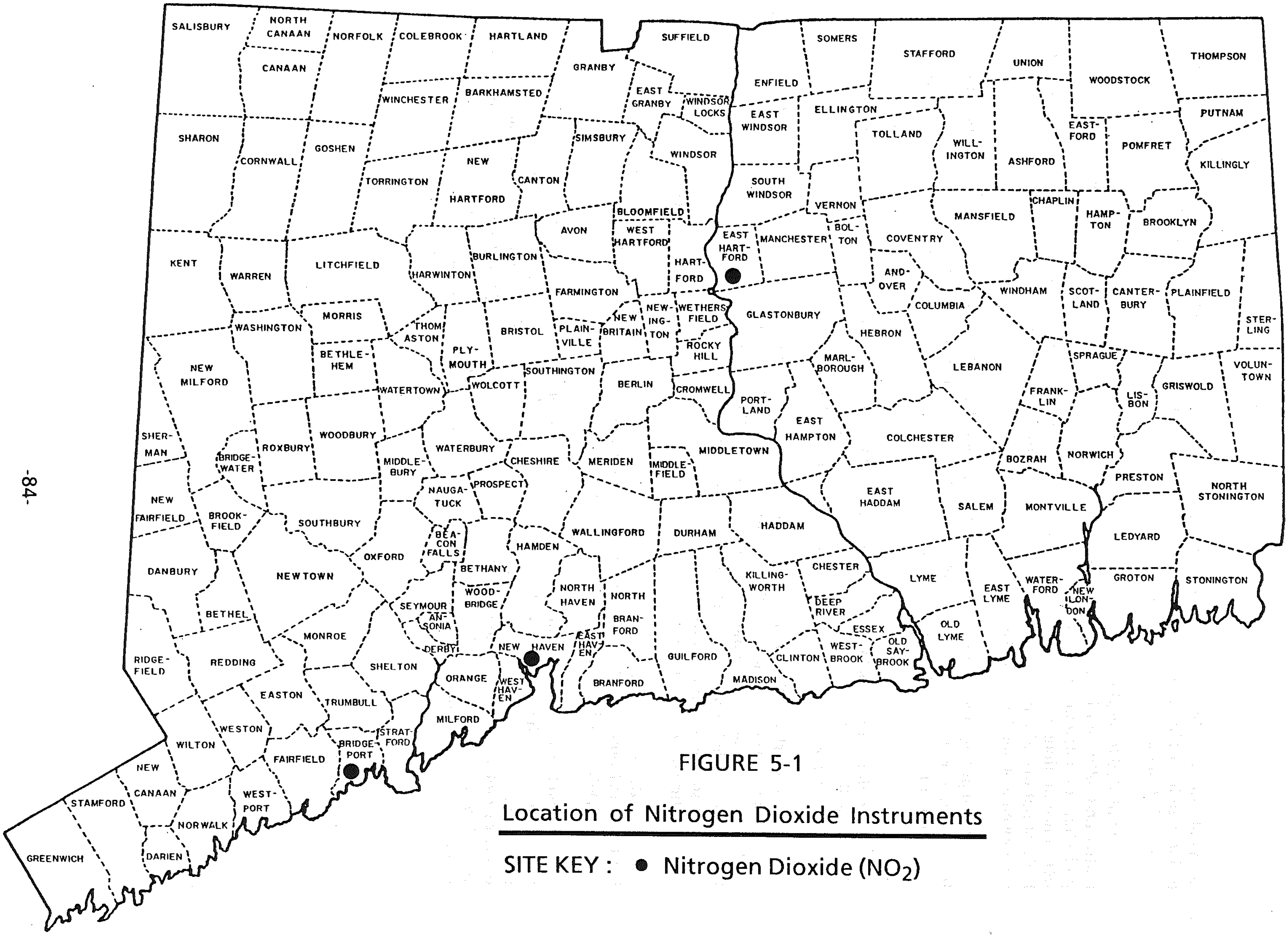


FIGURE 5-1

Location of Nitrogen Dioxide Instruments

SITE KEY : ● Nitrogen Dioxide (NO_2)

TABLE 5-1

1989 -1991 NITROGEN DIOXIDE ANNUAL AVERAGES

Town Name	Site	Year	Samples	Arithmetic Mean	95-Percent-Limits Lower	95-Percent-Limits Upper	Standard Deviation
Bridgeport	013	1989	7886	48.10	47.92	48.28	25.58
Bridgeport	013	1990	8137	47.97	47.82	48.12	25.98
Bridgeport	013	1991	8500	46.72	46.63	46.82	24.88
East Hartford	003	1989	8038	38.33	38.20	38.47	21.79
East Hartford	003	1990	8287	35.92	35.81	36.03	21.71
East Hartford	003	1991	7541	38.21	38.03	38.40	21.75
New Haven	123	1989	8221	53.54	53.41	53.66	23.85
New Haven	123	1990	8343	50.73	50.61	50.84	24.42
New Haven	123	1991	8575	51.98	51.91	52.06	25.06

N.B. The arithmetic mean and standard deviation have units of $\mu g/m^3$.

TABLE 5-2

1991 TEN HIGHEST 1-HOUR AVERAGE NO2 DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
BRIDGEPORT-013 (8500)	NO2	.089	.089	.087	.085	.085	.082	.082	.080	.078	.075
	DATE	2/ 5/91	7/19/91	6/28/91	5/24/91	7/18/91	11/19/91	1/15/91	6/27/91	5/13/91	3/ 1/91
METEOROLOGICAL SITE	DIR (DEG)	250	250	260	240	260	230	140	250	230	150
NEWARK	VEL (MPH)	5.7	1.2	9.2	9.1	8.7	5.4	.8	8.6	4.8	4.0
	SPD (MPH)	7.6	9.5	11.1	10.1	10.5	7.2	3.3	10.4	7.9	4.5
	RATIO	0.747	0.132	0.830	0.904	0.830	0.757	0.249	0.829	0.613	0.892
METEOROLOGICAL SITE	DIR (DEG)	270	200	240	200	260	170	200	230	180	190
BRADLEY	VEL (MPH)	2.7	5.5	7.1	8.5	3.8	4.7	1.2	4.4	6.0	6.9
	SPD (MPH)	5.3	7.5	9.6	10.5	5.0	7.3	2.9	7.2	8.2	7.2
	RATIO	0.501	0.734	0.740	0.808	0.759	0.636	0.420	0.610	0.730	0.962
METEOROLOGICAL SITE	DIR (DEG)	240	240	270	250	240	260	90	260	130	170
BRIDGEPORT	VEL (MPH)	5.2	4.6	7.2	6.3	5.7	6.6	3.0	6.7	2.7	2.4
	SPD (MPH)	5.5	4.7	7.3	6.5	6.0	7.0	3.6	6.9	3.9	3.5
	RATIO	0.950	0.969	0.983	0.977	0.944	0.943	0.823	0.975	0.703	0.698
METEOROLOGICAL SITE	DIR (DEG)	280	240	270	260	270	270	250	290	250	240
WORCESTER	VEL (MPH)	7.3	5.0	11.1	9.0	7.6	9.6	3.8	8.2	6.8	8.0
	SPD (MPH)	7.6	5.6	11.4	9.3	8.1	9.9	4.5	8.6	7.5	8.2
	RATIO	0.953	0.889	0.980	0.968	0.940	0.967	0.847	0.952	0.916	0.980
EAST HARTFORD-003 (7541)	NO2	.075	.074	.074	.071	.067	.061	.060	.060	.060	.059
	DATE	7/19/91	11/19/91	8/28/91	7/18/91	7/20/91	2/ 4/91	4/ 7/91	2/ 5/91	11/20/91	1/29/91
METEOROLOGICAL SITE	DIR (DEG)	250	230	260	260	270	270	240	250	240	130
NEWARK	VEL (MPH)	1.2	5.4	6.9	8.7	5.4	4.6	10.0	5.7	10.6	2.7
	SPD (MPH)	9.5	7.2	8.6	10.5	8.1	7.0	11.4	7.6	11.9	4.3
	RATIO	0.132	0.757	0.800	0.830	0.676	0.658	0.883	0.747	0.891	0.625
METEOROLOGICAL SITE	DIR (DEG)	200	170	270	260	280	260	240	270	180	160
BRADLEY	VEL (MPH)	5.5	4.7	4.1	3.8	4.9	6.6	6.3	2.7	8.7	1.4
	SPD (MPH)	7.5	7.3	6.0	5.0	6.0	9.5	9.1	5.3	9.6	5.2
	RATIO	0.734	0.636	0.686	0.759	0.808	0.697	0.693	0.501	0.903	0.263
METEOROLOGICAL SITE	DIR (DEG)	240	260	250	240	250	240	270	240	240	180
BRIDGEPORT	VEL (MPH)	4.6	6.6	5.0	5.7	4.6	5.1	8.3	5.2	9.0	2.6
	SPD (MPH)	4.7	7.0	5.2	6.0	4.6	5.2	8.3	5.5	9.1	3.9
	RATIO	0.969	0.943	0.961	0.944	0.990	0.987	0.998	0.950	0.992	0.661
METEOROLOGICAL SITE	DIR (DEG)	240	270	280	270	290	270	260	280	240	250
WORCESTER	VEL (MPH)	5.0	9.6	8.4	7.6	6.8	6.2	9.3	7.3	9.7	4.4
	SPD (MPH)	5.6	9.9	8.6	8.1	6.9	6.3	9.6	7.6	9.9	5.3
	RATIO	0.889	0.967	0.979	0.940	0.984	0.982	0.968	0.953	0.973	0.830
NEW HAVEN-123 (8576)	NO2	.114	.099	.096	.085	.085	.084	.081	.080	.080	.080
	DATE	6/28/91	7/18/91	5/16/91	6/10/91	8/ 2/91	1/15/91	7/19/91	4/ 6/91	7/20/91	8/16/91
METEOROLOGICAL SITE	DIR (DEG)	260	260	230	260	270	140	250	240	270	280
NEWARK	VEL (MPH)	9.2	8.7	7.5	7.2	6.7	.8	1.2	4.7	5.4	5.6
	SPD (MPH)	11.1	10.5	8.9	8.1	9.6	3.3	9.5	6.2	8.1	7.5
	RATIO	0.830	0.830	0.844	0.895	0.697	0.249	0.132	0.756	0.676	0.746
METEOROLOGICAL SITE	DIR (DEG)	240	260	210	230	280	200	200	240	280	260
BRADLEY	VEL (MPH)	7.1	3.8	7.4	5.4	8.3	1.2	5.5	3.7	4.9	4.9
	SPD (MPH)	9.6	5.0	9.1	9.5	9.9	2.9	7.5	6.6	6.0	7.6
	RATIO	0.740	0.759	0.821	0.564	0.836	0.420	0.734	0.559	0.808	0.638

TABLE 5-2, CONTINUED

1991 TEN HIGHEST 1-HOUR AVERAGE NO2 DAYS WITH WIND DATA

UNITS : PARTS PER MILLION

TOWN-SITE (SAMPLES)	RANK	1	2	3	4	5	6	7	8	9	10
METEOROLOGICAL SITE	DIR (DEG)	270	240	240	240	260	90	240	240	250	260
BRIDGEPORT	VEL (MPH)	7.2	5.7	4.2	4.5	5.6	3.0	4.6	5.0	4.6	5.8
	SPD (MPH)	7.3	6.0	4.5	4.6	5.8	3.6	4.7	5.2	4.6	6.3
	RATIO	0.983	0.944	0.934	0.975	0.978	0.823	0.969	0.975	0.990	0.913
METEOROLOGICAL SITE	DIR (DEG)	270	270	250	270	280	250	240	280	290	280
WORCESTER	VEL (MPH)	11.1	7.6	6.4	7.0	5.9	3.8	5.0	7.3	6.8	8.2
	SPD (MPH)	11.4	8.1	7.2	7.2	6.5	4.5	5.6	7.8	6.9	8.5
	RATIO	0.980	0.940	0.894	0.979	0.918	0.847	0.889	0.944	0.984	0.969

FIGURE 5-2

AVERAGES OF THE ANNUAL NO_2 CONCENTRATIONS AT THREE SITES

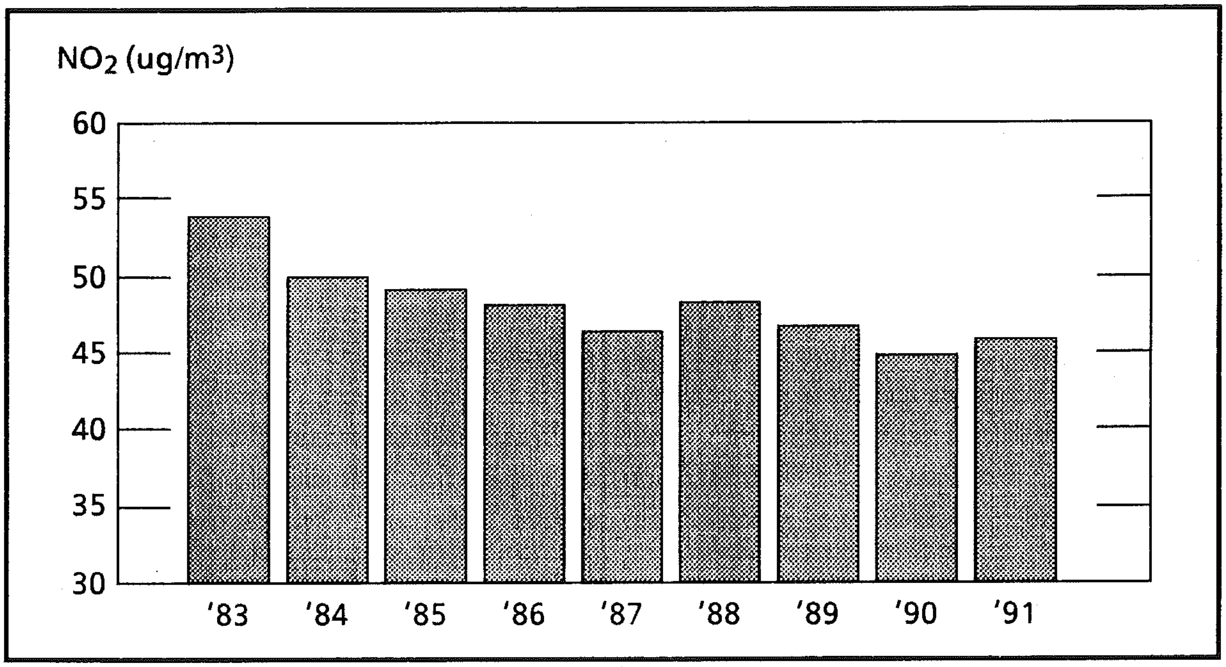
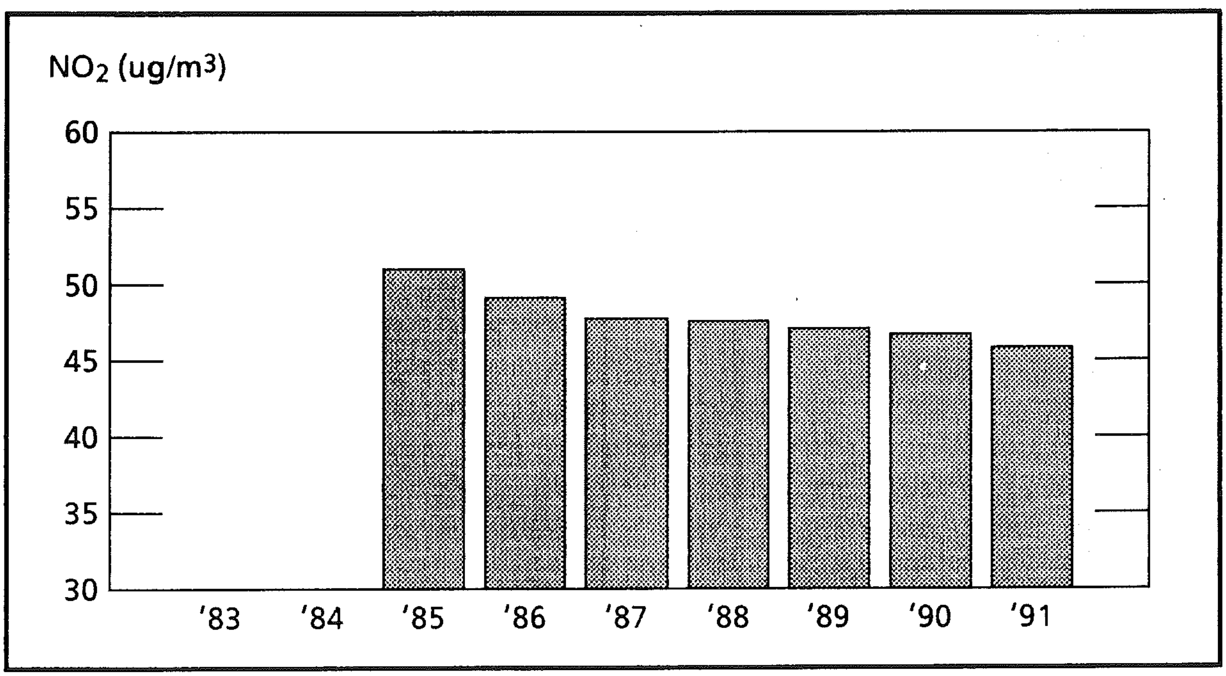


FIGURE 5-3

3-YEAR AVERAGES OF THE ANNUAL NO_2 CONCENTRATIONS AT THREE SITES



VI. CARBON MONOXIDE

HEALTH EFFECTS

Carbon monoxide (CO) is a colorless, odorless, poison gas formed when carbon-containing fuel is not burned completely. It is by far the most plentiful air pollutant. Fortunately, this deadly gas does not persist in the atmosphere. It is apparently converted by natural processes to carbon dioxide in ways not yet understood, and this is done quickly enough to prevent any general buildup. However, CO can reach dangerous levels in local areas, such as city-street canyons with heavy auto traffic and little wind.

Clinical experience with accidental CO poisoning has shown clearly how it affects the body. When the gas is breathed, CO replaces oxygen in the red blood cells, reducing the amount of oxygen that can reach the body cells and maintain life. Lack of oxygen affects the brain, and the first symptoms are impaired perception and thinking. Reflexes are slowed, judgement weakened, and drowsiness ensues. An auto driver breathing high levels of CO is more likely to have an accident; an athlete's performance and skill drop suddenly. Lack of oxygen then affects the heart. Death can come from heart failure or general asphyxiation if a person is exposed to very high levels of CO.

CONCLUSIONS

The one-hour National Ambient Air Quality Standard of 35 parts per million (ppm) was not exceeded at any of the five carbon monoxide monitoring sites in Connecticut during 1991. There was one exceedance of the 9 ppm eight-hour standard in 1991 and it occurred at the Hartford 017 site.

In order to put the monitoring data into proper perspective, it must be realized that carbon monoxide concentrations vary greatly from place-to-place. More than 95% of the CO emissions in Connecticut come from motor vehicles. Therefore, concentrations are greatest in areas of traffic congestion. The magnitude and frequency of high concentrations observed at any monitoring site are not necessarily indicative of widespread CO levels. In fact, 4 of the 5 CO monitors in Connecticut are sited specifically to measure CO levels from high traffic areas. The fifth monitor (Hartford 013) is located in a populated area and represents background levels of a neighborhood scale.

As Connecticut's SIP control strategies are implemented, there should continue to be a decrease in the number of areas with traffic congestion. Also, as federal and state mandated controls which reduce emissions from new motor vehicles are implemented, a reduction in ambient CO levels should be achieved.

Unlike SO_2, particulate matter, and O_3, elevated CO levels are not often associated with southwesterly winds, indicating that this pollutant is more of a local-scale, rather than a regional-scale, problem. Moreover, high CO levels tend to occur during the colder months when there are low atmospheric mixing heights, stable conditions and high CO auto emissions due to cold engine operation. Stable conditions, which are characterized by cold temperatures at the surface and warm temperatures aloft, discourage surface mixing and result in calm surface conditions. With little or no surface winds, CO emissions can accumulate to unhealthy levels.

METHOD OF MEASUREMENT

The DEP Air Monitoring Unit uses instruments employing a non-dispersive infrared technique to continuously measure carbon monoxide levels. The instantaneous concentrations are electronically recorded at the site, averaged for each hour, and stored for transmission to the central computer in Hartford. Due to the relative inertness of CO, a long sampling line can be used without the danger of CO being depleted by chemical reactions within the lines. The most important consideration in the measurement of CO is the placement of the sampling probe inlet -- that is, its proximity to traffic lanes.

DISCUSSION OF DATA

Monitoring Network - The network in 1991 consisted of five carbon monoxide monitors: Bridgeport 004, Hartford 013, Hartford 017, New Haven 019, and Stamford 020. They are all located in urban areas. All the sites are also located west of the Connecticut River, with three of them in coastal towns (see Figure 6-1).

Precision and Accuracy - The carbon monoxide monitors had a total of 240 precision checks during 1991. The resulting 95% probability limits were -2% to +6%. Accuracy is determined by introducing a known amount of CO into each of the monitors. Five audits for accuracy were conducted on the monitoring network in 1991. Three different concentration levels were tested on each monitor: low, medium and high. The 95% probability limits ranged from -2% to +4% for the low level test; 0% to +2% for the medium level test; and -12% to +8% for the high level test.

8-Hour and 1-Hour Averages - An 8-hour concentration is said to exceed the standard of 9 ppm if it is equal to or greater than 9.5 ppm. Hartford 017 had one exceedance of the 8-hour CO standard, which means that the standard was not violated in Connecticut in 1991 (see Table 6-1).

Regarding the maximum 8-hour running average at each site, there were decreases from 1990 to 1991 at Bridgeport 004, New Haven 019 and Stamford 020, and there were increases at Hartford 013 and Hartford 017. The second highest 8-hour running average increased from 1990 to 1991 at Bridgeport 004 and Hartford 017, and decreased at Hartford 013 and New Haven 019. There was no change at Stamford 020.

As for 1-hour averages, no site in the state recorded a value exceeding the primary 1-hour standard of 35 ppm. Bridgeport 004, Hartford 013, Hartford 017 and Stamford 020 recorded maximum 1-hour values that were higher than the year before, while New Haven 019 had a lower value. Second high 1-hour values were likewise higher in 1991 at all the sites except New Haven 019.

The maximum and second high CO concentrations at each site are presented in Table 6-1. Table 6-2 presents monthly highs and a monthly tally of the number of times the standards were exceeded at each site. Seasonal variations in CO levels can be observed using this table.

Trends - Due to the local nature of CO emissions, it is not appropriate to give an estimate of widespread CO trends. However, local CO trends can be addressed in a number of ways. Exceedances of the 8-hour standard can be tracked in order to determine if a CO problem is worsening or abating at a site. This is illustrated in Table 6-3 and in Figure 6-2. One can see that over the past five years the Hartford-017 site has shown a higher frequency of exceedances relative to the other sites, with a downward trend since 1988. No exceedances are evident at any of the other sites during this period. For this reason, only Hartford 017 in included in Figure 6-2.

Another way of illustrating local CO trends is to use running averages. Running averages have the advantage of smoothing out the abrupt, transitory changes in pollutant levels that are often evident in consecutive sampling periods and from one season to the next. Figure 6-3 shows the 36-month running averages of the hourly CO concentrations at each monitoring site. CO levels have flattened out at Bridgeport 004. At Stamford 020 concentrations are edging up after trending down for some years. CO concentrations clearly continue to fall at Hartford 017, while they are rising at Hartford 013 and New Haven 019.

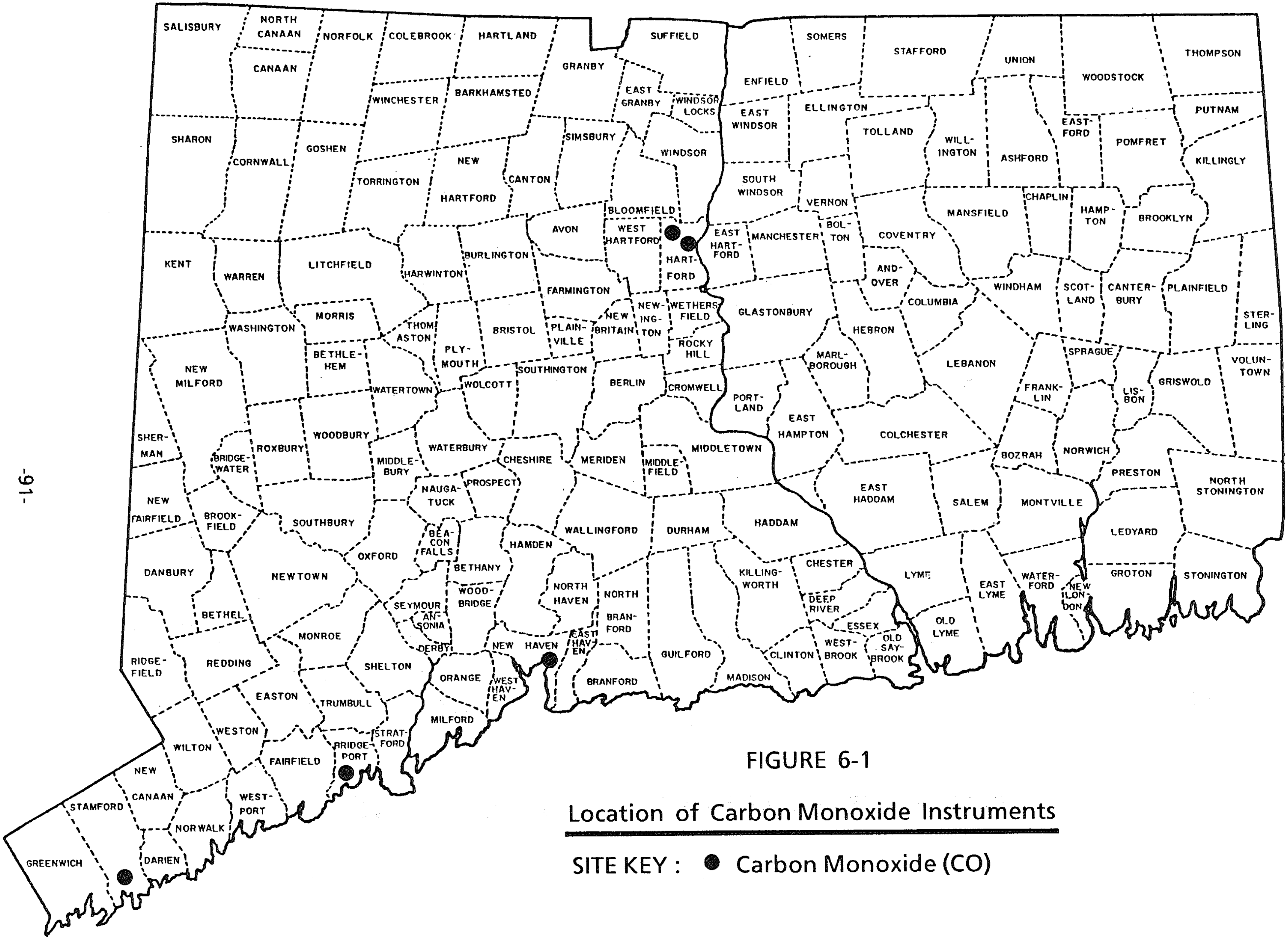


FIGURE 6-1

Location of Carbon Monoxide Instruments

SITE KEY : ● Carbon Monoxide (CO)

TABLE 6-1

1991 CARBON MONOXIDE STANDARDS ASSESSMENT SUMMARY

TOWN-SITE	MAXIMUM 8-HOUR RUNNING AVERAGE	TIME OF MAXIMUM 8-HOUR RUNNING AVERAGE[1]	2ND HIGH 8-HOUR RUNNING AVERAGE	TIME OF 2ND HIGH 8-HOUR RUNNING AVERAGE[1]	MAXIMUM 1-HOUR AVERAGE	TIME OF MAXIMUM 1-HOUR AVERAGE[2]	2ND HIGH 1-HOUR AVERAGE	TIME OF MAXIMUM 1-HOUR AVERAGE[2]
Bridgeport-004	5.9	12/29/01	5.5	02/05/13	14.4	01/16/18	9.7	01/29/18
Hartford-013	6.2	01/16/02	4.0	11/06/02	7.8	01/15/22	7.1	01/15/23
Hartford-017	12.2	01/15/24	8.9	02/14/20	20.6	01/15/18	19.0	01/15/17
New Haven-019	6.5	02/19/23	6.2	02/05/01	10.8	02/04/19	9.7	02/04/20
Stamford-020	6.3	01/16/24	6.0	01/29/01	15.7	01/16/18	11.9	01/28/19

[1] The time of the 8-hour average is reported as follows: month/day/hour (EST), specifying the end of the 8-hour period.
[2] The time of the 1-hour average is reported as follows: month/day/hour (EST), specifying the end of the 1-hour period.

N.B. The CO averages are expressed in terms of parts per million (ppm).

TABLE 6-2

1991 CARBON MONOXIDE SEASONAL FEATURES

TOWN-SITE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bridgeport-004	Max. 1-Hour	14.4	9.5	4.8	3.9	3.0	2.3	3.1	3.6	2.8	4.6	9.7	7.7
	Max. Running 8-Hour	5.1	5.5	3.1	2.5	2.2	2.1	2.5	2.4	2.0	3.2	4.3	5.9
	No. of 8-Hour Exceedances	0	0	0	0	0	0	0	0	0	0	0	0
Hartford-013	Max. 1-Hour	7.8	4.6	2.6	2.8	2.3	1.9	2.0	2.8	3.2	4.1	4.8	5.1
	Max. Running 8-Hour	6.2	3.3	2.0	1.9	1.7	1.4	1.6	2.0	2.4	3.0	4.0	3.7
	No. of 8-Hour Exceedances	0	0	0	0	0	0	0	0	0	0	0	0
Hartford-017	Max. 1-Hour	20.6	15.3	7.9	6.7	5.9	5.8	6.5	6.4	6.0	7.8	7.0	9.2
	Max. Running 8-Hour	12.2	8.9	5.5	4.4	4.3	4.0	4.3	3.9	3.6	5.8	5.6	5.6
	No. of 8-Hour Exceedances	1	0	0	0	0	0	0	0	0	0	0	0
New Haven-019	Max. 1-Hour	9.2	10.8	4.9	8.3	6.2	5.2	4.4	6.4	4.4	6.2	7.3	7.8
	Max. Running 8-Hour	5.6	6.5	3.3	4.3	3.3	3.8	3.1	3.6	3.6	5.2	5.1	5.8
	No. of 8-Hour Exceedances	0	0	0	0	0	0	0	0	0	0	0	0
Stamford-020	Max. 1-Hour	15.7	10.8	6.9	5.1	4.2	3.5	4.4	5.4	4.7	8.3	7.6	7.6
	Max. Running 8-Hour	6.3	5.9	3.4	2.9	3.1	2.8	2.7	3.4	3.3	3.8	5.3	5.5
	No. of 8-Hour Exceedances	0	0	0	0	0	0	0	0	0	0	0	0

N.B. The CO concentrations are in terms of parts per million (ppm).

TABLE 6-3

EXCEEDANCES OF THE 8-HOUR CO STANDARD FOR 1987 -1991

SITE	1987	1988	1989	1990	1991
Bridgeport-004	0	0	0	0	0
Hartford-013	0[a]	0	0	0[b]	0
Hartford-017	8	3	1	0	1
New Haven-019	0	0	0	0	0
Stamford-020	0	0	0	0	0

[a] Data are missing for January and February.
[b] Data are missing for April through most of October due to road construction.

FIGURE 6-2

EXCEEDANCES OF THE 8-HOUR CO STANDARD FOR 1987-1991

SITE: HARTFORD-017

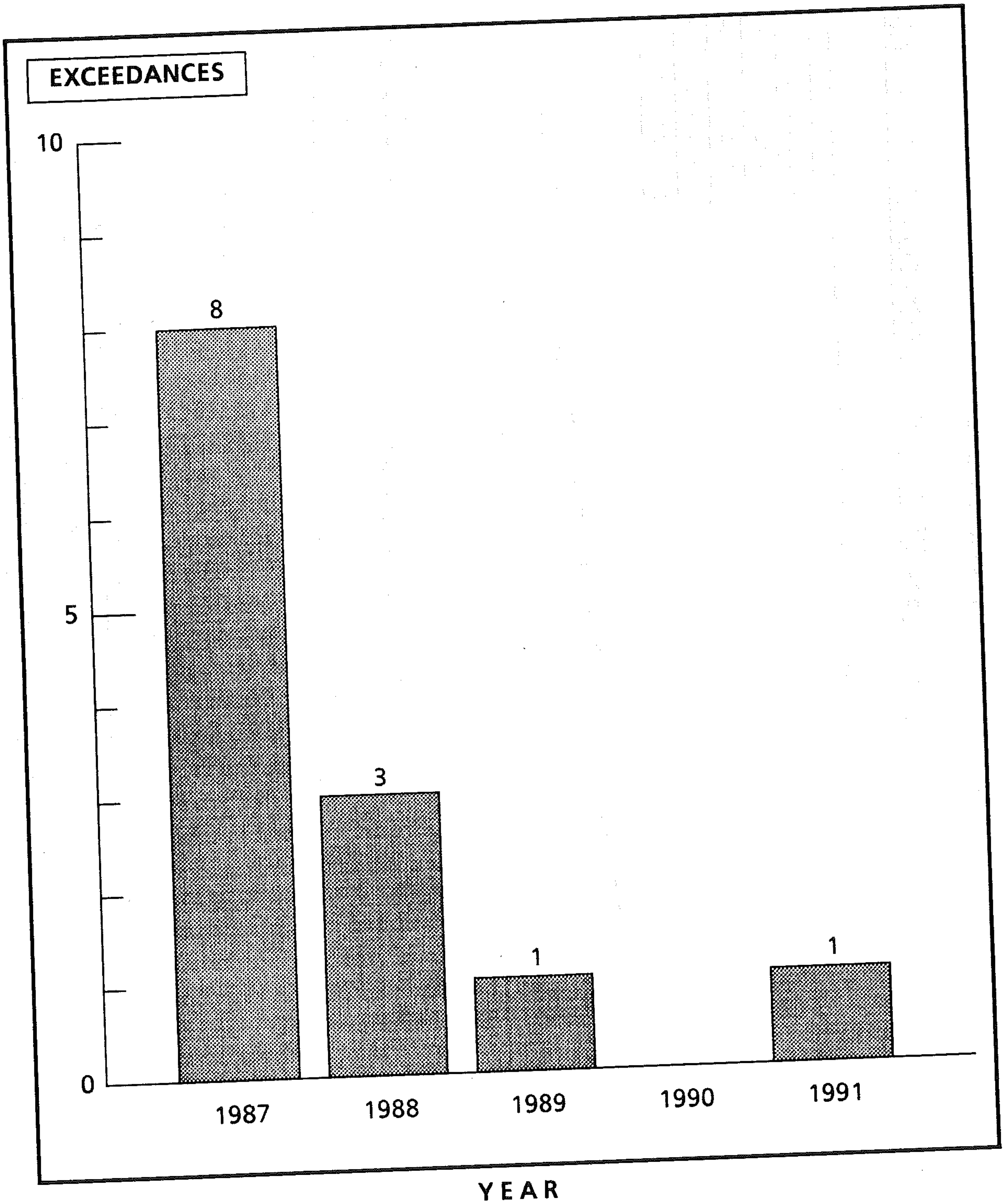
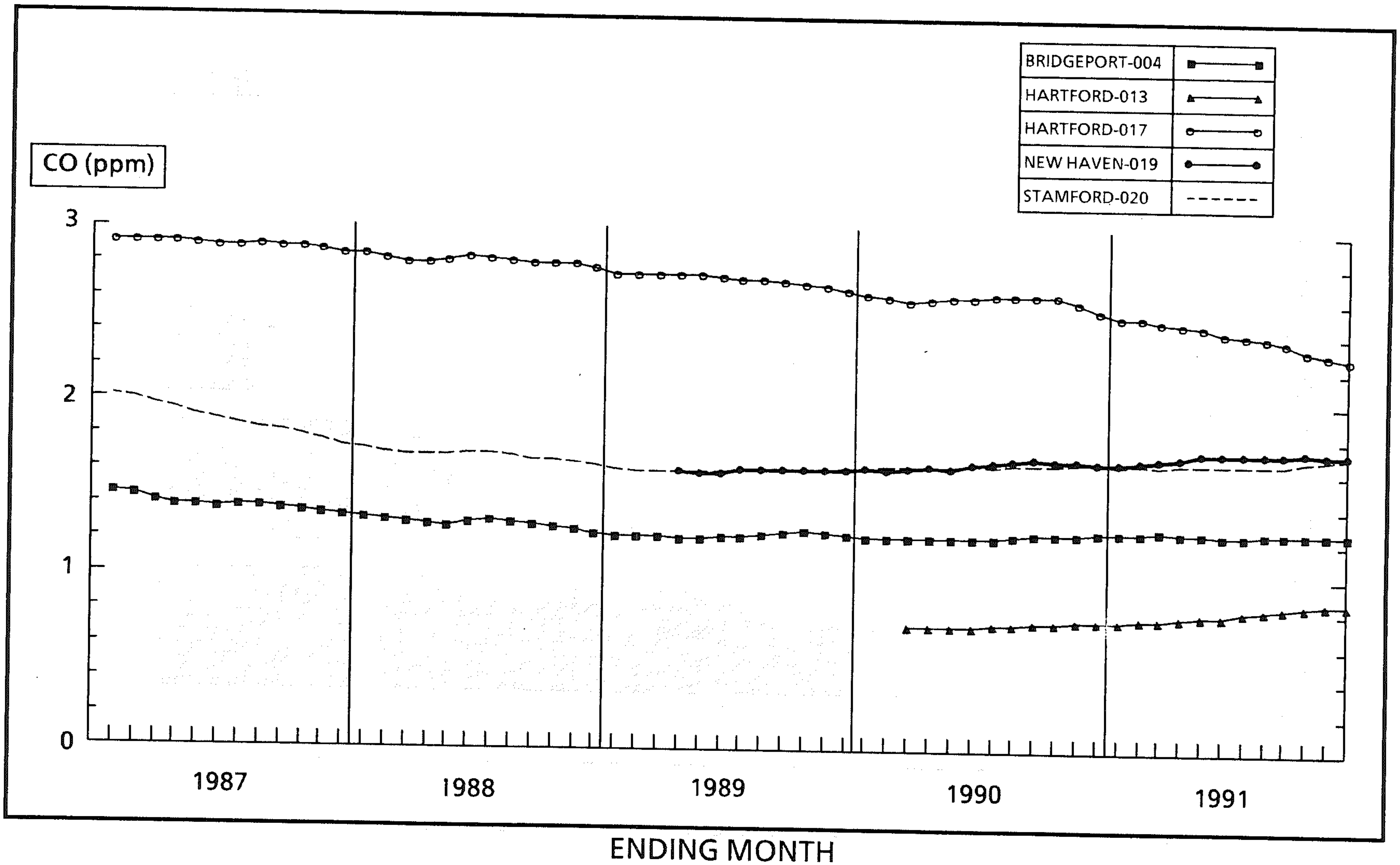


FIGURE 6-3

36-MONTH RUNNING AVERAGES OF THE HOURLY CO CONCENTRATIONS



VII. LEAD

HEALTH EFFECTS

Lead (Pb) is a soft, dull gray, odorless and tasteless heavy metal. It is a ubiquitous element that is widely distributed in small amounts, particularly in soil and in all living things. Although the metallic form of lead is reactive and rarely occurs in nature, lead is prevalent in the environment in the form of various inorganic compounds, and occasional concentrated deposits of lead compounds occur in the earth's crust.

The presence of lead in the atmosphere is primarily accounted for by the emissions of lead compounds from man-made processes, such as the extraction and processing of metallic ores, the incineration of solid wastes, and the operation of motor vehicles. Nationally, in 1991, these source categories contributed 43%, 14% and 33%, respectively, of the atmospheric lead. The motor vehicle contribution, while still a large source of airborne lead emissions, has decreased significantly over the years and, since 1988, is no longer the largest source of nationwide airborne lead emissions. These emissions are in the form of fine-to-course particulate matter and are comprised of lead sulfate, ammonium lead halides, and lead halides, of which the chief component is lead bromochloride. The halide compounds appear to undergo chemical changes over a period of hours and are converted to lead carbonate, oxide and oxycarbonate.

The most important sources of lead in humans and other animals are ingestion of foods and beverages, inhalation of airborne lead, and the eating of non-food substances. From the standpoint of the general population, the intake of lead into the body is primarily through ingestion. The airborne lead settles out on crops and water supplies and is then ingested by the general population. The direct intake of lead from the ambient air is relatively small.

Overexposure to lead in the United States is primarily a problem in children. Age, pica, diet, nutritional status, and multiple sources of exposure serve to increase the risk of lead poisoning in children. This is especially true in the inner cities where the prevalence of lead poisoning is greatest. Overexposure to lead compounds may result in undesirable biologic effects. These effects range from reversible clinical or metabolic symptoms, which disappear after cessation of exposure, to permanent damage or death from a single extreme dose or prolonged overexposure. Clinical lead poisoning is accompanied by symptoms of intestinal cramps, peripheral nerve paralysis, anemia, and severe fatigue. Very severe exposure results in permanent neurological, renal, or cardiovascular damage or death.

CONCLUSIONS

The Connecticut primary and secondary ambient air quality standard for lead and its compounds was not exceeded at any site in Connecticut during 1991.

The monitoring sites where the lead levels were highest were generally in urban locations with moderate to heavy traffic. In Connecticut, this is due to the fact that the primary source of lead to the atmosphere is the combustion of gasoline, which still contains trace amounts of lead.

SAMPLE COLLECTION AND ANALYSIS

The Air Monitoring Unit used hi-vol samplers in 1991 to obtain ambient concentrations of lead. These samplers are used to collect particulate matter onto fiberglass filters. The particulate matter collected on the filters is subsequently analyzed for its chemical composition. Wet chemistry techniques are used to separate the particulate matter into various components. The lead content of the particulate matter is determined using an atomic absorption spectrophotometer.

Unlike hi-vol particulate samples which are analyzed separately, the hi-vol lead sample is a composite of all the individual samples obtained at a site in a single month. That is, a cutting is taken from each filter during the month, and these cuttings are collectively chemically analyzed for lead.

DISCUSSION OF DATA

Monitoring Network - In 1991, only hi-vol samplers were operated in Connecticut to monitor lead levels (see Figure 7-1). There were 5 such samplers operated throughout the state by the DEP in areas with populations of 200,000 or more: Bridgeport, East Hartford, Hartford, New Haven and Waterbury. The samplers are situated near some of the busiest city streets and highways in order to monitor "worst-case" lead concentrations.

Much of the lead monitoring network was dismantled in 1988 due to the changeover from hi-vol to PM_{10} monitoring in the particulate matter network. By the end of that year, all but two of the hi-vol lead samplers were terminated: Hartford 013 and New Haven 013. By the end of 1989, the two remaining hi-vol samplers were terminated and only lo-vol samplers were in use.

In 1991, the lo-vols were replaced by hi-vols. The primary reason for this has to do with data losses resulting from instrument problems or failures. With a lo-vol, an entire month of data is invalidated because lo-vols operate continuously for a month. In the case of a hi-vol, instrument problems or failures result in the loss of only a single 24-hour sample.

Precision and Accuracy - Due to the very low airborne lead concentrations, precision checks yield 95% probability limits that are too low to calculate. Accuracy for lead can be assessed in two ways. One is by auditing the air flow through the monitors. No audits for flow accuracy were conducted on the monitoring network in 1991. Accuracy can also be defined as the accuracy of the analysis method. This is determined by the chemical analysis of known lead samples. On this basis, 15 audits were performed on the network. Two different concentration levels were tested: high and low. The 95% probability limits for the low level ranged from -9% to +9%; those for the high level ranged from -10% to +7%.

NAAQS - Connecticut's ambient air quality standard for lead and its compounds, measured as elemental lead, is: 1.5 micrograms per cubic meter ($\mu g/m^3$), maximum arithmetic mean averaged over three consecutive calendar months. This standard was enacted on November 2, 1981. Previously, Connecticut's lead standard was substantially identical to the national standard: 1.5 $\mu g/m^3$ for a calendar quarter-year average. The change to a 3-month running average means that a more stringent standard applies in Connecticut, since there are three times as many data blocks within a calendar year which must be below the limiting concentration of 1.5 $\mu g/m^3$.

3-Month Running Averages - Three-month running average lead concentrations for 1991 are given in Table 7-1. All are significantly below the primary and secondary standard of 1.5 $\mu g/m^3$.

Trends - A downward trend in measured concentrations of lead has been observed since 1977. This is due to the increasing use of unleaded gasoline. Figure 7-2 shows that the decrease in statewide ambient average lead concentrations has been commensurate with a decrease in lead emissions from gasoline combustion from 1982 to 1989. In fact, this relationship is so close it has a correlation coefficient of 0.987 (see Figure 7-3). Reliable data on the sales of leaded gasoline in Connecticut are no longer available; so lead emissions will no longer be updated in Figure 7-2. And Figure 7-3 will contain only pre-1990 data.

The downward trend in airborne lead concentrations can be expected to level off at some point in the near future, when the use of leaded gasoline is finally phased out or minimized. Lead emissions will then rise and fall with the number of vehicle miles travelled (VMT's) by the population. This is due to the fact that so-called unleaded gasoline still contains a small proportion of lead.

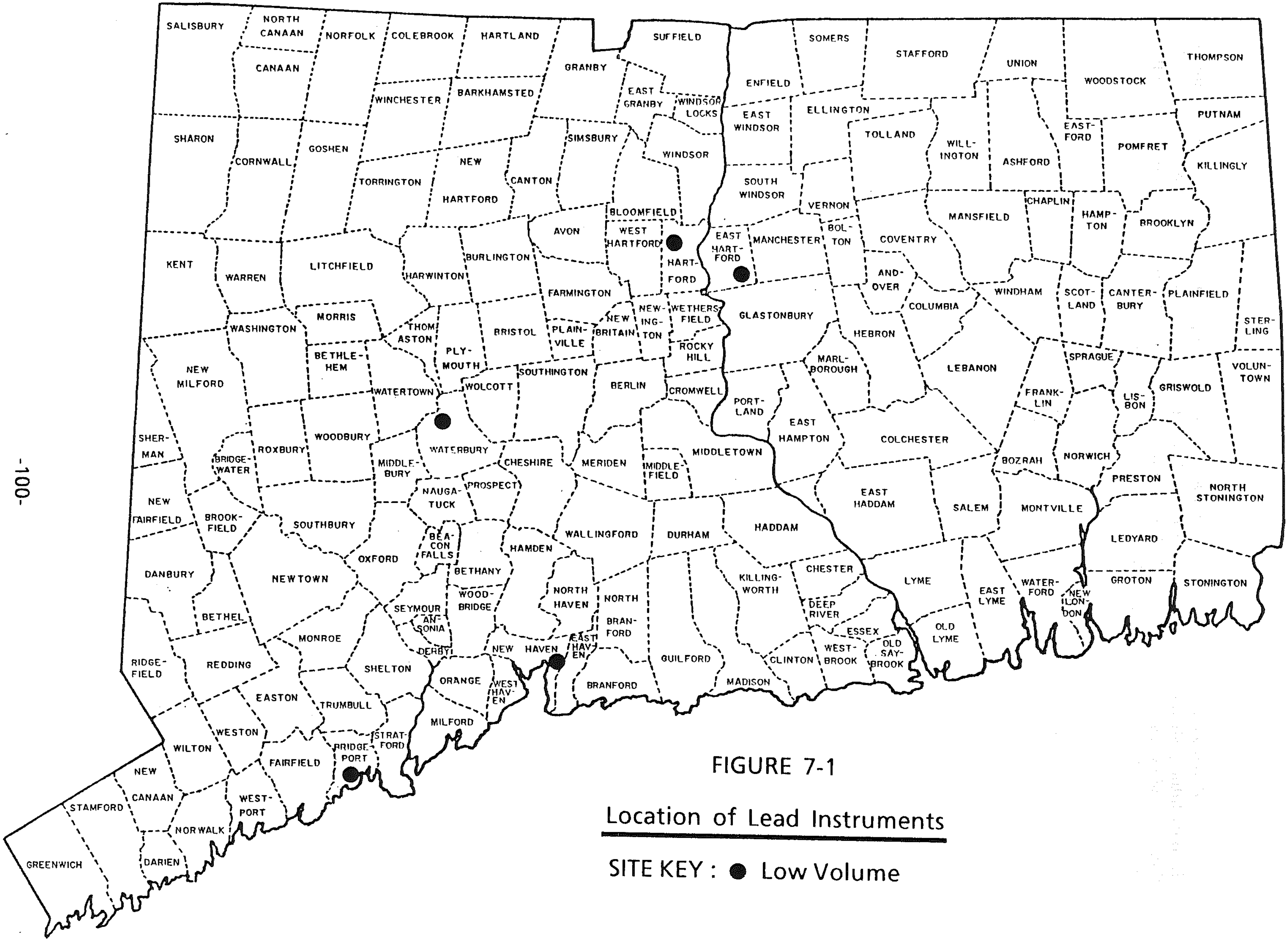


FIGURE 7-1

Location of Lead Instruments

SITE KEY : ● Low Volume

TABLE 7-1

1991 3-MONTH RUNNING AVERAGE LEAD CONCENTRATIONS[a]

TOWN-SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bridgeport-010	------	------	0.016	0.016	0.013	0.016	0.012	0.016	0.013	0.016	0.017	0.017
East Hartford-004	------	------	0.014	0.021	0.032	0.040	0.037	0.025	------	------	------	0.010
Hartford-016	------	------	0.017	0.030	0.026	0.023	0.013	0.017	0.020	0.023	0.023	0.023
New Haven-018	------	------	0.048	0.072	0.069	0.081	0.070	0.080	0.067	0.063	0.062	0.065
Waterbury-123[b]	------	------	0.020	0.023	0.032	0.087	0.196	0.518	0.627	0.563	0.257	0.120

a The lead concentrations are in terms of micrograms per cubic meter ($\mu g/m^3$).
b High concentrations of lead were measured during the last six months of the year due to restoration work on a local bridge.

N.B. Dashes indicate insufficient data for a 3-month average.

FIGURE 7-2

STATEWIDE ANNUAL LEAD EMISSIONS FROM GASOLINE AND STATEWIDE ANNUAL AVERAGE LEAD CONCENTRATIONS

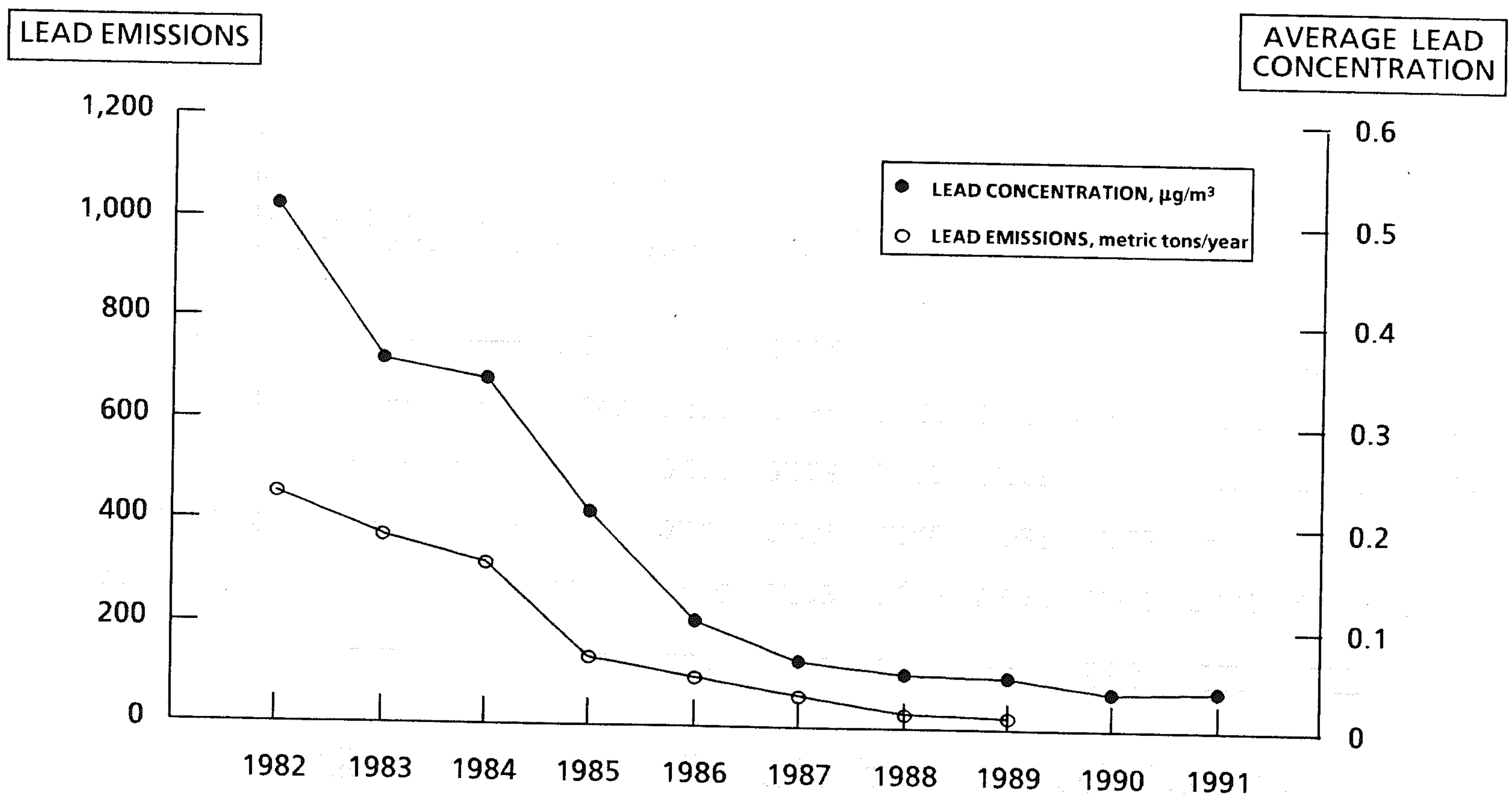
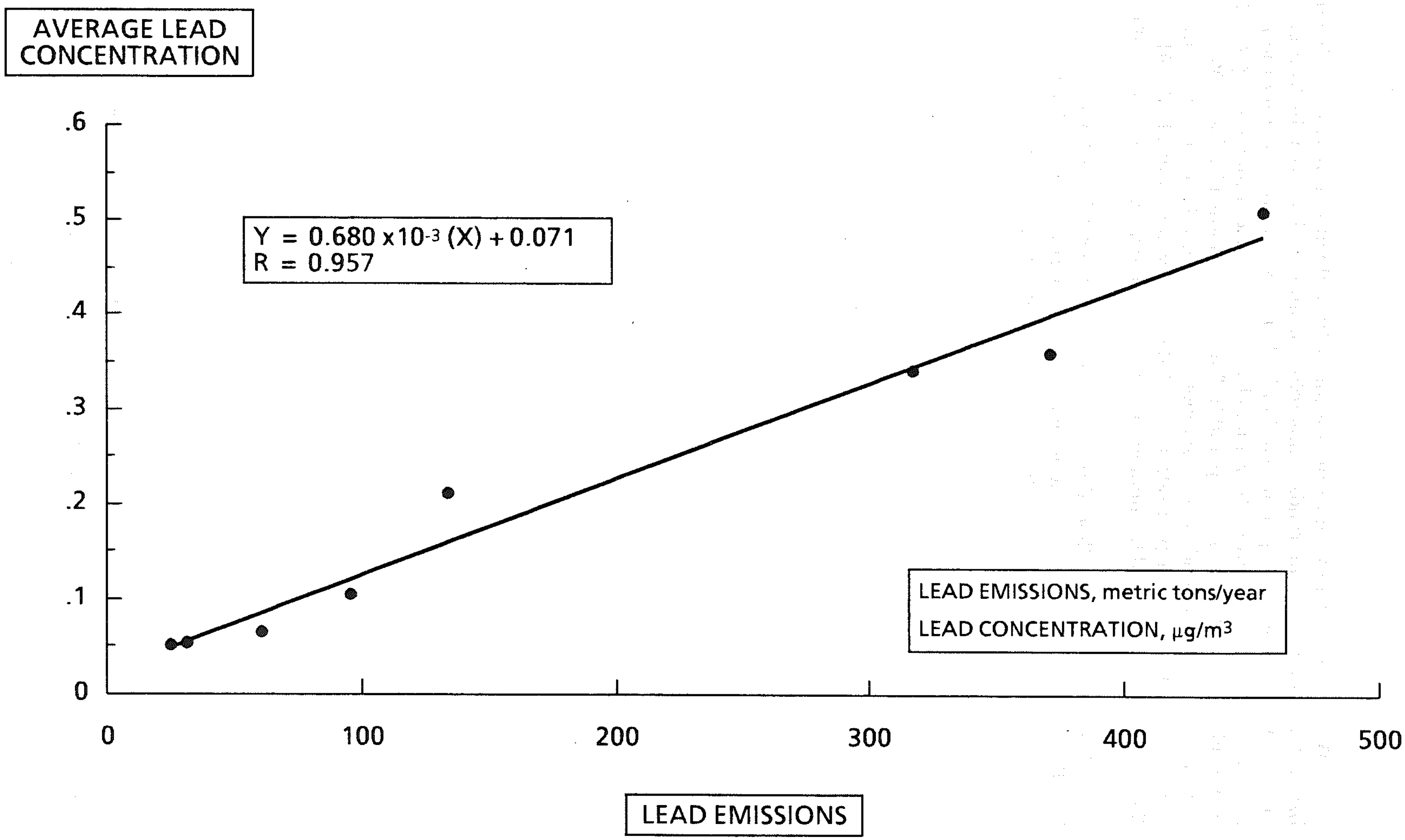


FIGURE 7-3

STATEWIDE ANNUAL AVERAGE LEAD CONCENTRATIONS

VS.

STATEWIDE ANNUAL LEAD EMISSIONS FROM GASOLINE



VIII. CLIMATOLOGICAL DATA

Weather is often the most significant factor influencing short-term changes in air quality. It also has an affect on long-term trends. Climatological information from the National Weather Service station at Bradley International Airport in Windsor Locks is shown in Table 8-1 for the years 1990 and 1991. Table 8-2 contains information from the National Weather Service station located at Sikorsky Memorial Airport near Bridgeport. All data are compared to "mean" or "normal" values. Wind speeds[1] and temperatures are shown as monthly and yearly averages. Precipitation data includes both the number of days with more than 0.01 inches of precipitation and the total water equivalent. Also shown are degree days[2] (heating requirement) and the number of days with temperatures exceeding 90°F.

Wind roses for Bradley Airport and Newark Airport have been developed from 1991 National Weather Service surface observations and are shown in Figures 8-2 and 8-4, respectively. Wind roses from these stations for 1990 are shown in Figures 8-1 and 8-3, respectively.

[1] The mean wind speed for a month or year is calculated from all the hourly wind speeds, regardless of the wind directions.

[2] The degree day value for each day is arrived at by subtracting the average temperature of the day from 65°F. This number (65) is used as a base value because it is assumed that there is no heating requirement when the outside temperature is 65°F.

TABLE 8-1

1990 AND 1991 CLIMATOLOGICAL DATA

BRADLEY INTERNATIONAL AIRPORT, WINDSOR LOCKS

	AVERAGE TEMPERATURE °F			NO. OF DAYS WHEN MAX. TEMP. EXCEEDED 90 °F			DEGREE DAYS			PRECIPITATION IN EQUIVALENT INCHES OF WATER			NO. OF DAYS WITH MORE THAN 0.01 INCHES OF PRECIPITATION			AVERAGE WIND SPEED (MPH)		
	1990	1991	Mean[a]	1990	1991	Mean[b]	1990	1991	Normal[c]	1990	1991	Mean[a]	1990	1991	Mean[d]	1990	1991	Mean[d]
Jan	34.7	27.0	26.6	0	0	0.0	935	1170	1234	4.03	2.45	3.52	13	9	10.6	8.7	9.2	9.0
Feb	33.0	33.9	27.9	0	0	0.0	890	863	1047	3.37	1.78	3.19	10	11	10.2	10 1	9.4	9.4
Mar	40.2	40.5	37.2	0	0	0.0	763	755	874	2.46	4.52	3.70	9	14	11.3	9.1	10.5	9.9
Apr	49.2	53.3	48.2	2	1	0.3	478	373	486	4.55	3.54	3.75	13	8	11.1	9.6	9.8	10.0
May	56.7	65.8	59.2	0	4	1.2	251	107	197	6.38	5.18	3.73	15	9	11.8	9.5	9.5	8.9
Jun	69.0	70.5	67.9	1	7	3.6	21	16	20	3.59	2.37	3.57	10	9	11.4	9.0	8.5	8.1
Jul	74.4	73.7	73.2	6	9	7.8	5	1	0	2.09	2.90	3.55	8	8	9.6	8.1	7.4	7.5
Aug	73.3	73.1	71.0	5	8	4.8	0	0	8	8.32	8.69	3.94	12	9	9.8	7.6	8.0	7.2
Sep	64.0	62.1	63.5	0	2	1.3	112	156	102	2.13	5.67	3.62	9	10	9.4	7.7	7.9	7.3
Oct	57.4	55.1	53.0	0	0	*	276	311	391	7.63	3.17	3.25	12	9	8.4	9.3	9.7	7.8
Nov	44.5	42.7	42.1	0	0	0.0	608	663	702	3.76	4.03	3.83	8	10	11.1	10.2	8.5	8.5
Dec	36.7	32.8	30.3	0	0	0.0	873	990	1113	4.86	2.96	3.70	12	14	11.9	9.8	9.1	8.7
YEAR	52.8	52.5	50.0	14	31	19.1	5212	5405	6174	53.17	47.26	43.30	131	120	126.8	9.1	9.0	8.5

* Less than 0.05
[a] 1905-1991
[b] 1960-1991
[c] 1951-1980
[d] 1955-1991

Extracted From: Local Climatological Data Charts
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Environmental Data Service

TABLE 8-2

1990 AND 1991 CLIMATOLOGICAL DATA
SIKORSKY INTERNATIONAL AIRPORT, STRATFORD

	AVERAGE TEMPERATURE °F			NO. OF DAYS WHEN MAX. TEMP. EXCEEDED 90 °F			DEGREE DAYS			PRECIPITATION IN EQUIVALENT INCHES OF WATER			NO. OF DAYS WITH MORE THAN 0.01 INCHES OF PRECIPITATION			AVERAGE WIND SPEED (MPH)		
	1990	1991	Mean[a]	1990	1991	Mean[b]	1990	1991	Normal[c]	1990	1991	Mean[d]	1990	1991	Mean[e]	1990	1991	Mean[f]
Jan	36.7	31.7	28.5	0	0	0.0	869	1023	1101	4.01	2.86	3.55	11	11	10.6	---	---	13.2
Feb	35.0	36.2	30.6	0	0	0.0	836	799	963	1.94	1.83	3.23	11	11	9.7	---	---	13.6
Mar	40.1	42.2	38.0	0	0	0.0	766	700	831	2.10	4.07	3.91	8	15	11.2	---	---	13.5
Apr	49.2	51.8	48.1	1	0	*	476	396	492	4.87	3.19	3.84	12	10	10.5	---	---	13.0
May	56.9	64.5	58.5	0	2	0.2	243	106	220	6.89	3.83	3.77	15	9	11.1	---	---	11.6
Jun	69.1	70.3	67.8	0	4	1.0	12	14	20	1.91	2.29	3.33	10	8	9.6	---	---	10.5
Jul	73.9	75.5	73.3	2	8	3.1	5	0	0	2.83	2.17	3.71	8	9	8.5	---	---	10.0
Aug	73.9	74.8	72.0	1	3	1.7	1	0	0	6.47	7.84	4.04	14	9	9.3	---	---	10.1
Sep	65.6	65.1	65.2	0	0	0.3	77	91	49	1.75	3.47	3.44	8	9	8.5	---	---	11.2
Oct	59.6	56.7	54.7	0	0	0.0	208	268	285	5.72	1.88	3.37	8	9	7.2	---	---	11.9
Nov	46.6	45.9	44.2	0	0	0.0	546	566	585	1.89	2.82	3.79	9	9	10.1	---	---	12.7
Dec	40.0	36.7	33.3	0	0	0.0	771	871	955	3.53	4.27	3.62	13	14	11.3	---	---	13.0
YEAR	53.9	54.3	51.2	4	17	6.5	4810	4834	5501	43.91	40.48	43.60	127	123	117.5	---	---	12.0

* Less than 0.05
a 1903-1991
b 1966-1991
c 1951-1980
d 1894-1991
e 1949-1991
f 1958-1980

Extracted From: Local Climatological Data Charts
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Environmental Data Service

FIGURE 8-1

ANNUAL WIND ROSE FOR 1990
BRADLEY INTERNATIONAL AIRPORT
WINDSOR LOCKS, CONNECTICUT

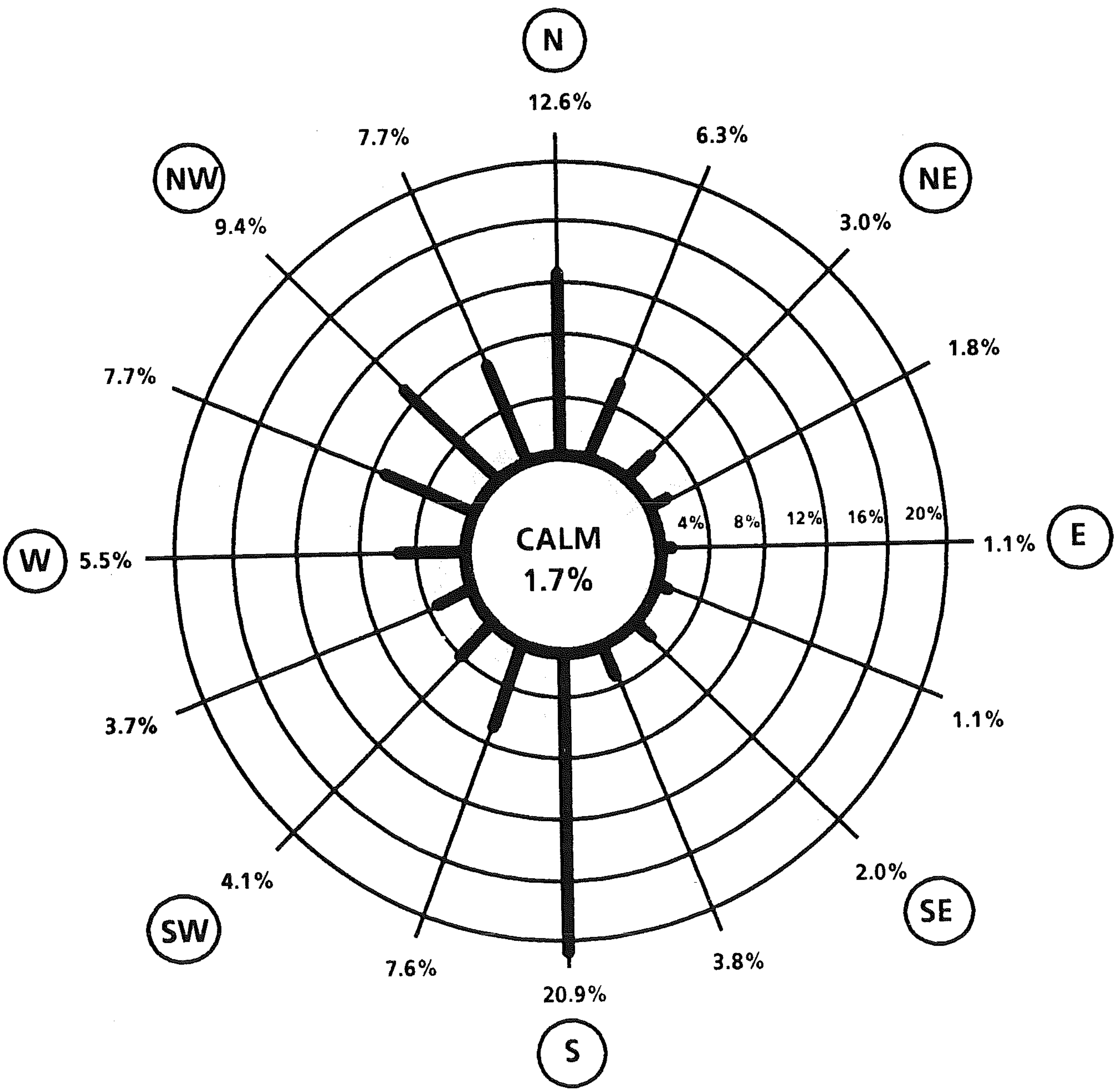


FIGURE 8-2

ANNUAL WIND ROSE FOR 1991
BRADLEY INTERNATIONAL AIRPORT
WINDSOR LOCKS, CONNECTICUT

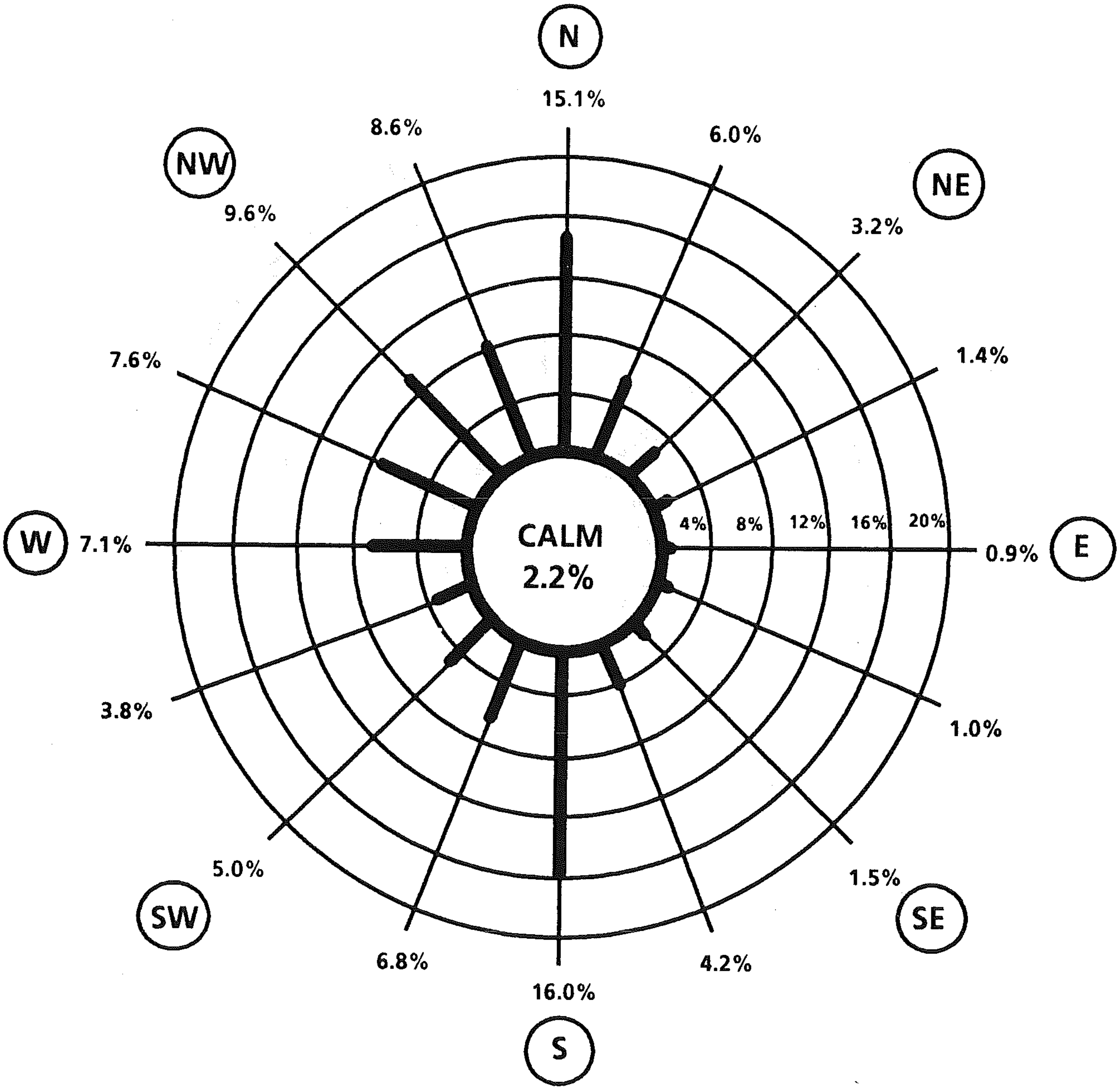


FIGURE 8-3

ANNUAL WIND ROSE FOR 1990
NEWARK INTERNATIONAL AIRPORT
NEWARK, NEW JERSEY

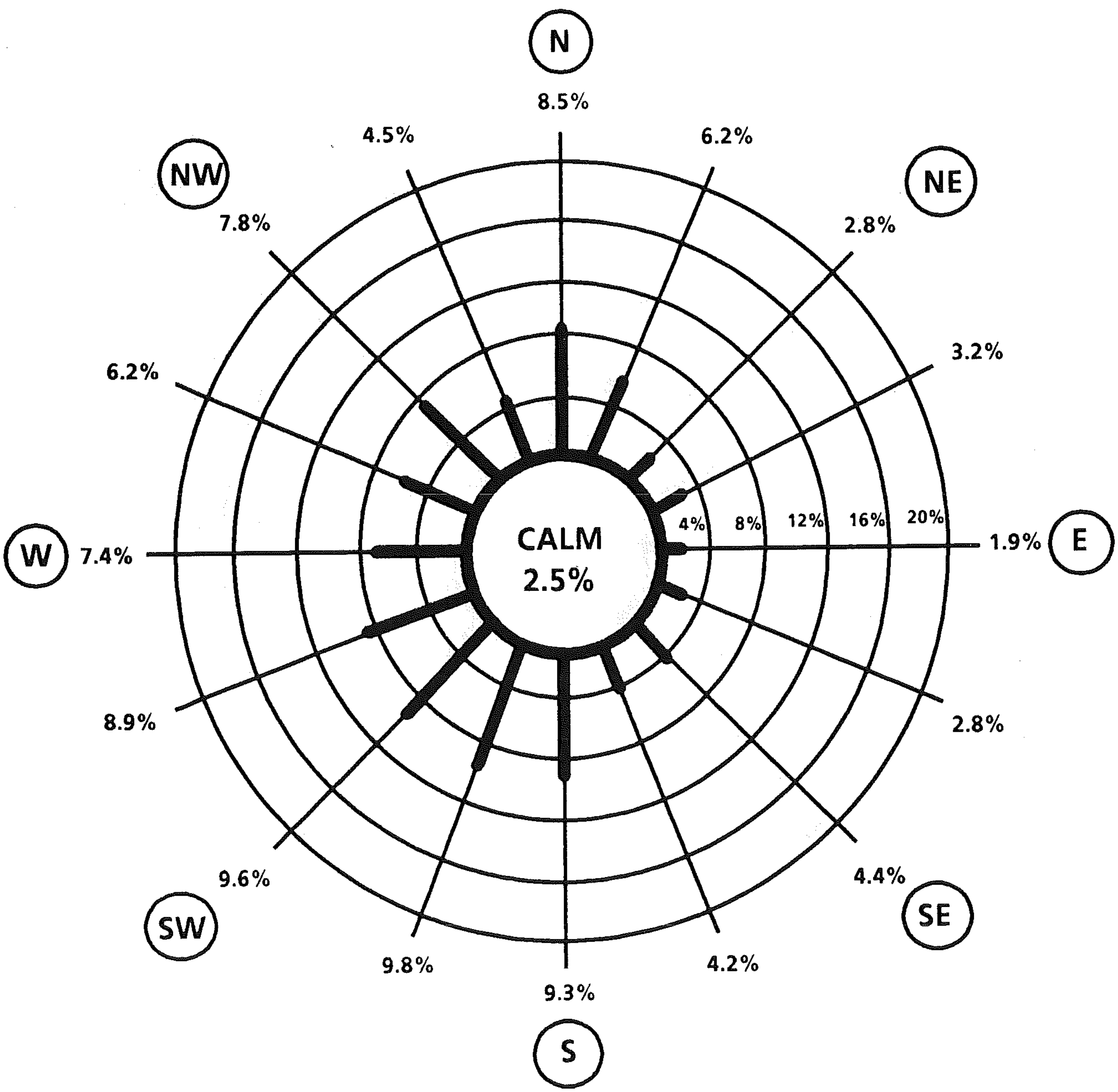
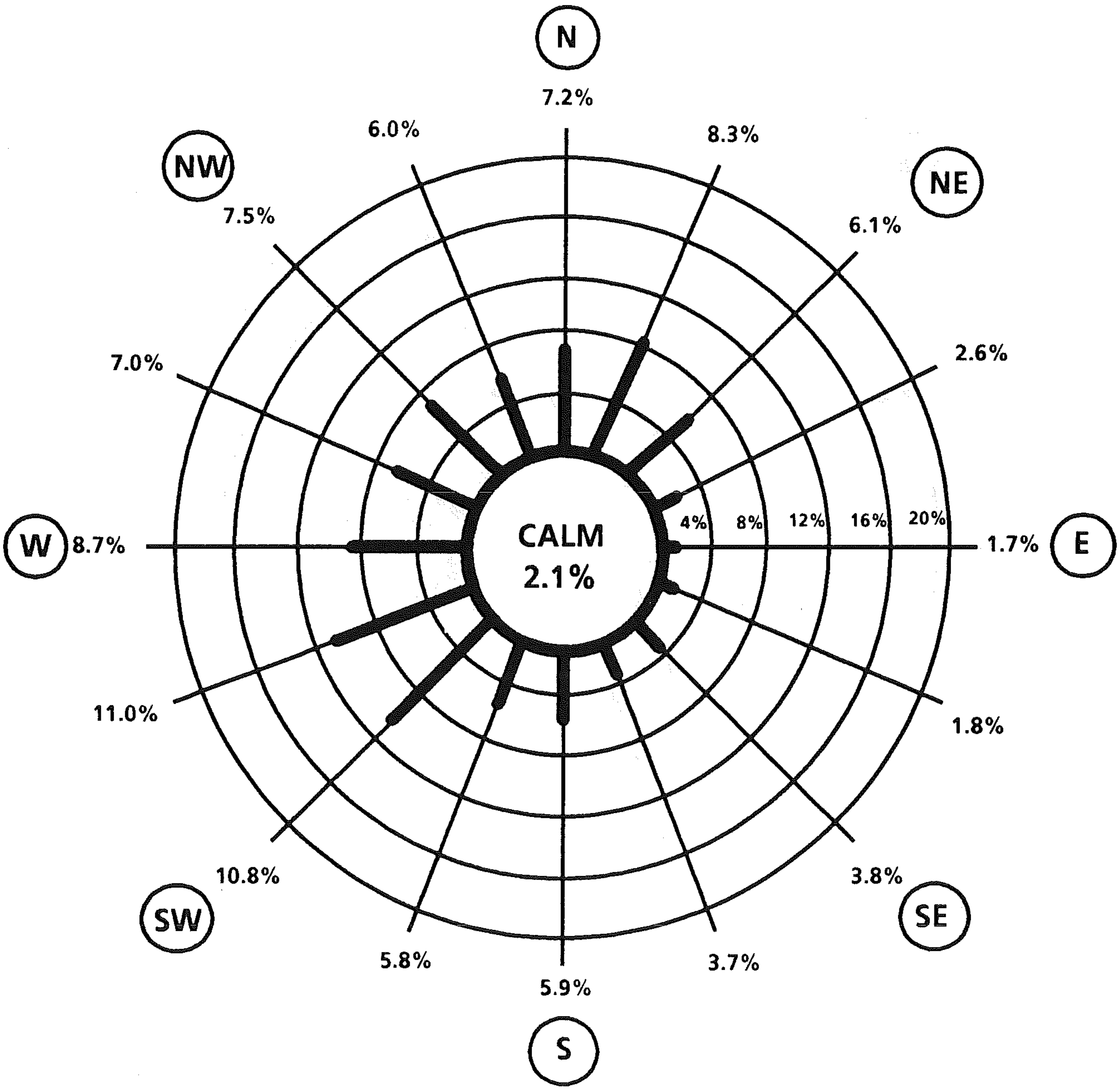


FIGURE 8-4

ANNUAL WIND ROSE FOR 1991
NEWARK INTERNATIONAL AIRPORT
NEWARK, NEW JERSEY



IX. ATTAINMENT AND NON-ATTAINMENT OF THE NAAQS IN CONNECTICUT

The State of Connecticut can be broadly designated as either attainment or non-attainment with respect to the National Ambient Air Quality Standards (NAAQS) for the following pollutants: particulate matter no greater than 10 micrometers in diameter (PM_{10}); sulfur dioxide (SO_2); ozone (O_3); nitrogen dioxide (NO_2); carbon monoxide (CO) ; and lead (Pb). The 1991 designations are:

Attainment	Non-attainment
NO_2	CO
Pb	Ozone
SO_2	PM_{10}

When the State has been designated as attainment for a pollutant, all regions of the State are in compliance with all the standards (i.e., short term and long term; primary and secondary) for the particular pollutant. This is the case for NO_2, Pb and SO_2.

When the State has been designated as non-attainment for a pollutant, one or more of the standards for the pollutant has been violated in one or more regions of the State. The non-attainment designation that is subsequently applied to a region can reflect the "degree" of non-attainment depending upon a number of factors: the air pollution history in the region; previous designation of the region as either attainment or non-attainment; lack of air pollutant monitoring in the region; inferences made based on pollutant monitoring done in adjacent or similar regions; *et al*. For example, the whole state is designated as non-attainment for ozone, but the degree of non-attainment varies from region to region (see Figure 9-1). The region comprising Fairfield County (less Shelton), New Milford and Bridgewater is designated as "severe non-attainment" for ozone, while the rest of the State is designated as "serious non-attainment." The difference in the two designations is explained by higher ozone concentrations in exceedance of the 1-hour ozone standard in the Fairfield County region, which also contains portions of New York and New Jersey (not shown).

For CO, there is a mix of both attainment and non-attainment regions (see Figure 9-2). The region comprising Fairfield County (less Shelton), New Milford and Bridgewater is designated as "moderate non-attainment" primarily due to exceedances of the 8-hour CO standard in the New York / New Jersey portion of the region (not shown). The region comprising Hartford County (less Hartland), Tolland County, Middlesex County and Plymouth is designated as "moderate non-attainment" due to exceedances of the 8-hour CO standard in the city of Hartford. The region comprising New Haven County, Bethlehem, Watertown, Woodbury, Thomaston and Shelton is designated as "unclassified non-attainment." This designation reflects the fact that although no exceedances of the CO standards have been recorded here in the recent past, the region was previously part of the New Haven -- Hartford -- Springfield Air Quality Control Region which was designated as non-attainment due to exceedances of the 8-hour CO standard recorded in the city of Hartford. The two remaining regions of the State are designated as "unclassified attainment." This designation reflects the fact that although no CO monitoring has been done in these regions, their status as attainment areas can be inferred from population and traffic density data.

For PM_{10}, the entire State is designated as attainment, except for the city of New Haven (see Figure 9-3).

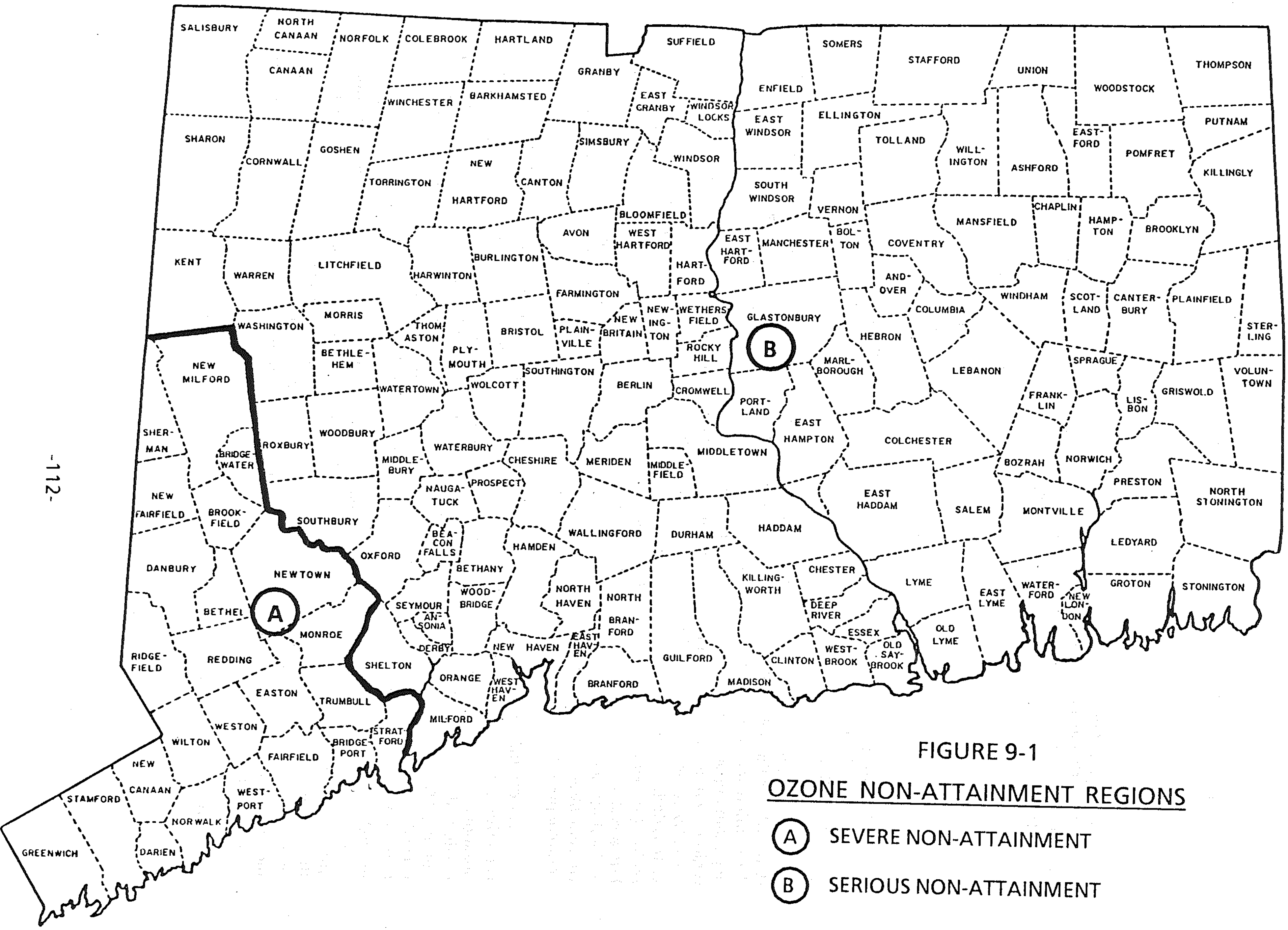


FIGURE 9-1

OZONE NON-ATTAINMENT REGIONS

(A) SEVERE NON-ATTAINMENT

(B) SERIOUS NON-ATTAINMENT

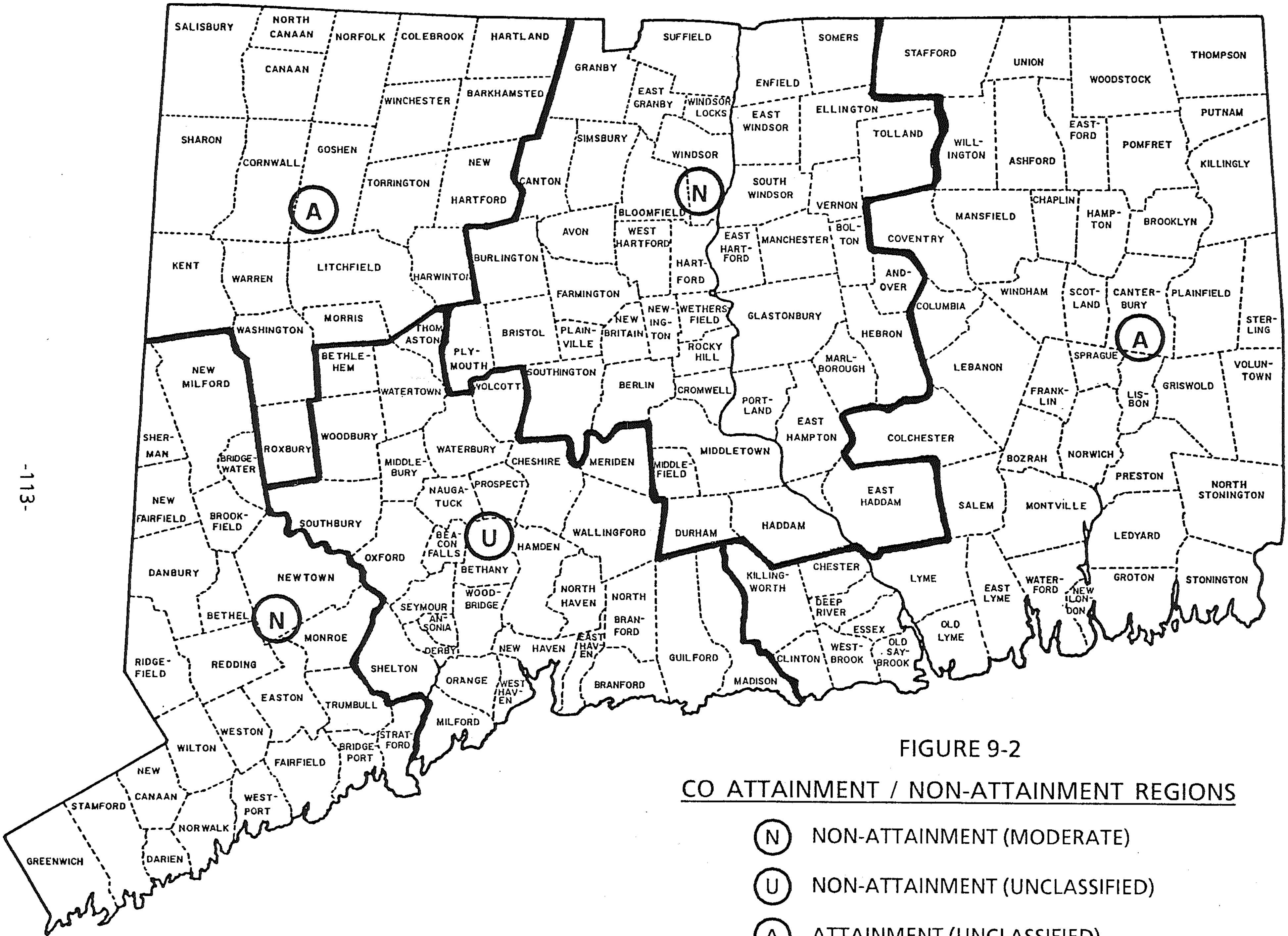


FIGURE 9-2

CO ATTAINMENT / NON-ATTAINMENT REGIONS

(N) NON-ATTAINMENT (MODERATE)

(U) NON-ATTAINMENT (UNCLASSIFIED)

(A) ATTAINMENT (UNCLASSIFIED)

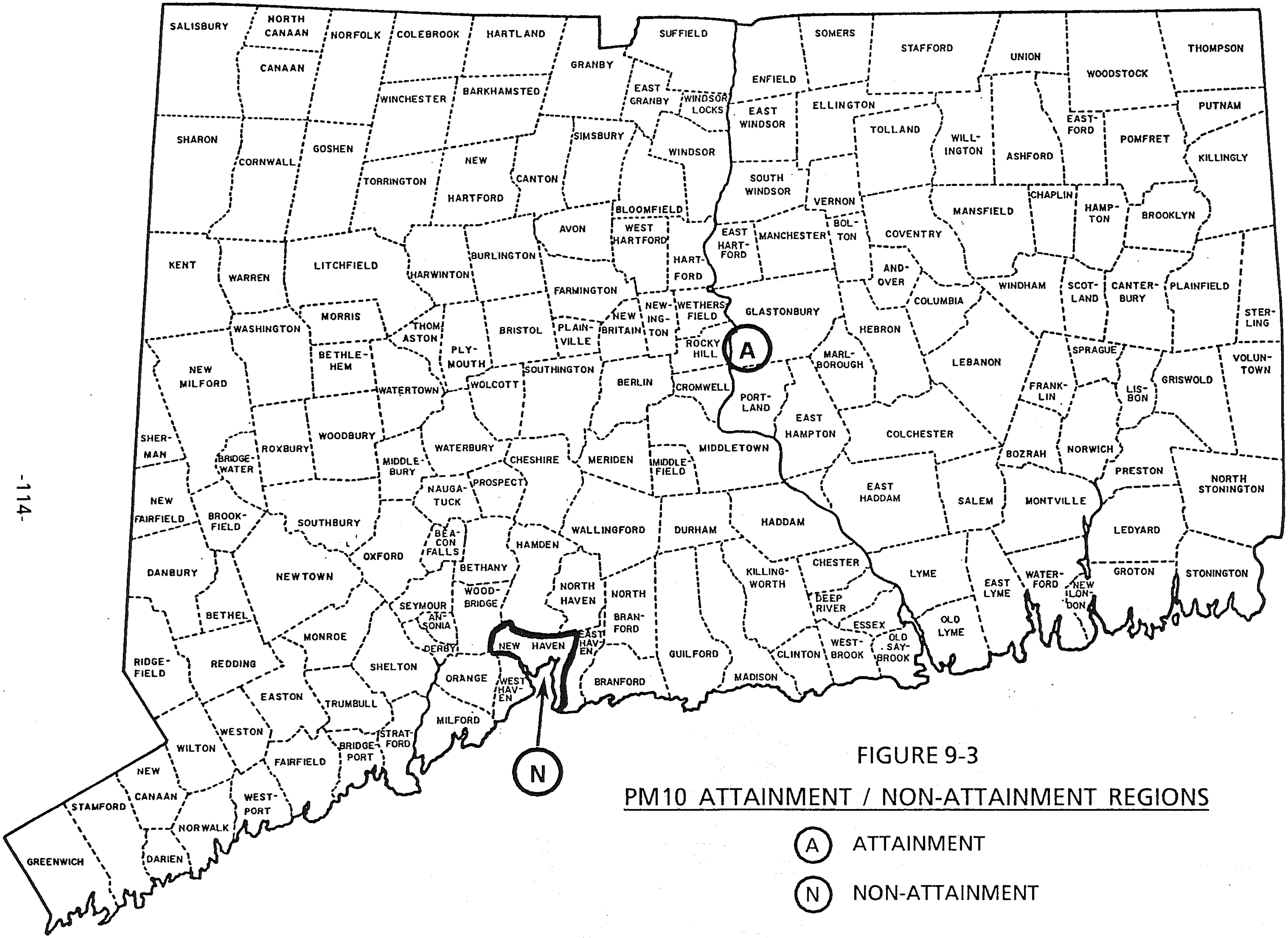


FIGURE 9-3

PM10 ATTAINMENT / NON-ATTAINMENT REGIONS

(A) ATTAINMENT

(N) NON-ATTAINMENT

X. CONNECTICUT SLAMS AND NAMS NETWORK

On May 10, 1979, the U.S. Environmental Protection Agency made public its final rulemaking for ambient air monitoring and data reporting requirements in the "Federal Register" (Vol. 44, No. 92). These regulations, which can also be found in Title 40 of the Code of Federal Regulations (CFR), Part 58, Appendix A through G, are meant to ensure the acceptability of air measurement data, the comparability of data from all monitoring stations, the cost-effectiveness of monitoring networks, and timely data submission for assessment purposes. The regulations address a number of key areas including quality assurance, monitoring methodologies, network design, probe siting and data reporting. Detailed requirements and specific criteria are provided which form the framework for ambient air quality monitoring. These regulations apply to all parties conducting ambient air quality monitoring for the purpose of supporting or complying with environmental regulations. In particular, state/local control agencies and industrial/private concerns involved in air monitoring are directly influenced by specific requirements, compliance dates and recommended guidelines.

QUALITY ASSURANCE

The regulations specify the minimum quality assurance requirements for State and Local Air Monitoring Stations (SLAMS) networks and for National Air Monitoring Stations (NAMS) networks, which are a subset of SLAMS. Two distinct and equally important functions make up the quality assurance program: assessment of the quality of monitoring data by estimating their precision and accuracy, and control of the quality of the data by implementation of quality control policies, procedures, and corrective actions. (See Part D of Section I, Quality Assurance).

The data assessment requirements entail the determination of precision and accuracy for both continuous and manual methods. A one-point precision check must be carried out at least once every other week on each automated analyzer used to measure SO_2, NO_2, CO and O_3. Standards from which the precision check test data are derived must meet specifications detailed in the regulations. For manual methods, precision checks are to be accomplished by operating co-located duplicate samplers. In 1991, Connecticut maintained three co-located PM_{10} monitors (Hartford 015, New Haven 123 and Waterbury 123) and one co-located lead monitor (Waterbury 123).

Accuracy determinations for automated analyzers (SO_2, NO_2, CO, O_3) are accomplished by audits performed by an independent auditor utilizing equipment and gases which are disassociated from the normal network operations. Accuracy determinations are accomplished via traceable standard flow devices for hi-vols and via spiked strip analyses for lead. For SLAMS analyzers, accuracy audits must be performed on each analyzer at least once per calendar year.

All precision and accuracy data are statistics derived through calculation methods specified by the regulations, with the data and results reported quarterly on personal computer floppy disks. The NAMS network is actually part of the SLAMS network; so the SLAMS accuracy determinations also apply to the NAMS network. The distinguishing characteristics of NAMS are: 1) the sites are located in high population, high pollution areas (i.e., urban areas); 2) only continuous instruments are used to monitor gaseous pollutants; 3) the regulations specify a minimum number and locations for them; and 4) the data, in addition to being included in the annual report, are required to be reported quarterly to EPA.

In order to control the quality of data, the monitoring program must have operational procedures for each of the following activities:

1. Selection of methods, analyzers, and samplers,
2. Site selection and probe siting,
3. Equipment purchase, check-out and installation,
4. Instrument calibration,
5. Control checks and their frequency,
6. Control limits for control checks, and corrective actions when such limits are exceeded,
7. Preventive and remedial maintenance,
8. Documentation of quality control information, and
9. Data recording, reduction, validation and reporting.

MONITORING METHODOLOGIES

Except as otherwise stated within the regulations, the monitoring methods used must be "reference" or "equivalent," as designated by the EPA. Table 10-1 lists methods used in Connecticut's network in 1991 which were on the EPA-approved list as of October 30, 1990. Additional updates to these approved methods are provided through the "Federal Register."

NETWORK DESIGN

The regulations also describe monitoring objectives and general criteria to be applied in establishing the SLAMS and NAMS networks and for choosing general locations for new monitors. Criteria are also presented for determining the location and number of monitors. Since January 1, 1984, these criteria have served as the framework for all State Implementation Plan (SIP) monitoring networks.

The SLAMS and NAMS networks are designed to meet four basic monitoring objectives: (1) to determine the highest pollutant concentration in the area; (2) to determine representative concentrations in areas of high population density; (3) to determine the ambient impact of significant sources or source categories; and (4) to determine general background concentration levels. Proper siting of a monitor requires precise specification of the monitoring objectives, which includes a spatial scale of representativeness. The spatial scales of representativeness are specified in the regulations for all pollutants and monitoring objectives. The 1991 SLAMS and NAMS networks in Connecticut are presented and described in Table 10-2.

PROBE SITING

Location and exposure of monitoring probes are described in Title 40 of the Code of Federal Regulations, Part 58, Appendix E. The probe siting criteria promulgated in the regulations are specific. They are also sufficiently comprehensive to define the requirements for ensuring the uniform collection of compatible and comparable air quality data.

These criteria are detailed by pollutant and include vertical and horizontal probe placement, spacing from obstructions and trees, spacing from roadways, probe material and sample residence time, and various other considerations. A summary of the probe siting criteria is presented in Table 10-3. The siting criteria generally apply to all spatial scales except where noted. The most notable exception is spacing from roadways which is dependent on traffic volume.

For the chemically reactive gases SO_2, NO_2, and O_3,the regulations specify borosilicate glass, FEP teflon or their equivalent as the only acceptable sample train materials. Additionally, in order to minimize the effects of particulate deposition on probe walls, sample trains for reactive gases must have residence times of less than 20 seconds.

TABLE 10-1

U. S. EPA-APPROVED MONITORING METHODS USED IN CONNECTICUT IN 1991

Pollutant	Monitoring Methods		
	Reference Manual	Reference Automated	Equivalent Automated
PM_{10}	Wedding & Associates Critical Flow Hi-vol		
SO_2			Thermo Electron 43 (0.5)
O_3			DASIBI 1008-RS (0.5)
CO		Thermo Electron 48 (50)	
NO_2		Thermo Electron 14 B/E (0.5)*	
Lead	High Volume Method		

* Approved for a 0.5 ppm range but operated on a 1.0 ppm range due to NOx exceedances of 0.5 ppm.

( ) = Approved range in ppm

TABLE 10-2

1991 SLAMS AND NAMS SITES IN CONNECTICUT

Town	Urban Area	Site	SLAMS or NAMS	Sampling Method	Analytic Method	Operating Schedule	Monitoring Objective	Spatial Scale of Representativeness
				PARTICULATE MATTER (PM_{10})				
Bridgeport	Bridgeport	010	N	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Bridgeport	Bridgeport	014	N	Hi-Vol	Gravimetric	6th day	High Concentration	Micro
Bristol	Bristol	001	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Burlington	NONE	001	S	Hi-Vol	Gravimetric	6th day	Background	Regional
Cornwall	NONE	005	S	Hi-Vol	Gravimetric	6th day	Background	Regional
Danbury	Danbury	123	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Darien	Stamford	001	N	Hi-Vol	Gravimetric	6th day	High Concentration	Micro
E. Hartford	Hartford	004	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Enfield	MA-CT*	005	S	Hi-Vol	Gravimetric	6th day	Population	Regional
Greenwich	Stamford	017	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Groton	New London/ Norwich	006	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Hartford	Hartford	013	N	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Hartford	Hartford	015	N	Hi-Vol	Gravimetric	6th day	High Concentration	Micro
Meriden	Meriden	002	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Middletown	Hartford	003	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Milford	Bridgeport	010	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
New Britain	New Britain	012	N	Hi-Vol	Gravimetric	6th day	High Concentration	Middle
New Haven	New Haven	013	N	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
New Haven	New Haven	018	N	Hi-Vol	Gravimetric	6th day	High Concentration	Middle
New Haven	New Haven	020	N	Hi-Vol	Gravimetric	6th day	High Concentration	Middle
New Haven	New Haven	123	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood

* Includes Springfield, Chicopee, Holyoke in MA; East Windsor, Enfield, Suffield, Windsor Locks in CT.

TABLE 10-2, CONTINUED

1991 SLAMS AND NAMS SITES IN CONNECTICUT

Town	Urban Area	Site	SLAMS or NAMS	Sampling Method	Analytic Method	Operating Schedule	Monitoring Objective	Spatial Scale of Representativeness
				PARTICULATE MATTER (PM_{10})				
New London	New London/ Norwich	004	N	Hi-Vol	Gravimetric	6th day	High Concentration	Middle
Norwalk	Norwalk	014	N	Hi-Vol	Gravimetric	6th day	High Concentration	Micro
Norwich	New London/ Norwich	002	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Stamford	Stamford	001	S	Hi-Vol	Gravimetric	6th day	High Concentration	Neighborhood
Torrington	NONE	001	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Voluntown	NONE	001	S	Hi-Vol	Gravimetric	6th day	Background	Regional
Wallingford	New Haven	006	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Waterbury	Waterbury	007	S	Hi-Vol	Gravimetric	6th day	Population	Neighborhood
Waterbury	Waterbury	123	N	Hi-Vol	Gravimetric	6th day	High Concentration	Middle
Willimantic	NONE	002	S	Hi-Vol	Gravimetric	6 th day	High Concentration	Neighborhood
				LEAD				
Bridgeport	Bridgeport	010	S	Hi-Vol	Atomic Abs.	6th day	High Concentration	Middle
E. Hartford	Hartford	004	N	Hi-Vol	Atomic Abs.	6th day	Population	Neighborhood
Hartford	Hartford	016	N	Hi-Vol	Atomic Abs.	6th day	High Concentration	Micro
New Haven	New Haven	018	S	Hi-Vol	Atomic Abs.	6th day	High Concentration	Middle
Waterbury	Waterbury	123	S	Hi-Vol	Atomic Abs.	6th day	High Concentration	Middle

TABLE 10-2, CONTINUED

1991 SLAMS AND NAMS SITES IN CONNECTICUT

Town	Urban Area	Site	SLAMS or NAMS	Sampling & Analytic Method	Operating Schedule	Monitoring Objective	Spatial Scale of Representativeness
				SULFUR DIOXIDE			
Bridgeport	Bridgeport	012	S	Pulsed Fluorescence	Continuous	High Concentration	Neighborhood
Bridgeport	Bridgeport	013	N	Pulsed Fluorescence	Continuous	High Concentration	Neighborhood
Danbury	Danbury	123	S	Pulsed Fluorescence	Continuous	Population	Neighborhood
E. Hartford	Hartford	006	N	Pulsed Fluorescence	Continuous	High Concentration	Neighborhood
East Haven	New Haven	003	S	Pulsed Fluorescence	Continuous	Population	Neighborhood
Enfield	MA - CT*	005	S	Pulsed Fluorescence	Continuous	Background	Regional
Greenwich	Stamford	017	S	Pulsed Fluorescence	Continuous	Background	Urban
Groton	New London/ Norwich	007	S	Pulsed Fluorescence	Continuous	Population	Neighborhood
Hartford	Hartford	018	N	Pulsed Fluorescence	Continuous	Population	Neighborhood
Mansfield	NONE	003	S	Pulsed Fluorescence	Continuous	Population	Neighborhood
New Haven	New Haven	123	N	Pulsed Fluorescence	Continuous	High Concentration	Neighborhood
Stamford	Stamford	123	S	Pulsed Fluorescence	Continuous	High Concentration	Neighborhood
Waterbury	Waterbury	123	S	Pulsed Fluorescence	Continuous	Population	Neighborhood

* Includes Springfield, Chicopee, Holyoke in MA; East Windsor, Enfield, Suffield, Windsor Locks in CT.

TABLE 10-2, CONTINUED

1991 SLAMS AND NAMS SITES IN CONNECTICUT

Town	Urban Area	Site	SLAMS or NAMS	Sampling & Analytic Method	Operating Schedule	Monitoring Objective	Spatial Scale of Representativeness
				NITROGEN OXIDES			
Bridgeport	Bridgeport	013	S	Chemiluminescent	Continuous	High Concentration	Neighborhood
E. Hartford	Hartford	003	S	Chemiluminescent	Continuous	High Concentration	Neighborhood
New Haven	New Haven	123	S	Chemiluminescent	Continuous	High Concentration	Neighborhood
				OZONE			
Bridgeport	Bridgeport	013	N	Chemiluminescent	Continuous	Population	Neighborhood
Danbury	Danbury	123	S	Chemiluminescent	Continuous	High Concentration	Urban
E. Hartford	Hartford	003	N	Chemiluminescent	Continuous	Population	Neighborhood
Greenwich	Stamford	017	S	Chemiluminescent	Continuous	High Concentration	Urban
Groton	New London/ Norwich	008	S	Chemiluminescent	Continuous	High Concentration	Urban
Madison	NONE	002	S	Chemiluminescent	Continuous	High Concentration	Urban
Middletown	Hartford	007	N	Chemiluminescent	Continuous	High Concentration	Urban
New Haven	New Haven	123	N	Chemiluminescent	Continuous	Population	Neighborhood
Stafford	NONE	001	N	Chemiluminescent	Continuous	High Concentration	Urban
Stratford	Bridgeport	007	N	Chemiluminescent	Continuous	High Concentration	Urban
Torrington	NONE	006		Chemiluminescent	Continuous	High Concentration	Urban
				CARBON MONOXIDE			
Bridgeport	Bridgeport	004	S	NDIR	Continuous	High Concentration	Micro
Hartford	Hartford	013	N	NDIR	Continuous	Population	Neighborhood
Hartford	Hartford	017	N	NDIR	Continuous	High Concentration	Micro
New Haven	New Haven	019	S	NDIR	Continuous	High Concentration	Micro
Stamford	Stamford	020	S	NDIR	Continuous	High Concentration	Micro

TABLE 10-3

SUMMARY OF PROBE SITING CRITERIA

Pollutant	Spatial Scale	Distance from Supporting Structure (meters)		Height Above Ground (meters)	Other Spacing Criteria
		Vertical	Horizontal[a]		
PM_{10}	Micro		>2	2 - 7	1. The sampler should be > 20 meters from the dripline and must be 10 meters from the dripline when any tree acts as an obstruction. 2. The distance from the sampler to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler, except for street canyon sites.[b] 3. There must be unrestricted air flow 270 degrees around the sampler, except for street canyon sites. 4. No furnace or incineration flues should be nearby.[c] 5. The spacing from roads varies with traffic[d], except for street canyon sites which must be from 2 to 10 meters from the edge of the nearest traffic lane.
	Middle, neighborhood, urban and regional		>2	2 - 15	1. The sampler should be > 20 meters from the dripline and must be 10 meters from the dripline when any tree acts as an obstruction. 2. The distance from the sampler to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler.[b] 3. There must be unrestricted air flow 270 degrees around the sampler. 4. No furnace or incineration flues should be nearby.[c] 5. The spacing from roads varies with traffic.[d]

TABLE 10-3, CONTINUED

SUMMARY OF PROBE SITING CRITERIA

Pollutant	Spatial Scale	Distance from Supporting Structure (meters)		Height Above Ground (meters)	Other Spacing Criteria
		Vertical	Horizontal[a]		
Pb	Micro		>2	2 - 7	1. The sampler should be > 20 meters from the dripline and must be 10 meters from the dripline when any tree acts as an obstruction. 2. The distance from the sampler to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler.[b] 3. There must be unrestricted air flow 270 degrees around the sampler, except for street canyon sites. 4. No furnace or incineration flues should be nearby.[c] 5. The sampler must be 5 to 15 meters from a major roadway.
	Middle, neighborhood, urban and regional		>2	2 - 15	1. The sampler should be > 20 meters from the dripline and must be 10 meters from the dripline when any tree acts as an obstruction. 2. The distance from the sampler to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler.[b] 3. There must be unrestricted air flow 270 degrees around the sampler. 4. No furnace or incineration flues should be nearby.[c] 5. The spacing from roads varies with traffic.[d]

TABLE 10-3, CONTINUED

SUMMARY OF PROBE SITING CRITERIA

Pollutant	Spatial Scale	Distance from Supporting Structure (meters)		Height Above Ground (meters)	Other Spacing Criteria
		Vertical	Horizontal[a]		
SO_2	All	3 - 15	>1	>1	1. The probe should be > 20 meters from the dripline and must be 10 from the dripline when a tree acts as an obstruction. 2. The distance from the inlet probe to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the inlet probe.[b] 3. There must be unrestricted air flow 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building. 4. No furnace or incineration flues should be nearby.[c]
O_3	All	>1	>1	3 - 15	1. The probe should be > 20 meters from the dripline and must be 10 from the dripline when a tree acts as an obstruction. 2. The distance from the inlet probe to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the inlet probe. 3. There must be unrestricted air flow 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building. 4. The spacing from roads varies with traffic.[d]

TABLE 10-3, CONTINUED

SUMMARY OF PROBE SITING CRITERIA

Pollutant	Spatial Scale	Distance from Supporting Structure (meters)		Height Above Ground (meters)	Other Spacing Criteria
		Vertical	Horizontal[a]		
CO	Micro	2.5 - 3.5	>1	>1	1. The probe must be >10 meters from the street intersection and should be at a midblock location. 2. The probe must be 2 to 10 meters from the edge of the nearest traffic lane. 3. There must be unrestricted airflow 180 degrees around the inlet probe.
	Middle neighborhood	3 - 15	>1	>1	1. There must be unrestricted airflow 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building. 2. The spacing from roads varies with traffic.[d]
NO_2	All	3 - 15	>1	>1	1. The probe should be > 20 meters from the dripline and must be 10 from the dripline when a tree acts as an obstruction. 2. The distance from the inlet probe to an obstacle, such as a building, must be at least twice the height the obstacle protrudes above the inlet probe.[b] 3. There must be unrestricted air flow 270 degrees around the inlet probe, or 180 degrees if the probe is on the side of a building. 4. The spacing from roads varies with traffic.[d]

[a] When the probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.

[b] Sites not meeting this criterion would be classified as middle scale.

[c] Distance is dependent upon height of furnace or incineration flue, type of fuel or waste burned, and quality of fuel (sulfur and ash content). This is to avoid undue influences from minor pollutant sources.

[d] Distance is dependent upon traffic ADT, pollutant, and spatial scale.

XI. PUBLICATIONS

The following is a partial listing of technical papers and study reports dealing with various aspects of Connecticut air pollutant levels and air quality data.

1. Bruckman, L., ***Asbestos: An Evaluation of Its Environmental Impact in Connecticut***, internal report issued by the Connecticut Department of Environmental Protection, Hartford, Connecticut, March 12, 1976.

2. Lepow, M. L., L. Bruckman, R.A. Rubino, S. Markowitz, M. Gillette and J. Kapish, ***"Role of Airborne Lead in Increased Body Burden of Lead in Hartford Children,"*** Environ. Health Perspect., May, 1974, pp. 99-102.

3. Bruckman, L. and R.A. Rubino, ***"Rationale Behind a Proposed Asbestos Air Quality Standard,"*** paper presented at the 67th Annual Meeting of the Air Pollution Control Association, Denver, Colorado, June 9-11, 1974, J. Air Pollut. Cntr. Assoc., 25: 1207-15 (1975).

4. Rubino, R.A., L. Bruckman and J. Magyar, ***"Ozone Transport,"*** paper presented at the 68th Annual Meeting of the Air Pollution Control Association, Boston, Massachusetts, June 15-20, 1975, J. Air Pollut. Cntr. Assoc.: 26, 972-5 (1976).

5. Bruckman, L., R.A. Rubino and T. Helfgott, ***"Rationale Behind a Proposed Cadmium Air Quality Standard,"*** paper presented at the 68th Annual Meeting of the Air Pollution Control Association, Boston, Massachusetts, June 15-20, 1975.

6. Rubino, R.A., L. Bruckman, A. Kramar, W. Keever and P. Sullivan, ***"Population Density and Its Relationship to Airborne Pollutant Concentrations and Lung Cancer Incidence in Connecticut,"*** paper presented at the 68th Annual Meeting of the Air Pollution Control Association, Boston, Massachusetts, June 15-20, 1975.

7. Lepow, M.L., L. Bruckman, M. Gillette, R.A. Rubino and J.Kapish, ***"Investigations into Sources of Lead in the Environment of Urban Children,"*** Environ. Res., 10: 415-26 (1975).

8. Bruckman, L., E. Hyne and P. Norton, ***"A Low Volume Particulate Ambient Air Sampler,"*** paper presented at the APCA Specialty Conference entitled "Measurement Accuracy as it Relates to Regulation Compliance," New Orleans, Louisiana, October 26-28, 1975, APCA publication SP-16, Air Pollution Control Association, Pittsburgh, Pennsylvania, 1976.

9. Bruckman, L. and R.A. Rubino, ***"High Volume Sampling Errors Incurred During Passive Sample Exposure Periods,"*** J. Air Pollut. Cntr. Assoc., 26: 881-3 (1976).

10. Bruckman, L., R.A. Rubino and B. Christine, ***"Asbestos and Mesothelioma Incidence in Connecticut,"*** J. Air Pollut. Cntr. Assoc., 27: 121-6 (1977).

11. Bruckman, L., ***Suspended Particulate Transport in Connecticut: An Investigation Into the Relationship Between TSP Concentrations and Wind Direction in Connecticut***, internal report issued by the Connecticut Department of Environmental Protection, Hartford, Connecticut, December 24, 1976.

12. Bruckman, L. and R.A. Rubino, ***"Monitored Asbestos Concentrations in Connecticut,"*** paper presented at the 70th Annual Meeting of the Air Pollution Control Association, Toronto, Ontario, June 20-24, 1977.

13. Bruckman, L., ***"Suspended Particulate Transport,"*** paper presented at the 70th Annual Meeting of the Air Pollution Control Association, Toronto, Ontario, June 20-24, 1977.

14. Bruckman, L., ***"A Study of Airborne Asbestos Fibers in Connecticut,"*** paper presented at the "Workshop in Asbestos: Definitions and Measurement Methods" sponsored by the National Bureau of Standards/U.S. Department of Commerce, July 18-20, 1977.

15. Bruckman, L., ***"Monitored Asbestos Concentrations Indoors,"*** paper presented at The Fourth Joint Conference of Sensing Environmental Pollutants, New Orleans, Louisiana, November 6-11, 1977.

16. Bruckman, L., paper presented at the Joint Conference on Applications of Air Pollution Meteorology, Salt Lake City, Utah, November 28 - December 2, 1977.

17. Bruckman, L., E. Hyne, W. Keever, ***"A Comparison of Low Volume and High Volume Particulate Sampling,"*** internal report issued by the Connecticut Department of Environmental Protection, Hartford, Connecticut, 1976.

18. ***"Data Validation and Monitoring Site Review,"*** (part of the Air Quality Maintenance Planning Process), internal report issued by the Connecticut Department of Environmental Protection, Hartford, Connecticut, June 15, 1976.

19. ***"Air Quality Data Analysis,"*** (part of the Air Quality Maintenance Planning Process), internal report issued by the Connecticut Department of Environmental Protection, Hartford, Connecticut, August 16, 1976.

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XII. ERRATA

During the preparation of this Air Quality Summary, a number of errors were discovered in previous editions of this document. For the benefit of the reader, the corrections are presented below:

- Regarding the 1990 Air Quality Summary,

    1. In Section III, on page 56, the Bridgeport 013 site was misnamed "Hallet Street." The correct name is "Congress Street."

    2. In Section III, on page 70, the number at the base of the bar for 1990 should be 15 (not 12).

- Regarding the 1989 Air Quality Summary,

    1. In Section III, on page 57, the Bridgeport 013 site was misnamed "Hallet Street." The correct name is "Congress Street."

- Regarding the 1988 Air Quality Summary,

    1. In Section III, on page 38, the Bridgeport 013 site was misnamed "Hallet Street." The correct name is "Congress Street."