1997
AIR QUALITY REPORT
COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE PREVENTION
DIVISION OF PLANNING AND EVALUATION

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ACKNOWLEDGEMENT

The data in this report represents the work of the Air Assessment Branch to collect representative, complete, and accurate air quality data throughout the Commonwealth.

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EXECUTIVE SUMMARY

Introduction

During 1997 the Massachusetts Department of Environmental Protection (MADEP) analyzed the ambient air for ozone (O3), sulfur dioxide (SO2), nitrogen oxide (NO2), carbon monoxide (CO), and particulate matter less than or equal to 10 microns (PM-10). These are criteria pollutants mandated to be monitored by the U.S. Environmental Protection Agency (U.S. EPA). Lead, also a criteria pollutant, was not monitored in 1997 because the airborne concentrations in Massachusetts have minimal in recent years. Lead monitoring will be reestablished in 1998 at one site. Enhanced ozone monitoring (or PAMS, for Photochemical Assessment Monitoring Stations) continued during 1997 and included the measurement of volatile organic compounds (VOC). VOC are contributors to the formation of ozone and include pollutants known or suspected to cause cancer or other serious health effects, such as birth defects.

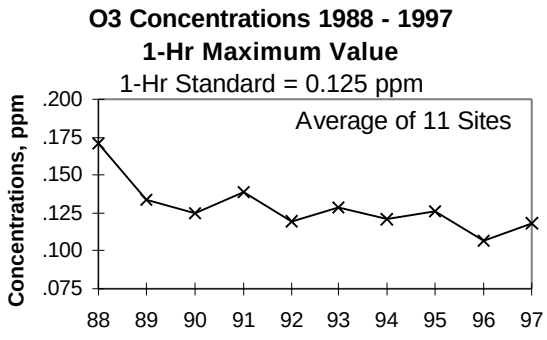
The monitoring data are used to report the state of air quality in Massachusetts and to develop and assess air pollution control strategies to reduce the burden of air pollutants. Massachusetts remains classified as in serious non-attainment for the O3 National Ambient Air Quality Standard (NAAQS).

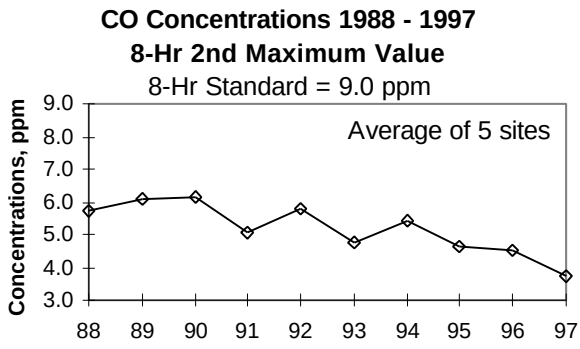
Air Quality Trends: How Clean Is the Air?

Trend data provide a means to address the question. As the figures below display, ten-year trends indicate that air quality is improving - and very substantially, for some pollutants. When interpreting trends, it must be recognized that air quality is influenced by many factors. For instance, the state of the economy, as reflected by industrial and commercial activity - and the resultant levels of pollutant emissions - as well as meteorological conditions should be considered when evaluating ozone trends. In recent years, while the Massachusetts economy has been strengthening, meteorological conditions have been favorable for lower O3 levels. With meteorological conditions more conducive to O3 formation (such as higher temperatures), the levels would have been higher.

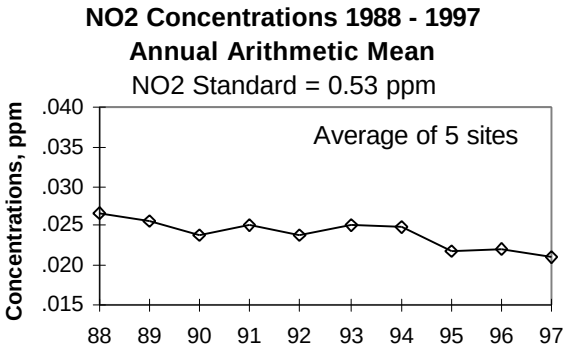
While current data trends are downward for many pollutants, MADEP believes that it is necessary to maintain and improve existing emission control programs in order to maintain these levels, and reduce them further (to attain the ozone NAAQS, for example), and at some point it may be necessary to adopt further controls. The challenge is to effectively balance the goals of continued emission reductions and promoting conditions beneficial to economic growth.

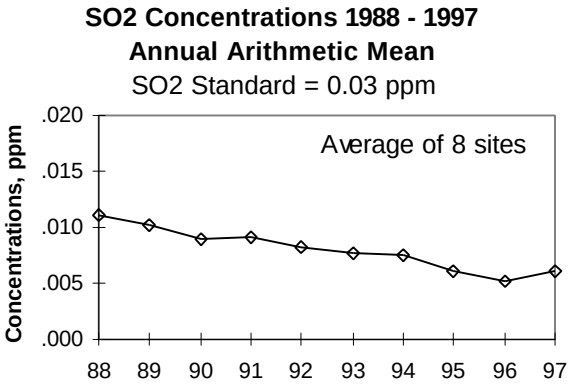
Ambient Air Trends



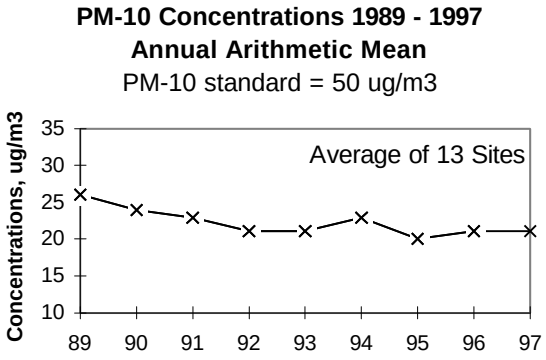


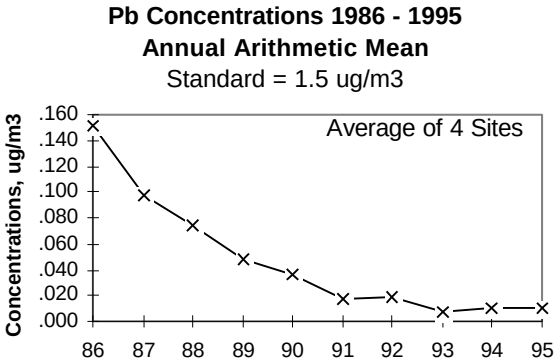
The O3 data indicate that the trend has been relatively stable, except for 1988, when meteorological conditions were conducive to O3 formation. The CO data show that the trend fluctuates but is clearly in a downward direction. CO as indicated by the 8-hour 2nd maximum concentration has decreased 35% over the ten-year period.





The NO2 trend is downward - the annual mean concentration has decreased 19% over the ten-year period. The SO2 data also indicates a downward trend with the annual mean concentration decreasing 45% over the period.

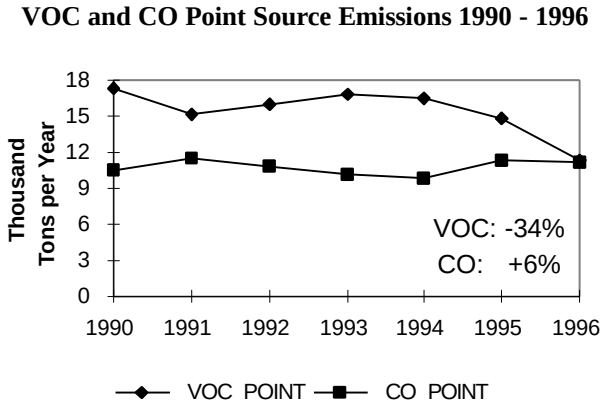


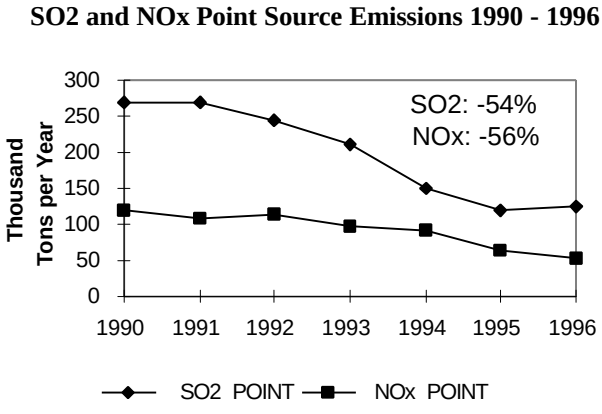


PM-10 shows a downward trend as concentrations have decreased 19% over the period. Lead monitoring in Massachusetts was ended in 1995. As the figure above indicates, the concentration of lead (Pb) in the air decreased dramatically over the ten-year period 1986 - 1995. This success is primarily the result of the increased usage of unleaded gasoline in cars.

The PAMS monitoring for VOC has been conducted for four years. Preliminary analysis of the ambient concentration levels indicate a decline of certain toxic VOC. There have been substantial decreases in benzene, ethylbenzene, toluene and xylene. The decreases are likely the result of the use reformulated gas beginning in January, 1995, which lessened the emissions of toxic pollutants from gasoline.

Emission Trends





The figures above indicate the trends in point source emissions for the period 1990 - 1996. There have been substantial decreases in VOC, SO2 and NOx emissions during the period. CO emissions have remained relatively constant throughout this period.

SECTION I

AMBIENT AIR CRITERIA POLLUTANT MONITORING

1. INTRODUCTION

This report presents 1997 annual air quality information for Massachusetts. Ambient air quality data is collected by the Air Assessment Branch, Division of Planning and Evaluation, Bureau of Waste Prevention (BWP), Department of Environmental Protection (DEP). The collected data is submitted into the Aerometric Information Retrieval System (AIRS), a computer-based repository of air quality information administered by the U.S. Environmental Protection Agency (U.S. EPA).

The ambient air quality data is used to verify compliance with state and national ambient air quality standards (see **Table 2**), to support development of regulations designed to reduce ambient air pollution, to assess the effectiveness of existing air pollution control strategies, to provide aerometric data for special research, and to fulfill U.S. EPA reporting requirements for ambient air quality data.

The Air Assessment Branch is responsible (in accordance with the Code of Federal Regulations (CFR), Title 40, Part 58) for monitoring ambient air quality for six criteria pollutants: sulfur dioxide (SO2), ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), lead (Pb), and particulate matter less than or equal to 10 microns (PM-10). **Table 3** provides a summary of the sources of the criteria pollutants and their health effects.

Non-criteria pollutants monitored include nitrogen oxide (NO), total nitrogen oxides (NOx), total reactive oxidized nitrogen (NOy), and total suspended particulates (TSP), which was the ambient particulate standard before July 31, 1987. Enhanced ozone monitoring (or PAMS - Photochemical Assessment Monitoring Stations) is performed in Massachusetts as required by the 1990 Clean Air Act. This involves measurement of ozone precursor and reaction product chemicals including volatile organic compounds (VOC). For further information on PAMS monitoring, see Section 3 of this report.

During 1997, the Air Assessment Branch maintained a public ambient air monitoring network of 38 stations located throughout the Commonwealth. The stations are equipped with various types of monitors that measure different pollutants. Continuous monitors measure SO2, CO, O3, NO2, NO, NOx, NOy, and VOC. At some stations (including the PAMS sites) meteorological parameters [wind speed/wind direction (WS/WD), relative humidity (RH), barometric pressure (BP), temperature (TEMP), and solar radiation] are monitored on a continuous basis as well. The data from the continuous monitors are averaged to provide hourly concentrations. Intermittent monitors measure PM-10, TSP, and VOC every 6th day taking samples for 24-hours. **Table 4** lists the public air monitoring network. **Table 5** lists the site directory of the public air monitoring network.

During 1997, the Air Assessment Branch also oversaw an industrial ambient air monitoring network composed of 10 air monitoring stations. The industrial network is composed of continuous monitors for SO2, NO2, NO, NOx, WS/WD and temperature, and intermittent monitors for TSP and sulfates (SO4). **Table 6** lists the industrial air monitoring network description. **Table 7** lists the site directory of the industrial ambient air monitoring network.

The data from the public and industrial ambient air quality networks are summarized in this report for public record and information. For further information pertaining to this report, contact the Air Assessment Branch at the address listed on the next page. For information pertaining to other air quality matters, please contact DEP's Division of lanning

and Evaluation in Boston or the regional offices. The DEP offices are listed in **Table 1**.

The maps on the following pages show the cities and towns covered by each regional office. Information about DEP's various programs is available on the internet from DEP's homepage (http://www.state.ma.us/dep/).

TABLE 1: DEPARTMENT OF ENVIRONMENTAL PROTECTION OFFICES

REGION 1 (WESTERN) 436 Dwight Street Springfield, MA 01103 (413) 784-1100 Mary Holland: Regional Director	**REGION 2 (CENTRAL)** 627 Main Street Worcester, MA 01608 (508) 792-7650 Gail Suchman: Regional Director
REGION 3 (NORTHEAST/MET-BOSTON) 205A Lowell Street Wilmington, MA 01887 (978) 661-7600 William Gaughan: Regional Director	**REGION 4 (SOUTHEAST)** 20 Riverside Drive Lakeville, MA 02347 (508) 946-2700 Paul Taurasi: Regional Director
DIVISION OF PLANNING AND EVALUATION One Winter Street Boston, MA 02108 (617) 292-5630 Barbara Kwetz: Director	**AIR ASSESSMENT BRANCH** William X. Wall Experiment Station 37 Shattuck Street Lawrence, MA 01843 (978) 975-1138 Donald Steele: Branch Chief

DEP's Western Region and neighboring communities

REGION 1 (WESTERN)
436 Dwight St.
Springfield, MA 01103
(413)784-1100

Mary Holland: Regional Director

DATA SOURCES:

Community Boundaries of Massachusetts and neighboring states - EOEA/MassGIS

/dep/projects/dep1/mxd/mapwise-regions.mxd

DEP's Central Region and neighboring communities

REGION 2 (CENTRAL)
627 Main St.
Worcester, MA 01608
(508)792-7650

Gail Suchman: Regional Director

DATA SOURCES:
Community Boundaries of Massachusetts and neighboring states - EOEA/MassGIS

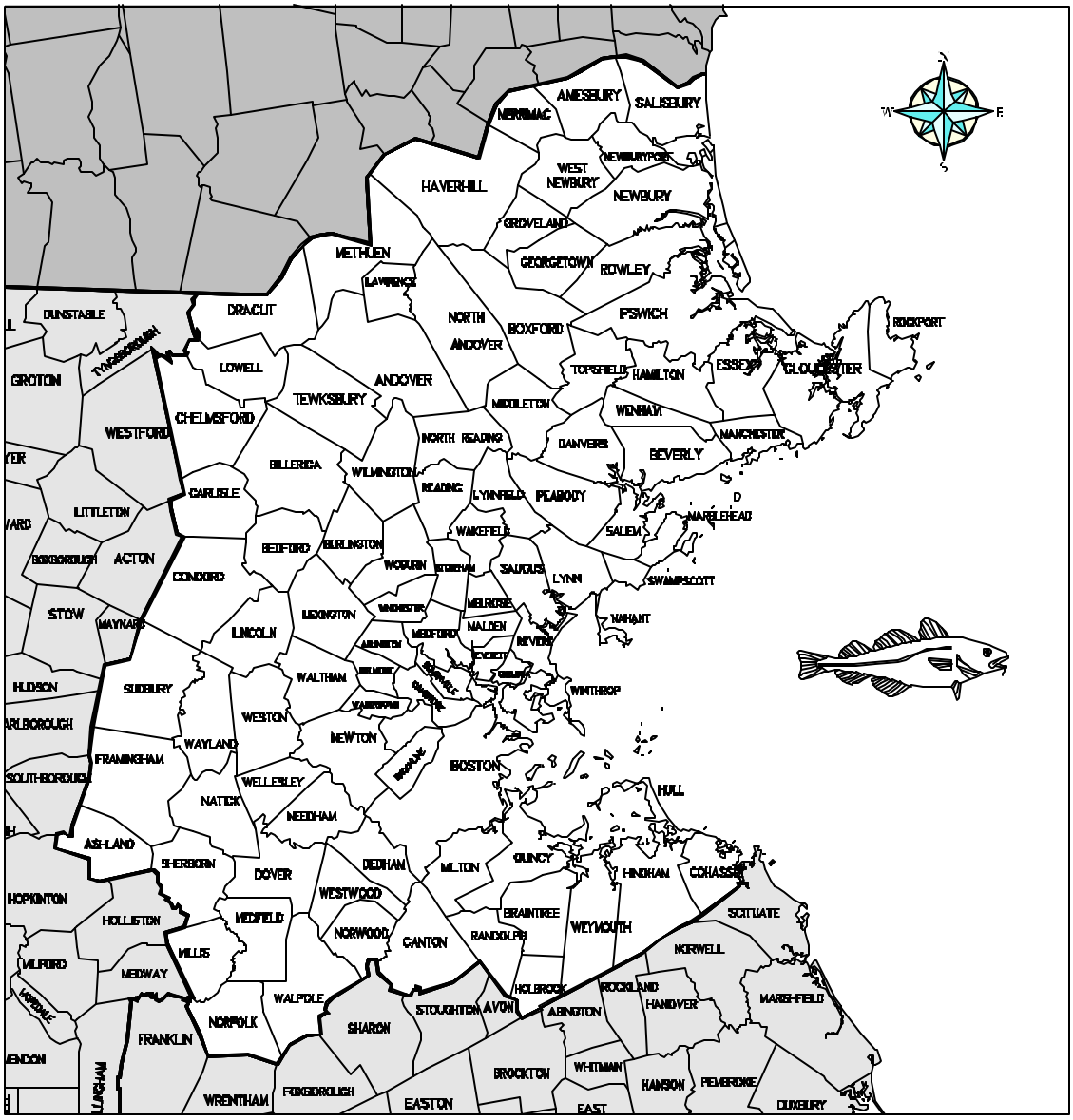
/dep/projects/dagel/mxd/mapsforregions.mxd

DEP's Northeast Region and neighboring communities

REGION 3 (NORTHEAST/MET-BOSTON)
205A Lowell St.
Wilmington, MA 01887
(978)661-7600

William Gaughan: Regional Director

DATA SOURCES:
Community Boundaries of Massachusetts and neighboring states - EOEA/MassGIS



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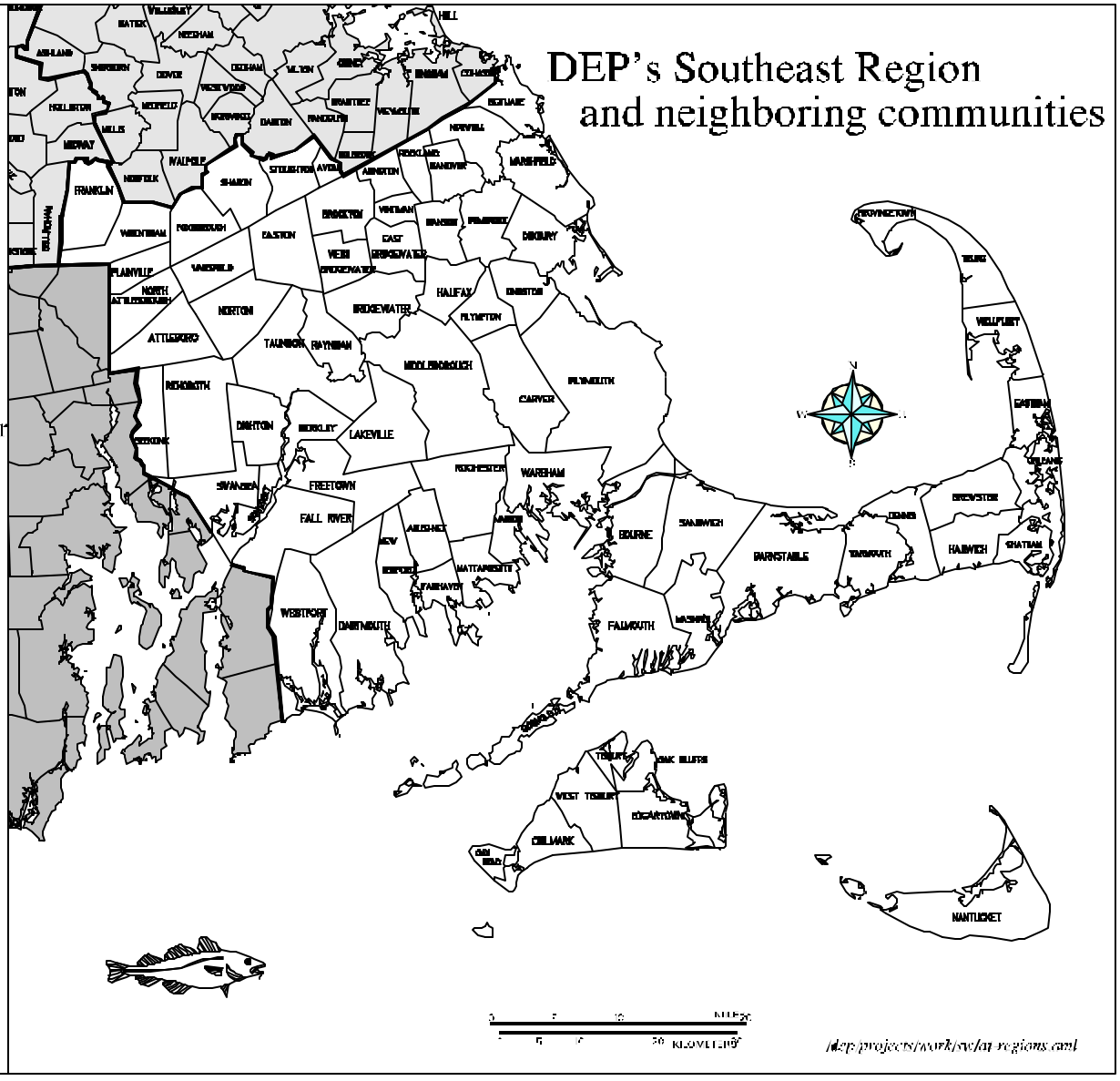
DEP's Southeast Region and neighboring communities



REGION 4 (SOUTHEAST)
20 Riverside Drive
Lakeville, MA 02347
(508)946-2700

Paul Taurasi: Regional Director

DATA SOURCES:

Community Boundaries of Massachusetts and neighboring states - EOEA/MassGIS

TABLE 2: STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS

POLLUTANT	AVERAGING TIME	PRIMARY (Health related)	SECONDARY (Welfare related)
SO2	Annual Arithmetic Mean	0.03 ppm 80 µg/m³	None
	24-Hour	0.14 ppm 365 µg/m³	None
	3-Hour	None	0.50 ppm 1300 µg/m³
CO	8-Hour	9 ppm 10 mg/m³	Same as Primary Standard
	1-Hour	35 ppm 40 mg/m³	Same as Primary Standard
O3	1-Hour[A]	0.12 ppm 235 µg/m³	Same as Primary Standard
	8-Hour[B]	0.08 ppm 157 µg/m³	Same as Primary Standard
NO2	Annual Arithmetic Mean	0.053 ppm 100 µg/m³	Same as Primary Standard
PM-10 Particulates up to 10 microns in size	Annual Arithmetic Mean[C]	50 µg/m³	Same as Primary Standard
	24-Hour[D]	150 µg/m³	Same as Primary Standard
PM-2.5 Particulates up to 2.5 microns in size	Annual Arithmetic Mean[E]	15 µg/m³	Same as Primary Standard
	24-Hour[F]	65 µg/m³	Same as Primary Standard
PB	Calendar Quarter Arithmetic Mean	1.5 µg/m³	Same as Primary Standard

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

Standards other than those based upon the annual arithmetic mean must not be exceeded more than once a year.

A The 1-hour O3 standard applies only to areas that were designated non-attainment when the 8-hour O3 standard was adopted in July 1997. To attain the 1-hour O3 standard, the daily maximum 1-hour average concentration must not exceed 0.12 ppm more than once a year, averaged over 3 consecutive years.

B To attain the 8-hour O3 standard, the 3-year average of the fourth-highest daily maximum 8-hour average over each year must not exceed 0.08 ppm.

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

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

E To attain the PM-2.5 annual standard, the 3-year average of the annual arithmetic mean of the 24-hour concentration from single or multiple population oriented monitors must not exceed 15.0 µg/m³.

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

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

TABLE 3: CRITERIA POLLUTANTS - THEIR SOURCES AND EFFECTS

POLLUTANTS AND THEIR SOURCES	HEALTH AND WELFARE EFFECTS
***OZONE (O3)** Ground level O3 is not emitted directly. It is a product of photochemical reactions involving nitrogen oxides and volatile organic compounds (VOC) - which are typically emitted in motor vehicle exhaust and industrial processes using solvents. O3 is formed downwind of these sources. Warm temperatures and sunlight stimulate O3 formation.	**HEALTH** O3 is a highly reactive gas which irritates the mucous membranes and other lung tissues causing respiratory impairment. O3 has been found to affect not only those with respiratory problems, such as asthma, but also healthy adults and children. Effects include breathing difficulty when exercising and reduced resistance to respiratory infections. Acute exposures cause bronchial constriction, lung edema, and abnormal lung development. **WELFARE** Toxic to plants causing leaf damage and decrease in growth. Weakens materials such as rubber and fabrics.
CARBON MONOXIDE (CO) The largest source of CO emissions are from motor vehicles resulting from the incomplete combustion of carbon in fuels. High levels of CO are possible near large parking lots and city streets with large numbers of slow-moving cars.	**HEALTH**. CO enters the bloodstream by combining with hemoglobin which reduces the amount of oxygen carried to organs and tissue. The health threat is most severe for those with cardiovascular disease. Healthy individuals are affected at higher concentrations (> 30 ppm). Symptoms include shortness of breath, chest pain, headaches, confusion, and loss of coordination. **WELFARE** No known effect on materials or vegetation.
SULFUR DIOXIDE (SO2) SO2 results largely from coal and oil combustion in heat and power generation facilities. Other sources include pulp and paper mills, refineries, and non-ferrous smelters.	**HEALTH** SO2 combines with water vapor to form acidic aerosols which irritate the respiratory tract. It aggravates symptoms associated with chronic lung diseases such as asthma and bronchitis. **WELFARE** SO2 is a primary contributor to acid deposition which causes acidification of lakes and streams. Acid deposition also damages materials (corrodes metals, degrades rubber and fabrics), injures vegetation, and causes visibility degradation.
NITROGEN DIOXIDE (NO2) NO2 is formed from the oxidation of nitric oxide (NO). NO is generated when combustion temperatures are high. Major sources of NO are power plants and automobile engines. NO and NO2 are O3 precursors.	**HEALTH** NO2 can lower resistance to respiratory infections and aggravates symptoms associated with asthma and bronchitis. **WELFARE** NO2 decreases visibility by causing a reddish-brown haze. It is a contributor to acid deposition which causes acidification of lakes and streams, as well as plant injury and damage to materials (metals, rubber, fabrics).
PARTICULATES (PM-10) Particulate matter are tiny airborne particles or aerosols which include dust, dirt, smoke, and liquid droplets. PM-10 encompasses particulate matter with an aerodynamic diameter of 10 microns or less. Sources include fossil fuel combustion emissions, industrial process emissions, and motor vehicles.	**HEALTH** PM-10 particles, because of their small size, are able to be inhaled and reach the thoracic region of the respiratory system. The health effects are often not immediately noticed. The particulates can accumulate in the lungs after long term exposure and affect breathing and respiratory symptoms. The lung's natural cleansing and defense mechanisms are impaired. **WELFARE** Causes soiling and corrosion to materials. Decreases visibility by forming atmospheric haze.
LEAD (PB) The primary source for airborne Pb used to be motor vehicles but the use of unleaded gas has dramatically reduced Pb emissions.	**HEALTH** Causes mental retardation and brain damage, especially to children. Causes liver disease; may be a factor in high blood pressure and damages the nervous system. **WELFARE** No direct impact on vegetation.

*Note: Ozone at the ground level can be a health and environmental problem, but ozone is beneficial in the stratosphere (30-60 miles above the Earth) where it filters out the sun's harmful ultraviolet radiation.

TABLE 4: 1997 PUBLIC NETWORK DESCRIPTION

NUMBER OF MONITORING STATIONS 38

NUMBER OF CITIES WITH MONITORING STATIONS 24

CONTINUOUS CRITERIA POLLUTANT (CO,NO2,O3,SO2) MONITORS 47

9 ..... CO (Carbon Monoxide)
12 ..... NO2 (Nitrogen Dioxide)
16 ..... O3 (Ozone)
10 ..... SO2 (Sulfur Dioxide)

NON-CONTINUOUS CRITERIA POLLUTANT (PM-10) MONITORS 16

16 ..... PM-10 (Particulate Matter-10 microns). Three stations have collocated[1] monitors. Quabbin has 2 monitors for every third day sampling.

METEOROLOGICAL MONITORS 46

7 ..... SOLAR RAD (Solar Radiation)
7 ..... BP (Barometric Pressure)
7 ..... RH (Relative Humidity)
11 ..... TEMP (Temperature)
12 ..... WD (Wind Direction)
12 ..... WS (Wind Speed)

OTHER MONITORS 13

5 ..... TSP (Total Suspended Particulates). One station has a collocated[1] monitor.

7 ..... PAMS (Photochemical Assessment Monitoring Station). Monitoring of VOC (volatile organic compounds).

1 ..... ACID RAIN. This is a wet/dry deposition sampler.

[1] Monitors are collocated (2 monitors at a station which run simultaneously) in order to assess precision.

TABLE 5: PUBLIC SITE DIRECTORY

CITY SITE LOCATION	DATE SAMPLING BEGAN	AIRS CODE	PARAMETERS MONITORED
ADAMS Mt. Greylock Summit	05/01/89	25-003-4002	O3
AGAWAM 152 Westfield St.	01/01/82	25-013-0003	PAMS;O3;NO2;NO;NOX;WS/WD; TEMP;SOLAR RAD;RH;BP
AMHERST N. Pleasant St.	04/01/88	25-015-0103	O3
BOSTON Kenmore Square 590 Commonwealth Ave.	01/01/65	25-025-0002	SO2;NO2;NO;NOX;CO;PM-10; TEMP
BOSTON Fire Headquarters Southampton St.	07/01/70	25-025-0012	PM-10
BOSTON Sumner Tunnel Visconti St. East Boston	01/01/74	25-025-0016	CO
BOSTON 340 Breman St. East Boston	01/01/79	25-025-0021	SO2;NO2;NO;NOX;CO;PM-10
BOSTON Fire Station 200 Columbus Ave.	01/01/81	25-025-0024	PM-10
BOSTON 1 City Square Charlestown	01/01/85	25-025-0027	PM-10;TSP
BOSTON Post Office Square	12/29/89	25-025-0038	CO
CHELSEA Soldier's Home Powder Horn Hill	0/01/84	25-025-1003	O3;SO2;NO2;NO;NOX
CHICOPEE Westover Air Force Base	01/01/83	25-013-0008	PAMS;O3;NO2;NO;NOX;WS/WD; TEMP;SOLAR RAD;RH;BP;
EASTON Borderland State Park	07/01/95	25-005-1005	PAMS;O3;WS/WD;TEMP; SOLAR RAD;RH;BP
FAIRHAVEN Wood School Scontuit Rd.	01/01/82	25-005-1002	O3;WS/WD

PUBLIC SITE DIRECTORY

CITY SITE LOCATION	DATE SAMPLING BEGAN	AIRS CODE	PARAMETERS MONITORED
FALL RIVER Fire Headquarters 165 Bedford St.	01/01/58	25-003-3001	PM-10
FALL RIVER Fire Station Globe St.	02/01/75	25-005-1004	SO2
HAVERHILL Consentino School Washington St.	07/19/94	25-009-5005	TSP
LAWRENCE Storrow Park High St.	01/01/80	25-009-0005	O3;SO2;WS/WD;PM-10
LOWELL Old City Hall Merrimack St.	07/17/81	25-017-0007	CO
LYNN Lynn Water Treatment Plant 390 Parkland St.	01/01/92	25-009-2006	PAMS;O3;NO2;NO;NOX;WS/WD; TEMP;SOLAR RAD;RH;BP;TSP
NEW BEDFORD YMCA 25 Water St.	01/01/84	25-005-2004	PM-10
NEWBURY US Department of the Interior Sunset Boulevard	08/01/84	25-009-4004	PAMS;O3;NO2;NO;NOX;WS/WD; TEMP;SOLAR RAD;RH;BP;TSP
QUINCY Fire Station Hancock St.	01/01/76	25-021-0007	PM-10
SCITUATE Police Station First Parish Rd.	01/01/87	25-023-2001	O3
SPRINGFIELD Howard School 59 Howard Street	01/01/78	25-013-0011	PM-10;TSP
SPRINGFIELD Liberty St.	04/01/88	25-013-0016	SO2;NO2;NO;NOX;CO;WS/WD; TEMP
SPRINGFIELD Longhill St.	01/01/78	25-013-1009	SO2

PUBLIC SITE DIRECTORY

CITY SITE LOCATION	DATE SAMPLING BEGAN	AIRS CODE	PARAMETERS MONITORED
SPRINGFIELD 1586 Columbus Ave.	11/01/81	25-013-2007	CO;PM-10;TSP
SUDBURY Nat. Wildlife Refuge Water Row Rd.	06/01/80	25-017-1801	O3;PM-10
TRURO Cape Cod National Park Fox Bottom Area	04/01/87	25-001-0002	PAMS;O3;NO2;NO;NOX; WS/WD;TEMP;BP;RH; SOLAR RAD
WALTHAM U. Mass Field Station Beaver St.	01/01/71	25-017-4003	O3;SO2;WS/WD;TEMP;Acid Rain
WARE Quabbin Summit	06/01/85	25-015-4002	PAMS;O3;SO2;NO2;NO;NOX;NOy; PM-10;WS/WD;TEMP;BP;RH; SOLAR RAD
WEST SPRINGFIELD Fire Station Van Deene St.	08/01/80	25-013-5003	PM-10
WORCESTER U. Mass Medical Center 419 Belmont St.	01/01/75	25-027-0013	PM-10
WORCESTER Worcester Airport	05/07/79	25-027-0015	O3;WS/WD;TEMP
WORCESTER YWCA 2 Washington St.	01/01/78	25-027-0016	PM-10
WORCESTER Fire Station Central St.	01/01/82	25-027-0020	SO2;NO2;NO;NOX;CO
WORCESTER Grafton and Franklin Sts.	07/28/92	25-027-0022	CO

TABLE 6: 1997 INDUSTRIAL NETWORK DESCRIPTION

NUMBER OF MONITORING STATIONS 10

NUMBER OF CITIES WITH MONITORING STATIONS 6

CONTINUOUS CRITERIA POLLUTANT (NO2,SO2) MONITORS 11

1 ..... NO2 (Nitrogen Dioxide)
10 ..... SO2 (Sulfur Dioxide)

METEOROLOGICAL MONITORS 19

1 ..... TEMP (Temperature)
9 ..... WD (Wind Direction)
9 ..... WS (Wind Speed)

OTHER MONITORS 9

4 ..... SO4 (Sulfate) One station had a collocated[2] monitor.
5 ..... TSP (Total Suspended Particulates) One station had a collocated[1] monitor.

[2] Monitors are collocated (2 monitors at a station which run simultaneously) in order to assess precision.

TABLE 7: INDUSTRIAL SITE DIRECTORY

REPORTING ORGANIZATION CITY SITE LOCATION	DATE SAMPLING BEGAN	AIRS CODE	PARAMETERS MONITORED
ATLANTIC GELATIN Stoneham (Hill St.) Hill Street	01/01/78	25-017-1701	SO2;WS/WD
BOSTON EDISON Boston Long Island	01/01/78	25-025-0019	SO2;WS/WD;TSP;SO4
BOSTON EDISON Dorchester Dewar Street	01/01/78	25-025-0020	SO2;WS/WD;TSP;SO4
BOSTON EDISON East Boston Breman Street	01/01/79	25-025-0021	SO2;WS/WD;TSP;SO4
BOSTON EDISON South Boston East First Street	01/01/93	25-025-0040	SO2;NO2;NO;NOX;WS/WD;TSP; SO4
EASTMAN GELATINE Peabody Fox Hill	01/01/82	25-009-1005	SO2;WS/WD
EASTMAN GELATINE Peabody Meadow Pond	01/01/82	25-009-1004	SO2;WS/WD
HAVERHILL PAPERBOARD Haverhill Nettle School	09/10/85	25-009-5004	SO2;WS/WD
NEW ENGLAND POWER CO. Fall River Globe Street	01/01/79	25-005-0010	SO2 Site shut down 7/1/97
NEW ENGLAND POWER CO. Swansea Sharp's Lot Road	01/01/75	25-005-6001	SO2;WS/WD;TSP;TEMP Site shut down 7/1/97

2. ATTAINMENT AND EXCEEDANCES OF AMBIENT AIR QUALITY STANDARDS

2.1 INTRODUCTION

The national ambient air quality standards (NAAQS) are listed in **Table 2** on page 9. Areas not meeting the NAAQS are designated as "non-attainment" areas. Massachusetts is classified as being in "serious" non-attainment for ozone (O3) statewide. There are also some specific communities which are in non-attainment for carbon monoxide (CO).

2.2 OZONE STATE IMPLEMENTATION PLAN

The federal Clean Air Act requires that states which are in non-attainment develop and implement strategies for attaining the standard. The State Implementation Plan (SIP) is the mechanism for documenting this process, and all revisions to the SIP must be approved by the U.S. EPA. The following list contains the measures that have been submitted to U.S. EPA since 1993 as part of Massachusetts' "Reasonable Further Progress" toward attainment. These serve as milestones which help document the progress toward meeting the O3 standard. Please note that this is not a comprehensive list of air regulations, as there are many DEP air regulations that are not specifically credited in the Reasonable Further Progress SIPs. Additional measures needed to meet the standard will be delineated in an Attainment Demonstration submittal, which DEP plans to submit to EPA in 1998.

List of Air Pollution Control Programs in Massachusetts for Reasonable Further Progress Toward Attainment of the One-Hour Ozone Standard (regulatory citations are in parentheses)

Stationary Point Source Controls:

- Reasonably Available Control Technology (RACT) for 50 Ton VOC Sources (310 CMR 7.18)
- RACT for 50 Ton NOx Sources (310 CMR 7.19)

Stationary Area Source Controls:

- Reformulated Architectural and Industrial Maintenance Coatings (310 CMR 7.25)
- Reformulated Traffic Markings (310 CMR 7.25)
- Reformulated Consumer and Commercial Products (310 CMR 7.25)
- Automotive Refinishing Controls (310 CMR 7.18)

On-Road Mobile Source Controls:

- Stage II Vapor Recovery Systems at Gasoline Stations (310 CMR 7.24)
- Federal Reformulated Gasoline
- Enhanced Automobile Inspection and Maintenance (I/M) up to 10,000 Gross Vehicle Weight Rating (310 CMR 60.02 - pending rewrite)
- Low Emission Vehicle (LEV) Program (310 CMR 7.40)
- Federal Motor Vehicle Program (FMVCP) - Pre-Clean Act New Engine Performance Standards
- Federal Tier I New Engine Performance Standards
- Traffic Flow Improvements

Off-Road Mobile Source Controls:

- Federal Reformulated Gasoline for Off-Highway Equipment
- Federal New Engine Performance Standards for Off-Highway Equipment

2.3 OZONE EXCEEDANCES

The ozone one-hour standard of 0.12 ppm was exceeded at three of the sixteen sites at which ozone was monitored during 1997. There were four exceedance days (days ozone exceedances occurred) during the year. **Table 8** lists the exceedances of the ozone standard during 1997 and **Table 9** lists the ozone exceedance days during 1997. **Figure 1** shows the ten-year trends for number of exceedance days and total ozone exceedances.

The one-hour ozone air quality standard is attained when expected exceedances of the 0.12 ppm standard are less than or equal to 1 per year at a site as averaged over a three year period (determined by federal regulations in Appendix H of 40 CFR, Part 50). **Figure 2** shows the expected annual O3 exceedances for the periods 1994-1996 and 1995-1997.

TABLE 8: 1997 1-HOUR OZONE EXCEEDANCES

CITY	AIRS CODE	DATE	HOUR	O3 VALUE (PPM)
Chicopee	25-013-0008	6/21	1800	0.127
Chicopee	25-013-0008	6/25	1400	0.126
Fairhaven	25-005-1002	7/17	1900	0.145
Ware	25-015-4002	6/21	1800	0.151
Ware	25-015-4002	6/25	1500	0.142
Ware	25-015-4002	7/1	1400	0.132

TABLE 9: 1997 1-HOUR OZONE EXCEEDANCE DAYS

DATE OF EXCEEDANCE	HIGHEST EXCEEDANCE SITE	AIRS CODE	MAXIMUM EXCEEDANCE VALUE (PPM)	NUMBER OF EXCEEDANCE SITES
6/21	Ware	25-015-4002	0.151	2
6/25	Ware	25-015-4002	0.142	2
7/1	Ware	25-015-4002	0.132	1
7/17	Fairhaven	25-005-1002	0.145	1

1-Hr O3 Exceedance Days & Total Exceedances 1988 to 1997

Ozone exceeded the 1-Hour standard (0.125 ppm)

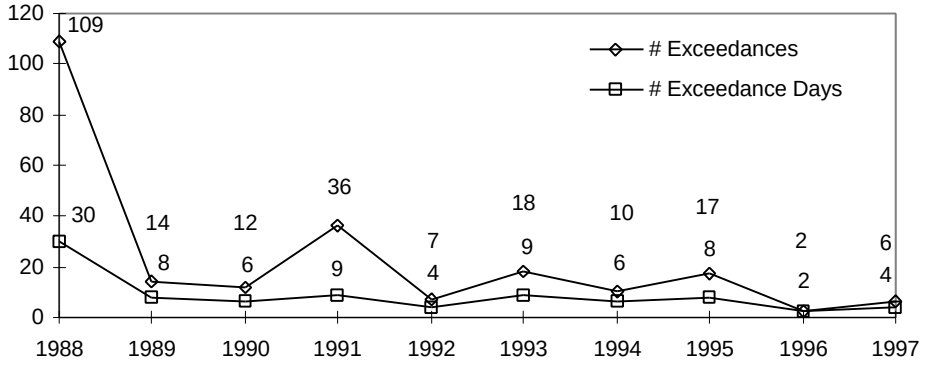
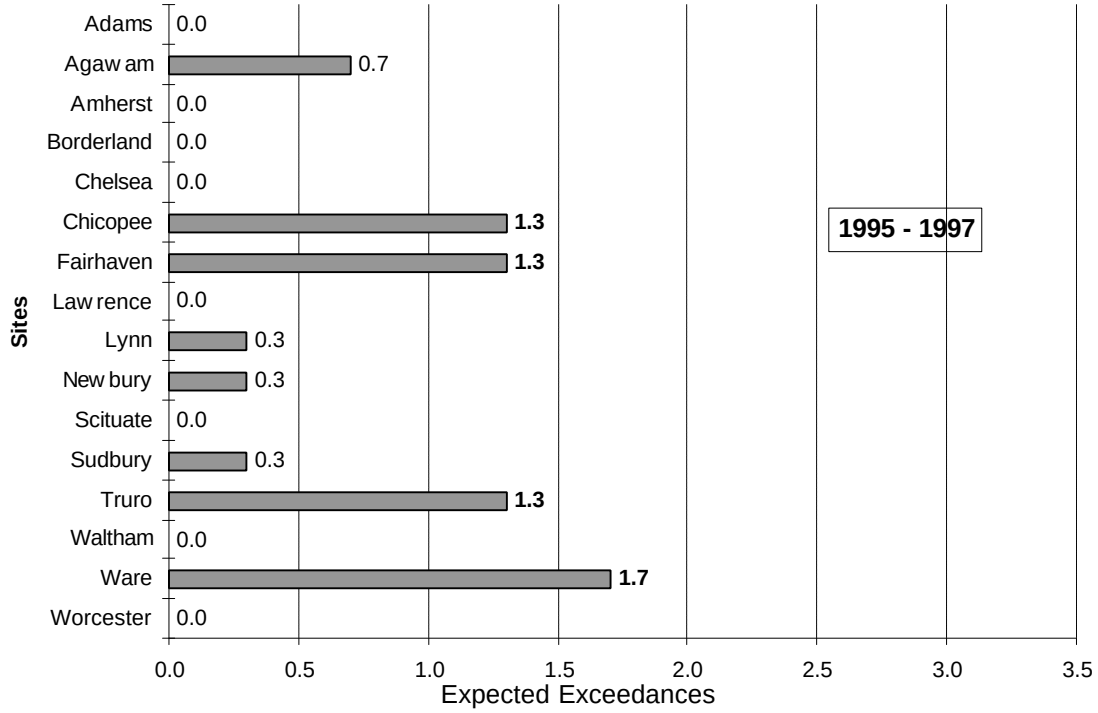


figure 1

3 Year Average of Expected Annual 1-Hr O3 Exceedances
(if greater than 1 site is in violation)



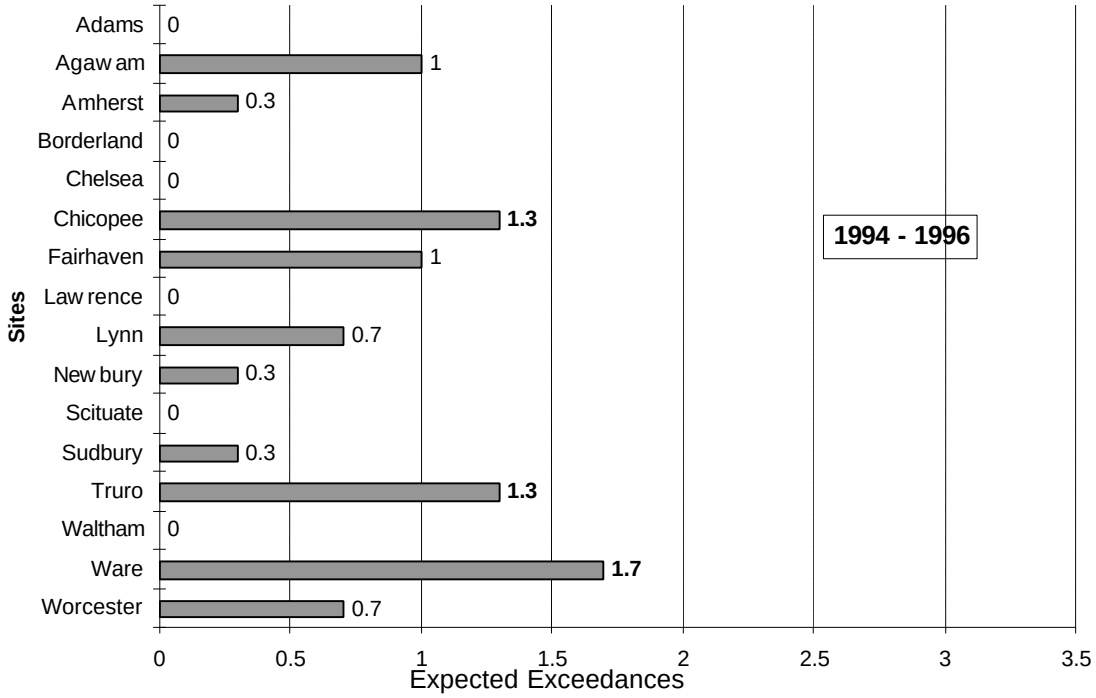


figure 2

The following figures track ozone on days when temperatures in Massachusetts were above 90° Fahrenheit. High temperature is one indicator of weather conditions that favor ozone production, although humidity, wind patterns, cloud cover, and other conditions are also important. **Figure 3** shows the ten-year trend of the number of days greater than 90° F and the number of days there was an exceedance of the 1-hour ozone standard (> 0.12 ppm). **Figure 4** tracks the ten-year trend of the annual average of all ozone readings from monitors on the 90° days.

Number of 1-Hr O3 Exceedance Days & Number of Days > 90ºF 1987-1996

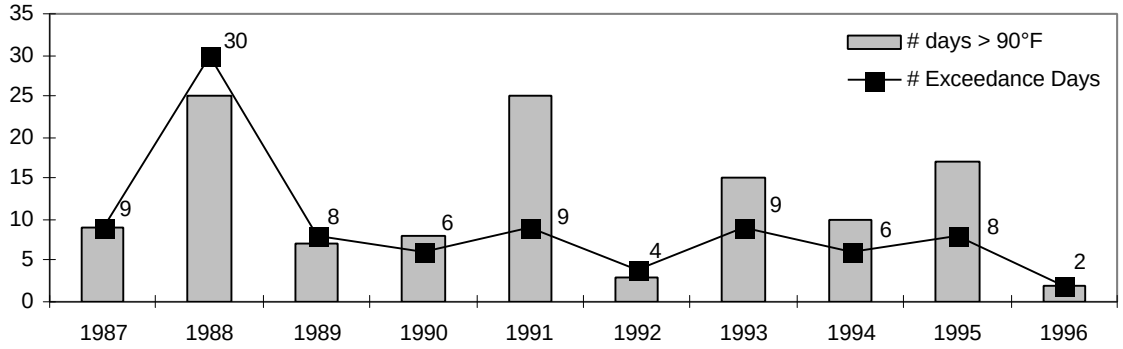


figure 3

Annual Average O3 Value On Days > 90ºF 1987 - 1996

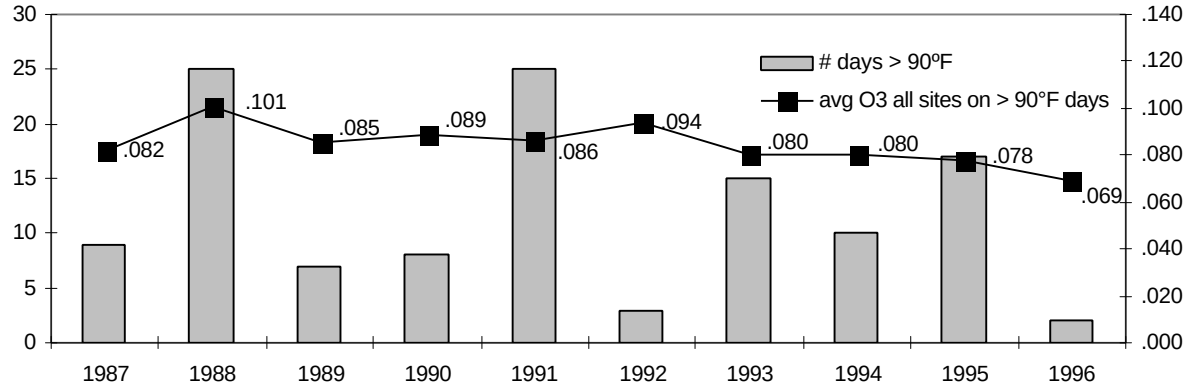


figure 4

2.4 THE NEW 8-HOUR OZONE STANDARD

U.S. EPA is required to establish national ambient air quality standards to protect public health. In 1997, EPA revised the O3 public health standard from a 1-hour standard of 0.12 ppm to an 8-hour standard of 0.08 ppm. The 8-hour standard is calculated as the 3-year average of the annual fourth-highest daily maximum 8-hour O3 concentration. If the 3-year average O3 concentration is 0.085 ppm or greater, a site is in violation of the standard. The 8-hour standard became effective September 16, 1997. However, the 1-hour standard continues to apply to an area until EPA determines that it meets and can maintain that standard. Massachusetts continues to violate the 1-hour standard and is considered in "non-attainment" for that standard.

The 8-hour standard provides increased health protection against longer exposure periods. Studies indicate that adverse health effects result from prolonged (6 to 8 hour) exposures to O3 at concentrations below the level of the 1-hour standard of 0.12 ppm. The 8-hour standard of 0.08 ppm is designed to lessen adverse O3-related health effects, such as respiratory symptoms and decreased lung function.

Figures 5 and 6 depict the levels in recent years for an 8-hour standard, had it applied to Massachusetts. These are for reference only. Measurements taken during the three-year period from 1997 through 1999 will be used to determine attainment status relative to the 8-hour standard.

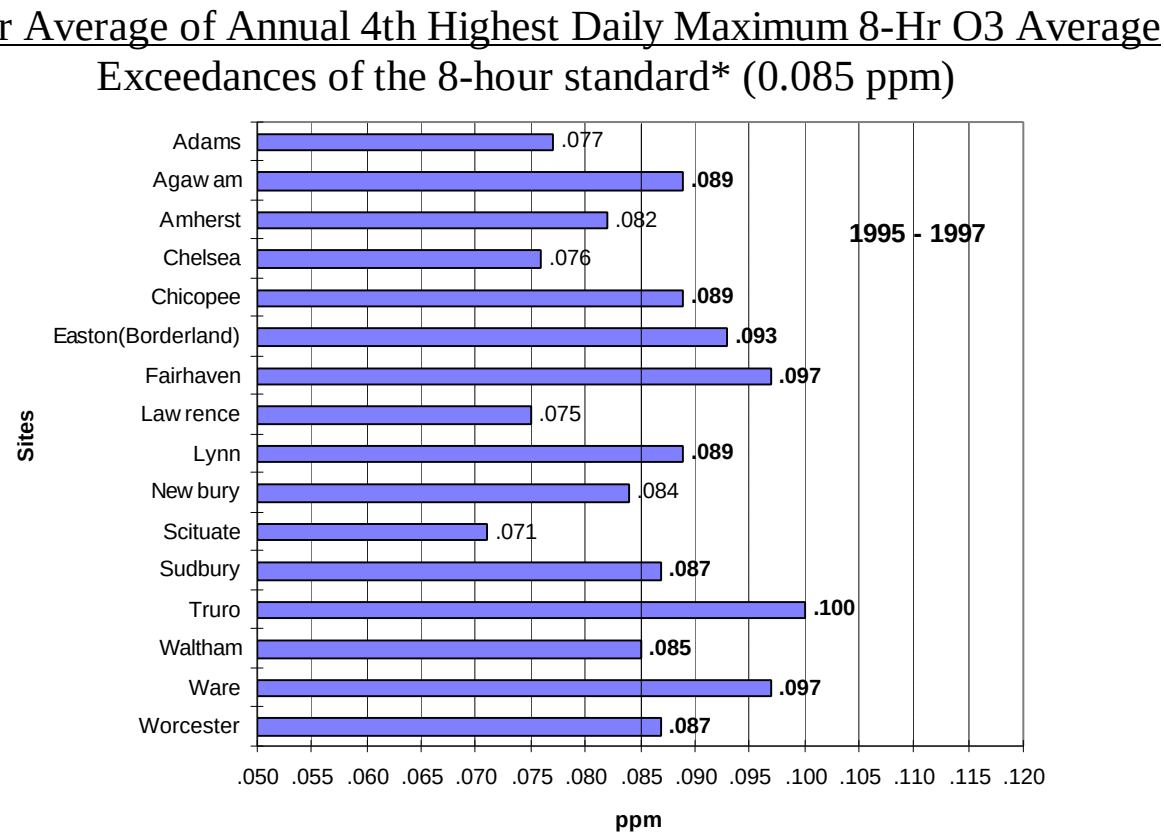


figure 5

*FOR REFERENCE ONLY. Data from the summers of 1997-1999 will be used for regulatory purposes. The 8-hour standard became effective September 16, 1997

8-Hr O3 Exceedance Days & Total Exceedances 1993 - 1997

Exceedances of the 8-hour standard* (0.085ppm)

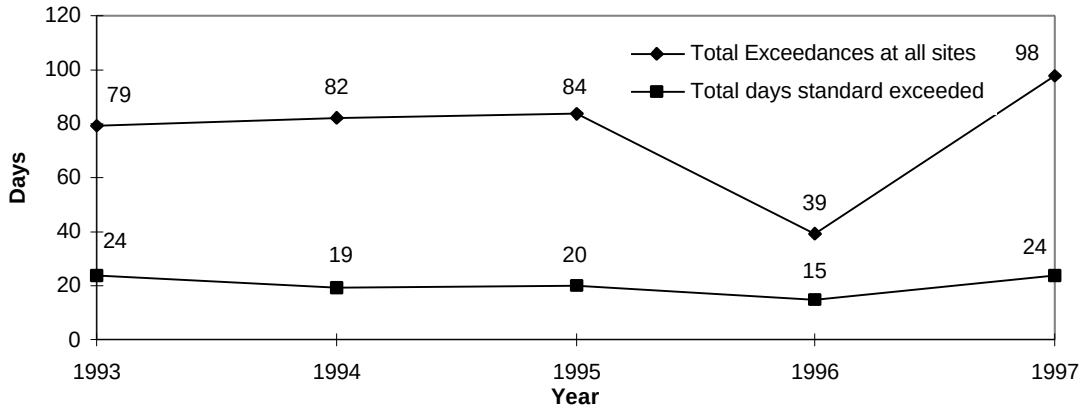


figure 6

*FOR REFERENCE ONLY. Data from the summers of 1997-1999 will be used for regulatory purposes. The 8-hour standard became effective September 16, 1997

2.5 CARBON MONOXIDE ATTAINMENT STATUS

Massachusetts has made significant progress in attainment of the CO standard by implementing air pollution control programs. The last violation of the CO NAAQS occurred in Boston in 1986.

The Boston area was redesignated as in attainment of the CO federal air quality standard by the U.S. EPA in 1996. Springfield, Worcester, Lowell, and Waltham will remain in non-attainment for CO, though there has been significant improvement, until studies and analyses support a request for redesignation.

2.6 CARBON MONOXIDE EXCEEDANCES

The carbon monoxide standard was not exceeded in 1997. The CO standard requires 2 exceedances at a site for the site to be in violation. The last CO violation was in 1986 in Boston. **Figure 7** tracks 8-hour exceedances and violations Massachusetts from 1987 - 1997.

CO 8-Hr Exceedances 1987 to 1997

of Exceedance Days and Violation Sites

8-Hr Standard = 9 ppm

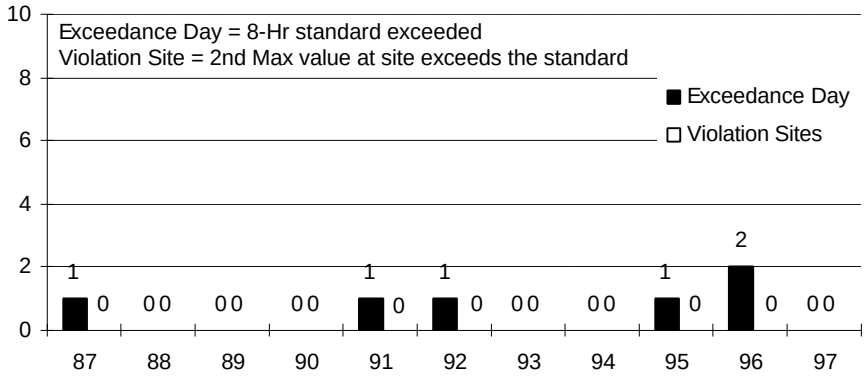


figure 7

2.7 THE NEW PARTICULATE MATTER (PM-2.5) STANDARD

U.S. EPA in 1997 added new fine particulate matter (PM) standards (PM-2.5) to the existing PM-10 standards. The numbers, 2.5 and 10 refer to the particle size, measured in microns, which are collected by the PM monitors. The PM standards were last revised in 1987, when PM-10 replaced total suspended particulates (TSP) as the particulate standard. In the 1997 action, U.S. EPA added an annual PM-2.5 standard of 15 micrograms per cubic meter ($\mu g/m^3$) and a 24-hour PM-2.5 standard set at 65 $\mu g/m^3$.

Scientific studies published since 1987 indicate that smaller (or fine) particles, less than 2.5 microns in diameter, are largely responsible for the health effects of greatest concern, and for visibility impairment (for example, atmospheric haze which obscures scenic views). U.S. EPA estimates that the new standards, along with clean air programs already planned, will reduce premature deaths by about 15,000 a year and serious respiratory problems in children by about 250,000 a year.

During 1998, U.S. EPA is testing and approving the PM-2.5 sampling monitors. In late 1998, Massachusetts will have a statewide network with 18 sites in 15 cities, with additional sites added in 1999.

3. AMBIENT AIR QUALITY DATA - PUBLIC NETWORK

3.1 POLLUTANT STANDARD INDEX (PSI)

The Pollutant Standard Index (PSI) provides a uniform way to understand pollution levels for five major pollutants regulated under the Clean Air Act. The pollutants are particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, and ozone. The PSI allows concentrations to be reported on a scale of 0 to 500. A PSI value of 100 is equivalent to the national ambient air quality standard for the pollutant - for example an ozone PSI of 100 is equivalent to the 1-hour standard of 0.12 ppm. EPA is currently planning to revise the PSI for all pollutants to incorporate any changes needed to reflect the latest scientific research. A new PSI will be proposed in Fall, 1998, and finalized in Spring, 1999.

The categories of the PSI air quality levels are as follows:

From 0 to 50..... good
From 50 to 100..... moderate
From 100 to 200..... unhealthful
From 200 to 300..... very unhealthful
Above 300..... hazardous

Table 10 lists the health effects associated with the different PSI categories and values. Massachusetts is in non-attainment for ozone. **Table 11** lists the number of days during the 1997 ozone season that the ozone PSI fell into the good, moderate, or unhealthful categories for the eastern and western regions of the state.

Figure 8 shows the ozone PSI 10-year trend of unhealthful days during the ozone season by region of the state. It shows the trend of unhealthful days being relatively stable, except for 1988, when meteorological conditions favorable for ozone formation in Massachusetts and other states in the Northeast contributed to an increase in the number of unhealthful days.

3.2 DAILY OZONE REPORT

During ozone season (April through September) the Division of Planning and Evaluation predicts each day's air quality with a rating of good, moderate, or unhealthful. The air quality rating is determined using the weather forecast and evaluating meteorological, ozone, and oxides of nitrogen data from the statewide monitoring network. The daily air quality report can be heard by calling the Air Quality Hotline at 1-800-882-1497 and is available on the internet from DEP's homepage (http://www.state.ma.us/dep/).

When the daily forecast is good, no restrictions on outdoor activities are necessary. If the forecast is moderate, it is recommended that exercise be done in the early morning or late evening, avoiding the hottest part of the day. On days the forecast predicts unhealthful air, everyone is encouraged to stay inside and avoid strenuous outdoor activity.

TABLE 10: POLLUTANT STANDARD INDEX (PSI) AND GENERAL HEALTH EFFECTS

INDEX VALUE	PSI DESCRIPTOR	GENERAL HEALTH EFFECTS	CAUTIONARY STATEMENTS
500	Very Hazardous	Premature death of ill and elderly. Healthy persons will experience adverse symptoms[1] that affect their normal activities.	All persons should remain indoors, keeping windows and doors closed. All persons should minimize physical exertion and avoid traffic areas.
400	Hazardous	Premature onset of heart and lung diseases. Significant aggravation of symptoms[1] and decreased exercise tolerance in healthy persons.	Elderly and persons with existing respiratory diseases should stay indoors and avoid physical exertion. General population should avoid physical activity.
300	Very Unhealthful	Significant aggravation of symptoms[1] and decreased exercise tolerance in persons with heart or lung disease. Widespread symptoms[1] in the healthy population.	Elderly and persons with existing heart or lung diseases should stay indoors and avoid physical activity.
200	Unhealthful	Mild aggravation of symptoms[1] in susceptible persons. Irritation symptoms[1] in the healthy population.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity.
100	Moderate		
50	Good		
0			

[1] Symptoms include eye and throat irritation and respiratory problems such as breathing difficulty and congestion.

TABLE 11: 1997 PSI BY REGION DURING OZONE SEASON (APRIL THROUGH SEPTEMBER)

MONTH	REGION	GOOD PSI	MODERATE PSI	UNHEALTHFUL PSI
APRIL	Eastern Western	17 21	13 9	0 0
MAY	Eastern Western	19 17	12 14	0 0
JUNE	Eastern Western	11 7	18 21	1 2
JULY	Eastern Western	10 14	19 15	2 2
AUGUST	Eastern Western	9 19	21 11	1 1
SEPTEMBER	Eastern Western	17 26	13 4	0 0
TOTAL (OZONE SEASON)	Eastern Western	83 104	96 74	4 5

DEFINITION OF PSI CATEGORIES	
GOOD	PSI OF 0 TO 50
MODERATE	PSI OF 51 TO 100
UNHEALTHFUL	PSI OF 101 TO 200

REGION	COUNTY
EASTERN	Essex, Middlesex, Suffolk, Norfolk, Bristol, Plymouth, Barnstable, Worcester
WESTERN	Berkshire, Franklin, Hampshire, Hampden

Number of Days in PSI Categories

By region during 1997 Ozone season
(April through September)

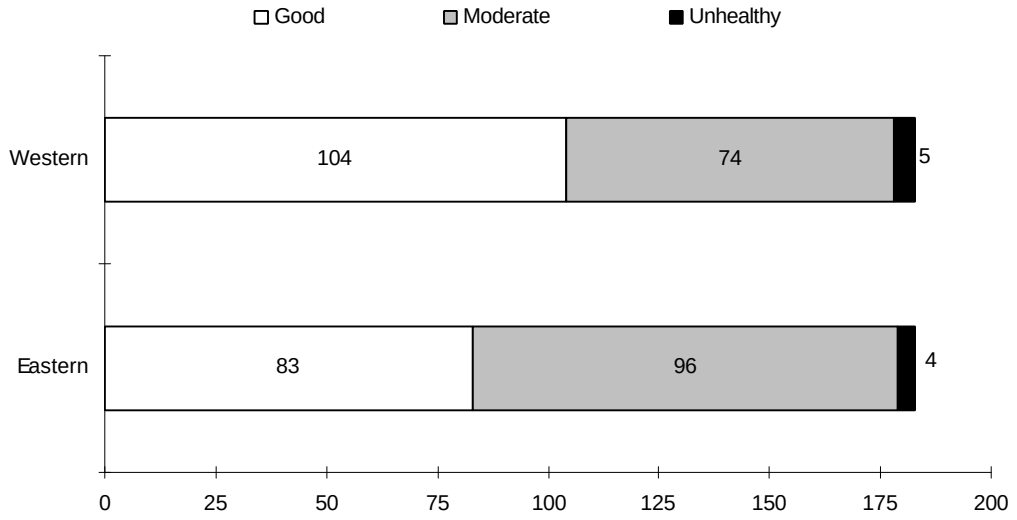


figure 8

REGION	COUNTY
EASTERN	Essex, Middlesex, Suffolk, Norfolk, Bristol, Plymouth, Barnstable, Worcester
WESTERN	Berkshire, Franklin, Hampshire, Hampden

PSI 10-Year Trends

of Unhealthful Days by Region

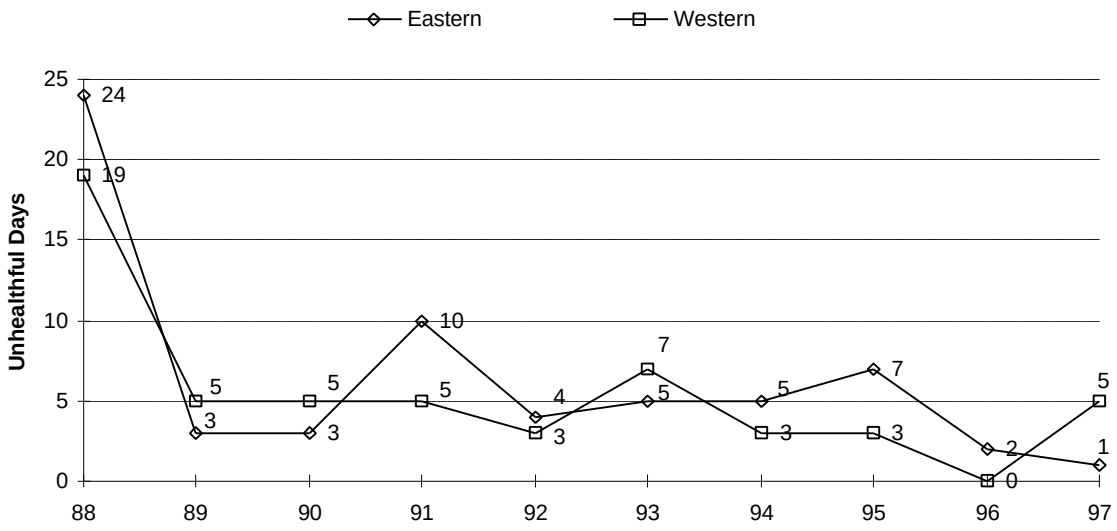


figure 9

3.3 OZONE (O3) DATA SUMMARY

There were sixteen O3 sites during 1997 in the state-operated monitoring network. All of the sites achieved the requirement of 75% or greater data capture for the year except for the site on Mt. Greylock in Adams (68%). The adverse weather conditions at this site necessitate a late start-up. The O3 data capture for all sites combined was 93%.

The O3 air quality standard (0.12 ppm 1-hour average) was exceeded at three of the sixteen sites. The highest 1-hour value was 0.151 ppm at Fairhaven which is 121% of the standard. See Part 2 (pg. 17) for more information regarding O3 exceedances and Massachusetts' O3 attainment status.

O3 is measured by an automated analyzer which takes samples continuously to provide hourly averaged values.

Trend data over the last ten years for each site tracking the number of days in which there were O3 exceedances is shown in **Figure 12**. The trend has been relatively stable except for 1988 when meteorological conditions contributed to an increase in the number of exceedance days.

Table 12 lists by site the O3 data during the ozone season (April 1 to September 30) including the four maximum 1-hour values, the number of values that exceeded the O3 air quality standard and the number of days that O3 data was reported (100% is 183).

TABLE 12: 1997 O3 DATA SUMMARY

OZONE (44201) MASSACHUSETTS UNITS: PPM (007)

OZONE SEASON: APR 01 TO SEP 30

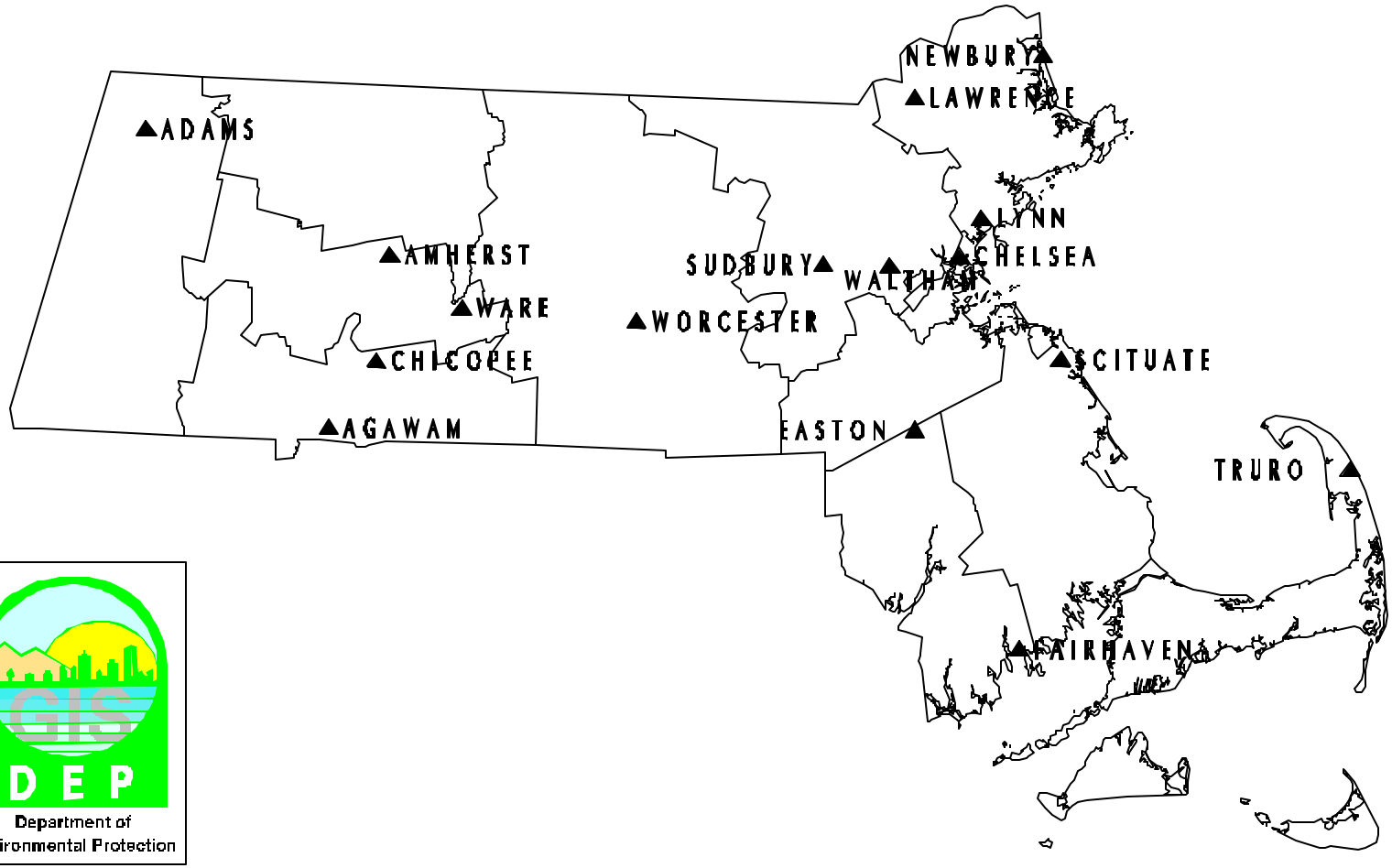
	P									VALID DAILY 1-HR MAXIMUM						MISS DAYS
	O	M					REP	NUM	NUM	------ MAXIMA ------				----- VALS>	.125	ASSUMED
SITE ID	C	T	CITY	COUNTY	ADDRESS	YR	ORG	MEAS	REQ	1ST	2ND	3RD	4TH	MEAS	EST	STANDARD
25-003-4002	1	2	ADAMS	BERKSHIRE	MT. GREYLOCK	97	1	122	183	.099	.087	.084	.083	0	0.0	0
25-013-0003	1	8	AGAWAM	HAMPDEN	152 S. WESTFIELD	97	1	175	183	.115	.114	.112	.110	0	0.0	2
25-015-0103	1	2	AMHERST	HAMPSHIRE	NORTH PLEASANT	97	1	175	183	.109	.106	.104	.103	0	0.0	2
25-025-1003	1	1	CHELSEA	SUFFOLK	POWDER HORN HILL	97	1	170	183	.094	.092	.090	.089	0	0.0	2
25-013-0008	1	7	CHICOPEE	HAMPDEN	ANDERSON ROAD	97	1	174	183	.127	.126	.116	.113	2	2.1	3
25-005-1005	1	7	EASTON	BRISTOL	1 BORDERLAND ST.	97	1	178	183	.114	.107	.107	.104	0	0.0	0
25-005-1002	1	2	FAIRHAVEN	BRISTOL	LEROY WOOD SCHOOL	97	1	182	183	.145	.123	.118	.112	1	1.0	1
25-009-0005	1	1	LAWRENCE	ESSEX	HIGH STREET	97	1	174	183	.115	.097	.091	.084	0	0.0	2
25-009-2006	1	8	LYNN	ESSEX	390 PARKLAND AVE	97	1	181	183	.121	.105	.101	.100	0	0.0	1
25-009-4004	1	7	NEWBURY	ESSEX	SUNSET BOULEVARD	97	1	180	183	.123	.118	.107	.102	0	0.0	3
25-023-2001	1	2	SCITUATE	PLYMOUTH	SCITUATE POLICE	97	1	181	183	.106	.095	.085	.081	0	0.0	2
25-017-1801	1	1	SUDBURY	MIDDLESEX	WATER ROW RD	97	1	177	183	.114	.107	.107	.099	0	0.0	2
25-001-0002	1	2	TRURO	BARNSTABLE	FOX BOTTOM AREA	97	1	124	183	.124	.116	.116	.115	0	0.0	1
25-017-4003	1	2	WALTHAM	MIDDLESEX	BEAVER STREET	97	1	181	183	.114	.114	.105	.103	0	0.0	2
25-015-4002	1	7	WARE	HAMPSHIRE	QUABBIN SUMMIT	97	1	176	183	.151	.142	.132	.123	3	3.0	5
25-027-0015	1	1	WORCESTER	WORCESTER	WORCESTER AIRPORT	97	1	177	183	.108	.106	.104	.104	0	0.0	4

PRIMARY STANDARD: 1-HOUR = 0.12 PPM
TO CONVERT UNITS FROM PPM TO mG/M³ MULTIPLY PPM x 1960.8

ABBREVIATIONS AND SYMBOLS USED IN TABLE 12

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (1 = NAMS, 2 = SLAMS, 3 = OTHER; 7 = PAMS/NAMS; 8 = PAMS/SLAMS) **REP ORG** = REPORTING ORGANIZATION **NUM MEAS** = NUMBER OF DAYS MEASURED **NUM REQ** = NUMBER OF DAYS IN OZONE SEASON **1ST,2ND,3RD,4TH MAXIMA** = MAXIMUM 1HR VALUE FOR THE 1ST,2ND,3RD,4TH HIGHEST DAY **VALS > 0.12 MEAS** = NUMBER OF MEASURED DAILY MAXIMUM VALUES GREATER THAN OR EQUAL TO 0.12 PPM **VALS > 0.12 EST** = NUMBER OF EXPECTED VIOLATIONS OF THE OZONE STANDARD
MISS DAYS ASSUMED < STANDARD = NUMBER OF MISSING DAYS ASSUMED TO BE LESS THAN THE OZONE STANDARD

1997 Public Ozone Monitoring Network



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DEP
Department of
Environmental Protection

May 07, 1998

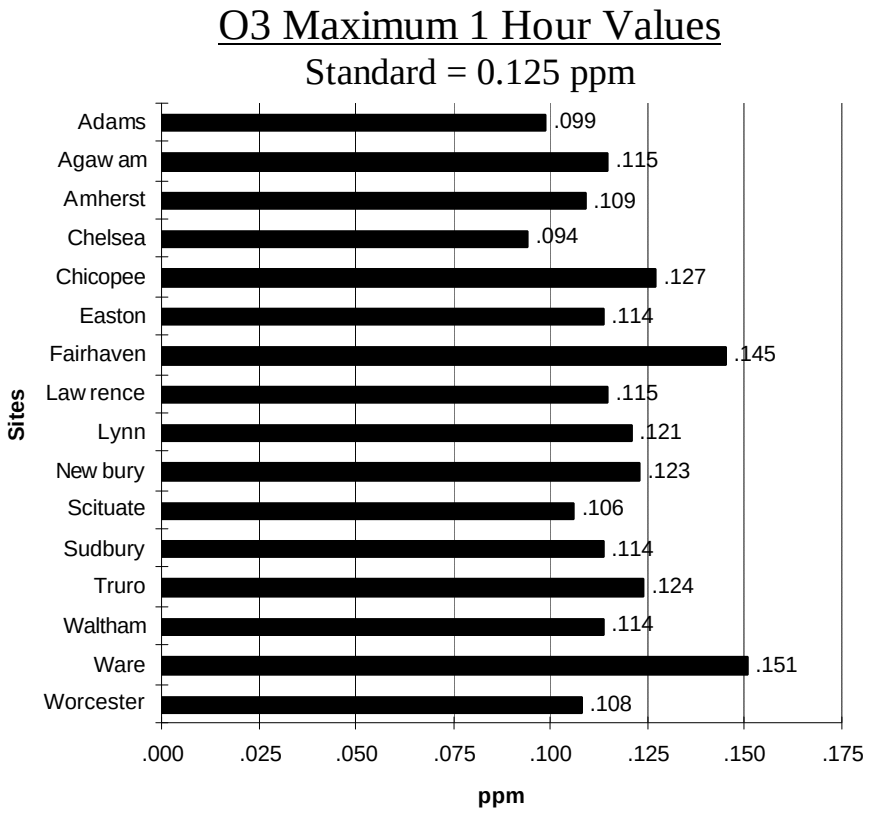


figure 10

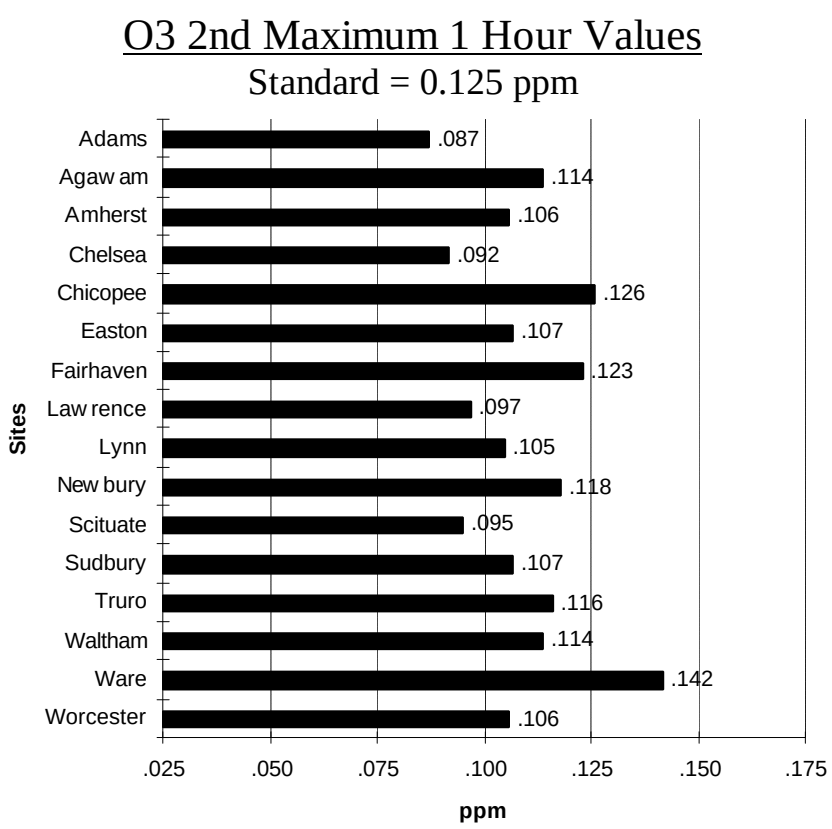
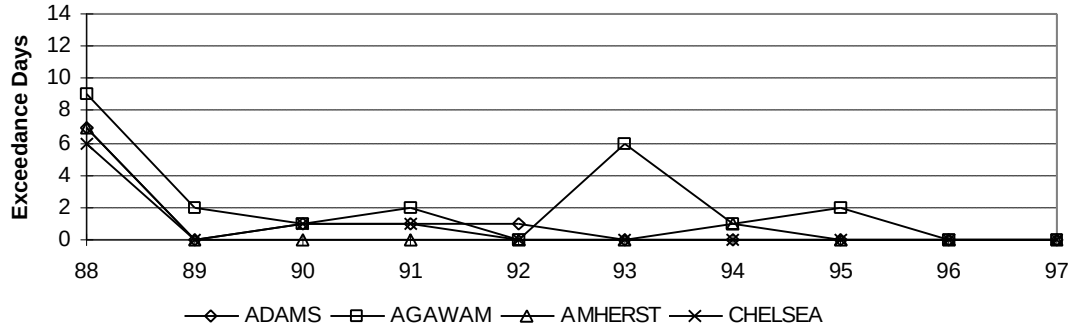


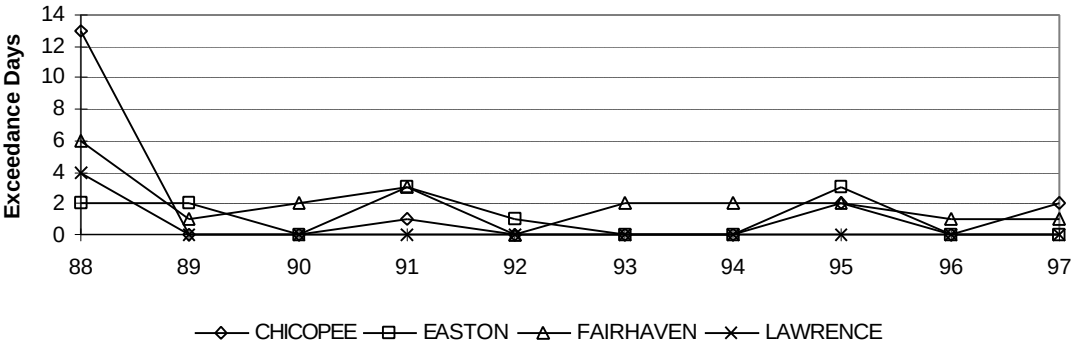
figure 11

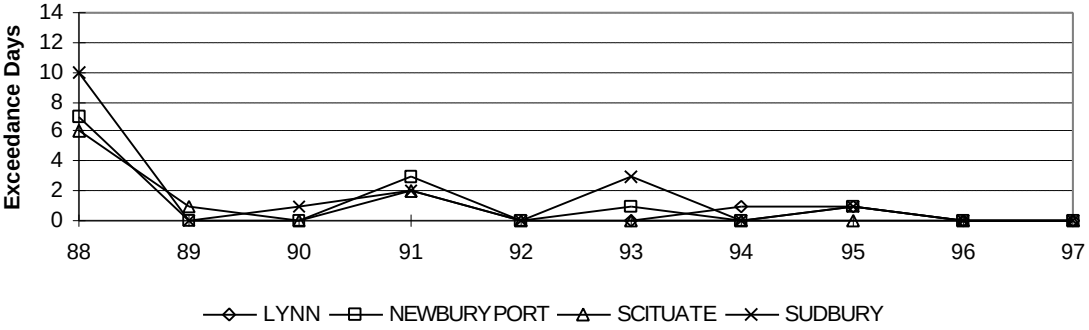
O3 10-Year Trends

of Days when O3 exceeded the standard (0.125 ppm)

The ten-year trend has been relatively stable except for 1988 which had meteorology favorable to O3 formation.







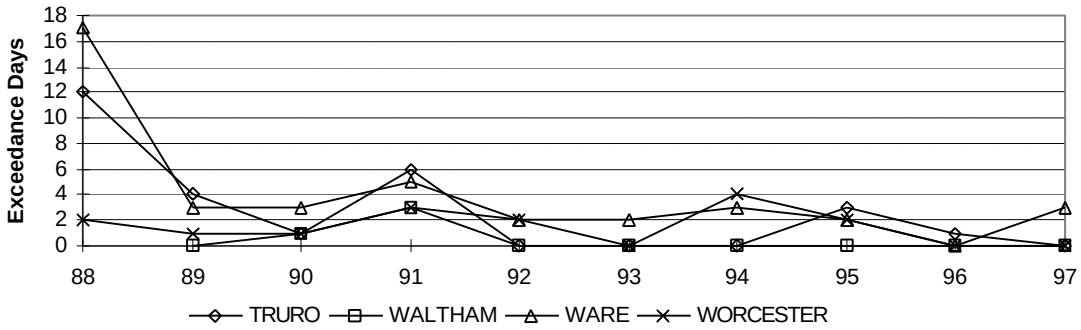


figure 12

O3 Data Capture

For all sites during 1997

15 out of 16 Ozone monitors met the 75% data capture requirement. The Adams site on Mt. Greylock collected 68%. The adverse weather conditions at this site necessitate a late start-up.

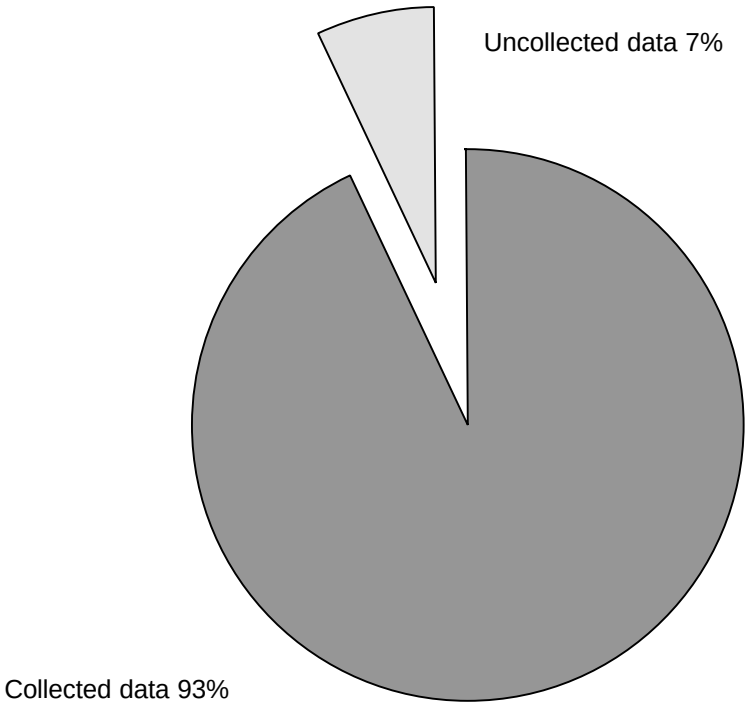


figure 13

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3.4 SULFUR DIOXIDE (SO2) DATA SUMMARY

There were ten SO2 sites during 1997 in the state-operated network. All of the sites achieved the requirement of 75% or greater data capture for the year except Ware (67%) which lost data due to an analyzer malfunction. The SO2 data capture for all sites combined was 94%.

There were no violations of the SO2 air quality standards during the year. The highest annual arithmetic mean was 0.009 ppm at Boston (Kenmore Sq.). which is 30% of the standard. The highest 24-hour value was 0.055 ppm at Chelsea which is 39% of the standard. The highest 3-hour value was 0.098 ppm also at Chelsea which is 20% of the standard.

SO2 is measured by an automated analyzer which takes samples continuously to provide hourly averaged values.

Trend data over the last ten years for each site tracking the annual arithmetic mean is shown in **Figure 18**. The data shows a downward trend for SO2.

Table 13 lists by site the SO2 data for 1997 including the number of hour observations (100% is 8760); the 1st and 2nd maximum values for 24-hour, 3-hour and 1-hour periods; as well as the annual arithmetic mean.

TABLE 13: 1997 SO2 DATA SUMMARY

SULFUR DIOXIDE (42401) MASSACHUSETTS UNITS: PPM (007)

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS > STD	MAX 3-HR 1ST	MAX 3-HR 2ND	OBS > STD	MAX 1-HR 1ST	MAX 1-HR 2ND	ANN ARIT MEAN
25-025-0002	1	1	BOSTON	SUFFOLK	KENMORE SQUARE	8293	.036	.034	0	.057	.051	0	.064	.063	.009
25-025-0021	1	1	BOSTON	SUFFOLK	340 BREMAN ST.	8535	.032	.030	0	.053	.048	0	.077	.072	.008
25-025-1003	1	1	CHELSEA	SUFFOLK	POWDER HORN HILL	8332	.055	.049	0	.098	.093	0	.124	.118	.007
25-005-1004	1	1	FALL RIVER	BRISTOL	GLOBE STREET	8549	.034	.024	0	.083	.067	0	.110	.093	.005
25-009-0005	1	1	LAWRENCE	ESSEX	HIGH STREET	8435	.028	.027	0	.051	.048	0	.082	.062	.005
25-013-0016	1	1	SPRINGFIELD	HAMPDEN	LIBERTY STREET	8667	.020	.020	0	.049	.035	0	.063	.048	.005
25-013-1009	1	1	SPRINGFIELD	HAMPDEN	LONGHILL STREET	8535	.021	.021	0	.036	.032	0	.047	.047	.005
25-017-4003	1	1	WALTHAM	MIDDLESEX	BEAVER STREET	8548	.020	.020	0	.035	.032	0	.051	.049	.004
25-015-4002	1	2	WARE	HAMPSHIRE	QUABBIN SUMMIT	5882	.023	.023	0	.039	.035	0	.062	.048	.005?
25-027-0020	1	1	WORCESTER	WORCESTER	CENTRAL STREET	8535	.025	.021	0	.039	.039	0	.053	.047	.004

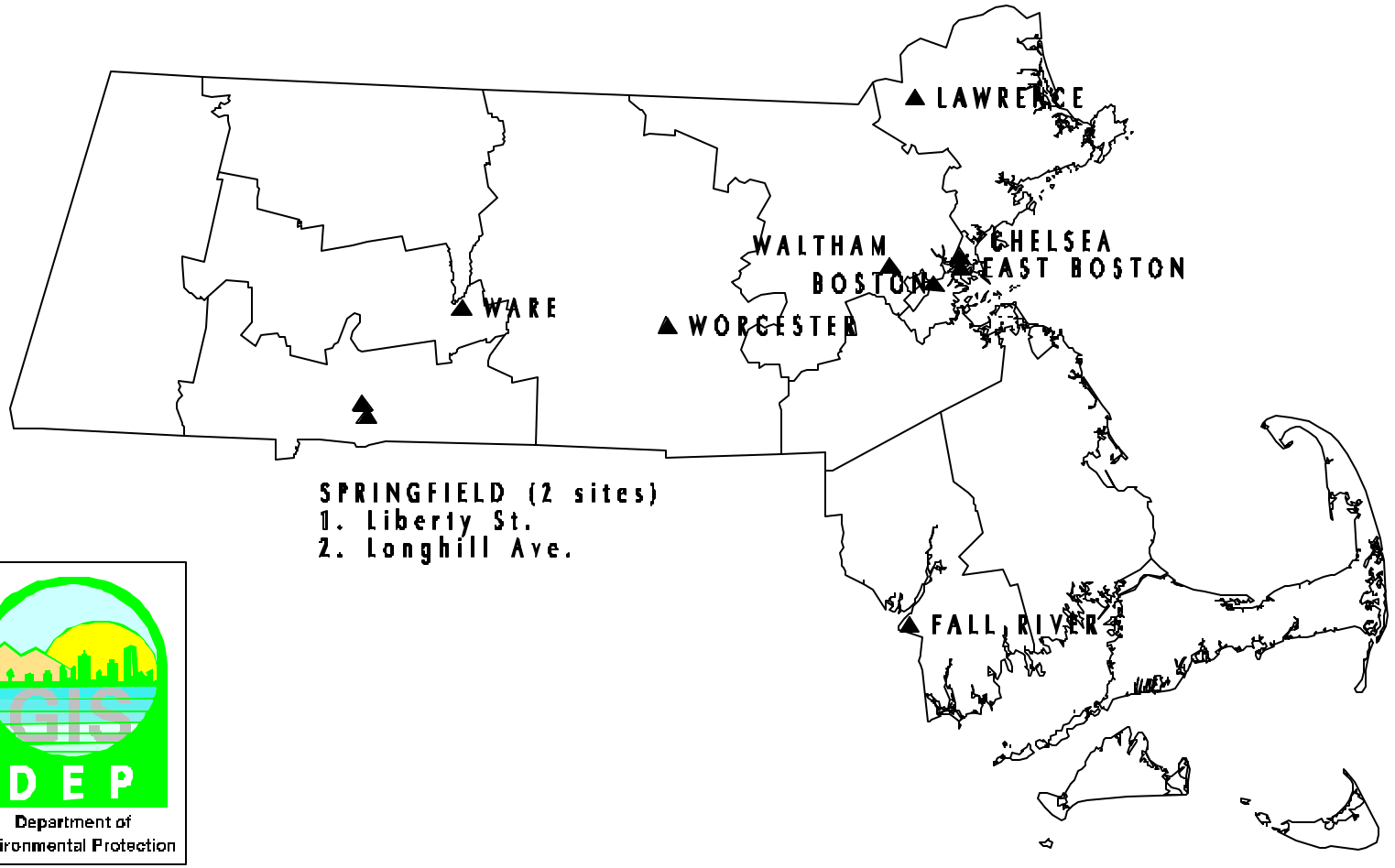
? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER < 75%)
TO CONVERT UNITS FROM PPM TO mG/M^3 MULTIPLY PPM x 2620

PRIMARY STANDARDS: ANNUAL ARITHMETIC MEAN = 0.03 PPM
24-HOUR = 0.14 PPM
SECONDARY STANDARD: 3-HOUR = 0.50 PPM

ABBREVIATIONS AND SYMBOLS USED IN TABLE 13

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (1 = NAMS, 2 = SLAMS, 3 = OTHER) **REP ORG** = REPORTING ORGANIZATION **#OBS** = NUMBER OF HOUR OBSERVATIONS **MAX 24-HR, MAX 3-HR, MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > .14** = NUMBER OF 24-HR AVG. GREATER THAN 0.14 PPM (24-HR STANDARD) **OBS > .50** = NUMBER OF 3-HR AVG. GREATER THAN 0.50 PPM (3-HR STANDARD) **ANN ARIT MEAN** = ANNUAL ARITHMETIC MEAN (STANDARD = 0.03 PPM)

1997 Public SO2 Monitoring Network



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SO2 Maximum 1-Hour Values

Standard = None

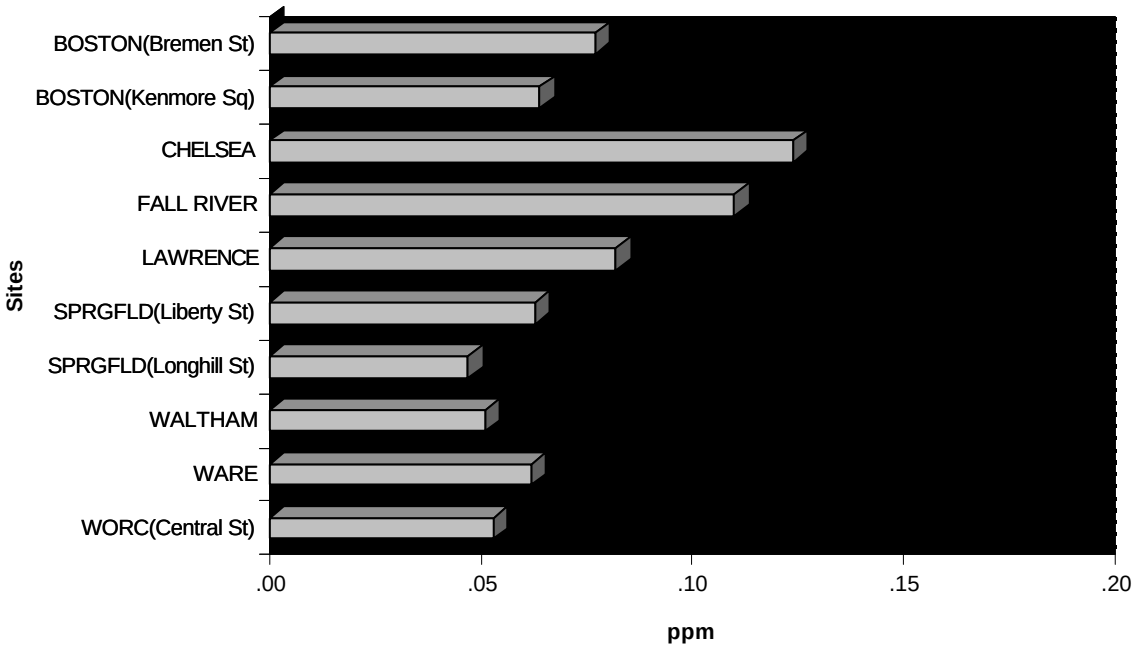


figure 14

SO2 2nd Maximum 3-Hour Values

Standard = 0.5 ppm

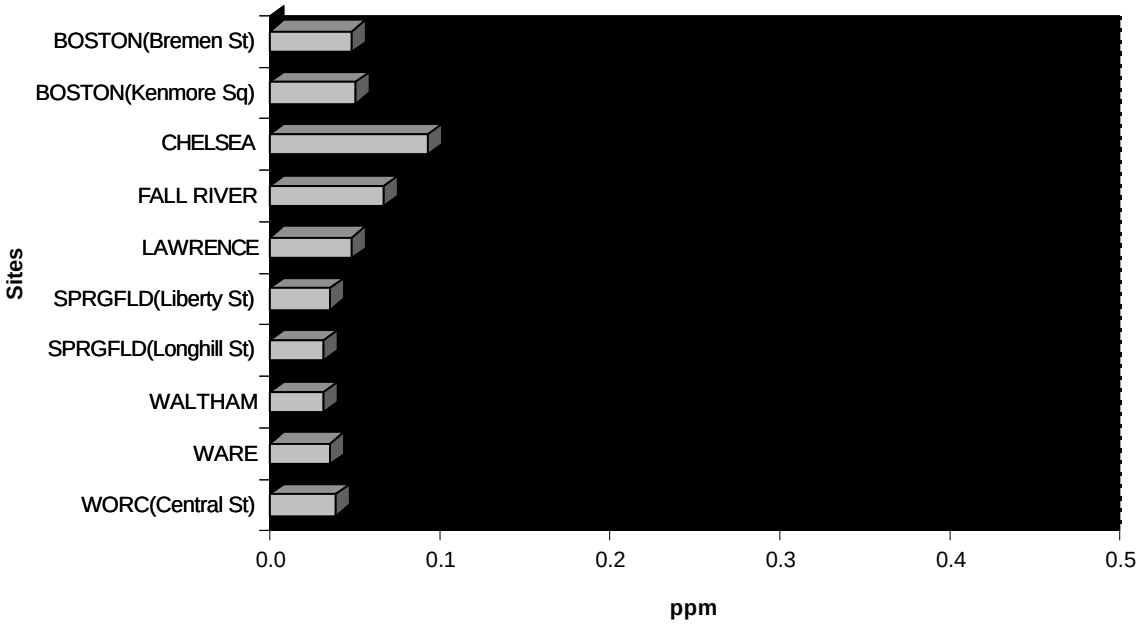


figure 15

SO2 2nd Maximum 24-Hour Values

Standard = 0.14 ppm

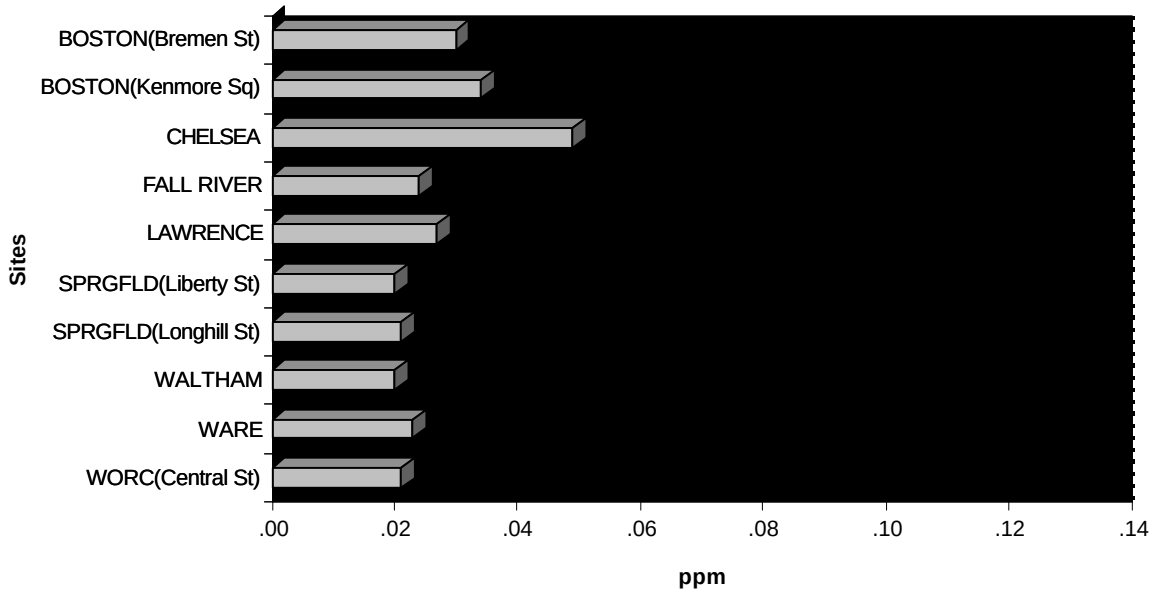


figure 16

SO2 Annual Arithmetic Means

Standard = 0.03 ppm

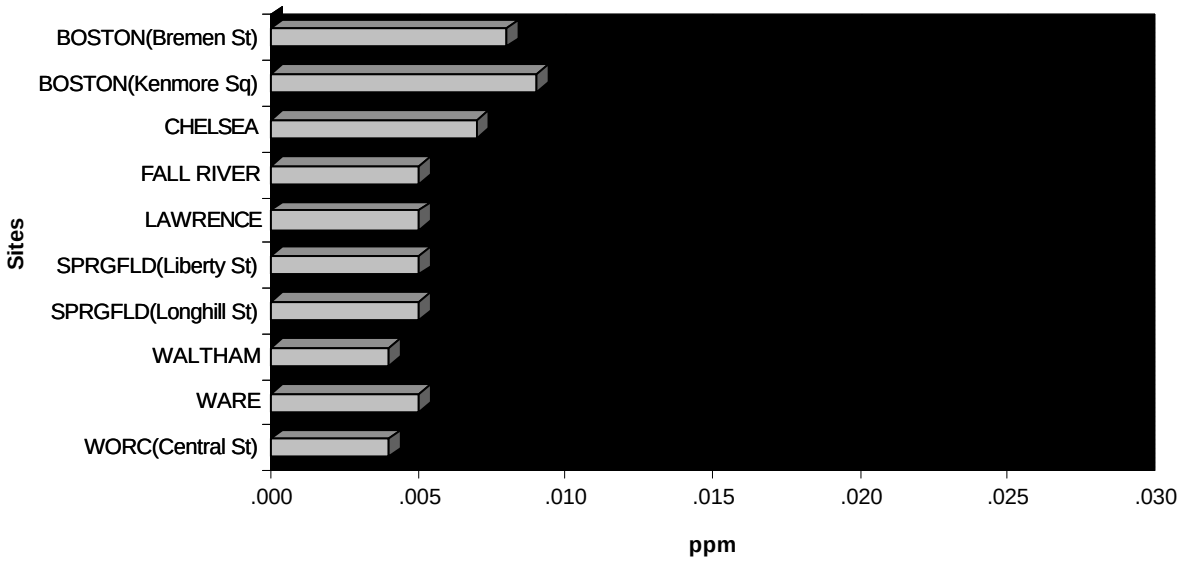


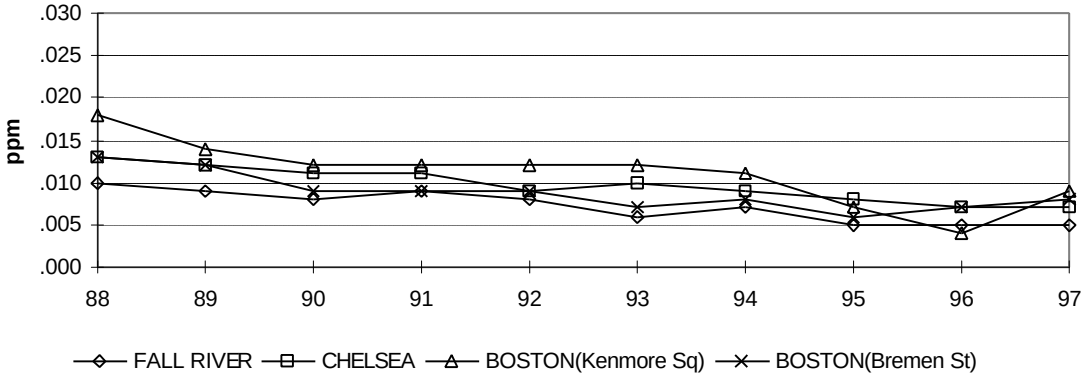
figure 17

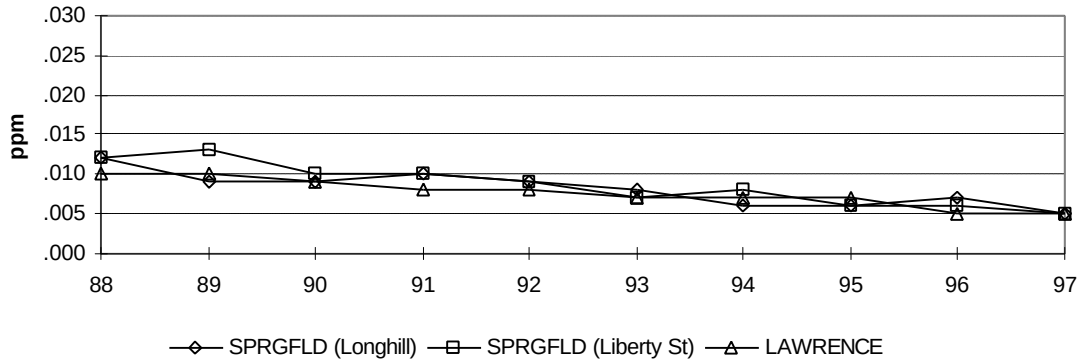
SO2 10-Year Trends

Annual Arithmetic Mean

Standard = 0.03 ppm

The data for the last ten years shows a downward trend for SO2.





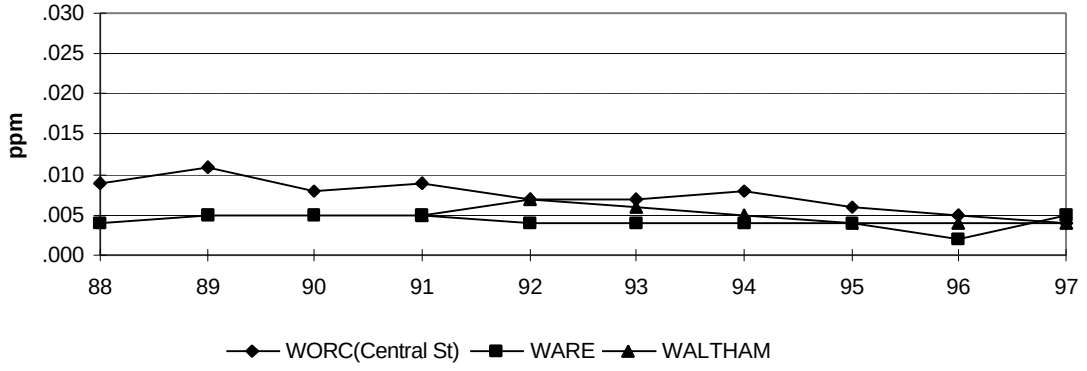


figure 18

SO2 Data Capture

For all sites during 1997

9 out of 10 SO2 monitors met the 75% yearly data capture requirement.
The site in Ware (67%) lost data due to an analyzer malfunction.

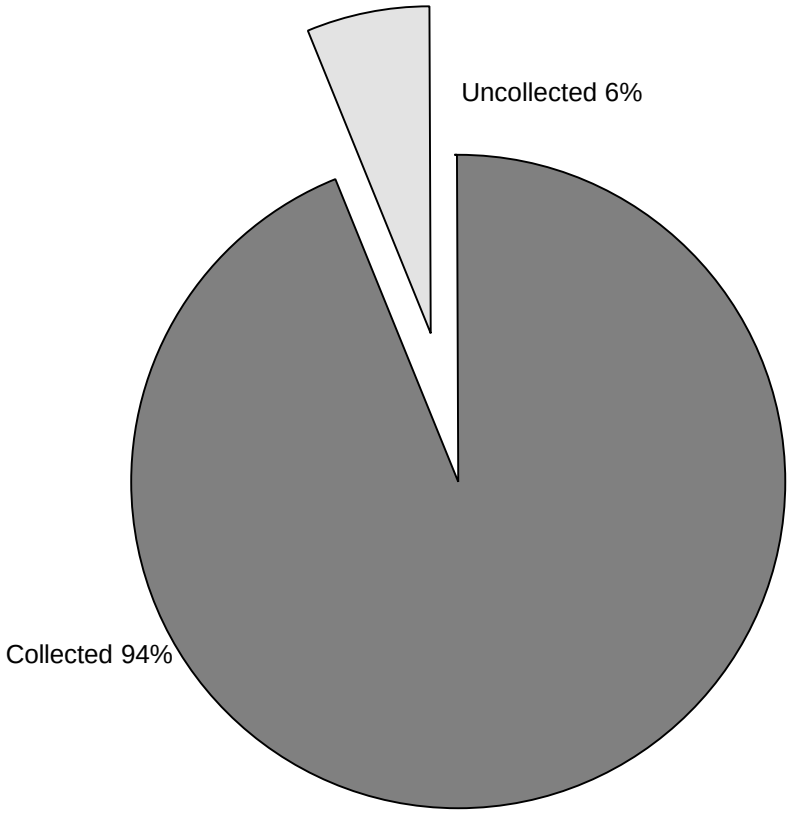


figure 19

3.5 NITROGEN DIOXIDE (NO2) DATA SUMMARY

There were twelve NO2 sites during 1997 in the state-operated network. A new site was established in Truro in July. All of the sites achieved the requirement of 75% or greater data capture for the year. The NO2 data capture for all sites combined was 93%.

There were no violations of the NO2 air quality standard during the year. The highest annual arithmetic mean was 0.030 ppm at Boston (Kenmore Sq.) which is 57% of the standard.

NO2 is measured by an automated analyzer which takes samples continuously to provide hourly averaged values.

Trend data over the last ten years for each site tracking the annual arithmetic mean is shown in **Figure 22**. The data shows a slightly downward trend for NO2 for the ten year period.

Table 14 lists by site the NO2 data for 1997 including the number of hour observations (100% is 8760), the 1st and 2nd maximum 1-hour values, and the annual arithmetic mean.

TABLE 14: 1997 NO2 DATA SUMMARY

NITROGEN DIOXIDE (42602) MASSACHUSETTS UNITS: PPM

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	#OBS	MAX 1-HR 1ST	MAX 1-HR 2ND	MAX 24-HR 1ST	MAX 24-HR 2ND	ARIT MEAN
25-013-0003	1	8	AGAWAM	HAMPDEN	152 SOUTH WESTFIELD STREET	8607	.065	.064			.011
25-025-0002	1	3	BOSTON	SUFFOLK	KENMORE SQUARE	8126	.134	.089			.030
25-025-0021	1	1	BOSTON	SUFFOLK	340 BREMAN STREET, EAST BOSTON	8505	.081	.079			.027
25-025-1003	1	1	CHELSEA	SUFFOLK	POWDER HORN HILL	7795	.081	.080			.022
25-013-0008	1	8	CHICOPEE	HAMPDEN	ANDERSON ROAD AIR FORCE BASE	8175	.070	.065			.012
25-005-1005	1	8	EASTON	BRISTOL	1 BORDERLAND ST.	8531	.050	.048			.009
25-009-2006	1	8	LYNN	ESSEX	390 PARKLAND AVE.	8177	.064	.063			.015
25-009-4004	1	8	NEWBURY	ESSEX	SUNSET BOULEVARD	8143	.050	.042			.007
25-013-0016	1	2	SPRINGFIELD	HAMPDEN	LIBERTY STREET PARKING LOT	7985	.074	.068			.022
25-001-0002	1	U	TRURO	BARNSTABLE	FOX BOTTOM AREA-CAPE COD	3762	.048	.047			.008?
25-015-4002	1	8	WARE	HAMPSHIRE	QUABBIN SUMMIT	7793	.054	.053			.009
25-027-0020	1	2	WORCESTER	WORCESTER	CENTRAL STREET FIRE STATION	7442	.095	.090			.019

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER < 75%)

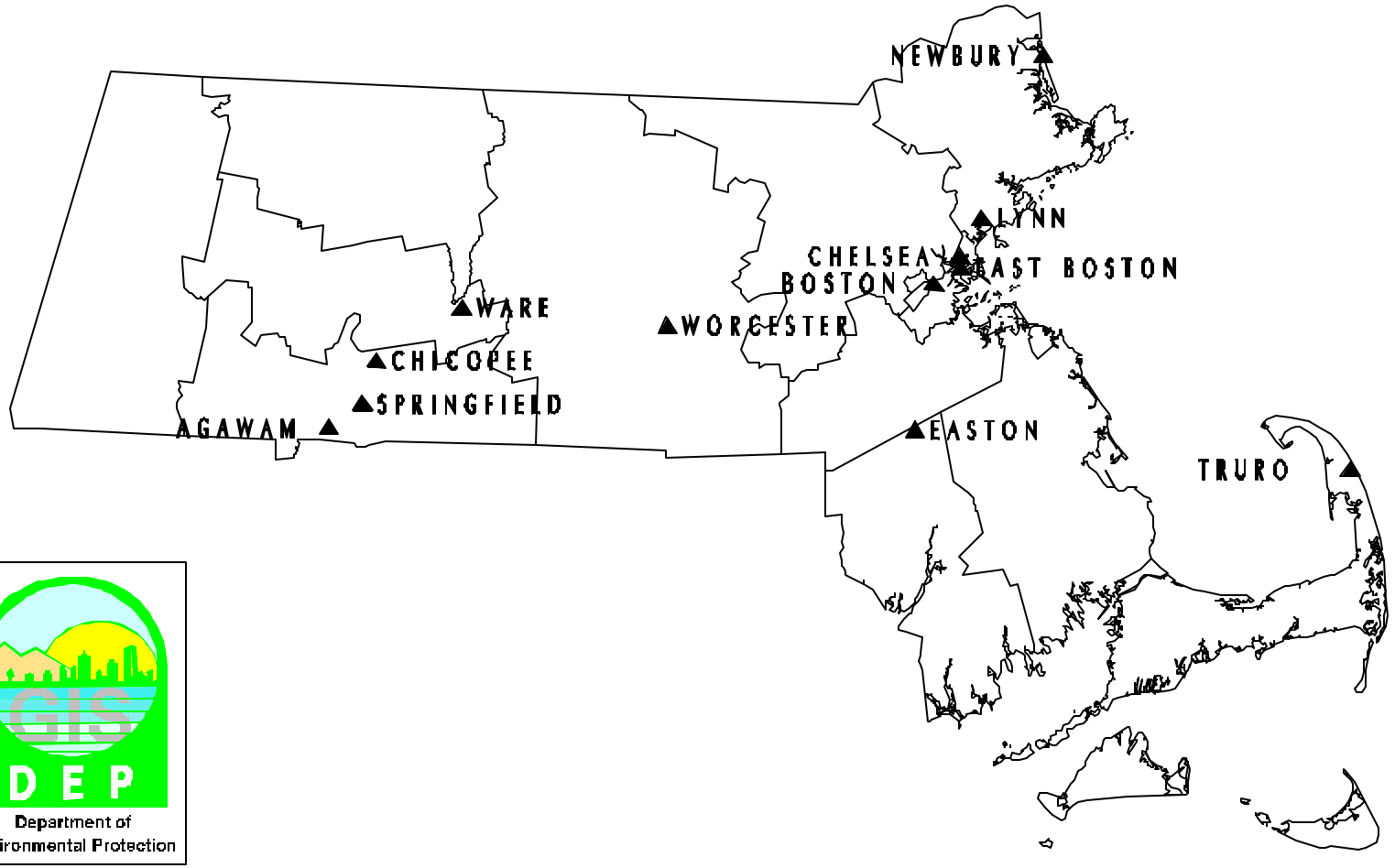
TO CONVERT UNITS FROM PPM TO mG/M^3 MULTIPLY PPM x 1880

PRIMARY STANDARD: ANNUAL ARITHMETIC MEAN = 0.053 PPM

ABBREVIATIONS AND SYMBOLS USED IN TABLE 14

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (1 = NAMS, 2 = SLAMS, 3 = OTHER; 7 = PAMS/NAMS; 8 = PAMS/SLAMS) **REP ORG** = REPORTING ORGANIZATION **#OBS** = NUMBER OF HOUR OBSERVATIONS **MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **ARITH MEAN** = ANNUAL ARITHMETIC MEAN

1997 Public NO2 Monitoring Network



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NO2 Maximum 1-Hour Values

State Standard = 0.186 ppm

(there is no federal standard)

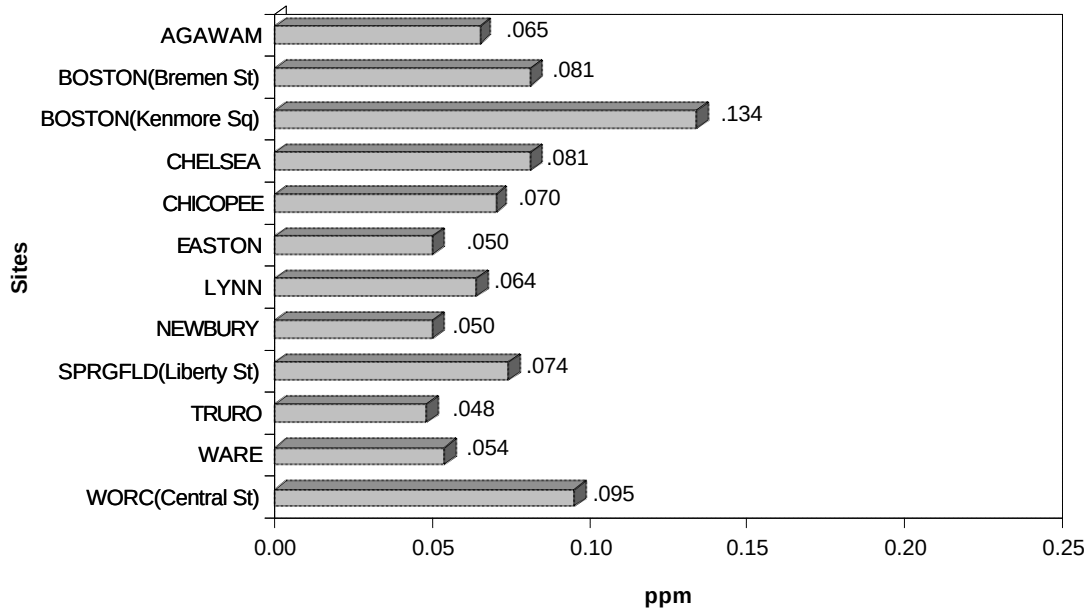


figure 20

NO2 Annual Arithmetic Means

Standard = 0.05 ppm

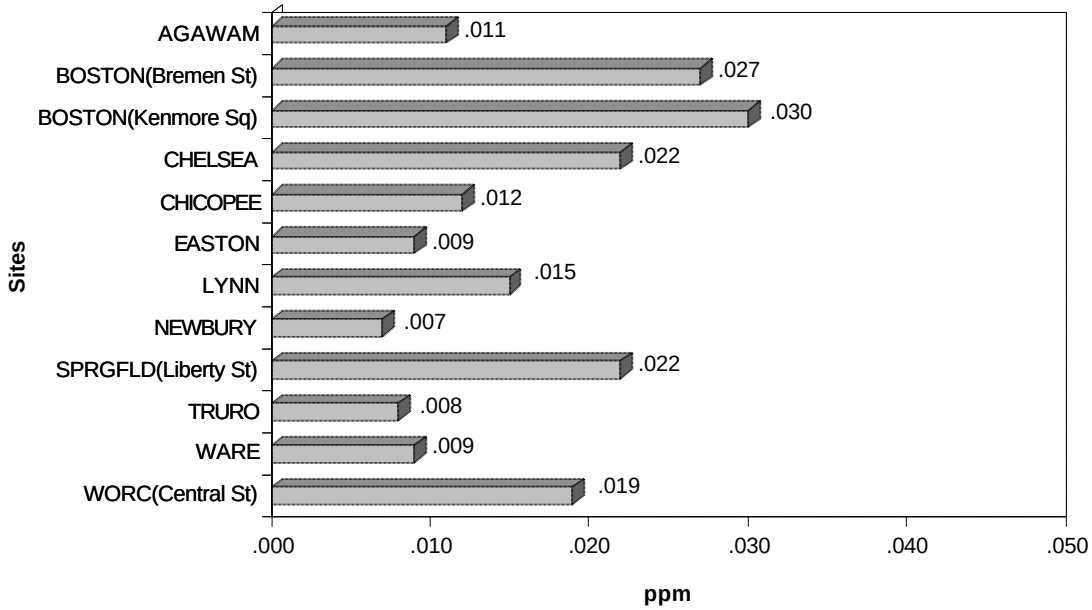


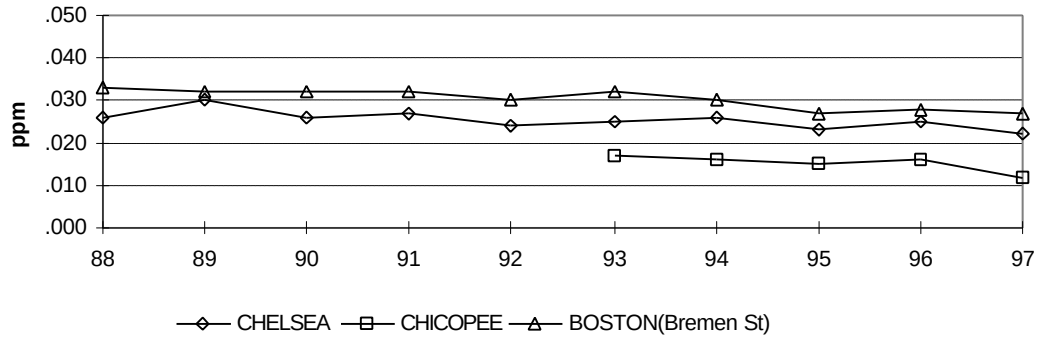
figure 21

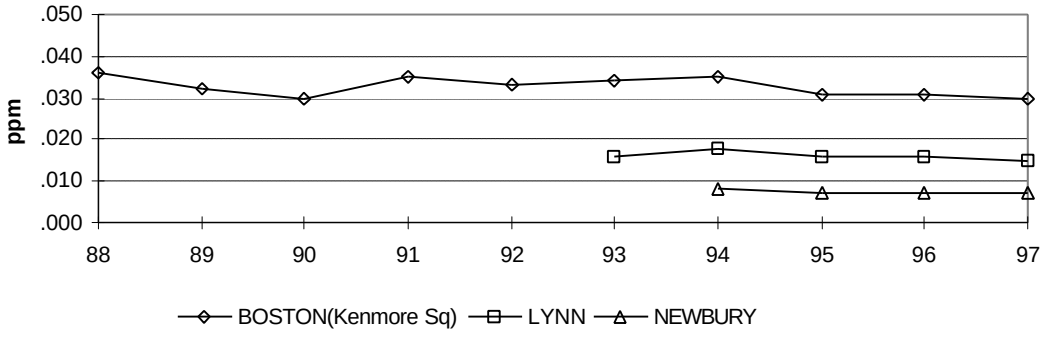
NO2 10-Year Trends

Annual Arithmetic Mean

Standard = 0.05 ppm

The data shows a slightly downward trend for NO2 over the last ten years.





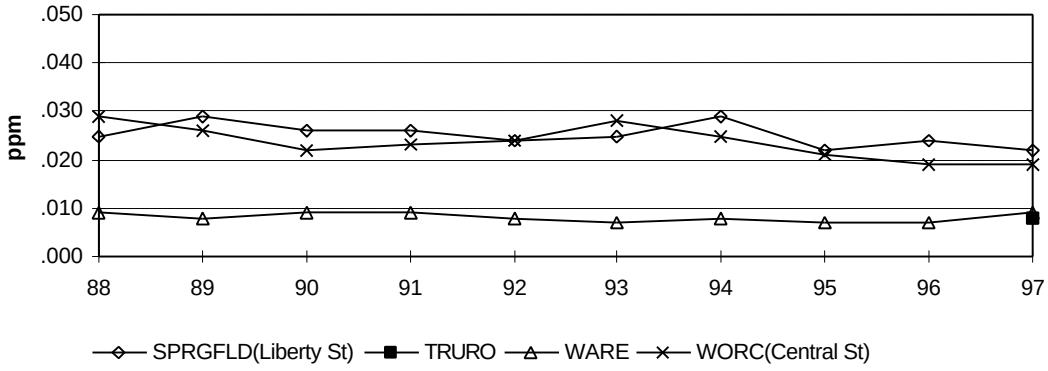


figure 22

NO2 Data Capture

For all sites during 1997

12 out of 12 NO2 monitors met the
75% yearly data capture requirement

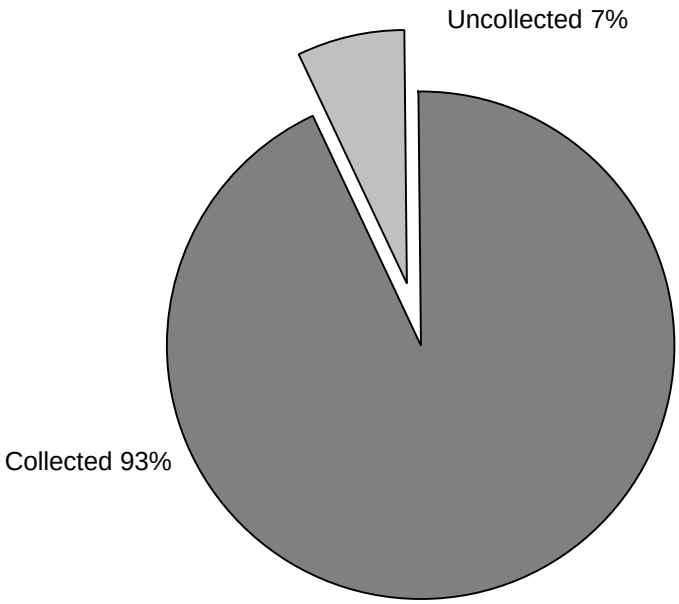


figure 23

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3.6 CARBON MONOXIDE (CO) DATA SUMMARY

There were nine CO sites during 1997 in the state-operated network. All of the sites achieved the requirement of 75% or greater data capture for the year. The CO data capture for all sites combined was 97%.

There were no violations of the CO 8-hour standards during the year. The highest 1-hour value was 7.9 ppm at Springfield (East Columbus Ave.) which is 23% of the standard. The highest 8-hour value was 6.1 ppm at Springfield (Liberty Street) which is 68% of the standard.

CO is measured by an automated analyzer which takes samples continuously to provide hourly averaged values.

Trend data over the last ten years for each site tracking the second maximum 8-hour average is shown in **Figure 26**. The data shows a yearly variability at most sites but generally the trend is downward.

Table 15 lists by site the CO data for 1997 including the number of hour observations (100% is 8760) and the maximum values for 1-hour and 8-hour periods.

TABLE 15: 1997 CO DATA SUMMARY

CARBON MONOXIDE (42101) MASSACHUSETTS UNITS: PPM (007)
REPORTING ORG: 001

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	#OBS	MAX 1-HR 1ST	MAX 1-HR 2ND	OBS> 35	MAX 8-HR 1ST	MAX 8-HR 2ND	OBS > 9
25-025-0002	1	2	BOSTON	SUFFOLK	KENMORE SQUARE, 590 COMM. AVE	8503	6.6	5.7	0	4.5	2.9	0
25-025-0016	1	2	BOSTON	SUFFOLK	SUMNER TUNNEL, EAST BOSTON	8650	5.9	5.4	0	4.4	3.8	0
25-025-0021	1	1	BOSTON	SUFFOLK	340 BREMAN STREET, EAST BOSTON	8661	6.6	5.1	0	4.6	3.7	0
25-025-0038	1	1	BOSTON	SUFFOLK	FEDERAL POST OFFICE BLDG	8439	6.7	6.6	0	4.9	4.7	0
25-017-0007	1	2	LOWELL	MIDDLESEX	OLD CITY HALL, MERRIMACK ST	7962	6.0	5.7	0	4.1	3.6	0
25-013-0016	1	1	SPRINGFIELD	HAMPDEN	LIBERTY STREET PARKING LOT	8546	6.8	6.5	0	6.1	5.3	0
25-013-2007	1	1	SPRINGFIELD	HAMPDEN	EAST COLUMBUS AVENUE	8536	7.9	7.0	0	5.3	4.9	0
25-027-0020	1	2	WORCESTER	WORCESTER	CENTRAL STREET FIRE STATION	8398	6.2	5.5	0	3.7	3.4	0
25-027-0022	1	2	WORCESTER	WORCESTER	FRANKLIN/GRAFTON PARKING LOT	8449	7.5	5.8	0	3.4	3.3	0

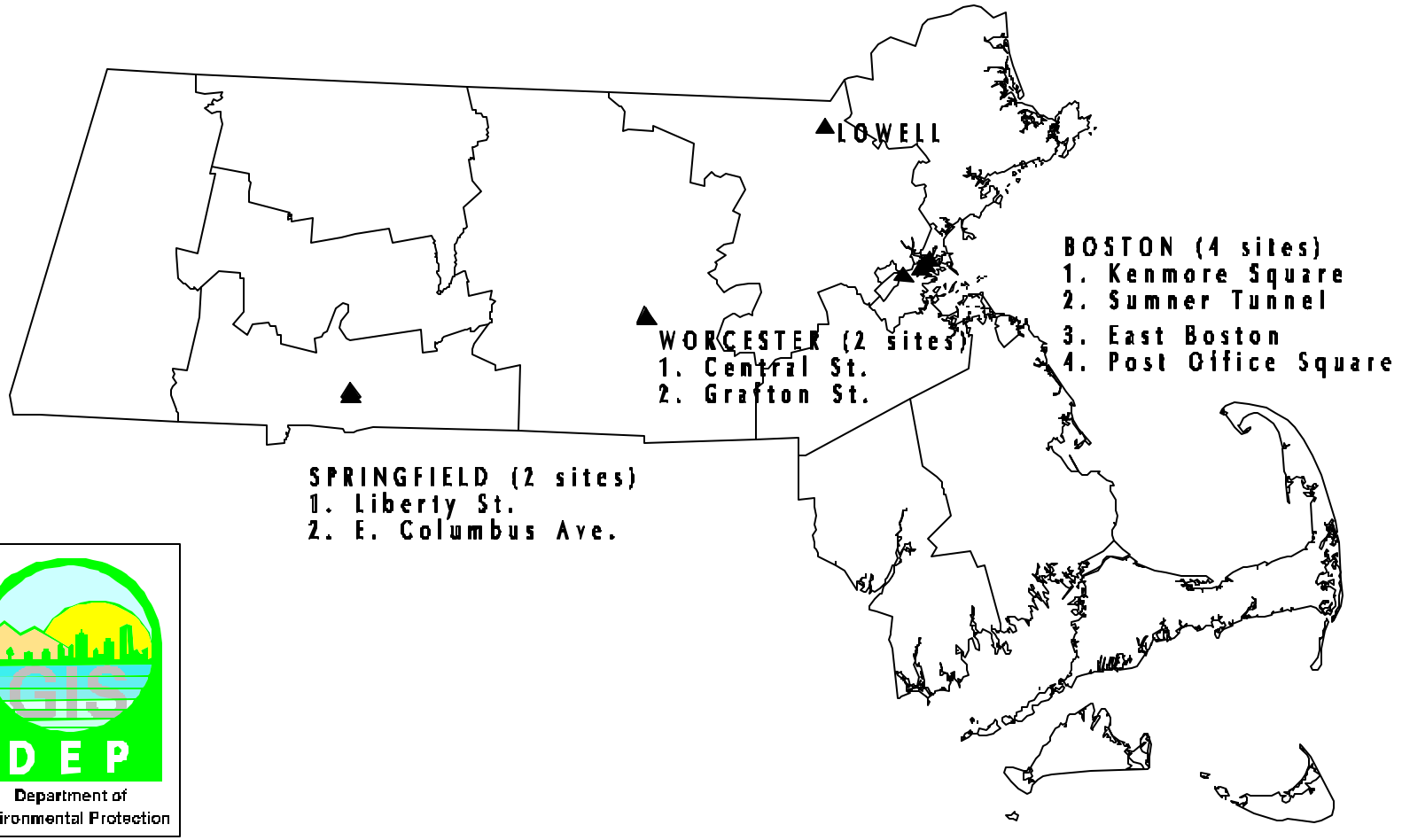
? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER < 75%)

PRIMARY STANDARDS: 8-HOUR = 9 PPM
1-HOUR = 35 PPM

ABBREVIATIONS AND SYMBOLS USED IN TABLE 15

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (1 = NAMS, 2 = SLAMS, 3 = OTHER) **REP ORG** = REPORTING ORGANIZATION **#OBS** = NUMBER OF HOUR OBSERVATIONS **MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > 35** = NUMBER OF 1-HR AVG. GREATER THAN 35 PPM (1-HR STANDARD) **OBS > 9** = NUMBER OF 8-HR AVG. GREATER THAN 9 PPM (8-HR STD)

1997 Public CO Monitoring Network



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CO 2nd Maximum 1-Hour Values

Standard = 35 ppm

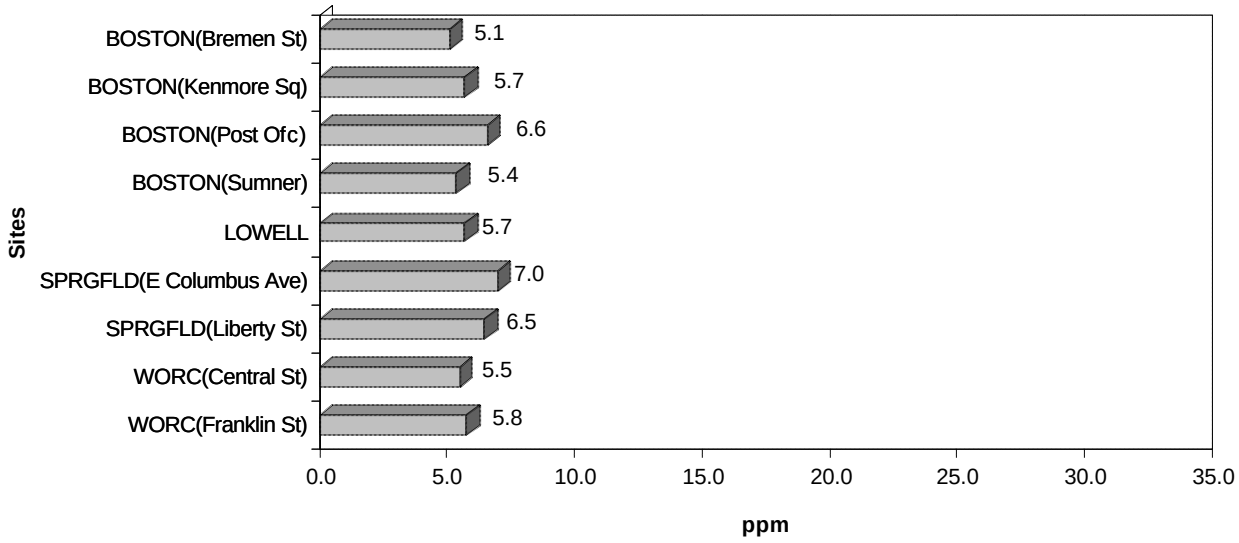


figure 24

CO 2nd Maximum 8-Hour Values

Standard = 9 ppm

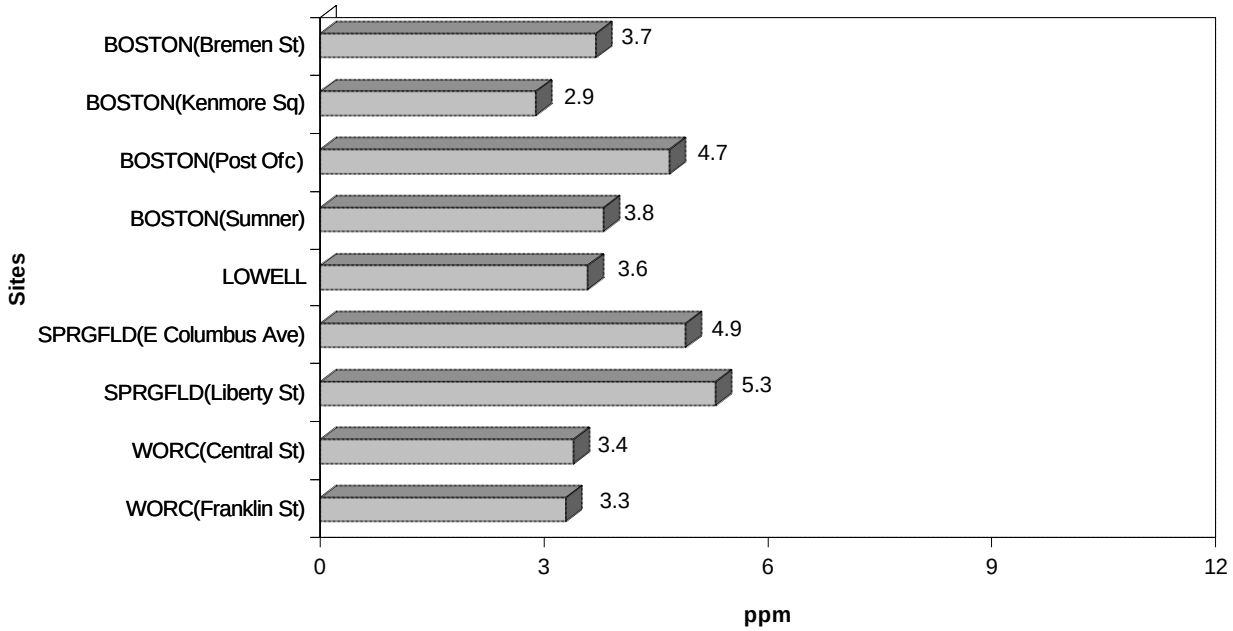


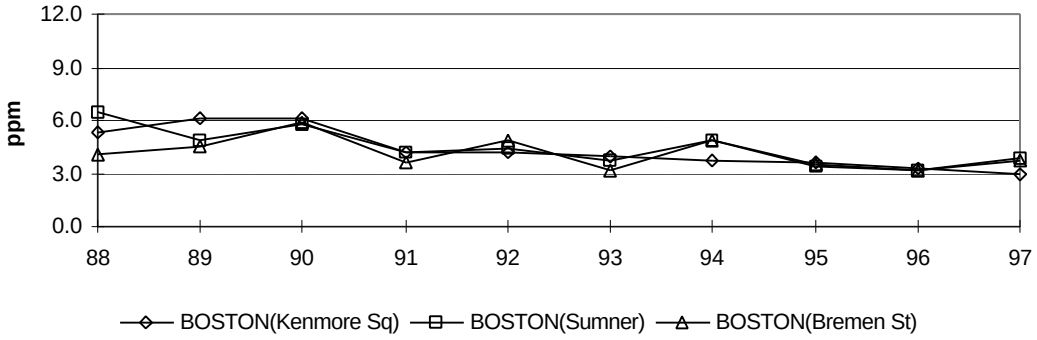
figure 25

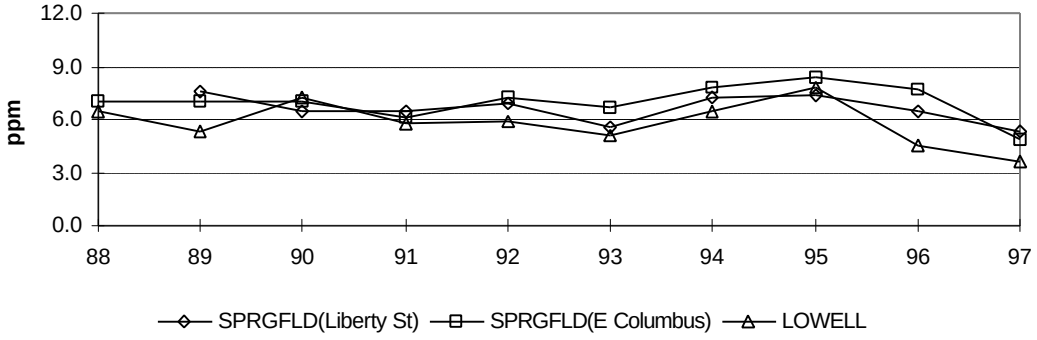
CO 10-Year Trends

2nd Maximum 8-Hour Value

Standard = 9 ppm

The data shows a yearly variability at most sites but generally the trend is downward.





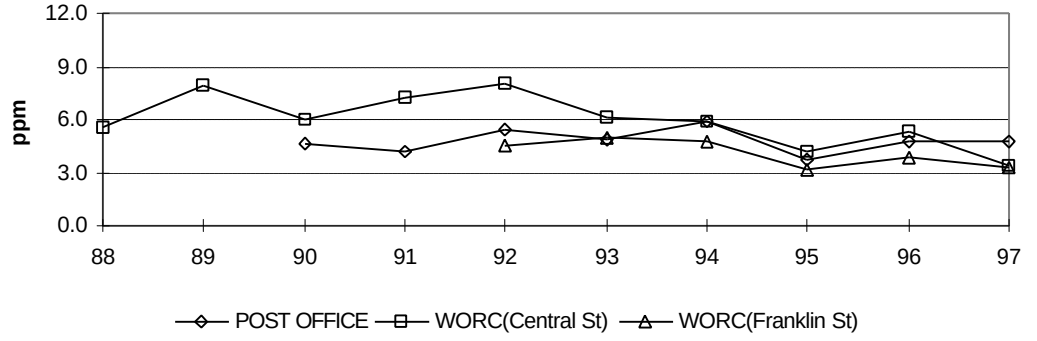


figure 26

CO Data Capture

For all data during 1997

9 out of 9 CO monitors met the
75% yearly data capture requirement.

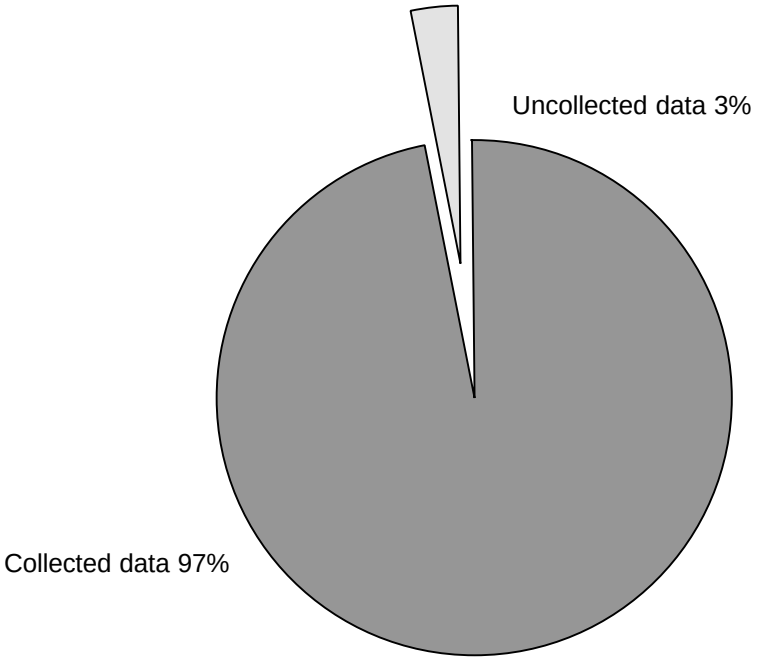


figure 27

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3.7 PARTICULATE MATTER 10-MICRONS (PM-10) DATA SUMMARY

PM-10 encompasses particulate matter which is 10 microns or less in diameter. These small particulates can be a health hazard because they can penetrate the respiratory system. There were sixteen PM-10 sites during 1997 in the state-operated network. Three sites had collocated samplers (samplers which operate simultaneously for precision assessment). Thirteen of the sixteen sites met the requirement of 75% data capture for each calendar quarter. The data capture requirement was not met at Boston (Southampton St.), Quincy, and Worcester (Washington St.) for various reasons - primarily power failures and sampler malfunctions. The PM-10 data capture for all sites combined was 91%.

There were no violations of the PM-10 air quality standards during the year. The highest 24-hour value was 110 μg/m³ at Boston (Columbus Ave.) which is 73% of the standard. The highest annual arithmetic mean was 29 μg/m³ at Springfield (East Columbus Ave.) which is 58% of the standard.

PM-10 is measured by a manual sampler in which samples are collected during a 24-hour period on an every sixth day schedule.

Trend data over the last ten years for each site tracking the annual arithmetic mean is shown in **Figure 30**. The trendline has been slightly downward over the period.

Table 16 lists by site the PM-10 data for 1997 including the number of observations (100% is 61; for Ware 100% is 122 because it samples at an increased frequency), the maximum values, and the annual arithmetic mean.

TABLE 16: 1997 PM-10 DATA SUMMARY

PM-10 TOTAL 0-10UM (81102) MASSACHUSETTS UNITS: UG/CU METER (001)

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	NUM OBS	SCHEDULED NUM OBS	SCHEDULED % OBS	NUM REQ	MAXIMUM VALUES 1ST	2ND	3RD	4TH	VALS > MEAS	150 EST	WTD ARITH MEAN
25-025-0002	1	1	BOSTON	SUFFOLK	KENMORE SQUARE	61	61	100	61	52	41	41	39	0	0.00	25
25-025-0012	1	1	BOSTON	SUFFOLK	115 SOUTHAMPTON ST.	52	51	85	61	67	59	40	37	0	0.0 0	20?
25-025-0012	2	3	BOSTON	SUFFOLK	115 SOUTHAMPTON ST.	35	35	57	61	65	57	39	32	0	0.0 0	22?
25-025-0021	1	2	BOSTON	SUFFOLK	340 BREMAN STREET	57	57	93	61	58	48	43	38	0	0.00	21
25-025-0024	1	1	BOSTON	SUFFOLK	200 COLUMBUS AVENUE	52	52	85	61	86	58	55	53	0	0.00	26
25-025-0027	1	1	BOSTON	SUFFOLK	ONE CITY SQUARE	58	58	95	61	54	45	43	40	0	0.00	24
25-025-0027	3	3	BOSTON	SUFFOLK	ONE CITY SQUARE	42	41	69	61	110	53	52	46	0	0.00	29?
25-005-3001	1	2	FALL RIVER	BRISTOL	CENTRAL FIRE STATION	59	59	97	61	58	43	41	35	0	0.00	18
25-009-0005	1	2	LAWRENCE	ESSEX	HIGH STREET, STORROW	60	57	98	61	42	36	31	29	0	0.00	15
25-005-2004	1	2	NEW BEDFORD	BRISTOL	YMCA,25 WATER STREET	58	58	95	61	51	35	34	30	0	0.00	18
25-021-0007	1	2	QUINCY	NORFOLK	HANCOCK STREET	47	47	77	61	62	39	30	29	0	0.00	17?
25-013-0011	2	2	SPRINGFIELD	HAMPDEN	59 HOWARD STREET	59	59	97	61	52	41	36	36	0	0.00	21
25-013-2007	1	1	SPRINGFIELD	HAMPDEN	EAST COLUMBUS AVENUE	60	60	98	61	69	58	55	52	0	0.00	29
25-013-2007	3	3	SPRINGFIELD	HAMPDEN	EAST COLUMBUS AVENUE	59	59	97	61	62	57	57	48	0	0.00	29
25-017-1801	1	2	SUDBURY	MIDDLESEX	WATER ROW RD	57	57	93	61	43	41	32	32	0	0.00	14
25-015-4002	1	2	WARE	HAMPSHIRE	QUABBIN SUMMIT	114	114	93	122	44	40	40	37	0	0.00	11
25-013-5003	1	2	WEST SPRGFLD	HAMPDEN	W. SPRINGFIELD FIRE	60	60	98	61	48	46	38	32	0	0.00	19
25-027-0013	1	2	WORCESTER	WORCESTER	419 BELMONT STREET	59	58	97	61	53	38	35	34	0	0.00	19
25-027-0016	1	1	WORCESTER	WORCESTER	2 WASHINGTON STREET	51	50	84	61	50	44	39	37	0	0.00	20?

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER < 75%)

PRIMARY STANDARDS: ANNUAL ARITHMETIC MEAN = 50 μg/m³
24-HOUR VALUE = 150 μg/m³

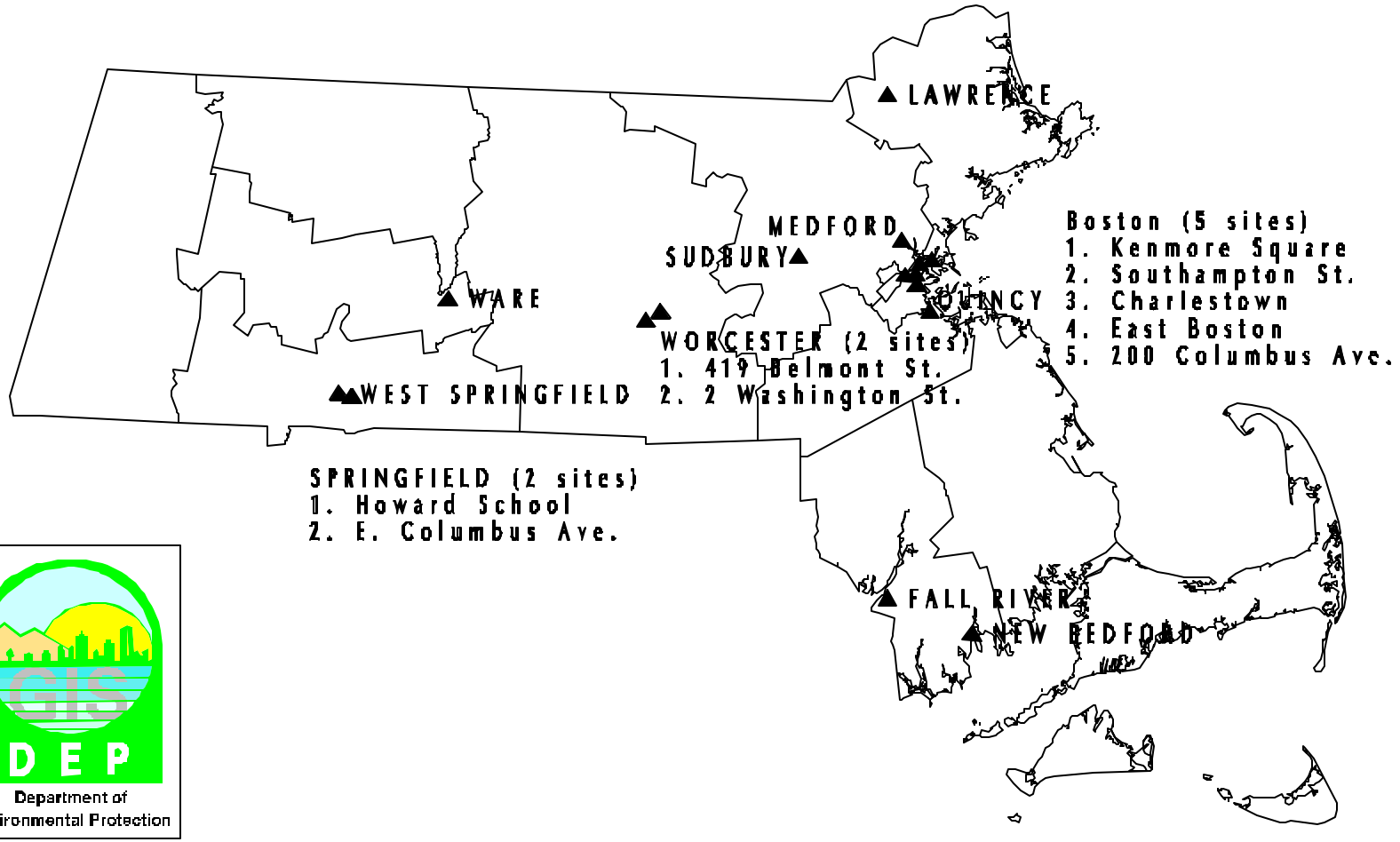
ABBREVIATIONS AND SYMBOLS USED IN TABLE 16

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (1 = NAMS, 2 = SLAMS,

3 = OTHER) **REP ORG** = REPORTING ORGANIZATION **NUM OBS** = NUMBER OF OBSERVATIONS **SCHEDULED NUM OBS** = NUMBER OF OBSERVATIONS SCHEDULED **% OBS** = PERCENT COMPLETED OBSERVATIONS (BASED ON NUMBER REQUIRED) **NUM REQ** = THE NUMBER OF OBSERVATIONS REQUIRED FOR 100% **MAXIMUM VALUES 1ST, 2ND, 3RD, 4TH** = 1ST, 2ND, 3RD, AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **VALS > 150 MEAS** = NUMBER OF VALUES GREATER THAN 150 µg/m³ (PM-10 STANDARD) **VALS > 150 EST** = NUMBER OF EXPECTED VIOLATIONS **WTD ARITH MEAN** = WEIGHTED ANNUAL ARITHMETIC MEAN (STANDARD = 50 µg/m³) **?** = INDICATES THAT NUMBER OF OBSERVATIONS WERE INSUFFICIENT TO CALCULATE MEAN. THE DATA CAPTURE AT A SITE MUST EXCEED 75% FOR EACH QUARTER.

The PM10 monitoring network map is on this page.

1997 Public PM10 Monitoring Network



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PM-10 2nd Maximum 24-Hour Values

Standard = 150 μg/m3

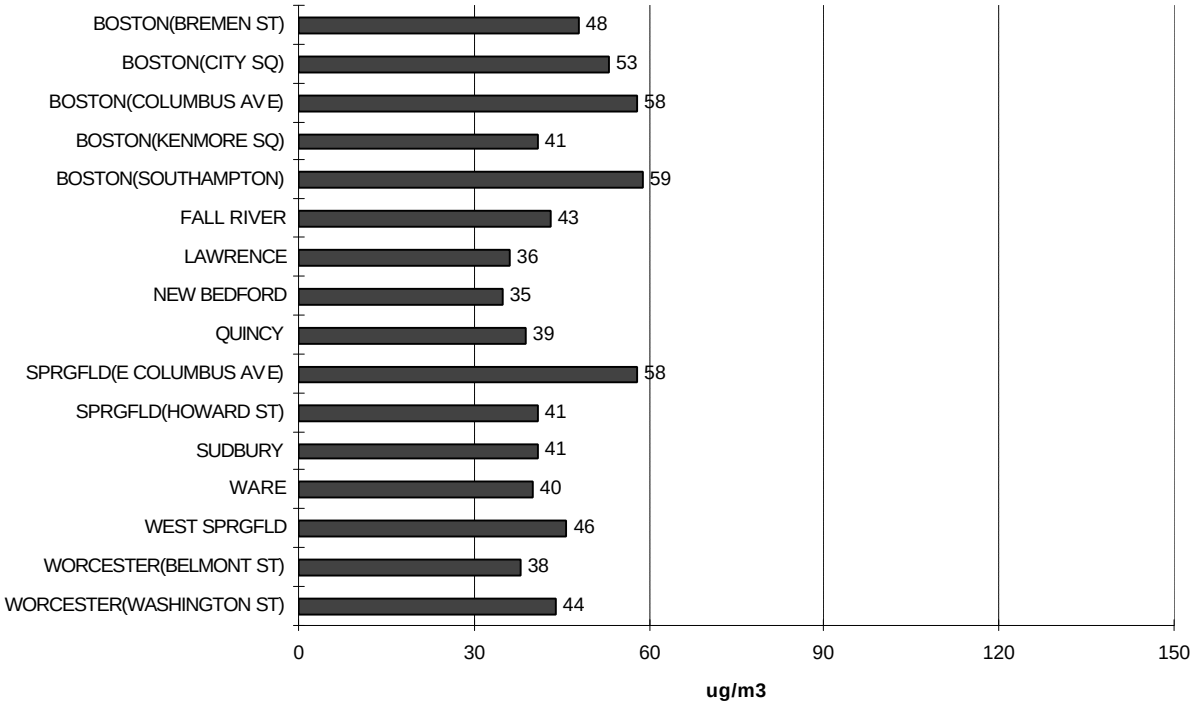


figure 28

PM-10 Annual Arithmetic Mean

Standard = 50 μg/m3

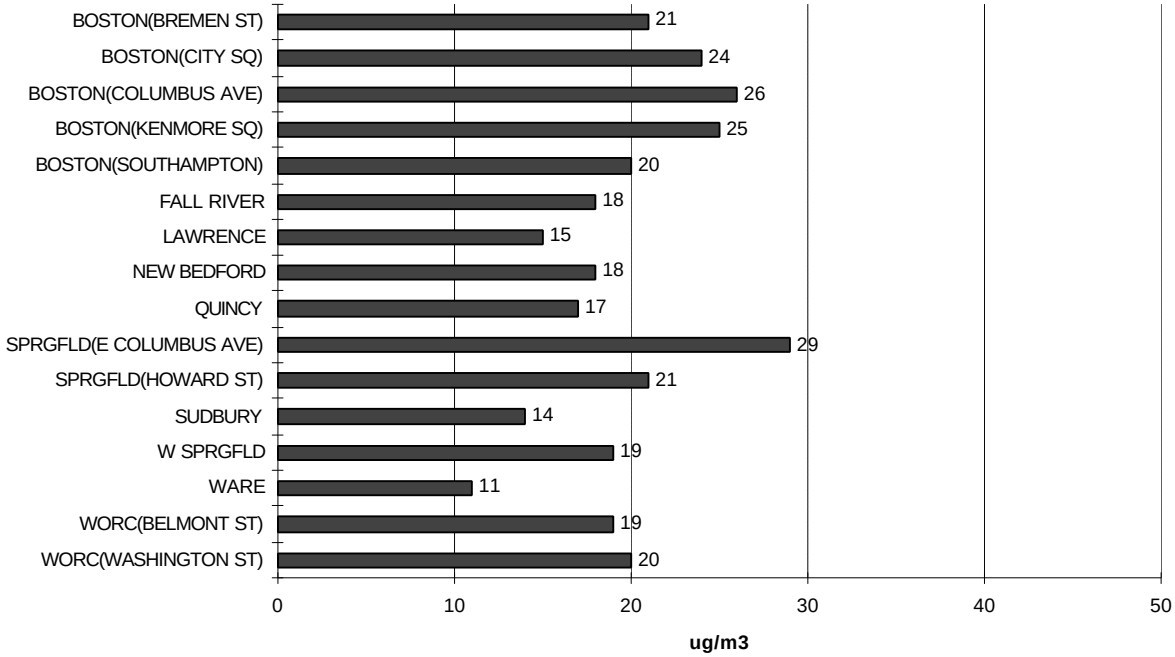


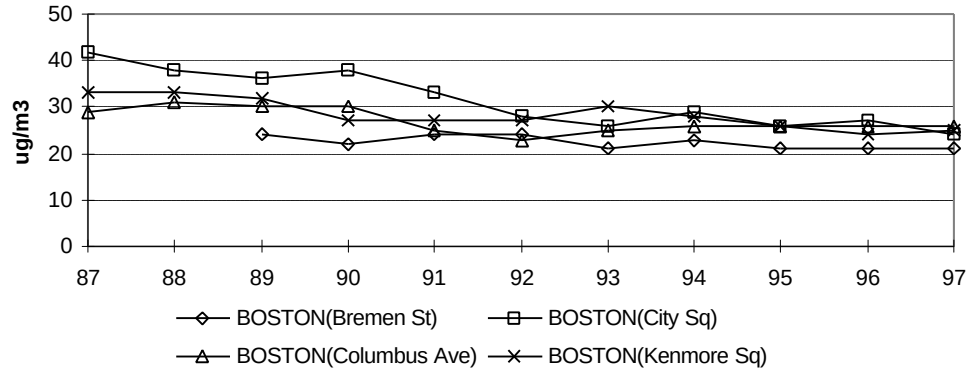
figure 29

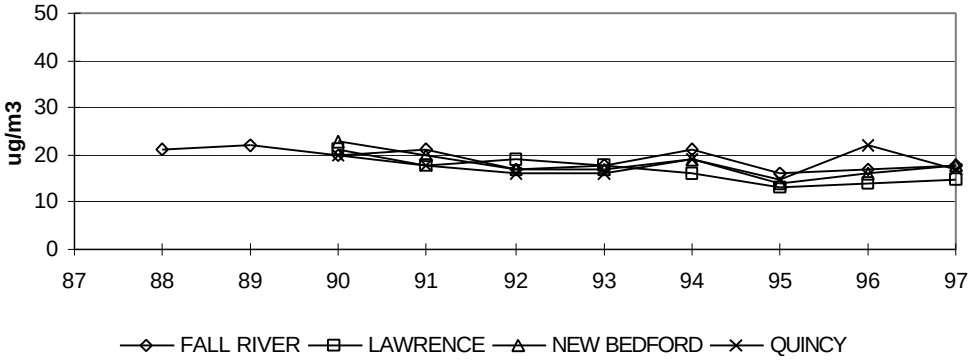
PM-10 10-Year Trends

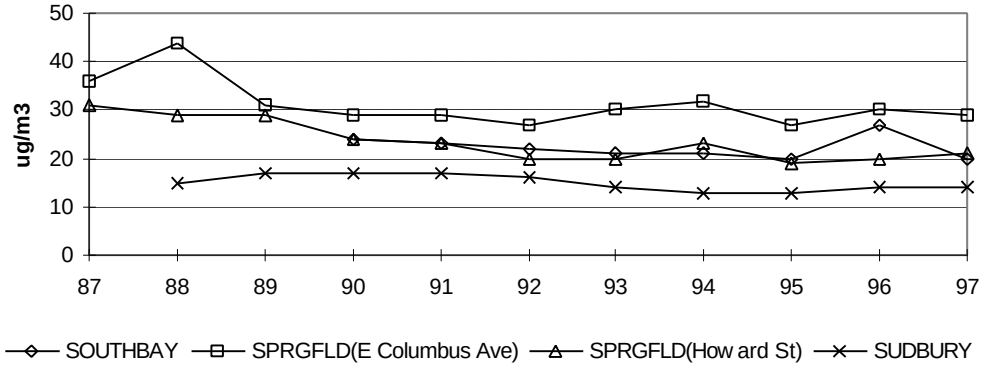
Annual Arithmetic Mean

Standard = 50 μg/m3

The data shows a slightly downward trendline over the ten year period.







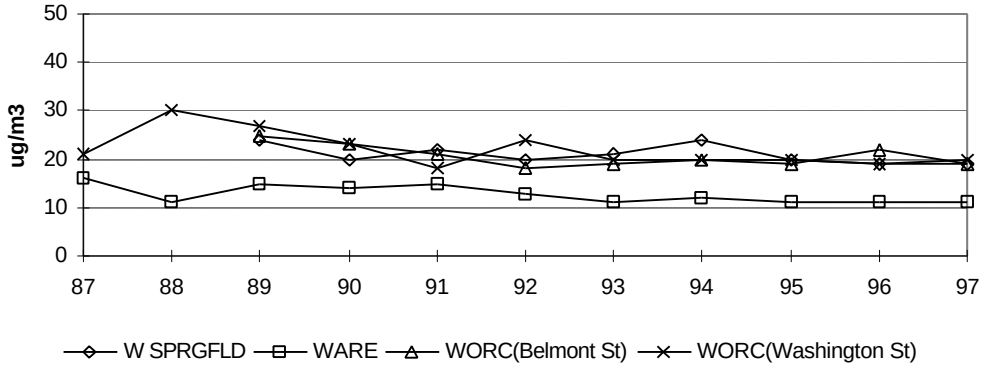


figure 30

PM-10 Data Capture
For all sites during 1997

13 out of 16 PM-10 monitors met the requirement of 75% yearly data capture. The data capture requirement was not met at Boston (Southampton St.), Quincy, and Worcester (Washington St.) for various reasons - primarily power failures and sampler malfunctions.

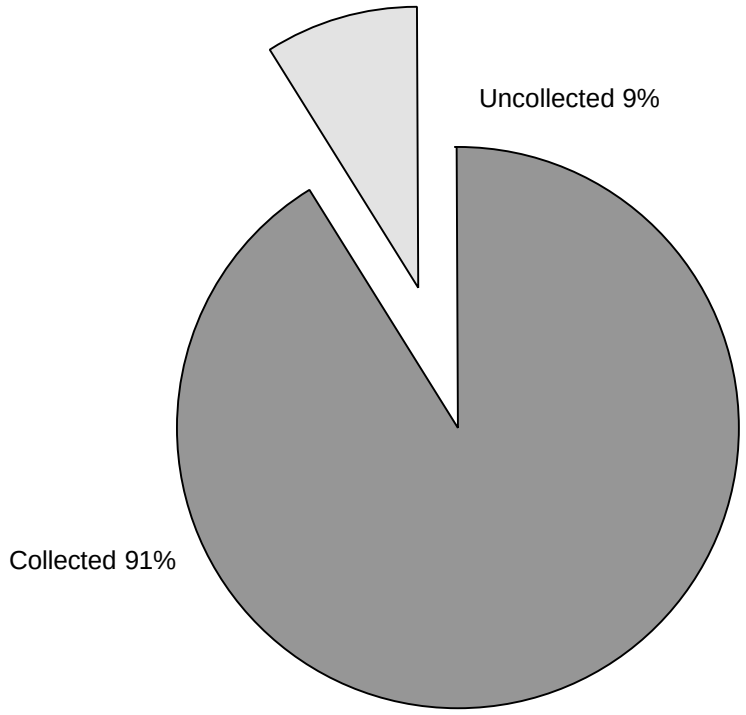


figure 31

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3.8 TOTAL SUSPENDED PARTICULATE (TSP) DATA SUMMARY

TSP was replaced by PM-10 as the particulate air quality standard effective July 31, 1987, and is no longer a criteria pollutant. PM-10 was made the particulate standard because it collects smaller particulates (10 microns or less) which are more likely to be a health hazard because they can penetrate the respiratory system.

TSP sampling is maintained because the samples may be used for metals analyses associated with emissions from resource recovery facilities. TSP sampling was conducted at five sites during 1997. All of the TSP sites failed to achieve the data capture requirement of 75% data capture for each calendar quarter. Reasons for data loss included sampler malfunctions and site inaccessibilty.

TSP is measured by a manual sampler in which samples are collected during a 24-hour period on an every sixth day schedule.

Trend data over the last five years for each site tracking the annual arithmetic mean is shown in **Figure 33**. The data shows a stable trendline.

Table 17 lists by site the TSP data for 1997 including the number of observations (100% is 61), the maximum values and the geometric means.

TABLE 17: 1997 TSP DATA SUMMARY

SUSPENDED PARTICULATE (11101) MASSACHUSETTS UNITS: UG/CU METER)

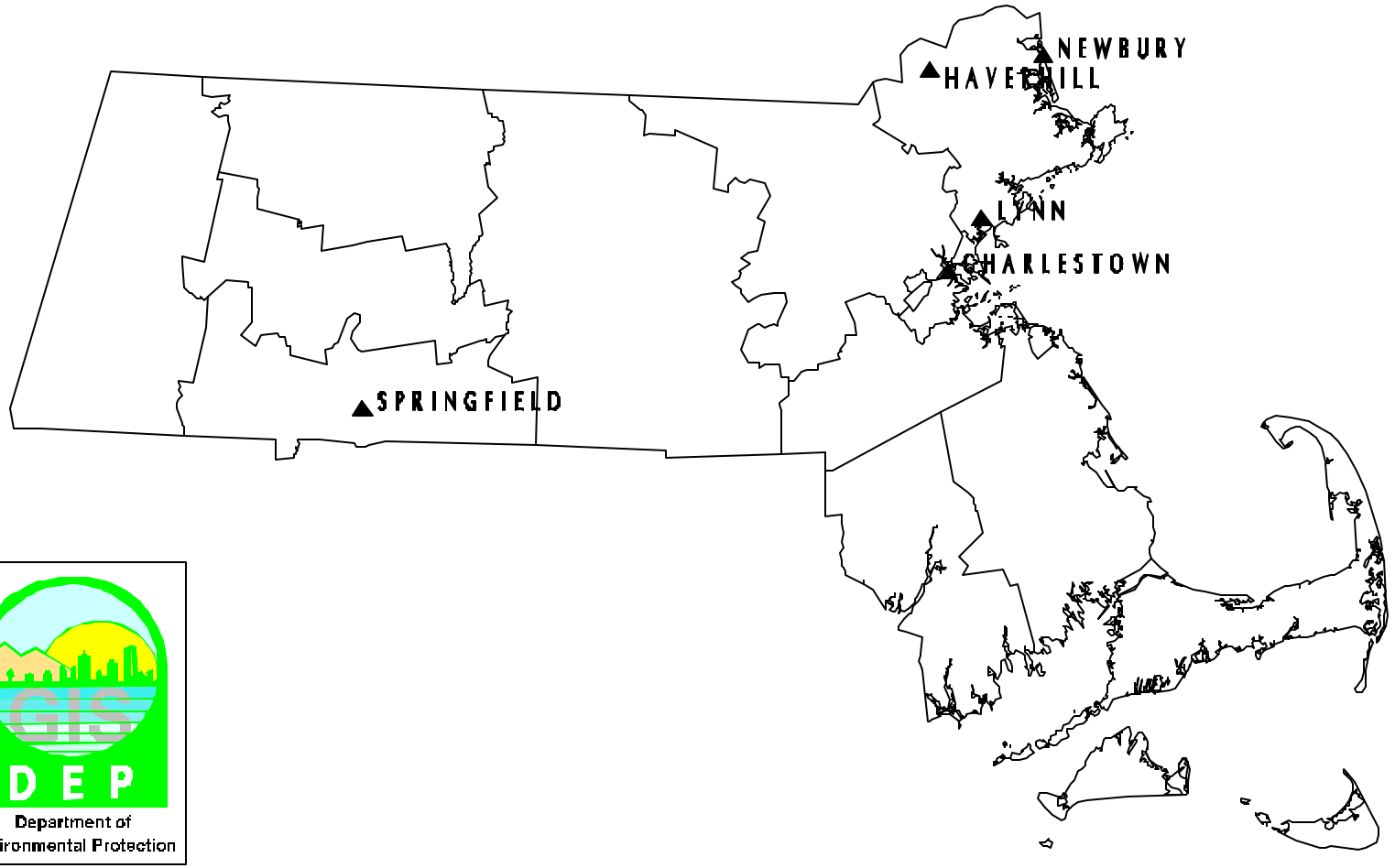
SITE ID	POC	MT	CITY	COUNTY	ADDRESS	-- #OBS	MAXIMUM 24-HR VALUES 1ST	2ND	3RD	4TH	ARITH MEAN	GEO MEAN	GEO STD
25-025-0027	1	2	BOSTON	SUFFOLK	ONE CITY SQUARE, CHARLESTOWN	52	102	93	92	91	53?	48?	1.5
25-025-0027	2	3	BOSTON	SUFFOLK	ONE CITY SQUARE, CHARLESTOWN	45	171	123	101	91	60?	55?	1.5
25-009-5005	1	3	HAVERHILL	ESSEX	WASHINGTON ST.	33	74	67	62	62	33?	27?	2.2
25-009-2006	1	3	LYNN	ESSEX	390 PARKLAND AVE.	51	86	72	67	56	34?	30?	1.7
25-009-4004	1	3	NEWBURY	ESSEX	SUNSET BOULEVARD	53	77	72	60	58	30?	26?	1.7
25-013-2007	1	3	SPRINGFIELD	HAMPDEN	EAST COLUMBUS AVENUE	54	157	142	136	121	75?	70?	1.5

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA (NUMBER OF OBSERVATIONS FOR AT LEAST 1 QUARTER < 75%)

ABBREVIATIONS AND SYMBOLS USED IN TABLE 17

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (2 = SLAMS, 3 = OTHER) **REP ORG** = REPORTING ORGANIZATION **# OBS** = NUMBER OF OBSERVATIONS **MAXIMUM VALUES 1ST,2ND,3RD,4TH** = 1ST,2ND,3RD AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **ARITH MEAN** = ARITHMETIC MEAN **GEO MEAN** = GEOMETRIC MEAN **GEO STD** = GEOMETRIC STANDARD DEVIATION

1997 Public TSP Monitoring Network



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TSP Data Summary

No Standards

The former TSP standards were 260 μg/m3 (24 hours)
and 75 μg/m3 (annual geometric mean).

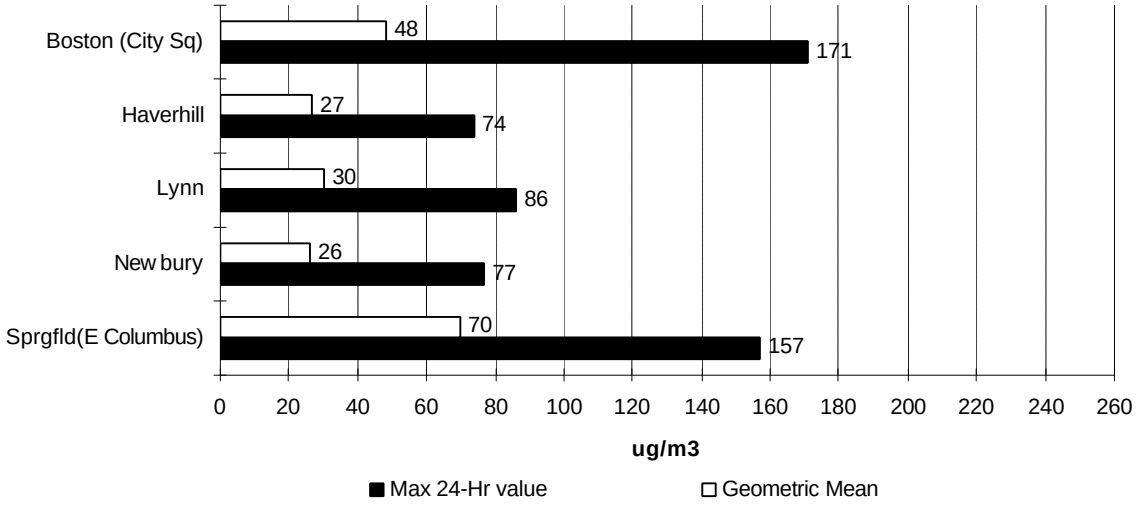


figure 32

TSP 5-Year Trends

Annual Geometric Mean

No Standard

The data shows a stable trend for TSP over the last five years.

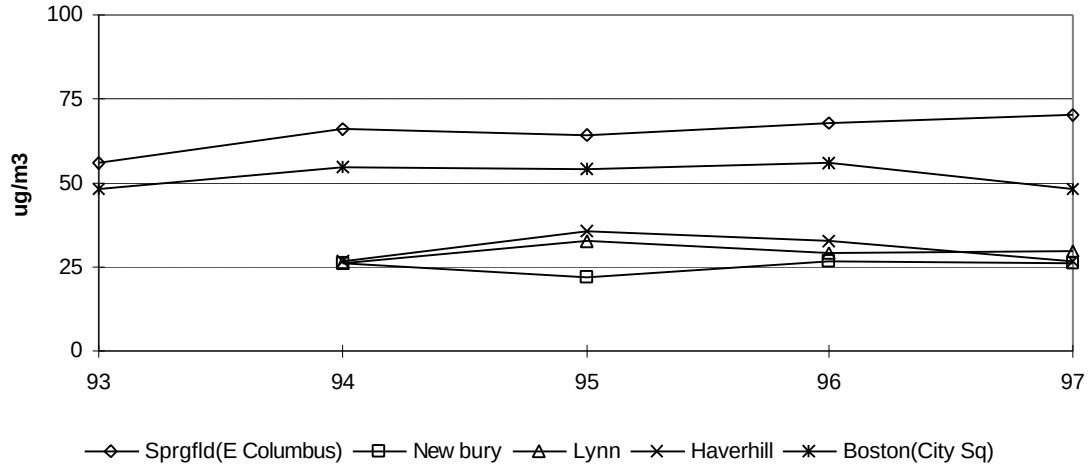


figure 33

3.9 ACID DEPOSITION

The Waltham (Beaver St.) site is part of the National Atmospheric Deposition Program (NADP). The NADP also operates sites in Massachusetts in Truro and Ware. **Figure 34** shows the ten year trend (data from the three Massachusetts sites are averaged) for the pH of precipitation which is an indicator of acidity. The data indicates that precipitation is becoming less acidic (the pH is increasing) which is a positive trend.

Figure 35 shows the trends (data from the three Massachusetts sites are averaged) for some compounds which affect the quality of surface waters. Nitrate increases acidity and can cause algae blooms, chloride can cause brackish water, and sulfate increases acidity. The data indicates the trends are downward for sulfate and relatively stable for chloride and nitrate.

10-Year Trend* of Precipitation pH

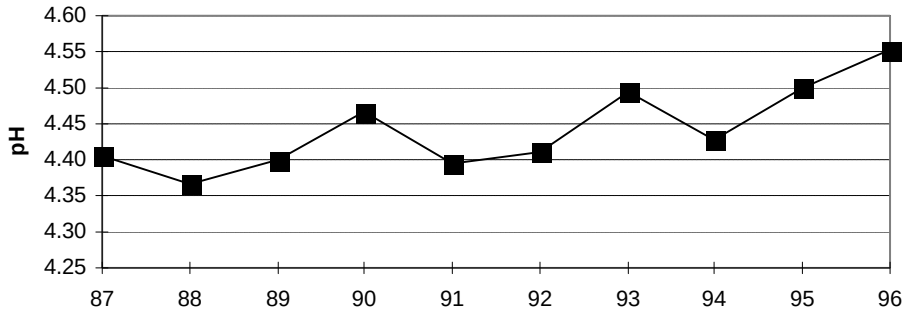


figure 34

10-Year Trends* of Nitrate, Chloride and Sulfate Deposition

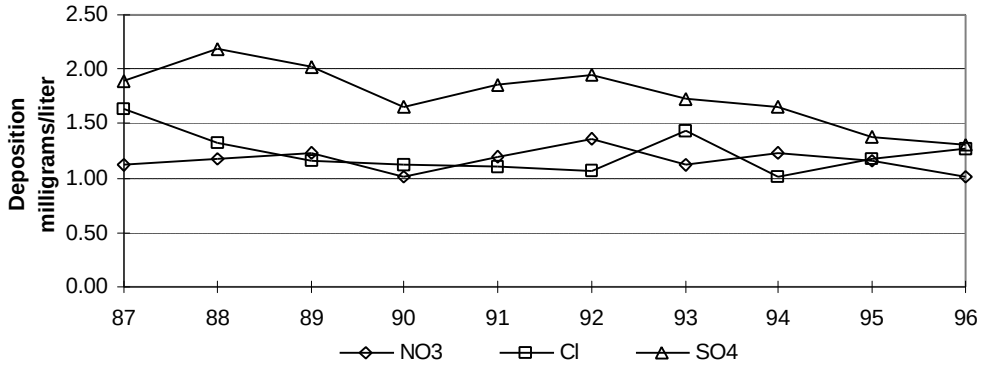


figure 35

* data represents the average of the Truro, Waltham and Ware sites.

4.0 QUALITY CONTROL AND QUALITY ASSURANCE

The standard operating procedures (SOPs) used to generate the data in this report include quality control (QC) and quality assurance (QA) techniques which document the precision and accuracy of the submitted data.

The requirements, techniques and goals of a QC/QA program are described in the U.S. Code of Federal Regulations (CFR), title 40, part 58 and in the U.S. EPA "Quality Assurance Handbook for Air Pollution Measurement Systems", Volumes 1 and 2.

Quality Control (QC) is comprised of those activities performed by personnel who are directly involved in the generation of the data. Examples of personnel who would perform QC functions are site operators and laboratory support personnel. QC activities include functions such as calibrations, data validation, and performance checks to assess the precision of ambient air analyzers and samplers. Precision is defined as a measure of the repeatability of a measurement system.

Quality Assurance (QA) is comprised of those activities performed by personnel who are not directly involved in the generation of the data and who may therefore make an unbiased assessment of the quality of the data. QA activities include functions such as site inspections and conducting performance audit checks to assess the accuracy of ambient air analyzers and samplers. Accuracy is defined as a measure of closeness of an observed measurement value to the truth.

Requirements and Techniques for Performing Precision and Accuracy Checks

Precision and accuracy of air quality data cannot be determined by examining the data itself, but requires the use of specific operator and auditor checks from which precision and accuracy can be assessed.

The requirements and techniques for performing precision and accuracy checks is set forth by the U.S. EPA as described in 40 CFR, Part 58, Appendix A. A condensed description of the requirements and techniques for performing precision and accuracy checks follows.

Precision and Accuracy for Automated Methods (continuous data)

Automated methods are used for monitoring pollutants (SO2, NO2, O3, CO) for which continuous analyzers perform the measurement.

Precision is assessed by performing a one-point check at least once every two weeks. The precision check is made by challenging the analyzer with a known concentration of gas between 0.08 and 0.10 ppm for SO2, NO2 and O3 analyzers, and between 8 and 10 ppm for CO analyzers.

Accuracy is assessed by performance audits which challenge the analyzer with audit gas of different concentration levels so that the analyzer response is tested throughout its measurement range.

Precision and Accuracy for Manual Methods (intermittent data)

Manual methods are used for monitoring pollutants (PM-10 and TSP) for which intermittent samplers perform the measurement.

Precision is assessed by selecting one or more monitoring sites for collocated sampling. The collocated samplers run together during sampling periods. The measurements of each sampler are compared to calculate precision.

The accuracy of manual sampling methods is assessed by auditing a portion of the measurement process. For PM-10 and TSP the flow-rate during sample collection is audited.

Calculation and Meaning of Precision and Accuracy Statistics

The analyzer and sampler percent differences obtained from QC and QA checks are used to assess the precision and accuracy of the data being generated in the sampling network. Precision and accuracy are given in the context of lower and upper 95 percentile limits. The calculated values for the lower and upper 95 percentile limits are given in units of percentage for each parameter.

The meaning of the 95 percentile limits is that 95% of the data obtained for each parameter is estimated to be precise and accurate to within the percentage range defined by the lower and upper limits. As an example, if the lower and upper 95 percentile limits for a parameter based upon precision checks are calculated to be -7.4% and +4.3%, then 95% of the data for that parameter is precise to within the range of -7.4% through +4.3%.

95 Percentile Limit Goals

The QC/QA procedures are designed to obtain data which is of known and acceptable precision and accuracy. As a goal, the 95 percentile probability limits for precision (all parameters) and PM-10 and TSP accuracy should be less than ±15%. The 95 percentile probability limits for accuracy for all other parameters should be less than ±20%.

The 1997 precision and accuracy data summary is listed in **Table 18** on the following page.

TABLE 18: 1997 PRECISION AND ACCURACY DATA

PRECISION-ACCURACY DATA KEY								PRECISION DATA						ACCURACY DATA							
RG	ST	RO	TYP	CLASS	POLL	YEAR-Q	# OF ANLYZRS	# OF PRECIS CHECKS	PROB LIM LO	PROB LIM UP	LOC STD SOURCE	TYP AUD	#AUDITS L1-3	#AUDITS L4	PROB LIM LO-L1	PROB LIM UP	PROB LIM LO-L2	PROB LIM UP	PROB LIM LO-L3	PROB LIM UP	PROB LIM LO-L4	PROB LIM UP
001	25	1	C	A	CO	1997	9	223	-05	+08			15	0	-05	+12	-09	+10	-10	+11		
CARBON MONOXIDE						1997-1	9	60	-05	+08	A	1	4	0	-03	+13	-05	+10	-01	+08		
						1997-2	9	52	-05	+08	A	1	4	0	+01	+14	+00	+10	-02	+09		
						1997-3	9	56	-06	+07	A	1	4	0	-12	+09	-16	+04	-19	+12		
						1997-4	9	55	-03	+06	A	1	3	0	+07	+07	+03	+05	-04	+03		
001	25	1	C	A	SO2	1997	10	250	-09	+06			17	0	-04	+11	-06	+08	-07	+06		
SULFUR DIOXIDE						1997-1	10	60	-10	+05	A	1	5	0	-03	+10	-06	+10	-08	+08		
						1997-2	10	61	-06	+05	A	1	3	0	-16	+24	-16	+15	-16	+13		
						1997-3	10	64	-06	+04	A	1	4	0	-04	+03	-08	+04	-08	+02		
						1997-4	10	65	-10	+05	A	1	5	0	+03	+12	-01	+09	-04	+08		
001	25	1	C	A	NO2	1997	12	286	-12	+09			17	2	-15	+09	-11	+05	-14	+07	-19	+18
NITROGEN DIOXIDE						1997-1	11	71	-11	+07	A	1	5	0	-19	+13	-19	+12	-18	+10		
						1997-2	11	68	-09	+08	A	1	4	2	-22	+23	-07	+06	-08	+08	-19	+18
						1997-3	12	75	-12	+07	A	1	3	0	-20	+10	-11	+02	-20	+06		
						1997-4	12	75	-11	+09	A	1	5	0	-07	+01	-08	+04	-09	+08		
001	25	1	C	A	O3	1997	16	314	-06	+07			37	0	-06	+08	-05	+07	-06	+07		
OZONE						1997-1	8	48	-03	+05	F	2	6	0	-05	+07	-03	+05	-02	+04		
						1997-2	16	98	-07	+07	F	2	9	0	-12	+09	-11	+08	-12	+08		
						1997-3	16	106	-06	+06	F	2	16	0	-06	+07	-04	+06	-04	+06		
						1997-4	9	62	-02	+06	F	2	6	0	-07	+09	-04	+08	-04	+10		

PRECISION-ACCURACY DATA KEY								PRECISION DATA						ACCURACY DATA				
RG	ST	RO	TYP	CLASS	POLL	YEAR-Q	# OF SMPLS	COLLC SITES	PROB LIM LO	PROB LIM UP	COLL SAMP BELOW LIM	VAL COLL DATA PRS	LOC STD SOURCE	AUDITS TYP	AUDITS #	PROB LIM LO-L1-UP	PROB LIM LO-L2	PROB LIM UP	PROB LIM LO-L3-UP
1	25	001	I	F	TSP	1997	42	1	-27	+42	1	41	M	1	13		-09	+07	
SUSPENDED PARTICULATE						1997-1	13	1	-04	+34	0	13	M	1	0				
						1997-2	11	1	-31	+53	0	11	M	1	3		-15	+12	
						1997-3	12	1	-40	+38	0	12	M	1	7		-13	+12	
						1997-4	6	1	-31	+37	1	5	M	1	3		-09	+06	
1	25	001	I	F	PM10	1997	128	3	-15	+28	48	80	M	1	44		-05	+08	
PM10 TOTAL 0-10UM						1997-1	37	3	-06	+22	14	23	M	1	9		-14	+14	
						1997-2	30	3	-26	+33	12	18	M	1	9		-12	+11	
						1997-3	36	3	-15	+28	13	23	M	1	15		-04	+10	
						1997-4	25	3	-15	+26	9	16	M	1	11		+00	+06	

ABBREVIATIONS AND SYMBOLS USED IN TABLE 18

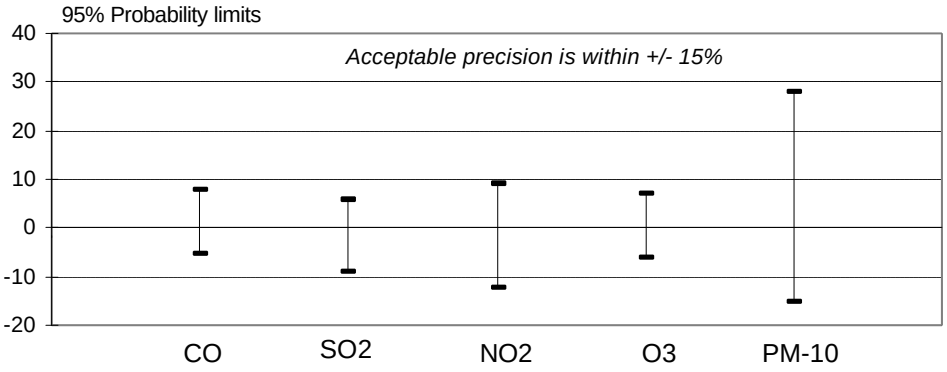
RG = EPA REGION **ST** = STATE **RO** = REPORTING ORGANIZATION **TYP** = ANALYZER TYPE (CONTINUOUS OR INTERMITTENT) **CLASS** = ANALYTICAL (A); FLOW (F) **YR** = YEAR **# OF ANLYZRS** = NUMBER OF ANALYZERS **PRECIS CHECKS** = NUMBER OF PRECISION CHECKS **PROB LIM LO/UP** = LOWER AND UPPER 95% PROBABILITY LIMITS **LOC STD SOURCE** = AUDIT GAS SOURCE **TYP AUD** = AUDIT TYPE (1 = DONE BY REPORT ORG) **# AUDITS L1-3** = NUMBER OF AUDITS **PROB LIM LO-L1-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT LOW RANGE **PROB LIM LO-L2-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT MIDDLE RANGE **PROB LIM LO-L3-UP** = LOWER AND UPPER 95% PROBABILITY LIMITS AT HIGH RANGE **# OF SMPLS** =NUMBER OF SAMPLERS **COLLC SITES** = NUMBER OF COLLOCATED SITES **COLL SAMP BELOW LIM** = NUMBER OF COLLOCATED SAMPLES BELOW THE LIMIT SET FOR PRECISION CALCULATION **VAL COLL DATA PRS** = NUMBER OF VALID COLLOCATED SAMPLES (ABOVE THE LIMIT USED FOR PRECISION CALCULATION)

PRECISION DATA: Acceptable lower and upper 95% probability limits are within ±15%.

ACCURACY DATA: Acceptable lower and upper 95% probability limits are within ±15% for TSP and PM-10. For CO, SO2, NO2 and O3 acceptable limits are within ±20%.

1997 Precision Summary

Upper and lower 95%
probability limits

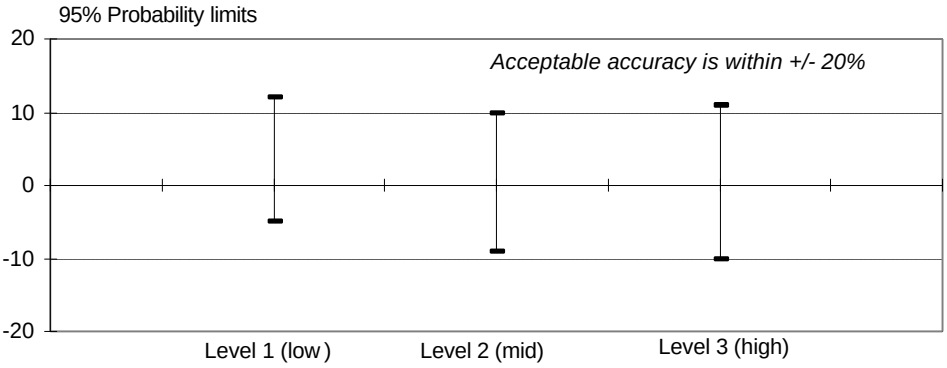


	CO	SO2	NO2	O3	PM-10
Upper	+8	+6	+9	+7	+28
Lower	-5	-9	-12	-6	-15

figure 36

1997 CO Accuracy Summary

Upper and lower 95%
probability limits

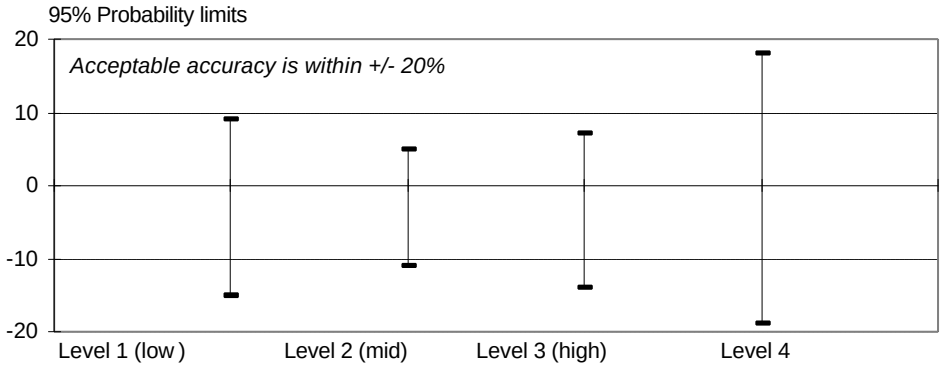


	Level 1 (low)	Level 2 (mid)	Level 3 (high)
Upper	+12	+10	+11
Lower	-5	-9	-10

figure 37

1997 NO2 Accuracy Summary

Upper and lower 95%
probability limits

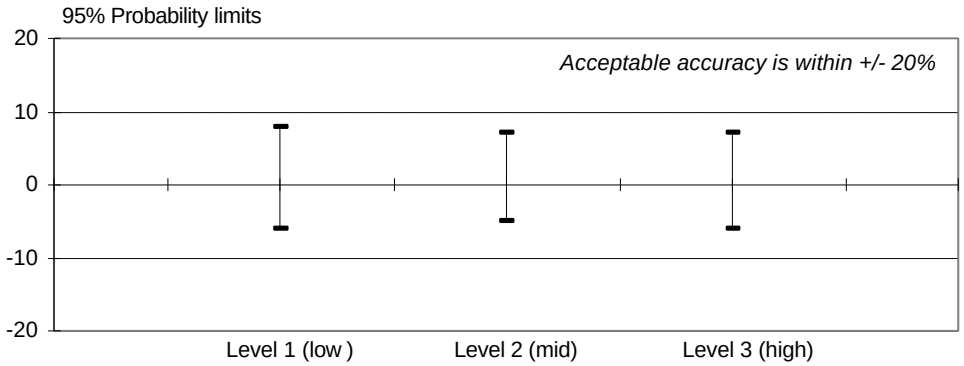


	Level 1 (low)	Level 2 (mid)	Level 3 (high)	Level 4
Upper	+9	+5	+7	+18
Lower	-15	-11	-14	-19

figure 38

1997 O3 Accuracy Summary

Upper and lower 95%
probability limits

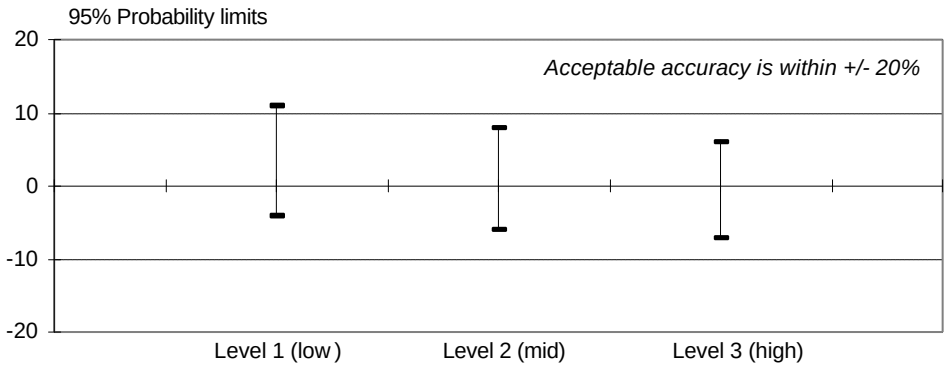


	Level 1 (low)	Level 2 (mid)	Level 3 (high)
Upper	+8	+7	+7
Lower	-6	-5	-6

figure 39

1997 SO2 Accuracy Summary

Upper and lower 95%
probability limits

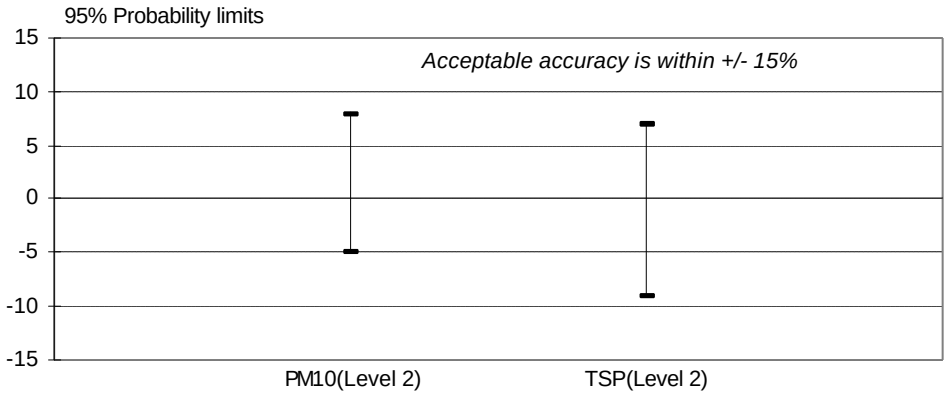


	Level 1 (low)	Level 2 (mid)	Level 3 (high)
Upper	+11	+8	+6
Lower	-4	-6	-7

figure 40

1997 PM-10 and TSP Accuracy Summary

Upper and lower 95%
probability limits



	PM-10 (Level 2)	TSP
Upper	+8	+7
Lower	-5	-9

figure 41

4. AMBIENT AIR QUALITY DATA - INDUSTRIAL NETWORK

4.1 INTRODUCTION

The industrial ambient air quality network is comprised of monitoring stations operated by industries with facilities that potentially may emit large amounts of criteria pollutants. An example would be a coal burning power plant which would emit SO2. The monitoring stations in the industrial network are sited to measure the maximum values from the specific point source. For a power plant, when the pollutant (SO2) value reaches certain trigger values the power plant switches to a lower sulfur content fuel. Because of the different siting criteria the measured values for the industrial stations may be higher than for the public stations.

The data from the industrial network is submitted to the Air Assessment Branch. After it has gone through the quality assurance process the data is submitted into the Aerometric Information Retrieval System (AIRS).

4.2 SULFUR DIOXIDE (SO2) DATA SUMMARY

There were ten SO2 sites during 1997 in the industrial network. All of the sites achieved the requirement of 80% or greater data capture for the year. There were no violations of the SO2 air quality standards during the year. The highest annual arithmetic mean was 0.008 ppm at the Atlantic Gelatin site in Stoneham and at two Boston Edison sites in Boston (East. First St. and Dewar St.) which is 27% of the standard. The highest 24-hour value was 0.044 ppm at the New England Power Co. site located in Swansea (Sharps Lot Road) which is 31% of the standard. The highest 3-hour value was 0.151 ppm at the New England Power Co. site located in Swansea (Sharps Lot Road) which is 30% of the standard. **Table 19** lists by site the SO2 summary data for 1997.

4.3 NITROGEN DIOXIDE (NO2) DATA SUMMARY

There was one NO2 site during 1997 in the industrial network operated by Boston Edison in Boston (E. First St.). It met the requirement of 80% or greater data capture. There were no violations of the NO2 air quality standard during the year. The highest annual arithmetic mean was 0.022 ppm which is 44% of the standard. **Table 20** lists the NO2 summary data for 1997.

4.4 TOTAL SUSPENDED PARTICULATE (TSP) DATA SUMMARY

There were five TSP sites during 1997 in the industrial network. All of the sites met the requirement of 80% or greater data capture. TSP is no longer a criteria pollutant (it was replaced by PM-10 in 1987) so there are no standards for it. The highest 24-hour Boston value was 216 µg/m3 at the Boston Edison site in Boston (East First St.). which is 83% of the old standard (260 µg/m3). The highest annual geometric mean was 49 µg/m3 at the Boston Edison site in Boston (Breman St.) which is 65% of the old standard (75 µg/m3). **Table 21** lists by site the TSP summary data for 1997.

4.5 SULFATE (SO4) DATA SUMMARY

There were four SO4 sites during 1997 in the industrial network. All of the sites met the requirement of 80% or greater data capture for the year. There are no standards for SO4 since it is not a criteria pollutant. The highest 24-hour value was 20 µg/m3 at three Boston Edison sites in Boston (Breman St., Dewar St., and East First St.). The highest annual arithmetic mean value was 9.13 µg/m3 at the Boston Edison site in Boston (Breman St.). **Table 22** lists by site the SO4 data summary for 1997.

TABLE 19: 1997 INDUSTRIAL NETWORK SO2 DATA SUMMARY

SULFUR DIOXIDE (42401) UNITS: 007PPM

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	REP ORG	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS > STD	MAX 3-HR 1ST	MAX 3-HR 2ND	OBS > STD	MAX 1-HR 1ST	MAX 1-HR 2ND	ARIT MEAN
25-025-0019	1	4	BOSTON	SUFFOLK	LONG ISLAND, BOSTON	5	8286	.026	.022	0	.038	.036	0	.051	.049	.005
25-025-0020	1	4	BOSTON	SUFFOLK	DEWAR STREET, DOR	5	8350	.037	.033	0	.056	.053	0	.063	.062	.008
25-025-0021	2	4	BOSTON	SUFFOLK	340 BREMAN STREET	5	8344	.025	.022	0	.038	.034	0	.058	.043	.006
25-025-0040	1	4	BOSTON	SUFFOLK	531A EAST FIRST ST	5	8321	.034	.033	0	.066	.051	0	.089	.083	.008
25-005-0010	1	4	FALL RIVER	BRISTOL	GLOBE AND WILCOX ST	17	4301	.021	.015	0	.061	.050	0	.089	.070	.004?
25-009-5004	1	4	HAVERHILL	ESSEX	NETTLE SCHOOL	2	8248	.013	.012	0	.021	.019	0	.026	.024	.004
25-009-1004	1	4	PEABODY	ESSEX	END OF GLEN ROAD	26	8635	.026	.026	0	.042	.041	0	.103	.072	.005
25-009-1005	1	4	PEABODY	ESSEX	PERKINS STREET PL	26	8395	.031	.029	0	.066	.055	0	.125	.106	.005
25-017-1701	1	4	STONEHAM	MIDDLESEX	HILL STREET	25	8533	.038	.035	0	.092	.076	0	.108	.105	.008
25-005-6001	1	4	SWANSEA	BRISTOL	SHARPS LOT ROAD	17	4088	.044	.021	0	.108	.100	0	.151	.138	.005?

TO CONVERT UNITS FROM PPM TO mG/M^3 MULTIPLY PPM x 2620

PRIMARY STANDARDS: ANNUAL ARITHMETIC MEAN = 0.03 PPM
24-HOUR = 0.14 PPM
SECONDARY STANDARD: 3-HOUR = 0.50 PPM

ABBREVIATIONS AND SYMBOLS USED IN TABLE 19

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (4 = INDUSTRIAL) **REP ORG** = REPORTING ORGANIZATION **#OBS** = NUMBER OF HOUR OBSERVATIONS **MAX 24-HR, MAX 3-HR, MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **OBS > .14** = NUMBER OF 24-HR AVG. GREATER THAN 0.14 PPM (24-HR STANDARD) **OBS > .50** = NUMBER OF 3-HR AVG. GREATER THAN 0.50 PPM (3-HR STANDARD) **ARIT MEAN** = ARITHMETIC MEAN (STANDARD = 0.030 PPM)

TABLE 20: 1997 INDUSTRIAL NETWORK NO2 DATA SUMMARY

NITROGEN DIOXIDE (42602) UNITS: 007 PPM

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	REP ORG	#OBS	MAX 1-HR 1ST	MAX 1-HR 2ND	MAX 24-HR 1ST	MAX 24-HR 2ND	ARIT MEAN
25-025-0040	1	4	BOSTON	SUFFOLK	531A EAST FIRST ST	5	8231	.081	.080			.022

TO CONVERT UNITS FROM PPM TO mG/M^3 MULTIPLY PPM x 1886.8

PRIMARY STANDARD: ANNUAL ARITHMETIC MEAN = 0.05 PPM

ABBREVIATIONS AND SYMBOLS USED IN TABLE 20

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (4 = INDUSTRIAL) **REP ORG** = REPORTING ORGANIZATION **#OBS** = NUMBER OF HOUR OBSERVATIONS **MAX 1-HR 1ST 2ND** = FIRST AND SECOND HIGHEST VALUE FOR TIME PERIOD INDICATED **ARIT MEAN** = ARITHMETIC MEAN (STANDARD = 0.05 PPM)

TABLE 21: 1997 INDUSTRIAL NETWORK TSP DATA SUMMARY

SUSPENDED PARTICULATES (11101) UNITS: 001 UG/CU METER (25C)

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	REP ORG	#OBS	MAXIMUM 24-HR VALUES 1ST	2ND	3RD	4TH	ARITH MEAN	GEO MEAN	GEO STD
25-025-0019	1	4	BOSTON	SUFFOLK	LONG ISLAND, BOSTON HARBOR	5	61	73	68	63	57	32?	29	1.5
25-025-0020	1	4	BOSTON	SUFFOLK	DEWAR STREET, DORCHESTER	5	61	87	66	65	64	39?	36	1.4
25-025-0021	2	4	BOSTON	SUFFOLK	340 BREMAN ST., EAST BOSTON	5	60	109	93	90	83	52	49	1.5
25-025-0040	1	4	BOSTON	SUFFOLK	531A EAST FIRST STREET	5	57	125	108	96	90	49	44	1.5
25-025-0040	2	4	BOSTON	SUFFOLK	531A EAST FIRST STREET	5	59	216	129	108	107	53	47	1.7
25-005-6001	1	4	SWANSEA	BRISTOL	SHARPS LOT ROAD	17	30	66	47	35	35	25?	23?	1.5

ABBREVIATIONS AND SYMBOLS USED IN TABLE 21

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (4 = INDUSTRIAL) **REP ORG** = REPORTING ORGANIZATION **# OBS** = NUMBER OF OBSERVATIONS **MAXIMUM VALUES 1ST,2ND,3RD,4TH** = 1ST,2ND,3RD AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **ARITH MEAN** = ARITHMETIC MEAN **GEO MEAN** = GEOMETRIC MEAN **GEO STD** = GEOMETRIC STANDARD DEVIATION

TABLE 22: 1997 INDUSTRIAL NETWORK SO4 DATA SUMMARY

SULFATE (TSP) (12403)

SITE ID	POC	MT	CITY	COUNTY	ADDRESS	REP ORG	#OBS	-MAXIMUM VALUES- 1ST	2ND	3RD	4TH	ARITH MEAN
25-025-0019	1	4	BOSTON	SUFFOLK	LONG ISLAND, BOSTON	5	61	18	15	15	14	7.67
25-025-0020	1	4	BOSTON	SUFFOLK	DEWAR STREET, DORCHESTER	5	61	20	16	15	15	8.08
25-025-0021	2	4	BOSTON	SUFFOLK	340 BREMAN STREET	5	60	20	19	16	16	9.13
25-025-0040	1	4	BOSTON	SUFFOLK	531A EAST FIRST STREET	5	57	20	17	16	16	8.46
25-025-0040	2	4	BOSTON	SUFFOLK	531A EAST FIRST STREET	5	59	20	18	15	14	8.61

ABBREVIATIONS AND SYMBOLS USED IN TABLE 22

SITE ID = AIRS SITE IDENTIFICATION NUMBER **POC** = PARAMETER OCCURRENCE CODE (DIFFERENTIATES BETWEEN MONITORS AT A SITE) **MT** = MONITOR TYPE (4 = INDUSTRIAL) **REP ORG** = REPORTING ORGANIZATION **# OBS** = NUMBER OF OBSERVATIONS **MAXIMUM VALUES 1ST,2ND,3RD,4TH** = 1ST,2ND,3RD AND 4TH HIGHEST 24-HOUR VALUES FOR THE YEAR **ARITH MEAN** = ARITHMETIC MEAN

SECTION II

EMISSIONS INVENTORY

1. EMISSIONS INVENTORY SECTION

1.1 EMISSIONS TRENDS: 1990-1996

Emissions trends are presented for four major pollutants of concern: volatile organic compounds (VOC), nitrogen oxides (NOx), sulfur dioxide (SO2) and carbon monoxide (CO). Emissions data are not available for particulates and lead. The emission trends cover the period of 1990 to 1996. Since Massachusetts is non-attainment for the ozone and CO National Ambient Air Quality Standards, Massachusetts is required to submit State Implementation Plans (SIP) to EPA. The SIP describes the control measures and projected emissions of VOCs and NOx, since these "ozone precursors" in reaction with sunlight under the right conditions produce ozone.

The initial requirement of the SIP included a 1990 base year emissions inventory for ozone precursors and CO, from which control programs were developed. Emission inventories are required to be submitted every three years to EPA. The 1990 emissions estimates, 1993 preliminary emissions estimates, and the projected 1996 emissions were submitted to EPA as part of the SIP process. The numbers reported here reflect the most recent SIP revision from March, 1997.

Sulfur dioxide emissions are tracked annually by DEP because of the requirements of the 1985 State Acid Rain (STAR) program. The STAR program is more stringent than the national program because it imposes an emissions cap of 412,000 tons which is based on the average annual emissions during the four year period of 1979 - 1982. If this cap is exceeded DEP is required to implement additional control measures. The SO2 cap has never been exceeded in the state since the inception of the STAR program.

1.2 POINT SOURCE EMISSION TRENDS

The point source section of the inventory comprises the large industrial polluters and is the only category in which actual data is available for all seven years. The point source emissions are presented in **Figures 42 and 43**. The electric utility emissions **(Figure 44)** are presented because they comprise the major proportion of NOx and SO2 point source emissions.

VOC and CO Point Source Emissions 1990-1996

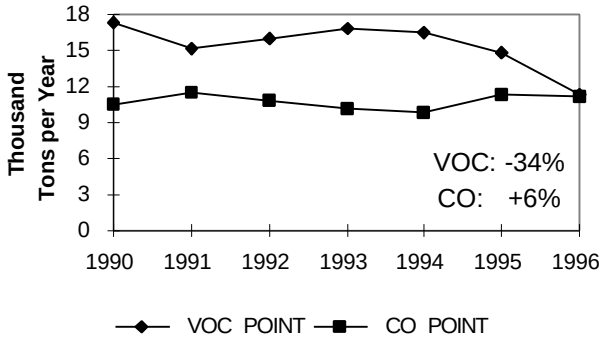


figure 42

SO2 and NOx Point Source Emissions 1990-1996

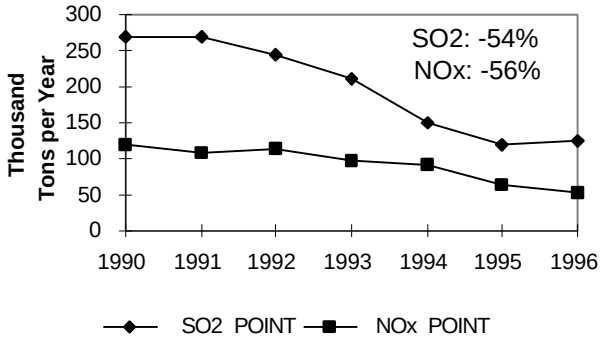


figure 43

SO2 and NOx Electric Utility Emissions 1990-1996

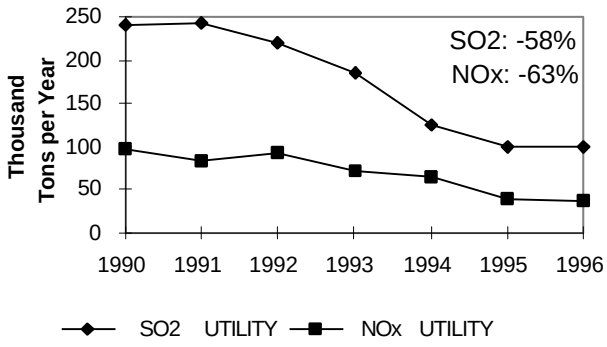


figure 44

1.3 TOTAL VOC EMISSIONS

Total VOC emissions were projected to be reduced from 986 tons per summer day (TPSD) in 1990 to 731 TPSD in 1996 **(Figure 45**). This 26% reduction was projected to occur net of economic and industrial growth and is based on the 1990 to 1996 controls that DEP was to have implemented to meet the first set of milestone reductions required under the 1990 Clean Air Act Amendments.

The 1996 emission estimates for VOC and other precursors are based on projected controls from all programs that were included in the 15% Reasonable Further Progress SIP, which required reductions by 1996. Although the Enhanced Inspection and Maintenance program for motor vehicles will be implemented beginning in 1999, the 1996 projected emissions reflect reductions from the program.

The emission reductions are also attributable to other control measures such as: Federal Motor Vehicle Control Program (FMVCP); Reasonable Available Control Technology (RACT) corrections for point sources; Stage II vapor recovery for gasoline stations; architectural coatings (i.e., lower paint emissions); and, reformulated gasoline (i.e., lower volatility). See Section 2.2 (pg. 17) for a more comprehensive list of air pollution control programs.

Definitions for sources of pollution described in Figures 45, 46 and 47.

Point: A stationary source of air pollution, primarily from smokestacks in manufacturing and power plants.

Area: Small point sources too numerous to measure individually, such as those found in gas stations, dry cleaners and consumer products. Taken in the aggregate they may cause a great deal of pollution.

Mobile: Common on-road vehicles such as autos, trucks, motorcycles and buses.

Non-Rd: Non-Road sources are engines that are usually not operated on a road, such as construction equipment, boats, snowmobiles, lawnmowers, etc.

Overall, there is a substantial projected emissions reduction for all four pollutants from 1990 to 1996, even though there has been significant growth in population and economic activity in Massachusetts. The projected reductions in total statewide emissions for each of the following pollutants from 1990 to 1996 are:

VOC..... -26% (see figure 45)
NOx..... -27% (see figure 46)
SO2..... -41%
CO..... -47%

Composite VOC Emissions 1990 - 1996 (1996 projected)

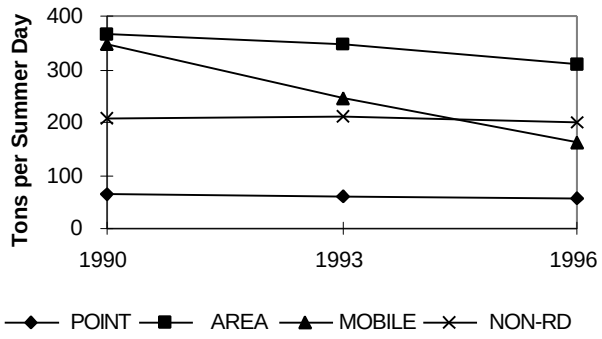


figure 45

1.4 TOTAL NOX EMISSIONS

NOx emissions **(Figure 46)** are projected to be reduced from 934 TPSD in 1990 to 684 TPSD in 1996. This 27% reduction is based on NOx point source emission controls in conjunction with the above mentioned on-road mobile source I/M and FMVCP controls.

Composite NOx Emissions 1990 - 1996 (1996 projected)

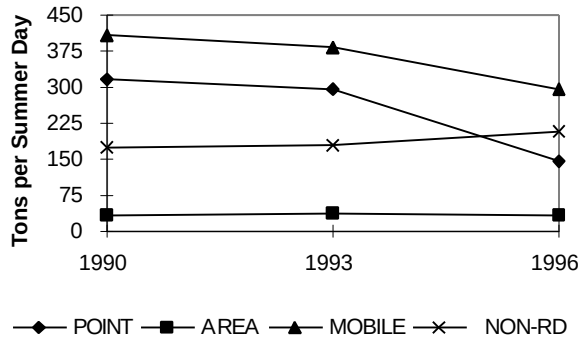


figure 46

1.5 ON-ROAD MOBILE SOURCE EMISSIONS

Substantial reductions of on-road mobile VOC and NOx emissions are shown **(Figure 47)** with a contrasting increase in daily vehicle miles traveled (DVMT). The projected trends from 1990 to 1996 are:

VOC..... -53%
NOx..... -28%
DVMT..... +3%

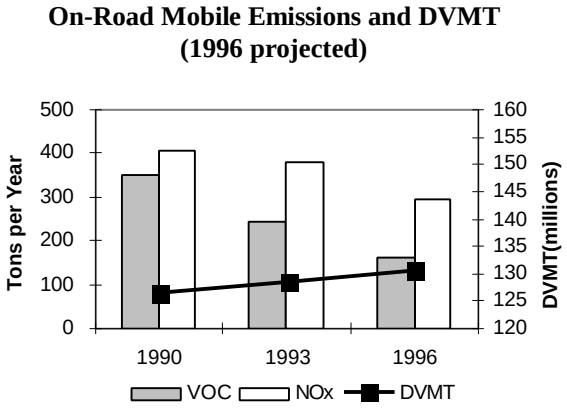


figure 47

SECTION III

PAMS/SPECIAL STUDIES MONITORING

1. PAMS/SPECIAL STUDIES SECTION

1.1 OVERVIEW

The PAMS/Special Studies Section is charged with the development and implementation of strategy and procedures for measuring non-criteria pollutants as required by enhanced ozone ambient air monitoring requirements of the 1990 Clean Air Act. This section also conducts special air monitoring surveys for toxic air pollutants at specific locations (outdoor and indoor) during situations where the DEP has jurisdiction and interest.

1.2 PAMS PROGRAM

The **PAMS** (Photochemical Assessment Stations) monitoring program has become a major component of the Massachusetts ambient air monitoring effort over the last five years. The Boston and Springfield Metropolitan Areas have been designated "Serious" non-attainment of the NAAQS national ozone standard. Consequently, the 1990 Clean Air Act prescribed that enhanced ozone or PAMS monitoring be conducted at specified categories of locations in those two areas of the state.

The PAMS enhanced ozone monitoring season is during the months of June through August when meteorological conditions are conducive to the formation of high concentrations of ozone. The 1990 Clean Air Act provisions require the measurement of individual ozone precursor and reaction product chemicals which include categories of Volatile Organic Compounds (VOC) and Oxides of Nitrogen in addition to ozone (O3) itself. VOC categories include photo-reactive hydrocarbons and carbonyl compounds (aldehydes and ketones). The reporting of oxides of nitrogen include nitric oxide (NO), total nitrogen oxides (NOx), and nitrogen dioxide (NO2). At several PAMS sites a new nitrogen oxides parameter (NOy) is being monitored on a pilot basis. The PAMS program also requires the measurement of a comprehensive list of meteorological parameters at each location.

The PAMS monitoring regulations prescribe numbers and configurations of monitoring networks based on metropolitan populations. These regulations allow for the phase-in of the sites on a one per year basis with the most intensive and highest priority sites first. This formula results in a total of five (5) sites in Metropolitan Boston over five (5) years {1993 through 1997} and a total of three (3) stations in Metropolitan Springfield from 1993 through 1997. The DEP submitted an overall network plan to the U.S. EPA for review and approval in October, 1993. Plans call for the following networks:

Year	Boston Network	Springfield Network	Other	PAMS Designation
1993	Lynn	Chicopee	------	Type 2
1994	Newbury	Ware	------	Type 3
1995	Easton**	Agawam	------	Type 1
1996	Acadia, Maine	------	------	Type 4
1997			Truro*	Type 2
1998	Boston (Long Island)	------	------	Type 2

* Type 4 site for Providence, RI. **Is also a Type 3 site for Providence, RI.

PAMS DESIGNATIONS: Type 1 = Upwind of Central City
Type 2 = Near downwind (to the central city)
Type 3 = Downwind at Highest Ozone Location
Type 4 = Far Downwind at edge of modeling domain

The above networks are designed for a southwest to northeast predominant wind direction and have been proposed based on this wind direction and their position and distance relative to the studied metropolitan area. The second Boston Type 2 is required to be oriented downwind of Boston in the second most predominant wind direction, which is from the northwest. This station is located on Long Island in the Boston Harbor and monitoring will operational for the 1998 PAMS season.

In addition to the surface monitoring stations described above, one upper air meteorological measuring station is required by the PAMS program for each network. An acoustic/radar based instrument has been procured for the Boston PAMS network and has been installed in Stow for the 1998 season. No firm plans have been made yet to address the Springfield Network requirement.

Oxides of nitrogen and ozone are measured by traditional U.S. EPA equivalent methodologies. VOC (both hydrocarbons and carbonyls) are measured using not fully developed laboratory based techniques. At our intensive (labeled Type 2) stations, hydrocarbons are measured on an hourly basis using Automated Gas Chromatography. At our less intensive sites (Type 1 and 4), eight (8) three hour discrete whole air canister samples are taken every third day for subsequent gas chromatograph (GC) analysis for hydrocarbons. Composite 24-hour samples are similarly taken every sixth day at all PAMS sites during the season.

Type 3 downwind stations have a similar monitoring schedule to the other non-intensive location categories. However, these have been outfitted with hourly sampling AutoGCs like the Type 2 locations. Canisters from Type 1 sites and the Type 4 station in Truro are analyzed by a dedicated AutoGC at the Lawrence office.

Carbonyl compounds are measured over three hour sampling times using chemically coated cartridges, which are analyzed in a laboratory using liquid chromatography. These samples are taken continuously throughout the season only at Type 2 stations.

VOC and other PAMS parameter data was collected at seven sites during 1997. Massachusetts and other states performing PAMS measurements continue to work on the development of new quality control, quality assurance, and technical procedures. More extensive data validation and a new PAMS data analysis program have recently been emphasized.

1.3 PAMS RESULTS

Although the reporting of over 60 PAMS non-criteria pollutants to the U.S. EPA AIRS Database for all six sites was extremely labor intensive, most has been submitted for 1997 as of this date.

Below is a table that summarizes the changes in VOC concentrations for selected species from Lynn which has been in operation for three years. There have been substantial decreases in some of the VOC such as benzene, ethlybenzene, toluene, and xylene. The decreases in these compounds is consistent with the use of reformulated gasoline which began January, 1995. The reformulated gasoline contains lesser amounts of toxic pollutants so there are fewer emissions. It should be noted that PAMS monitoring has been done for only four years and during that time the analysis techniques have continued to be refined. As monitoring continues the trends can be evaluated with more confidence.

Summary for Selected VOC Concentrations at Lynn (1994-1997)
Concentrations (PPBC - parts per billion carbon)

Parameter	1994	1995	1996	1997
Benzene	2.50	1.26	1.29	1.23
Toluene	6.72	5.27	5.04	4.07
Ethylbenzene	1.24	0.96	0.79	0.63
o-xylene	1.34	1.19	0.89	0.71
Propane	4.00	3.55	3.63	3.00
Acetylene	1.93	1.72	1.66	1.27
N-hexane	1.40	1.17	1.42	1.22
Ethylene	2.66	2.24	2.15	1.92

Three-hour carbonyl compound data from Lynn and Chicopee has been input into the AIRS system for 1997. The following are average values (in parts per billion volume) for target carbonyl compounds.

Mean Carbonyl Concentrations (1997)
3 hour Interval
Concentrations (PPBV - parts per billion volume)

	Chicopee	Lynn
Formaldehyde	7.8	4.9
Acetaldehyde	3.5	2.4
Acetone	8.7	7.5

1.4 SPECIAL STUDIES

The Air Assessment Branch (PAMS/Special Studies Section) continues to conduct indoor and outdoor ambient, site specific special air monitoring studies for other DEP divisions and regional offices. We also review monitoring plans and results from special studies conducted by private consultants in projects overseen by DEP. Several one day indoor site related special studies for petroleum related volatile organic compounds and chlorinated hydrocarbons were conducted by the Air Assessment Branch during 1997.

APPENDIX A: PUBLIC SITE CROSS REFERENCE

PUBLIC SITE CROSS REFERENCE: AIRS #, LOCATION COORDINATES

CITY SITE LOCATION	AIRS #	UTM ZONE	LOCATION COORDINATES UTM(East) & (North); LATITUDE & LONGITUDE
ADAMS Mt. Greylock	25-003-4002	18	UTM(East)650160 (North)4721890 LAT +42:38:12 LONG -73:10:07
AGAWAM Westfield St.	25-013-0003	18	UTM(East)692120 (North)4659040 LAT +42:03:42 LONG -72:40:41
AMHERST N. Pleasant St.	25-015-0103	18	UTM(East)703800 (North)4696975 LAT +42:24:01 LONG -72:31:25
BOSTON Kenmore Square (Commonwealth Ave.)	25-025-0002	19	UTM(East)327095 (North)4690373 LAT +42:20:54 LONG -71:05:57
BOSTON Fire Headquarters (Southampton St.)	25-025-0012	19	UTM(East)329584 (North)4688213 LAT +42:19:46 LONG -71:04:06
BOSTON Sumner Tunnel (Visconti St.)	25-025-0016	19	UTM(East)332000 (North)4692500 LAT +42:22:07 LONG -71:02:25
BOSTON East Boston (Breman St.)	25-025-0021	19	UTM(East)333008 (North)4693531 LAT +42:22:41 LONG -71:01:42
BOSTON Fire Station (Columbus Ave.)	25-025-0024	19	UTM(East)329406 (North)4690316 LAT +42:20:55 LONG -71:04:16
BOSTON Charlestown (City Square)	25-025-0027	19	UTM(East)330090 (North)4693015 LAT +42:22:22 LONG -71:03:49
BOSTON Post Office Sq.	25-025-0038	19	UTM(East)330840 (North)4691500 LAT +42:21:34 LONG -71:03:15
CHELSEA Soldiers Home (Powder Horn Hill)	25-025-1003	19	UTM(East)332910 (North)4696126 LAT +42:24:06 LONG -71:01:52
CHICOPEE Westover AFB	25-013-0008	18	UTM(East)701792 (North)4674012 LAT +42:11:39 LONG -72:33:22
EASTON Borderland State Park (Borderland St.)	25-005-1005	19	UTM(East)322200 (North)4658820 LAT +42:03:47 LONG -71:08:56

PUBLIC SITE CROSS REFERENCE: AIRS #, LOCATION COORDINATES

CITY SITE LOCATION	AIRS #	UTM ZONE	LOCATION COORDINATES UTM(East) & (North) LATITUDE & LONGITUDE
FAIRHAVEN Wood School (Scontuit Rd.)	25-005-1002	19	UTM(East)343300 (North)4610800 LAT +41:38:07 LONG -70:52:53
FALL RIVER Fire Headquarters (Bedford St.)	25-005-3001	19	UTM(East)320961 (North)4618523 LAT +41:42:01 LONG -71:09:06
FALL RIVER Fire Station (Globe Street)	25-005-1004	19	UTM(East)319694 (North)4616888 LAT +41:41:07 LONG -71:09:59
HAVERHILL Consentino School (Washington St.)	25-009-5005	19	UTM(East)327700 (North)4736400 LAT +42:45:46 LONG -71:06:21
LAWRENCE Storrow Park (High St.)	25-009-0005	19	UTM(East)324221 (North)4730569 LAT +42:42:34 LONG -71:08:47
LOWELL Old City Hall (Merrimack St.)	25-017-0007	19	UTM(East)310489 (North)4723770 LAT +42:38:42 LONG -71:18:42
LYNN Water Treatment Plant (Parkland St.)	25-009-2006	19	UTM(East)337855 (North)4704157 LAT +42:28:28 LONG -70:58:21
NEW BEDFORD YMCA (Water St.)	25-005-2004	19	UTM(East)339500 (North)4610110 LAT +41:37:43 LONG -70:55:36
NEWBURY US Department of the Interior (Sunset Boulevard)	25-009-4004	19	UTM(East)352040 (North)4738800 LAT +42:47:22 LONG -70:48:33
QUINCY Fire Station (Hancock St.)	25-021-0007	19	UTM(East)332391 (North)4682065 LAT +42:16:29 LONG -71:01:57
SCITUATE Police Station (First Parish Rd.)	25-023-2001	19	UTM(East)354000 (North)4673000 LAT +42:11:51 LONG -70:46:06
SPRINGFIELD Howard School (Howard St.)	25-013-0011	18	UTM(East)699454 (North)4663358 LAT +42:05:56 LONG -72:35:17
SPRINGFIELD Liberty Street	25-013-0016	18	UTM(East)699140 (North)4664480 LAT +42:06:32 LONG -72:35:29
SPRINGFIELD Longhill St.	25-013-1009	18	UTM(East)700185 (North)4661896 LAT +42:05:08 LONG -72:34:47

PUBLIC SITE CROSS REFERENCE: AIRS #, LOCATION COORDINATES

CITY SITE LOCATION	AIRS #	UTM ZONE	LOCATION COORDINATES UTM(East) & (North) LATITUDE & LONGITUDE
SPRINGFIELD East Columbus Ave.	25-013-2007	18	UTM(East)699150 (North)4663534 LAT +42:06:02 LONG -72:35:30
SUDBURY National Wildlife Refuge (Water Row Rd.)	25-017-1801	19	UTM(East)303344 (North)4695074 LAT +42:23:06 LONG -71:23:20
TRURO Cape Cod National Park (Fox Bottom)	25-001-0002	19	UTM(East)415100 (North)4647381 LAT +41:58:33 LONG -70:01:29
WALTHAM U Mass Field Station (Beaver St.)	25-017-4003	19	UTM(East)317750 (North)4694520 LAT +42:23:01 LONG -71:12:50
WARE Quabbin Summit	25-015-4002	18	UTM(East)719712 (North)4686127 LAT +42:17:54 LONG -72:20:05
WEST SPRINGFIELD Fire Station (Van Deene St.)	25-013-5003	18	UTM(East)696403 (North)4663920 LAT +42:06:17 LONG -72:37:29
WORCESTER U Mass Medical Center (Belmont St.)	25-027-0013	19	UTM(East)272392 (North)4683693 LAT +42:16:26 LONG -71:45:36
WORCESTER Worcester Airport	25-027-0015	19	UTM(East)262797 (North)4684016 LAT +42:11:27 LONG -71:52:34
WORCESTER YWCA (Washington St.)	25-027-0016	19	UTM(East)269108 (North)4682163 LAT +42:15:33 LONG -71:47:57
WORCESTER Fire Station (Central St.)	25-027-0020	19	UTM(East)269152 (North)4683021 LAT +42:16:02 LONG -71:47:56
WORCESTER Grafton & Franklin St.	25-027-0022	19	UTM(East)269599 (North)4682294 LAT +42:15:39 LONG -71:47:36

APPENDIX B: INDUSTRIAL SITE CROSS REFERENCE

INDUSTRIAL SITE CROSS REFERENCE: AIRS #, DATE SAMPLING BEGAN, LOCATION COORDINATES

REPORTING ORGANIZATION CITY	AIRS #	DATE SAMPLING BEGAN	UTM ZONE	LOCATION COORDINATES UTM(East) & (North) LATITUDE & LONGITUDE
ATLANTIC GELATIN Stoneham (Hill St.)	25-017-1701	01/01/78	19	UTM(East)326462 (North)4704385 LAT +42:28:28 LONG -71:06:40
BOSTON EDISON Boston (Long Island)	25-025-0019	01/01/78	19	UTM(East)337595 (North)4686595 LAT +42:19:00 LONG -70:58:15
BOSTON EDISON Dorchester (Dewar St.)	25-025-0020	01/01/78	19	UTM(East)330548 (North)4685952 LAT +42:18:34 LONG -71:03:22
BOSTON EDISON East Boston (Breman St.)	25-025-0021	01/01/79	19	UTM(East)333008 (North)4693531 LAT +42:22:41 LONG -71:01:42
BOSTON EDISON South Boston (East First St.)	25-025-0040	01/01/93	19	UTM(East)331871 (North)4690009 LAT +42:20:46 LONG -71:02:28
EASTMAN GELATINE Peabody (Meadow Pond)	25-009-1004	01/01/82	19	UTM(East)341340 (North)4708630 LAT +42:30:56 LONG -70:55:53
EASTMAN GELATINE Peabody (Fox Hill)	25-009-1005	01/01/82	19	UTM(East)341130 (North)4709640 LAT +42:31:30 LONG -70:56:03
HAVERHILL PAPERBOARD Haverhill (Nettle School)	25-009-5004	09/10/85	19	UTM(East)331385 (North)4737365 LAT +42:46:20 LONG -71:03:40
NEW ENGLAND POWER CO. Fall River (Globe St.)	25-005-0010	01/01/79	19	UTM(East)318960 (North)4617230 LAT +41:41:17 LONG -71:10:31
NEW ENGLAND POWER CO. Swansea (Sharp's Lot Rd.)	25-005-0010	01/01/75	19	UTM(East)318960 (North)4617230 LAT +41:41:17 LONG -71:10:31