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MAINE

ANNUAL REPORT ON AIR QUALITY 1993

MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

1993 ANNUAL REPORT
ON AIR QUALITY
IN THE STATE OF MAINE

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1. INTRODUCTION

1.1 Purpose and Overview

The purpose of this report is to present the air quality monitoring data generated by and for the Maine Department of Environmental Protection, Bureau of Air Quality Control, and to provide a historical perspective from which the significance of that data can be interpreted. Air Quality monitoring measures the concentrations of various pollutants in the ambient air. The monitoring is in response to State and Federal requirements to determine whether the air we breathe is attaining and maintaining National and State Ambient Air Quality Standards which are designed to protect the health and welfare of the public. Federal Primary Standards are intended to protect public health. Federal Secondary Standards are intended to protect public welfare. The State Standards are at least as strict as Federal Standards and in some cases are more strict. The reasoning behind establishing more stringent standards is that generally air quality in Maine is significantly cleaner than in other areas and should remain cleaner. The current Federal and State Standards are presented in Tables 1-1 and 1-2. Table 1-3 is a summary indicating all the violations of ambient air quality standards in the State by regions. Later on in this report those violations will be listed by the sites at which they occurred.

A significant portion of the data collected in the State is collected by industry. The DEP has required industry to establish monitoring programs primarily when there are air quality problems associated with the industry, or when an industry is planning to build or expand causing a potential increase in air emissions. The State is still collecting monitoring data for long term trends, special studies and for compliance determinations. Ambient air monitoring by both industry and the State will continue in various regions where necessary until such time as standards are being met and background information has been collected.

Included in this section are some figures which depict some of the results of air quality monitoring and control in the State. Figures 1- 1 through 1-7 display trends or the lack of a trend which have been occurring at several long term key sites around the State.

Figure 1-1 depicts the annual geometric means for total suspended particulates at several long term sites. The number of sites monitoring for total suspended particulates has significantly decreased since the standard was eliminated and will continue to do so. These sites generally show fairly stable or slightly downward trends over the last ten years. The site in Lincoln which had been showing an upward trend for the past five years showed a decrease in 1993.

Figures 1-2A and 1-2B indicate trends over the last nine years in the annual arithmetic means for fine particulate. The majority of the sites collecting PM10 data are showing either a downward trend or are low enough that they are probably recording regional background concentrations and are not indicating a significant trend in either direction.

Figures 1-3A, 1-3B, 1-4A and 1-4B indicate the sulfur dioxide trends at seven sites with a long term history. All of the sites appear to indicate relatively stable long term sulfur dioxide levels since

TABLE 1-1
NATIONAL AMBIENT AIR QUALITY STANDARDS (1993)

POLLUTANT	AVERAGING TIME	CONCENTRATION
Particulates (PM_{10})	Expected Annual Arithmetic Mean:	
	Primary	50 ug/m^3
	Secondary	50 ug/m^3
	Twenty-Four Hour:***	
	Primary	150 ug/m^3
	Secondary	150 ug/m^3
Lead (Pb)	Calendar Quarter	1.5 ug/m^3
Carbon Monoxide (CO)	One Hour**	35 ppm
	Eight Hour**	9 ppm
Ozone (O_3)	One Hour***	0.12 ppm
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.05 ppm
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.03 ppm
	Twenty-Four Hour**	0.14 ppm
	Three-Hour Secondary**	0.50 ppm

* = Federal Guideline Only.
** = Not to be exceeded more than once per year.
*** = Statistically estimated number of days with exceedances is not to be more than 1 per year.
ppm = Parts of pollutant per million parts of air.
ug/m^3 = Micrograms of pollutant per cubic meter of air.

TABLE 1-2
STATE OF MAINE AMBIENT AIR QUALITY STANDARDS (1993)

POLLUTANT	AVERAGING TIME	CONCENTRATION
Particulates (PM_{10})	Annual Arithmetic Mean	40 ug/m^3
(Effective 9-30-89)	Twenty-Four Hour**	150 ug/m^3
Lead (Pb)	Twenty-Four Hour*	1.5 ug/m^3
Carbon Monoxide (CO)	One Hour*	35 ppm (40 mg/m^3)
	Eight Hour*	9 ppm (10 mg/m^3)
Ozone (O_3)	One Hour*	.081 ppm (160 ug/m^3)
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	.053 ppm (100 ug/m^3)
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	.022 ppm (57 ug/m^3)
	Twenty-Four Hour*	.088 ppm (230 ug/m^3)
	Three Hour*	.439 ppm (1150 ug/m^3)
Hydrocarbon	Three Hour*	160 ug/m^3
Particulates (TSP)***	Twenty-Four Hour	150 ug/m^3

* = Not to be exceeded more than once per year.
** = Statistically estimated number of days with exceedances is not to be more than 1 per year.
*** = Indication of a nuisance condition only.
PPM = Parts of pollutant per million parts of air.
ug/m^3 = Micrograms of pollutant per cubic meter of air.
mg/m^3 = Milligrams of pollutant per cubic meter of air.

TABLE 1-3
NUMBER OF AMBIENT AIR QUALITY VIOLATIONS BY REGIONS (1993)

	REGIONS					
POLLUTANT	107	108	109	110	111	TOTALS
FINE PARTICULATE(PM10):						
Annual Arithmetic Mean						
State	0	0	0	0	?	0
Federal	0	0	0	0	?	0
Twenty-four Hour						
State	0	0	0	0	?	0
Federal	0	0	0	0	?	0
LEAD:						
Twenty-four Hour						
State	?	?	?	0	?	0
Federal	?	?	?	0	?	0
CARBON MONOXIDE:						
One Hour	?	?	?	?	?	?
Eight Hour	?	?	?	?	?	?
OZONE:						
One Hour						
State	117	?	85	267	0	469
Days						
Federal	0	?	0	4	0	4
NITROGEN DIOXIDE:						
Annual Arithmetic Mean	?	?	?	0	?	0
SULFUR DIOXIDE:						
Annual Arithmetic Mean						
State	0	0	0	0	?	0
Federal	0	0	0	0	?	0
Twenty-four Hour						
State	0	0	0	0	?	0
Federal	0	0	0	0	?	0
Three Hour						
State	0	0	0	0	?	0
Federal	0	0	0	0	?	0

* Annual Means generated by only a few samples are not included in this summary.
? No monitoring done for this pollutant within this region during 1993.

1983 with no significant trend in either direction or in some cases a slight downward trend. In Figure 1-3B there are three sites that show fluctuations in the short term concentrations over the last few years. All three of these sites are in towns with large industrial sources and probably indicate brief periods of upset conditions or unusual meteorological conditions which resulted in the

FIGURE 1-1
TOTAL SUSPENDED PARTICULATE TRENDS

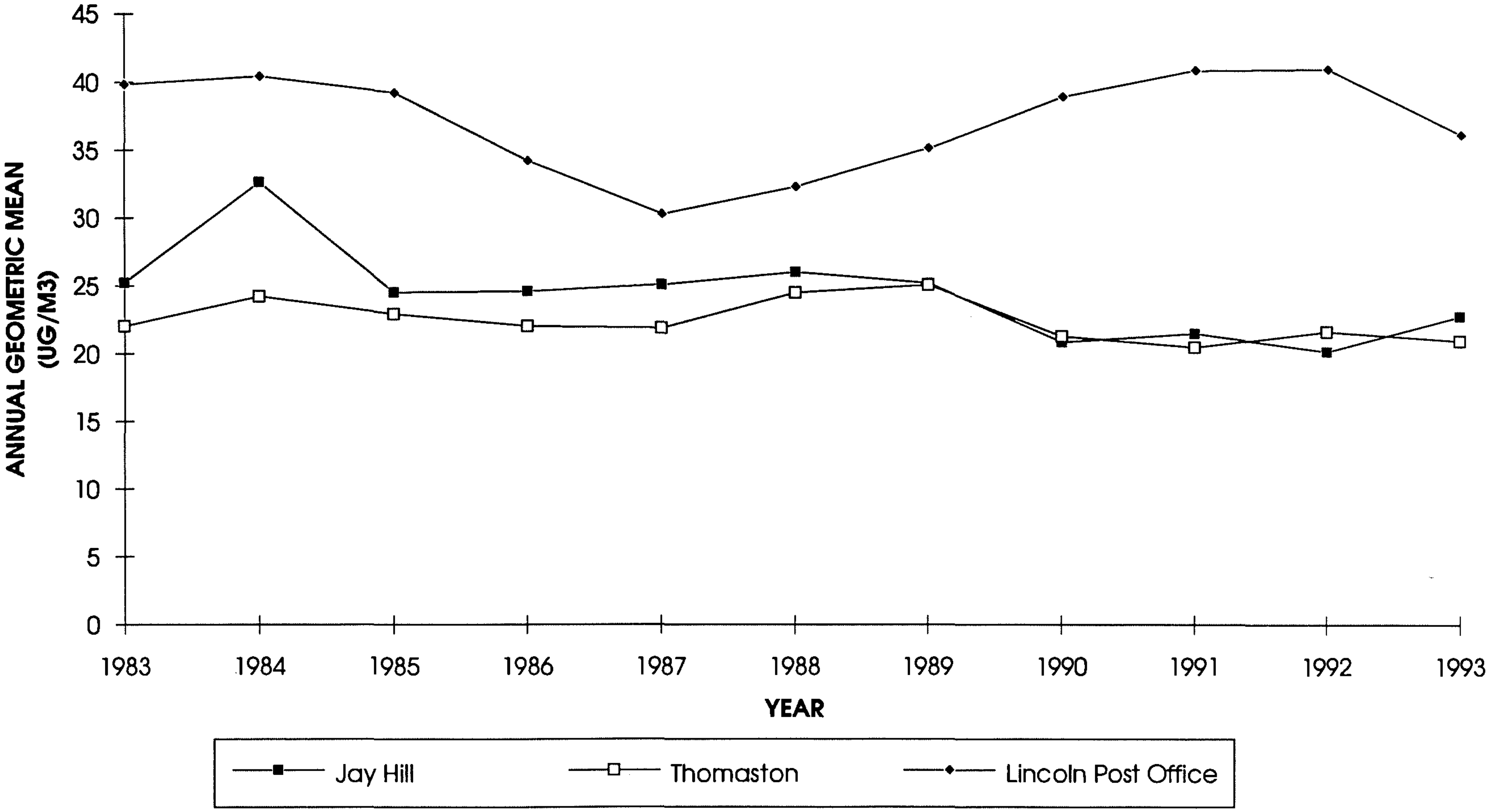


FIGURE 1-2A
PM10 TRENDS - SOUTHERN MAINE

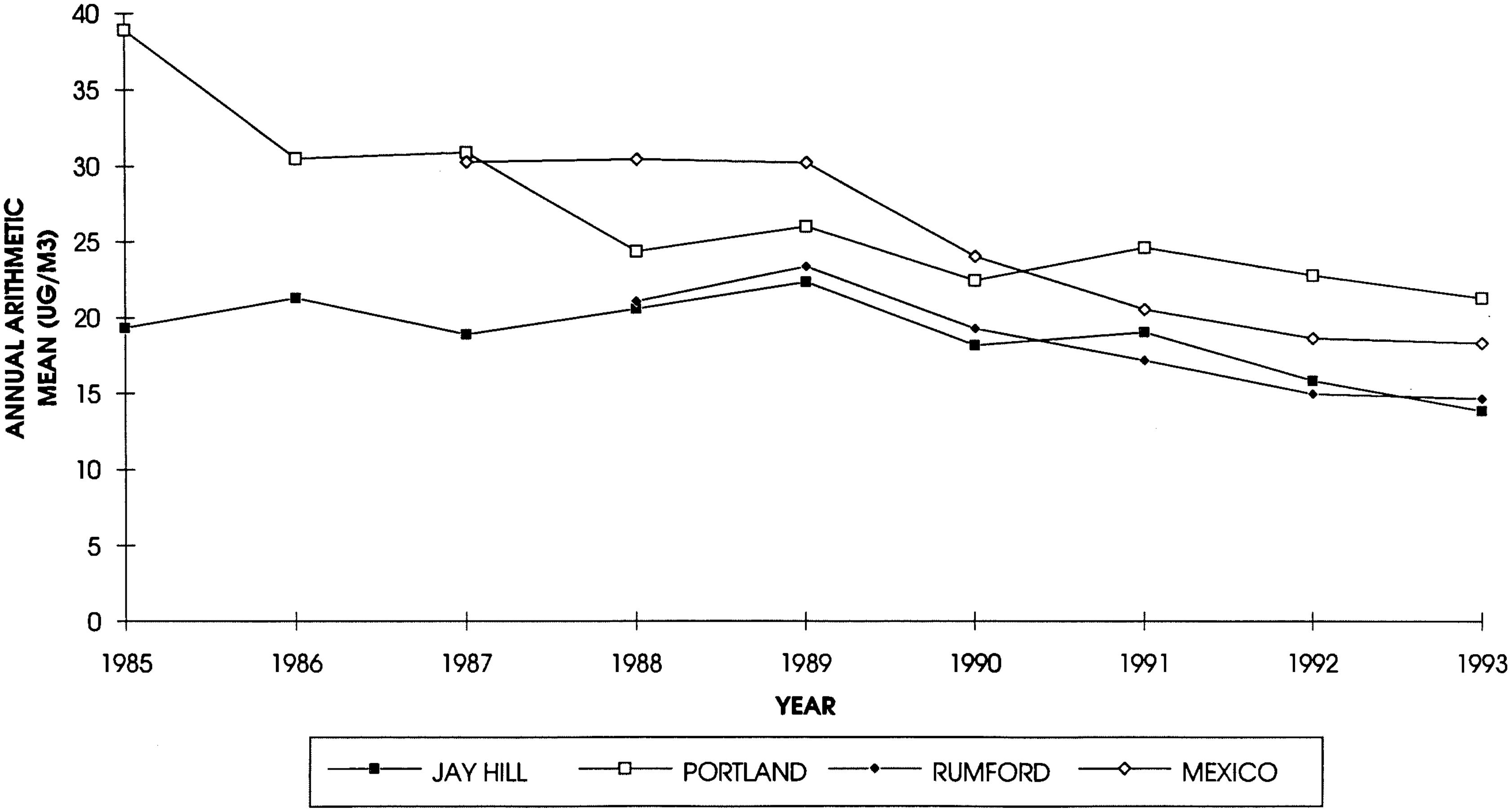


FIGURE 1-2B
PM10 TRENDS - NORTHERN MAINE

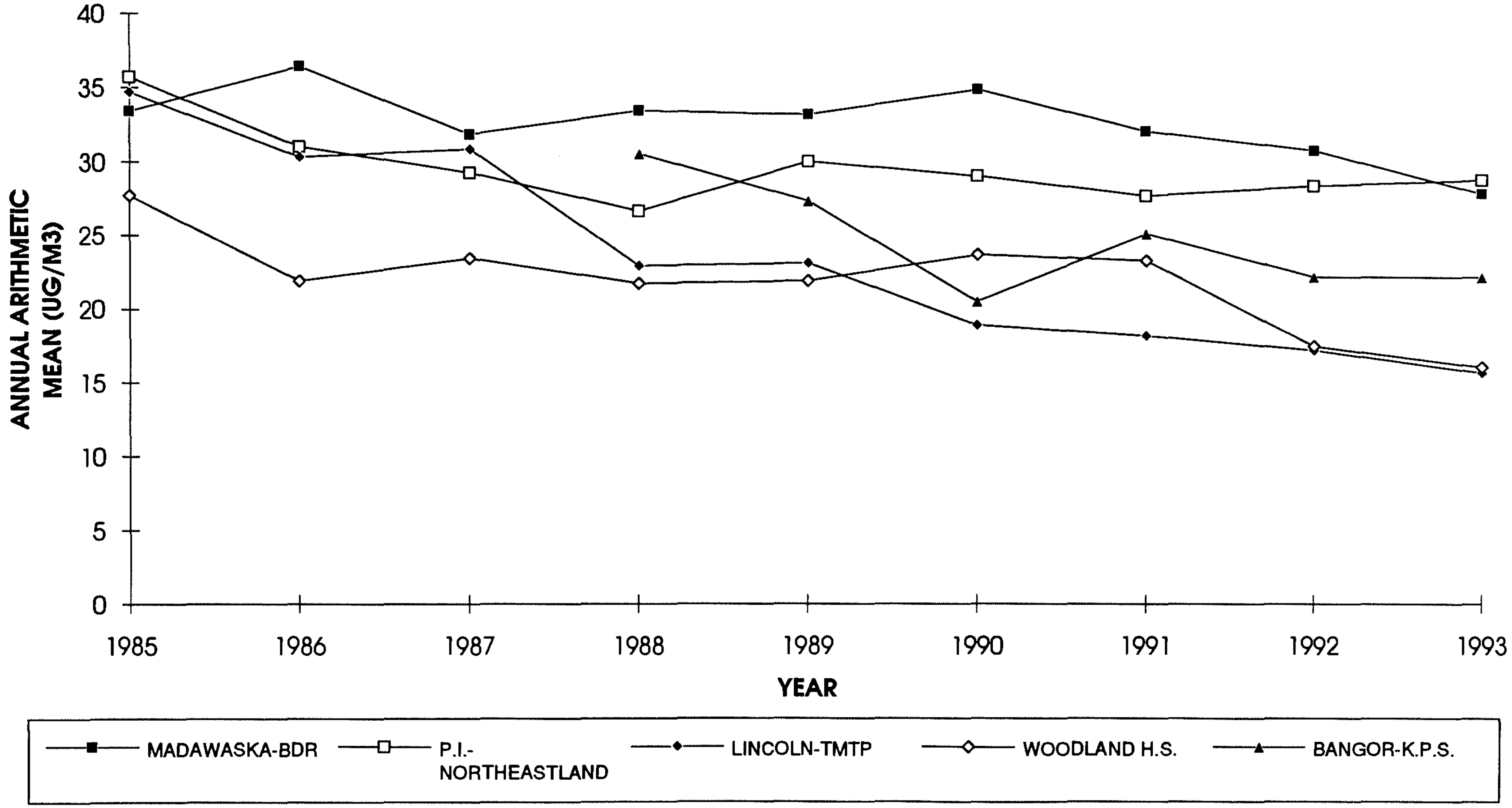


FIGURE 1-3A
SO. MAINE SO2 TRENDS - 24 HOUR

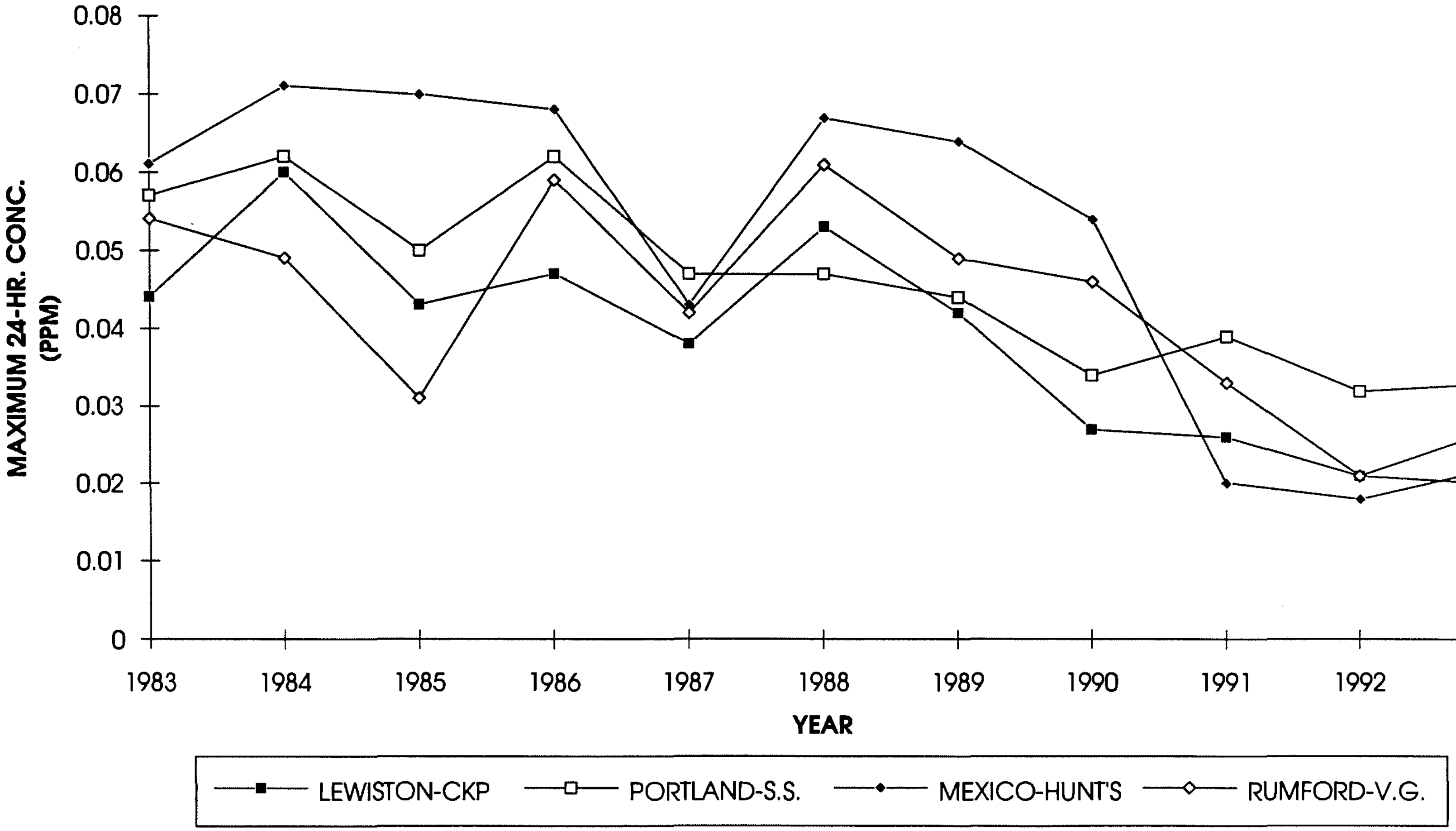


FIGURE 1-3B
NO. MAINE SO2 TRENDS - 24 HOUR

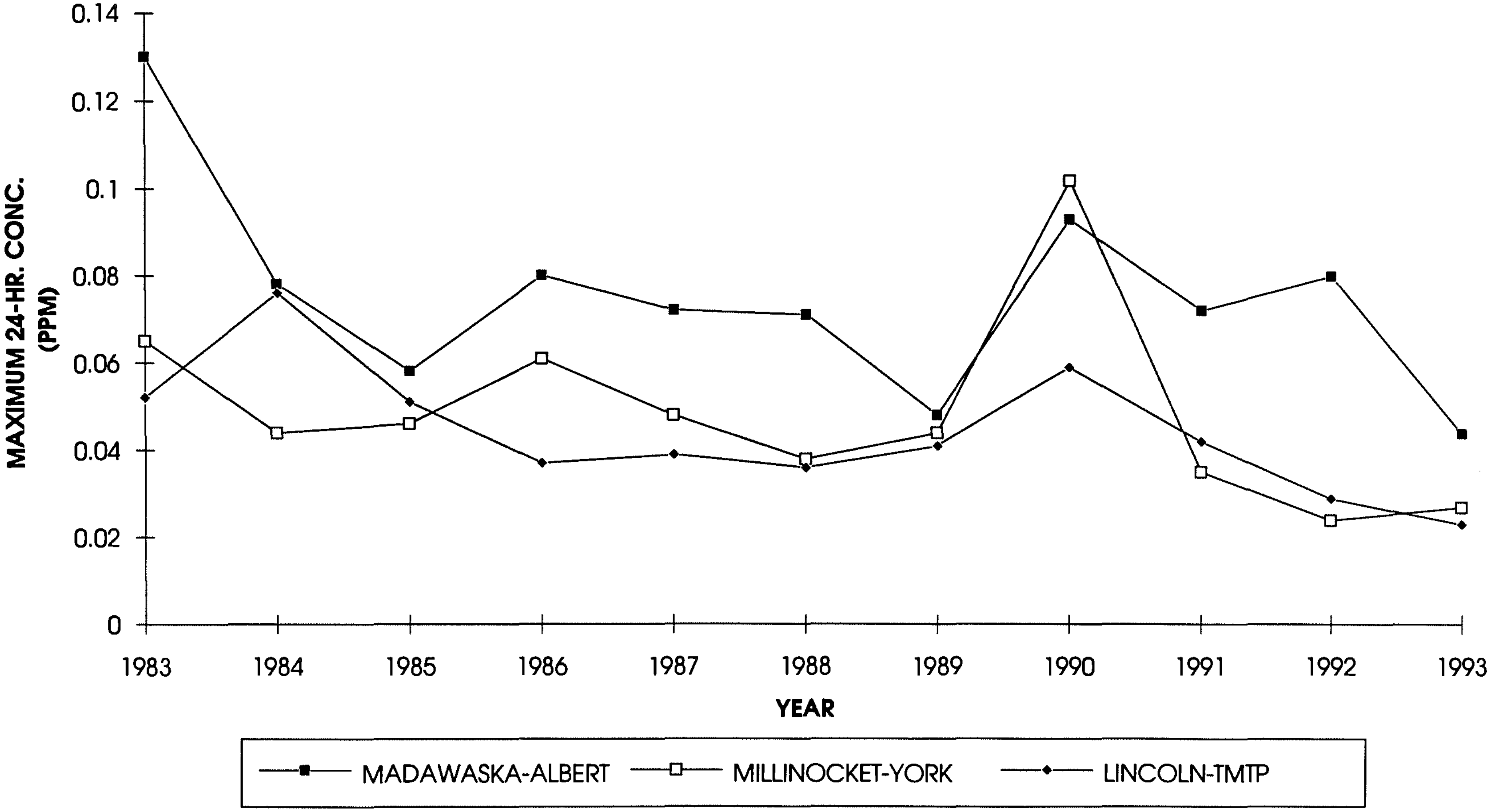


FIGURE 1-4A
SO. MAINE SO2 TRENDS - AAM

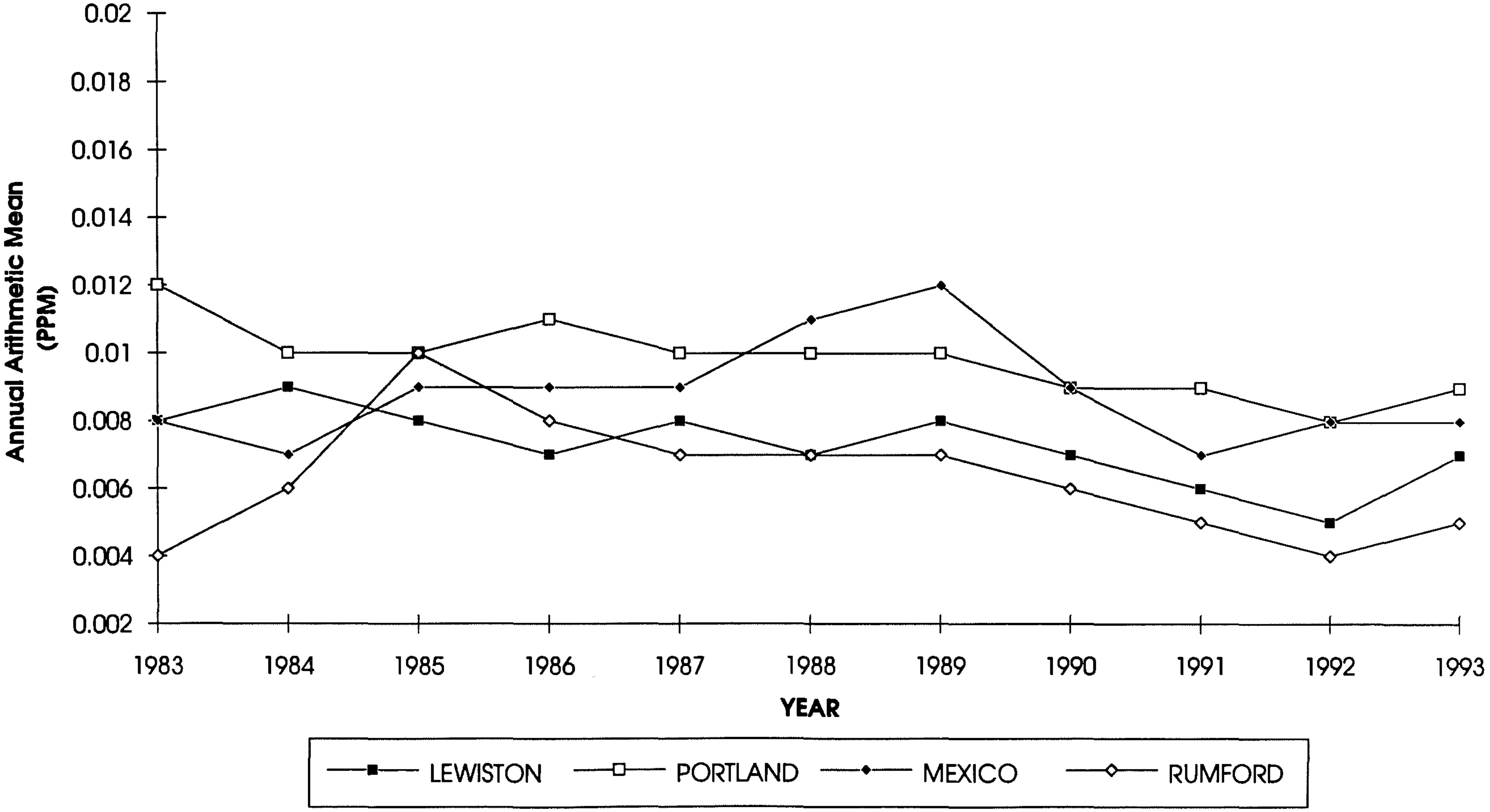
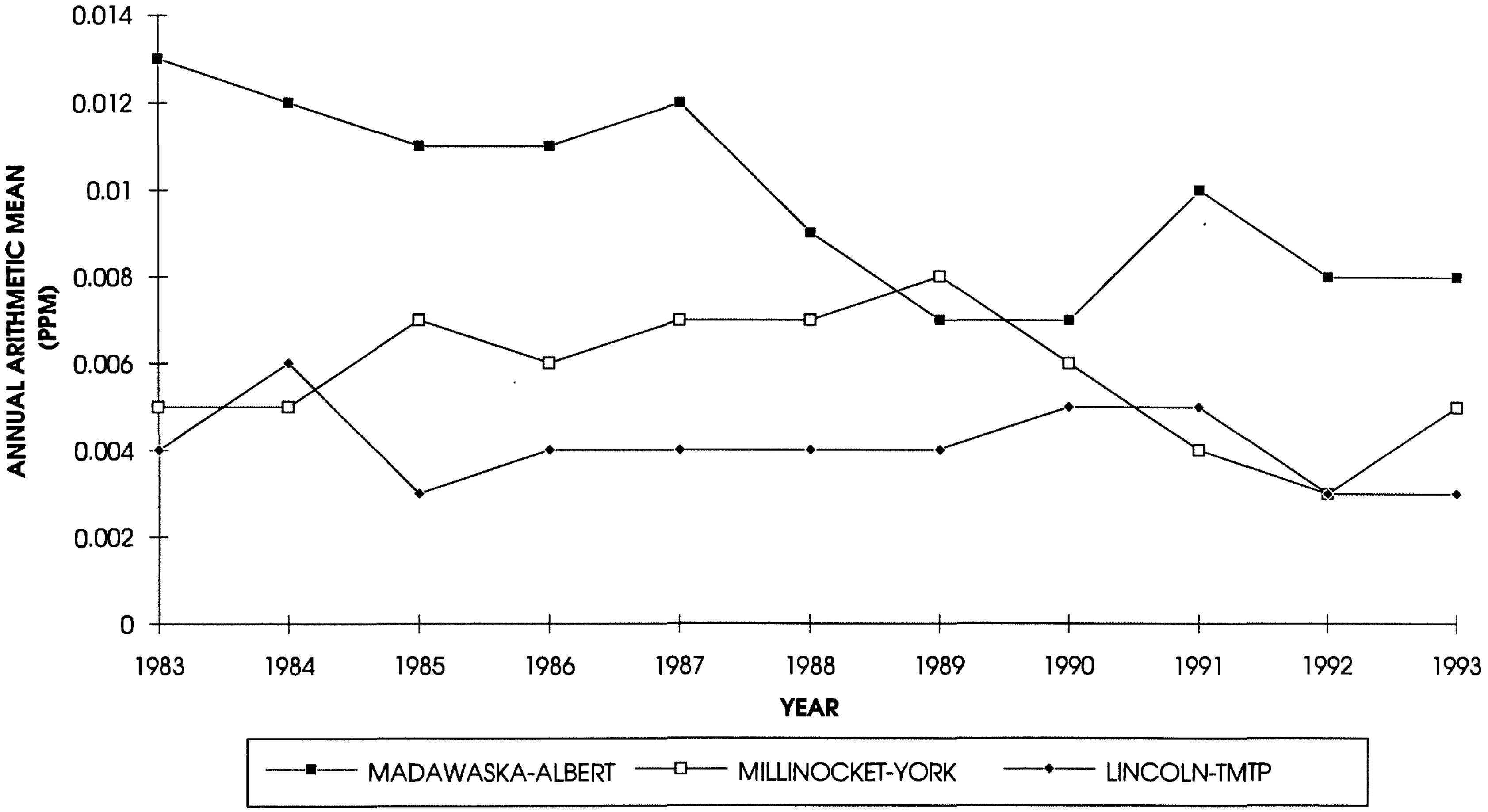


FIGURE 1-4B
NO. MAINE SO2 TRENDS - AAM



higher concentrations.

Figure 1-5 depicts the number of hourly violations of the State ozone standard. As can be seen from the graphs, the violations vary greatly from year to year and while showing a very significant increase in the number of violations during 1988 there was a significant decrease during 1989 which carried over to later years at most of the sites. Weather conditions are responsible for a lot of the variability from year to year and the conditions during 1988 were very conducive to the formation of ozone while those of subsequent years were not as conducive. Because of the significant effect weather has on the formation of ozone, Maine, as well as the rest of the northeast, will need to control emissions to such a level that even under ideal weather conditions ozone levels can be kept below the standards.

Figures 1-6 and 1-7 indicate the very significant reduction that has occurred in lead levels throughout the State in both short term concentrations and in the annual arithmetic means. These significant downward trends are primarily due to the decreased use of lead in gasoline. Current lead levels are less than 20% of the State standard and even less of the Federal standard and are expected to remain at those levels with only minor fluctuations expected in either direction. Because of the extremely low lead levels recorded in Maine, only two sites remained in operation for 1993.

Data summarized in this report is available for review in the DEP headquarters in Augusta and copies can be obtained from that office for a nominal fee.

1.2 Description of Air Monitoring Network

The Maine ambient air monitoring network consists of three types of monitoring sites or stations, which are required by the U.S. Environmental Protection Agency as set forth in Title 40 of the Code of Federal Regulations, Part 58 (40 CFR 58). The types of monitoring sites are distinguished from one another on the basis of the general monitoring objectives they are designed to meet. All of the instruments at a particular monitoring site may not have the same designation. The three types of monitoring sites with their monitoring objectives are as follows:

1. State/Local Air Monitoring Station (SLAMS) Network.

   The SLAMS network is designed to meet a minimum of four basic monitoring objectives:
   a. To determine highest concentrations expected to occur in the area covered by the network.
   b. To determine representative concentrations in areas of high population density.
   c. To determine the impact on ambient pollution levels of significant sources or source categories.
   d. To determine general background concentrations levels.

FIGURE 1-5
OZONE TRENDS - HOURS OF STATE VIOLATION

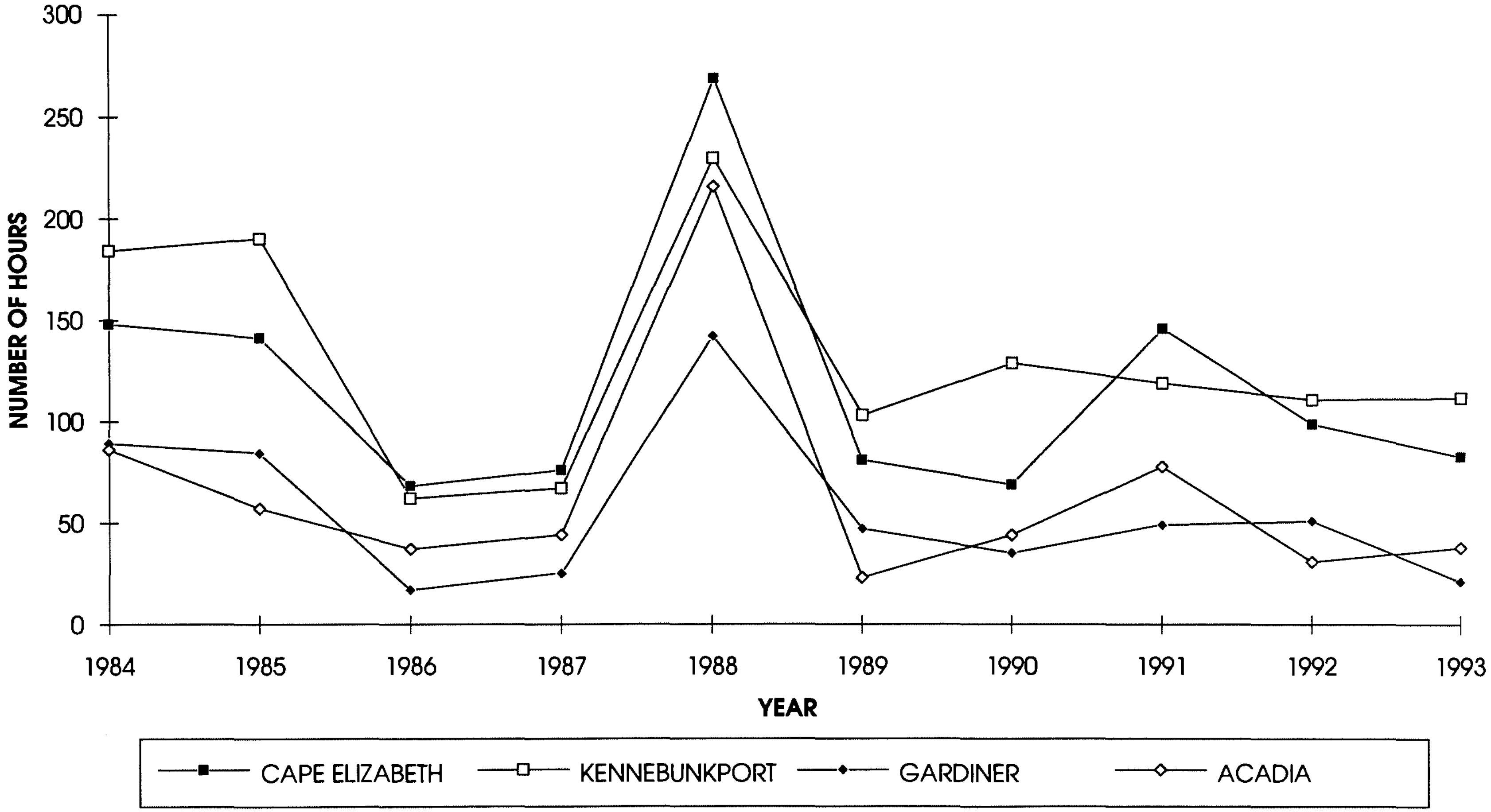


FIGURE 1-6
LEAD TRENDS - SECOND HIGH 24 HOUR

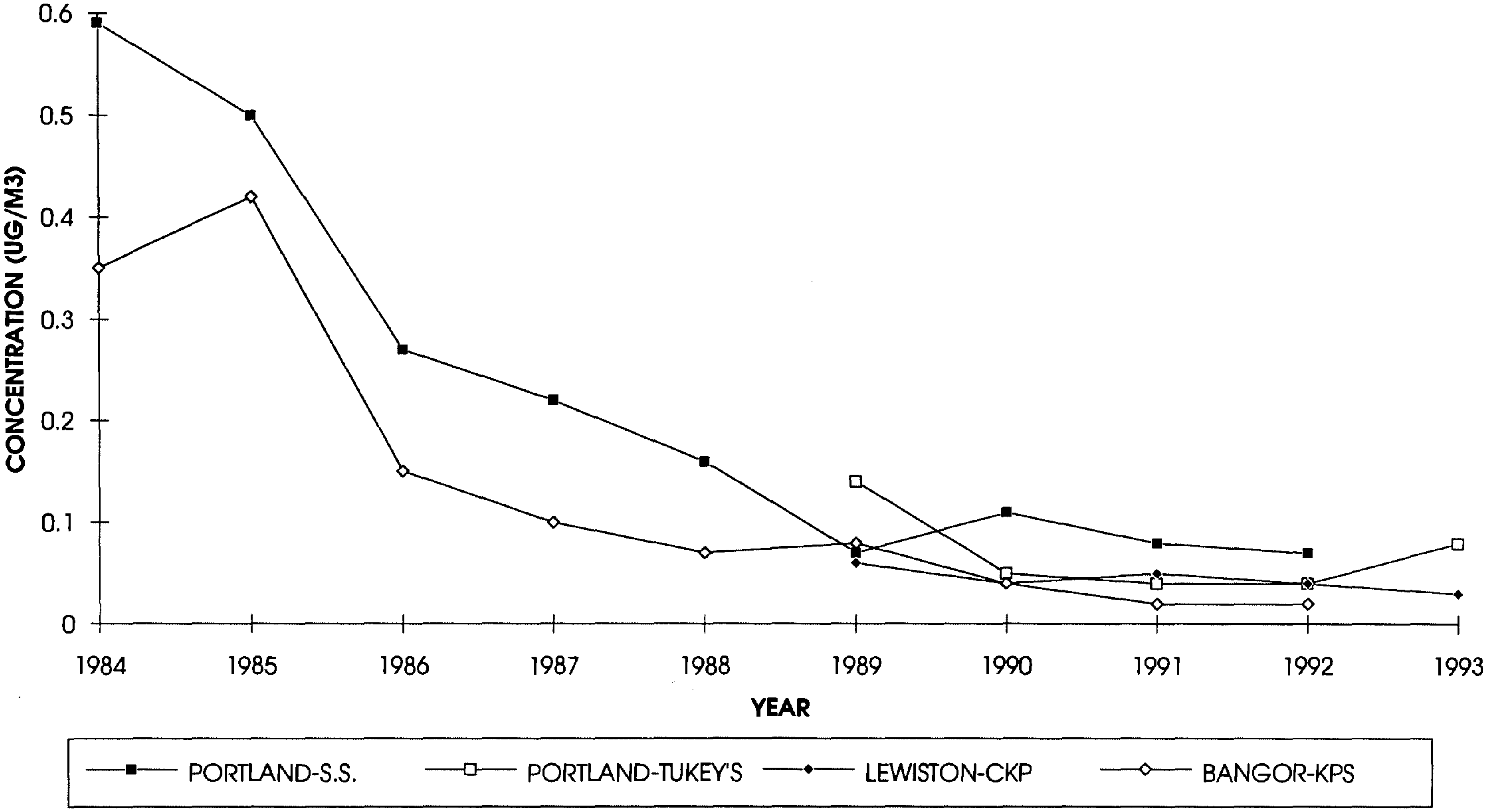
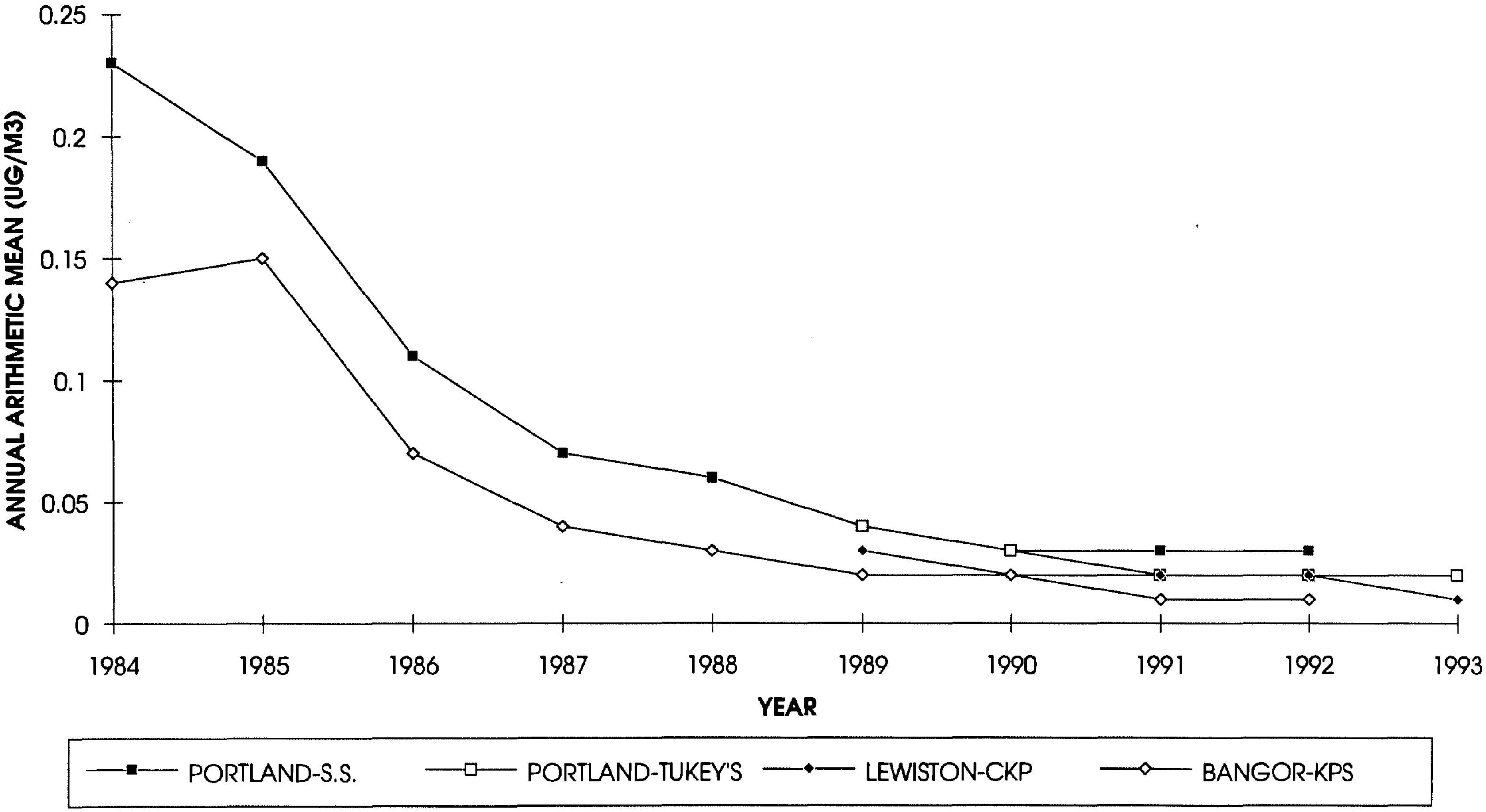


FIGURE 1-7
LEAD HISTORICAL TRENDS - AAM



2. National Air Monitoring Station (NAMS) Network.

   The NAMS network is a subset of the SLAMS network with the following objectives:

   a. To monitor in the areas where the pollutant concentration and the population exposure are expected to be the highest consistent with the averaging time of the NAAQS.
   b. To monitor in areas of expected maximum concentrations.
   c. To monitor in areas which combine poor air quality with a high population density.
   d. To provide data for national policy analysis/trends and for reporting to the public on major metropolitan areas.

3. Special Purpose Monitoring Station (SPMS) Network.

   Any monitoring site that is not a designated SLAMS or NAMS is considered a special purpose monitoring station. Some of the SPMS network objectives are:

   a. To verify the maintenance of ambient air standards in areas not covered by or represented by the SLAMS/NAMS network.
   b. To provide additional data for developing local control strategies and to document their effectiveness.
   c. To provide data on noncriteria pollutants.

The number of monitors operated for the various monitoring types are summarized in Table 1-4. This monitoring network has been fairly stable for the last couple of years. There were two less ozone sites operated this year. Both of the sites shut down were island sites which were difficult to operate and maintain because of the access to the sites. The total suspended particulate network was significantly reduced due to the elimination of the standard and the control of fugitive dust problems. Sulfur dioxide and lead monitoring have also been reduced due to sufficient data having been collected documenting the compliance status and low levels of those pollutants in most areas of the State.

Table 1-5 provides a breakdown of who operated the monitors during 1993. The breakdown indicates most point-source oriented pollutant monitors are operated by the sources which contribute to the problem whereas secondary pollutants or population caused pollutant monitors are generally operated by the DEP, or other governmental agencies.

Air quality data are developed using two basic methods: 1) the continuous monitoring of gaseous pollutants and; 2) the periodic sampling of particulate and gaseous pollutants. In addition to pollutant monitoring there is also the continuous monitoring of meteorological parameters. One hundred and two monitors collected data at seventy-four different sites during 1993.

Continuous gaseous monitoring was done at twenty-five sites in Maine during 1993. Ozone was monitored at twelve of these stations, nitrogen dioxide at two and sulfur dioxide at thirteen. Carbon Monoxide was not monitored during 1993.

Particulate sampling was done at forty sites in Maine during 1993. Eleven of these stations

TABLE 1-4
DISTRIBUTION OF AIR MONITORING INSTRUMENTS
1993

POLLUTANT	NAMS	SLAMS	SPMS	TOTAL
Fine Particulate	2	15	21	38
Total Suspended Particulate	0	0	11	11
Lead	0	0	2	2
Carbon Monoxide	0	0	0	0
Sulfur Dioxide	2	3	8	13
Nitrogen Dioxide	0	0	2	2
Ozone	0	6	6	12
Sulfate	0	0	3	3
WS/WD	0	0	19	19
Atmospheric Depsition	0	0	2	2
Total	4	24	74	102

TABLE 1-5
MONITOR OPERATORS DURING 1993

POLLUTANT	DEP*	INDUSTRY**	TOTAL
Fine Particulate	16	22	38
Total Suspended Particulate	2	9	11
Lead	2	0	2
Carbon Monoxide	0	0	0
Sulfur Dioxide	4	9	13
Nitrogen Dioxide	2	0	2
Ozone	11	1	12
Sulfate	2	1	3
WS/WD	7	12	19
Atmospheric Deposition	2	0	2
Total	48	54	102

* Includes other governmental agencies.
** Includes industries and their consultants.

monitored total suspended particulates. Thirty-eight of these sites collected fine particulate fractions. Also, lead monitoring was done at two stations. Three sites were analyzed for sulfates. There were also two sites collecting acid rain data as part of the State monitoring network as well as a University of Maine operated site.

In addition to pollutant monitoring, wind speed and direction was recorded at twenty sites around the State during 1993. Some of these sites also recorded other meteorological parameters such as sigma (stability) and temperature, precipitation and solar radiation.

Table l-6 presents all the monitoring sites in Maine that operated during 1993 and indicates which parameters were monitored at each site. The map in Figure 1-8 shows the Air Quality Control Regions within the State.

1.3 Document Organization

This document is divided by pollutant into chapters. Each chapter contains: 1) a description of the nature and sources of that pollutant, 2) its health and welfare effects, 3) a discussion on the standards (current and proposed) for that pollutant, 4) a discussion of the monitoring methods for that pollutant, 5) a table presenting the 1993 monitored data, 6) in the case of some pollutants, historical tables presenting 1993 data along with data for previous years to show trends, effects of control strategy, or change in emission sources.

1.3.1 Explanation of Data Summary Tables

The Data Summary Tables were designed to facilitate comparing 1993 air quality monitoring data with the standards for each pollutant. Therefore, the data are presented for each averaging time for which standards exist for a pollutant.

An annual average concentration is presented for each pollutant that has a long-term, annual standard (NO_2, SO_2, PM10).

For pollutants that have short-term standards, the highest short-term values are presented. Some pollutants are allowed to exceed the standard once during the year so the second highest value would be used to determine whether there was a violation or not.

All of the data collected during 1993 has been presented in the Data Summary Tables. However, in making comparisons of the data, one should be aware that a site with only a few samples will not be a valid indicator of pollutant concentrations in the area.

1.3.2 Explanation of Historical Comparison Tables

The Historical Comparison Tables present air quality data for 1993 and those years prior to 1993 when the same pollutant was monitored at the same site. The purpose of the Tables are to indicate

TABLE 1-6
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
ANDROSCOGGIN COUNTY			
Auburn 23 001 0005	Lewiston-Auburn Airport Lewiston Junction Road	DEP	WS/WD
Lewiston 23 001 0011	Country Kitchen Parking Lot Canal Street	DEP	SO2,TSP,Pb,FP
Livermore Falls 23 001 0013	James River/Otis Mill Route 4	James River Corp.	WS/WD,Temperature
AROOSTOOK COUNTY			
Madawaska 23 003 0006	Fraser Paper Company Bridge Street	Fraser Paper	WS/WD,Temperature
Madawaska 23 003 0009	Albert Street	Fraser Paper	SO2,Precipitation
Madawaska 23 003 0012	U. S. Post Office 430 E. Main Street	Fraser Paper	SO2,WS/WD
Madawaska 23 003 0013	Big Daddy's Restaurant 395 E. Main Street	DEP	FP
Madawaska 23 003 1005	Madawaska High School 7th Avenue	Fraser Paper	SO2
Presque Isle 23 003 1005	Northeastland Hotel 436 Main Street	DEP	FP
Presque Isle 23 003 1008	DEP Regional Office 528 Central Drive	DEP	WS/WD,FP
Presque Isle(NEW) 23 003 1011	Riverside Street	DEP	FP
CUMBERLAND COUNTY			
Bridgton 23 005 0002	Upper Ridge Road	DEP	FP
Portland 23 005 0010	Cheverus High School Ocean Avenue	DEP	WS/WD
Portland 23 005 0014	Shelter Site(P.E.O.P.L.) Elm Street	DEP	SO2,Pb,FP,Sulfate,NO,NO2, NOx
Portland 23 005 0015	Tukey's Bridge	DEP	Pb,FP

TABLE 1-6(Continued)
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
South Portland 23 005 0022	130 Wescott Road	DEP	FP
Westbrook 23 005 1008	Research Building S. D. Warren	S. D. Warren	FP
Westbrook 23 005 1009	S. D. Warren Co. Wind S. D. Warren Property	S. D. Warren	WS/WD,Temperature
Cape Elizabeth 23 005 2003	Shelter Site Two Lights State Park	DEP	Ozone(s),WS/WD(s),NO2(s), NO(s),NOx(s)
Westbrook(DISC) 23 005 7002	N. E. T. & T. Company Ash Street	S. D. Warren	FP
FRANKLIN COUNTY			
Jay 23 007 0003	Crash Road Gilbert Jewell Property	International Paper	TSP,FP(n)
Jay 23 007 0004	Jay Hill Bomaster Property	International Paper	TSP,FP
Jay 23 007 0008	Burnham Site	International Paper	TSP
Jay 23 007 2001	Weather Level I Lagoon Hill	International Paper	TSP,FP,WS/WD,Temp., Solar Radiation, Precip.
HANCOCK COUNTY			
Acadia National Park 23 009 0003	McFarland Hill Ranger Sta. Route #233	NPS/DEP	Acid Precipitation, Precipitation
Acadia NP 23 009 0101	Acadia NP Route #233	NPS	Ozone,WS/WD,Temperature, Dewpoint
KENNEBEC COUNTY			
Augusta 23 011 0008	Governor's Hangar State Airport	DEP	WS/WD
Augusta 23 011 0014	Rines Hill Parking Lot Water Street	DEP	FP
Waterville 23 011 1004	Front Street Municipal Park	DEP	TSP,FP,SO2
Winslow 23 011 2003	Gulley Hill Road	Scott Paper Company	TSP

TABLE 1-6(Continued)
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
Winslow 23 011 2004	Boston Avenue	Scott Paper Company	TSP,FP
Gardiner 23 011 2005	Pray Street School	DEP	Ozone(s)
KNOX COUNTY			
Isle Au Haut 23 013 0003	Isle Au Haut Fire Station	UM/DEP	Ozone(s)
Port Clyde 23 013 0004	Port Clyde Ozone St. George	DEP	Ozone(s)
Thomaston 23 013 1005	Dragon Cement Weather Route #1	Dragon Products	WS/WD
Thomaston 23 013 2001	Mitchell Property 2 Dexter Avenue	Dragon Products	TSP,FP
OXFORD COUNTY			
Mexico 23 017 0008	Labonville's Route #2	Boise Cascade	FP
Mexico 23 017 0011	Hunt's Property Route #2	Boise Cascade	SO2
Rumford 23 017 2002	Boise Cascade Weather II Swift River Pump House	Boise Cascade	WS/WD,Temperature,Solar Radiation
Rumford 23 017 2005	Taylor Mountain I	Boise Cascade	SO2,Sulfate,FP
Rumford 23 017 2006	Taylor Mountain II	Boise Cascade	SO2
Rumford 23 017 2007	Village Green Site	Boise Cascade	SO2,FP
North Lovell 23 017 3001	DOT Garage Route #5	DEP	Ozone(s)
PENOBSCOT COUNTY			
Bangor 23 019 0002	Kenduskeag Pump Station Washington Street	DEP	FP
Bangor 23 019 0010	BIA - Building #489 Air National Guard	DEP	WS/WD

TABLE 1-6(Continued)
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
Brewer 23 019 1002	Brewer Junior High School 5 Somerset Street	DEP	FP
Lincoln 23 019 1007	Thomas Motel Trailer Park 39 West Broadway	Lincoln Pulp & Paper	TSP,SO2,FP
Lincoln 23 019 1011	Lincoln Street	Lincoln Pulp & Paper	FP
Lincoln 23 019 1012	Penobscot River	Lincoln Pulp & Paper	FP
Lincoln 23 019 1013	Lincoln Mill Katahdin Avenue	Lincoln Pulp & Paper	WS/WD,Temperature
Lincoln 23 019 2003	Lincoln Post Office Building 50 Fleming Street	Lincoln Pulp & Paper	TSP,FP
Millinocket 23 019 2009	York Street	Great Northern Paper	SO2,FP
Millnocket 23 019 2013	Mill Stone Dam	Great Northern Paper	WS/WD,Temperature
Old Town 23 019 4003	Marsh Island Apartments 100 Main Street	DEP	FP
Howland 23 019 4007	Meadow Brook Road	DEP	Solar Radiation(n), Uv-B Radiation(n)
Holden(NEW) 23 019 4008	Summit of Rider Bluff	DEP	Ozone(s)
Old Town 23 019 5004	Woodlands Garage James River Corporation	James River Corp.	WS/WD,Temperature
Orrington 23 019 8001	Center Drive School	Penob. Energy Rec.	FP
Hampden 23 019 8011	McGraw School	Penob. Energy Rec.	FP
PISCATAQUIS COUNTY			
Greenville 23 021 0001	Squaw Brook Greenville	University of Maine	Acid Precipitation,Precipitation
Greenville(NEW) 23 021 0002	Greenville Municipal Airport	DEP	Ozone(s)

TABLE 1-6(Continued)
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
SAGADAHOC COUNTY			
Phippsburg(NEW) 23 023 0003	Small Point Navy Road	DEP	Ozone(s)
SOMERSET COUNTY			
Madison 23 025 1004	The Ballfield Main Street	Madison Paper Ind.	WS/WD,Temperature
Skowhegan 23 025 2001	Hinckley Hinckley Farm School	S. D. Warren	FP
Skowhegan 23 025 2002	Eaton Ridge	S. D. Warren	FP
Skowhegan 23 025 2003	Somerset Mill S. D. Warren	S. D. Warren	WS/WD,Ozone,Temperature
WASHINGTON COUNTY			
Woodland 23 029 0007	Secondary Treatment Pipeline	Georgia Pacific Corp.	FP
Woodland 23 029 0008	Woodland High School	Georgia Pacific Corp.	FP
Woodland 23 029 0018	Background	Georgia Pacific Corp.	FP
Jonesport 23 029 0019	Public Landing	DEP	Ozone(s)
Woodland 23 029 0020	100 Meter Tower	Georgia Pacific Corp.	WS/WD,Temperature, Dewpoint
YORK COUNTY			
Biddeford 23 031 0002	Biddeford Treatment Plant Water Street	DEP	FP,SO2
Biddeford 23 031 0005	Eagles Aerie 57 Birch Street	DEP	FP
Kennebunkport 23 031 2002	Parson's Way	DEP	Ozone(s)

TABLE 1-6(Continued)
1993 AMBIENT AIR MONITORING SITE DIRECTORY

SITE	ADDRESS	OPERATOR	PARAMETERS MEASURED
(AIRS Site #)			

NEW -Site established in 1993
DISC -Site discontinued in 1993

TSP -Total Suspended Particulates
SO2 -Sulfur Dioxide
NO -Nitric Oxide
NOx -Oxides of Nitrogen
NO2 -Nitrogen Dioxide
CO -Carbon Monoxide
Pb -Lead
WS/WD -Wind Speed and Direction
FP -Fine Particulate
NMHC -Nonmethane Hydrocarbons

n -Instrument installed during 1993
d -Instrument removed during 1993
s -Instrument operated seasonally during 1993
i -Instrument operated intermittently during 1993

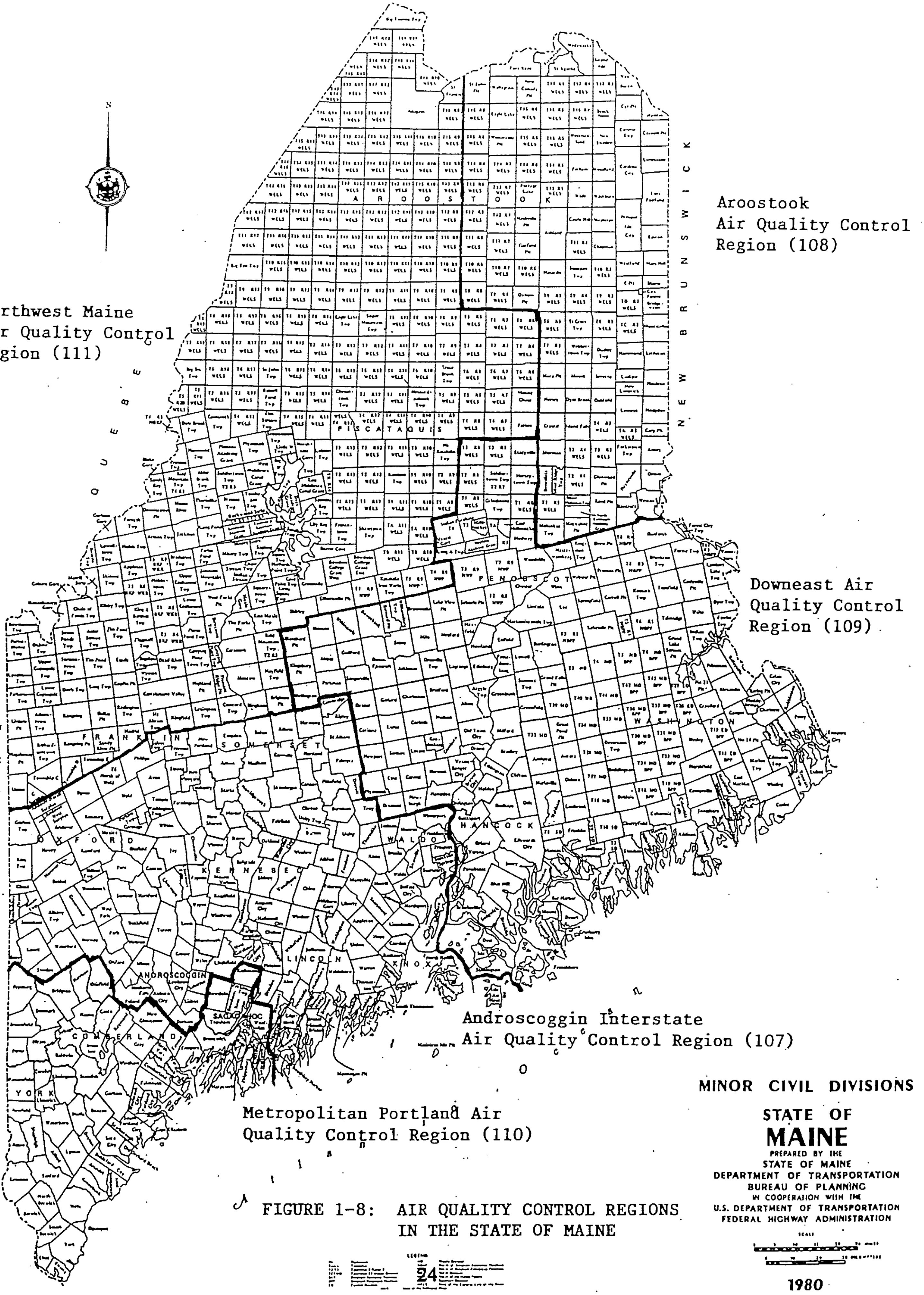


FIGURE 1-8: AIR QUALITY CONTROL REGIONS IN THE STATE OF MAINE

the variations in air quality from year to year. The Tables in some cases represent maximum concentrations for specific time periods and in others the number of days in each year that the standards were violated.

1.3.3 Explanation of Trends Tables

The highest hourly concentration in a year is not the best indicator of long-term air quality trends because it is an erratic value. Therefore, special trend tables are presented for carbon monoxide and ozone. The trend tables present the 10th, 50th, and 90th percentile values to represent the bulk of the air quality data for each year. Percentiles indicate the fraction, or percent, of the value that are below a particular level. For example, if the 90th percentile value for some sets of CO observations is 5.0 ppm, it means that 90% of the time the concentrations of CO are less than 5.0 ppm. Conversely, it also means that 10% of the time the concentrations are above 5.0 ppm. Thus the existence or lack of long-term trends in overall air quality for CO and O3 can be more reliably determined using the Trends Tables, than by looking at just the Historical Comparison Tables.

The ozone data has been incorrectly interpreted in the past and consequently the trends tables have not reported the ozone data in a consistent format. Starting in 1988 data was stored in the AIRS database instead of the old SAROAD system. Under the SAROAD system reports were generated which indicated the percentiles or frequency distribution of all the hourly data values reported. Reports generated under the AIRS system are now based on percentiles calculated based on each days maximum hourly value. Thus, a 50th percentile of .050 ppm means that 50% of the days monitored had a maximum hourly value during the day of .050 ppm or less. All of the trend information for ozone beginning with the 1991 Annual Report have been revised to reflect this method of calculation based on the AIRs report format. If a report format can be developed that will provide percentiles based on total hourly values then that statistic will be used in future reports as it is a better indicator of total exposure to high ozone levels.

2. CARBON MONOXIDE (CO)

2.1 Description and Sources

Carbon monoxide is colorless, odorless and tasteless gas. Therefore you do not even know you are breathing it until you feel its detrimental effects. It constitutes the largest single fraction of the pollutants found in urban atmospheres. It is produced primarily by the incomplete combustion of organic materials used as fuels for transportation and in the heating of buildings; it also results from industrial processes, refuse burning, and agricultural burning. Several natural sources of CO of both biological and non-biological origin have also been identified, but their contributions to urban atmospheric concentrations are thought to be small. Background levels of CO (resulting from natural and technological sources) found in relatively nonpolluted air range from 0.025 to 1.0 ppm. Urban carbon monoxide is produced primarily by motor vehicles.

Because motor vehicle traffic is the major source of CO, daily concentration peaks coincide with morning and evening rush hours. The worst carbon monoxide problems are found where large numbers of slow moving cars congregate. These problems are further aggravated when they occur in a "street canyon" situation. When there are large amounts of slow moving traffic in a street canyon situation, with the wind blowing perpendicular to the street, carbon monoxide can be trapped in the canyon and build up to unhealthful levels.

CO problems are usually worse in winter because: l) cold weather makes motor vehicles run dirtier and requires more combustion for space heating; and 2) on winter nights a strong inversion layer develops in the atmosphere, that traps pollution near the ground, preventing it from mixing with cleaner air above.

2.2 Health and Welfare Effects

Carbon monoxide affects the central nervous system by depriving the body of the oxygen it needs. Tests of automobile drivers show exposure to carbon monoxide can impair driver's judgement and ability to respond rapidly in traffic. It can also impair vision and produce headaches.

Carbon monoxide enters the bloodstream by combining with hemoglobin, the substance that carries oxygen to the cells. Hemoglobin that is bound up with CO is called carboxyhemoglobin. This combination occurs 200 times more readily with CO than with oxygen, so the amount of oxygen being distributed throughout the body by the bloodstream is reduced in CO's presence. Blood laden with CO can weaken heart contractions, lowering the volume of blood distributed to various parts of the body. It can also significantly reduce a healthy person's ability to perform manual tasks, such as working, jogging and walking. A life-threatening situation exists in patients with heart disease, who can't compensate for the oxygen loss. The 4.2 million people in the U.S. suffering from angina pectoris (a heart disease characterized by brief spasmodic attacks of chest pain due to insufficient oxygen levels in the heart muscles) are especially susceptible. Carbon monoxide is also harmful to persons who have lung disease, anemia or cerebral-vascular disease. Others sensitive to carbon monoxide include the human fetus, and people exposed to long-term concentrations, such as traffic officers.

People who sit in idling cars over sustained periods risk harmful CO exposure, as do cigarette smokers. Since about two percent of cigarette smoke is carbon monoxide, if you or someone else smokes while driving in heavy traffic, you may both experience the harmful effects of CO from the cigarette smoke and the engine exhaust accumulated in streets. Even three or four hours after you're exposed, half the excess CO still remains in your bloodstream. Because it takes time for CO to build up in the bloodstream, the severity of health effects depends both on the concentration being breathed and the length of time the person is exposed.

2.3 Standards

The existing standards for carbon monoxide are currently set at 9 parts CO per million parts air (ppm), averaged over a period of 8 hours, and 35 ppm averaged over 1 hour, not to be exceeded more than once per year. As a result of a review and revision of the health criteria, EPA had proposed to retain the existing primary 8-hour standard at 9 ppm and to lower the primary 1-hour standard to 25 ppm. However, this change has not occurred and the standards remain the same. The change in the 1-hour standard had been proposed because of the more rapid accumulation of blood carboxyhemoglobin in moderately exercising sensitive persons compared to resting individuals. The impact of exercise, which is greater for short-duration exposures, was not considered in the original standard.

2.4 Monitoring

Carbon monoxide was not monitored in Maine during 1993.

3. OZONE (O3)

3.1 Description and Sources

Ozone is a highly reactive form of oxygen which, at very high concentrations, is a blue unstable gas that has a characteristic pungent odor most commonly identified around an arcing electric motor, lightning storms, or other electrical discharges. However, at normal ambient concentrations, ozone is colorless and odorless. Ozone is the major component of photochemical "smog", but the haziness and odors of smog are primarily caused by other components.

Natural ground level ozone occurs in low concentrations (less than .05 ppm) due to natural physical and chemical phenomena. Occasionally, unique meteorological conditions can result in natural levels between .05 and .10 ppm.

Ozone is not emitted directly from a source as are other pollutants. It forms as secondary pollutant. It's precursors are hydrocarbons and nitrogen oxides, which chemically react in sunlight to form ozone. The hydrocarbons are emitted in automobile exhaust, from gasoline and oil storage and transfer, and from industrial use of paint solvents, degreasing agents, cleaning fluids, ink solvents, incompletely burned coal or wood and many other sources. Plants also give off hydrocarbons such as terpenes from pine trees. Nitrogen oxides are emitted by all combustion sources.

The highest ozone levels generally occur during summer afternoons when the high temperatures and strong sunlight promote photochemical reactions. Stagnant weather may cause smog to remain in an area for several days. The winds may also transport ozone many miles outside of the urban environment. For example, it is estimated that the majority of the ozone in the State of Maine is transported into the State from sources located outside the State. In addition a much smaller amount of the ozone is naturally occurring background concentrations, part of which is also transported into the State. The remaining ozone is assumed to be due to local sources within the State. Because of long-range transport, local control of emissions by itself may not solve the ozone problem. An effective national program may be necessary to achieve national compliance.

Ground-level ozone, discussed above, should not be confused with the stratospheric ozone layer, located about seven miles high in the atmosphere, which shields the earth from cancer-causing ultraviolet rays. Concentrations of ozone in this layer may reach as high as 10 ppm. Concern over potential reduction of the necessary levels of ozone in the stratosphere by reactions with fluorocarbons from aerosol cans has resulted in the removal of most of these propellants from the market. However, ozone at ground level, where it is breathed, is a pollutant.

3.2 Health and Welfare Effects

Ozone at low concentrations causes eye irritations and at higher concentrations difficulty in breathing for people with respiratory problems, the elderly, and children. Many plants, such as white pine, soybeans and alfalfa, are extremely sensitive to ozone, and ozone is known to weaken materials such as rubber and fabrics.

3.3 Standards

The existing National Ambient Air Quality Standard (NAAQS) for ozone is 0.12 ppm and will be attained when "the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one." This standard was effective February 8, 1979 and replaced a more restrictive 0.08 ppm standard that was established April 10, 1971. The change was the result of a required assessment of existing NAAQS to include a review of new health effects data that have become available since 1970. As a result of this review and national public comments, the standard was changed to a level that is considered to be sufficient to protect the public health and welfare. Since then additional research has concluded that there is in fact damage being caused by ozone levels less than the existing Federal standard. Based on recent studies there appears to be significant vegetation damage at levels considerably below the Federal standard and some "adverse" health effects at the current Federal standard. As of the date this report was compiled no proposals have been made for changing the Federal standard. The current State Standard is .081 ppm. It was established at the same time the original Federal Standard was established and has not been changed. In the past the State standard was interpreted to be .080 ppm but a conversion of the actual 160 ug/m3 standard to ppm yields .081. Therefore, only hourly averages in excess of .081 ppm are considered exceedances of the State standard.

3.4 Monitoring

Ozone was monitored at twelve sites in Maine during 1993 using continuous monitoring equipment of two kinds, either chemiluminescence or ultra-violet absorption analyzers. Maine's ozone monitoring season is limited to April through October due to the weather conditions which are not conducive to ozone formation at other times of the year.

Table 3-1 is the 1993 Data Summary for Ozone. Table 3-2 presents the Ozone Historical Comparisons and Table 3-3 presents the Ozone Trends. Tables 3-4 and 3-5 summarize the number of days during each month when either the state or federal standards have been exceeded.

The ozone data has been incorrectly interpreted in the past and consequently the trends tables have not reported the ozone data in a consistent format. Starting in 1988 data was stored in the AIRS database instead of the old SAROAD system. Under the SAROAD system reports were generated which indicated the percentiles or frequency distribution of all the hourly data values reported. Reports generated under the AIRS system are now based on percentiles calculated based on each days maximum hourly value. Thus, a 50th percentile of .050 ppm means that 50% of the days monitored had a maximum hourly value during the day of .050 ppm or less. All of the trend information for ozone beginning with the 1991 Annual Report have been revised to reflect this method of calculation based on the AIRs report format. If a report format can be developed that will provide percentiles based on total hourly values then that statistic will be used in future reports as it is a better indicator of total exposure to high ozone levels.

TABLE 3-1
1993 OZONE DATA SUMMARY
(Parts Per Million)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HOURLY CONCENTRATIONS HIGHEST	HOURLY CONCENTRATIONS 2ND HIGH	NUMBER OF VIOLATIONS STATE*	NUMBER OF VIOLATIONS FEDERAL**
CUMBERLAND COUNTY						
Cape Elizabeth	Shelter Site	4798	0.122	0.116	83	0
HANCOCK COUNTY						
Acadia National Park	McFarland Hill Ranger Station	7645	0.112	0.104	38	0
KENNEBEC COUNTY						
Gardiner	Pray Street School	4878	0.098	0.096	21	0
KNOX COUNTY						
Isle Au Haut	Isle Au Haut Fire Station	4629	0.115	0.113	33	0
Port Clyde	Port Clyde Ozone	4248	0.131	0.122	49	0
OXFORD COUNTY						
Lovell	Route #5	4051	0.083	0.080	0	0
PENOBSCOT COUNTY						
Holden	Summit of Rider Bluff	3195	0.104	0.099	29	0
PISCATAQUIS COUNTY						
Greenville	Greenville Municipal Airport	1430	0.067	0.063	0	0
SAGADAHOC COUNTY						
Phippsburg	Navy Road	2529	0.132	0.126	72	2
SOMERSET COUNTY						
Skowhegan	Somerset Mill	4901	0.099	0.098	14	0
WASHINGTON COUNTY						
Jonesport	Public Landing	4820	0.105	0.103	18	0
YORK COUNTY						
Kennebunkport	Parson's Way	3822	0.134	0.127	112	2

* Total number of hours minus one greater than .081 ppm.

** Number of days with an hour that exceeds .12 ppm. Not a statistical estimate.

TABLE 3 - 2
OZONE HISTORICAL COMPARISONS
(1-Hour Concentrations)

CAPE ELIZABETH
Shelter Site

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1978	.160 PPM	202
1979	.155 PPM	116
1980	.178 PPM	141
1981	.122 PPM	98
1982	.140 PPM	117
1983	.163 PPM	187
1984	.146 PPM	148
1985	.165 PPM	141
1986	.128 PPM	68
1987	.152 PPM	76
1988	.168 PPM	269
1989	.136 PPM	81
1990	.144 PPM	69
1991	.141 PPM	146
1992	.125 PPM	99
1993	.116 PPM	83

KENNEBUNKPORT
Parson's Way

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1982	.120 PPM	42
1983	.148 PPM	149
1984	.147 PPM	184
1985	.168 PPM	190
1986	.138 PPM	62
1987	.145 PPM	67
1988	.168 PPM	230
1989	.147 PPM	103
1990	.162 PPM	111
1991	.150 PPM	119
1992	.127 PPM	111
1993	.127 PPM	112

JONESPORT
Public Landing

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1989	.099 PPM	18
1990	.106 PPM	17
1991	.117 PPM	69
1992	.103 PPM	37
1993	.103 PPM	18

GARDINER
Gardiner H.S./Pray Street School

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1980	.117 PPM	54
1981	.122 PPM	31
1982	.120 PPM	56
1983	.140 PPM	99
1984	.112 PPM	89
1985	.133 PPM	84
1986	.110 PPM	17
1987	.112 PPM	25
1988	.145 PPM	142
1989	.118 PPM	47
1990	.107 PPM	35
1991	.123 PPM	49
1992	.111 PPM	51
1993	.096 PPM	21

ACADIA
McFarland Hill Ranger Station

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1983	.135 PPM	98
1984	.130 PPM	86
1985	.117 PPM	57
1986	.108 PPM	37
1987	.126 PPM	44
1988	.153 PPM	216
1989	.113 PPM	23
1990	.118 PPM	44
1991	.125 PPM	78
1992	.105 PPM	31
1993	.104 PPM	38

ISLE AU HAUT
Isle Au Haut Fire Station

YEAR	SECOND HIGH	# OF STATE VIOLATIONS
1986	.107 PPM	26
1987	.151 PPM	87
1988	.185 PPM	111
1989	.115 PPM	35
1990	.131 PPM	55
1991	.136 PPM	123
1992	.109 PPM	79
1993	.113 PPM	33

TABLE 3 - 3
OZONE TRENDS
(1-Hour Concentrations)

CAPE ELIZABETH
Shelter Site

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1978	0.018	0.026	0.054
1979	0.038	0.053	0.106
1980	0.033	0.049	0.097
1981	0.030	0.047	0.086
1982	0.033	0.052	0.082
1983	0.034	0.049	0.095
1984	0.034	0.051	0.100
1985	0.037	0.052	0.092
1986	0.032	0.048	0.075
1987	0.034	0.048	0.074
1988	0.033	0.050	0.106
1989	0.034	0.048	0.070
1990	0.031	0.046	0.077
1991	0.034	0.048	0.089
1992	0.032	0.046	0.079
1993	0.028	0.041	0.077

KENNEBUNKPORT
Parson's Way

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1983	0.028	0.460	0.103
1984	0.031	0.049	0.103
1985	0.038	0.056	0.098
1986	0.033	0.048	0.077
1987	0.033	0.046	0.074
1988	0.035	0.052	0.119
1989	0.036	0.052	0.085
1990	0.035	0.050	0.089
1991	0.038	0.050	0.088
1992	0.033	0.047	0.086
1993	0.031	0.047	0.087

Percentiles calculated during 1985 only used 70% of the data.

JONESPORT
Public Landing

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1989	0.024	0.038	0.071
1990	0.019	0.038	0.063
1991	0.027	0.039	0.068
1992	0.027	0.040	0.066
1993	0.026	0.036	0.057

GARDINER
Gardiner H. S./Pray Street School

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1980	0.032	0.046	0.088
1981	0.029	0.045	0.073
1982	0.028	0.047	0.073
1983	0.033	0.047	0.083
1984	0.030	0.046	0.081
1985	0.033	0.049	0.082
1986	0.027	0.043	0.062
1987	0.028	0.041	0.065
1988	0.027	0.049	0.087
1989	0.034	0.047	0.073
1990	0.034	0.048	0.075
1991	0.031	0.044	0.074
1992	0.030	0.044	0.072
1993	0.026	0.039	0.064

Site relocated to the Pray Street School at the start of the 1991 monitoring season.

ACADIA
McFarland Hill Ranger Station

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1983	0.020	0.045	0.080
1984	0.030	0.045	0.087
1985	0.030	0.043	0.079
1986	0.030	0.042	0.063
1987	0.026	0.044	0.068
1988	0.031	0.049	0.097
1989	0.031	0.047	0.069
1990	0.033	0.044	0.070
1991	0.030	0.043	0.078
1992	0.026	0.038	0.068
1993	0.029	0.042	0.062

ISLE AU HAUT
Isle Au Haut Fire Station

	PERCENTILES		
YEAR	**10%**	**50%**	**90%**
1986	0.024	0.040	0.077
1987	0.033	0.045	0.078
1988	0.028	0.058	0.122
1989	0.025	0.036	0.069
1990	0.028	0.048	0.076
1991	0.033	0.048	0.088
1992	0.029	0.044	0.075
1993	0.028	0.040	0.071

TABLE 3-4
YEARLY STATE OZONE STANDARD EXCEEDANCE DAYS COMPARISON
STATE OF MAINE

	YEAR														
MONTH	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	AVERAGE
APRIL	1	0	5	1	1	0	0	0	0	0	1	1	0	0	0.71
MAY	3	4	5	2	3	6	2	3	6	2	1	5	6	1	3.50
JUNE	10	4	2	9	11	9	7	7	12	4	8	7	8	6	7.43
JULY	15	4	12	15	16	19	6	5	18	6	8	12	4	7	10.50
AUGUST	7	9	7	9	11	10	3	8	12	8	6	11	7	8	8.29
SEPTEMBER	2	1	2	12	5	6	2	3	3	6	4	2	4	3	3.93
OCTOBER	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.07
TOTALS	38	22	33	48	47	50	20	26	51	26	29	38	29	25	34.43
# OF SITES	7	6	8	6	6	8	9	10	9	9	9	11	14	13	

TABLE 3-5
YEARLY FEDERAL OZONE STANDARD EXCEEDANCE DAYS COMPARISON
STATE OF MAINE

	YEAR														
MONTH	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	AVERAGE
APRIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
MAY	0	3	0	0	0	1	0	0	1	0	0	0	1	0	0.43
JUNE	1	1	0	1	2	0	0	1	5	0	1	3	0	0	1.07
JULY	4	0	4	3	6	2	1	1	6	3	1	3	0	3	2.64
AUGUST	2	2	0	3	4	3	1	3	7	0	3	1	1	1	2.21
SEPTEMBER	0	0	1	3	0	0	0	0	0	1	0	0	0	0	0.36
OCTOBER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
TOTALS	7	6	5	10	12	6	2	5	19	4	5	7	2	4	6.71
# OF SITES	7	6	8	6	6	8	9	10	9	9	9	11	14	13	

4. NITROGEN DIOXIDE (NO2)

4.1 Description and Sources

In its pure state, nitrogen dioxide is a reddish-orange-brown gas with a characteristic pungent odor. It is corrosive and a strong oxidizing agent. Nitrogen dioxide comprises about 10% of the oxides of nitrogen (NOx) that are formed when nitrogen in the air combines with oxygen during high temperature combustion. Most of the rest of the NOx emitted by combustion sources is nitric oxide (NO). However, during the day most of the NO is photochemically transformed into NO_2. Thus, essentially all the NOx emitted can be assumed to eventually become NO_2.

4.2 Health and Welfare Effects

Exposure to NO_2 affects the delicate structure of lung tissue. High levels cause lung irritation and potential lung damage. Lower levels have been associated with increased respiratory disease. Oxides of nitrogen can cause serious injury to vegetation, including bleaching or death of plant tissue, loss of leaves, and reduced growth rate. NOx also deteriorates fabrics and fades fabric dyes. Nitrate salts formed from nitrogen oxides have been associated with the corrosion of metals. Nitrogen oxides can also reduce visibility.

4.3 Standards

The current standard for NO_2 is an annual arithmetic mean (average) value not to exceed .05 ppm. NO_2 is the only gaseous pollutant for which only a long-term (annual average) standard has been established.

4.4 Monitoring

Nitrogen Dioxide was monitored at two sites in Maine during 1993 using continuous monitoring equipment. Table 4-1 presents the data collected during 1993.

TABLE 4 - 1
1993 NITROGEN DIOXIDE DATA SUMMARY
(Parts Per Million)

SITE	ADDRESS	OBSERVATIONS	ARITHMETIC MEAN
CUMBERLAND COUNTY			
Portland	Shelter Site	1491	0.024
Cape Elizabeth	Shelter Site	2544	0.004

5. SULFUR DIOXIDE (SO2)

5.1 Description and Sources

Sulfur dioxide is a colorless irritating gas having the same pungent odor as a struck match. Most people can detect its taste at a level of about 0.3 to 1 part per million. SO_2 is highly soluble in water, forming sulfurous acid. On a worldwide basis, SO_2 is considered to be one of the major pollution problems. It is emitted mainly from stationary sources that utilize fossil fuels (coal, oil) such as power plants, ore smelters, and refineries.

5.2 Health and Welfare Effects

The health effects of sulfur dioxide appear to be always associated with high levels of particulates or other pollutants. The world's major recorded air pollution disasters have been associated with high levels of sulfur dioxide and particulates. The excess deaths attributed to these pollutants were due to respiratory failures and occurred predominantly, but not exclusively, in the elderly and infirm. Atmospheres containing high levels of sulfur dioxide are associated with elevated concentrations of other sulfur compounds such as sulfates and sulfuric acid mists, which are corrosive and potentially carcinogenic.

The corrosiveness of SO_2 and its derivatives also causes crop and material damage. Its transport and transformation into sulfurous and sulfuric acids contribute to acid precipitation, causing soils and lakes to become seriously acidified.

5.3 Standards

There are two existing Primary National Ambient Air Quality Standards for sulfur dioxide. The first is a long-term one year arithmetic average of 0.03 parts per million (ppm). The second is a short-term 24-hour average standard where concentrations are not to exceed 0.14 ppm more than once per year. The current Secondary NAAQS for SO_2 is a 3-hour average concentration of 0.5 ppm not to be exceeded more than once per year.

In addition there are three State standards for sulfur dioxide. The first is a long-term one-year arithmetic average of .022 parts per million. The second was a short-term 24-hour average standard of .088 ppm not to be exceeded. The third was a short-term 3-hour average concentration of .439 ppm not to be exceeded. During 1987 both of the short-term standards were amended to allow for one exceedance per year.

5.4 Monitoring

Sulfur dioxide was monitored at thirteen sites in Maine during 1993 using continuous monitoring equipment utilizing either the pulsed fluorescent or coulometric methods.

Table 5-1 is the 1993 Data Summary for SO_2. Tables 5-2 and 5-3 present the SO_2 Historical

Comparison Data. Table 5-3 in past years had indicated violations but because one exceedance was allowed per year beginning in 1987 this table now indicates exceedances of the standards rather than violations to maintain continuity for comparisons.

TABLE 5 - 1
1993 SULFUR DIOXIDE DATA SUMMARY
(Parts Per Million)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 3-HOUR AVE.	SECOND HIGHEST 3-HOUR AVE.	HIGHEST 24-HOUR AVE.	SECOND HIGHEST 24-HOUR AVE.	ANNUAL ARITH. MEAN
ANDROSCOGGIN COUNTY							
Lewiston	Country Kitchen Parking Lot	8281	0.068	0.055	0.027	0.025	0.007
AROOSTOOK COUNTY							
Madawaska	Albert Street	8282	0.117	0.113	0.044	0.042	0.008
Madawaska	U. S. Post Office	8253	0.226	0.121	0.070	0.044	0.009
Madawaska	Madawaska High School	8316	0.166	0.155	0.045	0.042	0.005
CUMBERLAND COUNTY							
Portland	Shelter Site	8291	0.117	0.067	0.033	0.033	0.009
KENNEBEC COUNTY							
Waterville	Front Street	8268	0.060	0.059	0.038	0.025	0.006
OXFORD COUNTY							
Mexico	Hunt's Property	8238	0.069	0.051	0.022	0.021	0.008
Rumford	Taylor Mountain 1	7714	0.068	0.054	0.026	0.020	0.007
Rumford	Taylor Mountain 2	7712	0.070	0.066	0.021	0.019	0.007
Rumford	Village Green Site	8232	0.046	0.046	0.020	0.015	0.005
PENOBSCOT COUNTY							
Lincoln	Thomas Motel Trailer Park	7770	0.049	0.041	0.023	0.022	0.003
Millinocket	York Street	8625	0.081	0.064	0.027	0.026	0.005
YORK COUNTY							
Biddeford	Biddeford Treatment Plant	2036	0.042	0.041	0.021	0.020	0.010*

* Insufficient data for a valid annual arithmetic mean.

TABLE 5 - 2
SULFUR DIOXIDE HISTORICAL COMPARISONS
(Maximum 24 - Hour Concentrations of Sulfur Dioxide)

		MAXIMUM 24 - HOUR CONCENTRATION (PPM)						
SITE	ADDRESS	1987	1988	1989	1990	1991	1992	1993
ANDROSCOGGIN COUNTY								
Lewiston	Country Kitchen Parking Lot	0.038	0.053	0.042	0.027	0.026	0.021	0.027
AROOSTOOK COUNTY								
Madawaska	Albert Street	0.072	0.071	0.048	0.093	0.072	0.080	0.044
Madawaska	U. S. Post Office	0.084	0.073	0.069	0.042	0.048	0.088	0.070
Madawaska	Madawaska High School	0.076	0.057	0.032	0.027	0.045	0.040	0.045
CUMBERLAND COUNTY								
Portland	Shelter Site	0.047	0.047	0.044	0.034	0.039	0.032	0.033
KENNEBEC COUNTY								
Waterville	Front Street	N/A	N/A	N/A	0.029	0.042	0.038	0.038
OXFORD COUNTY								
Mexico	Hunt's Property	0.043	0.067	0.064	0.054	0.020	0.018	0.022
Rumford	Taylor Mountain 1	0.098	0.125	0.044	0.066	0.022	0.021	0.026
Rumford	Taylor Mountain 2	0.065	0.074	0.053	0.063	0.027	0.024	0.021
Rumford	Village Green Site	0.042	0.061	0.049	0.046	0.033	0.021	0.020
PENOBSCOT COUNTY								
Lincoln	Thomas Motel Trailer Park	0.039	0.036	0.041	0.059	0.042	0.029	0.023
Millinocket	York Street	0.048	0.038	0.044	0.102	0.035	0.024	0.027
YORK COUNTY								
Biddeford	Biddeford Treatment Plant	N/A	0.044	0.032	0.024	0.028	0.028	0.021

TABLE 5 - 3
SULFUR DIOXIDE HISTORICAL COMPARISONS
(Sites with exceedances of the standards in the past seven years)

		TOTAL NUMBER OF EXCEEDANCES*						
SITES	ADDRESS	1987	1988	1989	1990	1991	1992	1993
OXFORD COUNTY								
Rumford	Taylor Mountain 1	1	1	0	0	0	0	0
PENOBSCOT COUNTY								
Millinocket	York Street	0	0	0	1	0	0	0

* Includes 3-Hour and 24-Hour Exceedances.

6. PARTICULATES (TSP and PM10)

6.1 Description and Sources

Particulates is the term given to the tiny particles of solid or semi-solid material found in the atmosphere. It is this "dirt" in the air that is visible as a "Brown Cloud", haze or smog. The sources of particulates are many: wind-blown dust and sand from roadways, fields, and construction; coal dust, fly ash, and carbon black from various combustion sources; and automobile exhaust, to name a few. Particulates that range in size from less than 0.1 micrometer up to approximately 45 micrometers are called "total suspended particulates." Particles larger than that range tend to settle out of the air and not remain suspended, except in high winds.

6.2 Health and Welfare Effects

The human nose filters out 99 percent of the large and medium-sized particles. The rest enter the windpipe and lungs, where some, known as inhalable particulates, cling to protective mucous and are removed. Some of the smallest, called respirable particulates, are deposited in the lungs' tiny air sacs (alveoli).

In the lungs particulates slow down the exchange of oxygen with carbon dioxide in the blood, causing shortness of breath. The heart may be strained because it must work harder to compensate for oxygen loss. Usually the people most sensitive to these conditions have respiratory diseases like emphysema, bronchitis, asthma, or heart problems. The elderly and children are also sensitive.

Particles themselves may be poisonous if inhaled or absorbed, damaging remote organs like the kidneys or liver. Swallowed mucous that is laden with poisonous particulate matter may damage the stomach.

In addition, particulates may be carriers of poisonous liquid or gaseous substances. Sulfur dioxide, a major air pollutant in its own right, is frequently absorbed by particulates and can react with them to form sulfates. Sulfates react with moisture in the air or in the respiratory tract to form a corrosive liquid (sulfuric acid) that irritates delicate membranes and slows down the cleansing action of mucous. This effect can reduce the body's ability to remove harmful bacteria, increasing the possibility of infection.

Adverse health effects from particulate matter aren't always seen immediately. Particulates can accumulate in the lungs after repeated, long-term exposure, causing respiratory distress and other health problems that may be manifested later.

Particles in the air block out and scatter sunlight, reducing visibility. Particulates soil and corrode metals, masonry, and textiles. Irritating odors are often associated with particulates, also.

6.3 Standards

Primary:

At the beginning of 1987 the primary particulate standards were for total suspended particulates (TSP), independent of particle size or chemical composition. The long-term standard was an annual geometric mean not to exceed 75 micrograms of particulates per cubic meter of air (ug/m^3). The short-term standard was a 24-hour average of 260 ug/m^3 not to be exceeded more than once per year.

In July of 1987 EPA published revised particulate standards to account for the deeper inhalability of small particles and eliminated the total suspended particulate standards. The new standards, rather than applying to TSP, apply to inhalable or fine particulates. A particle size of 10 micrometers was selected as the upper size limit with a 24-hour concentration of 150 ug/m^3 and an annual standard of 50 ug/m^3 expressed as an expected annual arithmetic mean (AAM). The short term standard is attained when the expected number of exceedances is no more than one per year. The expected AAM is determined by averaging the annual arithmetic averages from three successive years of data.

Secondary:

The secondary TSP standard was a 24-hour average of 150 ug/m^3 not to be exceeded more than once per year, designed to protect from soiling, corrosion, etc.

When EPA adopted the fine particulate standards they eliminated the secondary TSP standards and made the secondary fine particulate standards equal to the primary fine particulate standards.

State Standards:

As of the end of 1988 the State Standards for total suspended particulates still included an annual geometric mean of 60 micrograms per cubic meter and a 24-hour standard of 150 micrograms per cubic meter not to be exceeded. In addition, the Board of Environmental Protection adopted the Federal fine particulate standards for both the short term twenty-four hour and the annual arithmetic mean.

In 1989 the State Legislature passed a more restrictive annual standard for fine particulates of 40 ug/m^3. In addition, the TSP annual State standard was eliminated and the 24 hour standard was changed to be an indicator of a nuisance condition.

6.4 Monitoring

Total Suspended Particulates were monitored at 11 sites in Maine during 1993 using High-Volume Particulate Air Samplers (Hi-Vols).

Hi-Vols operate on the same principle as a vacuum cleaner in that the air is drawn through a filter to "catch the dust". The difference is that a Hi-Vol draws a calibrated volume of air through a pre-weighed filter pad (rather than a bag) for a twenty-four hour period. The change in weight of the filter pad is recorded as total suspended particulate or TSP in micrograms of particulates per cubic meter of air.

Table 6-1 is a summary of the TSP data collected in Maine during 1993. Table 6-2 is a historical comparison of the TSP Annual Geometric Means at sites which have been in existence over the last two years. Table 6-3 summarizes the number of exceedances of the TSP nuisance standard which have occurred over the last seven years and the sites at which they occurred.

Fine particulates were monitored at 38 sites during 1993 using PM10 samplers. The sampling is conducted with size-selective inlets and flow controlling devices designed to meet EPA's monitor specifications.

Table 6-4 is a summary of the fine particulate data collected in Maine during 1993. Tables 6-5 and 6-6 provide some historical comparison data over the last few years these monitors have been in operation.

TABLE 6 - 1
1993 TOTAL SUSPENDED PARTICULATES DATA SUMMARY
(Micrograms Per Cubic Meter)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 24-HOUR	SECOND HIGHEST	THIRD HIGHEST	ANNUAL GEOMETRIC MEAN
ANDROSCOGGIN COUNTY						
Lewiston	Country Kitchen Parking Lot	60	226	207	170	45.9
FRANKLIN COUNTY						
Jay	Crash Road	44	41	39	38	17.1 *
Jay	Jay Hill	45	71	59	57	22.8 *
Jay	Burnham	44	96	75	67	28.8 *
Jay	Weather Level 1	45	87	75	60	28.9 *
KENNEBEC COUNTY						
Waterville	Front Street	58	262	213	182	40.5
Winslow	Gulley Hill Road	181	348	248	202	40.4
Winslow	Boston Avenue	183	194	188	133	30.4
KNOX COUNTY						
Thomaston	Mitchell Property	118	96	86	74	21.0
PENOBSCOT COUNTY						
Lincoln	Thomas Motel Trailer Park	174	145	138	115	29.4
Lincoln	Lincoln Post Office Building	64	246	150	111	36.3

* Insufficient data collected for valid annual geometric mean.

TABLE 6 - 2
TOTAL SUSPENDED PARTICULATES HISTORICAL COMPARISON
ANNUAL GEOMETRIC MEANS (UG/M3)

SITE	ADDRESS	1987	1988	1989	1990	1991	1992	1993
ANDROSCOGGIN COUNTY								
Lewiston	Country Kitchen Parking Lot	N/A	N/A	50.5	47.1	55.0	52.1	45.9
FRANKLIN COUNTY								
Jay	Crash Road	19.4	20.7	19.6	16.0	18.0	16.7	17.1 •
Jay	Jay Hill	25.1	26.0	25.2	20.9	21.5	20.2	22.8 •
Jay	Burnham	N/A	36.0	32.9	28.1	28.8	29.6	28.8 •
Jay	Weather Level 1	34.1	38.3	35.0	27.5	26.0	28.1	28.9 •
KENNEBEC COUNTY								
Waterville	Front Street	N/A	N/A	N/A	39.9	48.7	46.3	40.5
Winslow	Gulley Hill Road	43.6	44.1	51.9 •	41.1	42.0	40.5	40.4
Winslow	Boston Avenue	N/A	N/A	N/A	33.3	32.7	35.2	30.4
KNOX COUNTY								
Thomaston	Mitchell Property	21.9	24.5	25.1	21.3	20.5	21.7	21.0
PENOBSCOT COUNTY								
Lincoln	Thomas Motel Trailer Park	33.9	34.1	33.9	32.8	37.9	32.9	29.4
Lincoln	Lincoln Post Office Building	30.3	32.3	35.2	39.0	41.0	41.1	36.3

• Insufficient data collected for valid annual geometric mean.

TABLE 6 - 3
TOTAL SUSPENDED PARTICULATES HISTORICAL COMPARISON
(Sites with samples greater than 150 ug/m3)

SITE	ADDRESS	1987	1988	1989	1990	1991	1992	1993
ANDROSCOGGIN COUNTY								
Lewiston	Country Kitchen Parking Lot	0	0	0	0	3	2	5
FRANKLIN COUNTY								
Jay	Burnham	1	1	0	0	0	2	0
Jay	Weather Level 1	1	0	0	0	0	0	0
KENNEBEC COUNTY								
Waterville	Front Street	N/A	N/A	N/A	3	3	2	4
Winslow	Gulley Hill Road	2	1	6	2	1	3	6
Winslow	Boston Avenue	N/A	N/A	N/A	N/A	0	1	2
KNOX COUNTY								
Thomaston	Mitchell Property	2	3	0	0	0	0	0
PENOBSCOT COUNTY								
Lincoln	Lincoln Post Office Building	2	0	2	3	3	4	1
Lincoln	Thomas Motel Trailer Park	0	2	4	0	2	2	0

TABLE 6 - 4
1993 FINE PARTICULATE DATA SUMMARY
(Micrograms Per Cubic Meter)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 24-HOUR	SECOND HIGHEST	THIRD HIGHEST	ANNUAL ARITH. MEAN	ANNUAL GEOM. MEAN
ANDROSCOGGIN COUNTY							
Lewiston	Country Kitchen Parking Lot	60	70	68	59	24.3	20.5
AROOSTOOK COUNTY							
Madawaska	Big Daddy's Restaurant	59	119	90	86	27.9	24.4
Presque Isle	Northeastland Hotel	133	108	97	94	28.8 *	26.2 *
Presque Isle	Northeastland Hotel(Continuous)	348	113	102	97	23.5	17.1
Presque Isle	Regional Office	115	50	33	29	13.5	12.2
Presque Isle	Riverside Street	35	53	38	34	19.0 *	15.9 *
CUMBERLAND COUNTY							
Bridgton	Upper Ridge Road	61	34	28	21	8.7	7.3
Portland	Shelter Site	64	64	48	45	21.4	19.8
Portland	Tukey's Bridge	61	96	91	72	29.0	24.4
South Portland	130 Wescott Road	57	40	39	35	19.7	18.1
Westbrook	Research Building	117	40	39	35	17.5	15.9
Westbrook	N. E. T. & T. Company	45	63	43	36	17.8 *	14.8 *
FRANKLIN COUNTY							
Jay	Crash Road	90	39	31	31	13.7 *	12.2 *
Jay	Jay Hill	137	43	40	37	13.9	12.3
Jay	Weather Level 1	45	31	29	28	16.9 *	15.4 *
KENNEBEC COUNTY							
Augusta	Rines Hill Parking Lot	60	102	76	69	24.8	20.7
Waterville	Front Street	60	78	65	54	23.4	19.6
Winslow	Boston Avenue	181	95	85	58	20.7	17.7
KNOX COUNTY							
Thomaston	Mitchell Property	120	36	35	33	14.1	12.6
OXFORD COUNTY							
Mexico	Labonville's	183	65	51	45	18.4	15.9
Rumford	Taylor Mountain 1	168	43	39	38	15.7	13.5
Rumford	Village Green	178	41	41	38	14.7	12.6

TABLE 6 - 4(Continued)
1993 FINE PARTICULATE DATA SUMMARY
(Micrograms Per Cubic Meter)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 24-HOUR	SECOND HIGHEST	THIRD HIGHEST	ANNUAL ARITH. MEAN	ANNUAL GEOM. MEAN
PENOBSCOT COUNTY							
Bangor	Kenduskeag Pump Station	56	67	52	46	22.2	19.1
Brewer	Brewer Junior High School	56	79	63	45	21.1	18.0
Lincoln	Thomas Motel Trailer Park	171	51	43	40	15.7	13.3
Lincoln	Lincoln Street	168	42	35	31	12.5	10.8
Lincoln	Penobscot River	171	34	31	27	10.6	8.5
Lincoln	Lincoln Post Office Building	170	120	113	107	25.9	21.6
Millinocket	York Street	61	61	51	49	19.0	16.4
Old Town	Marsh Island Apartments	58	83	68	58	22.1	18.4
Orrington	Center Drive School	61	32	27	25	11.1	9.9
Hampden	McGraw School	61	35	32	31	13.6	11.8
SOMERSET COUNTY							
Skowhegan	Hinckley	61	39	27	25	11.5	9.7
Skowhegan	Eaton Ridge	51	44	32	26	11.5	9.2
WASHINGTON COUNTY							
Woodland	Secondary Treatment Pipeline	58	40	38	34	12.8	10.7
Woodland	Woodland High School	168	82	74	67	16.1	12.6
Woodland	Background	60	23	18	18	8.8	7.6
YORK COUNTY							
Biddeford	Biddeford Treatment Plant	13	32	27	26	18.2	17.3
Biddeford	Eagles Aerie	44	39	35	33	18.3	16.7

* Insufficient data collected for valid annual geometric mean.

TABLE 6 - 5
FINE PARTICULATE HISTORICAL COMPARISON
ANNUAL ARITHMETIC MEANS (ug/m3)

		ANNUAL ARITHMETIC MEANS (ug/m3)					
SITE	**ADDRESS**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
ANDROSCOGGIN COUNTY							
Lewiston	Country Kitchen Parking Lot	N/A	N/A	24.7	28.5	24.4	24.3
AROOSTOOK COUNTY							
Madawaska	Big Daddy's Restaurant	33.4	33.2	34.9	32.1	30.8	27.9
Presque Isle	Northeastland Hotel	26.4	30.0	29.0	27.7	28.4 *	28.8 *
Presque Isle	Regional Office	N/A	15.8	14.1	16.3	14.9	13.5
CUMBERLAND COUNTY							
Bridgton	Upper Ridge Road	12.3	11.5	13.4	12.2	10.5	8.7
Portland	Shelter Site	24.4	26.1	22.5	24.7	22.9	21.4
Portland	Tukey's Bridge	N/A	N/A	N/A	27.6	24.1 *	29.0
Westbrook	Research Building	25.0	24.0	21.5	22.1	19.4	17.5
Westbrook	N. E. T. & T. Company	21.0	20.7	17.3	19.1	16.6	17.8 *
FRANKLIN COUNTY							
Jay	Jay Hill	20.6	22.4	18.2	19.1	15.9	13.9
Jay	Weather Level 1	17.7	18.1	15.6	16.4	14.9	16.9 *
KENNEBEC COUNTY							
Augusta	Rines Hill Parking Lot	N/A	N/A	N/A	26.3	24.9	24.8
Waterville	Front Street	N/A	N/A	25.8	28.0	24.5	23.4
Winslow	Boston Avenue	N/A	N/A	27.8	21.6	20.1	20.7
KNOX COUNTY							
Thomaston	Mitchell Property	22.5	18.2	15.3	15.2	14.2	14.1
OXFORD COUNTY							
Mexico	Labonville's	30.5	30.3	24.1	20.6	18.7	18.4
Rumford	Taylor Mountain 1	N/A	N/A	N/A	17.8	14.3	15.7
Rumford	Village Green	21.1	23.4	19.3	17.2	15.0	14.7
PENOBSCOT COUNTY							
Bangor	Kenduskeag Pump Station	30.5	26.2	20.5	25.1	22.2	22.2
Brewer	Brewer Junior High School	N/A	N/A	N/A	21.4	20.6	21.1
Lincoln	Thomas Motel Trailer Park	22.9	23.1	18.9	18.2	17.2	15.7
Lincoln	Lincoln Street	N/A	N/A	12.7	13.1	13.9	12.5

TABLE 6 - 5(Continued)
FINE PARTICULATE HISTORICAL COMPARISON
ANNUAL ARITHMETIC MEANS (ug/m3)

		ANNUAL ARITHMETIC MEANS (ug/m3)					
SITE	**ADDRESS**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Lincoln	Penobscot River	N/A	N/A	11.7	11.5	11.4	10.6
Lincoln	Lincoln Post Office Building	N/A	N/A	22.5	26.8	25.8	25.9
Millinocket	York Street	16.0	18.9	16.2	15.5	16.7	19.0
Old Town	Marsh Island Apartments	N/A	N/A	N/A	21.0	20.6	22.1
Orrington	Center Drive School	14.0	13.2	11.5	12.8	10.7	11.1
Hampden	McGraw School	15.7	15.1	12.9	14.4	13.9	13.6
SOMERSET COUNTY							
Skowhegan	Hinckley	22.3	21.9	13.8	14.2	13.4	11.5
Skowhegan	Eaton Ridge	14.5	15.5	13.6	14.0	11.9	11.5
WASHINGTON COUNTY							
Woodland	Secondary Treatment Pipeline	16.1	17.7	18.5	19.2	14.4	12.8
Woodland	Woodland High School	21.7	21.9	23.7	23.3	17.5	16.1
Woodland	Background	10.7	12.7	13.2	13.4	9.8	8.8
YORK COUNTY							
Biddeford	Biddeford Treatment Plant	N/A	26.9	22.0	22.1	18.3	18.2

* Insufficient data collected for valid annual geometric mean.

TABLE 6-6
FINE PARTICULATE HISTORICAL COMPARISON
(Sites with samples greater than 150 ug/m3)

		TOTAL NUMBER OF SAMPLES GREATER THAN 150 UG/M3						
SITE	ADDRESS	1987	1988	1989	1990	1991	1992	1993
AROOSTOOK COUNTY								
Madawaska	Big Daddy's Restaurant	1	1	0	0	0	0	0
Presque Isle	Northeastland Hotel	3	0	0	1	0	0	0

7. LEAD (Pb)

7.1 Description and Sources

Lead in the ambient air exists primarily as particulate matter in the inhalable size range. The predominant source of atmospheric lead is from motor vehicles that burn "leaded" gasoline. The lead in gasoline is in the form of tetraethyl lead, an "anti-knock" compound. Other major sources of atmospheric lead are the extraction and processing of metallic ores.

7.2 Health and Welfare Effects

When atmospheric lead is breathed in, it is absorbed into the bloodstream and distributed throughout the body along with lead from contaminated food and drinking water. Lead accumulation in the body can impair the production of hemoglobin. Clinical lead poisoning occurs when the body's accumulation of lead becomes too high. Symptoms of lead poisoning range from loss of appetite, fatigue, cramps and constipation, and pains in the ankles and wrists to loss of power in the arms and legs, anemia, kidney disease, mental retardation, blindness and death. Lead concentrations in the ambient air are not sufficient to produce lead poisoning but they do increase the risk of harm when other sources of lead are present. And, indirectly, lead fallout from automotive exhaust onto soil and street surfaces can be ingested in considerable amounts by infants and young children.

7.3 Standards

The current National Ambient Air Quality Standard for lead is a 3-month (calendar quarter) average concentration not to exceed 1.5 micrograms of lead per cubic meter of air.

The current State Standard for lead is a 24-hour average concentration of 1.5 micrograms of lead per cubic meter of air not to be exceeded more than once per year.

7.4 Monitoring

Lead was monitored at two sites in Maine during 1993 by taking samples of the Hi-Vol filters from those sites and analyzing the samples for lead content using an atomic absorption analyzer.

Tables 7-1 and 7-2 are the 1993 Data Summaries for Lead. Table 7-3 presents the Lead Historical Comparison Data.

TABLE 7-1
1993 LEAD DATA SUMMARY
(Micrograms Per Cubic Meter)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 24-HOUR	SECOND HIGHEST	THRD HIGHEST	ANNUAL GEOMETRIC MEAN
ANDROSCOGGIN COUNTY						
Lewiston	Country Kitchen Parking Lot	60	0.04	0.03	0.03	0.01
CUMBERLAND COUNTY						
Portland	Tukey's Bridge	61	0.14	0.08	0.08	0.02

* Insufficient data collected for valid annual geometric mean.

TABLE 7-2
1993 LEAD DATA SUMMARY BY QUARTERS
(Micrograms Per Cubic Meter)

		1993 QUARTERLY AVERAGES			
SITE	ADDRESS	1ST	2ND	3RD	4TH
ANDROSCOGGIN COUNTY					
Lewiston	Country Kitchen Parking Lot	0.02	0.01	0.01	0.02
CUMBERLAND COUNTY					
Portland	Tukey's Bridge	0.03	0.02	0.03	0.02

TABLE 7-3
LEAD HISTORICAL COMPARISONS
(Micrograms Per Cubic Meter)

		MAXIMUM 24-HOUR CONCENTRATION / AAM						
SITE	ADDRESS	1987	1988	1989	1990	1991	1992	1993
ANDROSCOGGIN COUNTY								
Lewiston	Country Kitchen Parking Lot	N/A	N/A	0.12/0.03	0.04/0.02	0.05/0.02	0.04/0.02	0.04/0.01
CUMBERLAND COUNTY								
Portland	Tukey's Bridge	N/A	N/A	0.08/0.04	0.08/0.03	0.06/0.02	0.04/0.02	0.14/0.02

8. SULFATES (SO4) AND NITRATES (NO3)

8.1 Description and Sources

Sulfates and Nitrates are compounds of varying harmfulness found everywhere in the atmosphere. They are produced by nature as well as man. Man-made sulfates have their origin in sulfur dioxide while nitrates have theirs in nitrogen oxides. Fine particulate compounds, including sulfates and nitrates are formed from chemical reactions between sulfur dioxide or nitrogen dioxide emitted into the air and other substances present there. These fine particulate compounds have a long atmospheric residence time, can be transported in the air for long distances, and are capable of penetrating deeply into the human respiratory tract.

8.2 Health and Welfare Effects

Epidemiological studies of populations exposed to particulate sulfates have shown that atmospheric sulfates, more than sulfur dioxide gas or total suspended particulates, are related to aggravation of asthma, aggravation of heart and lung disease in the elderly, and impairment of lung function in school children. This evidence was obtained from EPA's Community Health and Environmental Surveillance System (CHESS). From these studies, estimates of the sulfate threshold for adverse health effects have been derived, as shown in Table 8-1. However, these epidemiological studies have not been substantiated by laboratory studies.

Both sulfates and nitrates are considered to be contributors to the acid deposition problem.

8.3 Standards

There are currently no standards for levels of sulfates in ambient air. EPA has been working on a standard and is expected to make a proposal in the future.

There are no standards for nitrates nor are there any proposed.

8.4 Monitoring

Sulfate levels were measured at three sites in Maine during 1993 by taking samples of the Hi-Vol filters from those sites and analyzing the samples for sulfates using the Automated Technicon II Methylthymol Blue Procedure. There is no standard yet and the monitoring methodology is questionable but the data is being included in this report as an aid to those interested in further information about Maine's air quality. Table 8-2 summarizes the sulfate data collected during 1993.

Nitrate levels were not measured in Maine during 1993.

TABLE 8-1
SULFATE THRESHOLDS FOR ADVERSE HEALTH EFFECTS

THRESHOLD CONCENTRATION FOR ADVERSE HEALTH EFFECT	SUSPENDED SULFATES
Aggravation of Asthma	6 to 10 Micrograms Per Cubic Meter for 24 Hours.
Aggravation of Heart and Lung	9 Micrograms Per Cubic Meter for Disease in the Elderly for 24 Hours
Subtle Decreases in Childhood	9 to 13 Micrograms Per Cubic Meter Lung Function for 1 Year.
Increase in Acute Respiratory	13 Micrograms Per Cubic Meter for Disease in Children for 1 Year.

TABLE 8-2
1993 SULFATE DATA SUMMARY
(Micrograms Per Cubic Meter)

SITE	ADDRESS	NUMBER OF OBSERVATIONS	HIGHEST 24-HOUR	SECOND HIGHEST	THRD HIGHEST	ANNUAL ARITHMETIC MEAN
CUMBERLAND COUNTY						
Bridgton	Upper Ridge Road	60	15.6	9.8	8.5	2.8
Portland	Shelter Site	63	14.8	11.0	8.9	3.7
OXFORD COUNTY						
Rumford	Taylor Mountain I	57	14.4	12.8	11.9	4.2

9. ATMOSPHERIC DEPOSITION

9.1 Description and Sources

As a result of the combustion of tremendous quantities of fossil fuels such as coal and oil, the United States annually discharges approximately 50 million metric tons of sulfur and nitrogen oxides into the atmosphere. Through a series of complex chemical reactions these pollutants can be converted into acids, which may return to earth as components of either rain or snow. This atmospheric deposition, more commonly known as acid rain, may have severe ecological impacts on widespread areas of the environment.

9.2 Health and Welfare Effects

While direct health effects from acid rain have not been documented there are numerous indirect effects which could have definite effect on mankind. Atmospheric deposition is known to leach heavy metals such as mercury from rocks causing possible contamination of water supplies. Hundreds of lakes in North America and Scandanavia have become so acidic that they can no longer support fish life. The rain falling on forests and other non-farmlands could, in time, cause extensive changes in the soil chemistry. There is not enough information yet to make it possible to say exactly what the results might be, but there is no reason to think the changes will be beneficial.

9.3 Standards

There are no standards in effect or proposed for atmospheric deposition. The only permanent solution to the acid rain problem is to keep the acid levels low. The only practical way of achieving this is by reducing emissions at their sources.

9.4 Monitoring

During 1993 there were four sites collecting data on atmospheric deposition. Those four sites included two Bureau maintained sites in Bridgton and Acadia National Park, a University of Maine maintained site in Greenville and a National Weather Service maintained site in Caribou. The samples from these four sites are normally collected every Tuesday morning at 9:00 a.m.. Consequently, the samples are not necessarily a single storm event but are more likely to be a composite of all storm events during the previous week. The samples, if there was a significant storm, are used for field measurements of pH and conductivity and are then packaged up for shipment to the National Atmospheric Deposition Program central laboratory in Illinois. In the central laboratory they are also tested for pH and conductivity as well as additional components. Table 9-1 is a summary of the measurements taken at the central laboratory in Illinois from the DEP and the University of Maine sites for the year 1993. The sulfate deposition figures were corrected for marine aerosol contribution.

TABLE 9-1
1993 ATMOSPHERIC DEPOSITION DATA SUMMARY

		pH	pH	pH	DEPOSITION (Kg/ha)	
SITE	ADDRESS	MAXIMUM*	MINIMUM*	MEAN**	SO4***	NO3
CUMBERLAND COUNTY						
Bridgton	Upper Ridge Road	6.66	3.96	4.47	12	9
HANCOCK COUNTY						
Acadia National Park	McFarland Hill Ranger Station	6.19	3.95	4.59	15	11
PISCATAQUIS COUNTY						
Greenville	Squaw Brook	6.16	4.21	4.53	12	10

* Lab measurements.
** Precipitation weighted mean.
*** Corrected for marine aerosol and normalized to 52 weeks.

10. HYDROCARBONS (HC)

10.1 Description and Sources

Hydrocarbons are a class of compounds containing carbon and hydrogen in various combinations. They are found especially in petroleum, natural gas and coal. Some are gaseous, some liquid and some are solid. There are in fact over a thousand hydrocarbon compounds. Many of the polluting hydrocarbons are discharged into the air by incomplete combustion of organic materials. A major source of this kind of hydrocarbon emission is the burning of gasoline in automobiles. Other major contributors are organic solvent evaporation, industrial processes, solid waste disposal and fuel combustion in stationary sources. The control of hydrocarbon emissions are accomplished by combustion process optimization, recovery by mass transfer principles, restriction of evaporative loss and process material and fuel substitution.

10.2 Health and Welfare Effects

Hydrocarbon air pollutants enter into and promote the formation of photochemical smog (ozone) and thus contribute to the development of eye irritation and respiratory tract problems. By themselves, hydrocarbons may induce adverse health effects, although there is relatively little quantitative data to relate individual hydrocarbons to the risk of human disease.

10.3 Standards

The present State Standard for non-methane hydrocarbons is a three hour average concentration of 160 ug/m^3.

10.4 Monitoring

Hydrocarbons were not monitored as part of the State's continuous air monitoring program during 1993.

11. PRECISION AND ACCURACY

The U.S. Environmental Protection Agency regulations governing the SLAMS/NAMS network were published in 40 CFR Part 58. These regulations specify the minimum necessary requirements for the control and assessment of the quality of the ambient air monitoring data submitted to EPA. The State of Maine in its Quality Assurance Plan has required the same checks as the EPA program but has increased the number of checks required in some cases. Each organization that reports data to the State of Maine has their own reporting organization number and the precision and accuracy results are made available for each of those organizations as well as the DEP.

Precision and accuracy are two fundamental measures of the quality of data from a measurement process. Simply stated, "precision" is a measure of repeatability of the measurement process when measuring the same thing, and "accuracy" is a measure of closeness of an observed measurement value to the truth. Precision and accuracy of air monitoring or measurement data cannot be ascertained from the data themselves, but require the use of specially planned checks from which precision and accuracy can be estimated. The results are used to assess the quality of the monitoring data being reported to EPA by an agency.

The U.S. EPA has established guidelines for evaluating the upper and lower 95% probability limits. The quarterly probability limits for precision data should fall within a range of -15% to +15% and the quarterly probability limits for accuracy data should fall within a range of -20% to +20% (±15% for TSP and PM10). These ranges are only guidelines, but when they are exceeded, procedures should be reviewed to determine the reason for the wide variation in the data.

11.1 Precision

For automated methods, this requirement is met by challenging the analyzer to a one point precision check gas of known concentration of the precision check gas and the concentration indicated by the analyzer is used to assess the precision of the monitoring data. Data from all the monitors operated for a particular pollutant by a reporting organization are then combined to give overall precision data for that pollutant and that reporting organization. Precision checks for manual methods are obtained by operating co-located samplers at selected sites (specific requirements must be met for these sites). For each pair of co-located samplers, one is designated as the sampler which will be used to report air quality for the site and the other is designated as the duplicate sampler. The differences in the measured concentration (ug/m^3) between the two co-located samplers are used to calculate and assess the precision of the monitoring data.

11.2 Accuracy

To measure the closeness of an observed measurement value to the truth, some material or condition of known (true) property must be measured by the measurement system being checked. The measurement system is "challenged" with the "known" to obtain the observed measurement. For automated analyzers, "known" gaseous pollutant concentrations determined using different standards and different equipment from those used for routine calibration and spanning are introduced into the measurement instruments. In this way, two different calibration systems are involved: the one used for routine monitoring and the one used to assess the "known." For manual methods, it is difficult to challenge the total measurement system with "knowns." Therefore, an accuracy audit is made of only a portion of the measurement system. The two major portions of manual measurement systems are the flow and the analytical measurements. The flow measurement portion of the particulate methods are audited for accuracy. Blind samples are provided by EPA for analysis to determine the bad accuracy results.

The precision and accuracy results are reported in Tables 11-1 and 11-2. When reviewing this data, it is important to note that not all precision data collected is used in the analysis. The particulate precision data, especially PM10 data, because of the low concentrations recorded at most sites, is most affected by this. Typically only a small percent of the valid pairs are utilized in the analysis and because of that the probability limits can be much larger than might be expected. Additional review of the data will document those cases.

In a number of instances accuracy probability limits are not calculated even though audits were conducted. Apparently, the program used to calculate accuracy does not calculate it when there is only one monitor or one site in operation. Hopefully, the program will be revised in the future to account for all the data.

TABLE 11-1
1993 PRECISION DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NUMBER OF SITES	PRECISION CHECKS	PROBABILITY LIMITS LOWER 95%	PROBABILITY LIMITS UPPER 95%
Sites operated by Maine DEP					
Sulfur Dioxide	Q1	4	50	0	6
	Q2	3	38	-3	3
	Q3	3	32	-6	3
	Q4	3	39	-4	3
	Year	4	159	-5	6
Ozone	Q1	0	0		
	Q2	10	89	-3	5
	Q3	11	102	-3	3
	Q4	1	5	-3	1
	Year	11	196	-3	4
Nitrogen Dioxide	Q1	1	6	-9	19
	Q2	1	3	-1	19
	Q3	0	0		
	Q4	0	0		
	Year	2	9	-7	19
Total Suspended Particulate*	Q1	0			
	Q2	0			
	Q3	0			
	Q4	0			
	Year	0			
Lead*	Q1	1	14	**	**
	Q2	1	16	**	**
	Q3	1	14	**	**
	Q4	1	14	**	**
	Year	1	58	**	**
Fine Particulate*	Q1	4	48	-8	10
	Q2	5	58	-7	5
	Q3	4	46	-7	12
	Q4	3	34	-2	14
	Year	5	186	-7	10

TABLE 11-1(Cont.)
1993 PRECISION DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NUMBER OF SITES	PRECISION CHECKS	PROBABILITY LIMITS LOWER 95%	PROBABILITY LIMITS UPPER 95%
Sites operated by Penobscot Energy Recovery Company, Orrington					
Fine Particulate*	Q1	1	10	-9	-5
	Q2	1	16	-26	4
	Q3	1	15	-5	2
	Q4	1	15	**	**
	Year	1	56	-14	4
Sites operated by S. D. Warren Company, Westbrook					
Fine Particulate*	Q1	1	14	-2	7
	Q2	1	13	0	0
	Q3	1	14	-9	-1
	Q4	1	15	-11	10
	Year	1	56	-6	6
Sites operated by S. D. Warren Company, Skowhegan					
Ozone	Q1	0	0		
	Q2	1	6	-3	0
	Q3	1	6	-9	-1
	Q4	1	3	-4	-1
	Year	1	15	-7	1
Fine Particulate*	Q1	1	15	**	**
	Q2	1	14	**	**
	Q3	1	11	-6	32
	Q4	1	15	**	**
	Year	1	55	-8	22
Sites operated by International Paper Company, Jay					
Total Suspended Particulate*	Q1	1	14	-7	9
	Year	1	14	-7	9
Fine Particulate*	Q1	1	13	0	11
	Q2	1	16	-9	9
	Q3	1	15	-6	7
	Q4	1	14	3	11
	Year	2	58	-3	10

TABLE 11-1(Cont.)
1993 PRECISION DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NUMBER OF SITES	PRECISION CHECKS	PROBABILITY LIMITS LOWER 95%	PROBABILITY LIMITS UPPER 95%
Sites operated by Boise Cascade Paper Group, Rumford					
Sulfur Dioxide	Q1	4	50	-7	5
	Q2	4	52	-5	4
	Q3	4	53	-5	1
	Q4	4	45	-6	4
	Year	4	200	-7	4
Fine Particulate*	Q1	1	15	-7	12
	Q2	1	16	-6	3
	Q3	1	14	-5	1
	Q4	1	14	-8	4
	Year	1	59	-7	6
Sites operated by Dragon Products, Thomaston					
Total Suspended Particulates*	Q1	1	13	-19	12
	Q2	1	16	-11	4
	Q3	1	15	-2	11
	Q4	1	10	-2	9
	Year	1	54	-10	10
Fine Particulate*	Q1	1	14	**	**
	Q2	1	14	-10	16
	Q3	1	14	-14	8
	Q4	1	14	0	0
	Year	1	56	-8	10
Sites operated by Scott Paper Company, Winslow					
Total Suspended Particulate*	Q1	1	16	-9	16
	Q2	1	18	-14	-2
	Q3	1	16	-6	-2
	Q4	1	15	-5	1
	Year	1	65	-13	7
Fine Particulate	Q1	1	16	0	19
	Q2	1	18	-8	34
	Q3	1	16	-22	6
	Q4	1	17	-8	6
	Year	1	67	-10	23

TABLE 11-1(Cont.)
1993 PRECISION DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NUMBER OF SITES	PRECISION CHECKS	PROBABILITY LIMITS LOWER 95%	PROBABILITY LIMITS UPPER 95%
Sites operated by Lincoln Pulp & Paper Company, Lincoln					
Sulfur Dioxide	Q1	1	11	-5	5
	Q2	1	14	-16	4
	Q3	1	15	-1	8
	Q4	1	13	-5	10
	Year	1	53	-10	10
Total Suspended Particulate*	Q1	1	15	-8	7
	Q2	1	15	-7	7
	Q3	1	15	-6	14
	Q4	1	18	-10	7
	Year	1	63	-8	9
Fine Particulate*	Q1	1	14	-2	8
	Q2	1	15	-18	10
	Q3	1	14	-2	5
	Q4	1	16	-3	1
	Year	1	59	-8	8
Sites operated by Great Northern Paper Company, Millinocket					
Sulfur Dioxide	Q1	1	7	-8	10
	Q2	1	6	-7	3
	Q3	1	7	-5	1
	Q4	1	7	-3	4
	Year	1	27	-7	6
Fine Particulate*	Q1	1	15	-13	1
	Q2	1	11	-7	2
	Q3	1	15	-12	5
	Q4	1	15	-17	5
	Year	1	56	-13	3
Sites operated by Georgia Pacific Company, Woodland					
Fine Particulate*	Q1	1	14	-14	14
	Q2	1	16	-1	7
	Q3	1	15	**	**
	Q4	1	15	**	**
	Year	1	60	-10	12

TABLE 11-1(Cont.)
1993 PRECISION DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NUMBER OF SITES	PRECISION CHECKS	PROBABILITY LIMITS LOWER 95%	PROBABILITY LIMITS UPPER 95%
Sites operated by Fraser Paper Company, Madawaska					
Sulfur Dioxide	Q1	3	43	-4	4
	Q2	3	39	-3	3
	Q3	3	40	-1	3
	Q4	3	39	-1	3
	Year	3	161	-3	3

* The total number of precision checks collected is listed for this parameter but not all of the pairs are used in the calculation of probability limits.

** Insufficient data was available to calculate the probabilty limits.

TABLE 11-2
1993 ACCURACY DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NO. OF AUDITS	PROBABILITY LIMITS LEVEL 1 -95%	LEVEL 1 95%	LEVEL 2 -95%	LEVEL 2 95%	LEVEL 3 -95%	LEVEL 3 95%
Sites operated by Maine DEP								
Sulfur Dioxide	Q1	2			-11	1	-12	2
	Q2	2	-14	6	3	5	-6	6
	Q3	2	-9	12	-8	-1	-7	-1
	Q4	2	-9	-6	-11	-5	-13	-3
	Year	8	-11	4	-6	0	-10	1
Ozone	Q1	0						
	Q2	4	-3	2	3	2	-7	3
	Q3	14	-3	3	-3	3	-2	2
	Q4	2	-4	9	2	2	-1	6
	Year	20	-2	2	-2	1	-2	2
Nitrogen Dioxide	Q1	0						
	Q2	0						
	Q3	0						
	Q4	0						
	Year	0						
Total Suspended Particulate	Q1	2			-1	13		
	Q2	2			0	0		
	Q3	2			2	11		
	Q4	2			1	2		
	Year	8			3	4		
Lead	Q1	2	0	0	-2	0		
	Q2	1	0	0	-3	-3		
	Q3	5	-14	2	-9	12		
	Q4	3	5	5	-4	-4		
	Year	11	-12	10	-8	7		
Fine Particulate	Q1	21			-4	5		
	Q2	22			-5	4		
	Q3	14			-3	4		
	Q4	14			-4	8		
	Year	71			-3	7		

TABLE 11-2(Cont.)
1993 ACCURACY DATA SUMMARY

			PROBABILITY LIMITS					
	SUMMARY	NO. OF	LEVEL 1		LEVEL 2		LEVEL 3	
PARAMETER	PERIOD	AUDITS	-95%	95%	-95%	95%	-95%	95%
Sites operated by Penobscot Energy Recovery Company, Orrington								
Fine Particulate	Q1	3			0	3		
	Q2	3			0	1		
	Q3	3			1	9		
	Q4	3			0	7		
	Year	12			1	4		
Sites operated by S. D. Warren Company, Westbrook								
Fine Particulate	Q1	4			-6	0		
	Q2	4			-3	-2		
	Q3	0						
	Q4	7			-5	8		
	Year	15			-4	1		
Sites operated by S. D. Warren Company, Skowhegan								
Ozone	Q1	0						
	Q2	1			*	*		
	Q3	1			*	*		
	Q4	0						
	Year	2			*	*		
Fine Particulate	Q1	3			0	2		
	Q2	3			0	1		
	Q3	3			1	2		
	Q4	3			3	9		
	Year	12			1	3		
Sites operated by International Paper Company, Jay								
Total Suspended	Q1	9			-1	5		
Particulate*	Year	9			-1	5		
Fine Particulate	Q1	3			-6	4		
	Q2	3			-3	-2		
	Q3	3			-1	3		
	Q4	3			-7	9		
	Year	12			-4	3		

TABLE 11-2(Cont.)
1993 ACCURACY DATA SUMMARY

			PROBABILITY LIMITS					
	SUMMARY	NO. OF	LEVEL 1		LEVEL 2		LEVEL 3	
PARAMETER	PERIOD	AUDITS	-95%	95%	-95%	95%	-95%	95%
Sites operated by Boise Cascade Paper Group, Rumford								
Sulfur Dioxide	Q1	4	-6	-1	-8	-4	-7	-5
	Q2	4	-14	6	-11	1	-10	0
	Q3	4	-8	2	-9	2	-10	2
	Q4	2	-9	2	-10	5	-9	4
	Year	14	-8	1	-9	0	-9	-1
Fine Particulate	Q1	5			-2	7		
	Q2	5			2	5		
	Q3	5			3	5		
	Q4	3			0	6		
	Year	18			1	6		
Sites operated by Dragon Products, Thomaston								
Total Suspended Particulates	Q1	0						
	Q2	6			*	*		
	Q3	0						
	Q4	6			*	*		
	Year	12			*	*		
Fine Particulate	Q1	0						
	Q2	6			*	*		
	Q3	0						
	Q4	6			*	*		
	Year	12			*	*		
Sites operated by Scott Paper Company, Winslow								
Total Suspended Particulate	Q1	3			1	3		
	Q2	3			1	7		
	Q3	3			-3	7		
	Q4	3			-10	14		
	Year	12			-3	8		
Fine Particulate	Q1	0						
	Q2	4			*	*		
	Q3	0						
	Q4	4			*	*		
	Year	8			*	*		

TABLE 11-2(Cont.)
1993 ACCURACY DATA SUMMARY

			PROBABILITY LIMITS					
	SUMMARY	NO. OF	LEVEL 1		LEVEL 2		LEVEL 3	
PARAMETER	PERIOD	AUDITS	-95%	95%	-95%	95%	-95%	95%
Sites operated by Lincoln Pulp & Paper Company, Lincoln								
Sulfur Dioxide	Q1	1	*	*	*	*	*	*
	Q2	0						
	Q3	0						
	Q4	2	*	*	*	*	*	*
	Year	3	*	*	*	*	*	*
Total Suspended Particulate	Q1	3			-5	1		
	Q2	3			-5	-1		
	Q3	3			-7	-2		
	Q4	3			-4	4		
	Year	12			-2	-2		
Fine Particulate	Q1	5			2	5		
	Q2	5			-9	5		
	Q3	5			-2	8		
	Q4	5			-3	5		
	Year	20			-1	3		
Sites operated by Great Northern Paper Company, Millinocket								
Sulfur Dioxide	Q1	0						
	Q2	2	*	*	*	*	*	*
	Q3	0						
	Q4	2	*	*	*	*	*	*
	Year	4	*	*	*	*	*	*
Fine Particulate	Q1	0						
	Q2	4			*	*		
	Q3	0						
	Q4	4			*	*		
	Year	8			*	*		
Sites operated by Georgia Pacific Company, Woodland								
Fine Particulate	Q1	4			1	5		
	Q2	5			-5	-1		
	Q3	5			-6	3		
	Q4	5			-5	5		
	Year	19			-3	2		

TABLE 11-2(Cont.)
1993 ACCURACY DATA SUMMARY

PARAMETER	SUMMARY PERIOD	NO. OF AUDITS	PROBABILITY LIMITS LEVEL 1 -95%	LEVEL 1 95%	LEVEL 2 -95%	LEVEL 2 95%	LEVEL 3 -95%	LEVEL 3 95%
Sites operated by Fraser Paper Company, Madawaska								
Sulfur Dioxide	Q1	3	-18	7	-13	3	-14	5
	Q2	3	-14	2	-8	-4	-8	-3
	Q3	3	-1	12	-6	7	-1	4
	Q4	3	-2	8	-3	2	-7	3
	Year	12	-4	2	-4	-2	-5	-1

* Insufficient data was available to calculate the probability limits.

12. AIR TOXICS

12.1 Compound-specific Background

Chlorine/Chloroform:

Chlorine is principally used by the chemical manufacturers' industry to produce chemicals (principally chlorinated organics), by the pulp and paper industry for bleaching pulp to produce white paper, in water and waste treatment processes for disinfection, and in cooling towers to curb biofouling in heat transfer systems (1) (2). It is known that the presence of chlorine and hydrocarbons in water can form such chlorinated compounds as chloroform, dioxin, chlorinated phenols, and other chlorinated hydrocarbons. Since there are no major organic chemical production facilities in Maine, the primary sources of chloroform in Maine are water and waste-water treatment facilities, cooling towers, and the pulp and paper industry.

Theoretically, we expect to see levels of chloroform that are higher than normal around pulp mills. The Toxic Release Inventory developed by the U.S. Environmental Protection Agency (EPA) requires that certain manufacturing facilities submit chemical emissions data. These data indicate that pulp mills are one of the major industrial sources of chloroform in Maine.

Other sources of chloroform are waste water treatment facilities. DEP's Volatile Organic Compound (VOC) emissions inventory for the towns in the 1992 air toxics monitoring study indicate VOCs from these facilities (chloroform is one of many VOCs) are substantially less than pulp mill chloroform emissions alone. For example, based on EPA emission factors, the DEP has estimated that Westbrook's wastewater treatment works had VOC releases in 1990 of 5.5 tons; the S.D. Warren facility in Westbrook had chloroform releases of approximately 27 tons in 1990. Similarly, in Woodland, the emissions of VOCs from the sewage treatment facility were less than 1 ton, whereas Georgia Pacific emitted 177 tons of chloroform. According to the Agency for Toxic Substances and Disease Registry (ATSDR) Draft Toxicological Profile for chloroform (3), most of the chloroform in the environment originates from industrial processes.

Cooling tower emissions of chloroform in Maine, primarily associated with electric generators, is currently unknown.

Due to chloroform's volatility, it eventually is released to the air, where it breaks down slowly (in approximately 5 - 6 months). Since chloroform is persistent in the atmosphere, it can be transported for long distances depending on the meteorological conditions. Those areas with no major known sources of chloroform, but where chloroform is found, may be experiencing this phenomenon.

DHS guideline is: 210 micrograms per cubic meter averaged over 24 hours
0.43 micrograms per cubic meter averaged over 1 year
(1 in 100,000 excess cancer risk)
0.043 micrograms per cubic meter averaged over 1 year
(1 in 1,000,000 excess cancer risk)

Tetrachloroethylene:

The majority of tetrachloroethylene (PCE) releases are from the dry cleaning industry (4). Other emissions to the air are from processes that use PCE as a solvent, such as in metal degreasing operations. This use of PCE is being phased out as less toxic metal degreasing solvents enter the market. In general, PCE levels in the air are higher in urban/suburban areas than in more remote areas. PCE persists several months in the atmosphere.

DEP standard is: 0.01 micrograms per cubic meter average over 1 year
(1 in 1,000,000 excess cancer risk).

Benzene:

Nationally, petroleum refining operations and petrochemical manufacturing sites are the main sources of benzene in the environment (5). Emissions from burning coal and oil, benzene waste and storage operations, motor vehicle exhaust, evaporation from gasoline service stations, and use of industrial solvents also contribute to benzene levels in air. According to the Toxic Release Inventory - 1990 database, there are no major industrial users or sources of benzene at or above the TRI reporting thresholds in Maine. This suggests that in Maine, the primary sources of benzene are most likely combustion of fossil fuel, and evaporation from gasoline service stations. Once released to the atmosphere, benzene breaks down (photooxidizes) within a few days.

DHS guideline is: 450 micrograms per cubic meter averaged over 24 hours
0.12 micrograms per cubic meter averaged over 1 year
(1 in 100,000 excess cancer risk)
0.012 micrograms per cubic meter averaged over 1 year
(1 in 1,000,000 excess cancer risk)

Toluene:

Toluene is a solvent, and is also a component of gasoline. Nationally, marketing and combustion of gasoline represent the major sources of toluene emissions (6). Toluene releases will end up in the atmosphere, due to its volatility, where it will photooxidize within a few hours to a few days (6). In 1985, the DEP estimated that approximately 855 tons of toluene were emitted from the marketing of gasoline and its combustion. According to the 1990 TRI database only 234 tons of toluene were released from stationary sources. Toluene is used by some of the sources potentially impacting the monitors.

DEP standard is: 15,000 micrograms per cubic meter (instantaneous)
260 micrograms per cubic meter averaged over 24 hours
180 micrograms per cubic meter averaged over 1 year

Xylenes:

Solvents and thinners for paints and varnishes often contain xylenes. Xylenes are used as a solvent in the printing, rubber, and leather industries, and also as cleaning agents. They are also found in gasoline. Xylenes photooxidize in the atmosphere fairly rapidly, within 1 - 2 days. A total of 169 tons of xylenes were released to the air in 1990, based on TRI data. (7).

DHS guideline is: 65,000 micrograms per cubic meter (instantaneous)
300 micrograms per cubic meter averaged over 24 hours
300 micrograms per cubic meter averaged over 1 year

1,3-butadiene:

1,3-butadiene is associated with fossil fuel combustion. It is primarily released to the atmosphere during manufacture, use, transport, and storage of gasoline, but other sources exist, such as wood smoke (8). 1,3-butadiene breaks down rapidly in air, especially in the presence of sunlight. The total expected life of 1,3-butadiene is short; approximately 0.48 hrs (10) to 2 hours (8).

DHS guideline is: 370 micrograms per cubic meter averaged over 24 hours
0.036 micrograms per cubic meter averaged over 1 year
(1 in 100,000 excess cancer risk)
0.0036 micrograms per cubic meter averaged over 1 year
(1 in 1,000,000 excess cancer risk)

Carbon tetrachloride:

Carbon tetrachloride (CCl4) has been widely used as a refrigerant and aerosol propellant, although its use for these purposes is being phased out due to its effect on the stratospheric ozone layer. CCl4 was once used as a cleaning fluid, but this use was stopped in the mid-1960's. However, it is a very stable and persistent compound in the environment; it takes 30-100 years for half of the carbon tetrachloride that is released to be broken down into other components in the air (9).

DHS guideline is: 860 micrograms per cubic meter averaged over 24 hours
0.7 micrograms per cubic meter averaged over 1 year
(1 in 100,000 excess cancer risk)
0.07 micrograms per cubic meter averaged over 1 year
(1 in 1,000,000 excess cancer risk)

12.2 Monitoring

Air toxics monitoring was conducted in the Fall of 1991 at two sites in the Rumford/Mexico area, as a pilot study. The Department of Environmental Protection (DEP) then conducted an expanded monitoring effort in 1992 for four towns (10 sites) in southern Maine, two towns (five sites) Downeast, and one town (5 sites) in central Maine. The samples were collected for a 24-hour period, and analyzed for a suite of compounds commonly examined in laboratories doing air toxics work. The Department of Human Services (DHS) evaluated the data for potential health risks.

Very little is known about air toxics in Maine and the concentrations to which people are being exposed; an enhanced inventory is necessary to define all sources of hazardous air pollutants. DEP believes that the 1992 monitoring program was a start in understanding ambient air quality in Maine regarding toxics; in particular, in understanding the relationship between emissions and exposure.

During 1993 a limited number of canister samples were collected in the Rumford/Mexico area to provide additional information and to verify some of the previous data collected in that area. However, due to resource constraints those samples have not yet been analyzed.

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December, 1990

8. Toxicological Profile for 1,3-Butadiene
Dept. of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry (ATSDR)
Draft document, February 15, 1991

9. Toxicological Profile for Carbon Tetrachloride
Dept. of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry (ATSDR)
December, 1989

10. Handbook of Environmental
Organic Chemicals
Karel Verschueren
1983

13. HYDROCARBONS AS PRECURSORS TO GROUND LEVEL OZONE FORMATION

13.1 History and Establishment of Site

EPA, with the enactment of the Clean Air Act Amendments of 1990, specified the analysis of volatile organic compounds (VOC), which were determined to be ozone precursors, in areas where the National ozone standard (.12 ppm) was not being met. The state of Maine exceeds this standard on various days throughout the summer months. In addition, Maine's own Ozone standard (.081 ppm) is exceeded on a regular basis during the hot weather. A Photochemical Assessment Monitoring Site (PAMS) was established at Two Lights State Park in Cape Elizabeth in the spring of 1993 to determine which hydrocarbons and in what amount were present throughout the summer months when ground level ozone events are most likely to occur. This site has an ozone (O_3) monitor, a low-level nitrogen oxides (NO-NO_2-NO_x) monitor, a meteorological system and a gas chromatograph which has a sample preparation specific for the most volatile hydrocarbons (VOC's). A majority of these hydrocarbons are associated with gasoline, before and after combustion.

13.2 Monitoring

The hydrocarbons on the list of Target VOC Ozone Precursors (Table 13.1) are the compounds which are of interest to EPA and the DEP regarding ground level ozone formation. These compounds contain two to ten carbon atoms and are the most volatile of hydrocarbons. At the Two Lights State Park site, a 32 minute intergrated ambient air sample was taken and analyzed each hour, 24 hours a day between July first and September twenty-second. There was some down time, but analysis for these compounds did occur during most ground level ozone exceedances throughout the season of 1993.

13.3 Chemistry

The two chromatograms which follow (Figure 13.1) are the actual 54 calibration compounds which were analyzed at the Two Lights State Park site in 1993. Each large peak using the corresponding AIRS CODE is a compound on the Target VOC Ozone Precursor List (except for TNMOC which is the total of all of the compounds analyzed). These compounds are analyzed based on their number of carbons, their molecular weight and their volatility. The higher the volatility, the faster the compound comes through the column of the gas chromatograph.

13.4 Relationship with Ozone (O_3) and Nitrogen Oxides (NO_x)

The two charts which follow show the relationship between three important parameters during an ozone event, ground level ozone(O_3), and its two precursors: nitrogen oxides (NO_x), and total non-methane organic compounds (TNMOC). The first chart (Figure 13.2) represents a summer day with northwesterly winds when the ozone was low. The maximum hourly value was .037ppm. The second chart (figure 13.3) illustrates a day when the ozone reached an hourly value of .122ppm . This is over the Maine health standard of .081ppm and is considered to be in the unhealthful catagory. The wind was predominantly southwest throughout the day. This chart illustrates just one example of how these parameters are related during a ground level ozone event. Each event seems to have its own "personality", depending on when, where, and how it was formed. The continuous analysis of the photoreactive volatile organic compounds help us to understand the formation of ground level ozone. VOC's are an integral piece of the ground level ozone puzzle.

TABLE 13 - 1
TARGET VOC OZONE PRECURSORS - HYDROCARBONS

AIRS CODE	COMPOUND NAME	AIRS CODE	COMPOUND NAME
43206	ACETYLENE	43203	ETHYLENE
43202	ETHANE	43205	PROPYLENE
43204	PROPANE	43280	1-BUTENE
43214	ISOBUTANE	43216	trans-2-BUTENE
43212	n-BUTANE	43282	3-METHYL-1-BUTENE
43217	cis-2-BUTENE	43224	1-PENTENE
43221	ISOPENTANE	43220	n-PENTANE
43243	ISOPRENE	43226	trans-2-PENTENE
43227	cis-2-PENTENE	43228	2-METHYL-2-BUTENE
43244	2,2-DIMETHYLBUTANE	43283	CYCLOPENTENE
43234	4-METHYL-1-PENTENE	43242	CYCLOPENTANE
43284	2,3-DIMETHYLBUTANE	43285	2-METHYLPENTANE
43230	3-METHYLPENTANE	43246	2-METHYL-1-PENTENE
43231	n-HEXANE	43289	trans-2-HEXENE
43290	cis-2-HEXENE	43262	METHYLCYCLOPENTANE
43247	2,4-DIMETHYLPENTANE	45201	BENZENE
43248	CYCLOHEXANE	43263	2-METHYLHEXANE
43291	2,3-DIMETHYLPENTANE	43249	3-METHYLHEXANE
43250	2,2,4-TRIMETHYLPENTANE	43232	n-HEPTANE
43261	METHYLCYCLOHEXANE	43252	2,3,4-TRIMETHYLPENTANE
45202	TOLUENE	43960	2-METHYLHEPTANE
43253	3-METHYLHEPTANE	43233	n-OCTANE
45203	ETHYLBENZENE	45109	meta/para-XYLENE
45220	STYRENE	45204	o-XYLENE
43235	n-NONANE	45210	ISOPROPYLBENZENE
45209	n-PROPYLBENZENE	45207	1,3,5-TRIMETHYLBENZENE
45208	1,2,4-TRIMETHYLBENZENE		
43102	TOTAL NON-METHANE ORGANIC COMPOUNDS (TNMOC)		

FIGURE 13 - 1
CALIBRATION COMPOUNDS ANALYZED FOR AT TWO LIGHTS STATE PARK IN 1993

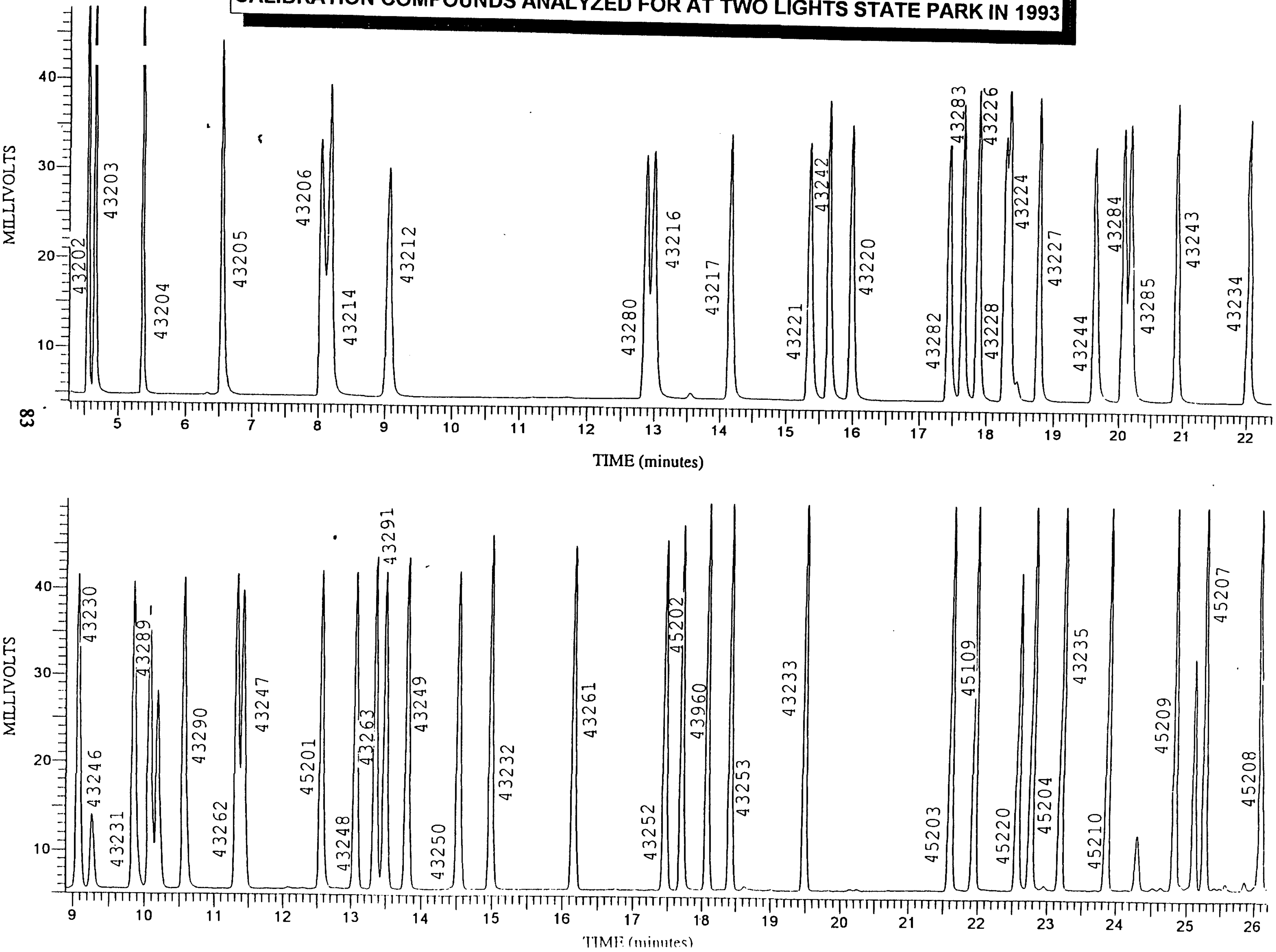
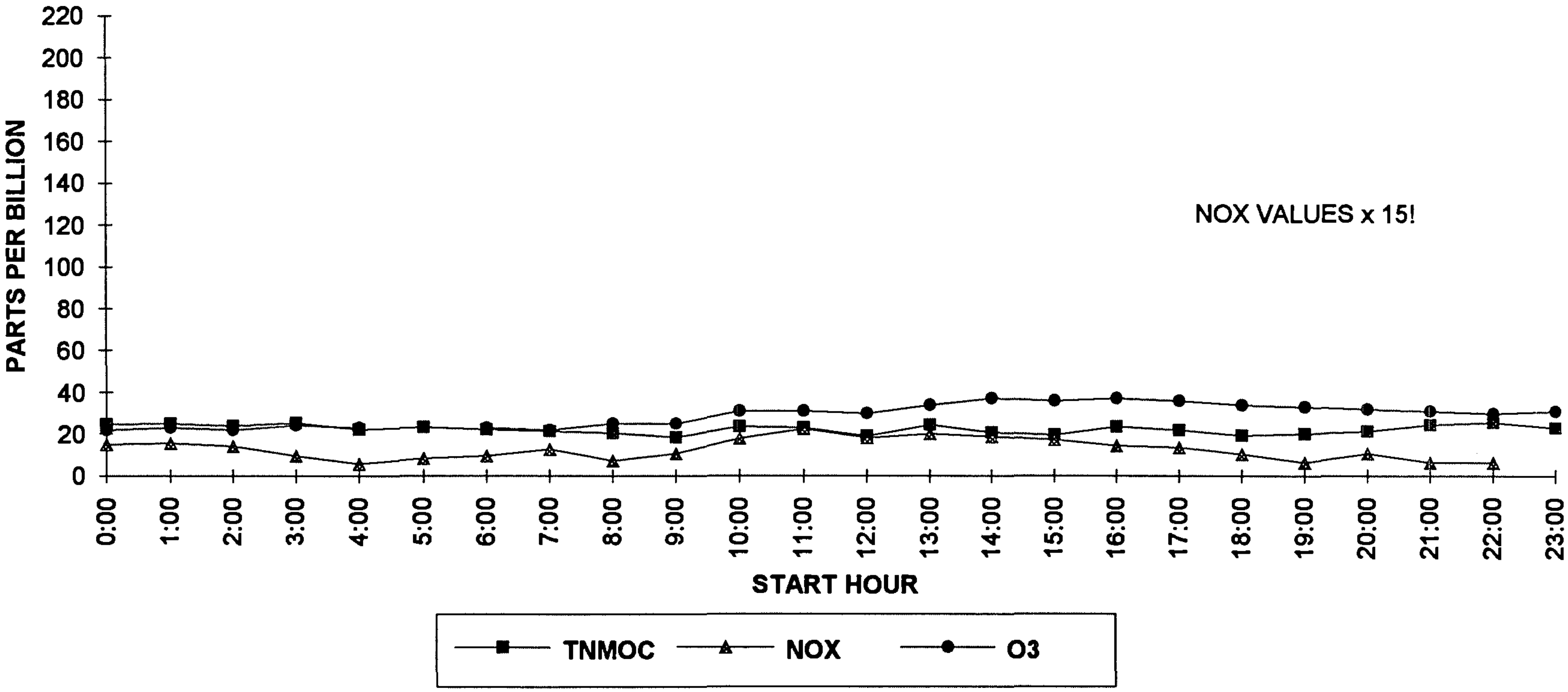
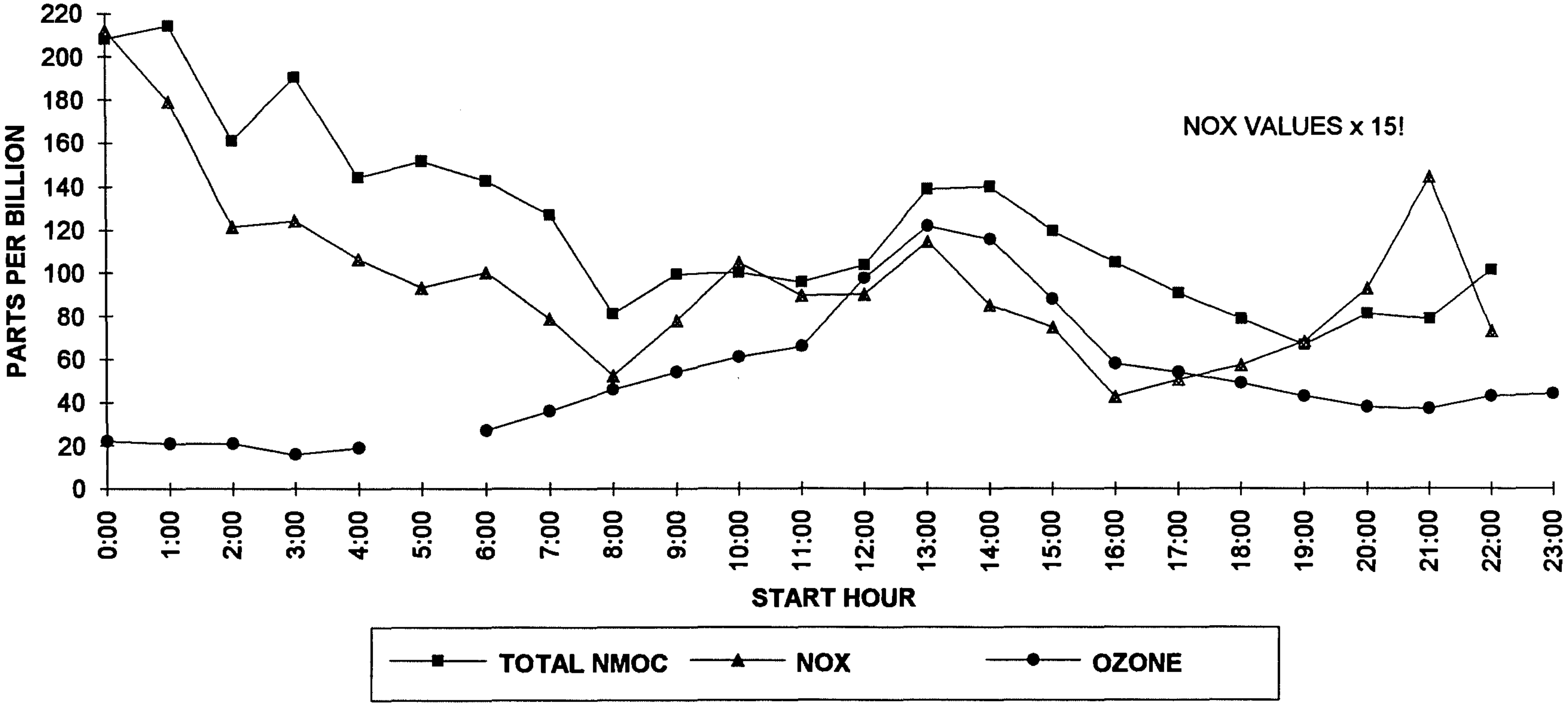


FIGURE 13 - 2
TWO LIGHTS STATE PARK
SUMMER DAY WITH NORTHWESTERLY BREEZE



NOX VALUES x 15!

FIGURE 13 - 3
TWO LIGHTS STATE PARK
OZONE EXCEEDANCE DAY(ME. STD.) WITH SOUTHWESTERLY BREEZE



14. ULTRAVIOLET-B(UV-b)

14.1 Description and Sources

Ultraviolet-b is part of the radiation reaching the earth's surface from the sun. Solar UV radiation is divided into three regions; UV-a(400-315 nanometers(nm)), UV-b(315-280nm) and UV-c(280nm to x-ray region). Because of the absorption by the upper atmosphere no light with a wavelength shorter than 280nm reaches the earth's surface. The majority of the UV-b is also absorbed by the ozone layer and the atmosphere. The amount of UV-b that actually reaches the earth's surface is further affected by ground level ozone, particulates and other pollutants, clouds and the elevation of the surface. In addition, the effects of the UV-b reaching the earth's surface are magnified by a reflective ground cover such as snow or water.

14.2 Health and Welfare Effects

Light in the UV-b wavelength region has been shown to be responsible for many biologically harmful effects in both plants and animals. In plants overexposure to UV-b is known to cause DNA damage and decreased agriculture yields. In animals overexposure to UV-b is known to cause skin cancer, eye damage, suppression of the immune response system, sunburns and premature wrinkling of the skin.

14.3 Standards

There are currently no standards for UV-b. Data from UV-b monitoring is reported as MED(Minimum Erythemal Dose) units. MED is a measurement based on the dose of effective radiation received and its ability to cause damage, such as sunburn, to the human skin. MED units are based on the time it took to cause erythemia(reddening) of the skin of the average caucasian using differing wavelengths of UV-b. Data is reported as the number of MED's received that hour. For example, if for a particular hour 4 MED's were reported then that means a person would have received four times the amount of sunlight it takes to cause sunburn in the average caucasian. Various agencies around the world have developed indices for rating the amount of exposure to UV-b that individuals receive. For example less than 2 MED's/hour might be considered low whereas 6 or more MED's/hour might be considered very high exposure.

14.4 Monitoring

During 1993 a monitoring site in Howland was equipped with a UV-b monitor and a total solar monitor. This site was chosen because of its rural location, stable land use, freedom from obstructions and the availability of other data from instruments already installed at the site. Some problems were experienced during this first year of operation, most notably frost forming on the dome of the total solar monitor. The lack of a Quality Assurance plan has also caused minor problems. Quality assurance checks currently performed are based on our present knowledge of this methodology. Table 13-1 is a summary of the top twenty hourly values for each of the parameters indicated. A more detailed description of the 1993 UV-b monitoring program is available from the Bureau of Air Quality Control.

TABLE 14-1
HIGHEST VALUES FOR TOTAL SOLAR, UV-B AND MED UNITS
(1993)

DATE	**TIME**	**TOTAL SOLAR watts/meter-2**	**DATE**	**TIME**	**AVG. UV-b 280-315nm**	**DATE**	**TIME**	**MED UNITS**
6/08/93	12:00	987.7866	7/05/93	12:00	1.87	7/05/93	12:00	4.92
7/15/93	13:00	976.5703	7/08/93	12:00	1.81	7/08/93	12:00	4.76
5/23/93	12:00	976.144	7/05/93	13:00	1.81	7/05/93	13:00	4.65
6/25/93	12:00	966.6899	7/07/93	13:00	1.75	7/05/93	11:00	4.58
5/27/93	11:00	964.0723	7/05/93	11:00	1.74	7/26/93	12:00	4.56
7/26/93	12:00	963.2915	7/26/93	12:00	1.74	6/25/93	12:00	4.55
7/05/93	12:00	963.1963	7/06/93	12:00	1.73	7/06/93	12:00	4.55
6/12/93	12:00	962.6631	7/11/93	12:00	1.72	7/11/93	12:00	4.52
6/08/93	13:00	960.6621	7/08/93	13:00	1.71	7/07/93	13:00	4.49
5/23/93	13:00	959.7744	7/08/93	11:00	1.70	7/08/93	11:00	4.47
6/08/93	11:00	958.4106	6/25/93	12:00	1.70	6/12/93	12:00	4.46
7/18/93	12:00	944.105	6/12/93	12:00	1.70	7/08/93	13:00	4.40
5/23/93	11:00	942.1084	7/06/93	13:00	1.68	7/14/93	11:00	4.34
7/05/93	13:00	937.9673	8/01/93	12:00	1.68	6/08/93	12:00	4.33
7/11/93	12:00	936.2417	7/26/93	13:00	1.67	7/06/93	13:00	4.33
6/25/93	11:00	932.606	7/13/93	13:00	1.66	8/01/93	12:00	4.32
6/12/93	11:00	932.4375	7/15/93	13:00	1.66	7/26/93	13:00	4.29
7/05/93	11:00	932.3335	7/14/93	11:00	1.65	7/15/93	12:00	4.29
5/02/93	12:00	931.645	6/08/93	12:00	1.65	7/13/93	13:00	4.28
6/25/93	13:00	930.6123	6/25/93	13:00	1.64	7/15/93	13:00	4.27