FIVE YEAR ASSESSMENT OF AMBIENT AIR MONITORING NETWORK 2015

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

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Five Year Network Assessment for the State of Maine
2015

EXECUTIVE SUMMARY

The Maine Department of Environmental Protection is pleased to provide a comprehensive review of the ambient air monitoring network operated by the Bureau of Air Quality. Staff of the Bureau has reviewed data from around the state including population statistics, health data, present and past air quality data, inventory information and traffic patterns. The review has concluded that ozone (O_3) and fine particle pollution ($PM_{2.5}$) are the primary criteria pollutants of concern affecting the citizens of Maine. Staff has concentrated much of their efforts and resources in recent years to delivering near real time air quality information and issuing timely air quality forecasts to the public, and will continue to expand and improve this process in the upcoming years. In addition to monitoring for criteria pollutants, Maine DEP continues an Air Toxics Program to track concentrations of certain air toxins. It is hoped the data will help regulators make more informed decisions on the need and appropriateness of additional controls for those compounds that pose the greatest health risk. Maine will continue to work with other federal and state agencies, tribal governments and industry to ensure that the air quality in the State of Maine will meet national and state standards for all the citizens of Maine.

OVERALL OBJECTIVES

The State is required to perform, and submit to the EPA Regional Administrator, an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D of CFR 58.10, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and where new technologies are appropriate for incorporation in the ambient air monitoring network. The network assessment will consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment will also identify any needed changes to population-oriented sites. The State agency will submit a copy of this 5-year assessment, along with a revised annual network plan to the Regional Administrator. The first assessment was completed on July 1, 2010. The assessment should provide a description of the networks and the relative value of each monitor and station. The annual monitoring network plan will provide for the actual proposed changes to the networks that are consistent with the findings of the five year assessment. The network assessment will cover the National Ambient Air Quality Standards (NAAQS), air toxics and meteorological monitoring networks designed to

support the ambient air monitoring program. As part of the assessment this report will look at population data, emissions inventory data, changes in traffic patterns, and the current and proposed air quality standards.

BACKGROUND AND OVERVIEW

Maine makes up over half the geographic area of Region I and has always faced unique challenges for determining air quality and pollution impacts. The population centers are primarily along the coast in the south and south central area and that is where most of the air monitoring has taken place. Maine's northeast location in the continental United States makes it particularly vulnerable to pollution generated elsewhere along the eastern sea-board, the central U.S and eastern Canada as well. Maine emits a relatively small amount of air pollution in comparison to the states located upwind. With controls installed on Maine sources since the 1970 Clean Air Act, and aggressive adoption of air emission regulations, much of the concern in the state is now with transport from the upwind states. Maine based emissions that continue to cause concern include air toxics from local sources including mobile sources and emissions from numerous small heating sources burning wood and wood chips/pellets. PM from mineral/concrete/asphalt manufacturing and traffic related fugitive PM continues to be a periodic problem. Haze impact on Maine's Class I areas from Maine sources is also a concern.

Transport is a very large portion of Maine's air pollution and assessment of that transport is extremely complicated. Most of the higher ozone concentrations are the result of transport with many transport trajectories crossing into Maine from the Gulf of Maine. Ozone transport near the surface from the S and SW travels over the Gulf of Maine where the pollutants and precursors undergo reactions and stratification quite unlike overland transport and are subject to land/sea winds that are inconsistent with overland air flow. Air Pollution Models are constantly being evaluated and upgraded but currently relying solely on the model predictions to make an accurate air quality forecast is not yet a reality. Model predictions can however be a very useful tool for forecasters if they know model limitations and bias and use other tools including evaluating monitoring data (including winds) from MEDEP, other states and Canadian networks. Along with the transport of ozone and its precursors are the many other pollutants associated with emission sources found within that air shed including air toxics, pollutants causing acid and heavy metals deposition, and $PM_{2.5}$ including sulfates, nitrates and organic compounds.

Transport is also common in the air masses from the W and SW that enter Maine's western border with New Hampshire and the Province of Quebec. Ozone monitoring in this area is very limited with some coverage from the line of inland sites set back from the coast to determine how far inland the coastal problem extends. The extreme SW portion of Maine was earlier covered by a Rochester, New Hampshire site. When that site was discontinued Maine was concerned and placed an ozone monitor in Shapleigh. The Shapleigh monitoring site has recorded five more days of ozone levels greater than 65 ppb than any other inland site in Maine in the past five years.

Transport further up the western border has not been evaluated; however, measurements on Mount Washington in New Hampshire and in Province of Quebec show exceedences of the potential future ozone standard close to Maine. Similar values can be expected to impact Maine; especially at higher elevations. Although the area is of low population density, people do live in and frequent those areas for work and recreation purposes and there is concern for the standards in the higher elevations in western Maine and along the Longfellow Mountain chain. Again, Maine makes up more than half of the geographic area of Region I and there are many areas where standards could be violated or the moderate level reached with no warning available to the more susceptible population. MEDEP will look to relocate the North Lovell site to a site that will better capture ozone levels at high elevations along the western border of Maine.

Transport of Fine Particulate Matter ($PM_{2.5}$) into Maine is also of concern to Maine. Maine has one of the highest adult asthma rates in the U.S. and particulate monitors that provide near real time data help forecasters to better predict elevated $PM_{2.5}$ levels and warn susceptible citizens in a more timely fashion.

Forest fires in western Quebec and Ontario Provinces often affect Maine, coming from North and Northwesterly winds and in very narrow bands across the state, resulting in an obvious ground level haze and odor. PM from anthropogenic sources transported into northern Maine from the Montreal/Quebec corridor is a problem that is not very well documented. Arsenic from Ontario smelters was measured in the 1980s, in the Presque Isle area, probably from the continuation of the plumes documented in northern Vermont around the same time. New monitoring for mercury in Caribou started in 2006 after water quality studies showed high levels of mercury in northeastern Maine; the monitoring will further evaluate possible mercury and metals transport and deposition from that corridor. Heavy metals are known to be in Maine soils and vegetation at concentrations that differ depending on where in Maine a soil sample is taken. This raises questions that need answers as to what is naturally occurring, what is from earlier deposition, and what is still being deposited. An example of heavy metal concern is a wide range of cadmium concentrations found in moose and deer livers throughout the state rendering those organs in some areas unhealthy to eat, yet they are still consumed by many people.

Transport of air toxins has been well documented by two Photochemical Assessment Monitoring Station (PAMS) sites operating in the state since 1993 and the data trends from these sites helped track the results of new control strategies in upwind states. At the end of 2014 the Cadillac Mountain PAMS site was shut down due to lack of resources. Similarly, the Cape Elizabeth site may soon be shut down as well, but it is the intent of the Maine DEP to operate the site as long as possible. The Cape Elizabeth PAMS site measures the Boston air plume and plumes associated with typical SW ozone episodes. The Cadillac Mountain site was impacted by several different plumes that turned inland from the Gulf of Maine as well as air masses associated with high elevation transport from the west.

Of special concern are elevated ozone concentrations that at times are over the current and proposed ozone NAAQS. The more stringent ozone standard to be in place in October 2015 will be much more difficult to attain, making PAMS sites in Maine even more critical for determining where the ozone and precursors originated, what compounds are involved, and what additional controls are needed. The new standard involves concentrations considerably below what the original PAMS system was designed to resolve. Recent work with the EPA has addressed the question about what compounds should now be measured when taking into account controls that have been phased in over the last three decades, new techniques in detection, and the significance that other compounds, including biogenic ones, now have on lower ozone concentrations.

POPULATION ANALYSIS

In order to look at the impact of air quality on populations around the state this report looks at the historical changes in population and the projected future changes. Figure 1

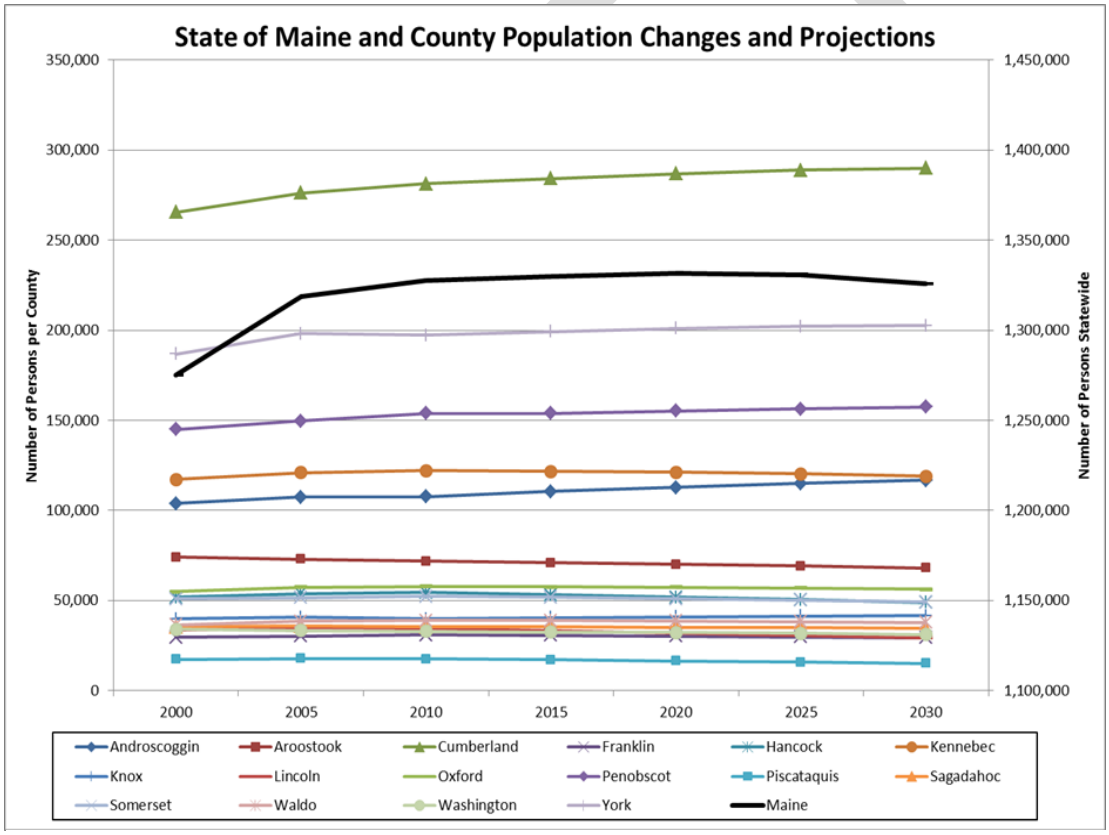

Figure 1 Maine State and County Population Changes and Projections

depicts the total population in the state and the breakdown by County since 2000. While Cumberland and York Counties in southern Maine have experienced considerable growth over the last fifteen years, the rest of the state experienced relatively flat growth with the exception of Aroostook County that has shown a fairly steady decline in population. Overall, the state has shown a 4.1% increase in population from 2000 to 2010 with a gain of over 52,000. Over 26,000 of that gain has been in York and Cumberland Counties.

Projections for 2015 through 2025 show slow growth. The more susceptible populations such as the young (age 19 and younger) and the elderly (age 65 and older) have shown different changes as depicted in Figures 2 and 3. Young children are included in the sensitive groups because on a per-body-weight basis they tend to inhale relatively more air than adults. Their elevated metabolic rate and young immune systems make them more susceptible to air pollution. The elderly also are more likely to be affected by air pollution, due to generally weaker lungs, heart and immune systems, or undiagnosed respiratory or cardiovascular health conditions. The population of young in the state has decreased since 2000 and the trend is not expected to change significantly in the future. The elderly population in the state has been steadily increasing and that rate of change is projected to increase as the present population ages and more retirees choose to live in Maine.

Health Data

There are several public health problems that have been at least partially linked to air pollution. Any individuals with chronic cardiovascular or lung health problems may be impacted by high levels of air pollution. Even healthy individuals need to be aware that they too can be affected and should adjust their activity accordingly.

This report emphasizes four particular health conditions that have been linked to air pollution. Asthma has been studied extensively and there are a lot of data that can be analyzed. Myocardial infarctions or heart attack statistics have also been compiled and can be reviewed for possible links to air pollution. More recently birth weights have been reviewed for possible links to air pollution. Data indicating the prevalence of these health problems in Maine are summarized in Table 1. Cancer prevalence may also be linked to air pollution. About 20 chemicals found in the environment, including arsenic, asbestos, benzene, cadmium, chromium, radon, and vinyl chloride, have been identified as known human carcinogens by national and international agencies. Many additional chemicals have been identified as being potential human carcinogens. The cancer burden posed by specific environmental carcinogens (aside from occupational exposure) has not been well defined. Despite the fact that the contribution of environmental carcinogens to the cancer burden is not as well understood as some of the other major causes of cancer, such as tobacco use, preventive measures should be initiated. Such measures are largely based on what is known at the present and include the reduction of exposure to hazardous chemicals in the workplace and the reduction of environmental pollution. Should any "cancer clusters" be identified by the Maine CDC that could possibly be linked to air pollution, additional monitoring may be needed.

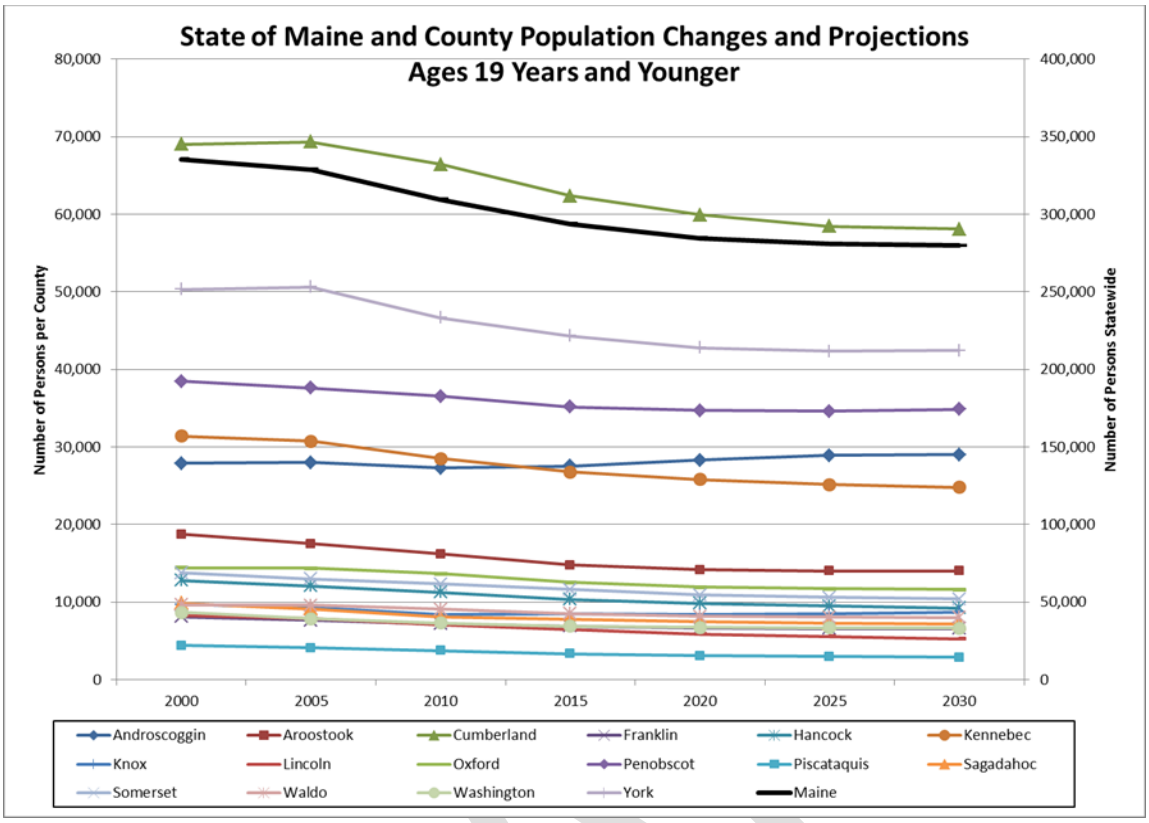

Figure 2 Maine State and County Population Changes and Projections Ages 19 and Younger

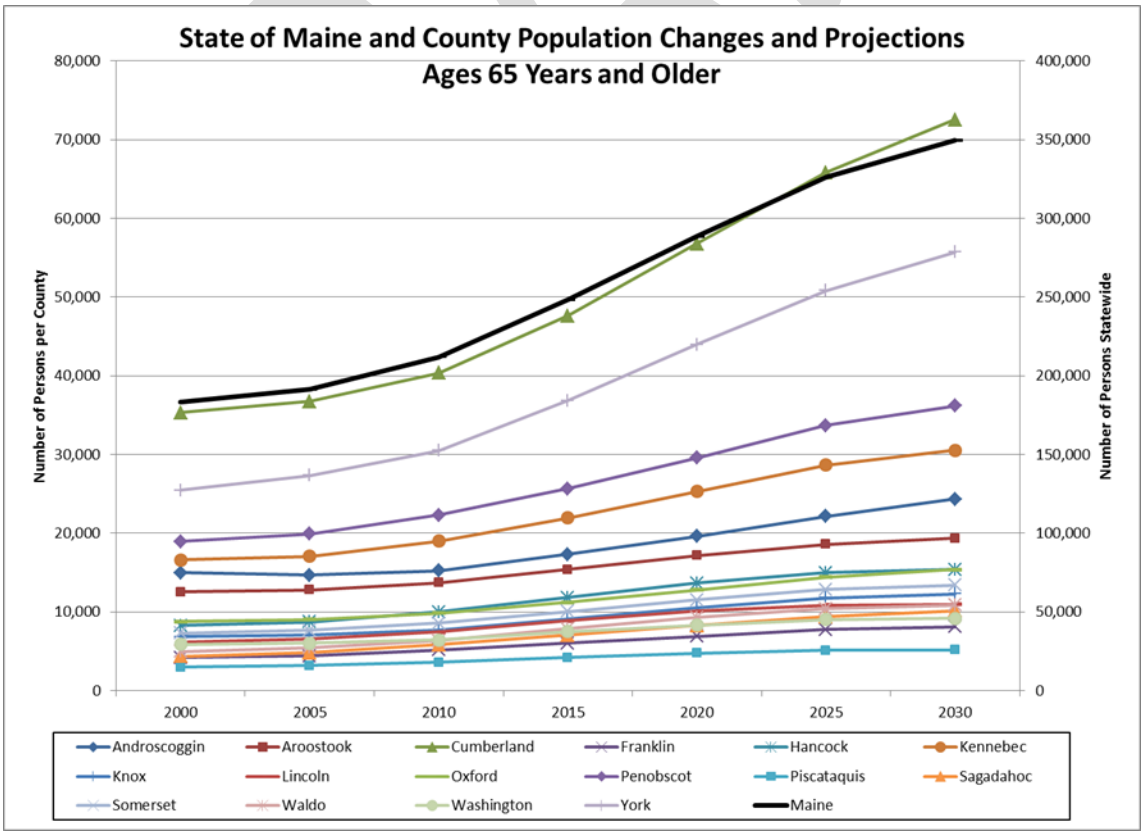

Figure 3 Maine State and County Population Changes and Projection Ages 65 and Older

At Risk Population Statistics by County

	Myocardial Infarction Hospitalizations (age-adjusted per 10,000) [2008]	Asthma Hospitalizations (age adjusted per 10,000) [2006-2010 combined]	Asthma Emergency Department Visits (age-adjusted rate per 10,000) [2010]	Adults with Asthma, percent [Maine data 2006-2010 combined; NE & US data 2008]	Low Birth Weight <2500 grams, percent of live births [2012]	0-19 YRS (2015 estimate)	% of County Population	65 YRS and older (2015 estimate)	% of County Population
Androscoggin	43.1	10.9	74.6	11.1	8.3	27,544	24.9	17,322	15.7
Aroostook	88.5	10.3	114.0	9.7	9.7	14,767	20.8	15,371	21.7
Cumberland	30.6	6.0	53.2	9.1	6.9	62,358	21.9	47,636	16.8
Franklin	49.8	10.6	60.3	9.0	8.2	6,883	22.6	6,015	19.7
Hancock	66.7	8.2	64.1	10.6	6.0	10,344	19.5	11,835	22.3
Kennebec	63.4	6.7	65.8	11.0	6.6	26,756	22.0	21,940	18.0
Knox	48.7	8.7	63.0	9.8	6.3	8,453	21.0	9,069	22.5
Lincoln	33.0	6.2	50.6	7.9	5.5	6,465	19.5	8,877	26.8
Oxford	38.7	8.5	69.7	10.4	6.3	12,528	21.8	11,204	19.5
Penobscot	61.7	10.7	54.9	12.9	6.9	35,179	22.9	25,634	16.7
Piscataquis	75.8	5.9	66.3	12.1	3.8	3,343	19.7	4,193	24.7
Sagadahoc	28.8	8.6	46.0	8.8	4.0	7,758	22.1	7,019	20.0
Somerset	61.8	8.0	92.9	10.5	4.8	11,602	22.5	10,025	19.4
Waldo	64.4	7.6	53.7	10.9	6.3	8,496	21.9	7,868	20.3
Washington	83.0	9.1	122.5	12.0	4.6	6,889	21.2	7,490	23.1
York	41.8	5.6	59.8	8.8	5.8	44,320	22.2	36,859	18.5
Maine	50.3	7.8	65.1	10.2	6.7	293,685	22.1	248,358	18.7
New England				9.7	7.5				
US				8.8	8.0				
Heart Attack Data: Data downloaded from the Maine Tracking Network data portal - Original source: Maine Health Data Organization (MHDO)									
Asthma Data: Data dowloaded from the Maine Tracking Network data portal - Original source: Maine Health Data Organization (MHDO)									
Low Birth Weight rate data: 2012; The Office of Data, Research, and Vital Statistics , Div. Public Health Systems, MECDC, Maine DHHS provided the data.									
Population data provded by the Maine Office of Policy and Management, from US Census Data.									
New England asthma rate from Living with Asthma in New England - Asthma Regional Council of New England, February 2010									

Table 1 At Risk Population Statistics by County

Asthma

Asthma continues to be a serious public health problem. The prevalence of asthma has increased significantly since the 1980's. Research by EPA and others has shown that ozone and particle pollution can cause or contribute to asthma attacks. Current asthma rates in New England are significantly higher than elsewhere in the US and Maine has consistently been found to have one of the highest asthma rates in New England. Data from 2006-2010 indicates over 10 percent of adults in Maine have asthma with individual counties ranging from a low of 7.9 percent in Lincoln County to a high of 12.9 percent in Penobscot County. There are a variety of factors that can contribute to the high rates such as gender, age, race/ethnicity, income, education level, marital status, weight, and smoking. Consequently, as we look towards the future it will be important to maintain an adequate network of ozone and particulate monitors around the state to be able to provide data that can lead to accurate forecasts of air quality. Those with asthma can then limit their activity during periods when high levels of ozone and/or particulates are forecast and hopefully prevent an attack.

Heart Attacks

Heart disease is still the leading cause of death in the United States. People with heart disease can be affected by increased levels of air pollution. Particle pollution or ozone can cause serious problems in a short period of time and can lead to heart attacks with no warning signs. In Maine, Aroostook, Washington and Piscataquis counties have a higher than average rate of heart attacks even after adjusting for the older population present in those counties. There are a variety of factors that contribute to higher rates of heart

attacks and while there has been demonstrated links between elevated air pollution and increased heart attack rates there is no specific data that establishes that link in those three counties.

Low Birth Weights

A body of evidence is emerging from several countries on the adverse consequences of ambient air pollution on fetal/birth outcomes, including preterm birth and fetal growth restriction.[1] The percent of low birth weight rates in Maine is lower than the New England rate and that is lower than the national average. Many other factors also influence the birth weights so establishing a link to air pollution in Maine may be very difficult.

Chronic Health Problems

Although not identified as a specific susceptible population any individuals with chronic health problems may be impacted by high levels of air pollution and even healthy individuals need to be aware that they too can be affected and should adjust their activity accordingly.

MOBILE SOURCE DISCUSSION

Most of Maine is rural and traffic is relatively light. Only a few locations in the state have annual average daily traffic counts that exceed 50,000 vehicles. The Maine Turnpike and a few of the more heavily traveled roads in the Portland area have the most traffic. The volume of traffic has changed very little over the last ten years. The majority of roads including those in most of the larger cities in Maine have increases of less than 2 percent. One factor that could lead to increased air pollution impacts is the amount of congestion or traffic slow-down on a road where the volume is beginning to exceed the capacity of the road. Data from the Maine DOT does not appear to indicate any significant congestion in Cumberland County where traffic volume would be most likely to cause an impact.

EMISSIONS INVENTORY SUMMARY

Since 1993, the Department has required facilities ("point sources") with emissions above certain thresholds to report, annually, their emissions of criteria air pollutants and to report triennially their emissions of hazardous air pollutants (HAPs). Figure 4 plots tons of criteria air pollutants released by point sources over several years. From this chart, it is evident that total emissions are decreasing for most criteria pollutants over time. The largest point sources of emissions in Maine are the paper products industry and electric power producers, although several of these large contributors have reduced or ceased operations in the last several years.

[1] DQ Rich, et al, 2009, "Ambient air pollutant concentrations during pregnancy and the risk of fetal growth restriction," Journal of Epidemiology and Community Health, Vol. 63, pp. 488-496

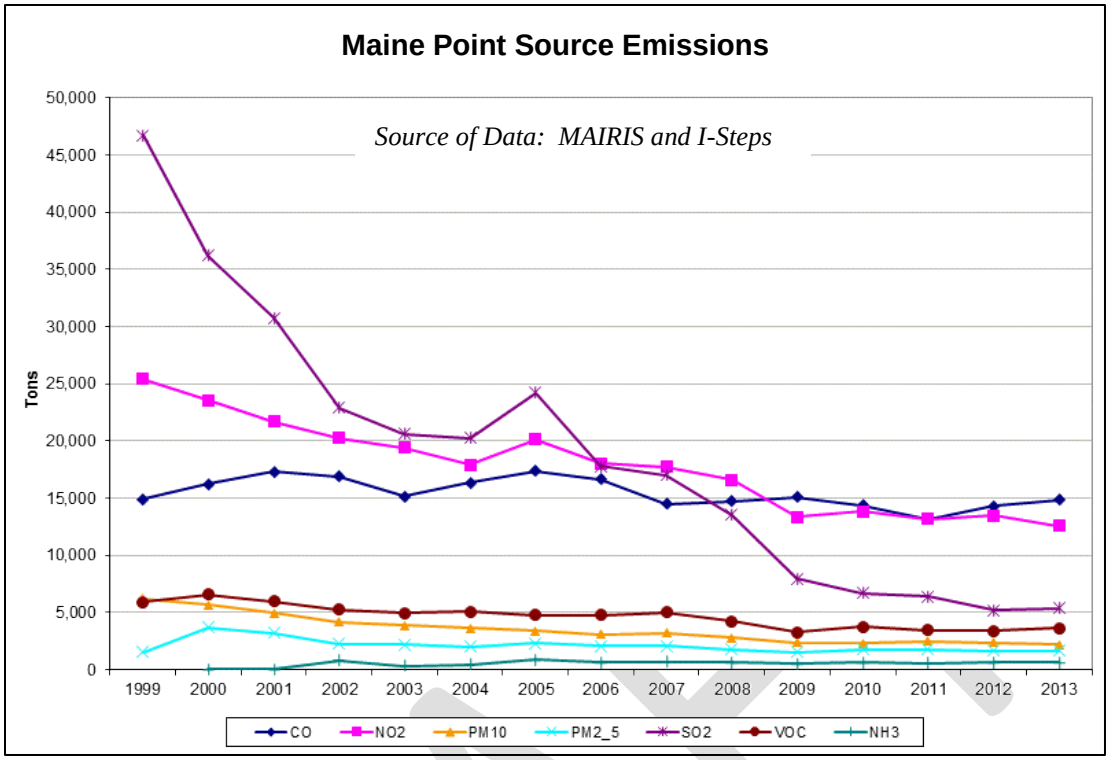

Figure 4 Maine Point Source Emissions

The list of more than 700 reportable HAPs has changed over the years, as well as facilities' methods for estimating their emissions, making it very difficult to assess long-term trends. Figure 5 illustrates reported emissions by point sources for selected HAPs found on the Maine Air Toxics Initiative's Air Toxics Priority List. Most of the reported emissions have decreased noticeably between the years 2005 and 2011.

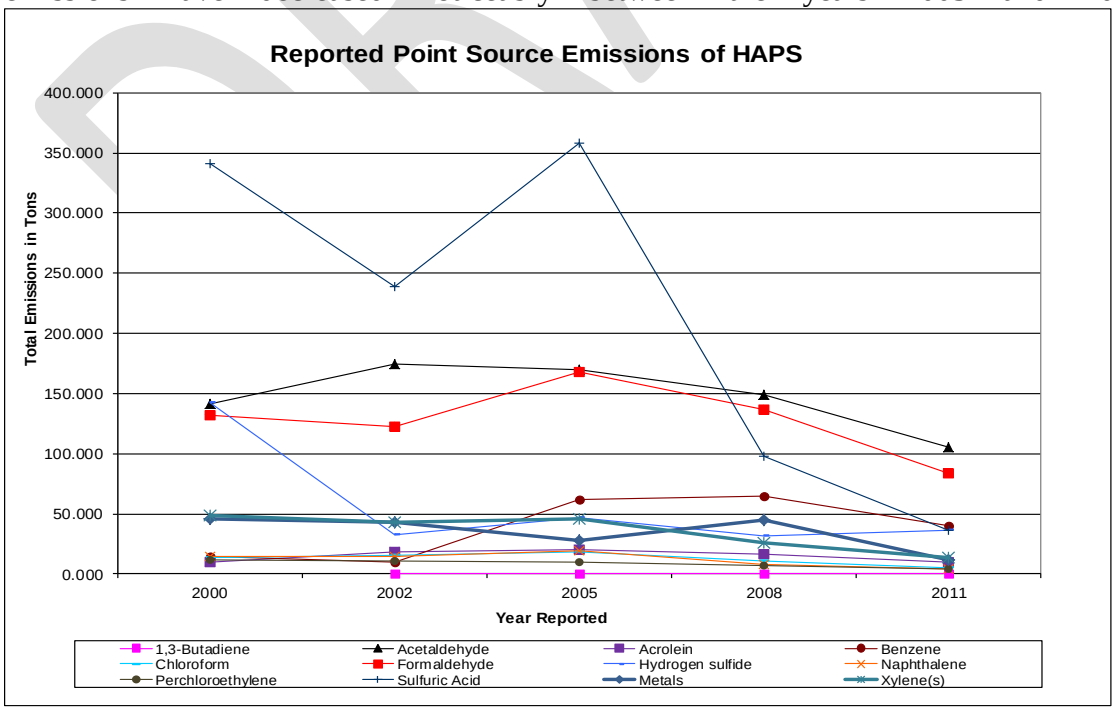

Figure 5 Reported Point Source Emissions of HAPs

In 2003, the Department began requiring facilities to also report emissions of six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. For 2008, facilities reported over 17 million metric tons of carbon dioxide equivalent emissions, which includes over 7 million metric tons from biomass. In 2011, Maine facilities reported 14.5 million metric tons of carbon dioxide equivalent emissions, with just of 6 million metric tons of the total from the combustion of biomass fuels[2].

The Department also complies with the Consolidated Emissions Reporting Rule and Air Emissions Reporting Requirements under 40 CFR Part 51 by submitting a comprehensive inventory for point, nonpoint, and mobile sources to EPA for inclusion in the National Emissions Inventory (NEI) every three years. Maine's comprehensive inventory includes criteria and hazardous air pollutants, and some greenhouse gas (GHG) estimates. Maine plans to incorporate estimates of GHGs for all source categories in future NEI cycles.

Evaluating trends between NEI datasets is also difficult due to changes in estimation methods, compound grouping, and reported source classifications. Maine's comprehensive triennial inventories as augmented by EPA for the years 2002, 2005, 2008 and 2011 are available at EPA's Emission Inventories website at: http://www.epa.gov/ttn/chief/eiinformation.html. The Department is currently reviewing estimates of 2014 emissions to be submitted for the NEI.

Figures 6 and 7 illustrate the relative contributions of the major source categories to overall emissions of a few selected pollutants.

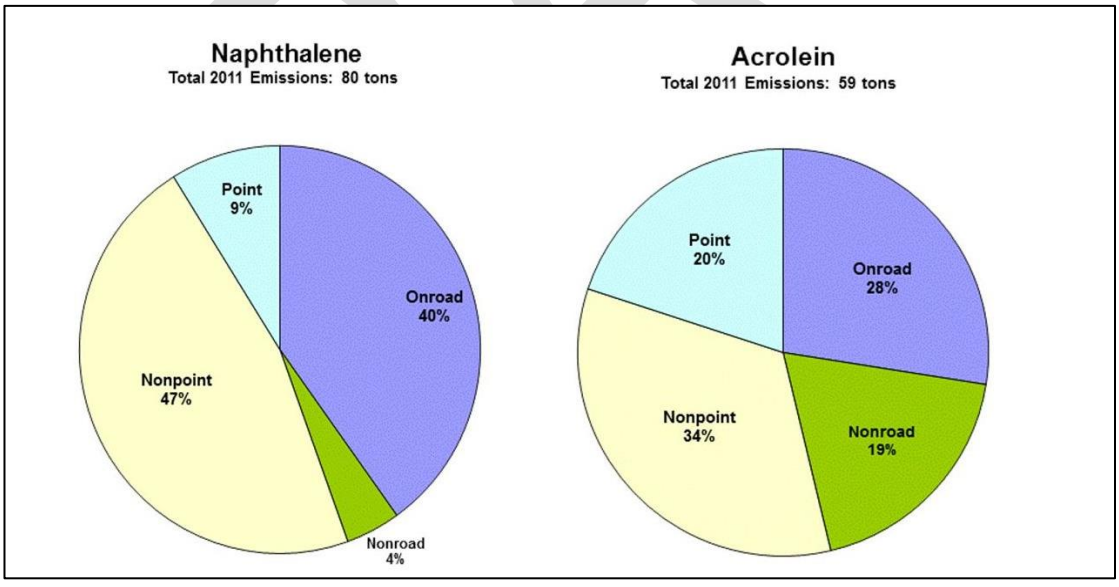

Figure 6 Origin of Source Emissions for Two HAPs in Maine (Napthalene and Acrolein)

[2]http://www.maine.gov/dep/ftp/AIR/DATA/GHG_SUMMARIES/

It is evident from Figures 6 and 7 that nonpoint sources and those sources that are not required to report their emissions contribute to the majority of both criteria and non-criteria (HAP) emissions. Non-reporting sources include gas stations, residential wood stoves, and dry cleaners. Not all emissions can be controlled. A subset of the total VOCs without the biogenic components – those substances, like pollen, that are naturally produced by living plants or animals - is depicted in figure 8 for comparison with the VOC chart in Figure 7.

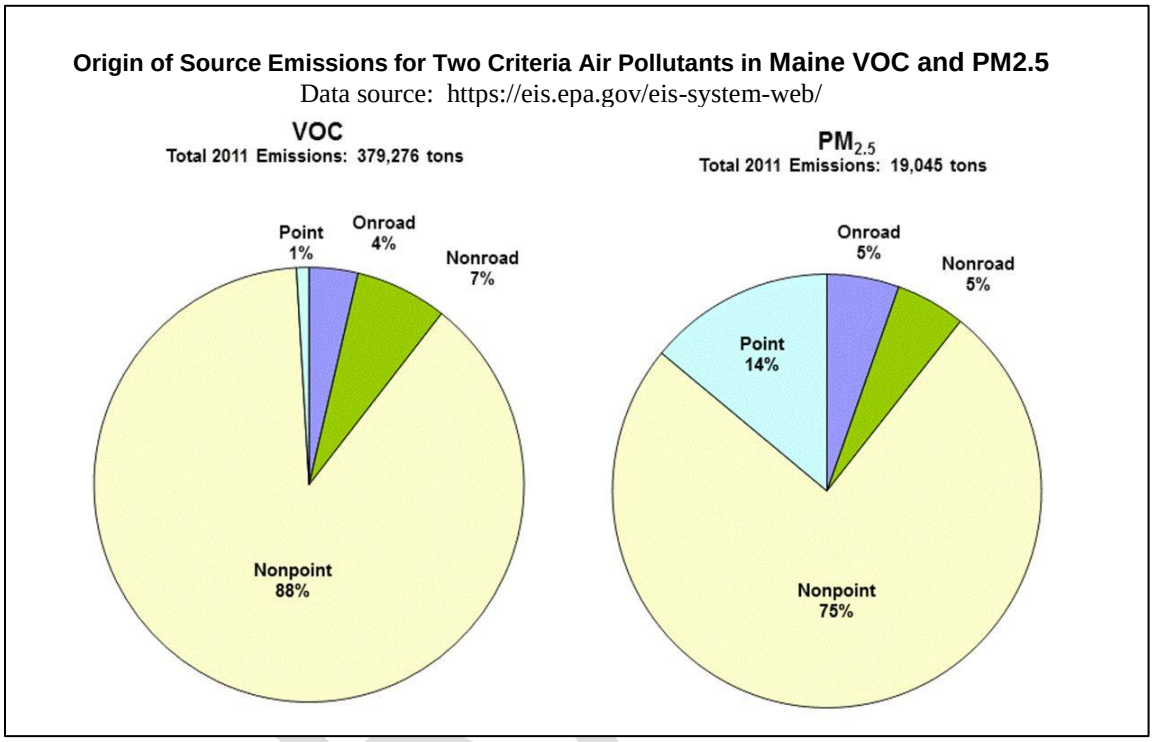

Figure 7 Origin of Source Emissions for Two Criteria Air Pollutants in Maine (VOC and PM2.5)

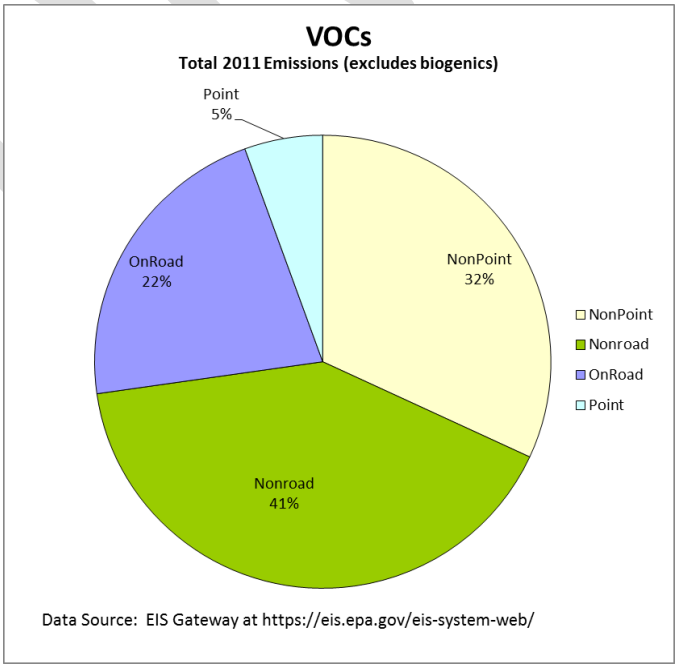

Figure 8 Total 2011 Emissions (Excluding Biogenics)

Maine also maintains a separate inventory of mercury emission sources. Figure 9 illustrates Maine's estimated mercury emissions from 1990 through 2011 by source. The major sources of emissions of mercury have shifted from the manufacturing and waste handling sectors in the 1990s to mobile sources in recent years. The Department estimates mercury emissions in Maine have declined more than 80% since 1990.

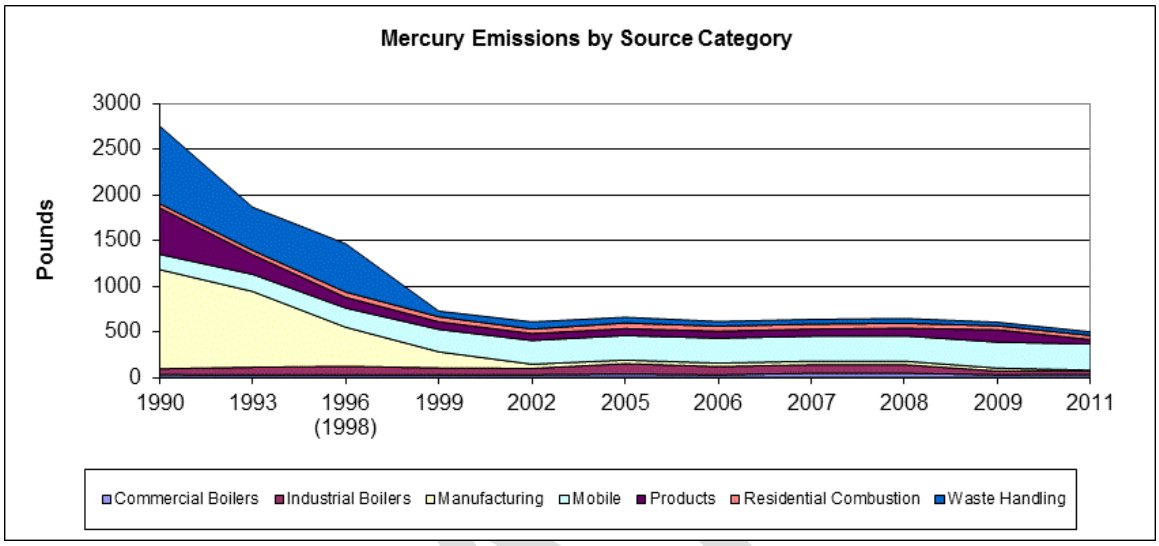

Figure 9 Mercury Emissions by Source Category

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

The Clean Air Act, (http://epa.gov/air/caa/) which was last amended in 1990, and 40 CFR part 50 requires EPA to set National Ambient Air Quality Standards http://www.epa.gov/ttn/naaqs/ for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants, which are called "criteria" pollutants. They are listed in Table 2. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$). Maine Ambient Air Quality Standards are identical to the NAAQS as enacted in 38 M.R.S.A.§584-A.

National Ambient Air Quality Standards					
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution [78 FR 3086, Jan 15, 2013]	$PM_{2.5}$	primary	Annual	12 µg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. In 2015, EPA revoked the 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and in 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under those standards ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Table 2 National Ambient Air Quality Standards

POLLUTANT BASED REVIEW/ANALYSES

Ozone

Ozone (O_3) is a gas composed of three oxygen atoms. Ozone has the same chemical structure whether it occurs miles above the earth or at ground level and can be "good" or "bad," depending on its location in the atmosphere. "Good" ozone forms naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and creates a layer that protects life on earth from the sun's harmful rays. Ozone is not usually emitted directly into the air. At ground level, ozone is formed by a chemical reaction between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight.

In the earth's lower atmosphere, ground-level ozone is considered "bad." Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit NO_x and VOC that help form ozone. Ground-level ozone is the primary constituent of smog. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Ground-level ozone also can reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. Ground-level ozone also damages vegetation and ecosystems. In the United States alone, ozone is responsible for an estimated $500 million in reduced crop production each year. Under the Clean Air Act, EPA has set protective health-based standards for ozone in the air we breathe. EPA and others have instituted a variety of multi-faceted programs to meet these health-based standards.

Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. As a result, it is known as a summertime air pollutant. Many urban areas tend to have high levels of "bad" ozone, but even rural areas are also subject to increased ozone levels because wind carries ozone, and the pollutants that form it, hundreds of miles away from their original sources. Figure 10 illustrates a type of analysis that can be done utilizing back trajectories. The air masses that contain high levels of ozone pollution can be tracked backwards based on wind direction and speed to determine where that air mass may have been and consequently identify possible sources of emissions that generated the high ozone levels. The back trajectories in Figure 10 indicate the possible locations that have contributed to all 2011-2013 exceedances of the 75 ppb 8-hour Ozone NAAQS in Maine. Using the back trajectories for analyzing ozone data as well as other pollutants can identify possible sources that may need further control.

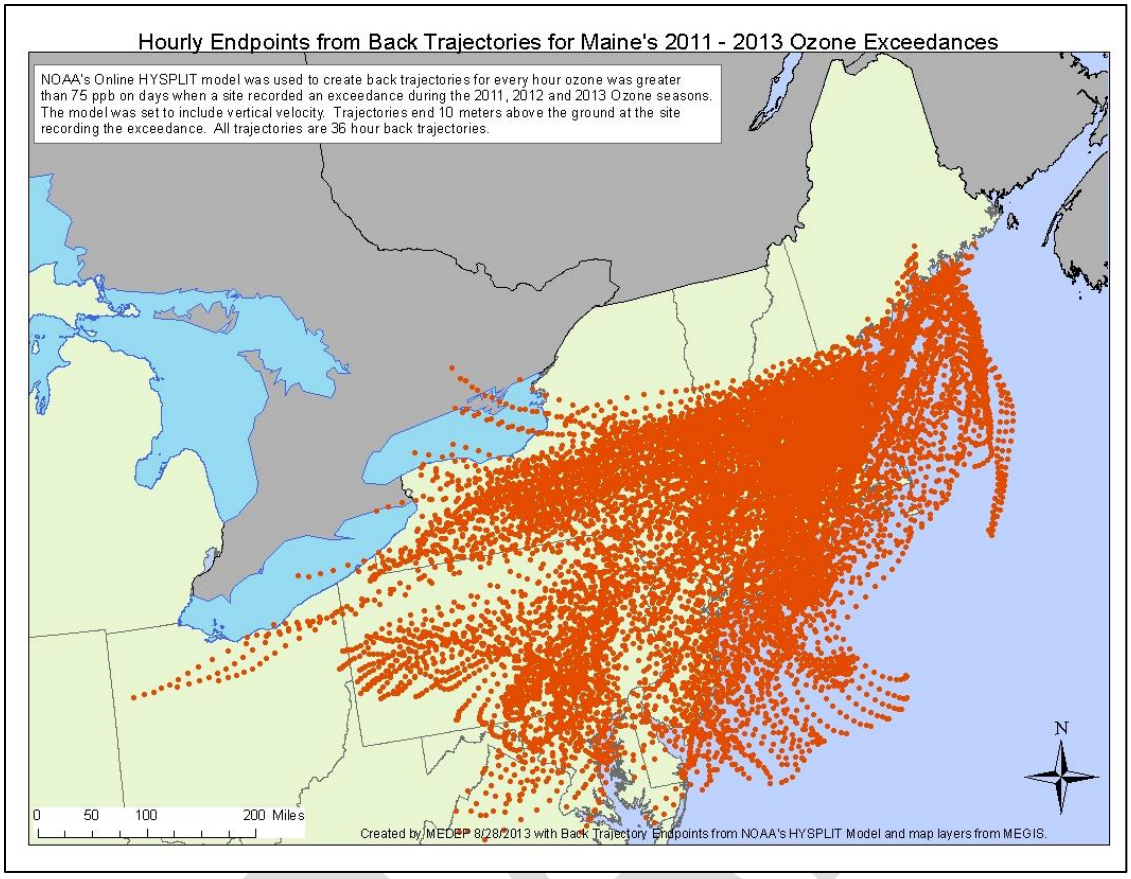

Figure 10 Hourly Endpoints from Back Trajectories for 2013 – 2014 Ozone Exceedences in Maine

Throughout the country, additional programs are being put into place to cut NO_x and VOC emissions from vehicles, industrial facilities, and electric utilities. Programs are also aimed at reducing pollution by reformulating fuels and consumer/commercial products, such as paints and chemical solvents that contain VOC. Voluntary and innovative programs also encourage communities to adopt practices, such as carpooling, to reduce harmful emissions. The Clean Air Act requires EPA to set air quality standards to protect both public health and the public welfare (e.g. crops and vegetation). Ground-level ozone affects both.

Health Effects

People with lung disease, children, older adults, and people who are active can be affected when ozone levels are in the moderate and higher Air Quality Index (AQI) ranges. Numerous scientific studies have linked ground-level ozone exposure to a variety of problems, including:

- airway irritation, coughing, and pain when taking a deep breath;
- wheezing and breathing difficulties during exercise or outdoor activities;
- inflammation, which is much like a sunburn on the skin;
- aggravation of asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis; and,
- permanent lung damage with repeated exposures.

Environmental Effects

Ground-level ozone can have detrimental effects on plants and ecosystems. These effects include:

- interfering with the ability of sensitive plants to produce and store food, making them more susceptible to certain diseases, insects, other pollutants, competition and harsh weather;
- damaging the leaves of trees and other plants, negatively impacting the appearance of urban vegetation, as well as vegetation in national parks and recreation areas; and
- reducing forest growth and crop yields, potentially impacting species diversity in ecosystems.

Ozone and PAMS Monitoring Networks

Ozone Network

The Maine DEP first conducted a program of monitoring for ambient levels of ozone in 1975. Since that time, the program has been greatly expanded to identify and delineate non-attainment areas and to provide the public with near real time hourly data that is also useful for the tracking and forecasting of ozone levels throughout the state. Sites have been added, moved and deleted throughout this process. Maine is currently operating a network of 14 sites with an additional three sites operated by Maine tribes and two sites being operated by EPA. The locations of the sites in Maine are shown in Figure 11. The current NAAQS for ozone is the three year average of the fourth high maximum daily eight hour average not to exceed 0.075 parts per million (ppm). Plots indicating current and historical NAAQS status at several sites in Maine are shown in Figure 12. All monitoring sites in Maine are currently attaining the ozone NAAQS and have continued to be attaining for every three year period starting with 2003-05. On December 17, 2014 the EPA submitted plans for a proposed new standard for ozone that would be in the range of 0.060 to 0.070 ppm. Under this plan EPA will, by October 2015, either retain the current 0.075 ppm standard or revise the standard. Initial designations for a revised standard will use 2014-2016 data.

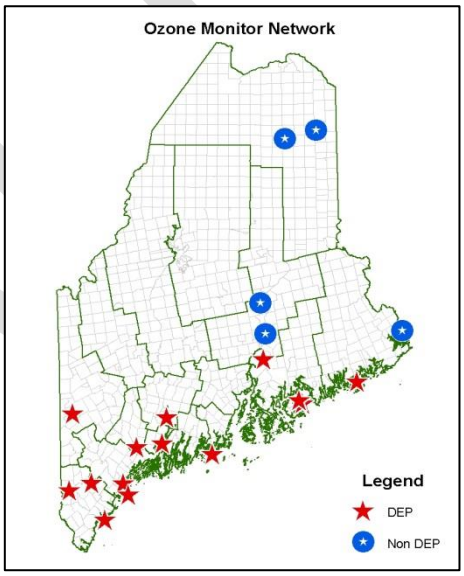

Figure 11 Maine Ozone Network

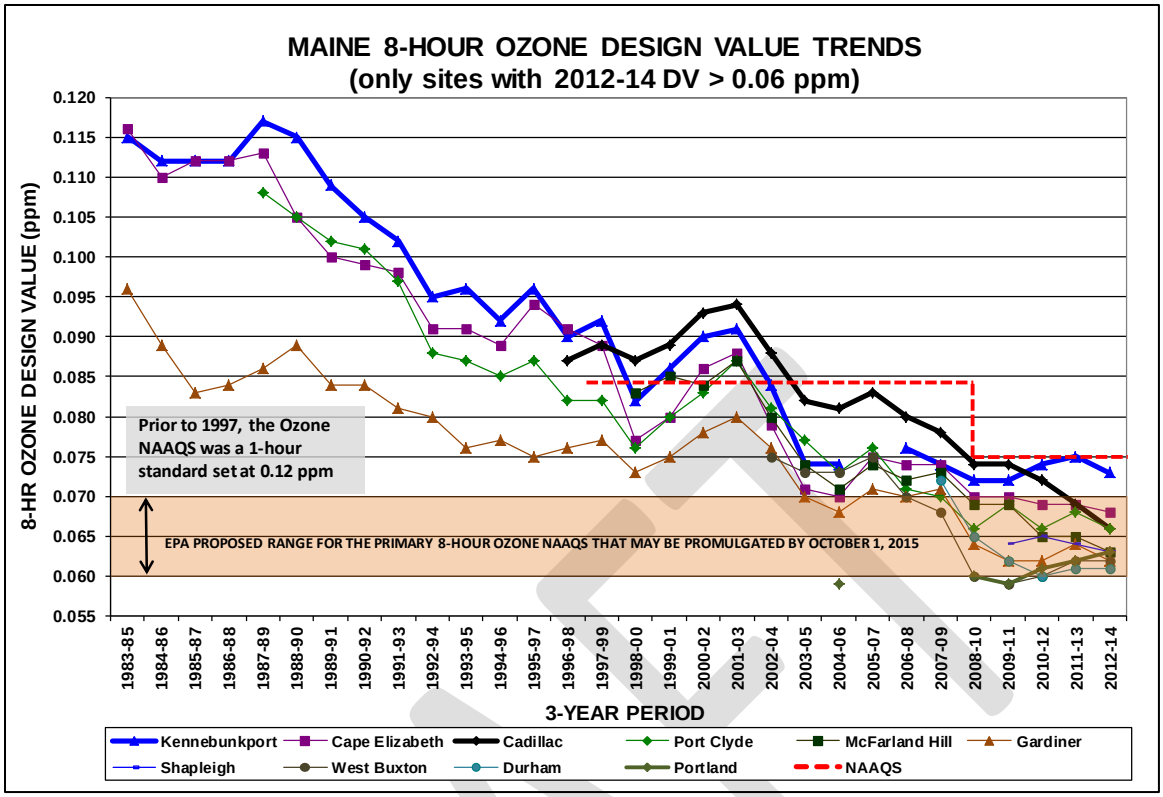

Figure 12 Maine 8 – Hour Ozone Design Value Trends

The current Maine DEP ozone monitoring network is essentially a three tiered network as depicted in Figure 13. This monitoring network covers the most populated regions of the state and areas that are expected to experience the highest levels of ozone in the state. The network also covers many rural and environmental justice areas.

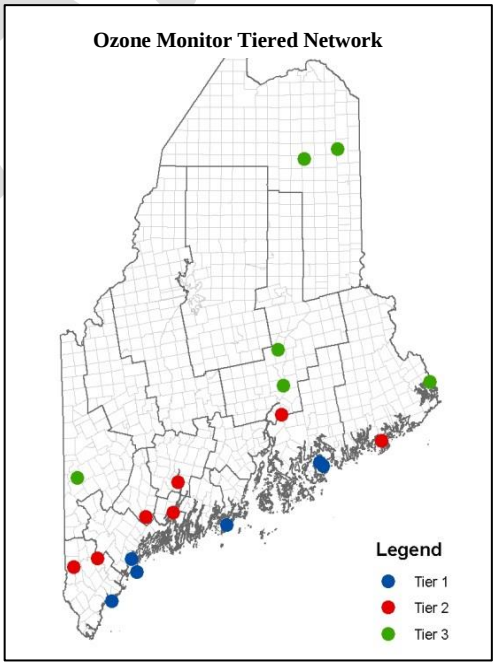

Figure 13 Ozone Monitor Tiered Network

The first tier is located along the southwest and mid-coastline where historically the worst ozone events and nonattainment have and currently occur. Monitors are located at Kennebunkport, Cape Elizabeth, Portland, Port Clyde, McFarland Hill, and the summit of Cadillac Mountain in Acadia National Park. Since a number of coastal monitoring sites in Maine are recording concentrations just below the current standard it is important to continue operating those monitors to show continued compliance (requirement in existing maintenance plans for the 1997 ozone standard) and/or a return to non-attainment in the future based on a lower standard. This tier contains the more populated areas in the Portland-South Portland-Biddeford MSA and also includes the

Rockland Micropolitan Statistical Area. It is important to note that the southern coastal area of Maine is one of the most densely populated areas of the state and has shown the greatest growth over the last 20 years.

The second tier of ozone monitors is located just inland, extending from southwest and central Maine to downeast of Acadia National Park. Monitors in Tier 2 are located at Shapleigh, West Buxton, Durham, Bowdoinham, Gardiner, Holden and Jonesport. The importance of this tier is the role it has and will continue to have in determining the attainment/nonattainment boundary and in forecasting how far inland moderate and higher AQI concentrations will occur with a more stringent ozone standard. Shapleigh, Bowdoinham and Jonesport monitors were specifically added to the Tier 2 network because of the more stringent 2008 standard. This tier also contains the most densely populated areas away from the coastline; including the Bangor and Lewiston-Auburn MSA's, part of the Portland-South Portland-Biddeford MSA, and the Augusta-Waterville Micropolitan Statistical Area.

The third tier of ozone monitors is located in the rural western and northern areas of the State. Maine DEP currently operates a monitor at North Lovell, the EPA operates sites at Howland and Ashland, and the Micmac, Penobscot Nation and Passamaquoddy Tribes also operate sites in this tier. Tier 3 is important for ozone mapping and forecasting purposes, especially during the spring months, and may be needed to determine the extent of nonattainment when a lower standard is promulgated.

Figure 14 verifies that Tier 1 contains sites with the highest ozone levels in the state with each site having unique statistics. Note how much lower the Portland monitoring site is compared with other Tier I sites. The Portland monitor is a special purpose monitor installed for the Bureau of Health and is considered a non-regulatory monitor.

That same figure also verifies that Tier 2 and 3 contain sites with lower ozone levels and the only two sites that match closely are the Bowdoinham and Durham sites. Since the Bowdoinham site was originally designed to be a replacement for the Tier 1 sites in Phippsburg and Georgetown, Maine DEP will discontinue the Bowdoinham site after a new site is installed somewhere nearer to the Phippsburg/Georgetown area.

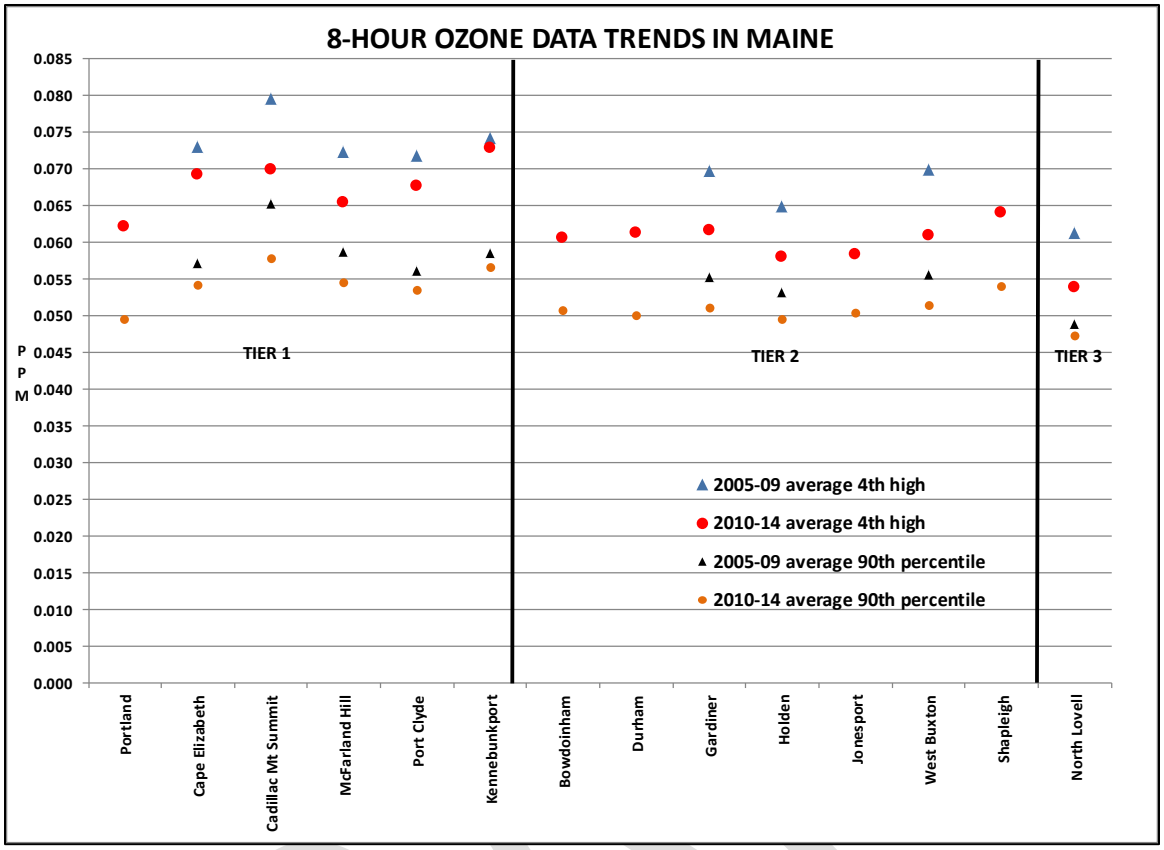

Figure 14 Maine 8 – Hr. Ozone Data Trends

PAMS Monitoring Network

The Photochemical Assessment Monitoring Stations (PAMS) network was originally established in 1993. The monitoring regulations for PAMS provide for the collection of an "enhanced" ambient air quality database which can be used to better characterize the nature and extent of the ozone problem, aid in tracking Volatile Organic Compounds (VOC) and Nitrogen Oxides(NO_x) emission inventory reductions, assess air quality trends, make attainment/non-attainment decisions, and evaluate photochemical grid-model performance. The MEDEP operated two PAMS in Maine but discontinued the Cadillac site at the end of the 2014 Ozone season due to lack of resources. These sites were required to be operational for the June – August period but also generally operate for May and September. The PAMS Network was designed to measure the precursors responsible for the development of ozone and were initially required for Serious, Severe or Extreme Non-attainment areas. Both of the sites in Maine were required as a result of Serious Non-attainment areas in other states. The site in Cape Elizabeth is considered an extreme downwind site for the Greater Connecticut non-attainment area and the Cadillac Mountain site in Acadia National Park was considered an extreme downwind site for the Boston non-attainment area that is currently attaining the 2008 Ozone NAAQS. As additional controls have been implemented and air quality has improved the many of the non-attainment areas have been reduced or eliminated. However, with a tightening of the

standard the status of some of these areas may change and continued monitoring of the ozone precursors remains important.

Future Ozone and PAMS Networks

As justified in the previous section, all monitors in the current ozone network are important for the current and more stringent future ozone standards. There are two areas of the state that may need additional monitoring as indicated in Figure 15. The area around Phippsburg along the coast had recorded some of the higher hourly concentrations in the state but the monitor was removed after the 1999 season at the request of the property owner. A site was established in Reid State Park for a few years but the site did not have good exposure as it was situated in a wooded area that may have resulted in lower ozone concentrations. That monitor was then relocated to a site further inland (Bowdoinham) to see if the higher concentrations were forming or being transported further inland. Whether the standard is lowered or not it may be important to find a site in the Phippsburg area to adequately document the levels of ozone impacting that area of the coast. However, obtaining permission to install monitoring sites on coastal property in Maine is very difficult. There may also be a need to establish a site in the mountains of western Maine. The highest background ozone concentrations during the year occur in the spring months before leaf-out. Maine has recently experienced some high spring ozone concentrations at inland sites as a result of the high background, long range transport, weather patterns and the lack of vegetation to absorb ozone. A high elevation site in the Bethel/Rangely area or possibly the Carrabassett/Greenville area is expected to help document transport and forecast spring ozone events. Whether or not there is a non-attainment area in Maine, there will be a need for data to provide accurate forecasting capability for ozone concentrations because much of the scientific literature suggests that the effects of ozone are felt by healthy individuals even at concentrations below the NAAQS.

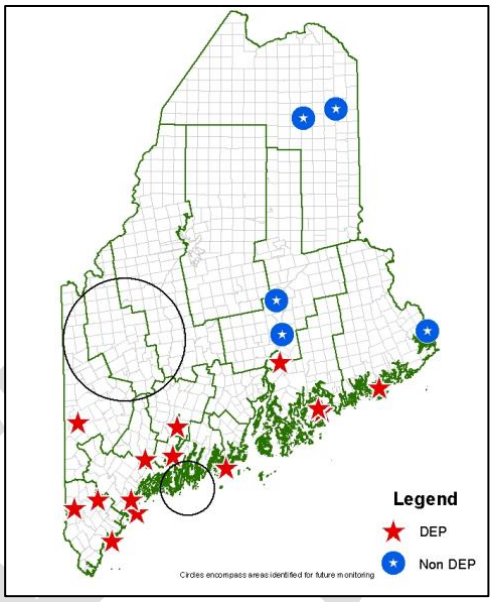

Figure 15 Future Ozone Network

National and regional discussions are currently in progress to determine the PAMS monitoring network for the future more stringent ozone standards. The current PAMS network in Maine is very useful in tracking historical VOC and NO_x control programs through trends analyses, and in documenting transport patterns. Future uses of the data and data analyses from this network other than trends analyses include State Implementation Plan requirements for a Section 126 of the Clean Air Act Petition, tracking implementation of reformulated gasoline (RFG), Attainment Demonstration Ozone Conceptual Model and inputs for the Attainment Demonstration Modeling analyses.

Particle Pollution

Particle Pollution (particulate matter or PM) consists of coarse particles ($PM_{2.5-10}$) with a diameter between 2.5 and 10 micrometers and fine particles ($PM_{2.5}$) that have a diameter 2.5 micrometers or smaller. The current PM_{10} standard includes both coarse and fine particles. Examples of coarse particle pollution include smoke, soot, dust and dirt. Examples of fine particle pollution include sulfates and nitrates that are formed in complicated chemical reactions when the oxides of sulphur and nitrogen are emitted into the atmosphere from power plants, industries and mobile sources.

Health Effects

Particle pollution, especially fine particles, can get deep into the lungs and into the blood stream causing serious health problems. Numerous scientific studies have linked particle pollution inhalation to a variety of ailments including:

- increased respiratory symptoms including irritation of the airways, coughing or difficulty breathing;
- decreased lung function;
- aggravated asthma;
- development of chronic bronchitis;
- irregular heartbeat;
- nonfatal heart attacks; and
- premature death for people with heart or lung disease.

Environmental Effects

Fine particle pollution (sulfates, organic matter, nitrates, elemental carbon and soil dust) is the primary cause of regional haze (visibility degradation)

Visibility reduction

Fine particles (sulfates, organic matter, nitrates, elemental carbon and soil dust) are the major cause of reduced visibility (haze) in scenic areas such as those located in national parks and wilderness areas.

Environmental damage

Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: making lakes and streams acidic; changing the nutrient balance in coastal waters and large river basins; depleting the nutrients in soil; damaging sensitive forests and farm crops; and affecting the diversity of ecosystems.

Aesthetic damage

Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments.

PM_{10}, $PM_{2.5}$ PM Course and Visibility/Speciation Monitoring Networks

$PM_{2.5}$ Network

The current $PM_{2.5}$ 24-hour filter Federal Reference Method (FRM) monitors in the state of Maine used to track compliance with NAAQS are primarily located in the most densely populated and source regions. An additional $PM_{2.5}$ monitor is located in Acadia National Park at the McFarland Hill site to help meet the NCore requirements. Continuous hourly $PM_{2.5,}$ Beta Attenuation Monitors (BAMs) monitors, used to help inform the public and also to be used to track compliance with NAAQS, are also located in the three largest cities in Maine. Additional BAMs locations are located at sites in Maine where DEP staff believe wintertime wood smoke issues may exist.

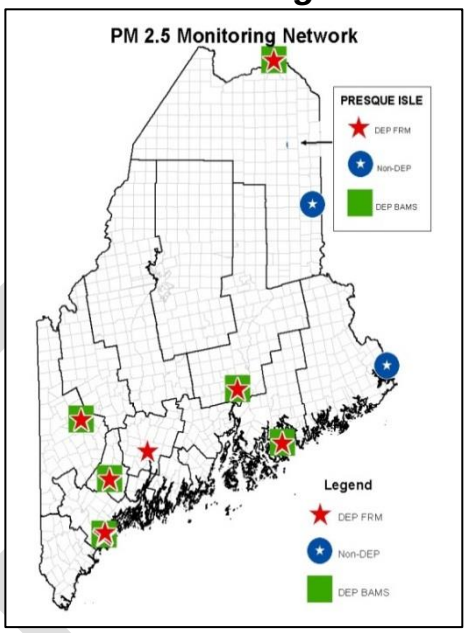

Figure 16 PM2.5 Monitors

The types of monitors and their locations are shown in Figure 16. The Maine DEP sites are listed below by monitoring strategy category:

- HIGHEST POPULATION AREAS
  Portland (FRM and BAM)
  Lewiston (FRM and BAM)
  Bangor (FRM and BAM)

- HEATING SEASON SITES OF INTEREST
  Rumford (FRM and BAM)
  Madawaska (FRM and BAM)

- NCore SITE
  McFarland Hill (FRM and BAM)

- OTHER POPULATION CENTERS OF INTEREST
  Augusta (FRM)
  Presque Isle (FRM and BAM)

Figures 17 and 18 demonstrate that all monitors are showing attainment of the 2006 24-hour $PM_{2.5}$ NAAQS and the 2012 Annual $PM_{2.5}$ NAAQS. Figure 19 shows that wintertime $PM_{2.5}$ is an important issue in Maine. Maine DEP recently installed BAMs monitors in Rumford, Madawaska and Presque Isle. Rumford and Madawaska were identified as areas where wood smoke may be an issue because they are located in valleys

where inversions can form during certain weather conditions and trap pollutants at ground level.

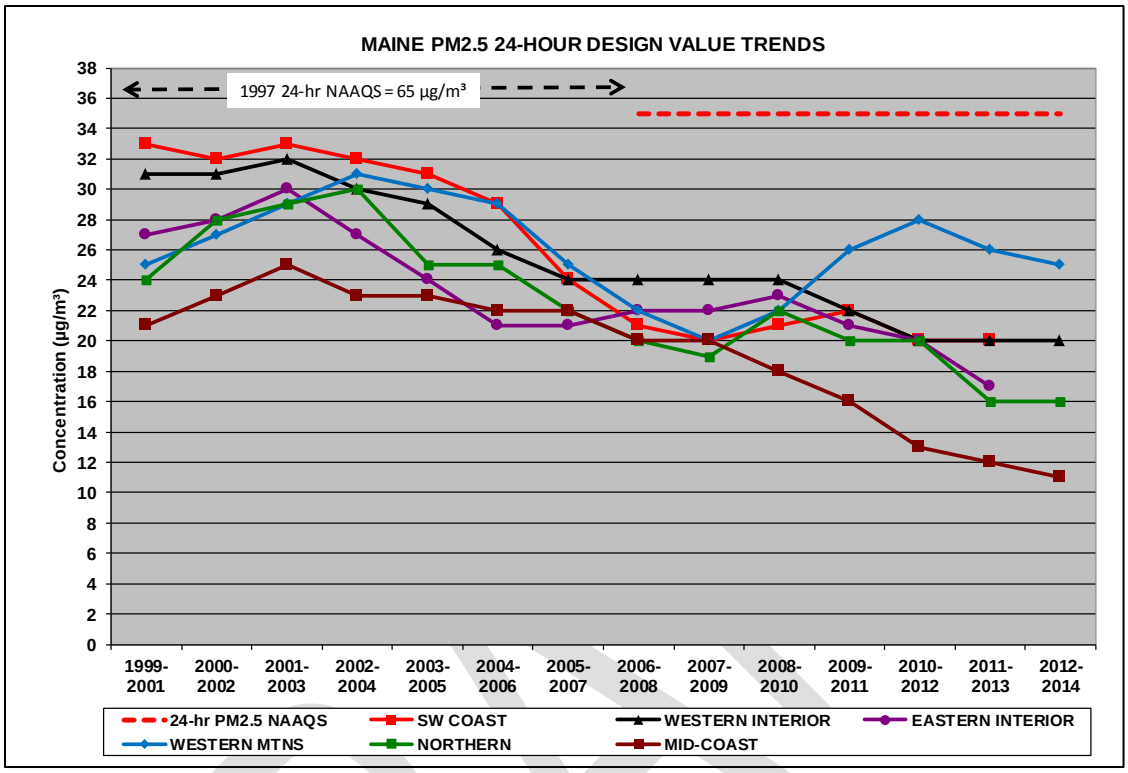

Figure 17 Maine PM2.5 24 – Hr. Design Value Trends

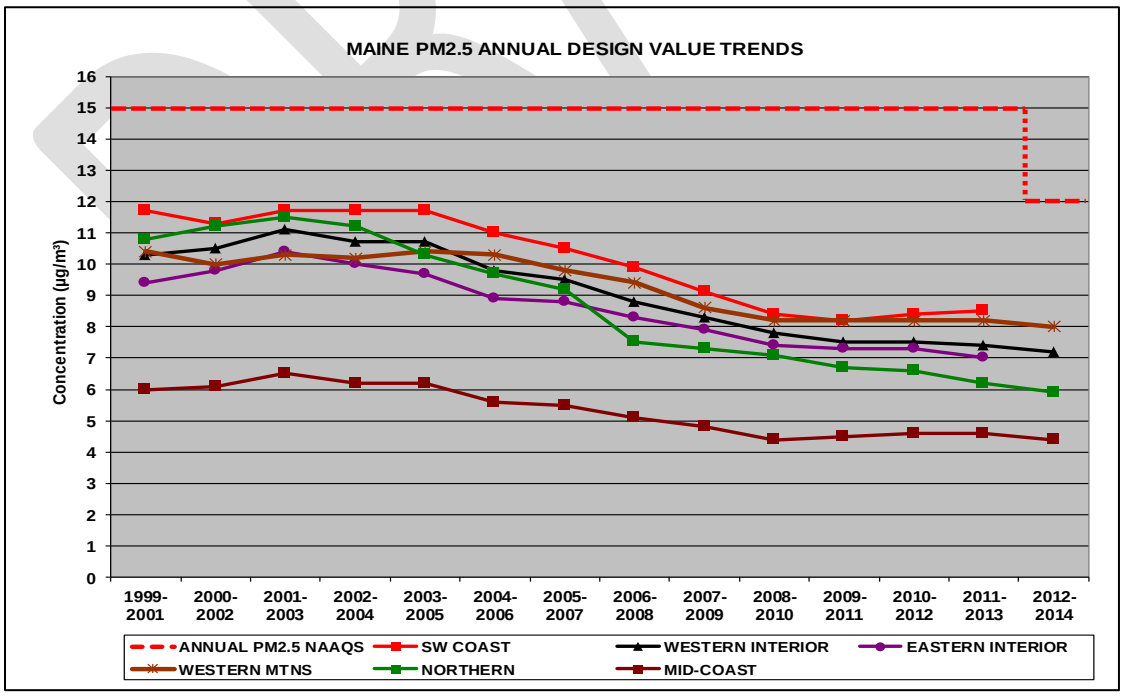

Figure 18 Maine PM2.5 Annual Design Value Trends

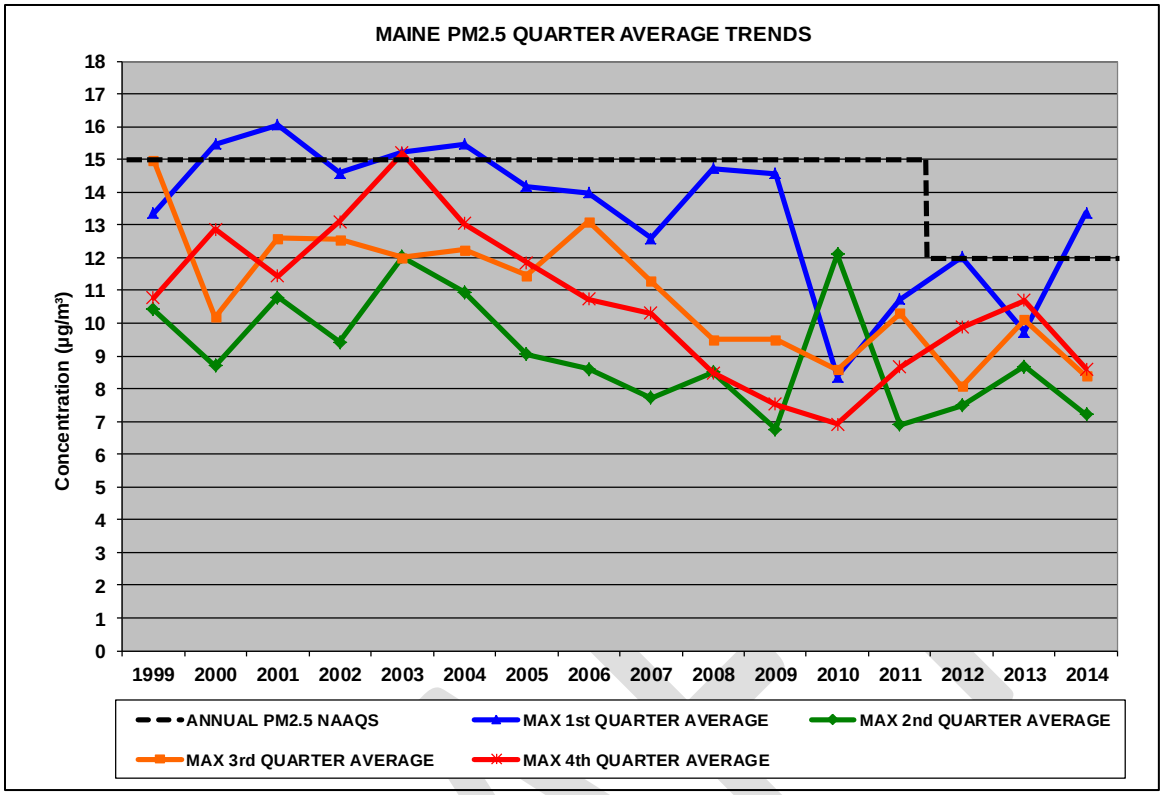

Figure 19 Maine PM2.5 Quarter Average Trends

At this time, and until the $PM_{2.5}$ NAAQS is revised, the only anticipated change in the network would be to add a special smoke study site in a river or mountain valley location that has a significant number of wood burning sources. Such a site would provide data for more accurate forecasting in complex mountain valley areas.

PM_{10} Network

The current PM_{10} 24-hour filter and continuous PM_{10} TEOM FEM monitors in the State of Maine used to track compliance with NAAQS are located in the more populated areas, at a source of interest and in a region that has historically experienced exceedances of the standard. The types of PM_{10} monitors and their locations are shown in Figure 20.

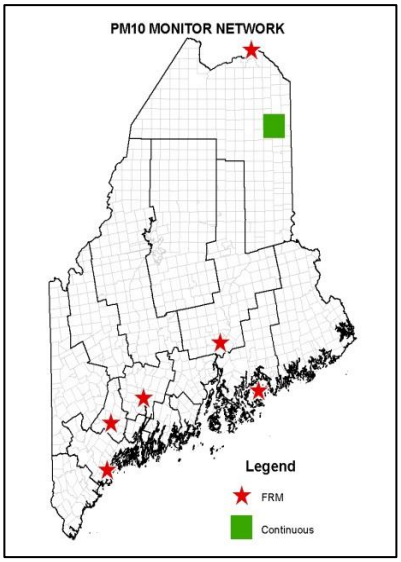

Figure 20 PM10 Monitors

The graph in Figure 21 shows that all sites are showing attainment of the current PM_{10} NAAQS. The last exceedance of the 24-hour standard occurred in Madawaska in 2006. More frequent monitoring was initiated in Madawaska in order to document the attainment status of the area. During that period of daily sampling there were no additional exceedances recorded.

The following is a list of Maine DEP PM_{10} sites in a relative order of importance.

- HIGHEST POPULATION AREAS
  - Portland (FRM)
  - Lewiston (FRM)
  - Bangor (FRM)

- REGIONS WITH HISTORICAL EXCEEDANCES
  - Presque Isle (FRM and TEOM) (maintenance plan)
  - Madawaska (FRM)

- OTHER POPULATION CENTER OF INTEREST
  - Augusta (FRM)
  - Van Buren (FRM)

- SOURCE OF INTEREST
  - Bradley (FRM)

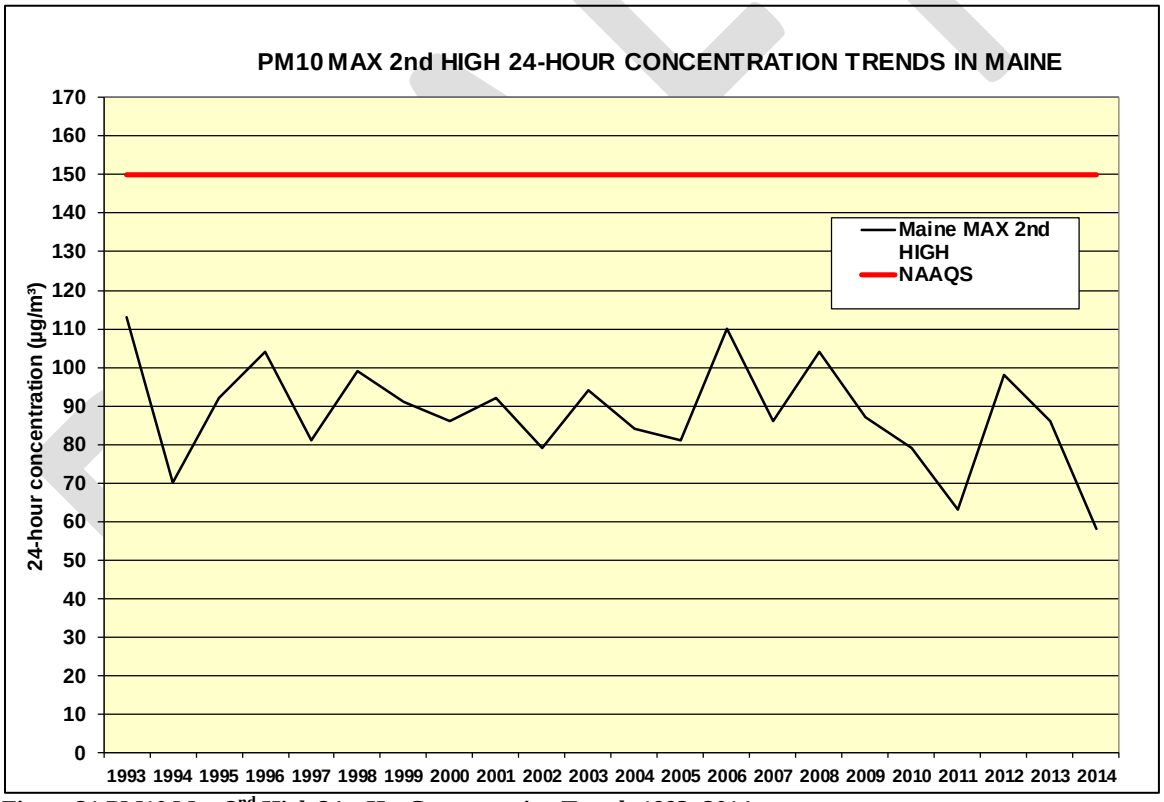

Figure 21 PM10 Max 2nd High 24 – Hr. Concentration Trends 1993- 2014

The PM_{10} network is currently adequate monitoring the highest population centers and maintenance areas of the state.

Visibility/Speciation Monitoring Network

Maine operates a particle speciation network by participating in the Interagency Monitoring of Protected Visual Environments or IMPROVE program. Monitors are currently located in Bridgton and Freeport. Sites are also operated by the National Park Service in the Acadia National Park Class I Area, the Fish and Wildlife Service in the Moosehorn Wilderness Class I area and by the Penobscot and Micmac tribes. The map in Figure 22 indicates the location of the IMPROVE monitors in the state.

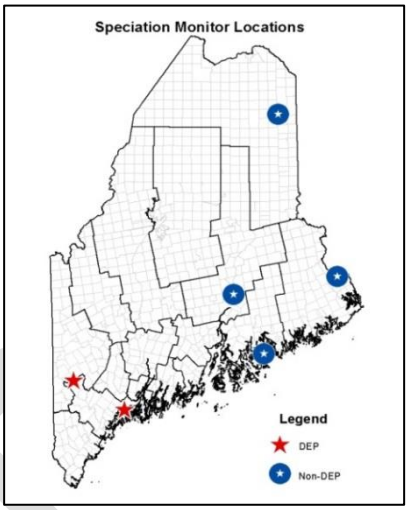

Figure 22 Speciation Monitors

Figure 23 shows how the IMPROVE data is used to track visibility using the deciview metric at the Acadia National Park site for the regional haze state implementation plan Deciview is a visibility metric based on the light extinction coefficient that expresses incremental changes in perceived visibility. All other sites in Maine show similar improvements.

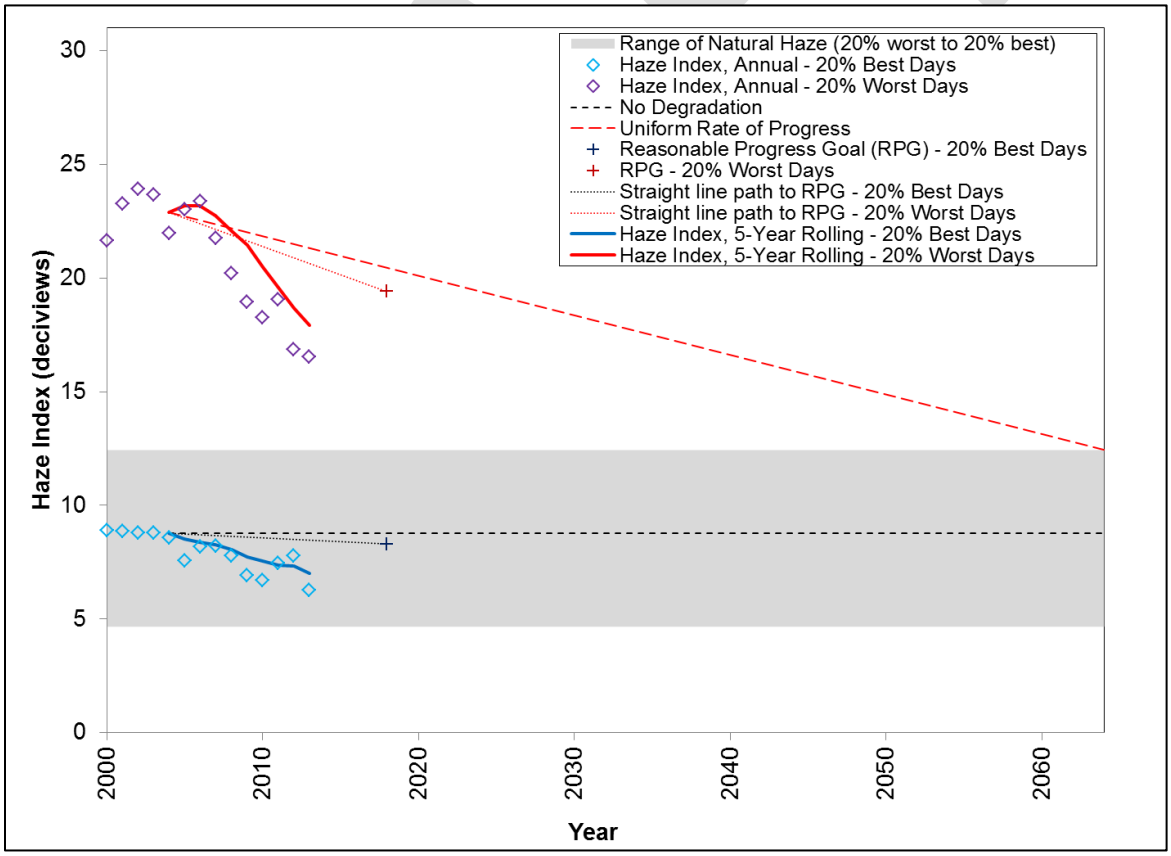

Figure 23 Acadia National Park Deciview Data

The visibility/speciation network adequately meets monitoring requirements at all three Class I areas in and near Maine. The Moosehorn Wilderness visibility/speciation monitoring is representative of conditions at the nearby Roosevelt-Campobello

International Park (RCIP) Class I area so no monitor is needed at RCIP. It is critical to continue monitoring at the three Class I areas to track visibility conditions as required in the Regional Haze Rule. Such monitoring is also a commitment made in Maine's annual State Implementation Plan (SIP). Bridgeton and Freeport sites were set up because EPA's PM2.5 network design criteria for Maine required the establishment of two speciation sites. The Department opted to use IMPROVE Protocol samplers to meet this requirement so that all PM speciation data in the state would be generated by using the same equipment and collected filters would be analyzed by the same lab. It is also important to note that these two sites are located in a Class II area – not in Class I.

Figure 24 plots the averages of sulfate, nitrate and organic compound measurements and the 90th percentiles since 2010 at all sites in Maine. Results clearly show that each site is measuring different local haze conditions. The Class I sites at Acadia National Park (ACAD) and Moosehorn (MOOS) measure relatively clean rural coastal conditions. The Penobscot Nation (PENO) and Freeport (CABA) sites are measuring more polluted urban conditions while the Micmac (PRIS) and Bridgeton (BRMA) sites are measuring inland rural conditions. Currently the Bridgeton and Freeport sites as well as the Penobscot Nation and Micmac tribal sites are being considered for defunding by EPA. EPA expects to finalize this decision in time to stop operations by January 1, 2016.

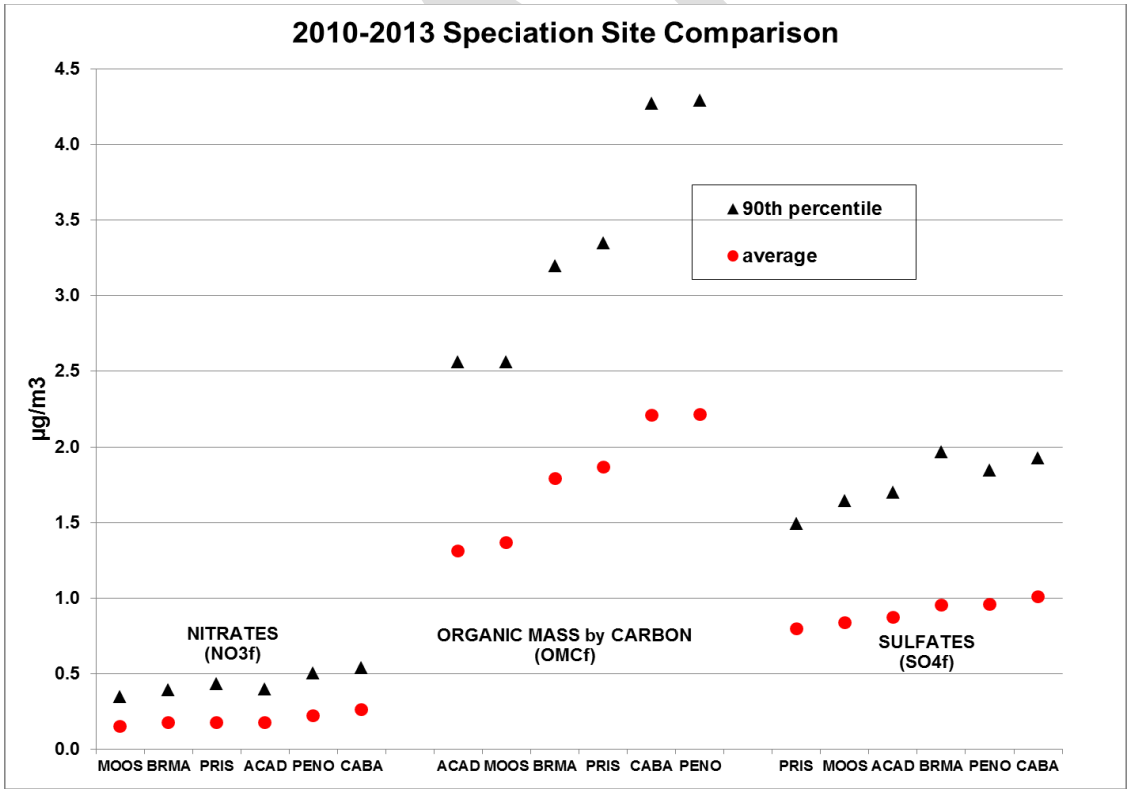

Figure 24 Speciation Site Comparisons

PM COARSE

PM Coarse is the fraction of particles that falls in the size range from 2.5 up to 10 microns in size. There is currently no standard for this size range. EPA has proposed a standard in the past but opted to do more research rather than promulgate a standard. The only monitoring requirement for PM Coarse is that it shall be monitored at all NCore sites as of January 1, 2011.

Maine is currently monitoring PM Coarse at two sites in Maine. PM Coarse at the NCore site in Acadia National Park is attained by the difference method. Two monitors at the site measure PM_{10} and $PM_{2.5}$ respectively and PM Coarse is calculated by subtracting the $PM_{2.5}$ from the PM_{10}. At the Kenduskeag Pump Station in Bangor a pair of collocated Dichotomous samplers each measure $PM_{2.5}$ and PM Coarse. PM_{10} is then calculated by summing the two fractions.

Should EPA propose a standard, the PM Coarse component of particulates could be calculated at several other sites in the state using the difference method. Lewiston, Augusta, Bangor and Madawaska sites have both PM_{10} and $PM_{2.5}$ monitors and can report PM Coarse data if necessary.

Lead

Results from national monitoring show no lead monitoring sites in Maine will be needed. In 2008, EPA promulgated a new lead (Pb) standard and issued some minimum monitoring requirements. At that time, Maine was to be required to operate one monitor in the Portland CBSA (Core-based statistical area). The state purchased an X-ray fluorescence (XRF) analyzer to measure lead concentrations from PM_{10} filters. The EPA lead requirement was subsequently revised to require lead monitoring at urban NCore sites only. The Bar Harbor NCore site is designated as a rural site, so there is no requirement for lead monitoring in Maine. Since Maine DEP already had the XRF capability to analyze particulate filters for Pb levels, in July 2013 we started analyzing batches of Rhode Island filters for Pb, starting with filters from June 2011. It is the intent at some point in the future, when resources permit, to conduct XRF analysis on a random selection of Maine PM_{10} filters to determine what the our actual background levels might be for lead and other metals.

Air Toxics

The report NATA results for 2005 http://www.epa.gov/ttn/atw/nata2005/was released March 11 2011 and lists the total cancer risk as 3.18 in 100,000. The following pie chart (Figure 25) indicates that nonpoint combustion sources and secondary formation are the primary cancer risk factors statewide. Mobile source (both on and non-road) emissions remain a secondary risk factor for citizens in more urban areas. Background levels (mostly carbon tetrachloride) are more of a factor in rural areas.

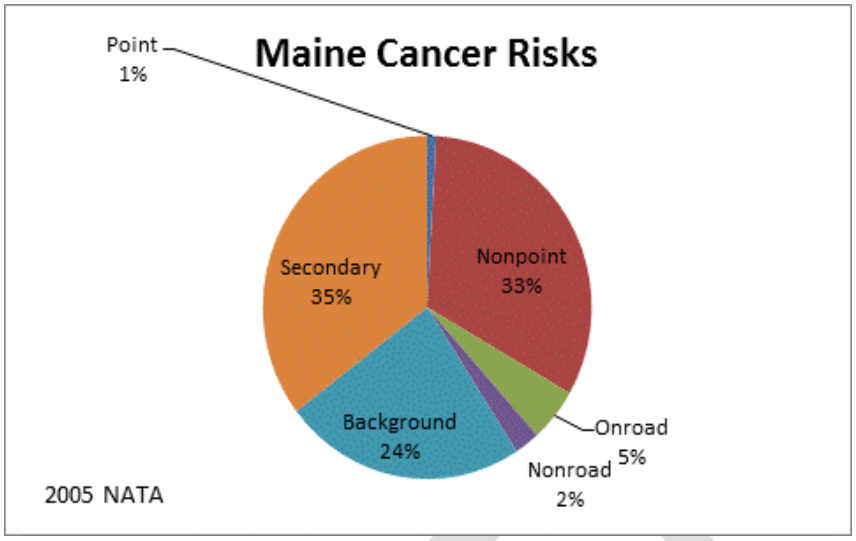

Figure 25 Maine Cancer Risks

Secondary formation, also known as atmospheric transformation is a process by which air pollutants are transformed in the air into other chemicals. When a pollutant is transformed, the original chemical no longer exists, but is replaced by one or more chemicals. Compared to the original pollutant, the newer reaction products may have more, less, or the same toxicity. Transformations and removal processes affect both the fate of a pollutant and its atmospheric persistence. The 2005 NATA estimated atmospheric transformation and subsequent ambient concentrations for three air toxics (acetaldehyde, formaldehyde, and acrolein), and atmospheric decay for one air toxic (1,3-butadiene decays to acrolein). These results suggest that current monitoring sites located in developed areas with significant traffic flow continue to provide valuable information for public health protection.

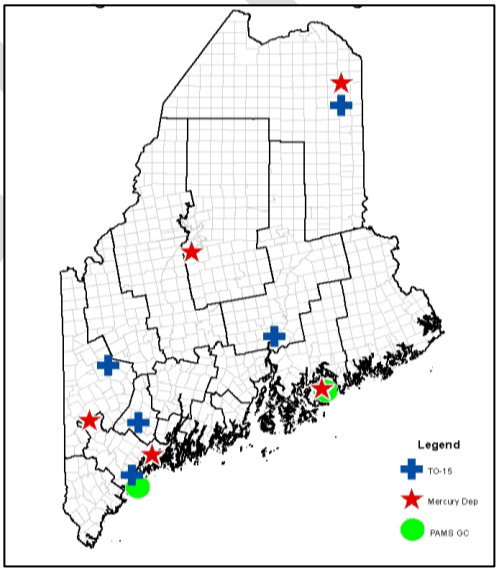

Figure 26 Air Toxics Monitors

The Department monitors year-round for toxic air pollutants in twelve Maine cities and towns, including photochemical organics, metals, and particulate. Figure 26 indicates the locations and the type of monitoring done at these sites.

The Department employs the TO-15 method to analyze selected compounds from the Maine Air Toxics Initiative's Air Toxics Priority List. These monitors play an important role in ground-truthing estimates of toxic emissions. The Department's estimates guide which toxics are selected for study, and monitoring results may indicate the need to evaluate emission factors for estimates.

The Department continuously reviews and evaluates which toxic pollutants will be monitored following TO-15 NATTS (National Air Toxics Trends Stations) protocols. As was done with the 2005 NATA data report, BAQ plans to review the 2011 NATA data when it is released later this year to assess what this latest available information reveals about changes in the occurrence and prevalence of air toxic compounds, their spatial distribution, and how this data compares to the ambient monitoring data collected for like compounds."

The air toxics monitoring that is being conducted in the five cities in Maine will provide background and baseline for the various pollutants monitored. These sites will be used to determine impacts and to identify any trends that may be occurring in these compounds. The data from these sites will also be very useful in the analysis of data collected in any areas of the state that may be considered as a "hotspot', either due to health data or high emissions. The concentrations of the various compounds can be compared to determine whether ambient concentrations are higher than normal and if so may be a contributing factor to any local health problems.

The Department also conducted air toxics monitoring during the ozone season at the two Photochemical Assessment Monitoring Stations (PAMS) in Cape Elizabeth and on Cadillac Mountain. The Cadillac Mountain PAMS site was shut down at the end of the 2014 ozone season. Year round HAPs monitoring at Cape Elizabeth began in 2014. Air toxics measurements from these sites represent out-of-state pollution due to the sites' locations for assessing long-range transport. The Department measures some of the most prevalent combustion by-products: benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) at these sites and all other toxics monitoring sites. PAMS measurements can help the Department estimate local versus transported pollutant concentrations of the BTEX compounds at other sites. PAMS data also provides more than a decade of measurements that can be used to evaluate trends. Figures 27 and 28 indicate a significant decline in overall annual average BTEX concentrations at both sites in the late 1990's, and much smaller variations in recent years. The toxics measurements at the sites do not trend closely with one another, however. The Department can use year-round monitoring in conjunction with PAMS data to perform more in-depth analyses of the patterns in toxics concentrations.

Figure 29 illustrates benzene monitoring results from five of the Department's year-round toxics monitoring sites during the period 2010-2014. In addition to the obvious annual cycle, the data plots for the individual sites indicate a decline in peak levels of benzene at the Lewiston (CKP) and Bangor (KPS) sites, but steady levels in Rumford and Presque Isle. Using the long-term data compiled from the Department's toxics monitoring sites, the Department can evaluate trends for any of the TO-15 compounds listed in Table 3.

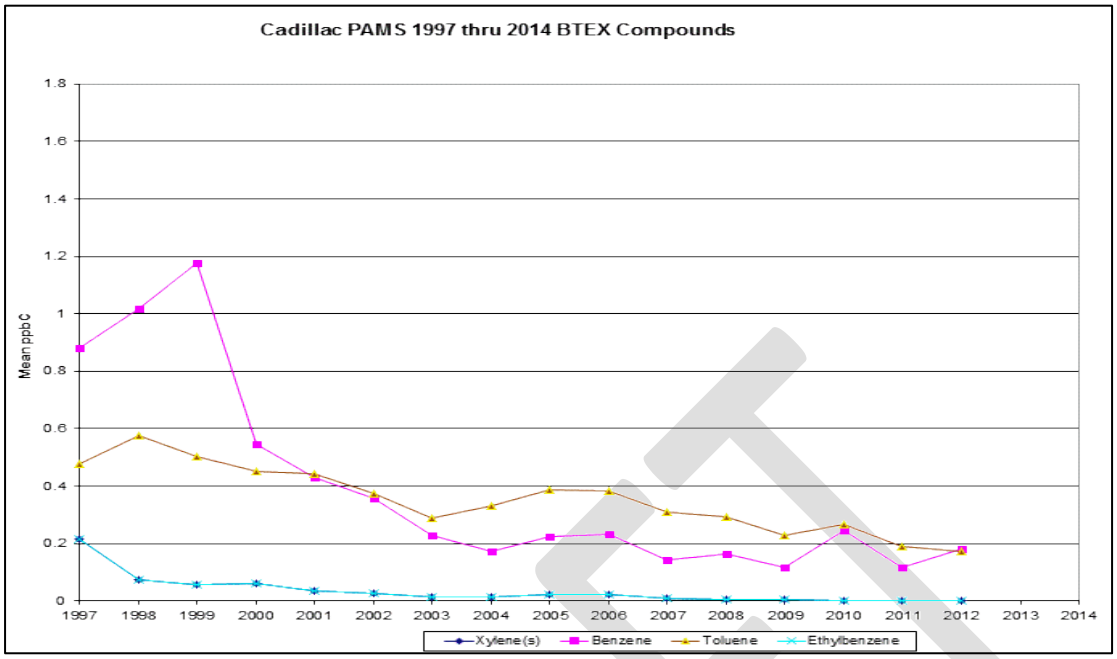

Figure 27 Cadillac Mtn. PAMS 1994 thru 2014 BTEX Compounds

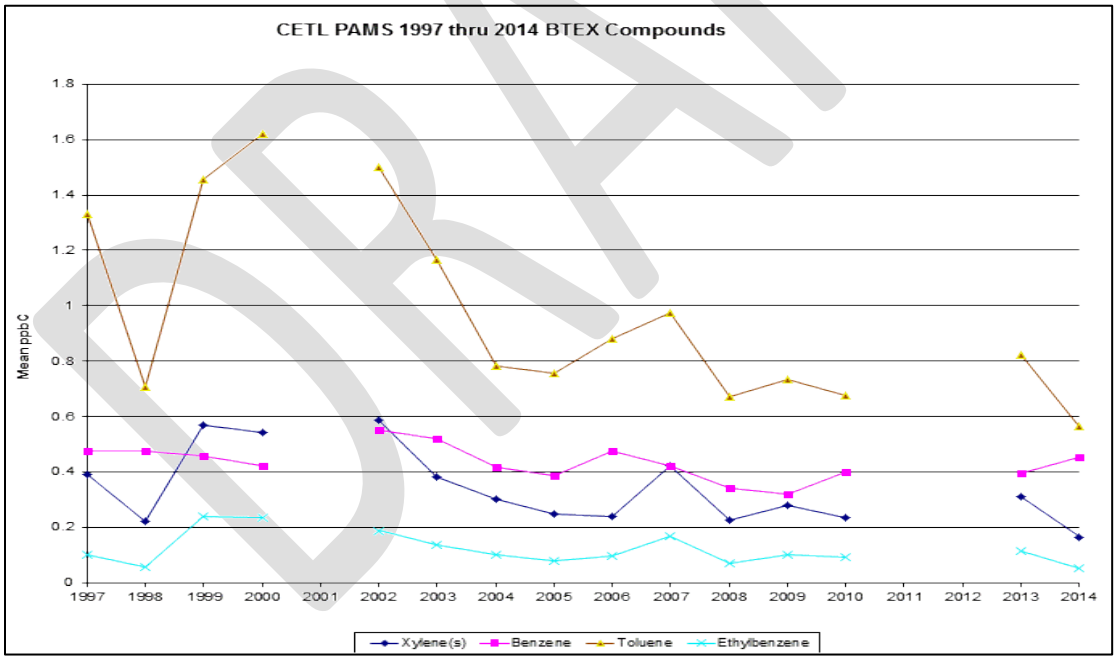

Figure 28 CETL PAMS 1994 thru 2014 BTEX Compounds

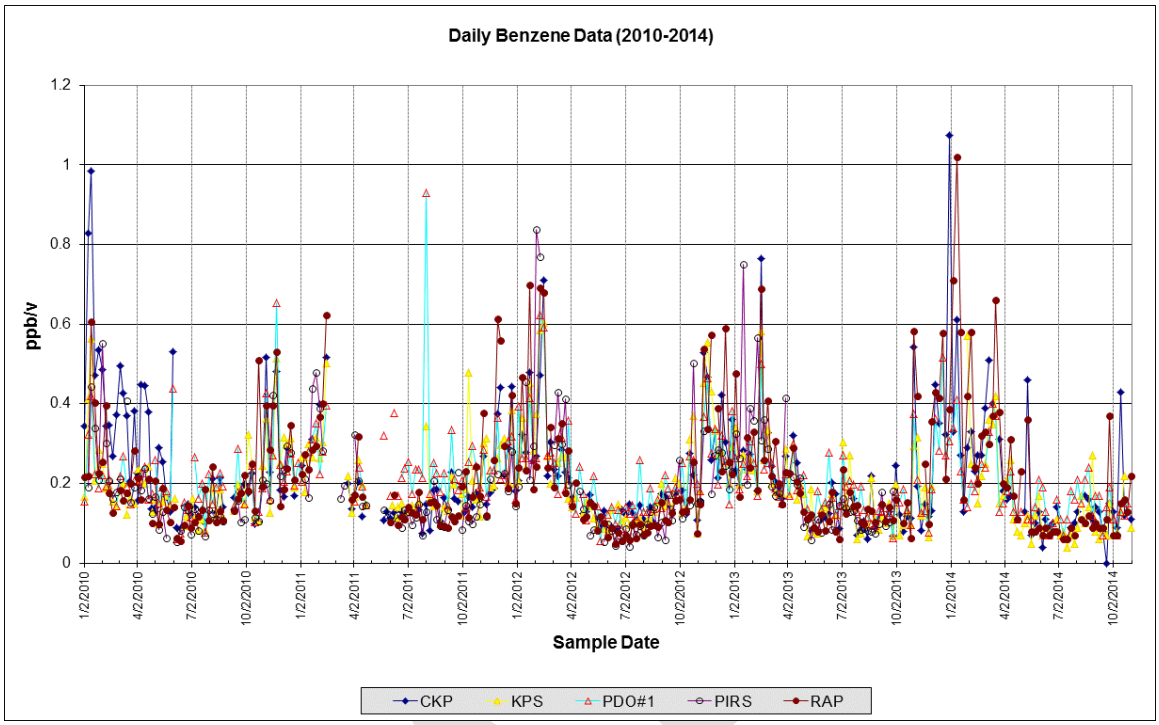

Figure 29 Daily Benzene Data (2010 – 2014)

Table 3 - List of TO-15 Compounds

ME DEP 2015 HAPs List		
	CAS #	**Compound Name**
1.)	75-71-8	Dichlorodifluoromethane
2.)	74-87-3	Methyl Chloride
3.)	75-01-4	Vinyl Chloride
4.)	106-99-0	1,3-Butadiene
5.)	74-83-9	Methyl Bromide
6.)	75-00-3	Ethyl Chloride
7.)	107-02-8	Acrolein
8.)	75-69-4	Trichlorofluoromethane
9.)	75-35-4	1,1-Dichloroethene
10.)	75-09-2	Methylene Chloride
11.)	156-60-5	trans-1,2-Dichloroethene
12.)	75-34-3	Ethylidene Dichloride
13.)	1634-04-4	MTBE
14.)	78-93-3	Methyl Ethyl Ketone
15.)	156-59-2	cis-1,2-Dichloroethene
16.)	67-66-3	Chloroform
17.)	107-06-2	Ethylene Dichloride
18.)	71-55-6	1,1,1-Trichloroethane
19.)	71-43-2	Benzene
20.)	56-23-5	Carbon Tetrachloride
21.)	10061-02-6	trans-1,2-Dichloroethene
22.)	108-10-1	Methyl Isobutyl Ketone
23.)	10061-02-6	cis-1,2-Dichloroethene
24.)	79-00-5	1,1,2-Trichloroethane
25.)	106-93-4	Ethylene Dibromide
26.)	79-01-6	Trichloroethylene
27.)	127-18-4	Tetrachloroethylene

Table 3 - List of TO-15 Compounds

ME DEP 2015 HAPs List		
	CAS #	**Compound Name**
28.)	108-88-3	Toluene
29.)	108-90-7	Chlorobenzene
30.)	100-41-4	Ethylbenzene
31.)	1330-20-7	m,p-Xylenes
32.)	79-34-5	1,1,2,2-Tetrachloroethane
33.)	95-47-6	o-Xylene
34.)	108-67-8	1,3,5-Trimethylbenzene
35.)	95-63-6	1,2,4-Trimethylbenzene
36.)	541-73-1	1,3-Dichlorobenzene
37.)	106-46-7	1,4-Dichlorobenzene
38.)	95-50-1	1,2-Dichlorobenzene
39.)	91-20-3	Naphthalene
40.)	76-14-2	Freon 114
41.)	64-17-5	Ethanol
42.)	67-64-1	Acetone
43.)	107-13-1	Acrylonitrile
44.)	76-13-1	Freon 113
45.)	75-15-0	Carbon Disulfide
46.)	109-99-1	Tetrahydrofuran
47.)	74-95-3	Dibromomethane
48.)	78-87-5	1,2-Dichloropropane
49.)	75-27-4	Bromodichloromethane
50.)	80-62-6	Methyl Methacrylate
51.)	97-63-2	Ethyl Methacrylate
52.)	591-78-6	2-Hexanone
53.)	124-48-1	Dibromochloromethane
54.)	630-20-6	1,1,1,2-Tetrachloroethane
55.)	75-25-2	Bromoform
56.)	100-42-5	Styrene
57.)	98-82-8	Isopropylbenzene
58.)	76-01-7	Pentachloroethane
59.)	67-72-1	Hexachloroethane
60.)	120-82-1	1,2,4-Trichlorobenzene
61.)	87-68-3	Hexachlorobutadiene
62.)	74-85-1	Ethylene
63.)	74-86-2	Acetylene
64.)	74-84-0	Ethane
65.)	115-07-1	Propylene
66.)	74-98-6	Propane
67.)	75-28-5	Isobutane
68.)	106-98-9	1-Butene
69.)	106-97-8	n-Butane
70.)	624-64-6	trans-2-Butene
71.)	590-18-1	cis-2-Butene
72.)	78-78-4	Isopentane
73.)	109-67-1	1-Pentene
74.)	109-66-0	n-Pentane
75.)	78-79-5	Isoprene
76.)	646-04-8	trans-2-Pentene
77.)	627-20-3	cis-2-Pentene
78.)	75-83-2	2,2-Dimethylbutane
79.)	287-92-3	Cyclopentane
80.)	79-29-8	2,3-Dimethylbutane
81.)	107-83-5	2-Methylpentane
82.)	96-14-0	3-Methylpentane
83.)	592-41-6	1-Hexene
84.)	110-54-3	n-Hexane
85.)	96-37-7	Methylcyclopentane

Table 3 - List of TO-15 Compounds		
ME DEP 2015 HAPs List		
	CAS #	**Compound Name**
86.)	108-08-7	2,4-Dimethylpentane
87.)	110-82-7	Cyclohexane
88.)	591-76-4	2-Methylhexane
89.)	565-59-3	2,3-Dimethylpentane
90.)	589-34-4	3-Methylhexane
91.)	540-84-1	2,2,4-Trimethylpentane
92.)	142-82-5	n-Heptane
93.)	108-87-2	Methylcyclohexane
94.)	565-75-3	2,3,4-Trimethylpentane
95.)	592-27-8	2-Methylheptane
96.)	589-81-1	3-Methylheptane
97.)	111-65-9	n-Octane
98.)	111-84-2	n-Nonane
99.)	103-65-1	n-Propylbenzene
100.)	620-14-4	m-Ethyltoluene
101.)	622-96-8	p-Ethyltoluene
102.)	611-14-3	o-Ethyltoluene
103.)	124-18-5	n-Decane
104.)	526-73-8	1,2,3-Trimethylbenzene
105.)	141-93-5	m-Diethylbenzne
106.)	105-05-5	p-diethylbenzene
107.)	1120-21-4	n-Undecane
108.)	112-40-3	n-Dodecane

Table 3 List of TO-15 Compounds

Maine's Air Toxics Strategy includes further investigation into air quality impacts from residential wood combustion. In 2010, the Department developed and employed a method to use levoglucosan as an indicator to distinguish wood smoke PM from other PM. This will enable the Department to collect air quality data from areas throughout the western mountains and remote areas of the state where emission estimates and inspections indicate wood smoke impacts may be greatest. The long-term measurements collected from the stationary monitoring sites provide valuable datasets for comparison, especially the mountain sites in Rumford and Greenville. The Department continues to analyze HAPs monitoring data compared to metals measured on archived particulate filters to identify air quality trends in monitored areas.

Mercury deposition monitoring informs water quality impact analyses and plays a critical role in identifying the contribution of air pollution to water pollution. We have identified 11 upwind states as the most significant contributors to mercury deposition in Maine. Ongoing deposition monitoring will indicate if future emission reduction strategies are effective.

Sulfur Dioxide

Sulfur Dioxide is a colorless irritating gas having the same pungent odor as a struck match. It is emitted mainly from stationary sources that utilize fossil fuels (coal, oil) such as power plants, ore smelters and refineries. High concentrations can lead to difficulty breathing and increased asthma symptoms. Sulfur dioxide had been a problem in areas of

the state in the 70's and early 80's but additional controls and the reduction of sulfur content in fuels has dramatically reduced the concentrations of sulfur dioxide in the air to well below the standards that were in effect at the beginning of this year.

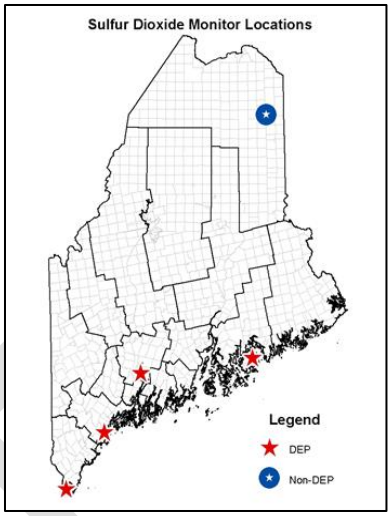

Figure 30 Sulfur Dioxide Monitors

However, as a result of a review of the standard EPA promulgated a new standard at a much lower level than the previous standard. On June 2, 2010 EPA issued a new 1-hour primary standard of 75 ppb that became effective on August 23, 2010. The revised standard includes a new "form" or "design value" which is the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations. In the final review of the standard EPA also required monitoring in Core Based Statistical Areas, based on a population weighted emissions index for the area.

Maine does not have any CBSA's that would require a monitor. The only required monitoring in Maine is for the NCore site in Acadia National Park that is a trace level SO_2 monitor. Sulfur dioxide monitors, primarily designed to collect urban and background/baseline data for the licensing program, are currently located in Portland and Gardiner. A special purpose SO_2 monitor was established in conjunction with the New Hampshire Department of Environmental Services at the request of the EPA. One year of data will be collected to determine if there are impacts to the citizens of Eliot, Maine from the emissions of two coal burning power plants located just across the river from town. The Micmac tribe also operates a monitor at their site in Presque Isle. The locations of monitors are indicated on the map in Figure 30.

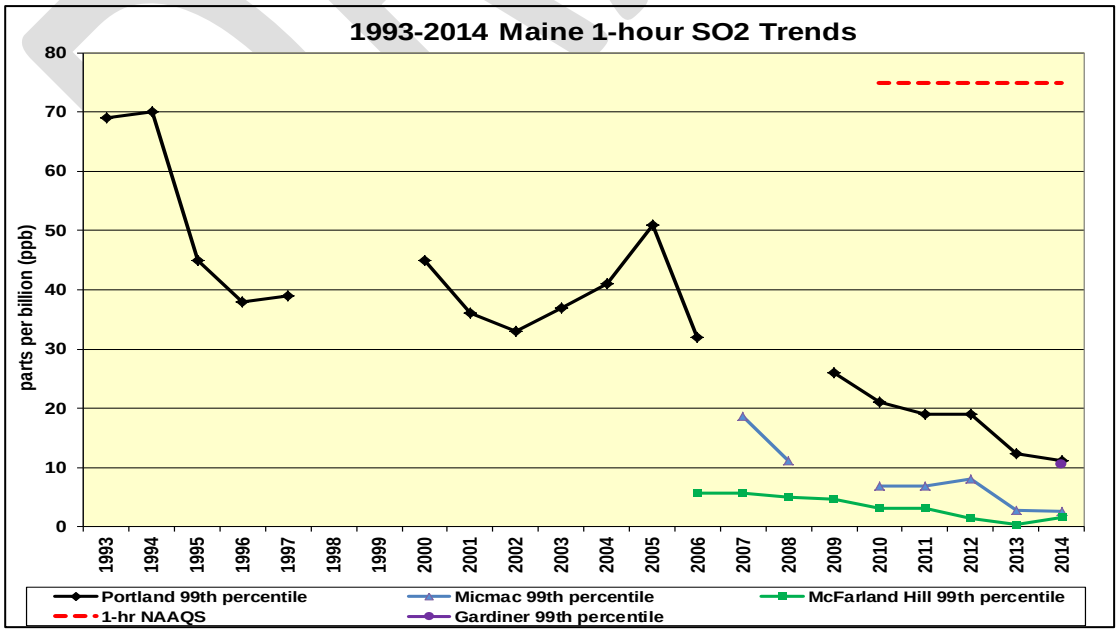

Figure 31 Maine SO_2 1 Hour Trends 1993 - 2014

Figure 31 depicts 99th percentile 1 hour concentration trends at all sites in Maine. The maximum 1-hour concentration recorded in Portland in the last three years is 24.8 ppb and the 2012-14 design value is 14 ppb which is well below the 75 ppb standard.

Nitrogen Dioxide

The locations of nitrogen (NO_2) dioxide and reactive oxides of nitrogen monitors (NO_y) are shown in Figure 32.

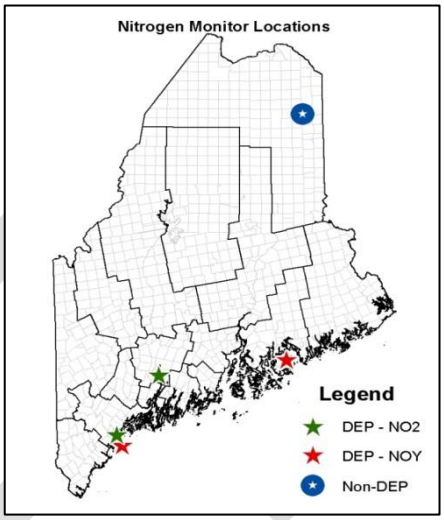

Figure 32 Nitrogen Monitors

On January 20, 2010 EPA strengthened the primary national ambient air quality standard for nitrogen dioxide by adding a 1-hour standard at 100 parts per billion (ppb) while still retaining the annual average standard of 53 ppb. The form of the 1-hour standard is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations.

The NO_2 regulations were revised on March 14, 2013, which included provisions for at least one monitor near a major road in an urban area with a population greater than or equal to 500,000 people. EPA also required a community-wide monitor in any urban area with a population greater than or equal to 1 million people.

EPA focused initial efforts on ensuring the near-road sites in large metropolitan areas, with the highest probability for high NO_2 concentrations, were placed in operation first. The smaller (Tier 3) areas, including Portland, are not required to be in operation until January 1, 2017. These existing plans for additional near road monitoring in the U.S. are being reviewed, because the near road sites already in operation have not produced the expected high levels of NO_2. There is nothing in the data to suggest that monitoring along less traveled roads such as those in Portland will produce higher concentrations of NO_2.

The maximum 1-hour concentration recorded in Portland in the last three years is 76.1 ppb and the 2012-14 Design Value is 45 ppb. In addition to this monitor, a low level oxides of nitrogen monitor is required at the NCore site in Acadia National Park. The Micmac tribe also operates a monitor at their site in Presque Isle. The existing monitors meet EPA monitoring requirements and will provide the data necessary for urban and rural concentrations needed for the licensing program. See figure 33 for a review of NO_2 trends in Maine since 2001.

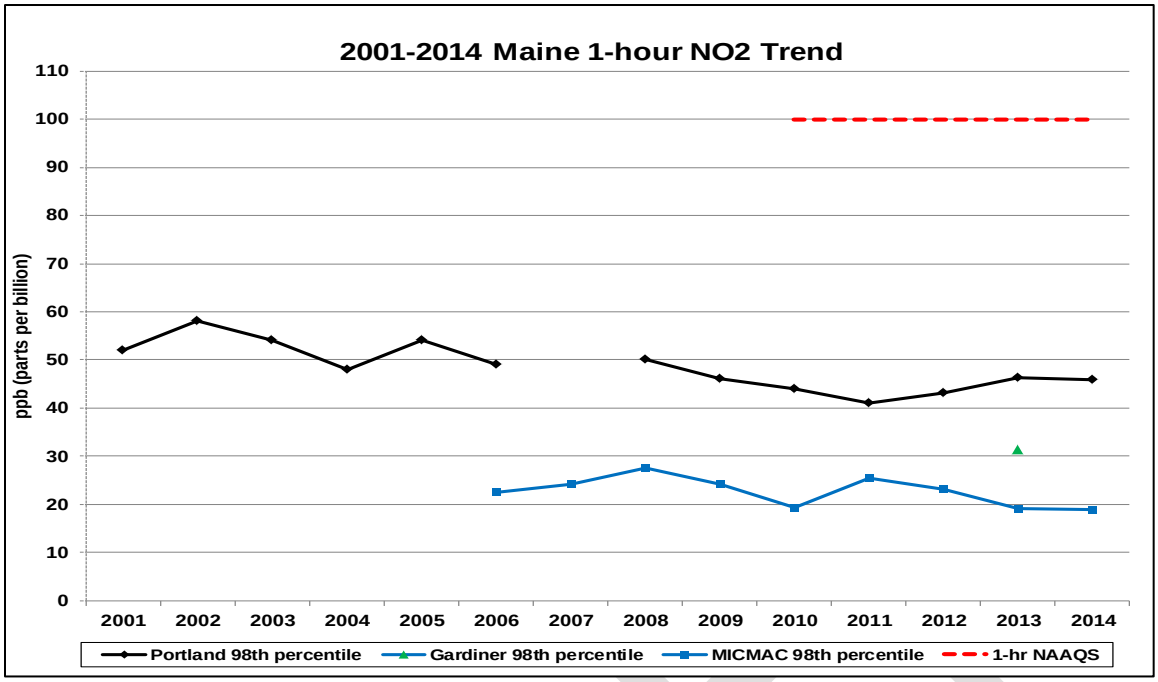

Figure 33 Maine NO_2 1 Hour Trends 2001 - 2014

Carbon Monoxide

The current NAAQS for CO is a 1-hour standard of 35 ppm and an 8-hour standard of 9 ppm. There is currently no secondary standard. These standards were promulgated in 1971. They have undergone several reviews since first promulgated but have not been changed. Maine had experienced some non-attainment problems in the 1970's in some of the "street canyon" areas of Bangor, Lewiston and Portland. Traffic pattern changes and newer vehicles resolved those problems and CO concentrations have been dropping ever since.

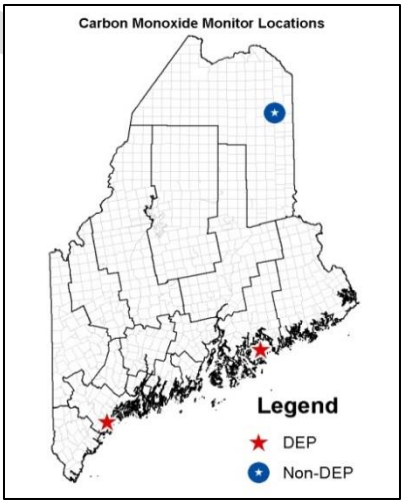

Figure 34 Carbon Monoxide Monitors

Carbon Monoxide is currently monitored in Portland at the Deering Oaks site and at the NCore site in Acadia National Park. The Micmac tribe also operates a monitor at their site in Presque Isle. The maximum 1-hour concentration recorded over the last three years at the Deering Oaks site in Portland site has been 2.1 ppm and the maximum 8-hour concentration over that same time period has been 1.8 ppm. Given the low concentrations the only required monitoring in the state are the trace level monitor at the NCore site in Acadia National Park and the urban monitor in Portland needed for the licensing program. The locations of carbon monoxide monitors are shown in Figure 34.

Atmospheric Deposition Monitoring

Background

The importance of collecting environmental data geared toward understanding and addressing the problem of atmospheric deposition was recognized nationally in the early 1970s. The objective was, and still is, to obtain quality assured data and information in support of research on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients and base cations in precipitation. Mercury was added to the list of compounds of interest in the mid-1990s (with additional mercury fractions being added in 2009) and ammonia was added in 2010. These data are then in turn used to support informed policy decisions on related air quality issues.

The National Atmospheric Deposition Program (NADP) was organized in 1977 under the leadership of the State Agricultural Experiment Station (SAES) program to increase the understanding of the causes and effects of acidic precipitation on agricultural crops, forests, rangelands, surface waters and other natural and cultural resources. A long-term precipitation chemistry network of wet-only deposition sites, distant from point source emission influences, began operation in 1978 collecting one-week long bulk precipitation samples. Precipitation chemistry is determined by having the samples analyzed by a Central Analytical Laboratory (the CAL, located at the University of Illinois in Champaign) for the routine parameters listed in Table 4 below, which provides data on amounts, temporal trends and geographic distributions of the atmospheric deposition of acids, nutrients and base cations by precipitation.

Wet Deposition Chemistry Parameters

Calcium	Magnesium	Potassium
Sodium	Ammonium	Nitrate
Chloride	Sulfate	Bromide
Free acidity (as pH)	Specific conductance	Orthophosphate (for QA purposes)

Table 4 Wet Deposition Chemistry Parameters

Sites that belong to this National Trends Network (NTN) benefit from having identical siting criteria, operating procedures, a common analytical laboratory, as well as a common quality assurance program. Presently, there are approximately 250 sites nationally in the NTN.

Over increasing concerns about mercury in the atmosphere, during the mid-1990s, a Mercury Deposition Network (MDN) was created within NADP to provide data and information on the wet deposition of this pollutant to surface waters, forested watersheds and other receptors. To help illustrate the extent of the mercury problem, 48 states and 8 Canadian provinces have health advisories warning against the consumption of fish with high fish tissue mercury concentrations taken from lakes and other water bodies. The MDN is also a long-term precipitation network of wet-only deposition sites, distant from point source emission influences, which began operation in 1996 by also collecting one-

week long bulk precipitation samples. Samples are analyzed by a different central laboratory (Frontier Global Sciences in Seattle, WA) for total mercury (sites can also opt to have samples analyzed for methyl mercury), which provides data on amounts, temporal trends and geographic distributions of the atmospheric deposition of mercury and mercury related compounds by precipitation. Like sites in the NTN, sites that belong to the MDN have the same benefits described previously. Presently, there are approximately 110 sites nationally in the MDN.

History

National Trends Network (NTN): Maine has a long history of operating and maintaining atmospheric deposition monitoring networks. More than three decades ago when concerns about "acid rain" topped many environmental organizations' agendas and captured the public's attention in both the United States and Canada, the University of Maine sponsored the first precipitation chemistry site in the state in Greenville (ME09), which began operation in November 1979 as part of the NADP's National Trends Network (NTN). Being the most forested state in the nation as a percentage of its total land area, both then and now, there was good reason to begin to collect measurements to assess the amount and kinds of acidic compounds, nutrients and base cations that were being delivered to our forest ecosystems through wet deposition. The following year quickly saw three additional NTN sites established: the first in Caribou (ME00) by the National Oceanic and Atmospheric Administration (NOAA) in April, the second in Bridgton (ME02) by Maine DEP (its first) in September, and the third one in Acadia National Park in Bar Harbor at Paradise Hill (ME99) by the National Park Service (NPS) in November 1980. A year later in November 1981, the NPS relocated this site to its current location at McFarland Hill (ME98), which concluded this early phase of NTN network growth in Maine.

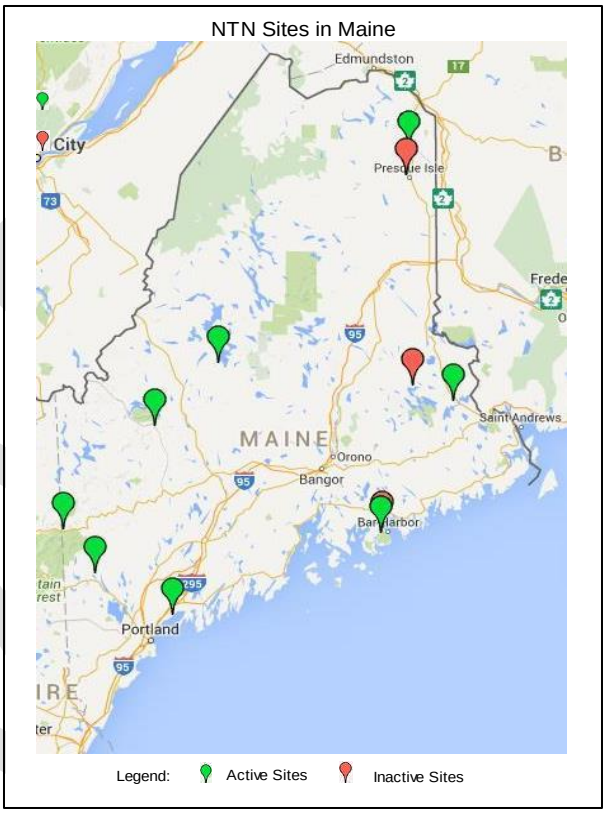

Figure 35 Maine National Trends Network (NTN)

To these sponsoring agencies credit, four of these early sites (ME00, ME02, ME09 and ME98) have remained in continuous operation to the present day, which is a powerful testament to their dedication to the network and their belief in the value and importance that this long-term trend data (35 years ±) provides to many varied outside stakeholders, in additional to their own internal data users. There's no better example of illustrating the "long" in long-term than this!

NOAA established a second site in Presque Isle (ME97) in June 1984, which was operated by the University of Maine. It was discontinued at the end of September 1988.

This four-site network remained very stable for the next 17 years, when the second and most recent phase of network growth occurred, beginning in January 1998. In collaboration with EPA-NE initially, Maine DEP sponsored its second NTN site in Freeport (ME96) as part of the 3-year Casco Bay Estuary Air Deposition Project. After the completion of this project in 2000, Maine DEP has continued to sponsor and operate this site. In September 1999, the US Geological Survey established its site in the White Mountain National Forest in Gilead (ME08). Finally, in 2002 the most recent site additions to the NTN in the state were by two Maine tribes: the Penobscot Indian Nation established a site on some tribal land in Carrabassett Valley (ME04) in March, and the Passamaquoddy Tribe did the same at a location on their land near Scraggly Lake (ME95) in June. This site was discontinued at the end of 2006 for a variety of operational reasons, but a replacement site was eventually established in Indian Township (ME94) in October 2013. See Figure 35 for a map of Maine's NTN site locations.

Mercury Deposition Network (MDN): Maine DEP has been a leader not only in the Northeast but nationally as well when it comes to measuring and documenting mercury levels in the environment, along with coming up with innovative ways of removing it from its various waste streams. Maine was one of the first seven states nationally to sponsor the first mercury deposition monitoring sites in the MDN in 1996. Maine DEP and the National Park Service combined resources and efforts to establish the state's first site in Acadia National Park in Bar Harbor at McFarland Hill (ME98 and collocated with the NTN sampler) in March 1996. DEP quickly followed up ME98's joint site sponsorship with the establishment of one on its own in Greenville at ME09 (also collocated with the NTN site) in September 1996. Building on these early successes, DEP established the state's third (and its second full) MDN site in Bridgton at ME02 in June 1997. In January 1998, through the same collaborative effort between EPA-NE and the Casco Bay Estuary Program described earlier for the

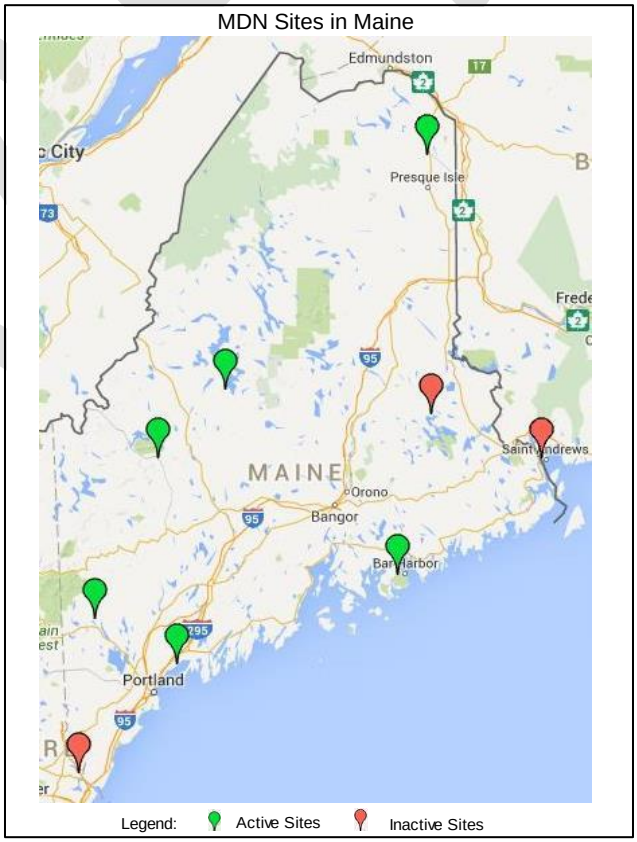

Figure 36 Maine Mercury Deposition Network (MDN)

Freeport NTN site (ME96), DEP installed the state's fourth MDN site as part of the Casco Bay Air Deposition Project. As with the NTN site in Freeport, DEP has also continued to fund and operate ME96 for mercury deposition after the study was completed in 2000. All four of these original sites continue in operation today, which now provides a very valuable 17 – 19 year data record.

The most recent addition of sites to the MDN in Maine came nearly 10 years later, to include one in Caribou at ME00 in May 2007, with the newest one in Carrabassett Valley at ME04 in February 2009. The MDN site at ME00 was initially established as a result of a DEP consent agreement with a facility that contained a provision for the funding of a Supplemental Environmental Project to study mercury deposition in northern Maine. DEP acted in a project support role, with the University of Maine in Orono as the recipient of the SEP funds, overseeing the implementation of the project. When these funds were exhausted at the end of 2012, DEP assumed the sponsorship of this site as part of its annual deposition network funding. The MDN site at ME04 is a result of the Penobscot Indian Nation's desire to collocate a mercury deposition site along with the NTN sampler at this tribal site. See Figure 36 for a map of Maine's MDN site locations.

Trends:

One of the principal data products produced by the NADP from the data measured by Maine's NTN and MDN sites, along with the other sites in those networks, are nationally color-shaded contour maps of both concentration and deposition amounts[1]. The different color shades represent defined numeric ranges of the precipitation-weighted mean concentration and annual wet deposition of a map's identified parameter, and depict its spatial variability across the country. Comparing annual maps to one another also provides the ability to look at temporal changes over time. An illustration of these color-shaded contour maps for sulfate ion concentration appears in Figures 37 and 38. As can be seen for Maine, as well as the rest of the country when comparing the two maps over the 28-year period represented, there has been an easily noticeable decrease in the concentrations of sulfate ion as measured via precipitation samples. Another example of illustrating this same trend in the data can be seen in the plots for sulfate for two of Maine's longest-term trend sites over an even longer period of time, as shown in Figures 39 and 40. By having this long-term trend measurement network in place over 30 years, its data has been able to empirically document the successful implementation of various sulfur emission reduction activities, on the state, regional and national levels, during this time period.

Related to and due in part to sulfate in precipitation creating sulfuric acid (as one example), the resulting pH of precipitation samples (determined from hydrogen ion analyses) is an important ecological parameter measured by the NTN network. The annual maps shown in Figures 41 and 42, and the trend plots shown in Figures 43 and 44, illustrate a corresponding improving trend in pH levels. Nitrate also contributes to the acidity found in precipitation when resulting chemical reactions create nitric acid. Nitrogen emission reduction activities have also been in place during the last three decades, no doubt contributing to the overall improvement in pH levels, but to a much

lesser extent than those for sulfur as illustrated in Figures 45 – 48. The nitrate ion maps show a discernable visual reduction in nitrate concentrations in the eastern half of the country. However, the western half shows either no change or some slight increases. The nitrate trend plots for two sites in Maine also illustrate a smaller magnitude of reduction – about half of that seen for sulfate over the same period of time.

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[1]National Atmospheric Deposition Program (NRSP-3). 2007. NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820

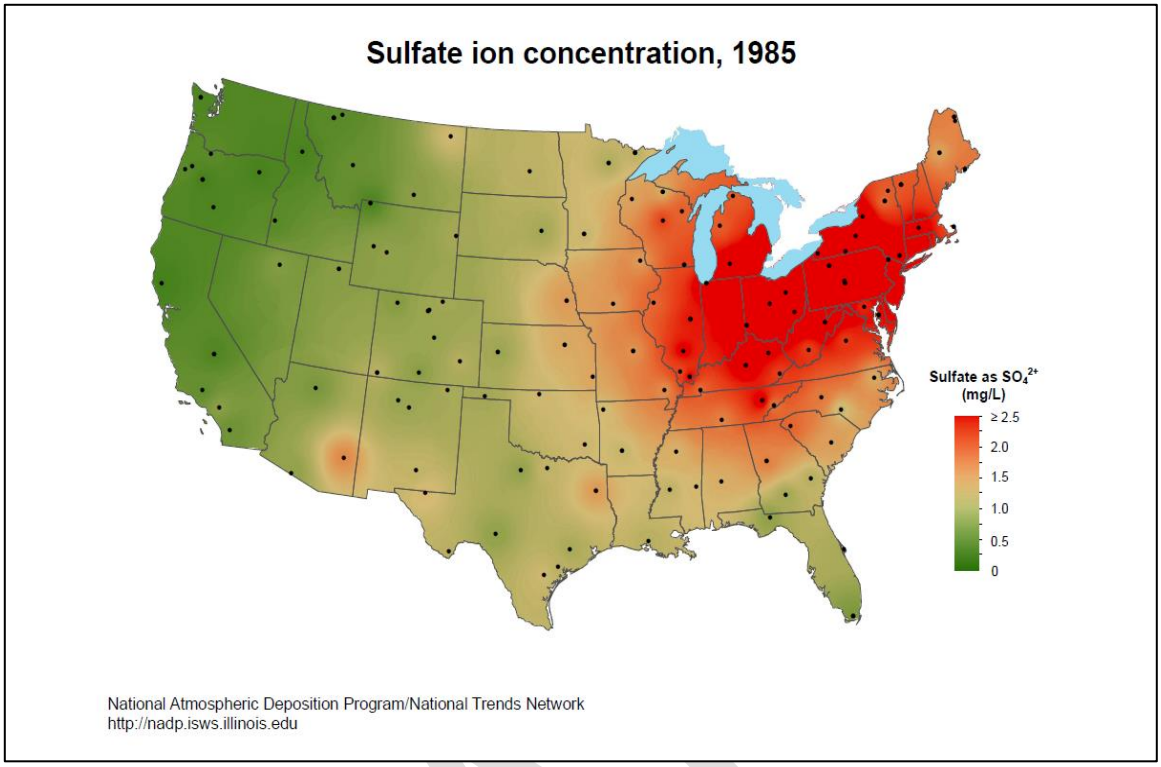

Figure 37 U.S. Annual Sulfate Ion Concentrations 1985

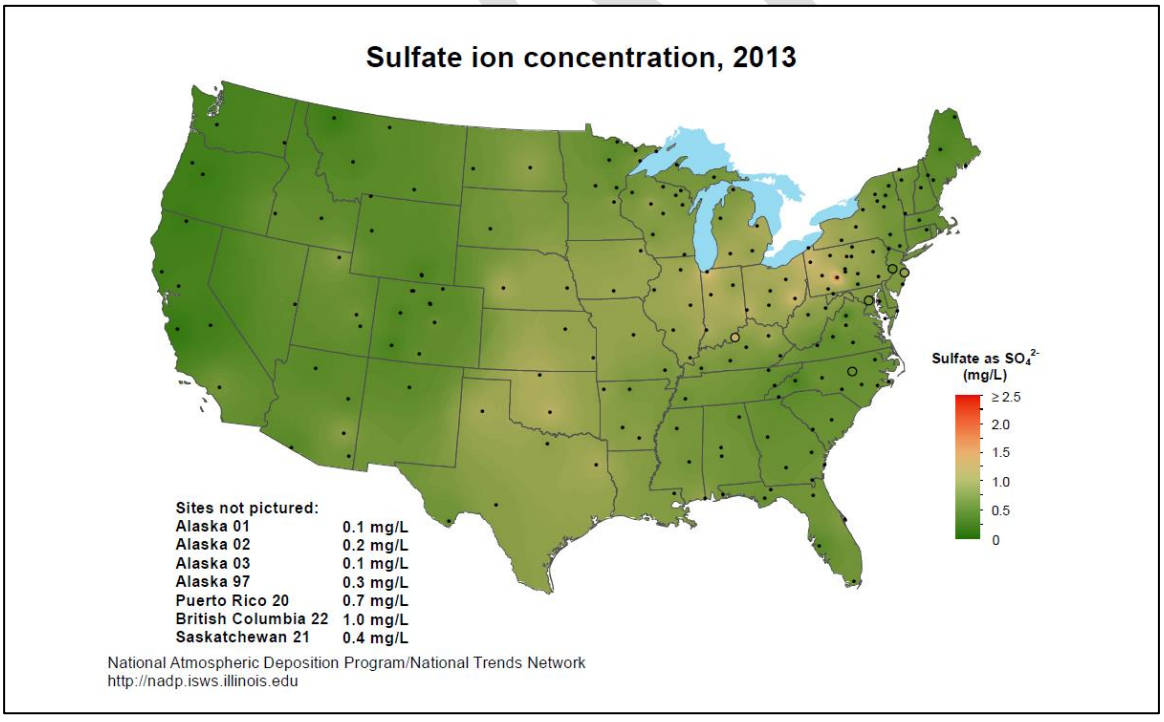

Figure 38 U.S. Annual Sulfate Ion Concentrations 2013

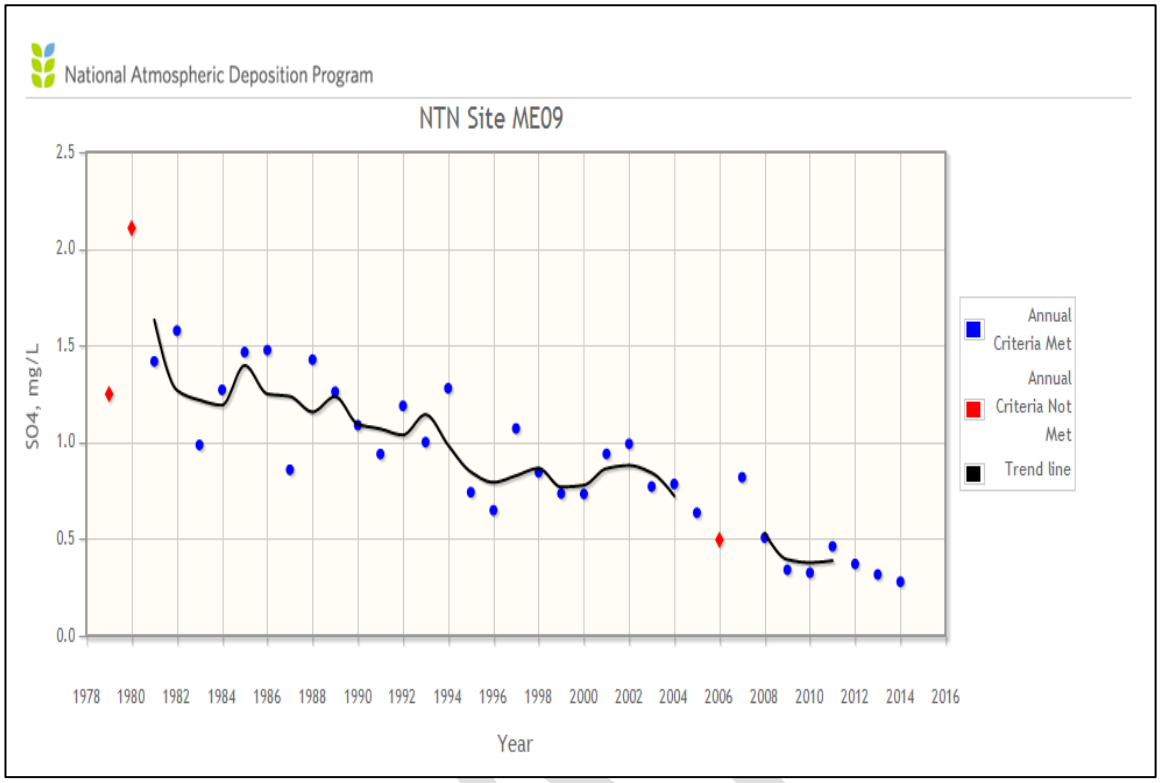

Figure 39 Annual SO_4 Concentrations ME09

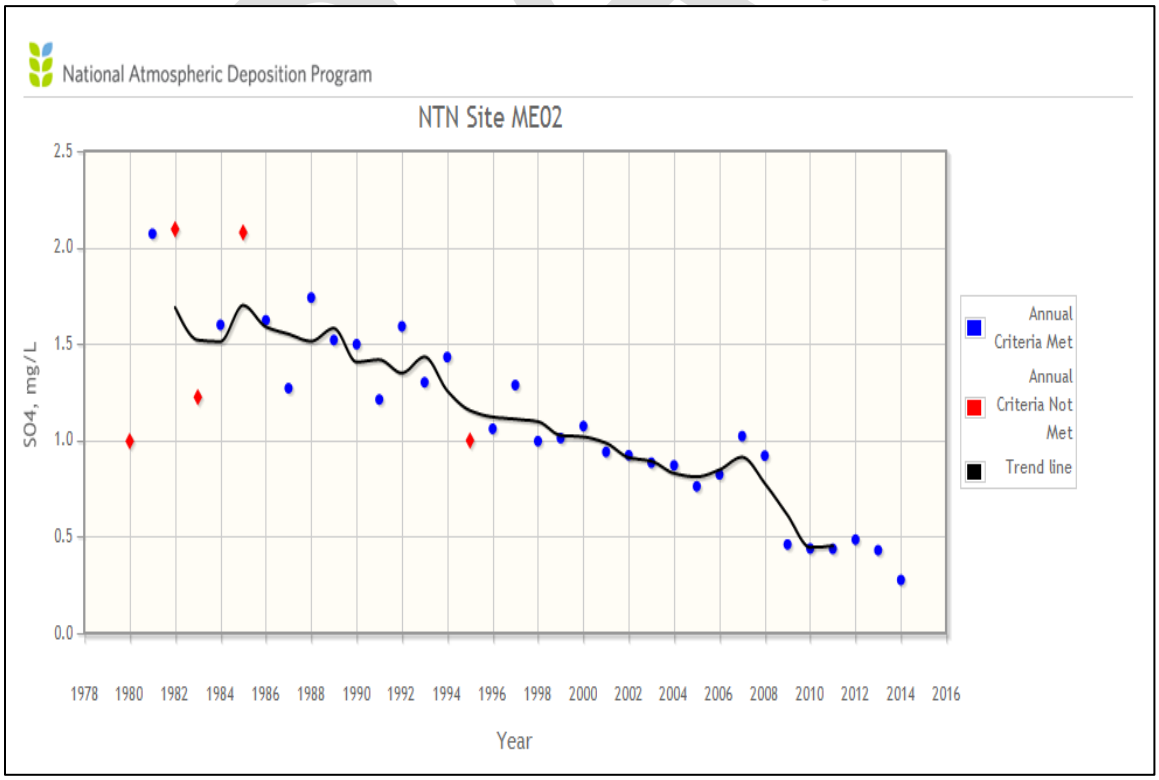

Figure 40 Annual SO_4 Concentrations ME02

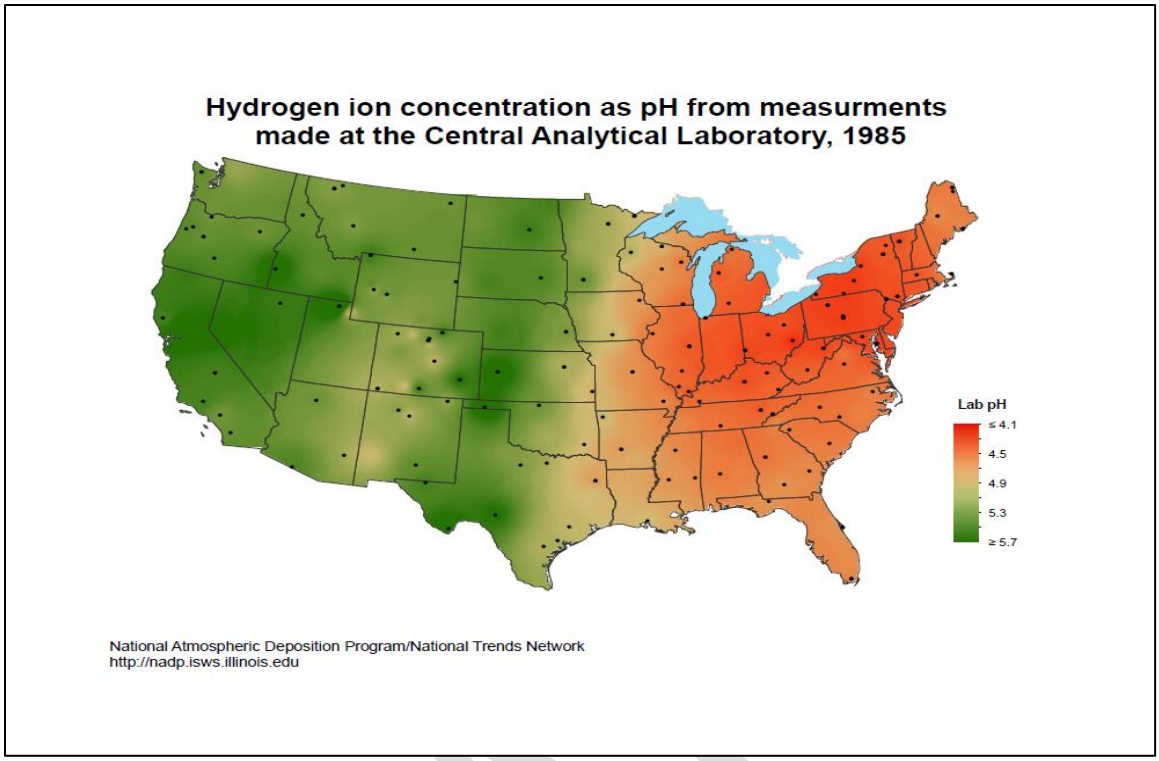

Figure 41 U.S. Annual Hydrogen Ion Concentrations, 1985

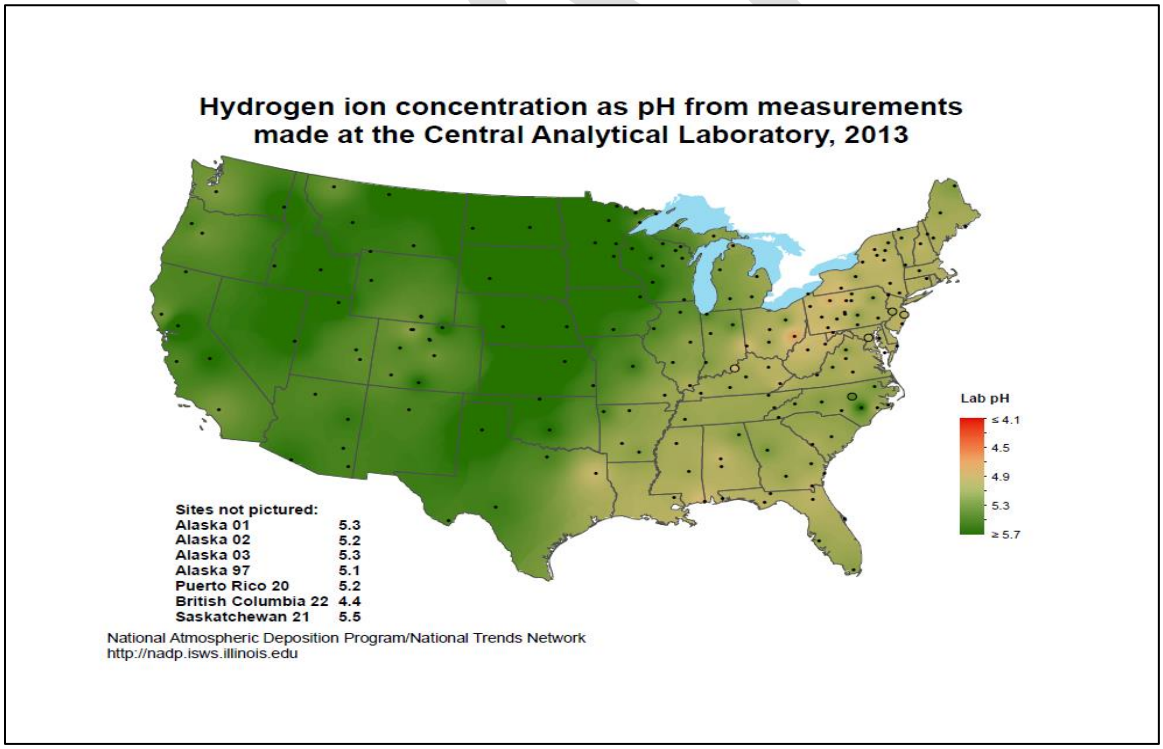

Figure 42 U.S. Annual Hydrogen Ion Concentrations, 2013

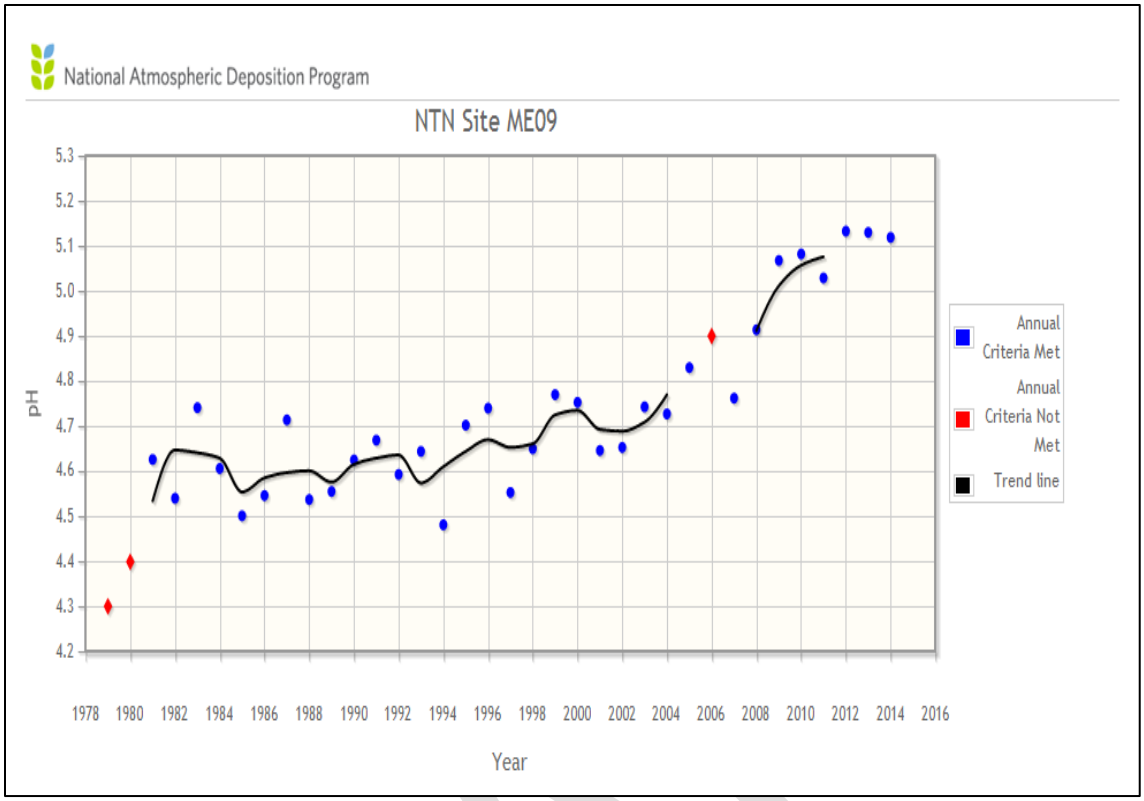

Figure 43 pH ME09 1979-2013

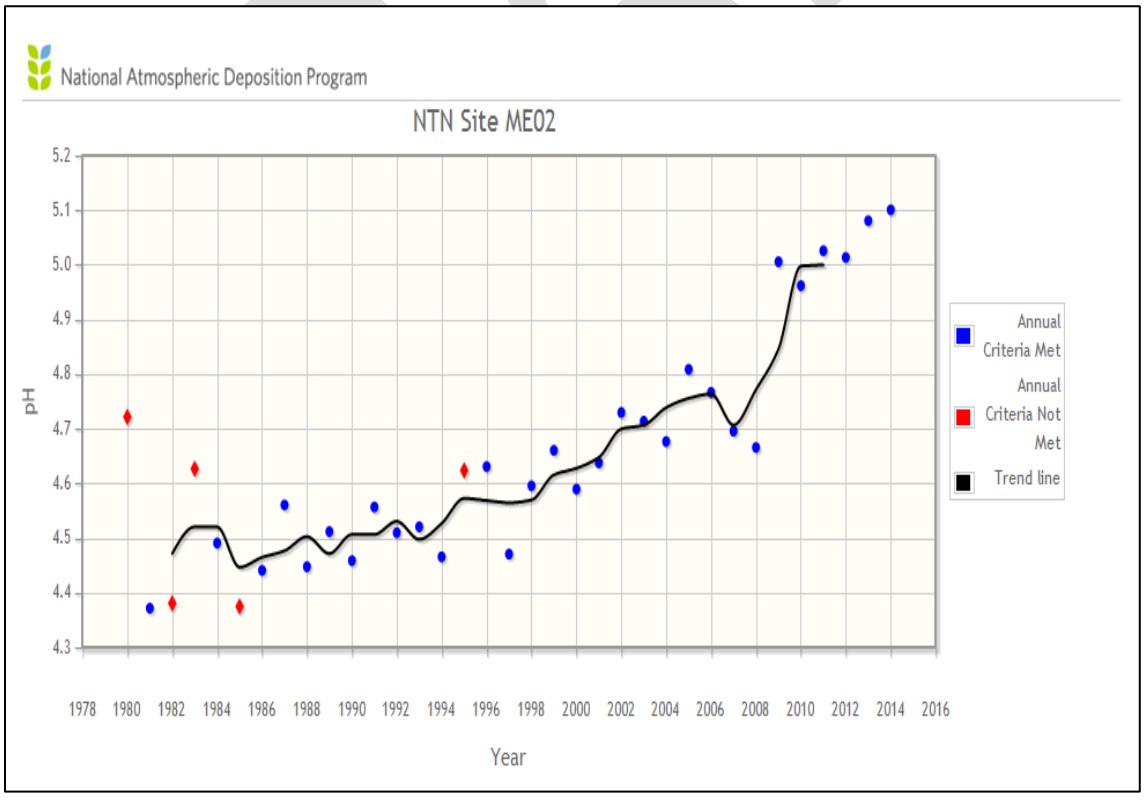

Figure 44 pH ME09 1980-2013

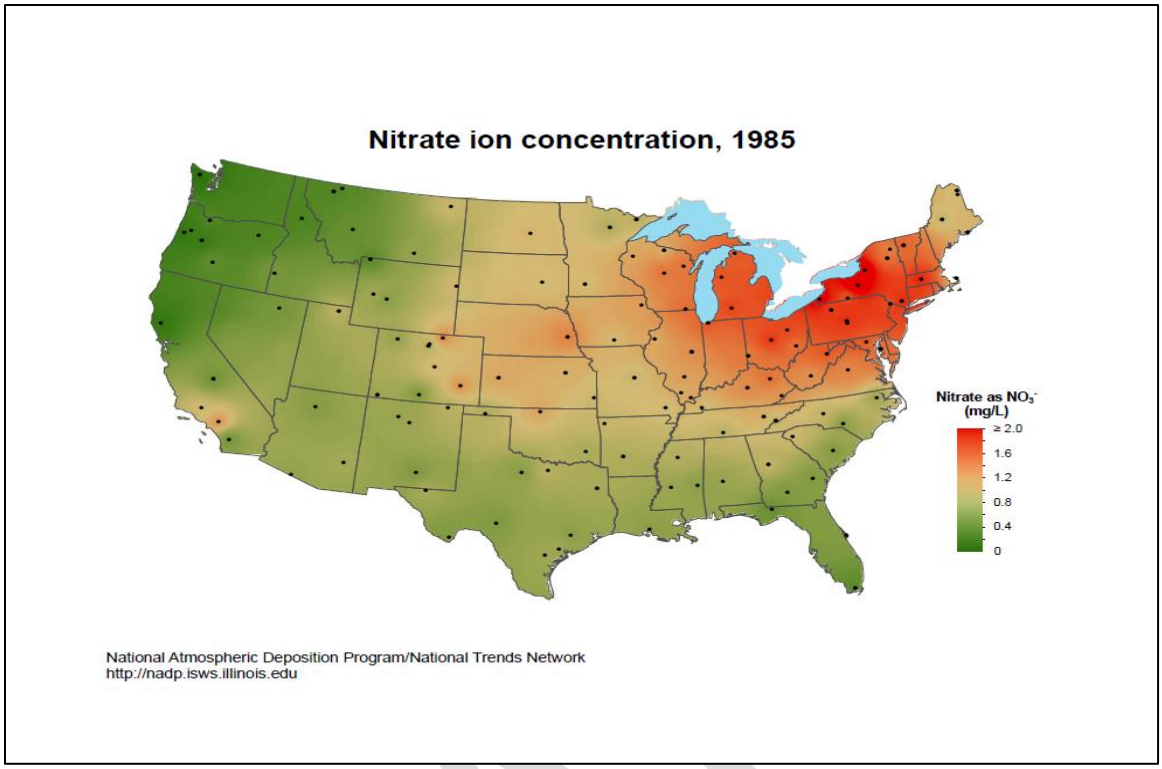

Figure 45 U.S. Nitrate Ion Concentration, 1985

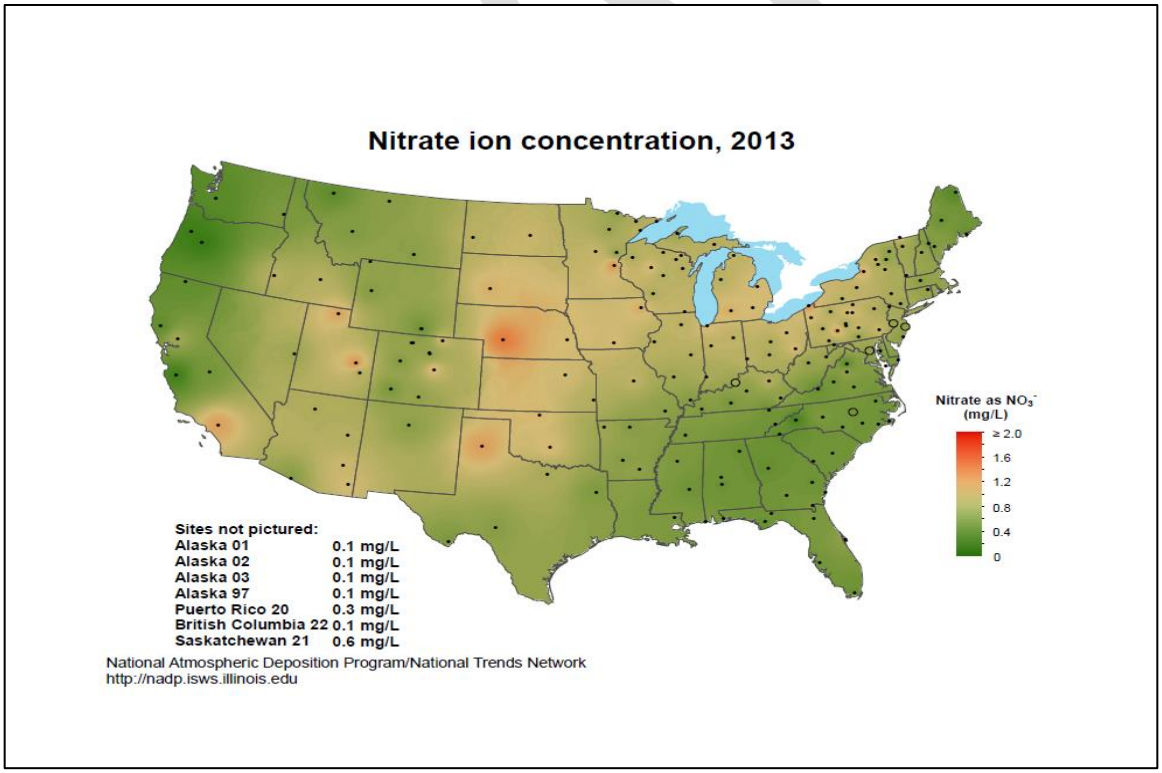

Figure 46 U.S. Nitrate Ion Concentration, 2013

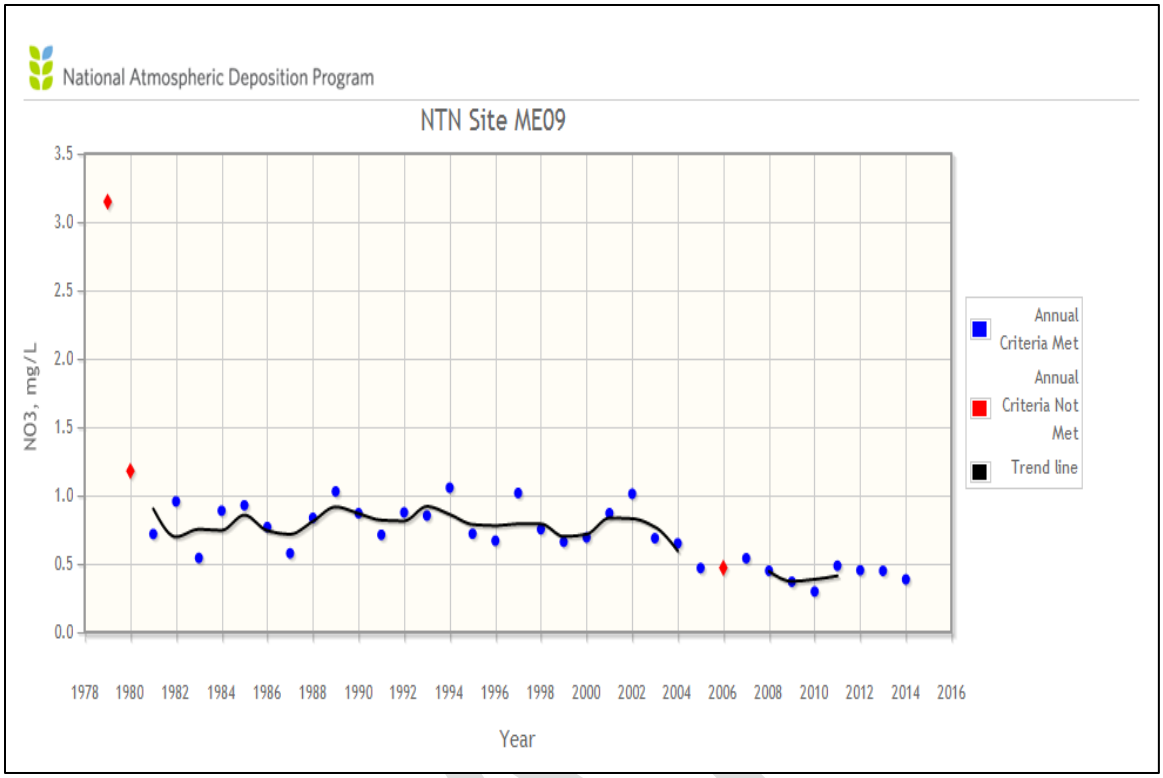

Figure 47 NO_3 ME09 1979-2013

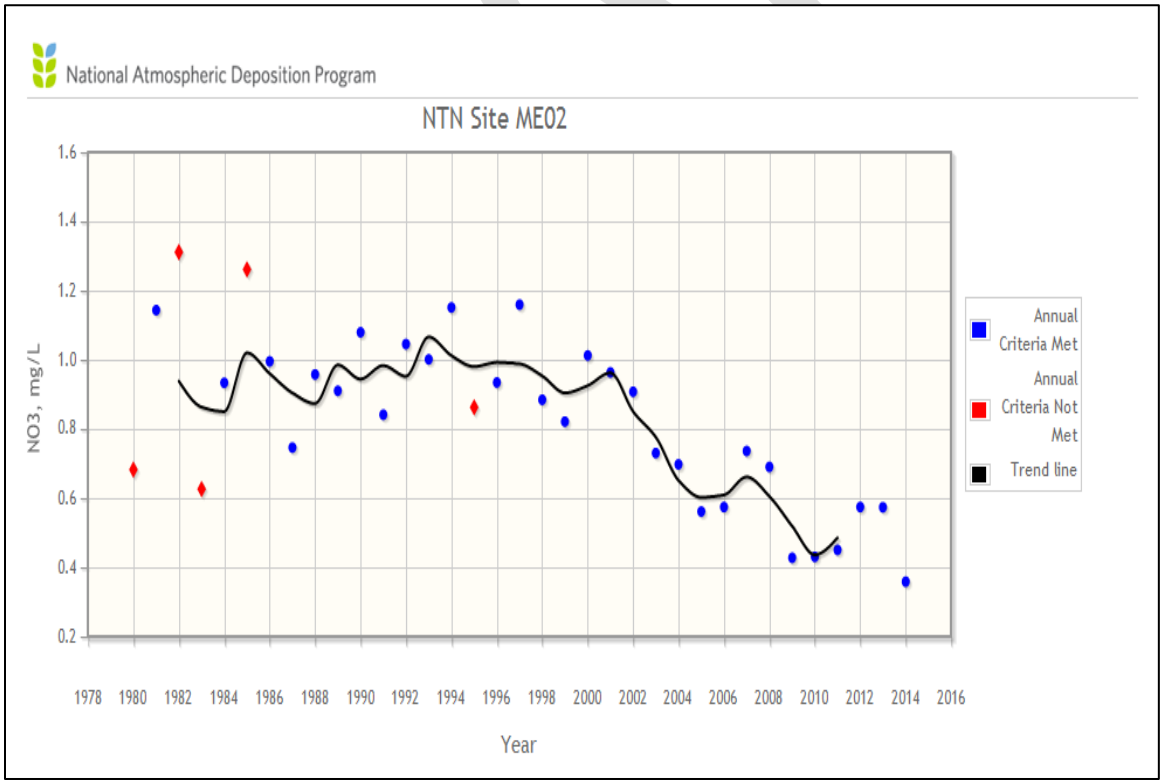

Figure 48 NO_3 ME02 1980-2013

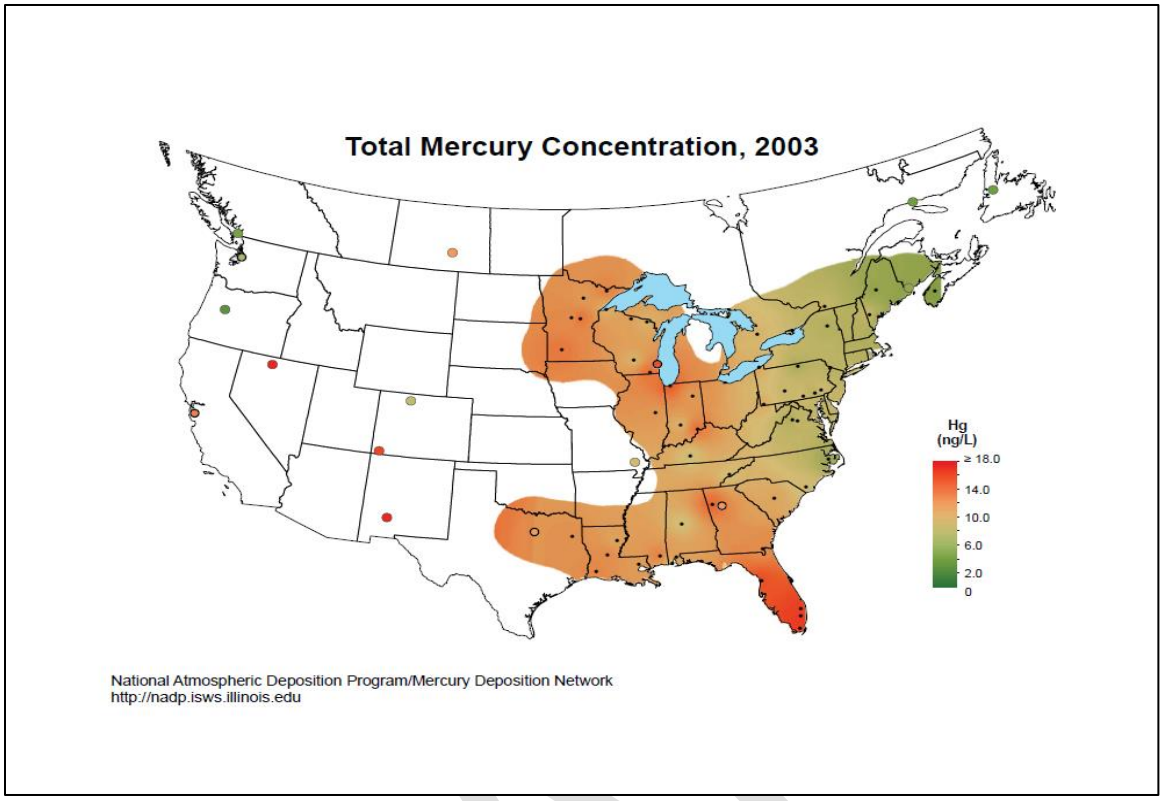

Figure 49 U.S. Total Mercury Concentration 2003

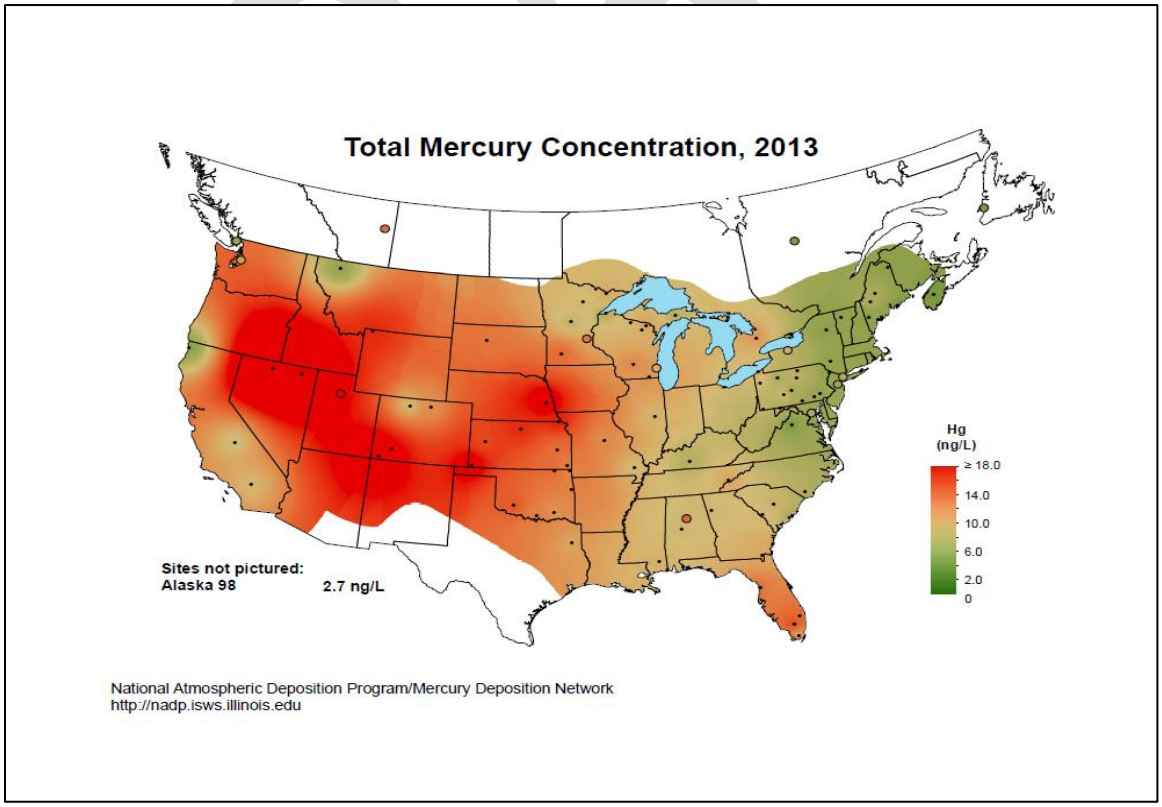

Figure 50 U.S. Total Mercury Concentration 2013

Lastly, to help illustrate the advantages and benefits of having a robust and truly long-term trend network and its data, Figures 49 and 50 show the annual color-shaded contour maps of the MDN sites nationally from 2003 and 2013. Because the number and density of sites in this network nationally (along with some other factors) were not as great as that of the NTN, the NADP felt the mapping program it uses to create its maps was not the most appropriate or best way to representatively depict total mercury concentrations (and deposition) until 2003 (even though MDN sites began collecting data in 1996). As one can see, visible discernable (and significant) trends are not as readily apparent over the 10-year time period represented by the maps. The apparent large increase in mercury concentrations in the western half of the country from 2003 – 2013 is due in part to the increase in the spatial density of sites in the MDN, which then provides the NADP mapping software with sufficient data source points to more appropriately interpolate concentration levels between sites, which it didn't have for the generation of the 2003 map.

Future NTN and MDN Monitoring Plans:

Maine DEP plans to continue its support of the statewide NTN and MDN deposition monitoring networks and its financial sponsorship of the sites it currently is responsible for, because of the many important benefits having such a long-term network provides. Their data are valuable to not only our own internal data users, policy makers and the general public, but also to an amazing variety of other users representing many other scientific disciplines, ranging from wildlife biologists, water quality specialists, and epidemiologists, to atmospheric chemists, government regulators and academic researchers from many different fields. Maine DEP has played a critically important role during the most recent few years of stepping in to provide both funding and operational support to some of the oldest and longest running sites in the state, and the nation, when their original sponsoring organizations were faced with funding cutbacks which would have meant the closing of these sites. Specifically, Maine DEP rescued the NTN sites at Greenville (ME09) and Caribou (ME00) when the University of Maine and NOAA, respectively, had their funding cut for continued operation of these sites. The closing down of these two sites, or any long-term trend site for that matter, at this point in their history would have represented an irreversible loss in being able to continue documenting the long term trends in deposition in Maine and in the country without any confounding interruption in the dataset. As long as resources allow, Maine DEP is committed to preserving the operational status of the sites in the state.

A priority effort for the agency during the past five years was collaborating with EPA-NE and the Passamaquoddy Tribe to re-establish the tribal NTN site (ME95) that was formerly located near Scraggly Lake. This was the only area of the state that did not have any wet deposition monitoring and the precipitation chemistry it provides for this heavily forested, agricultural and surface water based recreational area. Fortunately, that effort was successful with the establishment of a new site (ME94) in October 2013, as noted previously.

POLLEN MONITORING

Despite its pervasiveness, pollen exposure has received very little attention from the public health and air monitoring communities. This may be due in part to the fact that pollen is a naturally occurring substance, as well as the perceived lack of severity regarding its health impacts. Moreover, airborne pollen is a health concern solely because of its allergenic properties, which vary both qualitatively and quantitatively from individual to individual and with a large dependence on the particular pollen species. Mechanistically, pollen and fine particulate matter adversely impact the respiratory system through an inflammatory response. The prevalence of allergic rhinitis alone in the U.S. population has increased from 10% to 30% from 1970 to 2000 and effects approximately 40% of the children. Further, approximately 35 million people in the U.S. currently have asthma, and the numbers may grow to more than 100 million by 2025. In addition to rhinitis and asthma, pollen also contributes to sinusitis, conjunctivitis, urticarial (hives) and atopic dermatitis.

The difficulties associated with exposure assessment and establishing health criteria limit the ability to adequately define the public health problem. However, pollen health threats are real and are increasing in response to warmer temperatures and higher carbon dioxide levels. The potential effects of air pollution on pollen allergenicity are also expected to increase as the intensity, frequency and duration of air pollution episodes increase with a steadily warming climate. Winds can carry fine PM and pollen grains to locations that are away from where the air emission source(s) originated. Maine DEP-BAQ plans to stay engaged with, and wherever possible assist in, the efforts of local, state, regional and national health and scientific professionals and organizations seeking to translate the already known health impacts of pollen and a significant lack of pollen monitoring data into an effective and sustained public health action plan, establishment of a national pollen monitoring network and a health intervention strategy.

METEOROLOGICAL MONITORING

Integral to the analysis of air pollution data is the need for meteorological monitoring to provide wind speed and direction data. The wind speed and direction data can then be used to track both where the pollutants may have come from and where they may be going. To ensure the availability of data Maine has operated monitoring sites for wind speed, direction and stability in Presque Isle, Bangor, Augusta, Lewiston, Owls Head and Cape Elizabeth. A monitor is also operated on top of Cadillac Mountain in Acadia National Park during the summer season. In addition to these sites the National Park Service operates a monitor in Bar Harbor and the

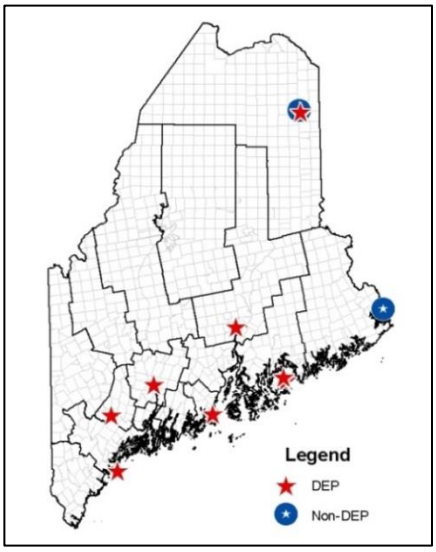

Figure 51 Meteorological Monitors

Passamaquoddy and Micmac tribes operate monitors at their sites. The locations of monitors around the state are shown in Figure 51.

The data from these sites can be used to develop wind roses covering any desired time period. The meteorological data can be combined with pollutant data to develop pollution roses. An example of wind rose covering a five-year period is shown in Figure 52 and a graph plotting ozone vs. wind direction is shown in Figure 53. Five year wind roses from all of the DEP and participating industrial monitors can be requested from the DEP at http://www.maine.gov/dep/air/meteorology/Windrosehome.html by clicking on 'contact us.' In the past there have been monitors operated at a number of industrial sites around the state either as part of a monitoring program or to gather data to be used in a modeling analysis for a source required to show compliance with air quality standards. For most modeling analyses a five year data set is required. A list of those sources that have collected and processed meteorological data for use in modeling can be found on the Bureau's web site at http://www.maine.gov/dep/air/meteorology/metdata.html.

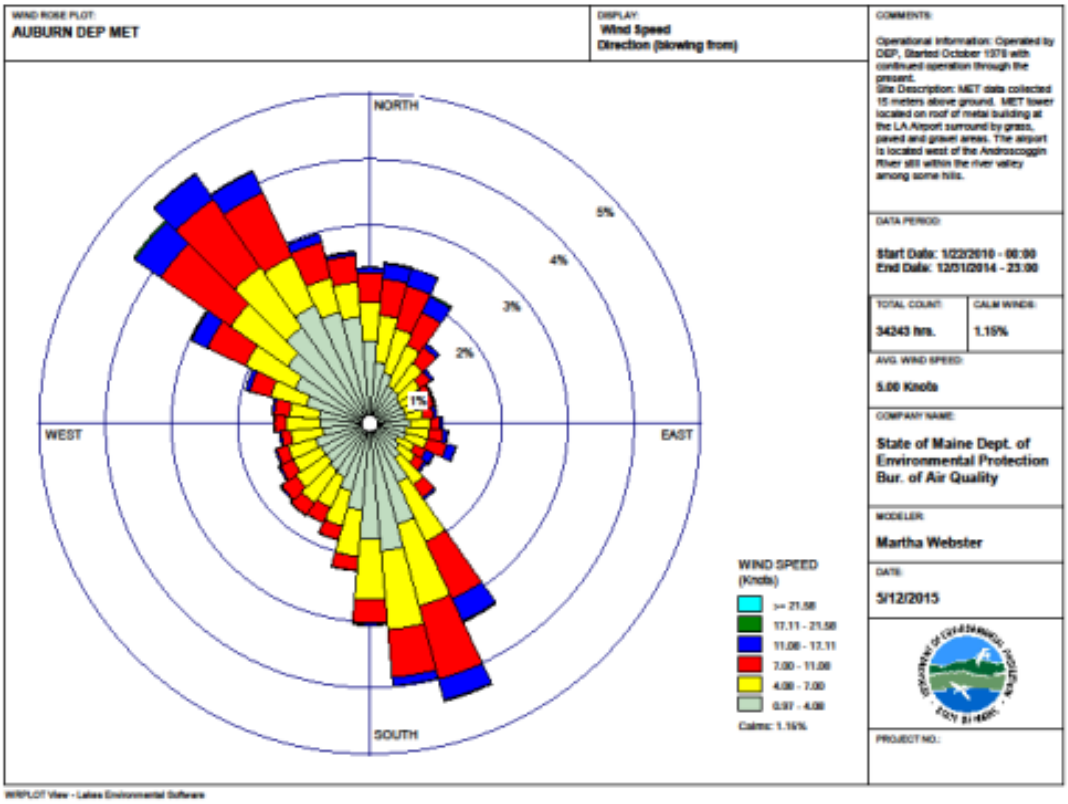

Figure 52 Five Year Annual Wind Rose for Augusta, Maine

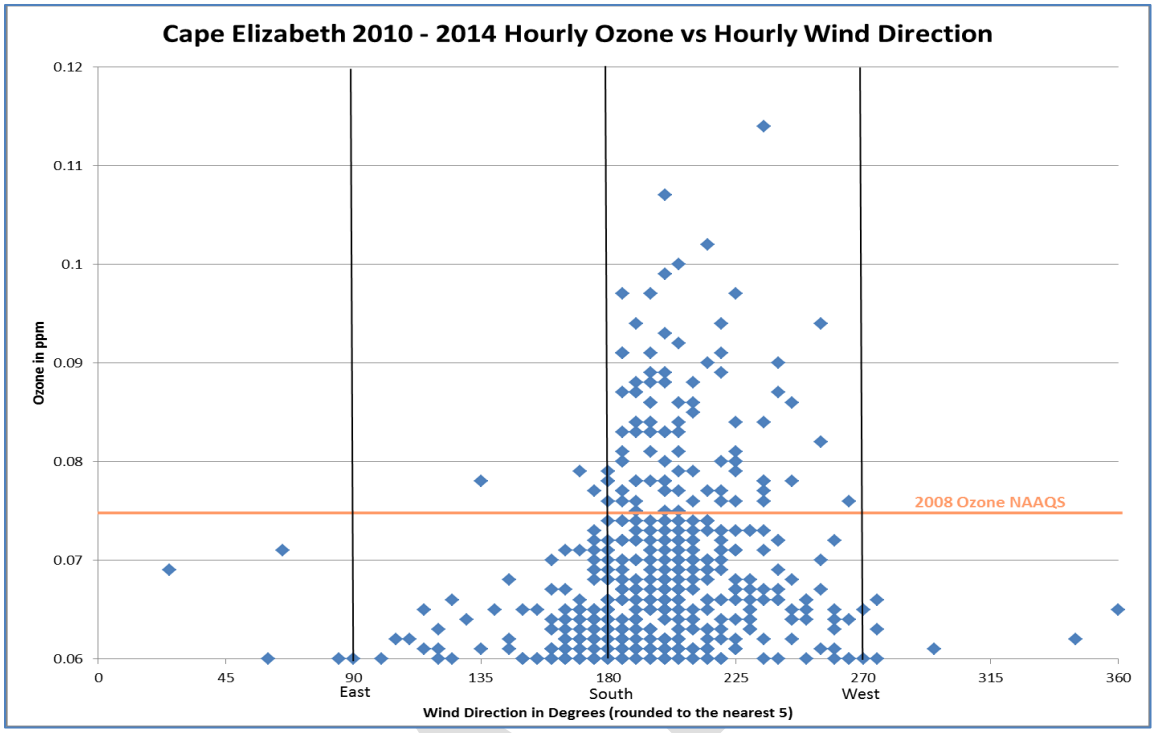

Figure 53 Cape Elizabeth Hourly Ozone concentrations vs. Wind Direction 2010-2014

MONITORING EQUIPMENT

Maine operates and maintains an extensive and expensive inventory of air monitoring equipment to support the current network. Most monitors and calibrators in use today cost several thousand dollars apiece. The requirement for a data logger and an adequate shelter to house the equipment can put the cost of establishing a simple, one pollutant site up to $50,000. The EPA has conducted research into more affordable monitoring equipment that might be useful in setting up a quick "hot spot" reconnaissance sampling effort, but few instruments have proved to meet the strict method requirements set forth in the Code of Federal Regulations.

The current equipment plan calls for instrument replacement after about ten years of use. Depending on available funds the actual equipment replacement cycle for monitoring and laboratory instrumentation is usually longer, approximately 15-20 years. The yearly budget for the Bureau has remained steady for the past several years at about $100,000 for capital equipment replacement. This amount, along with some capital equipment dollars available through EPA grants, has enabled the Bureau to maintain equipment and achieve a high data recovery rate for the monitoring network. In recent years Maine has been able to purchase several new continuous particulate monitors (BAMs), replace aging particulate filter monitors, replace several ozone monitors and calibrators, and trace level carbon monoxide, sulfur dioxide and nitrogen dioxide monitors. The existing inventory of monitoring equipment is adequate to maintain the current network.

The DEP will continue to respond, as it has in past years, to monitoring requests from municipality officials when specific neighborhood health concerns are identified and a specific source is targeted. Recent requests resulted in special monitoring sites established in Eliot, Waterville, Augusta, and Thomaston. The concerns involved emissions from power-generating plants, idling locomotives, open gravel and limestone pit operations, and major road and utility repairs. Of necessity, these monitoring sites are often temporary arrangements, and the data representative of only a very small, sub-neighborhood area. Additionally, most of the monitoring equipment we operate reports daily or hourly averages, in accordance with EPA requirements, because the regulatory code and ambient air standards generally refer to annual, 24-hour, and one hour averages. Any short interval "spikes" of high concentrations from a source are often masked by the long term average that includes much longer intervals of time when significantly lower concentrations are present. The recent neighborhood studies have not identified any violations but our efforts did serve to provide factual data for municipalities and industrial sources to use as a common denominator in further discussion and, in some cases, resolutions. In each of these instances, the DEP set up air sampling equipment to assess the circumstances. The deployed monitors were from the spare equipment inventory in most cases. Sometimes, old and outdated equipment was refurbished and pressed back into to service. The are no additional funds for overtime, more personnel or equipment for these special requests, so each request has to considered carefully before resources are diverted from other program areas.

One area of present interest, which may necessitate additional resources, is the modernization and expansion of the continuous gaseous and particulate network. Replacing the aging $PM_{2.5}$ and PM_{10} filter based monitors, most placed into service over fifteen years ago, with continuous monitoring equipment will reduce the costs associated with filter management, weighing and shipping. Additionally, these improvements will help the Department reach a goal of providing hourly values of criteria pollutant monitoring to the public though the Department web site. The Department has an existing web page and a link to the EPA AirNow web page but the site data are somewhat less informative than desired, and not easily updated when changes occur. Internet security issues, hardware incompatibility, user accessibility issues and some learning curve problems have hampered progress in this endeavor.

One area of budgetary concern is that some monitoring and calibration equipment, as well as some big-ticket replacement parts, may cost several thousand dollars apiece but do not reach the capital equipment level of $5000. This equipment has to compete with the rest of the operating budget for the Bureau and the budget does not always allow for routine replacement of this level of equipment.

QUALITY ASSURANCE

The Environmental Protection Agency has a policy requiring all projects involving the generation, acquisition, and use of environmental data be planned and documented, and have an Agency-approved quality assurance project plan (QAPP) prior to the start of data

collection. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements, and define QA/QC activities to be applied to the project, all within a single document. The QAPP should be detailed enough to provide a clear description of every aspect of the project and include information for every member of the project staff, including samplers, lab staff, and data reviewers. The QAPP facilitates communication among clients, data users, project staff, management, and external reviewers. Effective implementation of the QAPP assists project managers in keeping projects on schedule and within the resource budget. The EPA's QA policy is described in the Quality Manual and EPA QA/R-1, *EPA Quality System Requirements for Environmental Programs.*

Maine currently has four QAPP's in place for various air monitoring programs. The Particulate Matter (PM) NAAQS Pollutants QAPP was revised and approved by EPA on May 30, 2007. It is currently undergoing a revision to incorporate all aspects of PM_{10} monitoring using low volume manual samplers and continuous PM monitoring using TEOM samplers. The Gaseous NAAQS Pollutants QAPP was revised and approved by EPA on June 23, 2009. It is currently undergoing additional review with additional changes expected later this year. The Photochemical Assessment Monitoring Station (PAMS) QAPP was revised and approved by EPA on October 28, 2005. It is currently under review with additional changes expected later this year. The Air Toxic Volatile Organic Compound (VOC) Pollutants QAPP was revised and approved by EPA on September 28, 2004. It is currently under review with additional changes expected later this year. Additional revisions will be needed to address the trace level monitors required for the NCore site and for the lead monitoring requirements that will be effective next year.

Maine currently operates an extensive quality assurance program that includes auditing of all ambient monitors by staff from the Laboratory and Quality Assurance Section. In order to maintain a high level of confidence in the accuracy of data collected by ambient monitors the lab and QA staff conduct audits of the instruments each quarter. This program far exceeds the minimum requirements of EPA. This requirement will be relaxed in future revisions based on demonstrated results to date so as to allow for staffing or equipment issues that may prevent this requirement from being met each quarter.