Air Pollution Transport and How It Affects New Hampshire

May 2004

NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

Cover photo: Mount Jefferson, New Hampshire – Computer simulated split photograph demonstrating clear conditions and reduced visibility from small particle pollution

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May 2004

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NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

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A Message from the Governor

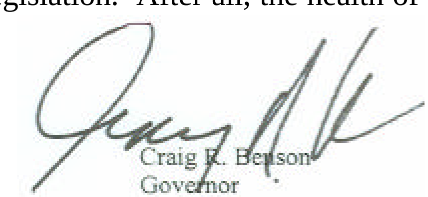
New Hampshire's environment is important to our quality of life and public health, as well as our economy. My administration has worked hard to preserve our natural resources in order to make this state a great place to live, work or simply take a vacation. Many people come to New Hampshire to enjoy our state's natural beauty, admire the breathtaking views of our mountains and breathe our fresh air. Though we have done much in this state to reduce pollution and ensure a healthy environment for all, keeping the air clean offers a particular challenge.

New Hampshire has been at the forefront of reducing emissions of air pollution within the state's borders, but research over the past few years has shown that most of the air pollution the state experiences comes from out of state sources. Some of these pollution sources are hundreds of miles away, but their emissions are transported into the state with the wind, even over these great distances. Though we are responsible for air pollution originating in New Hampshire, much of the responsibility for clearing the air is shared by other states and by the federal government. Air pollution does not respect geopolitical boundaries and it is for this reason that we have analyzed the effects on New Hampshire's citizens and businesses from this transported pollution.

This report presents an eye-opening assessment of the cost of air pollution from these far-away sources. Though many of us do not think of how air pollution affects our lives, the scientific analysis contained in this report estimates that the health-related impact of air pollution transported into our state exceeds $1 billion annually. Beyond that, are the increased costs of doing business, increased healthcare claims, and the loss of worker productivity due to respiratory illness which affect not only those people, but all of us. The health of many of New Hampshire's citizens has been greatly affected, thereby reducing their quality of life. When some of us suffer from the adverse health effects of air pollution, we all pay the price.

New Hampshire's businesses also feel the affects, and this is significant since the environment drives a big part of the state's economy. Failing to maintain a healthy environment will ultimately reduce business opportunities since many businesses will have to bear higher operational costs due to tighter federal regulations, along with higher energy costs. Tourism is also affected since much of the pollution originating from out of state also obscures the scenic views of our mountains and seacoast for which this state is noted.

This administration is committed to protecting our air and environment by working with regional and federal agencies to ensure that effective and reasonable legislation is passed to address this issue. The more that is known about the personal and economic impacts of air pollution, the stronger is our case to pass meaningful legislation. After all, the health of our citizens and the vitality of our state depend on it.



Air Pollution Transport and How It Affects New Hampshire

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REPORT HIGHLIGHTS

- New Hampshire experiences an average of ten days per year when the air quality is officially categorized as unhealthy. This is enough to classify portions of the state as nonattainment for ozone (i.e., dirty air regions), prompting certain federally required actions to reduce air pollution from in-state sources.
- During periods of unhealthy air quality for ozone and small particles in New Hampshire, approximately 92 percent to nearly 100 percent of this pollution originates from sources located outside of New Hampshire. These pollutants are transported into the state with the wind over great distances.
- New Hampshire has taken steps to reduce pollution emissions on a local basis to ensure that the problem doesn't get worse for our own citizens or for those living downwind.
- Since the large majority of air pollution in New Hampshire comes from out-of-state sources, emission reductions are necessary in upwind states to bring New Hampshire into compliance with clean air regulations.
- Emissions from large power plants in the Midwest and urban areas to the south of New Hampshire provide the vast majority of the pollution that causes unhealthy air quality, impaired visibility, acidification of lakes and forests, and mercury contamination throughout New Hampshire.
- When acid rain forming pollutants and mercury are released into the air, they are chemically transformed into acidic compounds and toxic mercury and carried many miles before being deposited onto land and into waterbodies. Some forms of mercury are more likely than others to deposit in areas near their source, creating local "hot spots."
- Small particles and ozone have been shown to produce adverse health effects even at levels below the current federal National Ambient Air Quality Standards (NAAQS).
- Failing to have a healthy environment will ultimately reduce business opportunities – which in turn will reduce jobs, lower income and jeopardize the economic outlook of affected communities.
- Direct health-related costs to New Hampshire from transported air pollution due to out-of-state sources are estimated to exceed $1 billion per year based on health-related cost data obtained from independent studies. Economic impacts beyond direct health-related costs that are not accounted for in this figure include:
    - Increased health claims and health risks for all New Hampshire residents.
    - Loss of worker productivity.
    - Higher electricity costs and operating costs for local power plants due to increased federal requirements for operation in dirty air regions.
    - Higher operating costs for certain businesses in the state due to increased federal requirements for operation in dirty air regions.
    - More expensive fuels (including gasoline) and vehicles due to increased federal requirements for operation in dirty air regions.

- With more vehicles on the road and steady growth in total miles driven both in New Hampshire and nationally, strong federal emission reduction requirements for motor vehicles are essential for meeting clean air goals.
- Effective national multi-pollutant legislation for electric generating units is critical to New Hampshire if the state expects to achieve consistently healthy air quality. Meaningful legislation will also avoid unnecessary and highly expensive pollution control measures required for downwind areas (a requirement under federal law for areas with poor air quality).
- The full benefits of the proposed federal Clear Skies Act will not be realized until 2020 – too late for New Hampshire to reach clean air goals by the required attainment date of 2010 – and will only be a marginal improvement over what the existing Clean Air Act provisions require. Both the proposed congressional Clean Air Planning and Clean Power Acts achieve greater reductions sooner.
- The New Source Review overhaul as proposed by EPA will allow older, dirtier facilities to continue to make major, life-extending improvements without installing pollution control equipment. The result will be continued unhealthy air quality for states like New Hampshire due to air pollution transport and increased requirements for local controls.
- Controlling pollution from power plants is cost-effective, returning over $12 of health-related benefits for every $1 spent on emission controls.

- SECTION 1 -
INTRODUCTION

Over the past 20 years, significant progress has been made in reducing emissions of air pollutants and improving air quality nationally and in New Hampshire. Programs implemented since the Clean Air Act Amendments of 1990 regulate more sources of air pollution and impose additional or more stringent regulations on previously controlled sources. Gradual air quality improvements can be attributed to mandated reductions in emissions from businesses and industries, as well as technological improvements in automobiles. Despite the progress in achieving pollution emission reductions, New Hampshire still continues to experience unhealthy air quality days and there are even a few locations in the state where the air quality is getting worse.

While some air pollution in New Hampshire comes from obvious sources within the state, much of it comes from sources outside of New Hampshire, sometimes from thousands of miles away. Just as weather forecasters look to where the wind is coming from to forecast the weather, air pollution forecasters look in the same direction to see where air pollution is coming from. The same wind that brings us the weather often brings air pollution along with it. This movement of air pollution – called "transport" – is not a simple process. Pollutants in the air undergo complex chemical reactions, and pollution is added or removed from the air as it moves along.

In many areas of the country, such as New Hampshire, achieving healthy air quality is not limited to local air pollution reductions. In order to succeed in clearing the air, New Hampshire must work both within the state and with our neighbors to coordinate needed air pollution emission reductions. Since the wind frequently comes into New Hampshire from our west and southwest, we need to look in these upwind directions for help in cleaning the air. Clean air is needed not only for our health and environment, but for the economic well-being of our businesses and tourism industry.

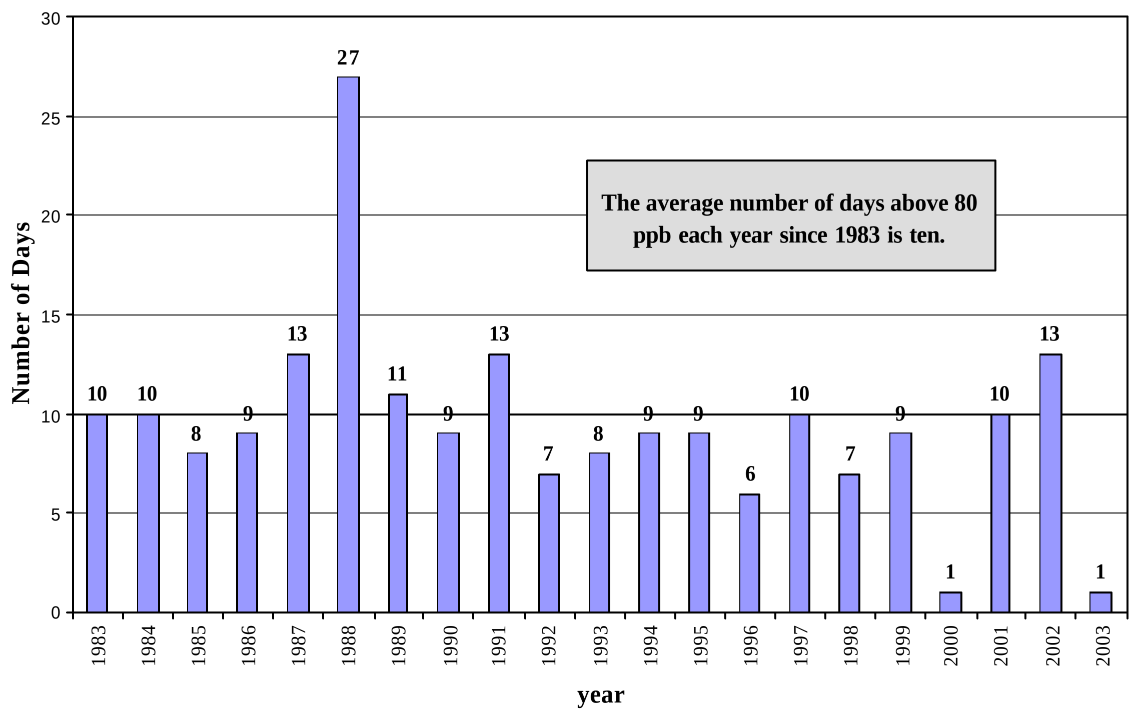
- SECTION 2 -
ASSESSMENT OF NEW HAMPSHIRE'S AIR QUALITY AND THE AIR POLLUTANTS THAT ARE MOST SUBJECT TO TRANSPORT

Ozone

New Hampshire experiences an average of ten unhealthy air quality days per year when levels of ground-level ozone exceed federal health-based standards, called National Ambient Air Quality Standards or "NAAQS" (see Figure 2.1). This is sufficient enough for the U.S. Environmental Protection Agency (EPA) to classify portions of the state as "nonattainment" for ozone, in other words, these areas do not meet federal ambient ozone standards (see Figure 2.2).

"Good Up High, Bad Nearby" *– Ozone can be good or bad, depending on where it is found. Ozone in the upper atmosphere (stratosphere) is naturally occurring and shields us from the sun's harmful ultraviolet rays. Ozone in the lower atmosphere is a manmade pollutant which can have harmful effects on living things.*

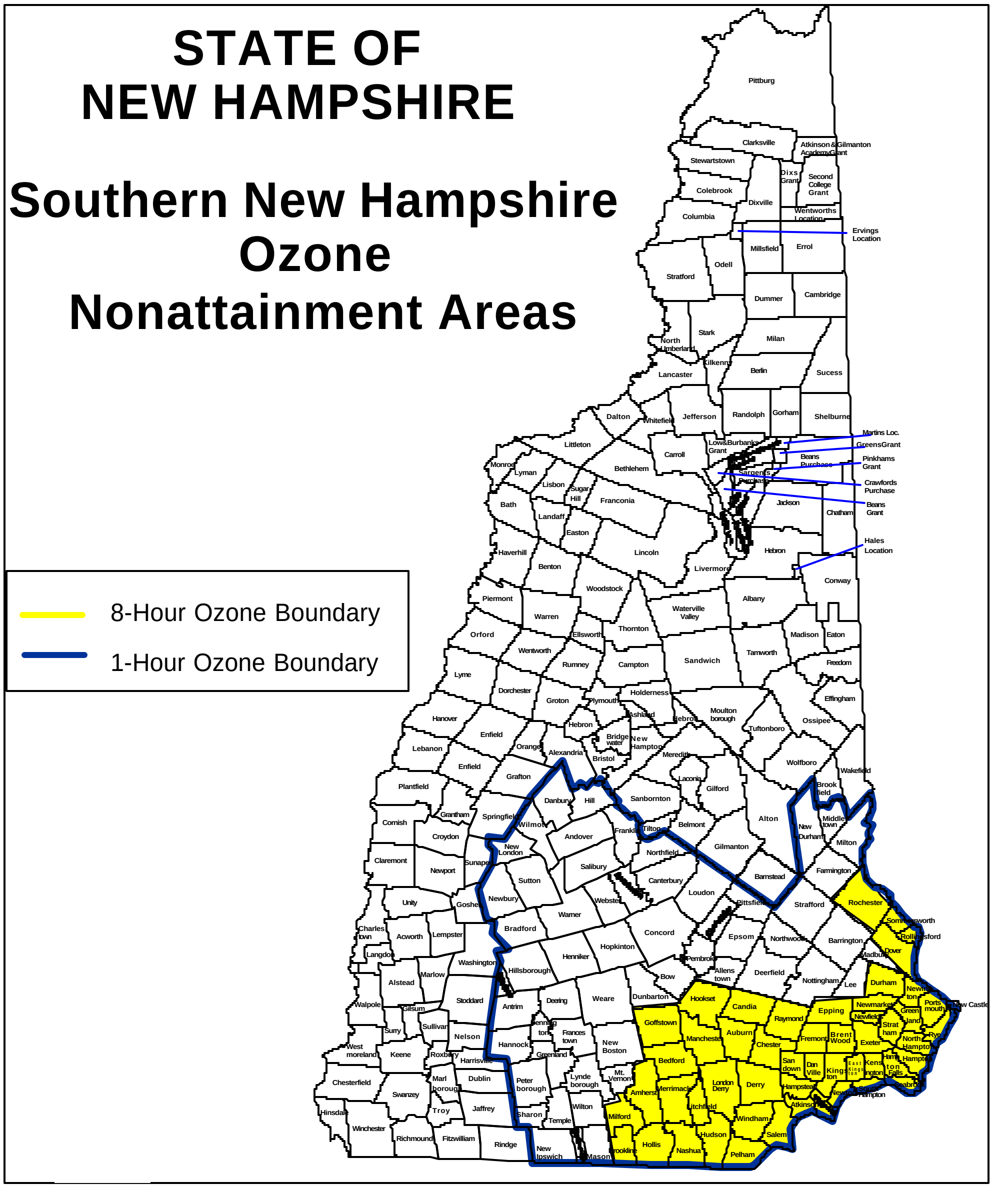
Figure 2.1 - Number of Unhealthy Ozone Days in New Hampshire (Over 80 parts per billion based on the eight-hour ozone standard)



Total number of days per year when the eight-hour average ozone standard was exceeded in New Hampshire. Changes from year to year are largely driven by weather variations. As some years are colder or rainier than others, some years are more conducive to ozone formation than others. Source: NHDES, December 2003

The main concern to humans relative to ground-level ozone is how it affects the respiratory system. Effects of short-term exposure include coughing, painful breathing, and temporary loss of some lung functions. Long-term exposures may cause repeated inflammation of the lungs, impairment of lung defense mechanisms and changes in lung structure, which could lead to premature aging of the lungs. Ozone can aggravate asthma, emphysema, bronchitis, and other respiratory diseases.

Figure 2.2 - Ozone Nonattainment Areas in New Hampshire, 2004

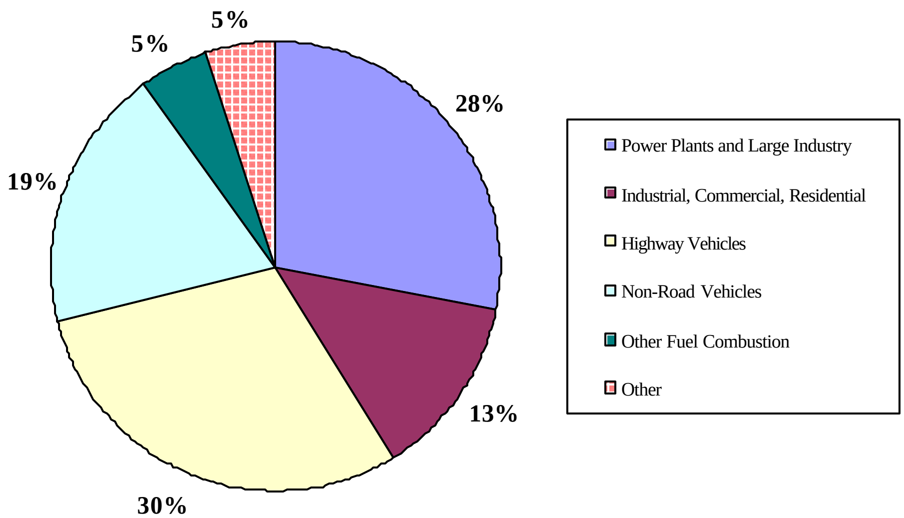


Areas in New Hampshire where air monitoring data indicates nonattainment with the eight-hour federal ozone standard (shaded yellow) and the one-hour federal ozone standard (within the dark blue line). Businesses located in nonattainment areas must adhere to more stringent requirements than businesses located in other areas.
Source: NHDES, July 2003

Ozone can also damage forests and other vegetation. Adverse effects of ozone exposure to vegetation include discoloration of leaves, light flecks, dark stipples, yellow spots, premature aging, leaf loss, and reduced growth rates and crop yields.

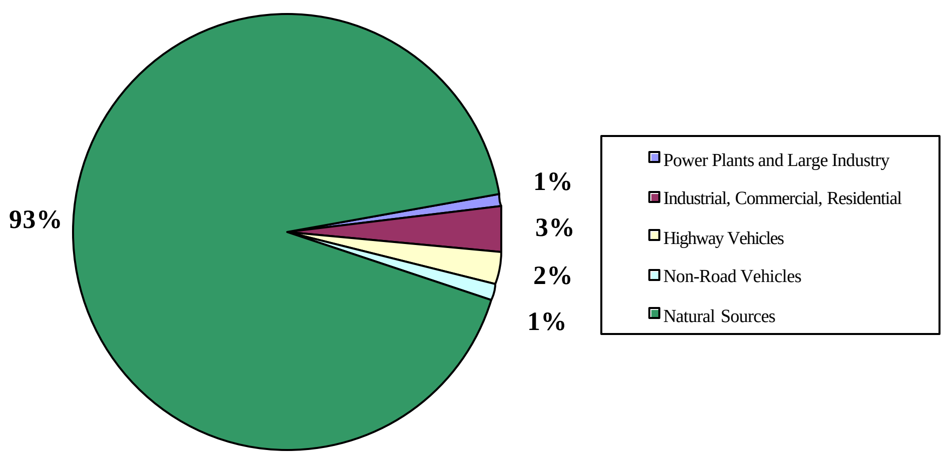
Unlike many other pollutants, ground-level ozone is not directly emitted into the atmosphere from a specific source. Instead, ground-level ozone is formed when nitrogen oxides (NOx) chemically react with volatile organic compounds (VOCs) through a series of complicated chemical reactions in the presence of strong sunshine (ultraviolet light). The sources of NOx and VOCs – called ozone precursors – are many and varied. Almost all NOx emissions originate from human activities related to fossil fuel combustion (see Figure 2.3). Conversely, over 90 percent of VOC emissions in New Hampshire result primarily from natural (biogenic) sources, mainly forests and urban vegetation (see Figure 2.4).

Figure 2.3 - National Nitrogen Oxide (NOx) Emissions by Sector, 1996



Data Source: EPA 1996 National Emissions Inventory (NEI)

Figure 2.4 - Volatile Organic Compound (VOC) Emissions in New Hampshire by Sector on a Hot Summer Day (when emissions are greatest), 1996

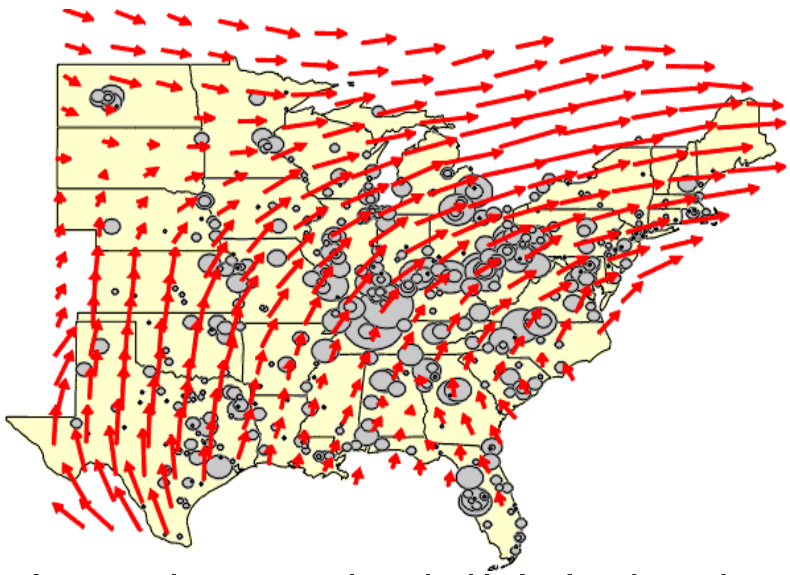


Data Source: NHDES and EPA

The formation of ozone is not an instantaneous process, nor is it limited in geographical scope. Numerous studies and modeling data show that in the northeastern United States, the wind often transports the pollutants responsible for ozone formation well beyond the locality that produced the emissions. This transport phenomenon is clearly demonstrated in Figure 2.5, which shows a typical wind pattern when ozone reaches unhealthy levels in the Northeast. The location and size of the major NOx pollution stationary sources are also shown.

Key Point: New Hampshire's unhealthy ozone days are caused by the transport of ozone and ozone precursors into the State from upwind jurisdictions in the Northeast and industrial Midwest.

Figure 2.5 - Wind Patterns and NOx Emissions on High Ozone Days in New Hampshire and the Northeast



Typical wind patterns when ozone reaches unhealthy levels in the Northeast and New Hampshire. The circles indicate the location and magnitude of NOx emissions from the major NOx pollution stationary sources – electric power plants.
Source: Northeast States for Coordinated Air Use Management (NESCAUM), 1997

Small Particle Pollution

As with ozone, portions of New Hampshire also experience elevated levels of small particles, defined as particles that are less than 2.5 micrometers (μm) in diameter, called $PM_{2.5}$. For comparison, a human hair is approximately 70 μm in diameter (see Figure 2.6).

Evidence of the dangers of small particles is growing in the published literature. These particles can be inhaled deeply into the lungs where they can induce or aggravate respiratory illnesses. Scientific studies have linked exposure to small particles with a series of significant adverse human health effects including: 1) respiratory symptoms in healthy individuals, e.g., coughing, wheezing; 2) aggravation of asthma, chronic bronchitis, or emphysema; 3) complications of cardiovascular disorders; 4) alterations in the respiratory system's defense against foreign materials; 5) damage to lung tissue; and 6) premature death.

Annual $PM_{2.5}$ concentrations have little variation across the state, averaging 10-11 micrograms per cubic meter (ug/m^3) (see Figure 2.7). The federal annual standard (NAAQS) for $PM_{2.5}$ is 15 $\mu g/m^3$. Over the past four years, annual weather fluctuations have resulted in a statewide range of 8-14 $\mu g/m^3$. Despite not exceeding the federal standard for small particles, the concentrations still frequently reach unhealthy levels for people who are most sensitive to the effects of particle pollution (the elderly, children, and people with lung or heart conditions).

Figure 2.6 - Size of Small Particle Pollution

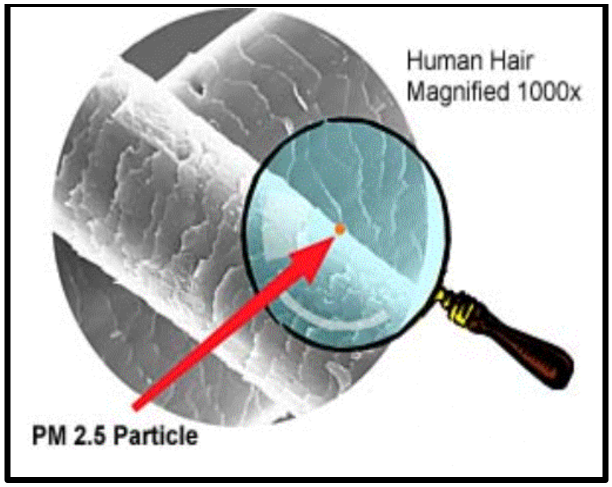
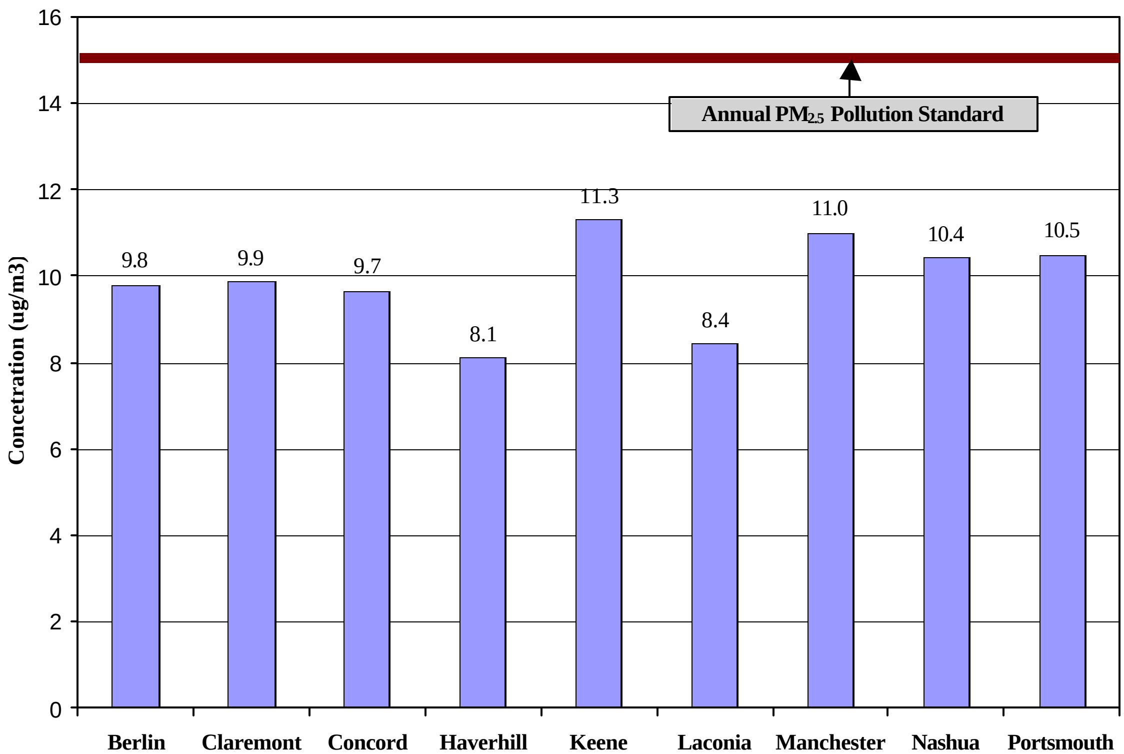


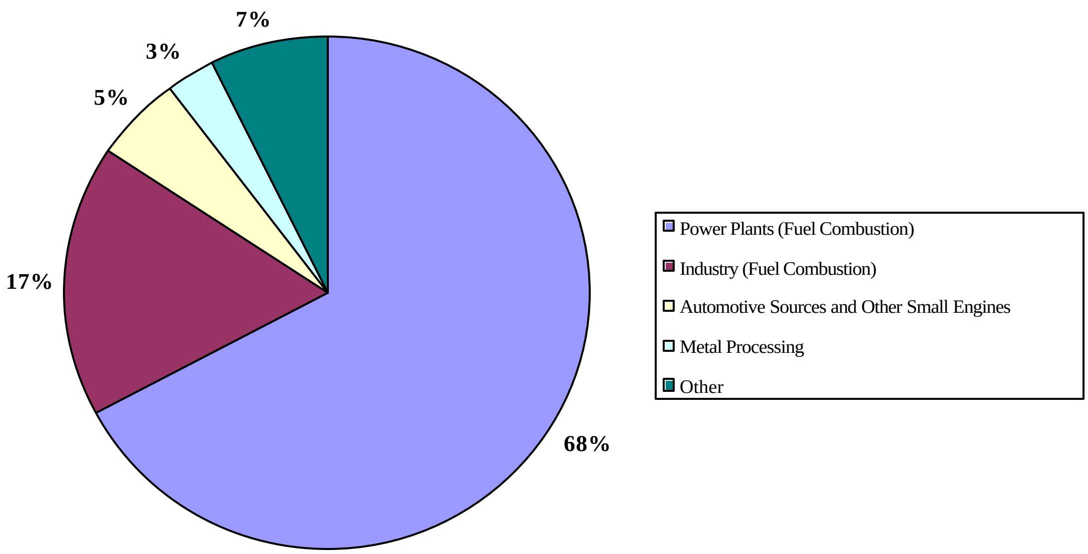
Figure 2.7 - Annual $PM_{2.5}$ Concentrations by Location, 2001-2003 Average



Average annual $PM_{2.5}$ concentrations measured in New Hampshire from 2001 through 2003. Note that the typical value of around 10 $\mu g/m^3$ is about two thirds of the standard. Data for 2003 is projected based on 9 months of complete data.
Source: NHDES, 2004

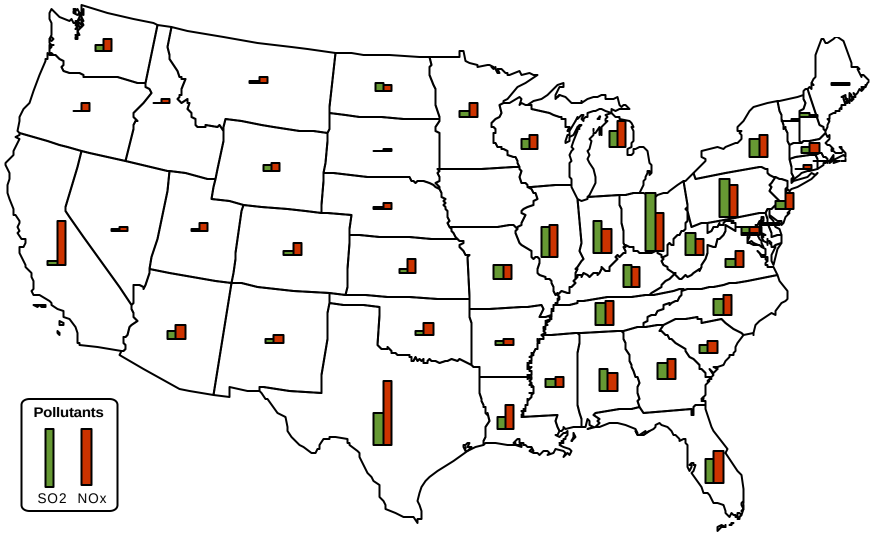
Small particles can be emitted directly from burning materials or they can be formed from other gases such as sulfur dioxide (SO_2), NOx, and certain VOCs, which react in the atmosphere. Most of the small particles found in the Northeast result from burning coal, diesel, gasoline, wood, and other fuels, with the large coal burning industries and power plants in upwind areas contributing the largest amounts (see Figures 2.8 and 2.9). These facilities release huge amounts of SO_2 that react with ammonia in the atmosphere to form ammonium sulfate [$(NH_4)_2$ SO_4] particles. NOx also reacts with ammonia to form ammonium nitrate (NH_4NO_3), but it does so to a much smaller degree and mostly during the cold winter months. Small particles are also composed of elemental carbon (soot), organic compounds, biogenic organic compounds such as terpenes, and metals such as iron, lead, cadmium, nickel, copper and zinc (see Figure 2.10).

Figure 2.8 - National Sulfur Dioxide Emissions, 1996



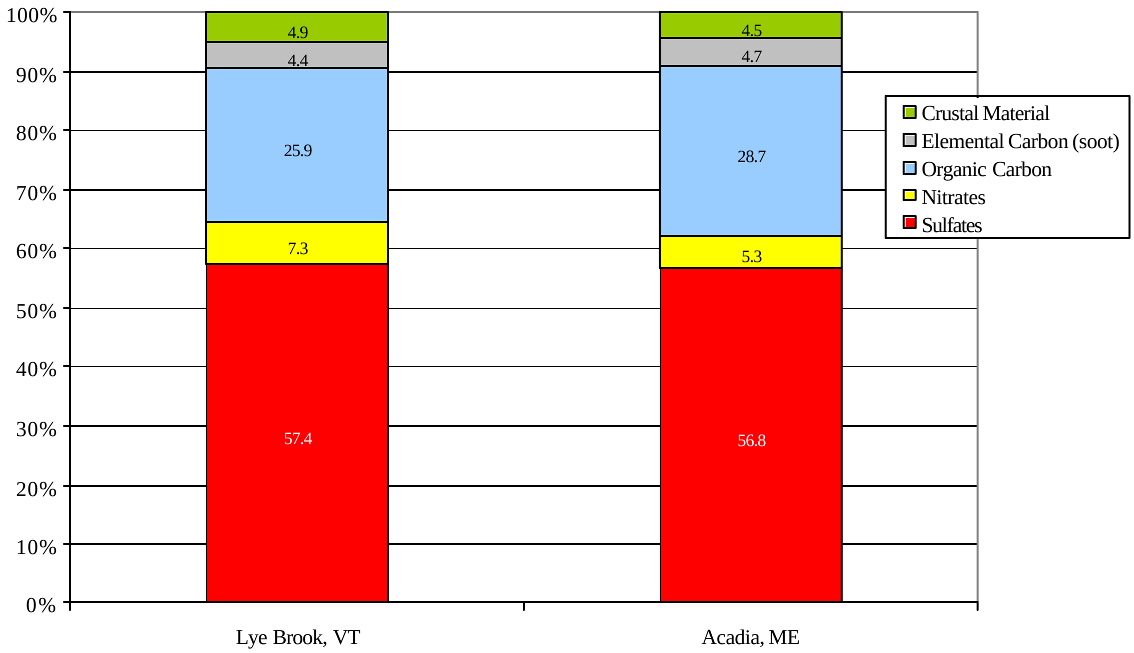
Data Source: EPA 1996 National Emissions Inventory (NEI)

Figure 2.9 - Total Sulfur Dioxide (SO_2) and Nitrogen Oxide (NOx) Emissions by State, 1996



Total SO_2 and NOx emissions by state. The highest emissions are not associated with population, but rather located in the states with the most electricity generated by coal combustion. The length of the bar represents the relative magnitude of emissions.
Source: EPA Clear Skies Act 2003 Website Technical Appendix A

Figure 2.10 - Composition of $PM_{2.5}$ Concentrations at Class I Areas in the Northeast, Annual Averages 1996 - 1999



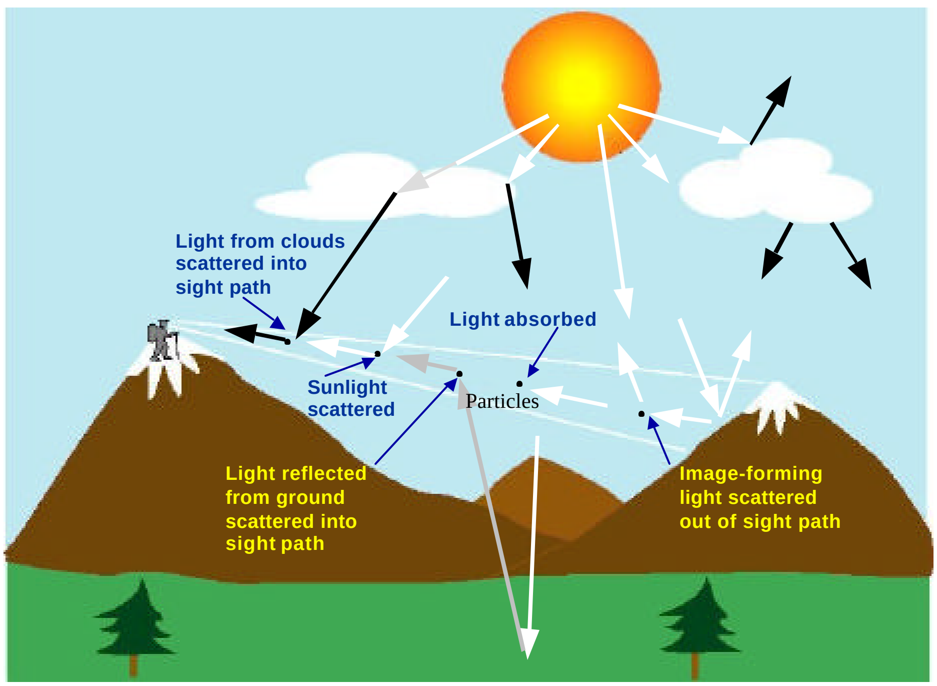
Measured annual composition of small particles collected in New England. Sulfate-based particles dominate the annual composition of small particles in the region and are the major cause of impaired visibility throughout the Northeast. The second largest component, organic carbon, is the result of particles formed from fuels and solvents released during combustion, re-fueling, cleaning, and other industrial processes. Elemental carbon is primarily composed of particles directly released during combustion. Soot from diesel engines is the leading source of these particles. Crustal materials are soils stirred by weathering, construction, or traffic. Nitrates are formed by chemical reactions involving NOx emissions and are primarily of concern during colder weather.
Source: NHDES and IMPROVE Database, 2001

Current research is studying the extent to which particle composition contributes to health impacts. While the findings are not yet complete, what has been made clear is that the small particles found in the Northeast carry toxic and often carcinogenic materials. Small particles formed by coal burning with an especially large sulfate component, which by itself is nontoxic, often carry toxic compounds such as mercury and arsenic. Diesel and wood smoke contain particles that carry numerous carcinogenic materials as well.

Key Point: Small particle pollution, which often carries toxic substances, has a local impact and is also very susceptible to long-range pollution transport.

Some of the same particles linked to serious health effects are the major cause of reduced visibility, even in supposedly pristine areas like the White Mountains in New Hampshire. Reduced visibility, or “regional haze,” occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere (see Figures 2.11 and 2.12). The classes of small particles principally responsible for reduced visibility in New Hampshire are sulfates, organic matter, carbon (soot), soil dust, and nitrates. While all small particles and several gaseous pollutants impair visibility, ammonium sulfate (a product of SO_2 pollution) is usually the most light-scattering pollutant in the Northeast. Ammonium sulfate swells with increasing relative humidity, resulting in greater amounts of re-directed visible light, dimmer views, and increased whitish haze.

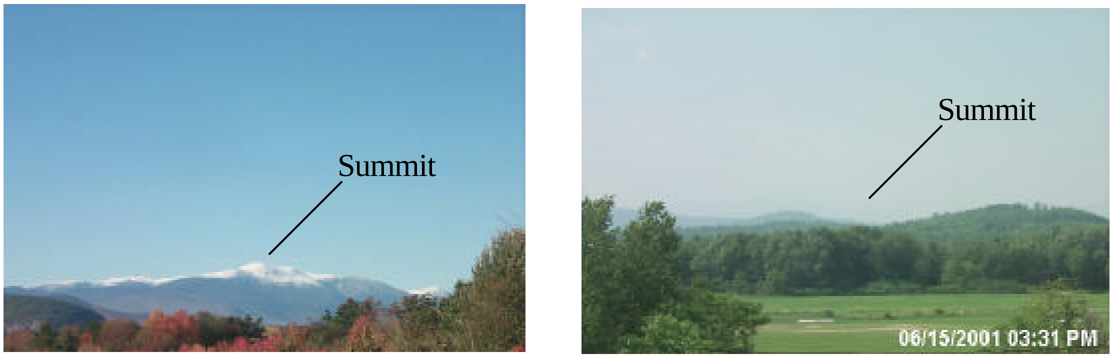
Figure 2.11 - What Causes Haze?



Visibility is reduced when light is absorbed, scattered, or interfered with. Large particles are efficient at absorbing light, thus darkening a distant image. Small particles can absorb light and scatter it (obscuring the image) and they can cause interfering light to be introduced to an image (adding a whitish appearance). Gases can cause light to scatter, adding or subtracting colors to a view of an image.
Source: Malm, 2000

Key Point: Small particle pollution transported into New Hampshire results in reduced visibility and hazy views in many regions of the White Mountains and throughout the state.

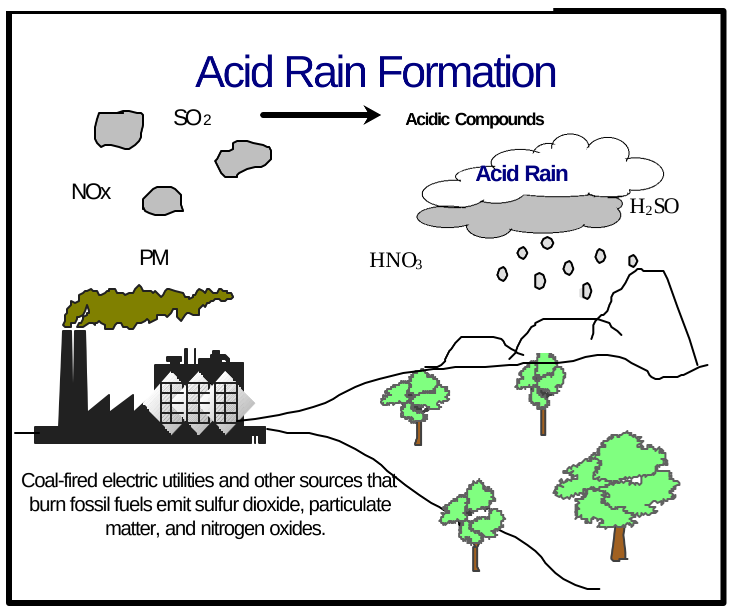
Figure 2.12 - The Difference Haze Makes on Visibility



Two photographs of Mt. Washington from the same location (camera angle slightly shifted), one on a clear day and one on a hazy day. The view of Mt. Washington on the right is completely obscured from about 17 miles away.
Source: HazeCam.net, 2001

Acid Rain and Acid Deposition

Figure 2.13 - How Acid Rain Forms



Acids are released directly into the atmosphere only in small amounts. The real source of most of the acids involved in acid rain and acid deposition is the acidification of SO_2 and NOx emissions. As these pollutants travel with the winds, they may oxidize into sulfuric acid and nitric acid within clouds where they will eventually pass to the ground and associated water resources through precipitation. Acids may also settle to the ground in the form of dry particles.
Source: NHDES, 1996

In addition to their contribution to ozone and small particle formation, the air pollutants SO_2 and NOx also react to form sulfuric (H_2SO_4) and nitric (HNO_3) acid, creating acid deposition (or "acid rain") (see Figure 2.13). This acid deposition increases the acidity of New Hampshire's streams, ponds, and lakes, adversely affecting fish populations. It also strips nutrients from the soil, slowing growth of crops and trees. Trees stripped of nutrients fall susceptible to insect infestation, drought, freezing, and ozone damage. The acids also leach aluminum (Al) from soils and rocks and carry it into nearby water bodies where it can be toxic to fish. Excess deposition of nitrogen-containing compounds to coastal waters and estuaries can cause algal blooms leading to low levels of dissolved oxygen in the water, which ultimately can cause fish and shellfish kills.

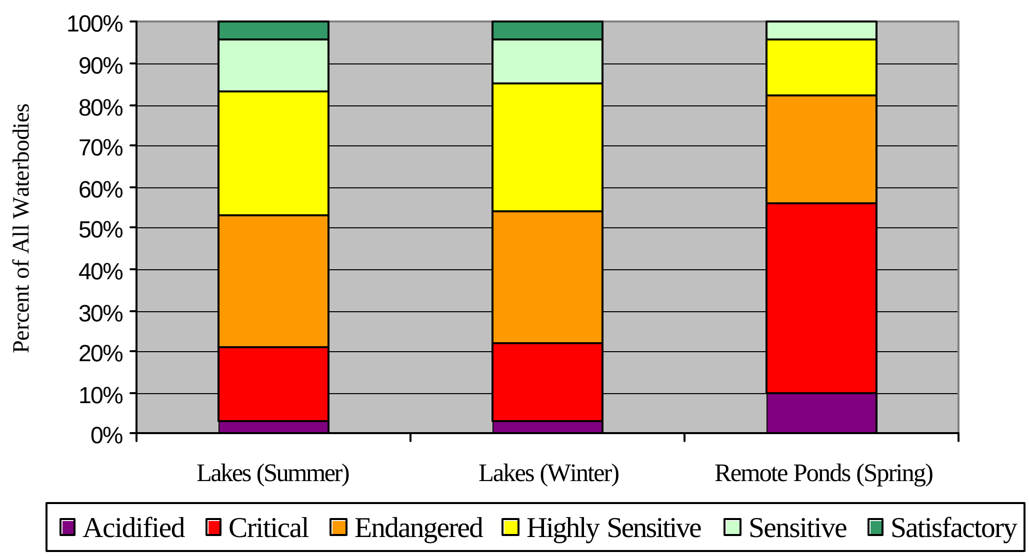
Key Point: Acid rain can fall up to and beyond 1,000 miles from where the acid-forming pollutants are released.

According to studies conducted by Hubbard Brook Research Station in Thornton, New Hampshire (Driscoll et al., 2001), acid deposition over the past 60 years has caused the acidity of the State's streams and lakes to reach critical levels. Under these conditions, native species of fish and plants can no longer thrive, and depletion of soil nutrients from acid leaching has threatened native species of white pine trees and forest productivity. In addition, the significant build-up of sulfates and nitrates in the soils throughout the region, much of which will continue to leach into nearby waterbodies, causes substantial slowing of the recovery of the state's water ecosystems.

Key Point: Research at Hubbard Brook concludes that if all air pollution transport were stopped today and the acidity of precipitation was returned to normal, it would still take 20 years for the New Hampshire's watersheds and forests to fully recover from the effects of acid deposition.

New Hampshire lakes are extremely vulnerable to acid deposition because their buffering capacity, which counteracts the effects of acid inputs, has been depleted due to decades of acid deposition. The buffering capacity of a water body, measured as Acid Neutralizing Capacity (ANC), is its ability to neutralize acid inputs without becoming more acidic. This capacity is determined primarily by the amount of calcium carbonate or other carbonates (e.g., limestone) in the system. New Hampshire's granite bedrock contributes few of these carbonate minerals to surface waters. A waterbody with either an ANC value of zero or less, or a pH below 5.0, denotes acidification. The lower the pH value is, the more acidic the waterbody. Acidified lakes are unlikely to support a naturally reproducing population of fish. An ANC of 10 or less is considered to be highly sensitive to acid inputs. Fully 85 percent of the State's lakes and 95 percent of the remote – mostly high-elevation – ponds are highly sensitive or worse (see Figure 2.14).

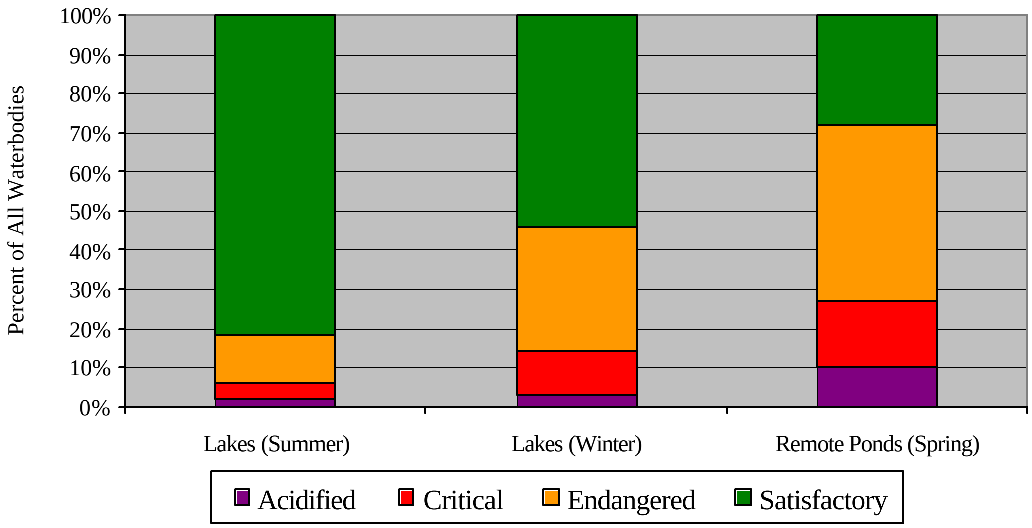
Figure 2.14 - Acid Neutralizing Capacity Classifications of New Hampshire Lakes and Remote Ponds



Source: NHDES, 2004

There are some significant differences in the acidity status of lakes and ponds between summer and winter (see Figure 2.15). During the summertime, the pH of waters may be artificially elevated (less acidic) due to photosynthesis. As a result, winter pH data is a better indicator of the pH that aquatic organisms are exposed to during the year. About 20 percent of the state's lakes in the summer – but about 45 percent in the winter – have pH values of 6 or less. Remote ponds sampled in the spring after the snowmelt period indicates that over 70 percent are endangered or worse.

Figure 2.15 - Acidity Classifications of New Hampshire Lakes and Remote Ponds (based on pH Level)



Source: NHDES, 2004

The effects of acid deposition can be especially harmful in the spring when the winter snow pack melts. The ecosystem is shocked with a large volume of water carrying several months' accumulation of deposited acids and toxic metals like mercury. Further, this toxic shock occurs during the critical first phases of the annual reproductive cycles of plants, animals, and fish. The New Hampshire Fish and Game Department stocks a number of remote ponds with brook trout after the spring snowmelt. Many of these ponds would probably not support a naturally reproducing brook trout population because of the exposure of the developing embryos to the springtime acid shock. In fact, some ponds are no longer stocked by the New Hampshire Fish and Game Department because of poor fish survival or poor returns (e.g., Cone Pond in Thornton and Constance Lake in Piermont).

New Hampshire's acidified lakes and remote ponds, based on ANC and pH level, are listed by name and location in Table 2.1. As this table shows, all geographical areas of New Hampshire have acidified waterbodies, indicating that all New Hampshire waterbodies are vulnerable to the effects of acid deposition.

Table 2.1 - Acidified Lakes and Remote Ponds in New Hampshire

Lake/Pond	Location	ANC	pH
Baker Pond	Chesterfield	0.0	5.2
Barrett Pond	Washington	0.0	5.3
Bear Hill Pond	Allenstown	-1.3	4.5
Bowker Pond	Fitzwilliam	-0.3	4.8
Brackett Pond	Wentworth	-0.8	4.7
Cone Pond	Thornton	-1.0	4.7
Constance Lake	Piermont	-0.2	4.9
Darrah Pond	Litchfield	-1.3	4.5
Divol Pond	Rindge	-1.2	4.6
Four Mile Pond	Dix's Grant	-0.2	5.1
Gordon Pond	Lincoln	-0.8	4.6
Kilburn Pond	Winchester	-1.3	4.5
Kinsman Pond	Lincoln	-1.9	4.5
Lily Pond	Alstead	-0.2	5.0
Long Pond	Lempster	-0.1	5.3
Loon Pond	Lincoln	-1.0	4.8
Lovewell Pond	Nashua	-3.0	4.3
Nancy Pond	Livermore	-0.8	4.7
Pisgah Reservoir	Winchester	0.0	4.4
Signal Pond	Errol	-0.6	4.9
Solitude Lake	Newbury	-0.3	4.9
Spruce Pond	Deerfield	-0.3	4.8
Willey Pond, Big	Strafford	-0.7	4.7
Willey Pond, Little	Strafford	-1.0	4.6
Winkley Pond	Barrington	-0.2	5.1

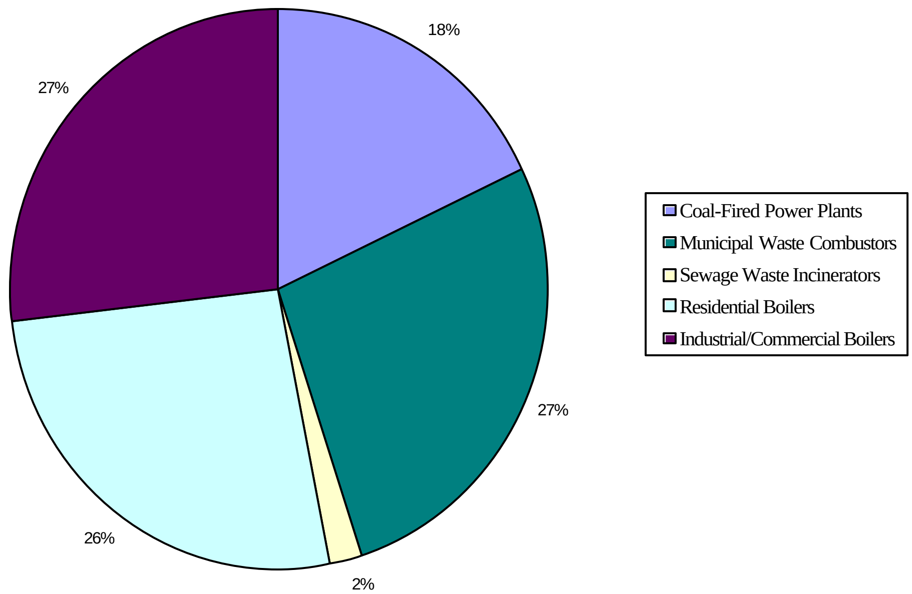
Source: NHDES, 2004

Mercury

Mercury emissions and their fate in the environment are a major concern that has emerged over the last decade. Mercury is a highly toxic pollutant that has been linked to many health effects, including neurological and developmental problems, cancer, and endocrine disruption in fish, wildlife, and humans. Once mercury is ingested by humans, it is readily distributed throughout the body, including the brain, and is passed through the placenta to a developing fetus.

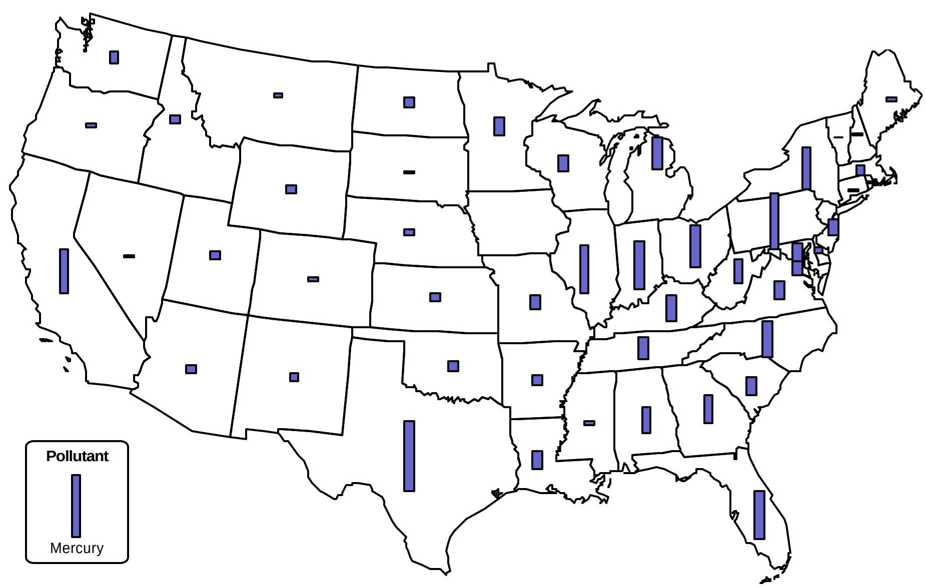
Mercury is usually emitted as a gas that is absorbed into clouds and is deposited (rained or snowed) onto nearby and distant areas, leading to mercury contamination. Coal burning sources and medical/municipal solid waste incinerators are the major sources of mercury emissions (see Figure 2.16). Nationally, mercury emissions follow similar patterns to those of SO_2 emissions in that coal-fired power plants are a large contributor and the industrial Midwest has a high concentration of these sources (see Figure 2.17). In recent years, laws have been passed requiring pollution controls on waste incinerators and most medical waste incinerators have closed, leaving fuel-burning sources as the primary source of mercury pollution in New Hampshire.

Figure 2.16 - New Hampshire Mercury Emissions by Source Sector, 2003



Note: Medical waste incinerator emissions are below 1%
Data Source: NHDES, 2003

Figure 2.17 - Total Mercury Emissions by State, 1996



The length of the bar represents the relative magnitude of emissions.
Data Source: EPA Clear Skies Act 2003 Website Technical Appendix A

Key Point: Mercury deposition normally follows acid rain patterns, but it can also have effects on a global scale. Once mercury enters the environment, it can remain as an active toxin for over 10,000 years.

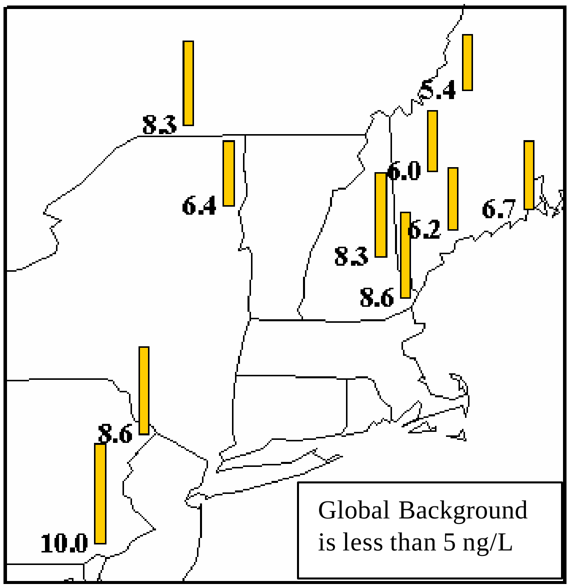
Mercury may be released into the atmosphere in (or chemically transformed into) three different forms. Elemental mercury $Hg_{(0)}$ has the longest atmospheric lifetime and transport range, and is commonly found in global mercury studies. Oxidized mercury $Hg_{(+2)}$ has an atmospheric lifetime on the order of hours, is commonly found to have local impacts near a major source, and is readily taken into the environment. Particle mercury $Hg_{(P)}$ is the third form and in the short-term is least readily absorbed into the environment. All forms of mercury are highly susceptible to being removed from the air through precipitation. Particle mercury is the most likely to deposit on the ground under dry conditions. The form of mercury produced by a given source depends on the fuel burned, the facility design, and emission controls applied.

Key Point: Any form of mercury deposited into a waterbody can be chemically transformed into methylmercury, a toxic form of mercury that readily enters the food chain.

Much of the health-related focus of mercury is on the contamination of certain foods, particularly fish. Fish eat the algae and plants that first take in mercury in the form of methylmercury. Since large fish eat smaller fish, mercury consumed by the small fish accumulates in their organs and gets passed to the larger fish that consume them. Ultimately, when people, birds, or wildlife consume the fish, the mercury is passed along to them. Older fish normally contain the most mercury from a lifetime of "bioaccumulation." While the overall magnitude (or quantity) of mercury air pollution emissions is relatively small compared to other pollutants of concern, a small amount of mercury can do a large amount of damage as it accumulates in the food chain over the years.

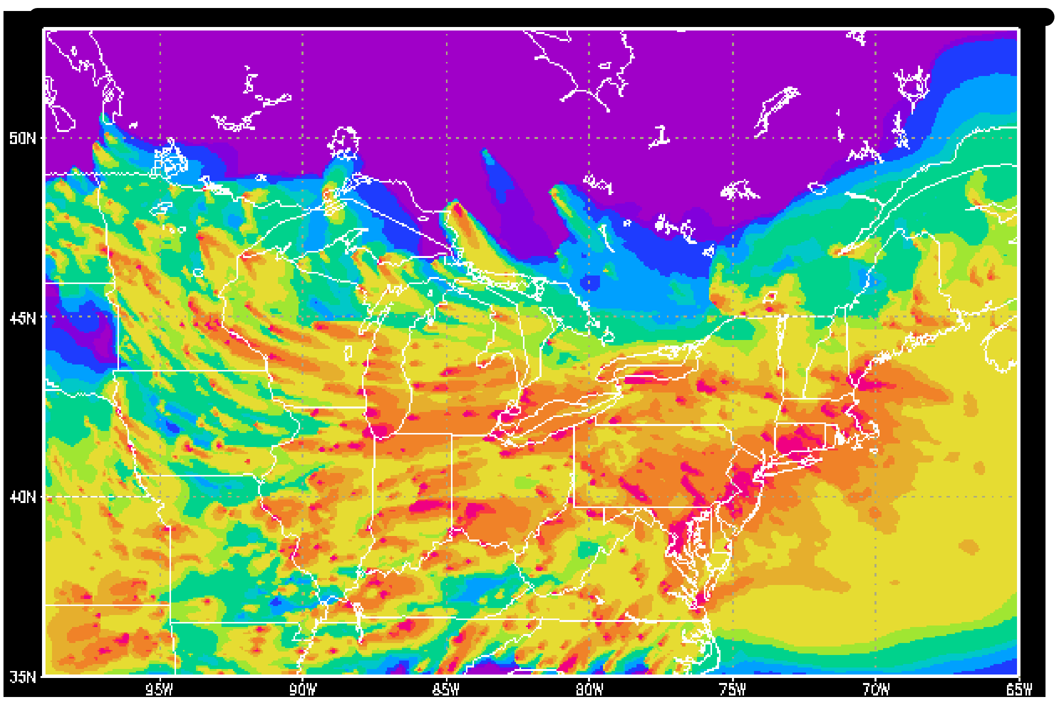
In most of New England, regional and global mercury sources dominate mercury deposition, giving a fairly uniform distribution (see Figure 2.18). However, there are hot spots near certain sources of mercury, calling for the control of mercury at local levels as well. Figure 2.19 shows modeled mercury concentrations and clearly depicts these hot spots. In a recent study of the Florida Everglades (2003) where over 95 percent of environmental mercury originates from air pollution, sampling found localized hot spots of mercury, attributed to nearby sources. When mercury impacts locally it is usually under rainy conditions where mercury is "washed-out" of the air.

Figure 2.18 - Annual Average Mercury Deposition (ng/L), 2000 - 2002



Mercury concentrations from deposition are measured in nanograms per liter (ng/L). Concentrations can be highly variable from year to year depending on weather factors including wind direction and precipitation. Years of drought can have lower than average mercury deposition because mercury is preferentially removed from the air with precipitation. This map indicates the three most recent years of data collected in the region. The data for New Castle in southeastern New Hampshire and Pike County in northeastern Pennsylvania are based on two (2) years of most recent data available.
Data Source: National Acid Deposition Program/Mercury Deposition Network (2004)

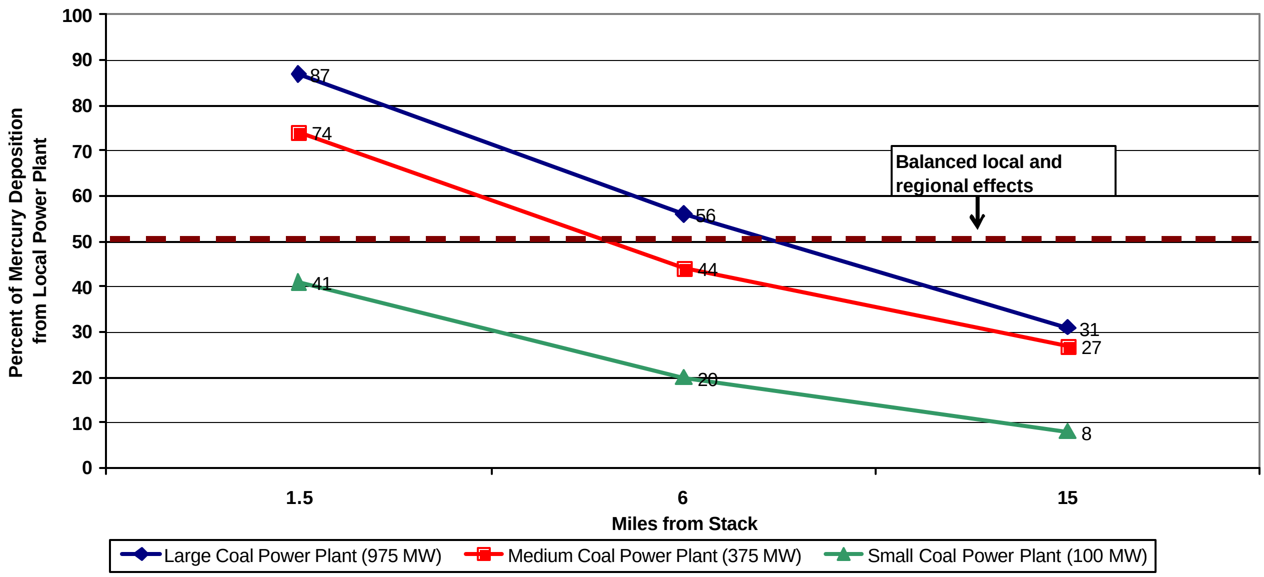
Figure 2.19 - Modeled Mercury Deposition Across the Northeast United States and Canada



Modeled deposition of mercury emitted from sources within the region over a 24-hour period on March 3, 2004. Dark reddish colors indicate relative hot spots of mercury deposition from nearby sources (local impact). The general yellow-orange color that covers most of the region represents mercury deposition from long-range transport of mercury from many sources within the region.
Source: University Of Michigan Website (http://www-personal.umich.edu/~kalwali/mich+ohio.html)

An earlier study by EPA (1998) found similar results to the Florida Everglades study. The EPA study looked at mercury deposition in close proximity to coal-fired power plants in the "arid" West and "humid" East. The study found that there is a considerable hot spot of mercury deposition near coal burning power plants, with the largest sources creating the largest shadow of local effects (see Figure 2.20). Based on data collected from other studies, the majority of this local effect occurs under the most humid of conditions, especially during periods of precipitation.

Figure 2.20 - Local and Regional Mercury Impacts from Coal-fired Power Plants



Local and regional mercury deposition impacts in close proximity to coal-fired power plants in the humid eastern United States. Curves show the highest mercury impacts occur near the source.
Source: EPA 1998 Data and NHDES, 2004

Key Point: Mercury can be deposited locally, but most of the time mercury is not immediately removed from the air pollution plume. Instead it ages and chemically transforms in the air until it enters a watershed.

- SECTION 3 -
HEALTH IMPLICATIONS OF OZONE AND SMALL PARTICLE POLLUTION AT LEVELS BELOW FEDERAL STANDARDS

Key Point: Ozone and small particles are called "zero-threshold" pollutants. This means they have proven health effects at levels below the current National Ambient Air Quality Standards (NAAQS), even at very low concentrations.

A recent study performed at Yale University (Pope et al., 2003) found that asthmatic children in Massachusetts and Connecticut suffered from asthma attacks, tightness of the chest, and shortness of breath at levels below the ozone standard. This study supports the findings of many other studies that negative health effects can be experienced when children are exposed to any level of ozone and/or small particle pollution ($PM_{2.5}$), even concentrations well below the NAAQS.

In the case of ozone, the Yale study found that for every 50 parts per billion increase in ozone levels, the likelihood of wheezing increased by 35 percent and chest tightness by 47 percent among asthmatic children on maintenance medication. A significant increase in shortness of breath and rescue medication use coincided with the highest levels of ozone recorded during the study period. These results support previous work suggesting that ozone, even at 40 percent below the level of the federal one-hour standard, is potentially hazardous to children with asthma. These levels are considered "good" by EPA's definition and it is often assumed that no adverse health effects occur at these ozone concentrations.

In response to the findings in many scientific studies, EPA promulgated new and more protective air quality standards in 1997 for both ozone and small particles ($PM_{2.5}$). In the case of ozone, a preponderance of research indicated that the health-based "one-hour" standard established in 1979 was not adequate enough to protect against prolonged exposures. A new "eight-hour" standard was established. For small particles, EPA established the $PM_{2.5}$ standard (in addition to the already existing PM_{10} standard) as a result of scientific evidence which demonstrates that these smaller particles have the most adverse health effects because of their ability to settle in the deepest regions of the lungs.

American Lung Association Report Rates N.H. Air Quality *– The American Lung Association releases an annual State of the Air report. As in previous years, the 2003 report gave Hillsborough and Rockingham counties failing grades for ozone air pollution. Cheshire and Merrimack Counties received a "C" for marginal air quality. Coos County includes the high elevations of the White Mountains, which receive large amounts of air pollution from out of state sources. According to the American Lung Association, over 400,000 people in New Hampshire are especially sensitive to air pollution. At least 206,000 live within the two failing counties alone, and at least another 68,000 sensitive individuals live in counties with marginal air quality.*

- SECTION 4 -
LOCAL AND TRANSPORTED AIR POLLUTION IMPACTS ON NEW HAMPSHIRE

Achieving clean air goals and attaining ambient air quality standards in New Hampshire requires looking at sources of air pollution, both locally and outside our borders. These sources and their impact on New Hampshire's air quality must be carefully and scientifically analyzed.

Key Point: In the mid-1990s, virtually all of the Northeastern states, including New Hampshire, demonstrated through modeling that they couldn't reach attainment of federal ozone standards by focusing only on local pollution controls. Even if the states turned-off all local sources of man-made air pollution within their boundaries, they would still have ozone nonattainment areas due to overwhelming air pollution transport.

Ozone Classification Areas *– Geographic regions are classified for ozone based on the federal standard according to a classification system established in the Clean Air Act Amendments of 1990. An area is designated as "nonattainment" if it is in violation of the standard. The "classification level" (severity) for the nonattainment area is based on the degree to which the standard was violated – the more severe the violation, the more severe the classification. Compliance deadlines are established in the Amendments dependent upon the classification – areas with more severe classification have later compliance deadlines. For example, the seacoast and southern areas of New Hampshire are classified as moderate nonattainment and are now required to demonstrate compliance by 2010. Unfortunately, following promulgation of the new eight-hour standard, subsequent litigation has significantly delayed implementation and compliance deadlines.*

NHDES has performed extensive regional modeling analyses of major air pollution episodes to assess the contribution of various sources to New Hampshire's air quality. The results of these scientific analyses used by NHDES and EPA show that transport from out-of-state pollution sources accounts for 92 percent to nearly 100 percent of New Hampshire's ozone and small particle air pollution when unhealthy air occurs in the state.

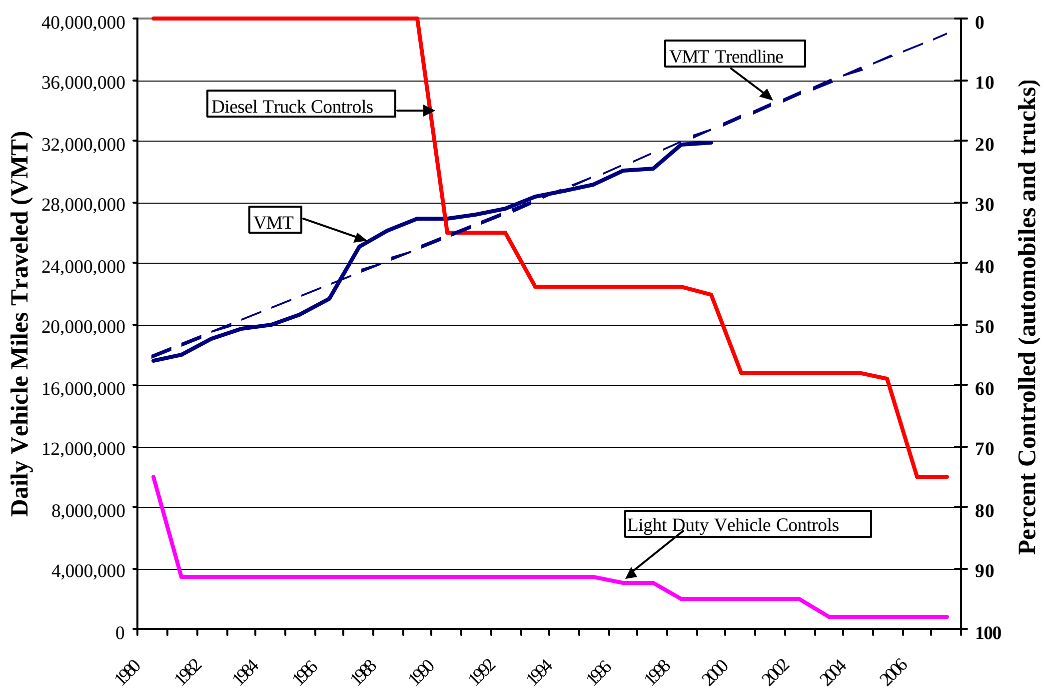
Despite this level of air pollution transport, federal laws hold New Hampshire accountable for achieving and maintaining clean air standards, even if the pollution originates outside of its boundaries. New Hampshire recognizes the need to enact these federally required local pollution reductions in order to keep the problem from getting worse for our own residents and for those living downwind. Local air pollution reductions ensure that hot spots of unhealthy air quality do not develop for our own citizens and that we don't send unhealthy air to our neighbors. By making reductions beyond federal requirements within the state, New Hampshire has demonstrated environmental leadership and has positioned itself to insist on similar reductions from upwind sources.

A common argument used by upwind sources against controlling air pollution emissions to address transport is that individual sources cause only small amounts of impact beyond their local areas. But science is finding that even small contributions have negative health implications at the local level. Those implications get much worse as the small contributions are multiplied by the many, many sources making the same claim – and this pollution is transported to downwind areas.

Power plants in the Midwest, for example, have claimed that individually they are such a small part of northeastern states' air pollution problems that they could shut down and the air quality in the Northeast would not improve. There are more than 15,000 power plants and industrial units which could make that claim. To avoid causing local air pollution problems, many of these sources have smoke stacks over 1,000 feet tall which help their pollution blow far downwind. This combined impact of over 15,000 sources causes air quality problems for states that are the furthest downwind – like New Hampshire.

Likewise, consider the impact of mobile sources. Emissions from cars, trucks, and buses (called mobile sources) contribute around 50 percent of NOx emissions and ten percent of SO_2 emissions nationally. Individually, new light duty vehicles are very clean compared to vehicles from 20 years ago. However, there are over 250 million vehicles on the road in the United States and Canada, and each vehicle currently averages around 16,500 miles per year. Thus, these relatively "clean" vehicles, when taken en masse, contribute a sizable share of air pollution in the Northeast and in upwind states, particularly along the heavily traveled I-95 corridor. Diesel vehicles are more of a problem because they are more polluting and many diesel trucks average over 100,000 miles per year. Overall, vehicle miles driven per year and vehicle size have been steadily increasing, counteracting much of the improvements made in vehicle emissions (see Figure 3.1).

Figure 3.1 - Vehicle Miles Traveled (VMT) and Level of Pollution Control



Comparison of the growth of daily vehicle miles traveled with the increased pollution control on diesel trucks and light duty cars and trucks.
Source: NHDES and EPA, 2004

Key Point: The growth in vehicle miles traveled is negating a significant portion of the air pollution reductions achieved through increased emission controls.

Pollutants from mobile sources are released in the lowest levels of the atmosphere, but they typically mix upward and are carried to distant areas with only a little less efficiency than pollutants from sources with tall smoke stacks.

It is difficult to determine culpability for air pollution transport. When New Hampshire receives air pollution from long-range transport, it is not obvious which specific source or source sector – power plants, industries, mobile sources, and area sources – is responsible for it. When every source tries to individually argue its way out of its contribution to air pollution transport, it leaves no cure for the transport problem.

Key Point: Addressing the transport problem will require all parties, including government, industry, businesses and consumers, to recognize their contribution and accept responsibility.

- SECTION 5 -
DEFINING THE TRANSPORT PROBLEM

Air pollution transport is very complicated since pollutants are transported differently depending on a number of characteristics and factors. Air pollution transport typically refers to the advection of pollutants in the air over long distances, usually beyond the immediate source areas of about 10 to 20 miles (see Table 5.1). Numerous researchers are continuing to study air pollution chemistry and transport mechanisms in order to better understand this phenomenon.

AIRMAP Project *– AIRMAP (Atmospheric Investigation, Regional Modeling, Analysis and Prediction) is a collaborative research project led by the University of New Hampshire and National Oceanic and Atmospheric Administration (NOAA) to obtain greater understanding of regional air quality, meteorology and climatic phenomena. AIRMAP research focuses on making scientific observations of the atmosphere, and the pollutants that travel in the atmosphere, in rural to semi-remote areas of New England.*

Table 5.1 - Air Pollution Transport Characteristics

Category	Range	Pollutants Transported
Local	Less than 20-30 miles	Particles, sulfur dioxide, oxides of nitrogen, volatile organic gases (may contain toxic materials), carbon monoxide, mercury (some forms), ozone (in some cases)
Regional	20-30 miles up to 1,000 miles	Ozone, small particles (may contain toxic materials), mercury (some forms)
National	1,000 to 3,000 miles	Dioxin, very small particles (may contain toxic materials), mercury (some forms)
Global	Greater than 3,000 miles	CFC's (chlorofluorocarbons), mercury (some forms), carbon dioxide

Much scientific information has been provided by the work of the Ozone Transport Assessment Group (OTAG). OTAG was created in 1995 as a temporary ad hoc group to perform modeling and scientific analyses to address the problem of air pollution transport in ozone nonattainment areas. OTAG consisted of representatives from 37 states (mostly east of the Mississippi River), several federal agencies, university researchers, and industries. OTAG and other transport research studies have developed the following general conclusions. Greater detail on air pollution transport mechanisms and confirming observations and assessments can be found in Technical Attachment A.

Modeling Air Quality *- Air pollution researchers use information on air pollution chemistry and transport mechanisms to perform atmospheric modeling. Atmospheric models reproduce air pollution events and project future conditions in order to determine emission reduction strategies needed to achieve air quality standards.*

- Some pollutants such as acids, small particles, and ozone (and its precursors NOx and volatile organic gases) move with the wind and can survive in the atmosphere for several days, or even several weeks.

- Three major transport pathways (patterns) have been discovered and tracked by researchers involved with the North American Research Strategy for Tropospheric Ozone - Northeast (NARSTO-Northeast) analyses. These analyses involved observations taken by aircraft, tethered balloon, and mountaintop air pollution monitors. These pathways include:

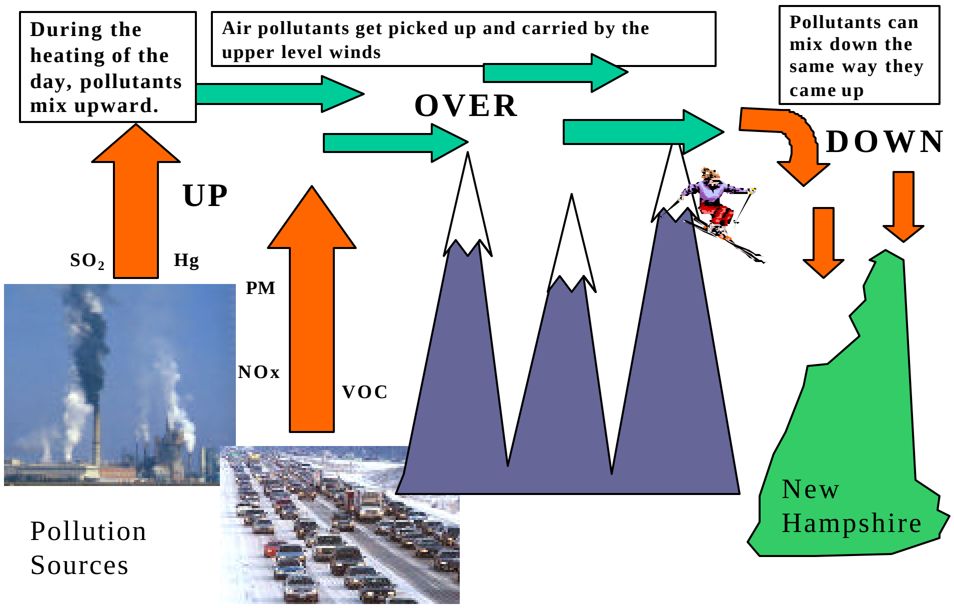
  Low-Level (also called Near-Surface Flow): Most emissions are released near the ground in the lowest 600 feet of the atmosphere and move horizontally with surface-level winds. These winds swirl around objects such as buildings and trees. There are also vertical motions to these winds that can lift pollution to higher levels and can bring pollution down from higher levels.

  Mid-Level (also called Channeled Flow): Mid-elevation winds from about 600 to 2,500 feet above the ground usually follow terrain features such as mountain ridges and can move pollution fairly quickly across a region of several hundred miles. Power plants often release pollutants directly into this layer. Pollution in this layer mixes up and down. Researchers have recently discovered a mid- to low-level wind phenomenon called the "low-level jet" that often forms at night and can move pollution at high speeds northeastward along the eastern front range of the Appalachian Mountains.

  High-Level (also called Synoptic Flow): Higher-elevation winds from around 2,500 to 7,000 feet above the ground follow large-scale weather features such as high and low pressure systems and cold and warm fronts. Pollution in this layer moves horizontally and mixes upward and downward to and from mid-levels during the heating of the day, often in great quantities. These systems can move pollutants at speeds of up to 100 miles per hour (see Figure 5.1).

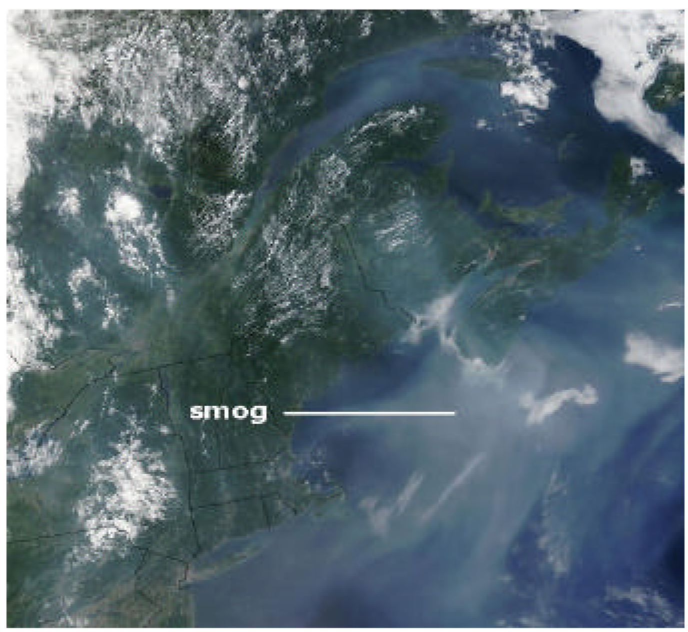
- Ozone pollution transport may travel with the wind through all three different transport pathways for over 600 miles (see Figure 5.2).
- Pollution generally decreases in concentration as it moves away from its source. However, when there are many sources of similar pollutants and when conditions permit, there is a cumulative effect where the concentrations can actually build downwind.
- The most pervasive and persistent air pollutants are also the same pollutants that survive in the atmosphere long enough to transport across jurisdictional boundaries.
- Carbon monoxide (CO), sulfur dioxide (SO_2), large particles, and certain air toxics are typically highest in concentration in near proximity to their sources.

Figure 5.1 - How Upper-Level Transport Works



Pollution transport should not be thought of only as a horizontal phenomenon. Pollutants can move upwards in the air and then travel downward in sinking air currents after being transported over great distances at elevations above 2,500 feet.
Source: NHDES, 2004

Figure 5.2 - Typical Widespread "Smog" Event in the Northeast



Satellite photograph shows a typical widespread "smog" (high concentrations of small particles and ozone) event throughout the Northeastern states and Canadian Maritime Provinces. Green indicates land, blue is water, bright white is clouds, and milky-white is from the sulfate particles within the smog.
Source: Sea WiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE, 2002

From its research, OTAG made a range of emission reduction recommendations, based on a modeling strategy that approximated attainment in most areas with the one-hour version of the ozone standard. EPA used these recommendations in forming a "22-State NOx State Implementation Plan (SIP) Call" to help downwind states achieve the one-hour ozone air pollution standard. Attaining the new standards for ozone (eight-hour version) and $PM_{2.5}$, which are more protective than the previous standards, will require an even greater degree of emission reductions beyond what is already required under the older standards and recommended in the NOx SIP call.

Since OTAG's studies have clearly shown that air pollution can travel great distances across several state boundaries, it will take a program that also does not recognize such boundaries to successfully provide healthy air for all. Ignoring what crosses into and out of individual jurisdictions guarantees prolonged debate, uncertainty, and continued health and environmental degradation. New Hampshire and other northeastern states have come to the conclusion that strong regional and national rules and/or legislation is the only fair way to rectify the transport problem and get upwind areas to take responsibility for the pollution that they create and send beyond their borders with the wind. The northeastern states cannot succeed on their own in meeting certain air pollution standards with piecemeal efforts.

Key Point: Ozone, mercury, small particles, and the pollutants that cause acid rain and regional haze may be transported very efficiently at higher levels of the atmosphere for hundreds to thousands of miles to downwind areas, like New Hampshire. Since these pollutants do not recognize state or other political boundaries, strong regional and national actions are necessary to get upwind areas to take responsibility for the pollution that they create.

- SECTION 6 -
THE ECONOMIC IMPACTS OF AIR POLLUTION TRANSPORT ON NEW HAMPSHIRE

The price of not acting regionally and nationally to address the transport of air pollution into New Hampshire comes in the form of negative direct and indirect economic impacts to the residents and businesses of the state. These economic impacts include increased costs for healthcare, reduced economic development due to increased costs of permitting and operating businesses in New Hampshire, and lost revenue from the travel and tourism industry.

Public health and economic well-being are influenced by many factors. Human health, for example, is influenced by genetics, environment, and social choices. These factors do not act individually, but collectively, resulting in compounded and often synergistic effects. Putting a price tag on any one of these factors is a complex process. Fortunately, recent research and scientific studies provide sufficient evidence to calculate the health-related costs associated with certain air pollutants.

Similarly, economic well-being is influenced by many factors, including air quality and the environment. Most economists agree that the United States cannot have a healthy economy without a healthy environment (Whitelaw, 2003). Protecting the natural resources of New Hampshire, including air quality, ensures that the state will remain a place for citizens and visitors alike to fully enjoy.

Key Point: Failing to have a healthy environment will ultimately reduce business opportunities, which in turn will reduce jobs, lower income and jeopardize the economic outlook of affected communities.

The following lists of potential impacts on healthcare, business and economic development, and travel and tourism are detailed in the sections below. Currently, research and data (as discussed below) are available to assign monetary values to the direct and indirect healthcare impacts. The economic impacts to businesses and tourism are discussed in qualitative terms, with no dollar amounts assigned, but the costs are expected to be considerable and are worthy of further research.

Potential impacts of air pollution transport on health-related costs:

- Increased mortality
- Increased emergency room asthma visits
- Increased asthma attacks
- Increased chronic bronchitis
- Increased acute bronchitis
- Increased hospital admissions
- Increased upper respiratory symptoms
- Increased lower respiratory symptoms
- Increased cardiovascular symptoms and illnesses
- Increased health claims and health risks for all New Hampshire residents
- Possible decrease in resistance to disease, viruses, and bacterial infection

Potential impacts of air pollution transport on business costs, including tourism:

- Increased employee work days lost
- Increased employee minor restricted activity days
- Higher insurance costs due to higher claims
- Higher cost of electricity
- Higher cost of fuels
- Added environmental remediation requirements (i.e., additional air pollution controls) for location in poor air quality area
- Lost ability to attract new businesses and jobs due to environmental remediation requirement for locating in poor air quality area
- Reduced crop yields and loss of agricultural business
- Lost tourism and associated business loss

Impacts on Health-Related Costs

NHDES has estimated direct health-related costs to air pollution transport of small particles and ozone based on analyses conducted by Abt Associates (October, 2000) and the Harvard School of Public Health (Levy et al., December, 2001). These analyses show that annual health-related value losses to New Hampshire approximating $790 million in 2007 would be attributable to adverse respiratory health effects due to small particle pollution ($PM_{2.5}$) transported into New Hampshire. Though the Abt Associates report projects cost estimates for only 2007, current cost estimates are expected to be similar. An additional $235 million per year are currently attributable to ozone air pollution transport for a total of over $1 billion annually. Accounting for the direct health-related values associated with all pollutants subject to transport (including mercury and other pollutants) would increase this total significantly, as would modeling indirect health-related costs. A full breakdown of the various health-related costs and methodologies used for each of these pollutants is provided in Technical Attachments B and C.

Key Point: Health-related cost impacts to New Hampshire from transported particle and ozone air pollution are expected to exceed $1 billion annually in the year 2007.

Small Particle Pollution ($PM_{2.5}$)

NHDES used the Abt Associates (October, 2000) report to estimate health-related costs associated with air pollution transport of small particles ($PM_{2.5}$). Abt Associates conducted extensive modeling and analyses to quantify the health impacts attributed to small particle air pollution relative to premature deaths, hospitalizations, emergency room visits, asthma attacks, and a variety of other respiratory symptoms.

Abt Associates developed a population-based exposure computer program called the Criteria Pollutant Air Modeling System to assess changes in human exposure due to modeled changes in air pollution concentrations. This model used inputs produced by an EPA accepted model for predicting airborne particle concentrations and apportioned the results according to county-level populations. Abt Associates developed health impact estimates for every state and major metropolitan area, including the New Hampshire/Boston Consolidated Metropolitan Statistical Area (CMSA). The model adjusts the results to avoid any double-counting individual medical cases and their associated valuations.

The valuation assessment (monetary value of each health impact in 1999 dollars) used by Abt Associates is based on a statistical evaluation to establish the mean of the population's willingness to pay (WTP) to avoid a given health result. The WTP is established based on reviews of associated published research. The methodology employed by Abt Associates was consistent with current and previous damage valuation work for EPA, and has been extensively reviewed by the EPA Science Advisory Board. NHDES does not attempt to debate the validity of the Abt and EPA methodology and data. Instead, NHDES uses this published work as-is as the means for estimating financial impacts to the state of New Hampshire.

The number of health effect incidences (i.e., number of deaths, hospital visits, number of cases, etc.) estimated by NHDES for New Hampshire for 2007 is based on extrapolations of the Abt Associates data to account for:

- New Hampshire's entire state population (New Hampshire's portion of the CMSA, which is 13.5 percent of the total New Hampshire/Boston CMSA, multiplied by a factor to account for the entire of the state).
- All sources of manmade $PM_{2.5}$ pollution (Abt Associates numbers are for power plant pollution only).
- The portion of New Hampshire's air pollution attributed to transport, 92 percent conservatively selected as the low end of the transport range for the entire state during modeled air pollution episodes.

The monetary value of each health incidence from the Abt Associates valuation assessment, expressed in 1999 dollars, was then applied to New Hampshire's estimated incidence numbers to estimate the total value for each impact category. Table 6.1 presents the direct health-related costs due to air pollution transport of $PM_{2.5}$. A more detailed version of this table and discussion of the calculations can be found in Technical Attachment B. In total, respiratory related healthcare costs resulting from transport of $PM_{2.5}$ air pollution amount to over $790 million per year. This cost estimate is largely driven by the cost of premature mortality.

The Abt Associates report reviewed the available literature on health valuations and arrived at values consistent with others who have attempted to calculate health impact costs. The estimates presented in Table 6.1 are substantiated by approximating New Hampshire's portion of EPA's $43 billion (2010) and $93 billion (2020) estimated benefits from reductions of $PM_{2.5}$ on a national basis under the federal Clear Skies Act of 2003 (see discussion in Section 7). Extrapolated $PM_{2.5}$ values for New Hampshire from the EPA analyses range from $1.07 to $1.17 billion in 2010 and from $1.16 to $1.26 billion in 2020. These values were estimated based on the ratio of predicted health outcomes for New Hampshire for mortality, chronic bronchitis, and emergency room/hospital admissions (123, 82, and 118 respectively) with those predicted on a national level (6,400, 3,900, 5,600 for 2010 and 11,900, 7,400, 10,400 for 2020).

Table 6.1 - Health-Related Costs from Transport of Small Particle Pollution into New Hampshire

Health Impact Category	Estimated N.H. Incidences (Projected for 2007)	Monetary Value per Incidence (Abt Associates, 1999$)	N.H. Estimated Annual Health Valuations for 2007 (1999$)
Premature deaths (Mortality)	123	$6,120,000	$753,470,000
Chronic bronchitis cases	82	$331,000	$27,110,000
Acute bronchitis	228	$57	$13,000
Hospital admissions	87	$14,811	$1,290,000
Emergency room asthma visits	31	$298	$9,000
Asthma attacks	1,947	$40	$106,000
Upper Respiratory Symptoms - URS	1,923	$23	$61,000
Lower Respiratory Symptoms – LRS	1,800	$15	$36,000
Work days lost	17,146	$105	$2,410,000
Minor restricted activity days	117,150	$48	$5,670,000
State Total			**$790,170,000**

The estimates presented above take into account measured $PM_{2.5}$ concentrations for a typical year. Another estimate of $664 million is arrived at using the modeling results as directly presented in the Abt Associates report, which were not based on a typical year. This valuation is lower because it uses data and modeling for 1996, a year with lower than normal $PM_{2.5}$ concentrations across the northern portion of New Hampshire.

It should be noted that more recent research has demonstrated an increase in cardiovascular symptoms such as heart attacks due to small particle pollution. Extrapolating from EPA estimates in the Clear Skies Act analyses, NHDES estimates that 107 non-fatal heart attacks could be avoided per year in New Hampshire by significantly reducing small particle pollution. Non-fatal heart attacks were not included in this report because valuation factors were not readily available.

Key Point: In determining the impacts associated with small particle pollution on health-related costs in New Hampshire, a picture begins to emerge from existing data as to their magnitude. One can see that the economic impacts from <u>only</u> small particle pollution transported into the state are significant.

Ozone

The link between ozone and its health effects is clear and well established in literature, and generally accepted by the scientific community. The costs associated with the health effects of ozone pollution are only now being realized. In a study conducted by the Harvard School of Public Health (Levy et al., December, 2001), health-related impacts due to ozone were isolated and estimated as being approximately $19.80 per person per part per billion (ppb) of ozone in the ambient air on an annual basis. The study valuation per incidence is done similarly for ozone as it is for small particles. The main difference is that research data are not as conclusive for some health conditions and thus those conditions were not included in the cost factor used in the Harvard study. Mortality, asthma, hospitalizations, and minor restricted activity day costs are included in the calculations. Hospitalizations for ozone-related conditions in the Harvard study were typically associated with acute bronchitis and cardiovascular outcomes, including ischemic heart disease, dysrhythmias, and heart failure. As with small particles, valuations are based on willingness to pay (WTP) estimates for each condition.

Building from the Harvard School of Public Health Study cost factor and estimating annual ozone levels throughout New Hampshire, NHDES conservatively estimates that transported ozone air pollution has a health-related value impact to the State of approximately $235 million per year. As shown in Table 6.2, this calculation is based on estimated annual manmade transport of ozone, county populations, and a value of $19.80 per person per part per billion. A more detailed breakdown of these calculations and a full explanation on the methodology used to determine the ozone concentrations is provided in Technical Attachment C.

Table 6.2 - Health-Related Costs from Transport of Ozone Pollution into New Hampshire

County/Monitor Location	Estimated Annual Ozone (ppb)[1]	Estimated Annual Manmade Transport (ppb)[2]	County Population (2000 census)	N.H. Estimated Annual Health Valuations for 2007 for Ozone[3] (1999$)
Belknap / Laconia[4]	33.9	14.9	56,325	$16,590,000
Carroll / Conway	27.5	8.4	43,666	$7,240,000
Cheshire / Keene	25.6	7.1	73,825	$10,360,000
Coos / Pittsburg	23.4	4.9	33,111	$3,200,000
Grafton / Haverhill	27.8	9.3	81,743	$15,040,000
Hillsborough / Nashua	27.3	10.4	380,841	$78,630,000
Merrimack / Concord	22.0	5.3	136,225	$14,240,000
Rockingham / Portsmouth[5]	27.8	10.6	277,359	$58,070,000
Strafford / Rochester	28.3	11.2	112,233	$24,810,000
Sullivan / Claremont[6]	27.0	8.5	40,458	$6,780,000
State Totals			**1,235,786**	**$234,970,000**

1 Estimated annual ozone averages including both manmade and naturally occurring ozone, based on monitoring data.

2 Manmade portion of the annual ozone averages attributed to transport, based on location specific factors derived from photochemical modeling.

3 Estimated health valuations based on $19.80 (Levy et al., December 2001) per person per part per billion of annual transported manmade ozone.

4 Transport factor for Concord was used.

5 Transport factor for Rye was used.

6 Applied a conservative transport factor of 0.99 because the actual factor rounded to 1.00.

Indoor ozone levels (where people spend the majority of their day) are normally about one-half of the outdoor levels (range of 30 to 70 percent). Individuals spending more time outdoors would have greater risk, while those spending more time indoors with air conditioning or air filtration would have a lower risk of ozone related complications. The valuation process used in the Harvard report considers both indoor and outdoor exposure to ozone.

Since care was taken in the published studies to isolate the effects of $PM_{2.5}$ and ozone, it is highly likely that when taken together, ozone and $PM_{2.5}$ health-related impacts will exceed the sum of the individual components. In other words, exposure to both pollutants in the air at the same time will likely have greater synergistic health impacts and costs than exposure to the pollutants individually.

It is interesting to note that one of the studies used in the derivation of the ozone cost estimates considered annual ozone levels in six eastern cities which were lower than the levels measured and estimated for New Hampshire. In fact, those cities had annual ozone concentrations of 20 to 22 ppb (two cities had 28 ppb) during a relatively high ozone period from the late 1970s to the early 1990s. The New Hampshire measurements and estimates ranged from 22 to 34 ppb and were based on the recent and relatively low ozone period of 2000-2002. Impacts would be higher than the $235 million estimate if more applicable data were available to refine the cost factor for the range of ozone concentration found in New Hampshire.

In addition, observations made over the past few winters in the Northeast have shown ozone levels well above what were previously assumed for the colder weather. Wintertime health impacts of ozone could be compounded for certain sensitive populations, such as people with asthma, bronchitis, or other respiratory diseases. New Hampshire has measured higher than expected ozone levels during the cold weather, especially in the rural parts of the state. Combining higher than expected ozone with respiratory ailments that are common to cold weather could also increase the cost of ozone health impacts beyond the cost factor used in this report.

Likewise, indirect health-related costs such as lost workdays and increased health insurance claims are not included. If these costs were included, the Harvard study cost factor would increase and therefore, the overall cost to New Hampshire would be higher.

Key Point: The $235 million cost for ozone related healthcare impacts is likely underestimated because the valuation factor is based on lower levels than occur exclusively in New Hampshire and on ozone levels monitored only during warm weather months. Recent observations demonstrate that exposure to ozone occurs year-round, compounding the health implications for sensitive populations and suggesting that overall healthcare impacts may be significantly more costly.

Impacts on New Hampshire's Businesses and Tourism Industry

Beyond increased employee work days lost and increased insurance claims that could increase insurance premiums paid by employers, there are added costs of doing business in areas that have unhealthy air quality. Higher operating costs result for certain businesses due to increased federal requirements and air pollution controls required for operation in dirty air regions (nonattainment areas). Obtaining national and regional pollution reductions makes a big difference in what local businesses must face in terms of emission controls and permit restrictions. If the air blowing into the state is already dirty, there is less room for local sources to release air emissions before the local air becomes unhealthy. In fact, there are already many instances when there is no room at all for local emissions because the incoming air is already unhealthy. This places a serious barrier on new businesses trying to locate in New Hampshire.

Many businesses in New Hampshire must work through strict environmental permitting rules and regulations and have to buy air pollution credits as a condition for obtaining an operating permit. In addition, because of strict air pollution controls required of most power plants in the New England area, the cost of electricity is relatively higher in New Hampshire in relation to states with better air quality, increasing the electricity rates paid by businesses in the State.

State agricultural businesses have seen stunted growth and reduced crop yield as a result of ozone pollution and acid rain. Ozone has been shown to suppress the immunity of crops and other foliage to freeze and insect damage. Loggers supplying the state's paper mills have noted a decline in forest health and growth rate of timber supplies in the Northeast. Acid rain further extends the problem by leaching nutrients from soils, thus slowing forest growth, and in some cases, killing vegetation. If crop growth and forest health decline due to transport of air pollution, so too does revenue from related industries, such as farming, the maple sugar industry, and the timber industry (NHDES Clean Power Strategy, 2001).

Tourism is the second largest industry in New Hampshire, bringing in more than $8.6 billion annually to the economy and employing over 65,000 residents (N.H. Division of Travel and Tourism). The tourism industry includes hotels, restaurants, attractions, museums, art galleries, theaters, parks, and sports facilities.

People that support the tourism industry often come to New Hampshire for the "clean air" and beautiful mountains and lakes. Visitors may be less satisfied with their stay in New Hampshire if they encounter unhealthy air in the state's supposedly pristine areas. People may be less likely to return to New Hampshire for vacation or business purposes and they may stay for shorter periods of time. The end result is lost revenue and a decline in New Hampshire's tourism industry.

Air Pollution in the White Mountains - *How does one account for the loss of not being able to see the other side of a lake or a nearby mountain because of haze? What are the costs associated with suffering from an ozone-induced burning sensation in the lungs from hiking in our White Mountains? Hikers in the high country don't expect reduced visibility and unhealthy air quality while hiking in the remote backcountry, but air pollution transport affects all areas of the northeastern United States and southeastern Canada, including New Hampshire's White Mountains. For example, the summit of Mt. Washington often records ozone levels comparable to the more populated areas in south central New Hampshire and the Boston Metropolitan area.*

- SECTION 7 -
ADDRESSING AIR POLLUTION TRANSPORT WITH MULTI-POLLUTANT CONTROL STRATEGIES

New Hampshire and the Northeast states have already worked together to implement a number of emission reduction programs within their boundaries in order to attain National Ambient Air Quality Standards (NAAQS) and provide healthy air quality. Even with these efforts, as described earlier, the only way the Northeast states will achieve their clean air goals is through aggressive national or near-national actions aimed at all major sectors of air pollution – power plants, industry, cars, trucks, distributed generators and various small engines such as boats, lawnmowers, and snowmobiles.

States are Limited *- States like New Hampshire have few options for significantly reducing mobile source emissions at a local level. States are already prevented from seeking cleaner vehicles and fuels than what is accepted on a national level unless they go as far as adopting "California level" emission control equipment (California is the only state allowed to set its own vehicle and engine emission levels and fuel needs). Further, state and local control options are being reduced due to a provision of a Fiscal Year 2004 VA-HUD appropriations bill which prohibits states from regulating non-road engines smaller than 50-horsepower. While seemingly small compared to power plants and other large industries, the small engines targeted for prohibition of state regulation include millions of lawnmowers, leaf blowers, and boat engines that produce a disproportionately large amount of air pollution.*

Relative to mobile sources, states must depend on EPA's regulatory programs to reduce mobile source pollution since the Clean Air Act prohibits all states, except for California, from establishing separate emission standards. EPA has passed or proposed regulations to address the mobile source sector. More stringent motor vehicle emissions and fuel standards went into effect beginning in 2004, which over time will reduce emissions from all light-duty vehicles, including minivans and sport utility vehicles, and require fuel with lower sulfur content. Additionally, there are pending and proposed regulations to reduce air pollution from heavy-duty diesel vehicles beginning in 2004 and 2007 and from non-road heavy-duty diesel sources such as construction equipment beginning in 2008. Unfortunately, EPA's regulatory programs for heavy-duty vehicles will not realize their full benefits for many years due to the durability of these types of engines and a slower fleet turnover rate. There also remains considerable uncertainty as to whether these plans will ever be fully implemented due to threats of legal action. With over 1.1 million registered vehicles in New Hampshire and steady growth in vehicle miles traveled, these federal emission control requirements for mobile sources are critical for meeting clean air goals.

Key Point: With more vehicles on the road and steady growth in total miles driven both in New Hampshire and nationally, strong federal emission reduction requirements for motor vehicles are essential for meeting clean air goals.

Given the limitations on further controlling mobile sources beyond federal actions, much of the focus of current emission reduction regulations is on large industry, especially power plants. Several states are examining and adopting air pollution control strategies designed to simultaneously control electric generating units (EGUs) (i.e., power plants) for more than one pollutant. This concept is growing in popularity since emission reductions for several pollutants are required to achieve compliance with the new air quality standards for ozone and small particle pollution.

In early 2002, New Hampshire was the first state in the nation to pass legislation requiring fossil fuel-fired power plants to reduce emissions of four pollutants – sulfur dioxide (SO_2), nitrogen oxides (NOx), mercury (Hg), and carbon dioxide (CO_2). Connecticut, Massachusetts, and North Carolina have also developed legislation that requires large utilities to reduce their emissions of SO_2, NOx, mercury, and in some cases, CO_2. Congress and EPA are also reviewing multi-pollutant options which would be applied on a national scale.

Industry prefers regulations that control several pollutants simultaneously because they provide a more comprehensive, cost effective approach to planning for long-term facility layout and equipment requirements. In the past, regulations required industry to address one pollutant at a time. This, unfortunately, resulted in industry having to occasionally relocate or replace equipment that had been installed to control one pollutant with new equipment to control other pollutants, thus increasing compliance costs. In many cases, the industry would have chosen a different type of pollution control technology capable of controlling more than one pollutant if it had known that reductions of another pollutant were soon to be required. From the industry's perspective, the "one pollutant at a time" procedure lacks regulatory certainty and is ultimately more expensive than controlling multiple pollutants simultaneously.

Key Point: Effective national multi-pollutant legislation for electric generating units is critical to New Hampshire if the state expects to achieve consistently healthy air quality and avoid unnecessary and expensive pollution control measures required under federal law for areas with poor air quality.

The following three EGU multi-pollutant legislative proposals are currently under consideration in Congress. A fourth proposal, known as the Clean Air Interstate Rule (CAIR), formerly known as the Interstate Air Quality Rule (IAQR), was first introduced by EPA in late 2003. This rulemaking proposal is described later in this Section.

Clear Skies Act of 2003 (S. 1844 & H.R. 999) – Proposed by President Bush and EPA, first introduced as legislation in 2002.

Clean Air Planning Act of 2003 (S.843 & H.R. 3093) – Proposed by Senators Carper, Chafee, and Gregg, and Congressman Bass, first introduced in 2002.

Clean Power Act of 2003 (S. 366 & H.R. 2042) – Proposed by Senators Jeffords and Reed in 2003.

Each of these legislative proposals is undergoing review and if successful, may be revised prior to implementation. The 2003 version of each proposal is the most recent available and is the version assessed in this report. A 2004 version of the Clear Skies Act has been proposed, providing some minor adjustments from the 2003 edition. All of the plans include reductions of NOx, SO_2, and mercury while the Clean Air Planning Act and Clean Power Act also include reductions in carbon dioxide (CO_2), a greenhouse gas. Each of these multi-pollutant plans contains market-based legislation that allows trading of air pollution credits through a cap and trade program, which speeds the process of implementing reductions and reduces overall costs.

Each of the legislative proposals (including comparisons to earlier versions) has been evaluated by NHDES relative to the following criteria (see Table 7.1):

(1) Its impact on New Hampshire's air quality and ability to meet clean air goals, i.e., which pollutants will be reduced, by how much, and by when.

(2) The cost to implement control technologies and strategies to achieve emissions reductions called for in the proposal.

(3) The benefits in terms of healthcare cost savings and business benefits.

(4) Its impact on New Hampshire's ability to protect itself under the law from upwind polluters (referred to as "States' Rights").

Relative to the control costs associated with implementing the proposals, according to early estimates, the Clean Air Planning Act and Clean Power Act are only marginally more expensive to implement than the Clear Skies Act. Based on EPA's calculations for the costs and benefits of the Clear Skies Act, the additional control costs for any of these legislative proposals range between five to ten percent of the overall air pollution control costs already required under the existing federal Clean Air Act. More recent cost estimates conflict with earlier data and project a higher range of costs for the proposals. Unfortunately, this data has yet to be verified and accepted by researchers.

More important than the cost of control is the cost-benefit ratio between the costs of control and the resulting health benefits. Based on EPA cost-benefit calculations for the Clear Skies Act, the healthcare benefits and associated cost savings are worth in the range of \$12 to \$18 for every \$1 spent on emission controls for the reduction

What is a Cap and Trade Program? *Under a cap and trade program, a limit, or cap, is set for the emissions of a specific pollutant for all sources affected. The cap generally reflects a certain reduction of the pollutant from baseline conditions. Sources are given allowances – each allowance represents a measured amount of a specific pollutant – based on a limited number of allowances to meet the cap. At the end of each year, every source must have enough allowances to cover its emissions for that year. Unused allowances may be sold or saved for future use. This market-based approach allows sources to optimize their emission reduction strategies while ensuring achievement of the overall reduction goal. Even though not every source makes actual air pollution reductions, the end result of cap and trade is that it 1) speeds up overall air pollution emission reductions, 2) reduces the overall costs of compliance, and 3) can even reduce emissions beyond required levels.*

levels proposed by the three multi-pollutant control acts, making pollution controls a good investment and any delay expensive (see Table B.3 in Technical Attachment B). Adding other benefits such as reduced mercury, reduced acid rain, improved visibility, and improved business costs to downwind areas could as much as double this cost/benefit ratio.

Key Point: The healthcare benefits and associated costs savings realized by installing the pollution control technologies proposed in the multi-pollutant programs far outweigh the costs of the pollution control technology itself.

Of the three multi-pollutant EGU program proposals, the Clear Skies Act is the least beneficial to New Hampshire, providing virtually no ozone benefit by the federally required attainment date of 2010. The benefits to New Hampshire will be from reduced $PM_{2.5}$ transport, but the full benefits from the Clear Skies Act won't occur until 2020 and those benefits will only be a marginal improvement over what the existing Clean Air Act provisions already require. A more expeditious implementation timeline is needed for New Hampshire to meet its federally mandated clean air attainment dates, thus reducing impacts to the state's economy and public health sooner rather than later.

Key Point: The full benefits of the proposed Clear Skies Act will not be realized until 2020. This will be too late for New Hampshire to reach clean air goals by the required attainment date of 2010 and will only be a marginal improvement over what the existing Clean Air Act provisions require. Both the Clean Air Planning Act and Clean Power Act achieve greater reductions sooner.

Additionally, according to a recent modeling analysis study performed for the Ozone Transport Commission (OTC), the air pollution reductions and the associated health benefits of the Clear Skies Act may have been somewhat overstated. OTC is a multi-state organization created by Congress to address the ozone problem in the Mid-Atlantic and Northeast region of the United States. Its study found that a much larger percentage of the nation's population will live in areas that are expected to fail to achieve clean air goals for ozone by their federally mandated attainment dates than claimed after implementation of the Clear Skies Act. Since most of the areas failing to meet the clean air standards are downwind states, these areas will have to then focus on local control measures, which may be very costly and ineffective at producing any additional meaningful reduction benefits.

With the goal of building an emission reduction strategy that will help the states meet their federally mandated clean air goals by their scheduled attainment dates, the OTC calls for aggressive national measures on all major sectors of air pollution sources, not just power plants, but also industry, cars, trucks and other motor vehicles. Similarly, an analysis done by the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officers (STAPPA/ALAPCO), a national association of air pollution officials, resulted in a multi-pollutant resolution designed to reach clean air goals by the required dates.

States' Rights

Another concern about the Clear Skies Act for New Hampshire is related to the concept of "States' Rights." Ensuring the authority of the state to protect itself from the actions of the federal government or other state governments (or "States' Rights" as provided under the federal Clean Air Act) is of critical importance in order for New Hampshire to shield itself from harm done to it by polluters in other states. The Clear Skies Act substantially weakens the state's ability to prevent degradation of air quality within New Hampshire due to pollution transport from other states. In one Clear Skies Act provision, New Hampshire will be prevented from asserting its right to address upwind pollution by seeking legal assistance in obtaining needed pollution emission reductions from facilities in upwind states, even if those sources significantly contribute to New Hampshire's inability to meet federal air quality standards. As a result, the Clear Skies Act will actually increase the burden on New Hampshire by shifting the burden of air pollution control away from polluting regions to the regions suffering from its effects. Both the Clean Air Planning Act and the Clean Power Act provide better protection of States' Rights.

The philosophy in the Clear Skies Act behind limiting states legal recourse is to provide protection to businesses during the process of phasing-in their emission reductions required by the Act. However, areas downwind of these sources may already know that the planned pollution reductions are not enough. By restricting States' Rights, the Clear Skies Act prevents downwind areas from acting in any legal way to protect their own residents and businesses for a number of years. After the restricted time period expires, the downwind states would then face modified rules for filing legal action that include cost calculations that are so burdensome that few states, if any, would have the resources to effectively complete them. EPA would be equally strained in finding the resources to review them.

Key Point: Limitation of States' Rights effectively shifts the burden of air pollution regulation back to increasing local controls. As has been demonstrated, this is not effective in reaching overall clean air goals in areas dominated by air pollution transport, like New Hampshire.

In New Hampshire, local controls for highly transported air pollutants (such as ozone and $PM_{2.5}$) are somewhat effective in keeping local and downwind air quality from getting worse, but are ineffective as a sole strategy for reaching local clean air goals. Local controls within New Hampshire are most effective for air pollutants that are not dependent on chemical, thermal, or phase-change to become harmful (including carbon monoxide, SO_2, large particles, mercury and other numerous toxic air pollutants). Since the most cost effective local control measures have already been implemented in the Northeastern states for certain pollutants, any additional requirements would mean less cost effective and less desirable local controls.

Table 7.1 summarizes the three federally proposed Acts for controlling multiple pollutants. Included in the table are EPA's estimates of annual health-related benefits on a national basis in 1999 dollars for the reduction of ozone and small particles. The methodologies used by EPA for calculating benefits associated with each proposal are similar to those used in this report. Greater detail can be found in Technical Attachment D.

Table 7.1 - Comparison of Federally Proposed EGU Multi-Pollutant Legislation

Proposal	Pollutants Final National Emission Caps (millions of tons per year)	Year for Implementing Final Cap	Impact on States' Rights	Estimated Annual National Benefit (1999$)
Clear Skies Act of 2003 (S. 1844 & H.R. 999)	NOx 1.7 SO_2 3.0 Mercury 15 CO_2 None	2018 2018 2018	Major	$4.3 billion – 2010 $4.4 billion – 2015 $6.3 billion – 2020
Clean Air Planning Act of 2003 (Carper/Chafee/Gregg/Bass) (S. 843 & H.R. 3093)	NOx 1.7 SO_2 2.25 Mercury 10 *(plus 70% reduction at each facility)* CO_2 2001 levels	2013 2016 2013 2013	Minor	$5.6 billion – 2010 $8.7 billion – 2020 *Estimated based on CAPA 2002*
Clean Power Act of 2003 (Jeffords/Reed) (S. 366 & H.R. 2042)	NOx 1.51 SO_2 2.25 Mercury 5 *(with unit-by-unit controls)* CO_2 2.05 billion tons	2009 2009 2008 2009	None	Not available

Source: NHDES, 2003

Cap and Trade Program and Mercury Considerations

Certain issues need to be considered when evaluating and implementing a cap and trade program. For example, as noted earlier, mercury can have local impacts, but it is also transported and deposited many miles from its source. The vast majority of the mercury pollution in New Hampshire comes in the form of rainfall contaminated with mercury from coal-burning sources. Therefore, the more stringent the control requirements for power plants on a nationwide and even global basis and the sooner they are implemented, the better off the residents of the state will be. Under a cap and trade program, NHDES estimates that a national cap of at most ten tons of mercury emitted by electric power plants per year and additional reductions from other source types are necessary to protect the health of the public from this very toxic pollutant. According to recent studies (e.g., Ozone Transport Commission), the control technology to reach this level is currently available, with additional options for control undergoing field-testing. While cost effectiveness varies, some types of control equipment have the added benefit of simultaneously reducing the emissions of several pollutants.

Key Point: Applying a cap and trade system to implement mercury reduction requirements must be done with caution since mercury has both local impacts and is subject to long-range transport. In order to adequately protect public health and the environment from this toxic pollutant, each facility must reduce mercury levels to some degree and these reductions can be used for complying with a national mercury emissions cap.

Since there is a mercury hazard to areas near the source of mercury emissions, providing economic relief to sources controlling their pollution emissions through the application of a traditional market-based cap and trade system must be done with caution. Such an application would have to differ from how cap and trade is traditionally used for SO_2 and NOx. These pollutants do not have the same localized hazards because they are less likely to be "washed-out" in the nearby area like mercury. In time, these pollutants convert into acids or particles, a process that might cause the pollutants to travel hundreds to thousands of miles before they are removed from the air. SO_2 and NOx are normally in gaseous form near the source and are regulated as criteria pollutants through the National Ambient Air Quality Standards (NAAQS). While mercury is also regulated in New Hampshire in gaseous form under New Hampshire's Ambient Air Limits (AALs) for most sources, the AALs do not address local "washed out" deposition which is very hazardous to the environment. A cap and trade application for mercury should be focused on expediting facility-specific controls. In addition, most credits or allowances would have to expire upon full implementation of the final cap in order to ensure that every community benefits from local controls.

EPA's Clean Air Interstate Rule and Mercury MACT Rule

A fourth multi-pollutant proposal to regulate NOx and SO_2 was published by EPA in January of 2004, called the Clean Air Interstate Rule (CAIR), formerly known as the Interstate Air Quality Rule (IAQR). This rule replicates the proposed Clear Skies Act in many ways, including the approximate pollution reduction levels and general timelines for 29 states and the District of Columbia. It should be noted that the Clean Air Interstate Rule is an outgrowth of a formerly proposed air pollution transport rule that originally included non-power plant, industrial type pollution sources, along with the EGUs included in the current proposal. Because the rule works within the Clean Air Act and there are no new provisions to the contrary, it does not limit or replace any other provisions such as States' Rights.

The Clean Air Interstate Rule proposed by EPA cannot address mercury due to certain restrictions contained in the Clean Air Act. As a result, in January 2004, EPA simultaneously issued two proposed regulations that would limit mercury emissions from coal-fired electric utility steam generating units: a proposed Maximum Achievable Control Technology (MACT) regulation and an alternative regulation that would establish a national mercury emissions cap and trade system.

EPA's simultaneous release of these two conflicting proposed mercury regulations has created considerable regulatory uncertainty and legal controversy, especially regarding EPA's preferred regulatory approach. Despite issuing the proposed MACT rule, EPA has stated its preference to withdraw its original regulatory finding that mercury is a hazardous air pollutant (HAP) and that MACT-based mercury emission controls for coal-fired electric utility steam generating units are appropriate and necessary. EPA would then not issue a final MACT standard for utility boilers. EPA would prefer to only issue the alternative regulation which allows for a national cap and trade program for mercury emissions from coal-fired electric utility steam generating units to achieve an overall 29 percent reduction of mercury emissions from coal-fired electric utility steam generating units by 2008 and a potential 70 percent reduction by 2018.

The proposed mercury MACT regulation requires electric utility steam generating units burning bituminous coal to meet a mercury emission limit (2.0 lbs/Trillion Btu) resulting in a 29 percent reduction by the end of 2007. The proposed MACT rule applies a phase-in of mercury controls through a market-based cap and trade program.

Key Point: In order to ensure that mercury reductions are effective both locally and nationally in reducing impacts, a mercury MACT program together with a national mercury emissions cap and trade system are necessary.

- SECTION 8 -
NEW SOURCE REVIEW AND ITS IMPACT ON AIR POLLUTION TRANSPORT

In the late 1980s, industry representatives reached an agreement with EPA and Congress that allowed the oldest power plants to avoid the installation and operation of expensive pollution controls as long as no major changes were made to improve them or extend their lifespan. Only basic maintenance was to be allowed under the agreement. When major repairs or upgrades were necessary, the owner could choose between making the improvements and adding the same pollution controls required of any large new facility, or retiring the plant from service. The goal was to let these old facilities operate under a "grandfathered" provision and avoid expensive controls while they complete their normal lifespan, at which time cleaner facilities would be constructed to replace their capacity. On the basis of this agreement, the New Source Review (NSR) requirements of the federal 1977 Clean Air Act Amendments were extended to apply to power plants under certain conditions when the Clean Air Act was amended in 1990.

<u>What is "New Source Review?"</u> - *The New Source Review program, a provision in the federal Clean Air Act, covers (1) the construction of new major power plants and industrial facilities; and (2) existing large facilities that make major modifications which result in a significant increase in air pollution. The program requires that new large facilities, including power plants, and major modifications to existing large facilities, obtain a permit before construction, which will be issued only if the new facility or major modification includes pollution control measures that reflect best available control technology or lowest achievable emission rate technology.*

Because NSR requirements affect power plants and other industrial sources, their implementation has a significant effect on air pollution transport. EPA is in the final phases of overhauling the NSR rule. While it is generally agreed that streamlining the rule would improve compliance, determining how to improve the rule has been a point of contention. After a detailed review of the changes being made by EPA, NHDES finds that some of the proposed changes create too many loopholes that defeat the Congressional intent of the program. In addition, many of the revisions increase, rather than reduce, the complexity of the rules. New Hampshire has challenged EPA's NSR revisions in court. A "stay" was recently granted on the most harmful of the revised rules, the "routine maintenance" exemption, which is described below.

Revisions to NSR are further complicated by the fact that several years ago, EPA and several states, including New Hampshire, filed a lawsuit against dozens of power plants to enforce the NSR provisions of the Clean Air Act. These facilities allegedly made major improvements to their equipment without first obtaining NSR permits and without installing the required pollution controls. Litigation by EPA and several states sought immediate review of these facilities and the prompt installation of pollution controls required under NSR. A number of settlements have resulted in large decreases in emissions. EPA is now in the awkward position of creating a new rule that conflicts with its previous position and at least one court's view of the Clean Air Act. In a sense, EPA has prosecuted past NSR violations while simultaneously amending the rules to allow for future violations of those same rules.

EPA's proposed revision to the "routine maintenance" exemption would allow facilities to perform maintenance and upgrade projects worth up to 20 percent of the unit's monetary value without installing pollution controls. The changes could also allow an incremental overhaul of a facility with multiple projects, each accounting for 20 percent of the plant's value, so that the full facility could be replaced without reducing its emissions. EPA's earlier rule changes, which are currently in effect, would also allow facilities to make modifications based on the facility's highest levels emitted over the past ten years. If a facility has made emissions reductions in recent years, it would be allowed to return to higher emission levels.

A number of states, including New Hampshire, feel that these rule changes are extremely unfair to businesses that added the required pollution control equipment when they upgraded their facilities. New Hampshire and several other states filed appeals in a federal appeals court to halt the new NSR rules from going into effect. Fortunately, the court ruled that the routine maintenance NSR rule would cause irreparable harm to downwind states and stayed that rule before it went into effect.

What does this mean for New Hampshire if the revision of the rules is ultimately successful? Very few New Hampshire facilities will benefit from the revised NSR. Those that do will likely lose any advantage gained under the revisions by incurring additional expenses required of businesses located in areas not meeting clean air standards. As discussed previously, when air pollution transport isn't addressed expeditiously, federal laws require that additional local pollution controls be implemented in any state with poor air quality. Because New Hampshire is overwhelmed by pollution transport, additional local pollution controls will be expensive and largely ineffective. New Hampshire counts on the reductions in upwind areas from the retirement of older, more polluting sources, or the addition of pollution controls on those sources, to lessen the transport of pollution over time.

Key Point: The New Source Review overhaul as proposed by EPA will allow older, dirtier facilities to continue to make major, life-extending improvements without installing pollution control equipment. The result will be continued unhealthy air quality for states like New Hampshire due to air pollution transport and increased requirements for local controls.

The NSR overhaul will allow older and dirtier power plants to continue operating without additional controls. These facilities would be allowed to extend and increase operations instead of being required to upgrade with cleaner and more efficient technology or retire in favor of newer clean technology. This defeats the program's goal of improving air quality and the economic business environment in downwind states like New Hampshire. The end result is continued higher costs for electricity, fuels, and cars, an economic disadvantage for new businesses locating in New Hampshire, and higher health impacts and associated costs. In short, the NSR changes will decrease the likelihood of better air quality in states like New Hampshire.

- SECTION 9 -
CONCLUSION

As the case for air pollution transport becomes more clearly defined and confirmed by scientific research, so do the effects on downwind states such as New Hampshire. Increasing scientific evidence shows that the health of the state's citizens and its environment are adversely impacted by long-range transport of air pollution from upwind sources. The economy of the State is significantly affected in terms of direct and indirect economic impacts to businesses and industry, including travel and tourism. Many businesses operating within the state will have to pay the costs of increased health care, decreased worker productivity resulting from air pollution-induced respiratory problems, and increased compliance with more stringent regulations as a result of unhealthy air.

While New Hampshire has made great strides in reducing air pollution from sources within the state, real progress toward cleaning the air cannot be made without the commitment of the federal government, governments of upwind states, and companies located in these states whose emissions directly impact New Hampshire. Though there has been resistance by both government and industry in regions upwind of the state to reduce emissions, the evidence is becoming clear that these emissions have a substantial health and economic impact on areas far downwind due to the phenomenon of air pollution transport.

At the same time that downwind states like New Hampshire are facing increasingly serious health and economic impacts from pollution transport, many federal regulations that are critical for achieving clean air goals are in jeopardy of being weakened. Revisions to the federal New Source Review program and proposals such as the Clean Air Interstate Rule and the Clear Skies Act do not adequately deal with transported air pollution and will leave downwind states such as New Hampshire with much of the burden of achieving clean air. Compared to states with similar populations, New Hampshire has already made more than its share of stationary source emission reductions. Relative to mobile sources, further local pollution controls are limited by the Clean Air Act, which prevents states from requiring cleaner vehicles, fuels and small engines. The only truly effective option to ensure clean air in downwind areas is to limit pollution produced in the industrial states to our south and west. Meaningful federal legislation is the tool by which the goal of clean air for all people can be accomplished.

The failure of the federal government to adopt meaningful rules and the resistance of upwind polluters has resulted in several rounds of litigation. With new federal proposals such as the Clear Skies Act severely limiting legal recourse to address pollution transport, the ability of states to force upwind emissions reductions is greatly diminished. Without effective federal statutes and regulations, there would no longer be a means to limit upwind pollution and states such as New Hampshire would have to seek alternative means to address unhealthy air.

Rolling back State's Rights and delaying the installation of pollution controls, which will inevitably result from some of the proposed legislation, would only add to the costs which downwind states must bear. Analysis has shown that the current regulatory system results in costs to New Hampshire exceeding $1 billion annually solely from the health-related impacts of transported air pollution. This number does not account for non-health-related costs to the state and its residents as a result of increased cost of doing business and lost revenue from tourism. It also does not address lost opportunities for attracting new companies to the state because of comparatively strict pollution control regulations federally required for areas of poor air quality.

Quality of life in New Hampshire is clearly being impacted by air pollution transported into the region from urban areas to the south of New Hampshire and large industrial sources in the Midwest. Unless meaningful legislation and regulations are adopted and effective emission controls are applied nationally, health impacts will increase, the costs borne by the people and businesses of the state will continue to rise, and overall quality of life in New Hampshire will suffer.