AIR

Air quality impacts both human and watershed health. Deterioration in air quality as a result of industrial emissions from the Ohio Valley as well as our own increased vehicle use and increased use of fossil fuels for electrical generation has impacted the quality of all life in Muskoka. Some unfamiliar terms may be clarified in the Glossary at the back of the report.

Indicators of the quality of the air in the Watershed include:

1) Air Quality Readings
   a) Reduce peak ground-level ozone (O_3) levels to less than 50 (defined as good to very good)
   b) Reduce peak fine particulate matter ($PM_{2.5}$) readings to less than 22 (defined as good to very good)
   c) Achieve zero air quality advisories annually

2) Transboundary Air Pollution
   a) Reduce all transboundary components of smog to below critical levels
   b) Reduce transboundary sulphur emissions to achieve acid deposition concentrations below critical load levels

Background

The key components of air quality monitored by governments include:

- Ground level ozone (O_3)
- Fine particulate matter ($PM_{2.5}$)
- Volatile Organic Compounds (VOC)
- Several specific chemicals including nitrogen oxide (NO_x), sulphur dioxide (SO_2), and carbon monoxide (CO).

Volatile organic compounds combine with nitrogen oxide in the presence of sunlight to create ozone, a well-known health hazard for all forms of life. Fine particulate matter is a proven persistent respiratory irritant for people and likely for all animals that breath air. Nitrogen oxide and sulfur dioxide combine with oxygen and water vapour to produce acids that make rain acidic. It has damaged much of our aquatic and terrestrial ecosystems for the past many years, although there has been some reductions during the past few years. Carbon monoxide is poisonous for all life. Since the industrial revolution, concentrations of all these pollutants have increased dramatically.

In the early 1980's air quality monitoring became more standardized and comprehensive. Since that time both Canada and the United States have taken measures to curb emissions, however, there has been only a slight improvement in air quality over that time period. A more aggressive approach is required if real improvement in air quality is to be realized.

The National State of the Environment Report on air quality provides information on ground level ozone levels (O_3), and its chemical reactants: nitrogen oxide (NO_x) and volatile organic compounds (VOC), as well as fine particulate matter $PM_{2.5}$.[23]

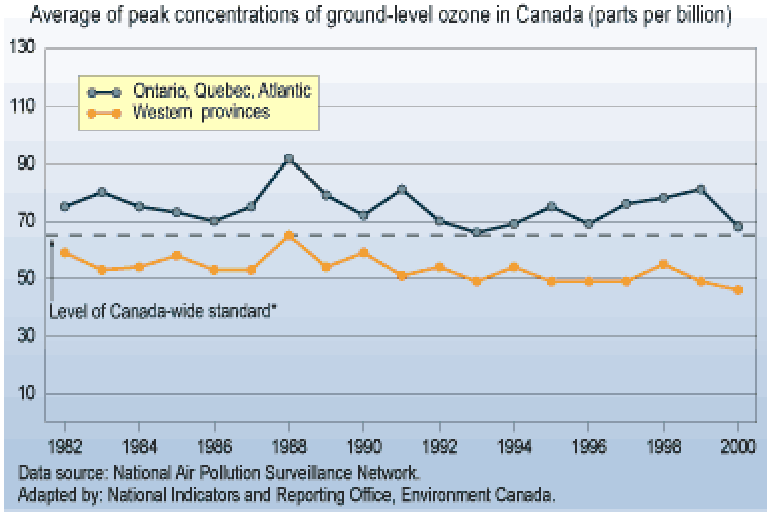
Ground-level ozone levels have not changed significantly across Canada since 1980 and tend to be higher east of the Manitoba/Ontario border. Levels are heavily dependent on the season, with the highest levels occurring in the warmer months. The overall rating for urban air quality in Canada in 2000 was 'no change to a slight improvement' over the 1990 to 2000 reporting period. This rating was based on

[23] Environment Canada, State of the Environment, Infobase, Air Quality http://www.ec.gc.ca/soer-ree/English/headlines/ind3.cfm

changes in ozone ranging from an improvement of 3% to a deterioration of 12% in various locations across the country since 1990. In general, levels of ozone in eastern Canada remain above the Canada-wide Standard of 65ppb.[24] (see figure 1)

Locally, the Parry Sound area stands out as having peak daily ozone readings of 85 to 95 parts per billion (ppb). This is higher than the surrounding area which tends to have peak levels in the 75 to 85 ppb range. All of which are above the Canada-wide standard of 65 ppb.[25] Hourly peak ozone levels in both locations can exceed 100 ppb.[26]

Figure 1: National Ground Level Ozone
(Source Environment Canada)



As seen in Figure 2 below, ambient levels of several other important pollutants have dropped over the last 10 years in urban areas. Meanwhile, emissions of volatile organic compounds from all sources have not shown an improvement (Figure 4). Changes in monitoring methods for fine particulates ($PM_{2.5}$) make it difficult to determine historical trends, but the data available do show that many areas record daily levels that can lead to adverse health effects (Figure 3). In all cases, annual averages do not highlight the peaks in contaminants experienced during the warm summer months. For example, the annual average reading for $PM_{2.5}$ at both the Parry Sound and Dorset air quality station is below 5 ppb, however, peak readings can exceed 70 ppb for short periods of time.

[24] ibid
[25] ibid
[26] Ontario Ministry of the Environment, Air Ontario website http://www.airqualityontario.ca/

Figure 2: Air Pollutant Levels for Key Parametres
(Source Environment Canada)

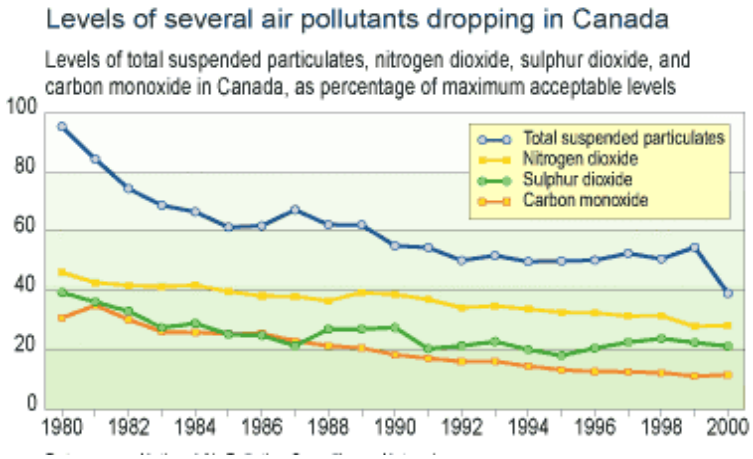


Figure 3: Levels of Fine Particulate
(Source Environment Canada)

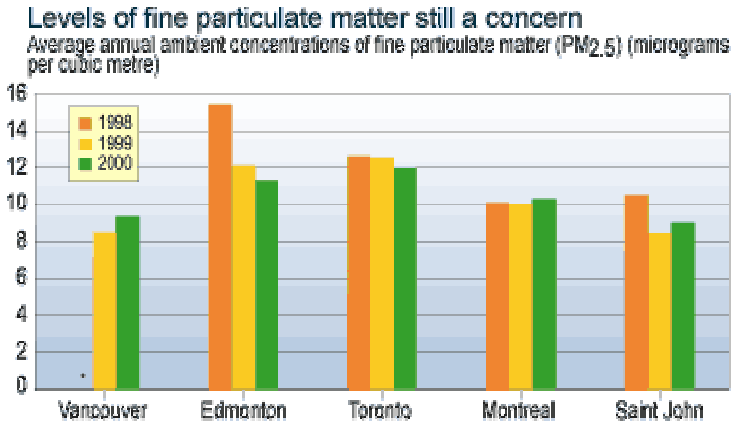
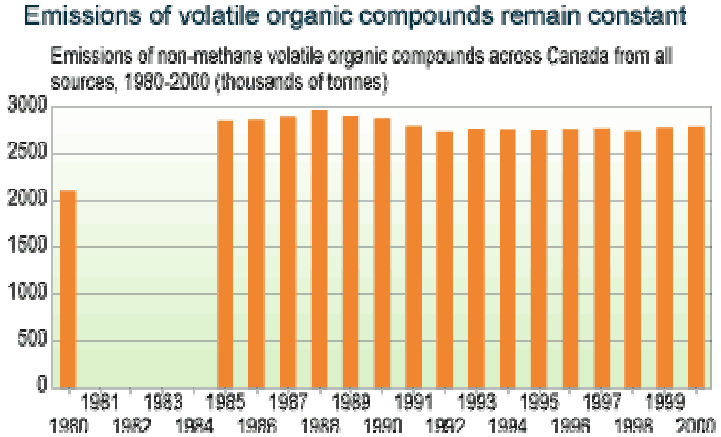


Figure 4: Volatile Organic Compound Levels
(Source Environment Canada)



Air Quality Readings

Components of air pollution come from various sources including point sources such as industry and coal-fires generation plants, mobile sources such as most forms of transportation, and natural sources such as forest fires. Although much of the air pollution that impacts this region comes from the United States a significant portion of that source is generated by fuel manufacturing, transportation of consumer goods and electricity generation that are used locally. Therefore, local actions to reduce electricity use and consumption of goods will reduce the demand for and the need to produce these goods and services.

Air quality readings are reported daily by the Ontario Ministry of the Environment (MOE) through the Air Quality Ontario site at www.airqualityontario. The Air Quality Index (AQI) is an indicator of air quality, based on hourly pollutant measurements of some or all of the six most common air pollutants: sulphur dioxide, ozone, nitrogen dioxide, total reduced sulphur compounds, carbon monoxide and fine particulate matter (see Table 1 for a description of which air pollutants are measure at each station). The critical pollutant in our watersheds is ozone and occasionally $PM_{2.5}$.

An Air Quality Index (AQI) value below 32 is considered relatively good and does not impact health significantly. Within the range of 32 to 49 (moderate category), there may be some adverse effects on very sensitive people, and values in the 50 to 99 range (poor category), may cause adverse health effects for both humans and other animals and significant damage to vegetation and property to statues, buildings and gravestones. An AQI value of 100 or more (very poor category) may cause adverse effects on a large proportion of those exposed.[27]

The MOE issues Smog Alerts (either Smog Watch or Smog Advisory) when poor air quality is expected. A Smog Watch is issued when there is a 50% likelihood of AQI readings above 50 within the next three days. A Smog Advisory is issued when it is almost a certainty that such conditions will occur within 24 hours or already exist.[28]

The watersheds of interest to the Muskoka Watershed Council are located on the eastern shores of Georgian Bay of Lake Huron. This geographic position is critical to the air quality of the region because much of the polluted air comes from the United States.

Air quality for the Muskoka watersheds can be determined by measurements made at Parry Sound, Barrie and Dorset. The readings from these stations have been compared to readings from North Bay, Sudbury and North Toronto to provide a comparison and establish a context for the local data. (Please see Table 1 for what data are available.)

Table 1
Provincial Air Monitoring Stations

Station	AQI (since)	O_3	$PM_{2.5}$	NO_2	CO	SO_2
Barrie	Y(2001)	T	T	T	T	T
Parry Sound	S(2001)	T	T			
Dorset	S(2000)	T	T			
North Bay	Y(2000)	T	T	T		
Sudbury	Y(2000)	T	T	T	T	T
North Toronto	Y(2000)	T	T	T		

Y – year round measurements
S – Seasonal measurements (May 1 to September 30)
O_3 – Ground level ozone
$PM_{2.5}$ – fine level particulate matter
NO_2 – nitrogen dioxide
CO – carbon monoxide
SO_2 – sulphur dioxide
T – Taken

[27] Air Quality Ontario website, http://www.airqualityontario.com/
[28] ibid

The prime reason for issuing an Air Quality Advisory in Muskoka/Haliburton/Parry Sound is for elevated levels of ozone. As an example 97% of days when advisories were issued were because of elevated levels of ozone. As temperatures rise in the summer, nitrogen oxide (NO_x) and volatile organic compounds (VOC) react in the presence of sunlight to form ozone, which is why poor air quality is usually a summer phenomena although it is becoming a more frequent winter event. The provincial air quality readings for Toronto, North Bay, Sudbury and Barrie verify this pattern and indicate that the air quality reading is generally good to very good for these sites from October to April unless there is an unusually warm period, in which case a reading of moderate may result.

The recreational area of Muskoka/Haliburton/Parry Sound has always been considered to be pristine, healthy and a good place to escape the dirty air of many of the urban areas to the south. In the early 1900's people were sent to the Sanatorium in Gravenhurst to enjoy the fresh air and recover from tuberculosis. However, since the industrialization of southern Ontario and the Ohio Valley in the States this has been a myth. Locally, with steam trains and steam boats, excessive lumbering and industrial development in the early 1900's, not to mention the pollutants that would have been carried into the watershed from more distant sources, local air quality has not been pristine for decades.

The current average summer air quality rating for the Muskoka/Parry Sound/Haliburton area is rated as good, with an average below 32. (See Table 2: Average Summer Air Quality Readings)

Table 2
Average Summer Air Quality Readings

Municipality	2003	2004	2005	2006	Four-year Average
Barrie	24.7	25.7	28.1	25.9	25.8
Dorset	26	25.5	28.9	26.5	26.7
Parry Sound	26.2	26.8	27.7	26.2	26.7
North Bay	24.7	23.3	25.7	23.8	24.4
Sudbury	23.6	21.3	25.3	24.5	23.7
Toronto	28.5	26.3	30.2	26.2	27.8

Source: Ontario Ministry of the Environment

However, there are 4 to 10 air quality advisories a year representing 10 to 30 days each summer. These moderate to poor ratings suggest unhealthy conditions for 25 to 35% of the time during the summers since readings have been provided (2003 – 2006) by the Ontario Ministry of the Environment. (See Table 3)

Table 3 indicates that while there is insufficient data to determine a long-term trend in readings, it does suggest that the readings at Dorset and Parry Sound, while marginally better than North Toronto, are more similar to our urban southern neighbours than the urban centres to the north.

Table 3:
Percent of Summer AQI Readings Ranked Good and Moderate/Poor

Year	Barrie		Parry Sound		Dorset		North Bay		Sudbury		North Toronto	
	% Good	% mod/poor	% Good	% mod/poor	% Good	% mod/poor	% Good	% mod/poor	% Good	% mod/poor	% Good	% mod/poor
2003	72	28	77	23	79	21	86	14	80	20	73	27
2004	83	17	75	25	82	18	85	15)	90	10	74	26
2005	78	22	69	31	63	37	73	27	77	23	64	36
2006	78	22	75	25	76	24	84	16	82	18	70	30

Source: Ontario Ministry of the Environment

Ozone Levels (O_3)

Ozone levels in the watershed are generally below 32 ppb at most times of the year and are consider to contribute to good to very good air quality. However, peak readings over 100 can occur. Generally, these higher readings are experienced for short periods of time (several hours) during the summer months and generally result in air quality advisories. Ozone levels vary throughout the day with hourly readings indicating that higher ozone levels tend to be experienced later in the afternoon.

Table 4
Peak Ozone Readings in parts per billion (ppb)

Year	Dorset	Parry Sound
2001	95	116
2002	106	102
2003	81	103
2004	89	99
2005	100	104
2006	88	89

Source: Ontario Ministry of the Environment

Fine Particulate Matter ($PM_{2.5}$)

Like ozone, the level of fine particulate matter in the watershed is considered to be very good at most times of the year with an average reading below 10 ug/m^3. Peak readings, however, can range from 36 to 71 ug/m^3. In the Haliburton/Muskoka/Parry Sound area, episodes of high $PM_{2.5}$ tend to last for a few hours to a few days. This is in contract to areas to the south which can experience high levels of $PM_{2.5}$ for weeks or even a full month in some cases. Although periods of elevated $PM_{2.5}$ are generally associated with periods of elevated levels of ozone, high $PM_{2.5}$ can also be associated with wood smoke during a temperature inversion in the winter months.

Table 5
Peak $PM_{2.5}$ Readings in micrograms per cubic metre (ug/m^3)

Year	Dorset	Parry Sound
2003	49	56
2004	47	45
2005	71	63
2006	38	36

Source: Ontario Ministry of the Environment

Transboundary Air Pollution

Smog Components

In June 2005, the Province of Ontario released a report entitled *Transboundary Air Pollution in Ontario.* This report identifies various components of air pollution and their origin. During widespread smog episodes, the report identifies that the United States contribution to ozone, excluding background levels, is expected to be as much as 90% in Ontario cities and towns on the northern shore of Lake Erie, the eastern shore of Lake Huron (Parry Sound on Georgian Bay) and in the extreme southwest near the United States border[29].

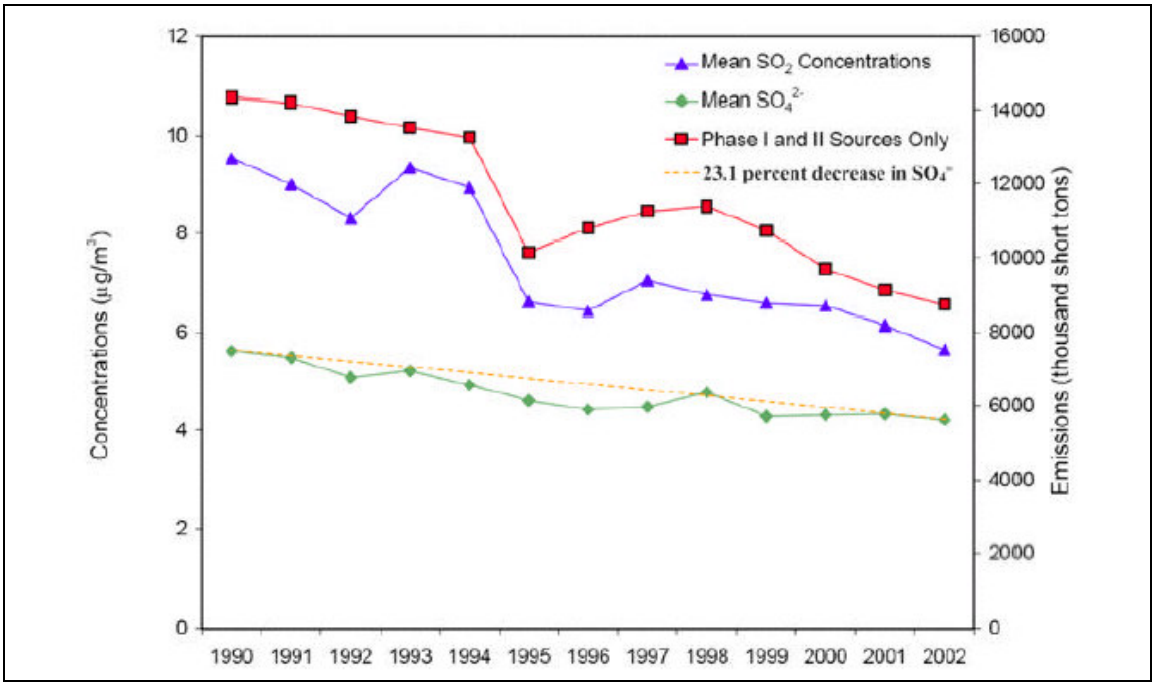
Like Ozone, fine dust particles (measured as $PM_{2.5}$) can be transported many hundreds of kilometers from their sources. Neighbouring American states release approximately 28 times as much primary fine

[29] Ontario Ministry of the Environment, Transboundary Air Pollution in Ontario, June 2005.

particulate matter as does Ontario, mainly from on-road transportation and industrial sources [30] However, due to the distance of Muskoka/Haliburton/Parry Sound to the United States, $PM_{2.5}$ from the United States is not as significant for air quality as ozone emissions.

In the past few decades, improvements have been measured in the reduction of several components of air pollution. For example, Figure 5 illustrates a reduction in sulphur dioxide (SO_2) emissions to the year 2002, the last year for which data are available. This reduction has translated into a 23% reduction in sulphate (SO_4) deposition across Ontario. A similar reduction has been recorded in the United States.[31]

Figure 5: Sulphur Dioxide and Particulate Sulphate Concentrations 1990 – 2002



Source: Ontario Ministry of the Environments

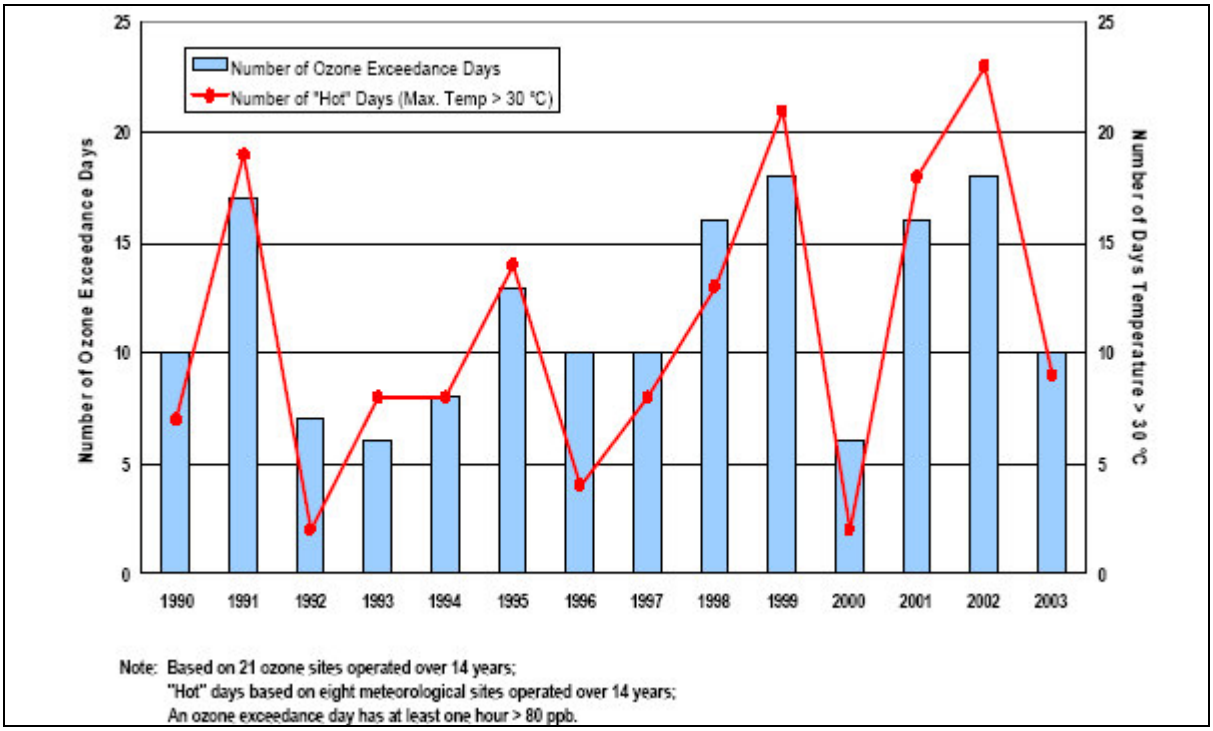
Figure 6 demonstrates, however, that weather plays a dominant role in year-to-year variation in smog episodes in Ontario. Ozone exceedance days tend to correlate to hot temperature days. As a consequence, there are no apparent long-term trends in elevated regional ozone levels in Ontario over the past two decades.[32]

In Muskoka, these provincial trends translate into a local level of air quality that is highly dependant on the pollutants carried into Canada with air masses flowing out of the United States. In particular, using the Canada-wide Standard for Ozone concentration, the Parry Sound area stands out as having peak readings of 85 to 95 parts per billion (ppb). This is higher than the surrounding area which tends to have peak levels in the 75 to 85 ppb range. All of which are above the Canada-wide standard of 65 ppb. Air mass flows demonstrate that these higher concentrations are coming from the United States. A similar pattern, with higher readings in the Parry Sound area, is not seen for the Canada-wide standard for $PM_{2.5}$.[33] At this point, there are no data indicating a change geographically or over time of these ozone and $PM_{2.5}$ levels.

[30] Ibid.
[31] ibid
[32] ibid
[33] ibid

Although studies indicate that over 50% of smog causing ingredients flow into the watershed from the United States, the other 50% of the nitrogen oxide and VOC come from local sources. Addressing these local sources of pollutants is essential to ultimately achieve better air quality in the area. Recreational activity, transportation and electricity use are all key contributors to poor air quality. As with all Ontarians, we need to continue to improve the fuel efficiency of the cars we drive, find alternative methods of transportation, reduce our electricity use, and work toward a smaller global footprint.

Figure 6: Trends for Ozone Exceedance Days and "Hot Days" in Ontario (1990 – 2003)



Source: Ontario Ministry of the Environment

Acid Rain

Acid deposition, commonly referred to as acid rain, primarily results from the transformation of sulphur dioxide and nitrogen oxide into dry or wet pollutants such as sulphuric acid and nitrous acid and ammonium nitrate. The sulphur compounds are the most significant pollutant in the watershed, therefore, the other compounds are not dealt with in this report.

The national indicator on acid rain shows that there was a 19% reduction in sulphur dioxide since 1990.[34] In December 2005, the Canadian Council of Ministers (federal and provincial) of the Environment (CCME) produced a five-year review of the Canada-Wide Acid Rain Strategy. Although CCME recognized that significant reductions in acid rain causing substances had been achieved by 2000, they realized that additional reductions were required to ensure that areas in eastern Canada that are particularly sensitive to acid deposition were meeting their critical loads.

In terms of acid rain, critical load is the amount of SO_4 deposition that an ecosystem can sustain without significant damage. The value is a function of the geology of the area and the ability of the ecosystem to buffer acid input. The watersheds of Muskoka are underlain by granite-gneisses bedrock that was formed during the Precambrian age (3.7 billion to 570 million years ago). Unlike the limestone region to the

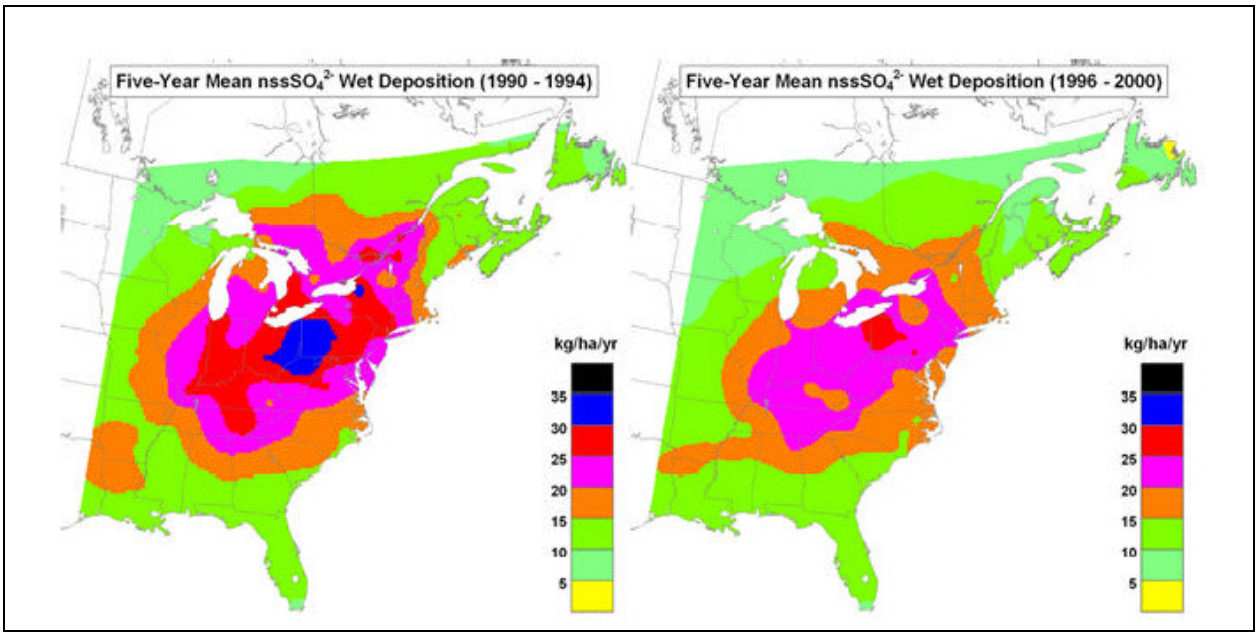
[34] Environment Canada, State of the Environment Report website, http://www.ec.gc.ca/soer-ree/English.

south, granite does not contain any calcium or other minerals that buffer either terrestrial or aquatic ecosystems from acid rain.

The Canada-Wide Acid Rain Strategy for Post-2000 established new sulphur reduction targets and timelines. In it, Ontario undertook to reduce its previous target for SO_2 under the former Eastern Canada Acid Rain Program by 50% to 442.5 kilotonnes (kT) per year by 2015. The Province is now considering advancing this timeline to 2010.[35] By 2000, Ontario had reduced it SO_2 emissions by 33% from the baseline.[36]

The result of these programs has been a reduction in acid rain in Muskoka over the last few decades. Figure 7 shows that SO_4 deposition rates in Muskoka have decreased from 20 - 25 kg/ha/yr in 1990-1994, to 15 - 20 kg/ha/yr from 1996-2000. Scientists indicate, however, that a further reduction to as low as 8 kg/ha/yr is required to ensure that critical load levels are achieved in this area.[37]

Figure 7: Changes in Sulphate Deposition 1990-1994 to 1996-2000



Source: Ontario Ministry of the Environment

Government Action

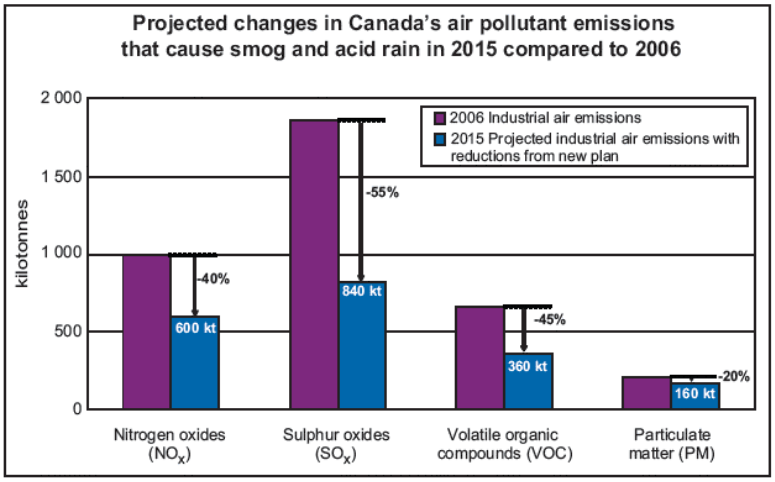
Real change in air quality, or the results of emissions, is not detectable due to the lack of data. What can be measured are changes in pollutant sources and efforts to reduce key emissions. Governments are acting on air quality concerns to approach healthy levels and a concerted effort will be required from all levels of government along with behaviour and lifestyle changes from the public.

Federal Government

The proposed Clean Air Act, released in October 2006, is ineffective for reducing pollutants or green house gases.[38]

[35] Canadian Council of Ministers of the Environment, *Five-year Review of The Canada-Wide Acid Rain Strategy for Post-2000*, December 2005. ISBN-10 1-896997 – 47 -3
[36] Ibid
[37] Ontario Ministry of the Environment, Transboundary Air Pollution in Ontario, June 2005.
[38] Government of Canada, Environment Canada http://www.gc.ca/main_e.html

Figure 8: Projected Reduction Targets



The act could be improved if reductions were based on total allowable emissions from all sources rather than just reductions in intensity from each individual source. A cap on total allowable emissions from all sources would make it possible to reach the ambitious projected targets displayed on Fig 10; but the act allows absolute levels to increase if higher levels of production occur. In April 2007, the Minister of the Environment indicated that he was not committed to bringing the bill back to the legislature for approval. Both David Suzuki and Al Gore chastised the minister responsible for the proposed act and Gore accused him of trying to mislead the public.

In May 2007, the government announced an accord with the United States to address the transboundary flow of fine particulate matter, but the flow of nitrous oxide and volatile organic compounds responsible for poor air quality in Muskoka was not addressed.

Province of Ontario

The Ontario government has an integrated approach for addressing air quality issues which includes leadership, promoting education and energy conservation, developing cleaner energy sources, improving public transit, reducing industrial emissions, supporting research and innovation, and protecting natural spaces. As a result of implementing these types of programs between the years 1990 and 2005, Ontario's emissions of sulphur dioxide and nitrogen oxide decreased by 45 per cent and 25 per cent, respectively.[39]

The Environment Commissioner of Ontario's (ECO) 2005/2006 report deals with air issues. While commending the Ministry of the Environment for reforming air quality rules for industry, the ECO cautions that the effectiveness of the reform will depend on the capacity of the Ministry to enforce compliance with new regulations. Because of reduced resources, the ministry is able to inspect only about 1-2% of industrial facilities a year.[40] The efforts of the provincial government should be monitored to determine the impact of proposed programs.

On the other hand, the government has postponed the closing of the Nanticoke coal-fired generation plant because alternatives are not in place and demand for electricity continues to grow. Installing scrubbers on fossil fuel plants along with encouraging conservation and renewable energy sources such

[39] Ontario Ministry of the Environment, Fact Sheet *Ontario Takes Action on Clean Air and Climate Change*, June 2006. http://www.ene.gov.on.ca/envision/news/2006/062602fs.htm
[40] CNW newsgroup Grave Consequences for Environmental Neglect, Warns Environmental Commissioner, website www.newswire.ca

as wind and solar may be a better alternative to committing to the nuclear energy path that is currently occurring in Ontario.

Further improvements in Ontario's air quality depend on the ability of the provincial and federal governments to negotiate stricter emission controls in the U.S. A foundation for any approach to our American neighbours in this regard will require strong political leadership along with demonstrating emission reductions. Continued monitoring and reporting air quality to the public is important to ensure the Ontario public is knowledgeable about the action required to protect the air we breathe.

United States

The United States passed the Clean Air Act in 1990. It regulates emissions that cause, smog, greenhouse gases and acid rain. Emissions in the States are much greater than in Canada. Although steps are being taken by the EPA and individual states to address various components of air pollution, there is no concerted effort to reduce the pollution coming from the industrialized areas of the States, which influences air quality in Central Ontario.

Local Actions

Much of the Provincial Air Quality plan will best be implemented at the local level by industries, municipalities, school boards, individuals and local non-government stewardship organizations. Programs that deal with energy reduction, transportation, public education, and greenhouse gas emissions should be locally based and supported if the necessary behavioural change is to be achieved. Local programs are beginning to be developed in many municipalities across the watershed and the local health unit has recently announced a pilot program in Gravenhurst to discourage idling. Local municipalities have been active in hydro generation for many years and continued support of this form of electricity generation will continue to support clean air.

Emerging Issues

Mercury

Mercury is a heavy metal found in soil, water and air. In Canada, airborne mercury comes primarily from coal-fired power plants in the United States and from Canadian metal smelting operations and incinerators. Mercury also has natural sources such as the weathering of bedrock and gaseous emissions from soils. It combines with other atoms to form a very toxic compound, methylmercury. It accumulates in all species, especially fish causing damage to the central nervous systems, reproductive failure among loons and river otters, and neurological and developmental damage in humans. Even very limited exposure to mercury may cause problems, such as learning disabilities in children. Women of childbearing age, pregnant women, children, and populations who depend on fish as a traditional food source are most at risk.

The Guide to Eating Sport Fish identifies restrictions for the eating of fish because of mercury contamination from most lakes in the watersheds of Muskoka. Based on a June 2005 report prepared for the Canadian Council of Ministers of the Environment (CCME), in October 2005, provincial and territorial environment ministers agreed to cut toxic mercury emissions from coal-fired power plants by 60 per cent in less than four years. Further monitoring of this commitment to determine its on-ground effect is required.

Winter Smog

Wood is used in more than 3 million Canadian homes as heat source. However, wood smoke reduces the quality of the air and can cause breathing difficulties and other health problems even at relatively low levels. In fact, residential wood burning is a major contributor to winter smog especially in rural areas.

In a hot wood fire only carbon dioxide (CO_2), water and traces of Calcium, Magnesium and phosphorus compounds are emitted into the air. Where as, smoke from the incomplete combustion of wood contains a mix of hazardous particles and chemicals such as volatile organic compounds, carbon monoxide and nitrogen oxide. The severity of the resulting winter smog depends on fresh air moving in. On a cold winter night, when a temperature inversion occurs and lots of fires are dampened down to a slow smoky burn, these pollutants are trapped close to the ground and cause major rural residential smog.[41]

Our Air – Summary (C)

Activity	Comment	Grade
Air Quality Readings		**C-**
• Ozone (O_3)	1. O_3 levels are above the Canada-wide standard.	*D*
• Fine Particulate Matter	1. Not a major cause of air quality advisories	*B*
• Air Quality Index	1. There are 4 to 6 Air Quality advisories each year representing 10 to 30 days a summer.	*D*
Transboundary Air Pollution		**C**
• Smog Components	1. Marginal improvement in ozone concentrations. 2. Reduction in several other chemicals from the Ohio Valley (SO_4, SO_2).	*D*
• Acid Rain	1. Real reductions in sulphate have been achieved. 2. Deposition will remain above critical loads	*B*

[41] Environment Canada, Clean Air On-line website, http://www.ec.gc.ca/cleanair-airpur/Winter_Smog-WSAFF4D58F-1_En.htm

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