CleanAir
HAMILTON

2007 Progress Report

June 2008

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Executive Summary

- *Clean Air Hamilton* is a community initiative to improve air quality in the City of Hamilton. It has a diverse membership with representation from environmental organizations, industry, businesses, academic institutions, and different levels of government. Initiated in 1998, *Clean Air Hamilton* works to improve air quality in Hamilton by:
    - Initiating research on air quality;
    - Providing policy advice to all levels of government;
    - Encouraging emission reductions among individuals and companies operating in Hamilton; and
    - Promoting behavioural changes in companies, government, institutions and individuals in Hamilton that will reduce energy consumption and improve air quality.
- The City's industrial sector is perceived by many in Hamilton to be the major contributor to poor air quality and that reductions in industrial emissions should be a primary focus of air quality improvements. While significant reductions in industrial emissions have been realized in recent years; efforts need to continue to make even more improvements; however, emissions from mobile sources (personal and commercial vehicles) and fugitive dusts must be reduced significantly if we are to make meaningful improvements to local air quality.
- Mobile monitoring studies conducting in Hamilton showed that high pollutant exposures occur near arterial roads and highways due to emissions from mobile (i.e., transportation) sources. There is a need to recognize the health impacts of transportation-related pollutants and incorporate this recognition in transportation planning and urban design.
- Hamiltonians need support and encouragement to reduce their transportation-related emissions by switching to sustainable transportation including public transit, bicycles, walking, hybrid and electric vehicles, etc. Cycling/walking routes throughout Hamilton that are separate from traffic, particularly on heavily travelled roads, would facilitate healthy, active transportation.
- Fugitive dusts, i.e., dusts from roads, construction sites and open commercial operations, particularly in the industrial areas of the City, have been shown to be significant sources of fine particulate material*. Clean Air Hamilton,* the Ministry of the Environment and the City will continue to work actively with local business owners and site operators in Hamilton to develop best practices and reduce fugitive dust emissions as well as NO_x and SO_2 emissions.
- Climate Change is now of broad environmental concern; many citizens are looking for ways to reduce their impacts of greenhouse gas emissions. Measures which result in reduced greenhouse gas emissions will also reduce emissions of harmful combustion by-products, resulting in improvements to local air quality. The **2008 Upwind/Downwind Air Quality Conference: Climate Change & Healthy Cities** (hosted by *Clean Air Hamilton* and the City on February 25th and 26th, 2008) focussed on these linkages and offered practical, affordable solutions for air quality improvement.
- The City needs to maintain support for actions that will to improve local air quality and increase the level of dialogue within community groups on the health impacts of poor air quality and the best actions and lifestyle changes that will lead to air quality improvements for all citizens.
- *Clean Air Hamilton* continues to encourage activities undertaken by the City, industries and citizens to reduce air pollutants and improve local air quality in their operations and transportation choices. *Clean Air Hamilton* actively cultivates partnerships with organizations that have air quality improvement goals that are aligned with those of *Clean Air Hamilton* and the City of Hamilton.

1.0 Introduction

Clean Air Hamilton is pleased to present the 2007 Progress Report on Air Quality to Hamilton City Council. This report presents local air quality trends and the activities undertaken by *Clean Air Hamilton* in 2007 to help improve air quality in the City of Hamilton. This report gives an update on new initiatives and on activities that have continued from previous years. This document consists of a 44-page report with five appendices:

- Appendix A presents strategic issues identified by *Clean Air Hamilton* for action, research and communication to be undertaken in the 2008-2010 time-frame;
- Appendix B presents updated Air Quality Trends for Hamilton and comparisons of Hamilton's air quality indicators to some cities in Ontario;
- Appendix C lists *Clean Air Hamilton* partnerships;
- Appendix D is a report on the 2008 Upwind/Downwind Conference, held on February 25 and 26, 2008
- Appendix E is a Glossary of Terms used in this Report to assist readers.

1.1 Background

The former Hamilton-Wentworth Regional Council endorsed the establishment of *Clean Air Hamilton* (then called the Hamilton-Wentworth Air Quality Improvement Committee or HAQIC) in 1998 following the publication of a series of reports by the Hamilton Air Quality Initiative (HAQI) in October 1997.

These reports are available online at: http://www.cleanair.hamilton.ca/

1.2 Successes Related to Contributions

Clean Air Hamilton continues to receive regional, national and international attention for its outstanding leadership and commitment to improving local air quality. The *Clean Air Hamilton* website receives over 1,500 hits a week and inquiries about *Clean Air Hamilton's* activities are received regularly from organizations and individuals in Canada, the U.S. and from around the world. Many innovative projects have emerged, directly and indirectly, from *Clean Air Hamilton*.

The City of Hamilton currently provides an annual budget of $80,000/year in support of *Clean Air Hamilton* and its activities. This money is leveraged by funding provided by partner institutions and by the in-kind support of community volunteers who donate their time and expertise. It has been estimated that *Clean Air Hamilton*'s volunteers provide time and air quality expertise that is worth about $400,000 per year to the City and the citizens of Hamilton.

Members of *Clean Air Hamilton* have engaged City Council and the community in decision-making and issues related to air quality, including transportation (e.g., mobile monitoring studies, anti-idling strategies, and the annual Commuter Challenge), planning (e.g., mobile monitoring), fugitive dust abatement, air monitoring (e.g., LIDAR workshop), education initiatives and community air quality awareness (e.g, Upwind/Downwind Conference, Living for the Environment Mohawk Conference, Earth Day, Dofasco Health and Safety Fair, David Suzuki Tour, and *Clean Air Hamilton* website).

2.0 *Clean Air Hamilton*

2.1 Vision Statement

"Clean Air Hamilton is an innovative, multi-stakeholder agent of change dedicated to improving air quality in our community. We are committed to improving the health and quality of life of citizens through communication and promoting realistic, science-based decision-making and sustainable practices."

2.2 Goals

Clean Air Hamilton has identified the following goals as a guide for actions over the next 2 to 5 years:

- To improve air quality throughout the City to meet all ambient air quality criteria ;
- To raise *Clean Air Hamilton*'s visibility in the community and to be recognized as the authoritative voice on local air quality issues;
- To provide information and advice that decision-makers value;
- To influence decision-makers to choose sustainable practices and alternatives;
- To galvanize broad-based support for a process and an action plan to improve air quality; and
- To affect behavioural changes to improve air quality.

2.3 *Clean Air Hamilton* Membership in 2007

Dr. Brian McCarry (Chair)	McMaster University
Alex Basiji	Health Canada
Stephen Brotherston	Citizen
Mike Brown	ArcelorMittal Dofasco
Robert Cash	Archer Daniels Midland
Ed Cocchiarella	ArcelorMittal Dofasco
Dr. Denis Corr	McMaster University/Rotek Environmental
Heather Donison	Planning & Economic Development, City of Hamilton
Mark Dunn	Ontario Ministry of the Environment
Barry Duffey	Ontario Ministry of the Environment
Ted Hammill	Bunge Canada/Hamilton Air Monitoring Initiative
Chris Hill	Public Works, City of Hamilton
Brenda Johnson	Environment Hamilton
James Kaspersetz	Citizen
Ross Kent	Citizen
Geoff Lupton	Public Works, City of Hamilton
Gerald Mickie	Horizon Utilities
Natasha Mihas	Public Health Services, City of Hamilton
Dr. Ted Mitchell	Citizen
Brian Montgomery	Planning & Economic Development, City of Hamilton
Hossein Naghdianei	Environment Canada
Thom Oommen	Green Venture
Andy Sebestyen	US Steel Canada/Hamilton Industrial Environmental Association
Carl Slater	Ontario Ministry of the Environment
Antonino Spoleti	Public Works, City of Hamilton

Steve Walsh	Public Health Services, City of Hamilton
Pete Wobschall	Green Venture

Clean Air Hamilton is dependent upon the voluntary contributions of its members. In order to continue to make air quality improvements in Hamilton, *Clean Air Hamilton* continues to supplement the voluntary contributions of members with renewed and ongoing commitments of funding from key stakeholders, including various levels of government, the City of Hamilton, local industries and academic institutions, as well as recruiting new members into the organization.

Clean Air Hamilton is committed to recruiting new members who have the time, expertise and interest in air quality issues to work in a committee-based format to find ways to improve air quality in the City. *Clean Air Hamilton* is particularly interested in engaging with committed individuals who want to work to improve air quality in Hamilton. *Clean Air Hamilton* is interested in working with individuals and with representatives from industries, schools and school boards, community groups and others who partner on one or more actions identified by *Clean Air Hamilton*. Interested individuals should contact the City of Hamilton's Air Quality Coordinator by telephone at (905) 546-2424 ext. 1275 or by e-mail at cleanair@hamilton.ca

2.4 Strategic Activities for 2008 and Beyond

Clean Air Hamilton has identified nine strategic issues related to air quality improvements and climate change that the committee wishes to focus on over the next 2-3 years. These issues have been identified for research, communication and program activities by Clean Air Hamilton in collaboration with our partners:

- **Public Health Protection:** Bring an Air Quality Health Index to Hamilton; create communications to citizens about the health effects of poor air quality, particularly on smog days and inversion days.
- **Active & Sustainable Transportation:** Encourage the use of active and sustainable means of energy-efficient transportation and encourage emissions reductions by moving away from single occupancy personal transportation.
- **Smart Drivers:** Reduce unnecessary idling of vehicles, reduce impacts of vehicle emissions, and reduce emissions from driving.
- **Air Quality Communication:** Continue to communicate on the impacts and sources of poor air quality, encourage behavioural changes, and increase support for Clean Air Hamilton.
- **Climate Change:** Provide a forum to discuss the linkages between climate change and air quality and encourage action to reduce climate change impacts in Hamilton.
- **Emission Reductions Strategies:** Develop a plan to reduce emissions from small, medium and large scale sources on "bad air" days, e.g., smog days.
- **Energy Conservation:** Encourage energy conservation by promoting best practices and by encouraging reducing wasteful uses of electricity. This promotion will make the connection between climate change and poor air quality.
- **Land Use Planning:** Encourage actions by the City through land use policies to promote reductions of emissions and improvements in air quality through better planning tools.
- **Tree Programs:** Develop a tree networking and tree inventory organization for all the tree planting activities across the City.

Details of these activities can be found in Appendix A.

3.0 Air Quality in Hamilton

3.1 Air Pollution Health Impacts – Hamilton and Ontario

Poor air quality is associated with a range of health impacts, including eye, nose and throat irritation, breathing difficulties, coughing, wheezing, and the exasperation of existing conditions like asthma. There is no evidence that air pollution causes asthma directly; however, there is ample evidence that poor air quality exacerbates a pre-existing asthma condition. Also, some segments of the population, particularly young children and the elderly, are much more susceptible to the adverse health effects of poor air quality.

Less appreciated is the fact that the *respiratory* illnesses many people associate with poor air quality account for less that 20 percent of the adverse health effects; cardiovascular impacts are far more prevalent. *Clean Air Hamilton*'s 2003 air pollution health assessment report projected that over 66 percent of the health outcomes arising from air pollution in Hamilton would be manifest as *cardiovascular* illnesses. The report estimated that five key air pollutants – nitrogen dioxide, ground level ozone, fine particulate matter, sulphur dioxide and carbon monoxide -- contribute to approximately 100 premature deaths and 620 hospital admissions in Hamilton each year (**see Figures 1 & 2 below**).

Figure 1: Air Pollution Health Impacts – Mortality, Cardiovascular Hospital Admissions and Respiratory Admissions (2003)

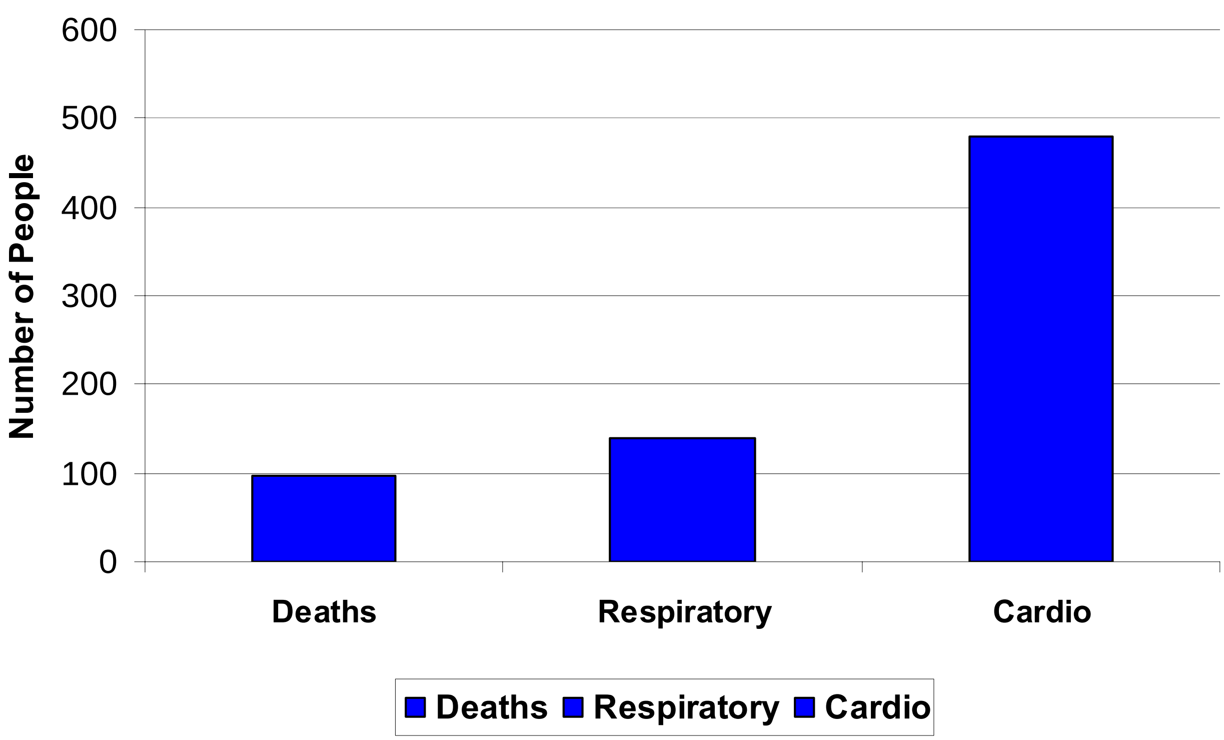
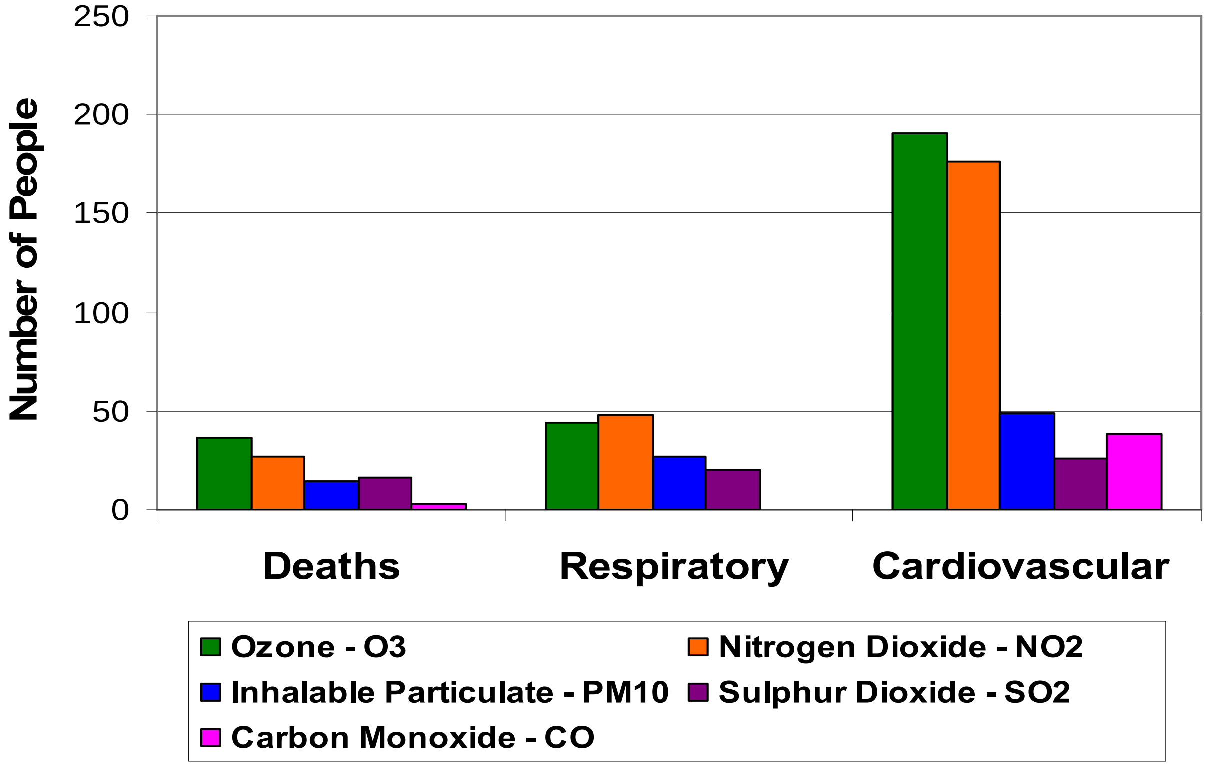


Figure 2: Air Pollution Health Impacts – Health Impacts by Pollutant



Backgrounder on Cardiovascular Disease:

The term “cardiovascular” refers to the heart and associated blood vessels. While any disease which affects the heart or blood vessels is termed cardiovascular (e.g., stroke) cardiovascular disease is commonly used to refer to blockages of arteries (due to build-up of *plaques*) and hardening of the arteries (called *arteriosclerosis*). When the blood vessels supplying blood to the heart are constricted or have hardened, the medical condition is called *coronary artery disease*. If blood flow is stopped for some reason, a heart attack (or *myocardial infarction*) will likely occur.

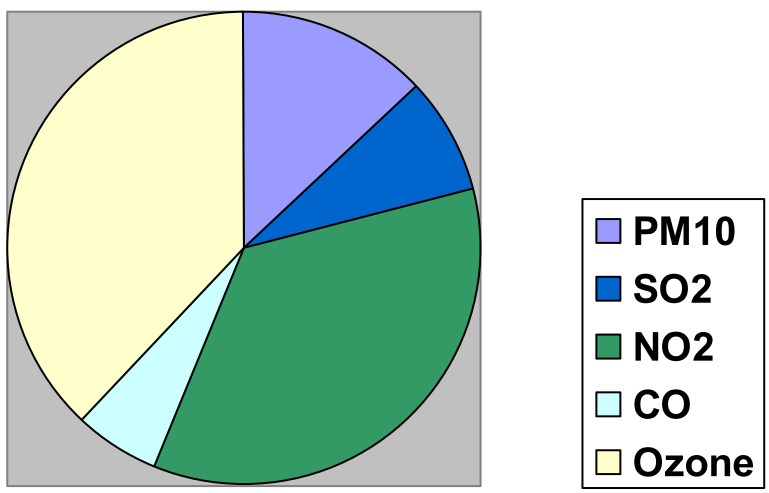
The accumulation of plaque and the hardening of arteries is chronic, and typically progresses for years or even decades without any apparent symptoms. In about 50% of cases, the first symptom of heart disease is a sudden heart attack.

While the risks of cardiovascular disease due to poor diet, lack of exercise and smoking are well established, recent research has focused on the contribution that air pollution can have on the incidence of cardiovascular disease and the triggering of heart attacks.

Recent investigations[1] examining the chronic health effects of exposure to air pollutants have demonstrated that there is an increased risk related to human health as the air quality gets poorer. Noteworthy, particulate matter less than 2.5 microns in diameter (called $PM_{2.5}$) has been shown to have a direct impact on the development of cardiovascular disease in humans. After controlling for the traditional risk factors (i.e., smoking, age, diabetes, diet/cholesterol, exercise/body mass index, etc.), it was determined that for each 10 $\mu g/m^3$ (micrograms per cubic meter) increase in $PM_{2.5}$, the risk of a cardiovascular disease increased by 24%. The risk of death from a cardiovascular event (e.g., heart attack, stroke) increased by 76%.

Other recent reports[2] have focussed on the health effects of “ultra-fine” particles in the air. These particles are extremely small (typically between 0.02 and 0.1 microns) and constitute a portion of the particulate fraction called $PM_{2.5}$ discussed above. Amazingly, these ultra-fine particles can be taken up directly by many cell types, including lung cells. The mechanisms of the health impacts that result from the uptake of these ultra-fine particles remain unknown.

Figure 3: Contribution of Air Pollutants to Air- Derived Health Impacts in Hamilton (%)



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[1] Sources:
Annette Peters, PH.D. et al, Exposures to Traffic and the Onset of Myocardial Infraction, New England Journal of Medicine, 2004
Kristen A. Miller, M.S. et al, Long-Term Exposure to Air Pollution and Incidence of Cardiovascular Events in Women, New England Journal of Medicine, 2007
Ontario Medical Association, The Illness Costs of Air Pollution, 2005
Murray Finkelstein, et al, Traffic Air Pollution and Mortality Rate Advancement Periods, American Journal of Epidemiology, 2004

[2] Sources:
Lawrence D. Frank, et al, Many Pathways from Land Use to Health, Journal of the American Planning Association, 2006
Alan Abelsohn, et al, Identifying and managing adverse environmental health effects: 2. Outdoor air pollution, Canadian Medical Association Journal, 2002
Public Health Agency of Canada, http://www.phac-aspc.gc.ca/ccdpc-cpcmc/cvd-mcv/index_e.html

Another finding from the large-scale epidemiology studies is that differences in morbidity and mortality due to pollution effects were observed within the same city, and not just between different cities. The significance of this finding is that differences cannot be dismissed as an indication of different levels of industrial activity between cities; the urban design and the transportation-based emissions within cities that arise from transportation sources play a significant role in the levels of pollutants to which we are exposed. Specifically, both greater street connectivity and the increased 'walkability' of neighbourhoods decrease driving, and the amount of air pollution associated with automobile emissions.

The increased risk of cardiovascular disease due to air pollution may seem insignificant when compared to the established cardiovascular risk factors (e.g., diet, exercise and smoking). However, because everyone is affected to some degree by poor air quality, even conservative risk estimates translate into substantial increases in total mortality within the population. In 2005 the Ontario Medical Association (OMA) issued an update to its 2000 report on the health impacts of poor air quality in Ontario. The 2005 OMA report estimated the Illness Cost of Air Pollution (ICAP) for Ontario in 2005 to be $16 B (or about $1250 per year for every person in Ontario). This estimate had been increased substantially from the OMA's 2000 report, based on new evidence of the chronic effects of exposures to air pollution (see above). This estimate includes not only the costs of hospital admissions and death but also the estimated costs of visits to doctors, lost work days, lost productivity, lack of wellness, etc.

Since the 2003 *Clean Air Hamilton* air pollution and health assessment report, several other air pollutant and health impact reports have been released. The Clean Air Hamilton 2003 assessment should be considered to be on the lower range of mortality estimates while the OMA's report estimates are on the higher end of the range; both are comparable overall.

While the OMA did not provide a breakdown of the illness cost for the Hamilton region, the local figure for the cost of air pollution impacts would be around $750 M, based on the proportion of the local population (~600,000) compared to the total population of the Province of Ontario (~12,500,000). The estimated health impacts on the health of Hamiltonians as a result of smog can be found in **Table 1**. These estimates are in line with the predictions made in the 2003 Air Quality Health Effects Report conducted for Clean Air Hamilton.

Table 1: 2005 Illness Cost of Air Pollution – Regional Data for Hamilton-Wentworth Regional Municipality

(Source: Ontario Medical Association, 2005)

	Number of Individuals in 2005	Number of Individuals in 2026 (Projected)
Premature Deaths	290	500
Hospital Admissions	810	1,200
Emergency Visits	2,840	4,250

Clean Air Hamilton has long advocated for the development of a health-based Air Quality Index; a well-conceived health index would provide the public with useful information about current air quality conditions and provide the public with strategies they can use to reduce their exposures.

Health Canada has developed an Air Quality Health Index (AQHI) and is in the process of piloting the use of this index in selected cities across Canada prior to a nation-wide adoption of the AQHI in a few years. Health Canada's new AQHI is calculated in a different manner compared to the current Air Quality Index (AQI) that is reported by the Ontario Ministry of the Environment. The fundamental difference between these two indices is the information which is used to calculate each index. The four key air pollution contributors to health effects impacts are oxides of nitrogen (NO_X), ozone (O_3), respirable particulate material ($PM_{2.5}$), and sulphur dioxide (SO_2). In the case of the MOE's AQI, only the highest relative reading of these three contributors is used to calculate the AQI. It has been recognized for several years that the impacts of air pollutants are additive; thus, it makes sense to use all three of the major contributors in determining health effects impacts. This latter approach was used in Clean Air Hamilton's health studies. This approach is also embodied into Health Canada's new AQHI.

Clean Air Hamilton is keen to bring the AQHI reporting system to Hamilton and is working with Health Canada to investigate whether Hamilton can become a test city for this new air quality health index.

For more information on Health Canada's AQHI visit http://www.ec.gc.ca/cas-aqhi/

3.2 Hamilton Air Quality – Trends and Comparisons over Past Ten Years

Examination of the trends in ambient air quality in Hamilton over the last decade shows that there have been significant reductions in the air levels of some pollutants such as benzene, total reduced sulphur and benzo[a]pyrene. The ambient levels of other pollutants, such as particulate material (PM_{10} and $PM_{2.5}$), nitrogen oxides (NO_x) and sulphur dioxide (SO_2) have decreased slowly over this period. These reductions have resulted from actions taken to reduce emissions by the industrial sector in Hamilton. On the other hand, those pollutants whose levels have reduced only modestly over the last decade are due primarily to transportation sources (i.e., cars and trucks), the roadway system due to road dust resuspension and various other sources of fugitive dusts.

Some progress has been made on reducing the air levels of oxides of nitrogen (NO_x); on the other hand, the levels of ground level ozone have been steadily increasing over the past decade, primarily due to long-range transport of pollutants into southern Ontario **(see Appendix B)**.

When we compare recent levels of air pollutants in Hamilton to levels of the same pollutants in other southern Ontario communities over the past 15 years, the trends show that:

- The levels of nitrogen oxides (NO_x) in Hamilton have decreased and are similar to or slightly higher than other cities in southern Ontario (except Toronto);
- The levels of ground-level ozone (O_3) in southern Ontario during the summer months have increased over the past decade; ozone levels in Hamilton are usually equal to or lower than levels in other Southern Ontario cities. Rural areas of Ontario near large lakes often experience the highest levels of ground-level ozone during smog events, particularly areas like Turkey Point, Simcoe and the Bay of Quinte;

- The levels of sulphur dioxide (SO_2) in Hamilton tend to be somewhat higher than in other southern Ontario communities due to local industrial activities; however, as noted above, SO_2 levels in Hamilton have continued to decrease in recent years.

The air quality in Hamilton is impacted by a combination of factors that do not co-occur in other communities in southern Ontario:

- The roads in and around Hamilton are heavily used by local citizens, commuters passing through Hamilton and long-distance traffic. As a consequence, the air quality is adversely impacted by the mobile emissions generated by gasoline-powered vehicles and transport trucks (diesel-powered vehicles);
- Hamilton is home to a large number of small, medium and large industries;
- Hamilton’s location at the west end of Lake Ontario, the local topography (i.e., the escarpment) and prevailing weather conditions contribute to situations wherein air pollutants levels below the escarpment are often higher than levels above the escarpment.
- Hamilton is also affected by trans-boundary air pollution (primarily ground-level ozone impacts and air particulate from sources in the mid-western United States) in a manner similar to the pollution experienced in many other communities in south-western Ontario; and
- On those rare occasions when winds come from the south, Hamilton may be impacted by emissions from the Nanticoke coal-fired generating station.

3.3 Smog Advisories and Smog Advisory Days

What is a Smog Advisory?

The Ontario Ministry of Environment (MOE) monitors the air quality in Ontario and provides a rating of the air quality called the Air Quality Index (AQI). A smog advisory is issued by the MOE when the Air Quality Index reaches or exceeds a value of 50; a smog advisory day is declared when it is predicted that it is likely that the AQI may reach or exceed 50 on an upcoming day or the AQI has already reached a value over 50 and is expected to remain above 50 for the advisory period. There are three AQI stations in Hamilton which provide the air quality index data used to calculate the AQI.

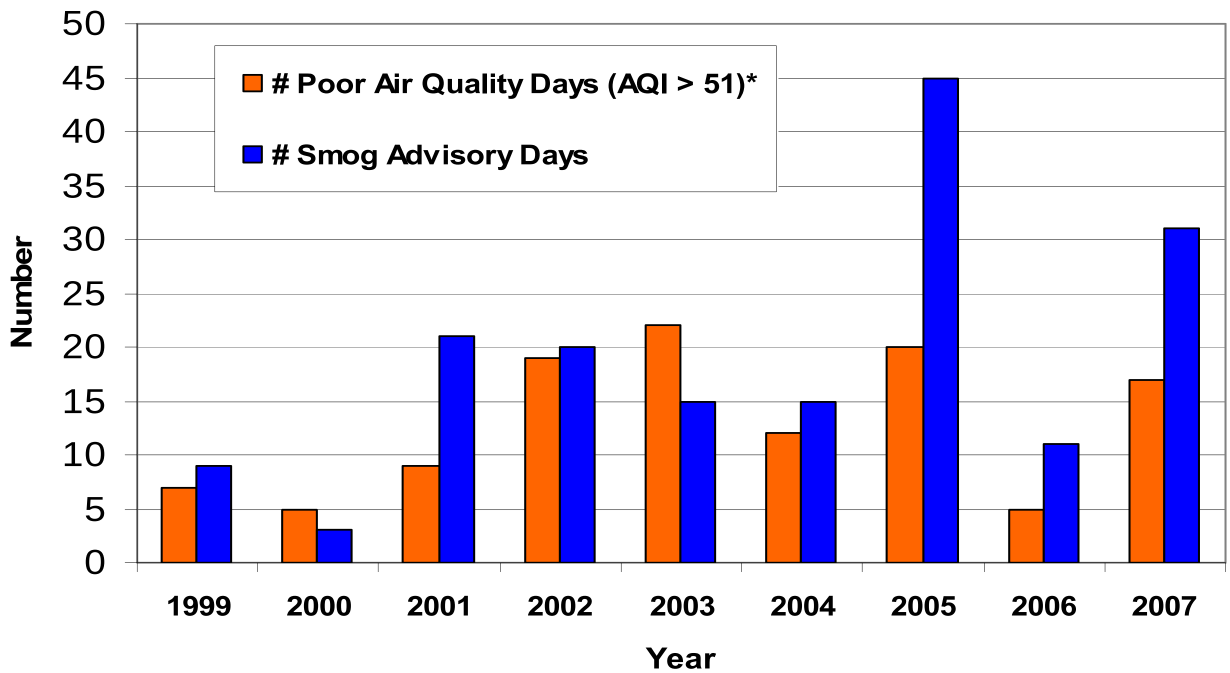
Smog advisories are issued to alert the public when widespread elevated levels of air pollution exist (i.e., when AQI values exceed a value of 50). Such conditions exist during persistent smog episodes and are commonly characterized by high levels of ozone and/or particulate matter in a regional context. Local advisories may be issued for just Hamilton, if local emissions are expected to cause AQI values of 50 or higher usually due to particulate matter.

The AQI is determined based on the highest value of any one of four key air contaminants – $PM_{2.5}$, nitrogen oxides (NO_x), sulphur dioxide (SO_2) or ground-level ozone (O_3). In the summer months smog days and air quality advisories are usually issued based on high ozone levels due to regional pollution whereas in the spring and fall the smog alerts are issued primarily due to high levels of particulate matter due to local pollution.

Gaseous air pollutants (NO_X, VOCs) can react during the day under the influence of sunlight to afford a complex mixture of chemical products, including ground-level ozone. This mixture of pollutants is commonly called smog. The ozone that forms one of the constituents of smog is called ground-level ozone to distinguish it from the ozone in the stratosphere (i.e., the ozone which is found ~20-40 km above the earth's surface); stratospheric ozone is important in absorbing harmful ultraviolet radiation from the sun and thus reducing the levels of ultraviolet light that reach the earth's surface. Ozone is a severe lung irritant and when inhaled along with respirable particulate matter and other pollutants such as nitrogen oxides, the impacts on the lungs of susceptible individuals, such as the elderly and the young, can be dramatic.

In 2007, there was an increase in the number of smog advisory days declared in Hamilton compared to the average over the past nine years (see **Figure 4**). In 2007 31 smog advisory days were declared by the Ontario Ministry of Environment for the City of Hamilton. **Figure 4** below shows the numbers of smog advisory days and poor air quality days over the past nine years. Poor air quality days are defined as days where the AQI was greater than 49 for at least 1 hour during the day.

Figure 4: Number of Poor Air Quality Days and Smog Advisory Days in Hamilton between 1999 and 2007



* Data from Downtown Hamilton Air Monitoring Station

Ontario's Smog Alert Program was enhanced on August 23, 2002 when $PM_{2.5}$ was incorporated into the provincial Air Quality Index. Prior to this date smog advisories were issued only for exceedances in ground-level ozone levels.

Figure 5: AQI Ranges (Ministry of the Environment)

Air Quality Index (AQI) Categories	
AQI Ranges and Categories	**Colour**
0-15 Very Good	
16-31 Good	
32-49 Moderate	
50-99 Poor	
100+ Very Poor	

What do the MOE's Air Quality Index readings mean in terms of health impacts?

- If the air quality value is below 16, the air quality is considered very good.
- If the air quality value is below 32, the air quality is considered good.
- If the AQI value is in the range of 32 to 49 (moderate category), there may be some adverse effects in sensitive individuals.
- An index value in the 50 to 99 range (poor category) may result in some short-term adverse effects on humans, particularly sensitive individuals, and on animals; these conditions may also cause some damage to vegetation and property.
- An AQI value of 100 or more (very poor category) may cause adverse effects on a large fraction of the exposed human and animal populations. There will also be increased damage to plants, crops and property.

For further information, consult the Ontario Ministry of Environment's Air Quality site at: www.airqualityontario.com.

3.4 Emission Sources within Hamilton

The task of compiling an accurate and up-to-date inventory of emission sources within an urban area is a significant challenge for a number of reasons. First, not all sources are required to report their emissions and are thus unaccounted for. Second, not all sources of emissions are reported accurately, often because those who report the data do not have the information needed or the skill set to complete an accurate report.

Table 2, derived from Environment Canada's 2001 Criteria Air Contaminant emissions database, lists total emissions by source type. **Table 3,** derived from the National Pollutant Release Inventory (NPRI), provides the totals of all reported sources of key air pollutants as reported by a selection of local industries. The primary reason that there is not a complete emissions inventory for Hamilton (or any city in Canada) is that many small and medium-sized companies are not required to report their emissions to either Environment Canada to the NPRI Program.

Table 2: Estimated Emissions by Source, Hamilton, 2001 (Tonnes/year)

Source	PM_{10}	$PM_{2.5}$	SO_2	NO_X	VOCs	CO
Industrial	10,167	2,764	25,771	10,903	28,540	501,768
Area Sources*	4,212	1,571	427	1469	6,908	8,566
Transportation (Off-Road)* * (On-Road)	879 (523) (256)	810 (482) (241)	1,638 (464) (191)	14,217 (7271) (6320)	10,282 (5514) (4105)	107,808 (68572) (41330)
Road Dust***	6,992	1,366	NA	NA	NA	NA
Total	22,250	5,145	27,836	26,589	45,244	618,142

Ref: RWDI Inc. (2004). Transportation Master Plan - Air Quality Policy Paper (May 2004 Draft). Prepared by the IBI Group for the City of Hamilton.

* Includes fireplaces & furnaces in homes & businesses & general solvent use.
** Excludes marine, railroad and aircraft emissions; includes vehicles and equipment used for construction, farming, and lawn and garden maintenance.
*** Road dust includes fine particulate matter from vehicle exhaust, tire wear, construction sites and industrial sites that can become airborne when disturbed.

Table 3: Total Emissions by Source Category for Hamilton (NPRI, 2004)

Source Category	***CO***	***SO_X***	***NO_X***	***PM_{10}***
Industrial	16,443	11,088	8,414	5,430
Fuel Combustion	9,428	421	1,659	1,707
Transportation	58,490	871	12,766	1,037
Incineration	377	40	173	2
Miscellaneous	197	0	0	118
Open Sources	0	0	0	21,669
Total Tonnes	**84,934**	**12,421**	**23,012**	**29,963**

NPRI: National Pollutant Release Inventory

Please note these two tables are for different years and sort the data differently so they are not directly comparable, however they both offer useful insights about the emission sources.

Based on the available emissions inventory data from the Ontario Ministry of the Environment and Environment Canada it is possible to conclude that:

- The transportation sector (i.e., mobile sources such as cars and trucks) is the leading source of NO_x emissions within the City of Hamilton, followed closely by the industrial sector.
- The industrial sector is the source of over one-half of the directly-emitted $PM_{2.5}$, followed by road dust and area sources such as fireplaces, home heating and small businesses;
- Road dust, construction activities and area sources such as fireplaces and home heating are a source of PM_{10}; industry sources account for the other half.
- The industrial sector is the leading source of SO_2 in Hamilton(~90%); and

- The industrial sector is the leading source (~60%) of volatile organic compounds (VOCs), followed by releases due to general solvent use by companies and individuals, followed by emissions from the transportation sector.

In 2005, a mobile monitoring study (see **Section 4.1**) conducted for *Clean Air Hamilton* and the City identified and ranked sources of air pollutants in Hamilton. Historical fixed-site air monitoring data and NPRI data for Hamilton (2004) were used to develop a target list of sources of health-impacting air pollutants and locations for the mobile study (**Figure 6**). Five separate industrial areas were identified in the city (**Figure 7**) - Flamborough/Waterdown (aggregates), East Mountain (aggregates), West Hamilton/Frid (mixed industrial and university), Northeast Industrial Area (heavy and mixed industrial) and Stoney Creek (mixed industrial and aggregates).

Figure 6: National Pollutant Release Inventory Identification of Industrial Areas

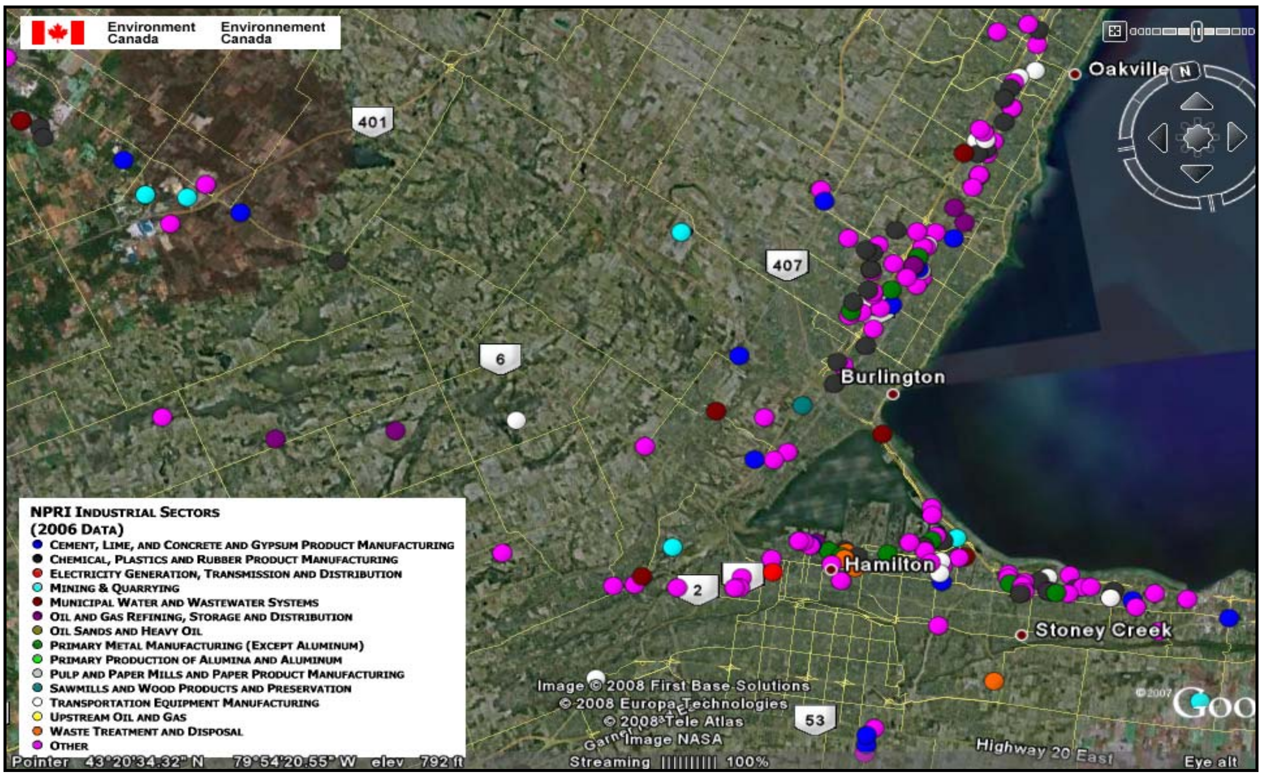
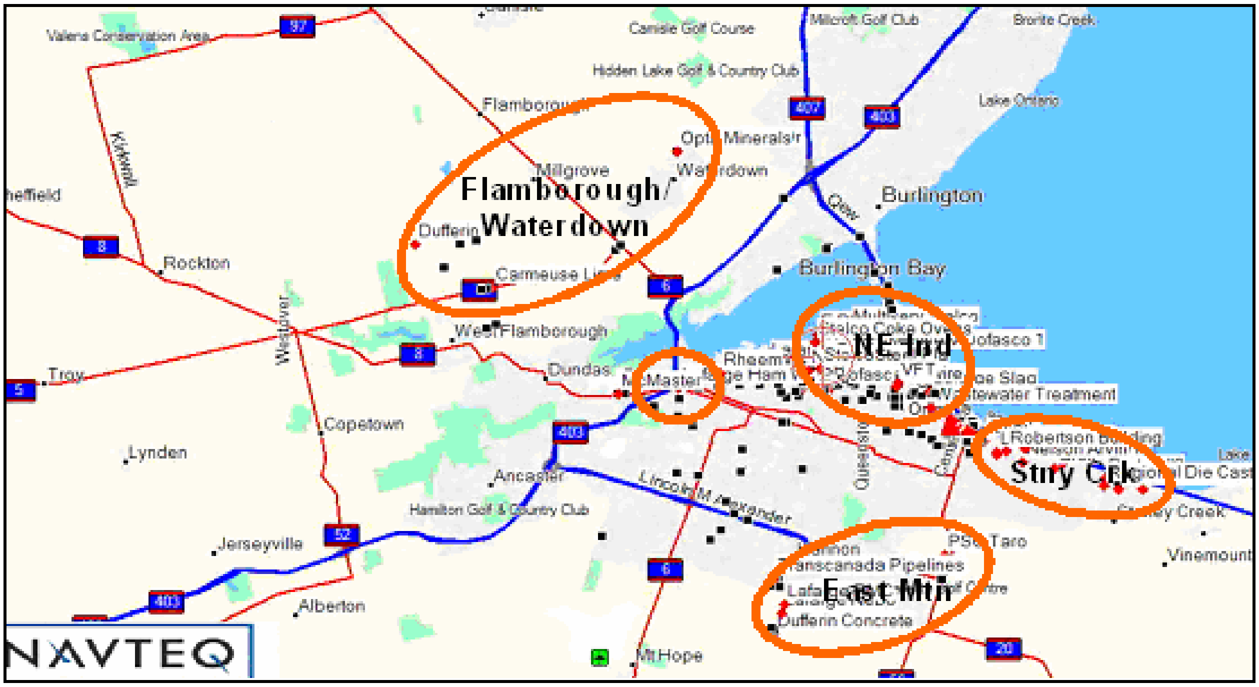


Figure 7: Emission Sources by Region in the Hamilton Area

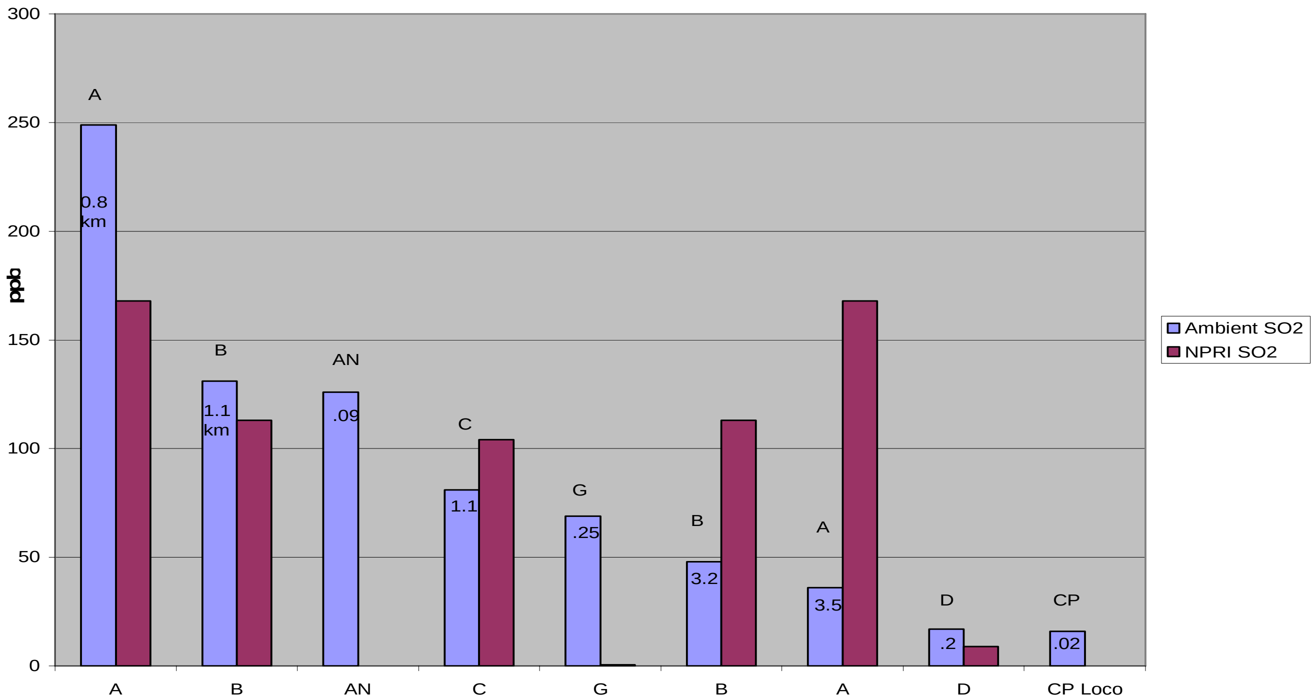


Mobile scans for the pollutants were performed in traverses across the city, at selected industrial areas, and at traffic intersections. Industrial point sources monitored included large integrated steel industries, steel by-products processors, recycling/scrap operations, foundries, chemical plants, storage piles, agricultural materials processing, brick manufacturing, university operations, vegetable oil processing, carbon black manufacturing, rail shunting/truck transfer and a cogeneration natural gas plant.

Although it might be expected that industrial sources would be responsible for the highest concentrations of pollutants, the 2005 mobile study found that overall, the highest concentrations were observed near major road intersections and along heavily used roads affected by dirt track-out in the industrial sectors of the city. These high levels are attributed to the impacts of city traffic emissions and the industrial transportation sector, respectively. Industrial point sources still made significant contributions, particularly for SO_2.

Figure 8 shows a comparison of the ambient SO_2 levels (blue bars) measured using the mobile monitoring vehicle when the vehicle is situated downwind of a number of companies in Hamilton. The maroon bars indicate the relative releases of SO_2 as reported by companies to the NPRI. Since measurements were made at locations at varying distances from the sources, distances from the sources (Kms) is also included in **Figure 8**.

Figure 8: Comparison of Ambient SO_2 Levels Measured near some Industries with Reported NPRI Data for SO_2 Releases.



A-Integrated Steel, B-Integrated Steel, AN-Steel Byproducts, C-Carbon Black, G-Steel, D-Lime and CP-Rail Yard

The NPRI emissions from integrated steel companies and the carbon black manufacturer are, in some cases, orders of magnitude higher than smaller companies. However these companies have long distances to fence lines and points of impact and sufficient dilution occurs so that monitored ambient levels are comparable to and often lower than those downwind of companies with smaller NPRI emissions. Of course during pollutant accumulation conditions such as atmospheric inversions, it will be total emissions that most influence ambient levels.

Overall, the mobile monitoring was useful in identifying and ranking pollutant sources, not all of which are captured in the NPRI database. Use of GIS technology proved to be essential in source identification; further data analysis and use of a more sophisticated GIS analysis of the data should prove worthwhile. Environment Canada NPRI data for some sources need to be reviewed. MOE STAC program data, which includes dispersion modeling, could be compared with ambient data to refine the emissions data. MOE's Regulation 419 (see **Section 3.5**) requires accurate data as input for the modelling calculations; the mobile monitoring data can be useful to help refine the local modeling calculations.

3.5 Ontario Regulation 419

There are a number of legislative acts and policies governing air quality at the federal and provincial levels. In Ontario a cornerstone Air Quality Regulation is Ontario Regulation 419/05- Air Pollution - Local Air Quality which took effect on November 30, 2005. The purpose of Ontario Regulation 419/05 is to protect local air quality from industrial emissions that impact local air quality. Ontario's Ministry of the Environment sets air quality standards that it claims are based on the best scientific information available and are set at a level that safeguards both human health and the natural environment. To date, 59 new or updated air standards have been introduced into the Regulation.

Regulation 419-05 imposes air concentration limits for contaminants. These concentrations are calculated using air dispersion models or a combination of modelling and ambient air monitoring measurements. Air dispersion models developed by the United States Environmental Protection Agency (US EPA) will be used to calculate concentrations of airborne contaminants at points of impingement near industries. Regulation 419/05 will replace the existing regulation (Reg. 346) over the next few years. Compliance with Ontario's new air standards (i.e., Regulation 419) will be demonstrated through the preparation of a document called an Emission Summary and Dispersion Modelling (ESDM) Report. Over the regulation phase-in period, specific industry sectors with greater potential to impact the environment will be required to complete and update their ESDM annually before other sectors.

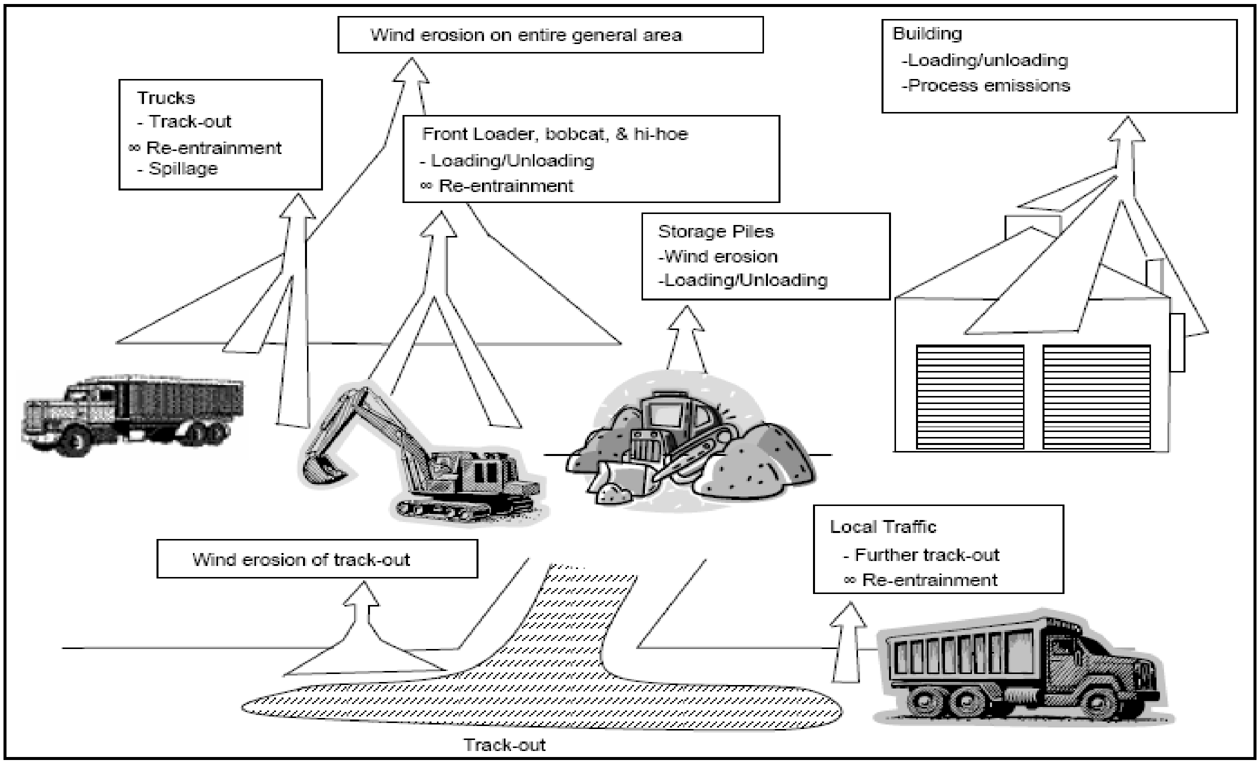
Several other regulatory requirements are now in effect, including the need for emitters to notify the Ministry should they discharge a contaminant that may result in an air limit exceedance. More information on Ontario Regulation 419/05 including guidance documents and frequently asked questions is available from the Ministry of the Environment at: http://www.ene.gov.on.ca/envision/AIR/regulations/localquality.htm

3.6 Fugitive Dusts

Clean Air Hamilton has identified fugitive dusts as a significant source of airborne particulate matter in Hamilton. Fugitive dusts are dusts that arise from non-point sources and include road dusts, agricultural dusts, and dusts that arise from materials handling, construction operations, handling of outdoor storage piles, etc. (see **Figure 9**). The compositions of fugitive dusts and road dusts vary depending upon the materials used or stored, adjacent land uses, local emission sources and traffic loads.

Only relatively recently has it been realized that re-suspended road dusts are a very significant source of inhalable particulate (PM_{10}) and respirable particulate ($PM_{2.5}$) that can impact human health. Historically, road dusts and fugitive dusts from industrial operations have been regarded simply as "nuisance" dusts and have been considered mainly as an aesthetic problem rather than an "air contaminant," "emission" or a concern for human health.

Figure 9: Common Sources of Fugitive Dusts*

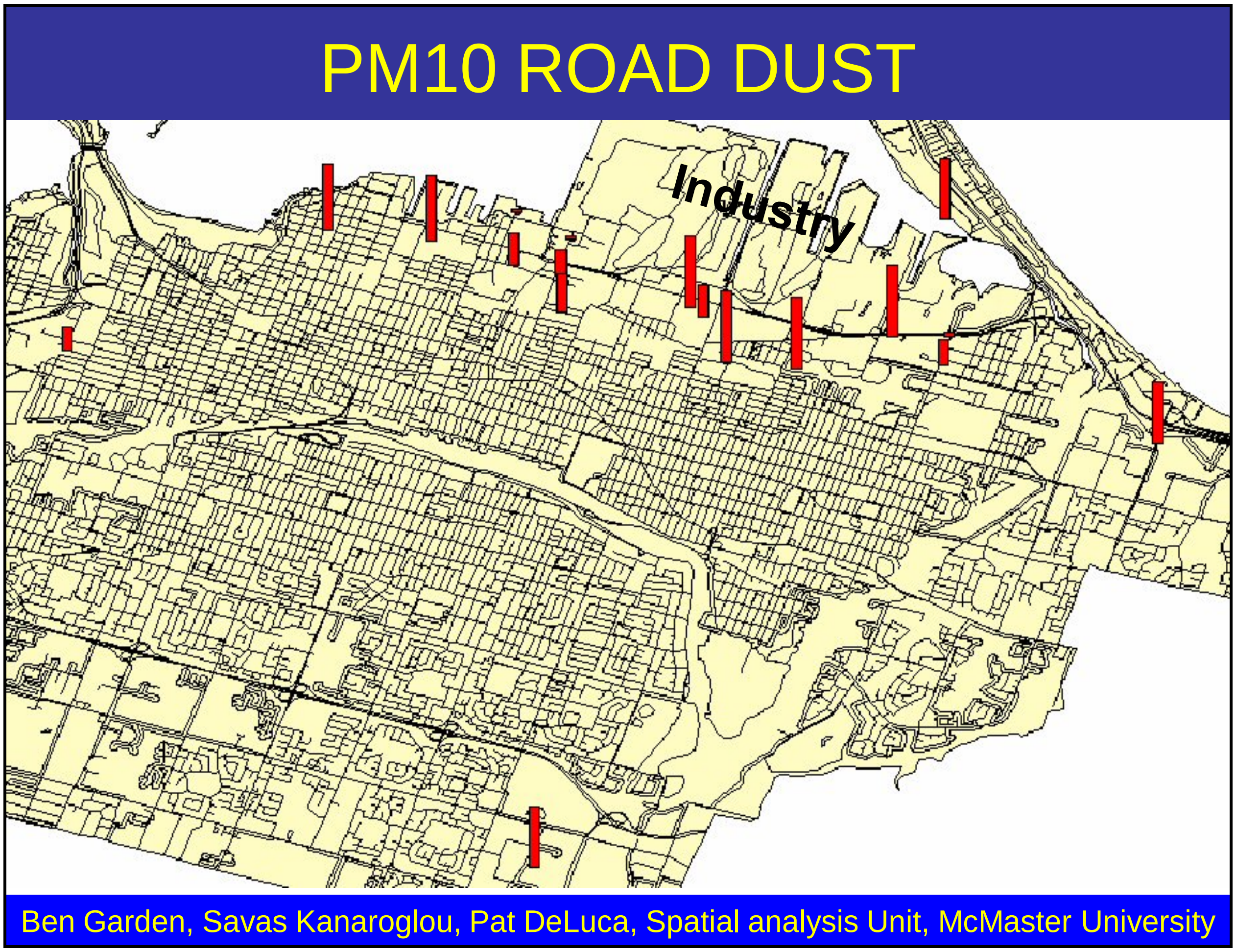


Courtesy of the Ministry of the Environment, 2006

Road dusts are not direct emissions from vehicles but consist of re-entrained particulate matter that is resuspended into the air due to vehicle movements on roadways. This particulate material arises from a variety of sources including vehicle exhaust particulates, tire wear, pavement wear, brake pad wear, etc. Road dusts can also be a result of track-out of dirt from construction sites and industrial sites, particularly from unpaved areas and roads on these sites. Severe, local road dust impacts occur routinely along some roadways in industrial areas, particularly during business hours when truck traffic is heaviest. The chemical composition of these dusts is also problematic, given the nature of the emissions from nearby industries and the deposition of these emitted materials onto roadways. Road dusts can contain elevated levels of a number of toxic substances, including metals such as chromium, manganese and iron, and organic contaminants such as polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCBs).

Mobile monitoring studies conducted for *Clean Air Hamilton* and the City have shown that the worst dust clouds on industrial roads coincided directly with extraordinarily high levels of particulate material on the roads. Along some roads in the industrial area of Hamilton re-suspended road dust resulted in very high concentrations of inhalable particulate material (PM_{10}, up to 2000 µg/m^3), respirable particulate ($PM_{2.5}$, up to 300 µg/m^3) and very small particles (PM_1, up to 125 µg/m^3). **Figure10** shows a mapping of some of the higher levels of PM_{10} across the city. The red bars on the map represent fourteen locations monitored in 2005/06 with values exceeding 500 µg/m^3 of PM_{10}.

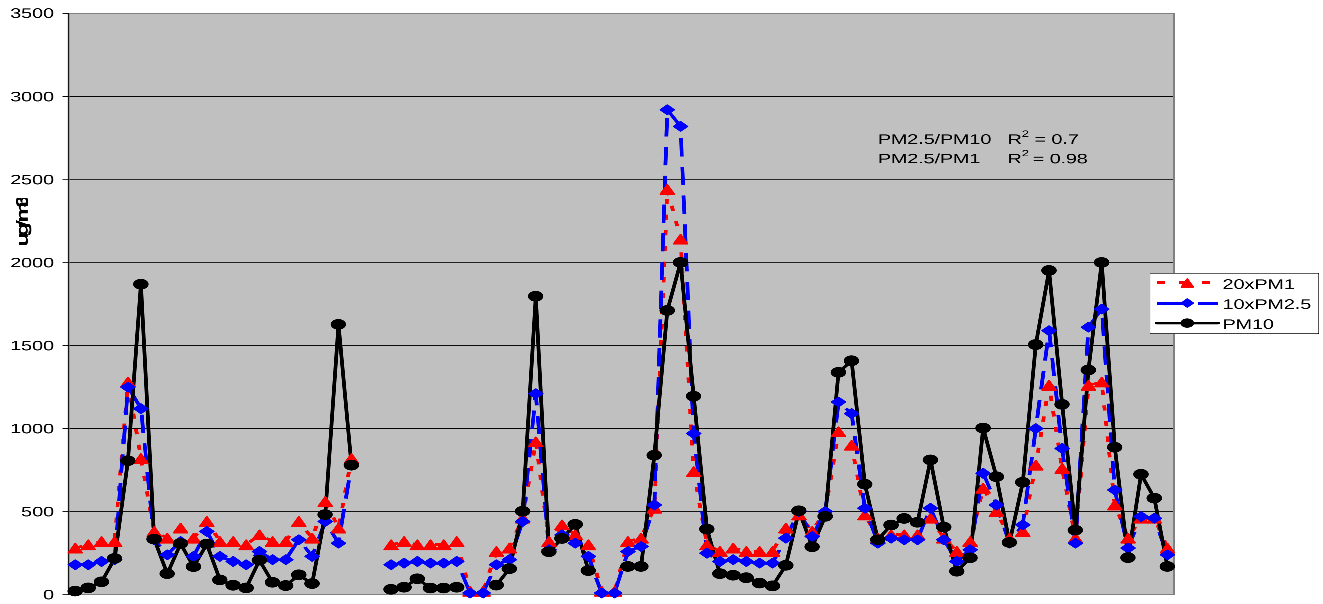
Figure 10: Fourteen Locations where PM_{10} exceeded 500 µg/m^3 in 2005/06 Survey.



A very strong correlation exists between particles of different particle sizes (PM_{10}, $PM_{2.5}$ and PM_1). To illustrate this correlation, PM_{10}, $PM_{2.5}$ and PM_1 data that were collected simultaneously during a mobile monitoring survey study are plotted together in **Figure 11**. To assist in interpreting this data easily, the values for $PM_{2.5}$ were multiplied by 10 and the values for PM_1 multiplied by 20; these data then were plotted along with the PM_{10} values for two different time periods when the mobile monitoring van drove along some industrial roads in Hamilton (see **Figure 11**).

High PM_{10} values were observed as the van drove by entrances to a number of industrial sites. It is very clear from **Figure 11** that the levels of the three particulate classes (PM_{10}, $PM_{2.5}$ and PM_1) are highly correlated; that is, exposures to high levels of these industrial road dusts are also exposures to high levels of particles that cause health effects. While the percentages of $PM_{2.5}$ and PM_1 relative to the total particulate burden are low, the overall particulate exposures in these dusts can be very significant, resulting in high exposures simultaneously to $PM_{2.5}$ and PM_1. The correlation between $PM_{2.5}$ and PM_1 in these data is very high indeed (R^2 = 0.98; an R^2 value of 1.00 is a perfect correlation).

Figure 11: Re-suspended Road Dust: Strong Covariance of PM_{10}, $PM_{2.5}$ and PM_1



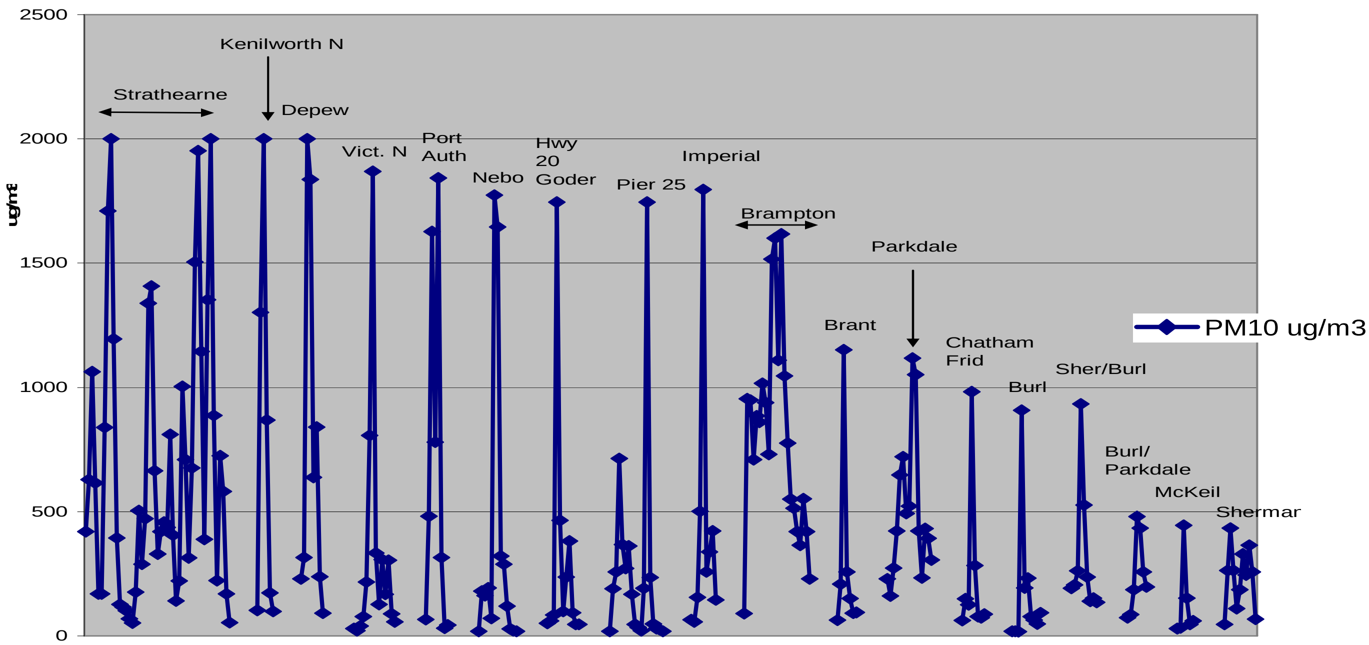
Road dusts have traditionally been regarded simply as nuisances and of little impact except for the need to wash vehicles regularly to keep them clean. Data from the mobile monitoring survey clearly show that road dusts have the potential for serious health effects impacts at the levels measured in Hamilton's industrial areas. Roads function as "line sources" of particulate materials; the greatest impacts of these dusts are on people working on the properties proximate to these roads or on local residents who may be impacted by these dusts.

Clean Air Hamilton continues to work with various stakeholders to reduce road dusts and road dusts impacts on the community. Education activities, monitoring programs and partnerships with various agencies and industries to reduce road dusts at source are the approaches *Clean Air Hamilton* has used to reduce the burden of road dust impacts on the citizens of Hamilton.

Fugitive dust control is an important responsibility at all industrial sites, particularly industries that handle or store large amounts of particulate-containing or particulate-generating materials, such as bulk storage facilities and the aggregate handling facilities. On-site management of soils and dusts has a direct influence on the amount of dusts generated and dispersed into the air due to normal plant operations; unpaved roads and unpaved areas on-site can result in the tracking of significant amounts of dirt and industrial materials off-site and onto City roadways. Industries need to implement dust control best practices on their sites to prevent dusts and soils from becoming airborne and to implement best practices to prevent or reduce the amounts of materials being tracked-out from their site. These practices include paving roads on-site, particularly the stretch of road that leads directly off-site, routine maintenance of on-site roads using street sweepers, installation of wheel wash stations at the exit to the property to remove dirt before trucks drive on City roads, etc.

Figure 12 shows a composite of real-time PM_{10} data obtained near 18 different locations in the City where visible clouds of road dust were observed during the mobile monitoring study. The peak concentration data from these 18 different locations across the City were combined into a single graph for comparison purposes. Fourteen of these eighteen locations were associated with track-out of dirt from specific industrial facilities. These track-out locations were identified as being in need of clean-up and additional street sweeping to reduce airborne particulate loadings due to road dust re-suspension.

Figure 12: PM_{10} Road Dust Track-out: 18 Locations, 14 Sources Monitored in 2005/2006



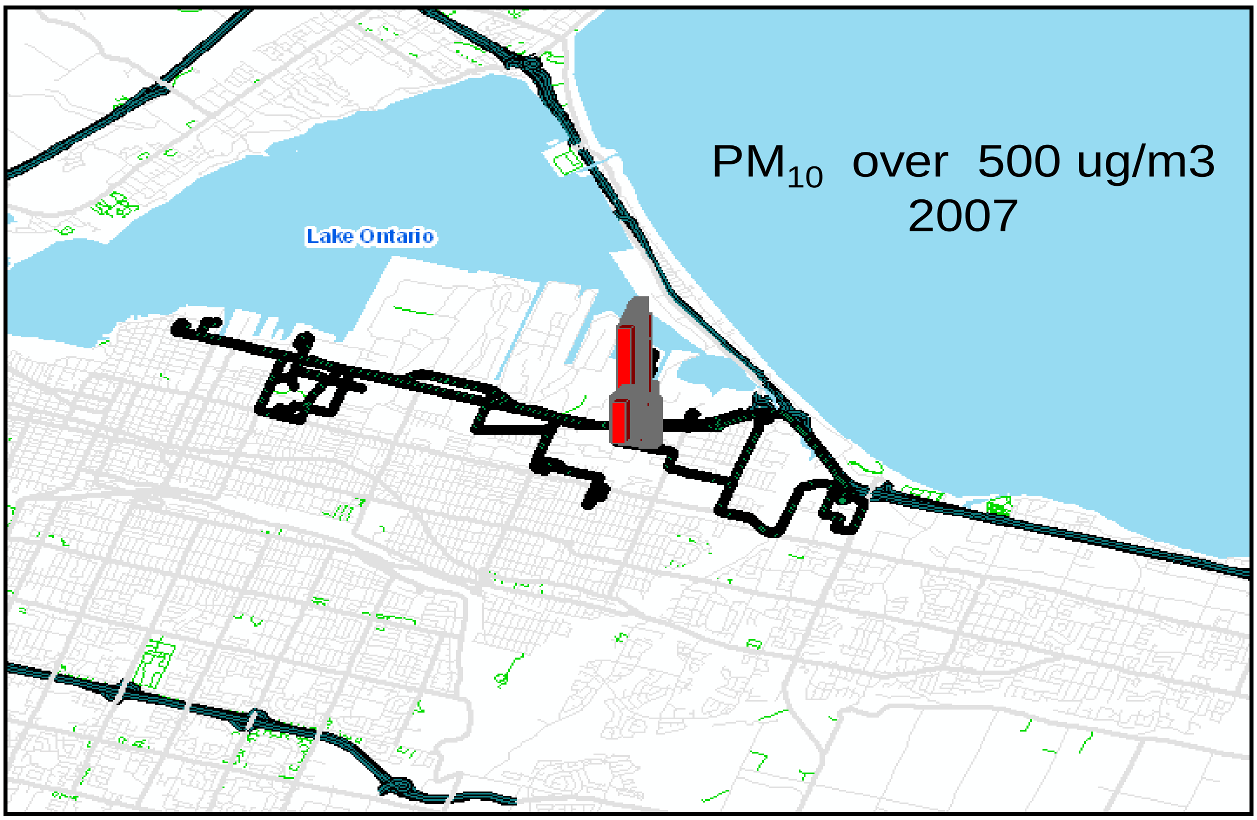
In December 2006, a Fugitive Emissions Workshop was held in Hamilton to provide local business owners and site operators with information regarding fugitive dusts and their associated health and environmental impacts. Organizers of the workshop included the Ministry of the Environment, Hamilton Industrial Environment Association, The City of Hamilton, the Hamilton Port Authority, and *Clean Air Hamilton*.

Following the workshop, the MOE sent information requests to a number of companies in Hamilton asking about dust mitigation practices employed at their facilities. The local office of the Ministry generated a priority inspection list to follow up with workshop attendees or other significant fugitive dust sources. These inspections form part of an ongoing operational plan for compliance to ensure that fugitive emission mitigation continues as a priority within the City of Hamilton. The City has increased street sweeping service level in the Strathearne Avenue area at the request of stakeholders. Following the Fugitive Emissions Workshop, this increased service level was extended to include a broader area within the Industrial Core, primarily focusing on problem areas. This service is performed nightly 2 to 3 times a week, as required.

In the meantime, Public Works undertook a Program entitled "Industrial Zone Air Quality Initiative". The intent of this program is to respond to concerns regarding poor air quality (airborne dusts) in the Burlington Street Industrial Area, providing increased regenerative street sweeping and increased frequency of boulevard, median and street flushing. Also, included in this program, are costs for design and implementation of alternative boulevard and median surface treatments which facilitate reductions in dust accumulation on existing gravel medians and under elevated segments of Burlington Street, boulevards and medians. This work will include soft landscaping surfacing (tree planting) as well as hard surfacing (Concrete and asphalt paving).

The Hamilton Port Authority paved 8 acres of land in 2007 at the Pier 15 site. This action served to reduce fugitive dust emissions, and reduce the run-off of potentially harmful sediments to Hamilton Harbour. The Hamilton Port Authority continues to work with the City to sweep Strathearne Avenue of fugitive dusts. A GIS analysis was performed of two fugitive dust sampling days in 2007 in order to check the effectiveness of the workshop and compliance initiative with regard to actual air quality improvements.

Figure 13: Two Locations Where PM_{10} Values Exceeded 500 ug/m^3 in 2007 Survey.



Based on data collected in 2005 when we found 14 locations had PM_{10} values above 500 µg/m^3 (Figures 10 and 12), we expected the 2007 data to show a similar number of locations with PM_{10} levels greater than 500 ug/m.^{3} To our surprise there were only 2 locations with levels above 500 ug/m.^{3} These sampling data indicate that significant improvements in local air quality conditions have resulted from the workshop and compliance initiative. However, these data are limited to two sampling days and further monitoring is required to demonstrate that these improvements are sustained across the industrial area of the city.

4.0 Transportation Emissions - Linkages to Air Quality and Health

4.1. Mobile Monitoring Research

Between late 2004 and 2007, mobile monitoring surveys were undertaken for Clean Air Hamilton to obtain a more comprehensive picture of the ambient air quality across the City of Hamilton. In particular, impacts due to traffic emissions and atmospheric inversion conditions were of concern. Aggregated health impacts of air pollutants under different conditions were also studied. This section highlights some of the findings of Phase 2 of this study which was conducted in 2007. A full report on the Phase 2 study will be made available in 2008.

Recent mobile monitoring studies from around the world have shown that the short-term, peak exposures that are experienced near to air emission sources can have serious detrimental health impacts in some individuals. The mobile monitoring approach seeks to collect data on these peak exposures which can then be generalized through mathematical modeling techniques.

A mobile monitoring vehicle is required for these types of studies. The vehicle was outfitted with a Global Positioning Satellite (GPS) detector and modified to support a data acquisition system and a data storage system. Data was collected using various real-time monitors on board the vehicle to measure NO_x (oxides of nitrogen), SO_2 (sulphur dioxide), PM (airborne particulate matter) and CO (carbon monoxide) simultaneously. **Figure 14** shows the mobile unit that was outfitted with the real-time air monitors and a meteorological station. In Phase 2 of the study, some of the monitoring systems were upgraded and outfitted with a better data collection system that is capable of simultaneously storing air pollutant data and global positioning satellite (GPS) data; the GPS data is used in collaboration with an enhanced geographic information system (GIS) program to allow for the mapping of air pollutant data locations.

Figure 14: Mobile Air Monitoring Unit and the Real-time Display on a Laptop Computer

The results from Phase 1 and the early part of Phase 2 of the study (see the *Clean Air Hamilton* Reports for 2004 – 2005 and 2005 – 2006) clearly demonstrated that mobile air monitoring techniques are a powerful addition to “traditional” air quality data obtained from a network of fixed monitoring stations. The mobile sampling can be used to focus on locations with specific issues, to roam city-wide or to determine representative local air quality conditions (e.g., at traffic intersections) which are common issues in numerous areas across this city and in other cities. Key factors such as distances from emission sources and wind direction can dramatically affect exposures of individuals to air pollutants. Data from Phase 1 made it clear that data from mobile surveys reflect the extraordinary variability of source emissions and the broad range of exposures to air pollutants that citizens of Hamilton experience during their day-to-day lives.

Previous examination of National Pollutant Release Inventory data as well as mobile sampling had identified five different industrial areas in Hamilton with corresponding downwind impacts of the measured pollutants (see **Section 3.4**). Traffic impacts were also monitored and used to refine traffic emission models, including the models used at the Centre for Spatial Analysis.

These model results gave a better understanding of peak traffic impact areas, namely the highway grid and mountain access.

Residential vs. Traffic-Related Emissions

Measurements made during Phase 1 of the Mobile Monitoring Study demonstrated unequivocally that the citizens of Hamilton were exposed to very high levels of pollutants due to traffic-related emissions. Pollutant concentrations were found to be very high on and close to roadways but that these levels decreased very quickly with increasing distance from roadways; concentrations of pollutants and the resulting exposures while driving can be very high indeed. The close proximity of many commuters to these direct emissions (both from diesel and gasoline vehicles) has been observed as a key factor in the increased incidence of heart attacks among commuters in Germany. Levels of 300 $\mu g/m^3$ of PM_{10} and 150 ppb (parts per billion) of nitric oxide (NO) were measured routinely, while ambient levels in residential areas were found to be between 20-40 $\mu g/m^3$ of PM_{10} and 4-20 ppb NO. Thus, peak roadway concentrations of these pollutants exceed levels observed in residential areas by 20 to 50 times.

Figure 15 shows the levels of four important air contaminants (sulphur dioxide-SO_2, carbon monoxide-CO, nitric oxide-NO and inhalable particulate material, PM_{10}) at seven road locations in Hamilton. The first five (on the left in the figure) are values obtained along major roads or intersections; the remaining data are the average for all roads in Hamilton and a typical example of data from a residential area in Hamilton; residential areas are at a distance from major roads but are usually within 200-500 m of such roads. The data collected near roads shows a range of values that span the city average near roads. The pollutant levels in the residential area were much lower than near the major roads. The levels of NO (a tracer for vehicle combustion) show the greatest differences between the roadside sites and the residential area. Clearly, residents living along major roads and those using major roads (motorists, pedestrians, cyclists, etc.) are exposed to higher levels of pollutants than individuals on side streets and in residential areas.

Figure 15: Mobile Monitoring Study - Levels of Four Air Contaminants Near Major Roads and on Residential Streets in Hamilton

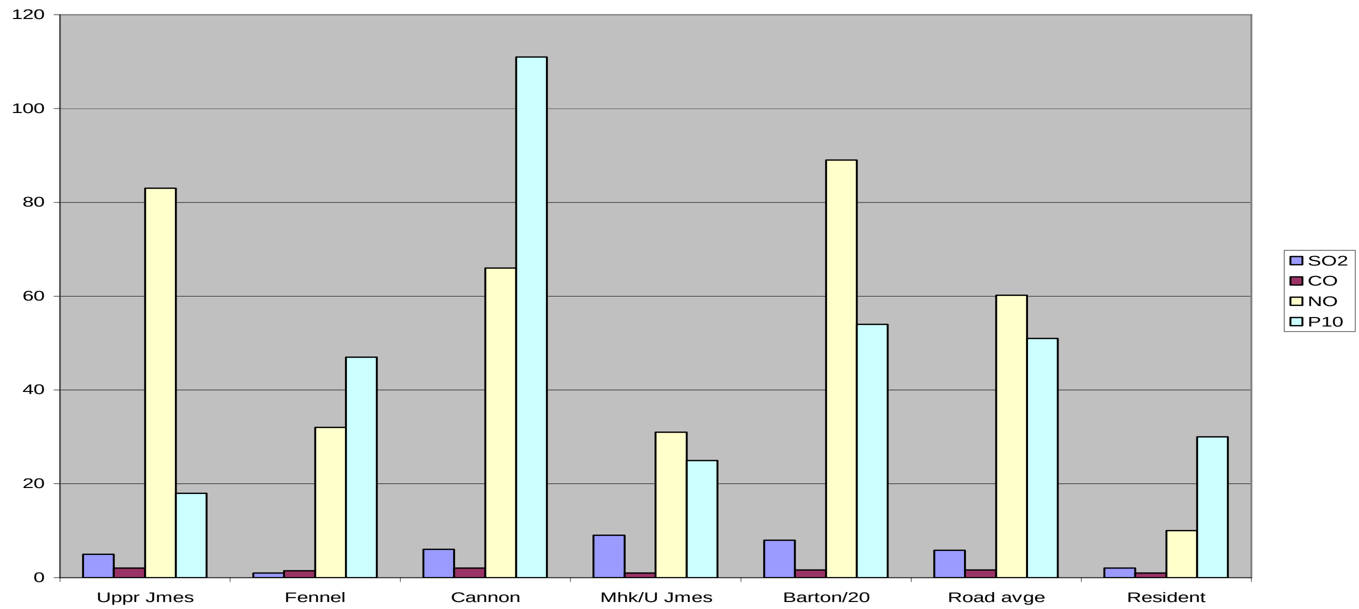
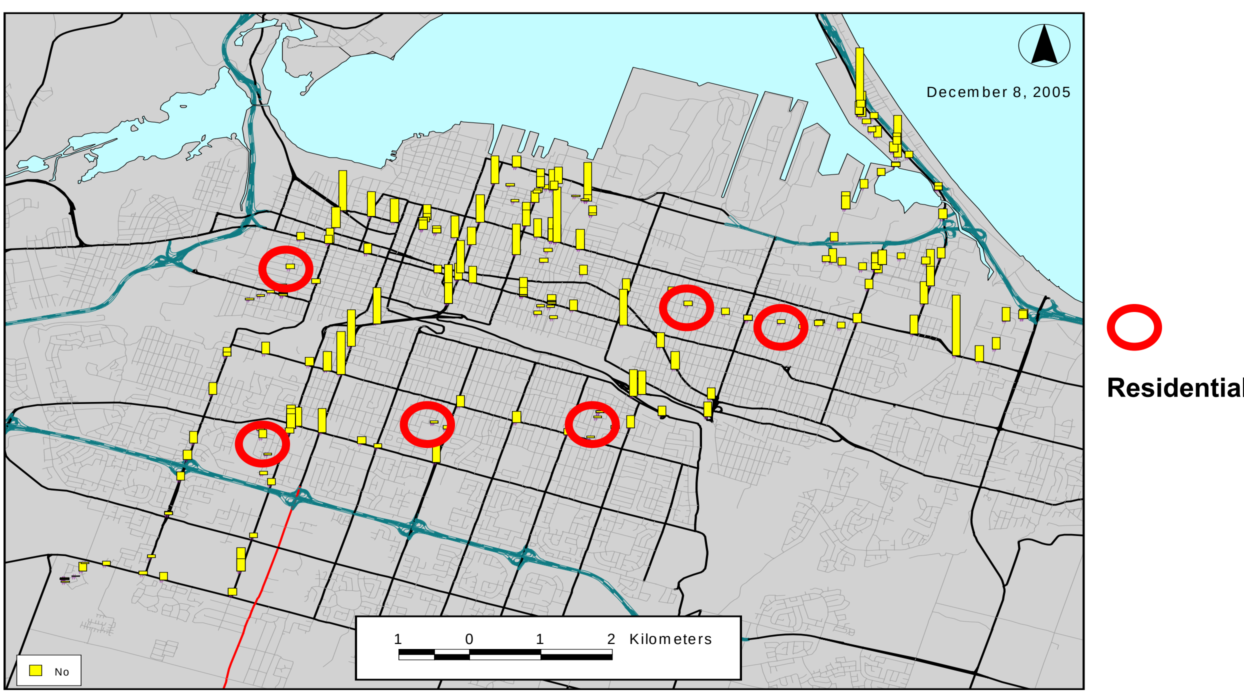


Figure 16 shows a map of Hamilton onto which has been superimposed the levels of nitric oxide (NO) in the air as measured by the air monitoring van at numerous locations in Hamilton. Nitric oxide is a combustion pollutant and is emitted directly by cars and trucks; as such, NO is an excellent measure of the impacts of vehicular pollution. Readings taken along 4-lane roads and at major intersections, together with a number of readings made in residential areas of the city are shown in **Figure 16** The greater the height of a yellow bar in **Figure 16**, the higher the level of NO measured.

Figure 16: Residential vs. Traffic-related Levels of Nitric Oxide (NO)



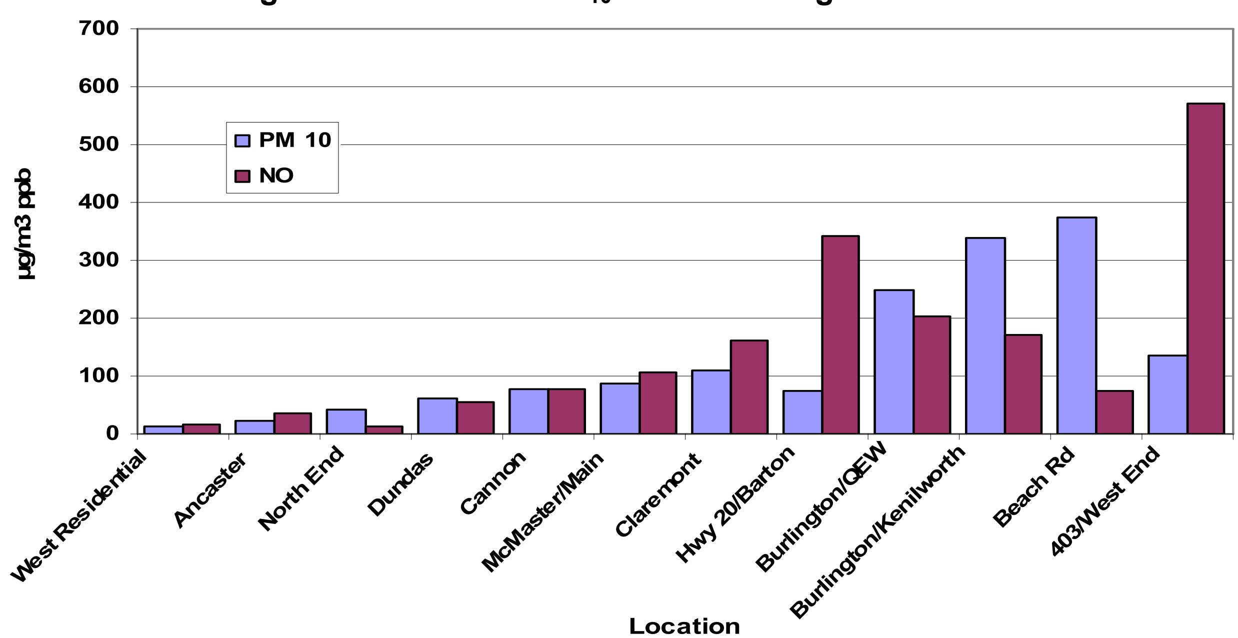
The areas circled in red in **Figure 16** are residential areas within the city; within these red circles the levels of NO are very low compared to the heights of some of the yellow bars associated with locations along major roads in the city. Clearly, residential areas experienced relatively low levels of traffic-related pollutants compared to levels measured along many major roads and major intersections within Hamilton.

These data were analyzed by researchers in the Centre for Spatial Analysis at McMaster University. Air pollutant data obtained in the Phase 1 work was analyzed and incorporated into various mathematical models of vehicle traffic that predict air quality outcomes based on traffic congestion and vehicle type. By using the mobile monitoring data in conjunction with the urban traffic models, the models predicted there would be high levels of traffic-related air pollutants in the West End of Hamilton near the Highway 403 interchanges, along the Claremont Access and in the East End of the city.

As a result of these modeling predictions, additional mobile monitoring work was undertaken in March 2007. In order to collect information in target areas identified by the modeling results, areas along the Highway 403 corridor from the west end of the city to Ancaster and some of the Mountain access roadways were measured. This air monitoring data showed that air quality modeling predictions were very consistent with the measured values; specifically, extremely high levels of NO (nitric oxide) were observed along the Highway 403 corridor from the junction at Main St. West and the 403 to the junction with the Lincoln Alexander Parkway.

A peak NO value of 586 ppb was measured along Highway 403. This NO level is the highest ever measured in Hamilton and is much higher than NO levels observed directly downwind of large industrial sources. The levels of NO measured on the Mountain accesses were much lower than those measured on Highway 403 and were not as high as had been predicted by the computer model. Note that the highest PM_{10} levels were measured in the east end of the city while the highest NO levels were measured in the west end.

Figure 17: Levels of PM_{10} and NO Along Roads in Hamilton



The data in **Figure 17** are organized in order of increasing levels of either PM_{10} or NO. The levels were lowest in residential areas (i.e., areas with low vehicular impacts) and highest in areas with the highest vehicular traffic. These levels are typical levels of exposures for humans working or driving in these areas. For clarity, this figure does not include any locations with high fugitive dust contributions. The primary sources of PM_{10} in these samples are combustion sources, particularly vehicles.

Some of the highest levels of air pollutants in the Hamilton area were measured on local highways, the QEW and Highway 403. Recent mobile monitoring data also suggests that noise barriers along highways not only reduce noise levels but also result in substantial reductions in exposures to combustion-derived air pollutants. More information will be made available in the full Phase 2 report due to be released in mid-2008.

Temperature Inversions, Traffic Emissions & Health Impacts

One phenomenon that can result in dramatically increased levels of air pollution is a meteorological event called a temperature inversion. During a temperature inversion air pollutants become "trapped" under an invisible blanket of air which prevents the normal dispersion of air pollutants. This "trapping" can be dramatic and can result in very poor air quality very rapidly. Temperature inversions occur primarily during the spring and fall months (and even during the winter months) when there is a greater probability of large temperature changes over a short period of time. Temperature inversions occur most frequently when the ground has cooled very rapidly (usually on a calm, clear night in the fall, winter or spring); under these conditions a layer of cold air develops close to ground level.

If conditions are just right and the weather changes bringing in warmer air (usually from the south-west), the warm air may form a layer above the cold air, thereby trapping the cold air below it. This "trapped air" condition usually occurs below the escarpment. Pollutants released into the "trapped" cold air cannot disperse as they normally would and remain trapped in the cold air layer near ground level. In this way pollutant levels can rise very rapidly and can reach very high levels within an hour or two.

An inversion is a very stable meteorological situation and can last for a few hours to several days. During these events, pollution (and human health impacts) can reach high levels.

In the mobile monitoring study, the impacts of individual pollutants have been examined, using different compounds as tracers for different sources, e.g., SO_2 for industry sources and NO for traffic sources. Since we know the relative health impacts of each pollutant, we can calculate predicted total health effects for these pollutants. The pollutant effect metrics used were those reported by Jerrett and Sahsuvaroglu in their May 2003 report to Clean Air Hamilton "A Public Health Assessment of Mortality and Hospital Admissions Attributable to Air Pollution in Hamilton" (School of Geography and Geology and McMaster Institute of Environment and Health). The latter health impacts were determined based on an assessment of the data in over 250 scientific publications linking air quality to public health.

Figure 18: Health Impacts Prediction Near the Intersection of Queenston Road and Centennial Parkway in Hamilton

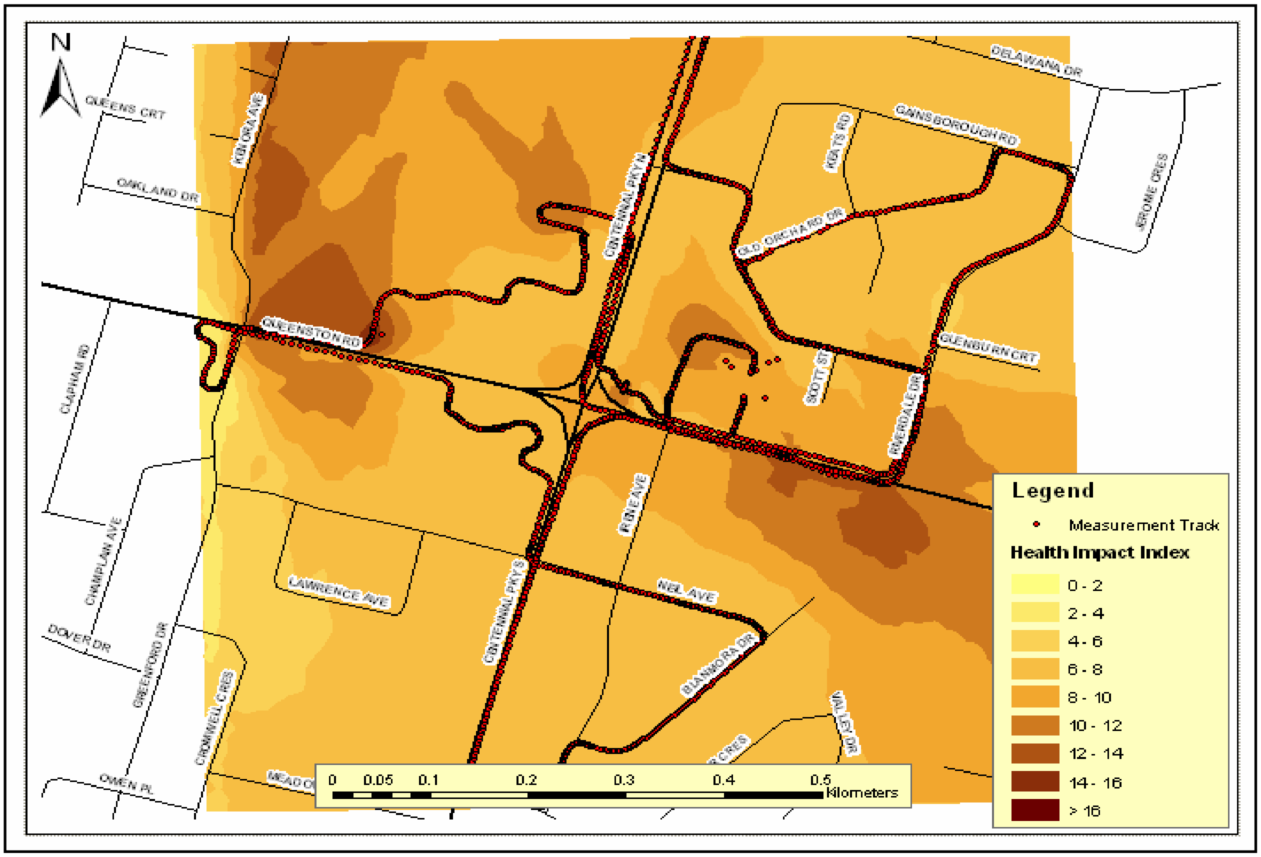


Figure 18 shows the intersection of Queenston Road and Centennial Parkway in the east end of Hamilton. The brown dots show the locations where data points were collected along the path of the mobile monitoring vehicle as it was driven along roads in the area. The wind direction during this sampling period is shown as a pale blue arrow. These data were used to calculate the pollutant levels over the entire area based on the air quality data from the brown dot locations. Then the resulting air quality "map" was used to calculate the health effects map shown as **Figure 18**: the darker the colour on the map, the greater the health effects impact.

It is clear from **Figure 18** that there are elevated health impacts due to the combination of air pollutants when you are located downwind of a busy intersection. Health effects impacts are expressed as annual mortality percentage increases as if there had been constant exposures at these levels throughout a year; while this is clearly not the case, these values are still very useful as comparisons but should not be used as absolute values. In other words, these "images" are snapshots which represent short-term exposures.

Figures 19, 20 and **21** below show the relationships between industrial emissions, traffic emissions and the resultant health impacts on an inversion day. In addition to the impacts of industrial emissions on both the lower and the upper city, the emissions of contaminants from mobile sources (particularly from vehicles on major roads and highways) are also very significant.

Figure 19: Health Impacts Due to Air Pollution on an Inversion Day with Light Winds From the Northeast.

(The green line shows the path of the mobile monitoring vehicle).

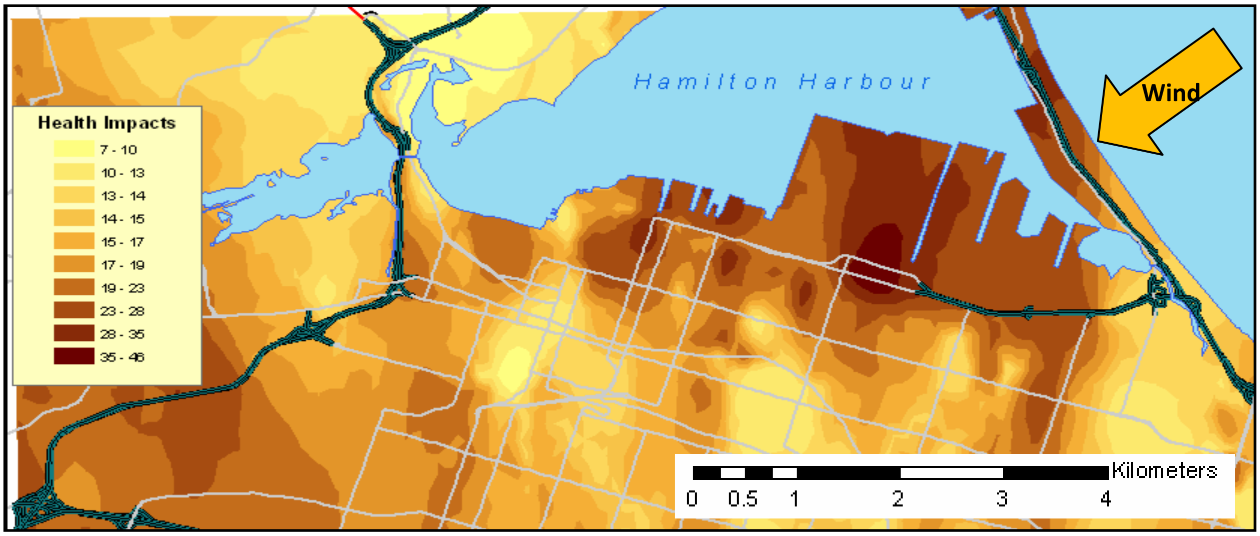


Figure 20: Prevailing Winds (from Southwest) Normal Day

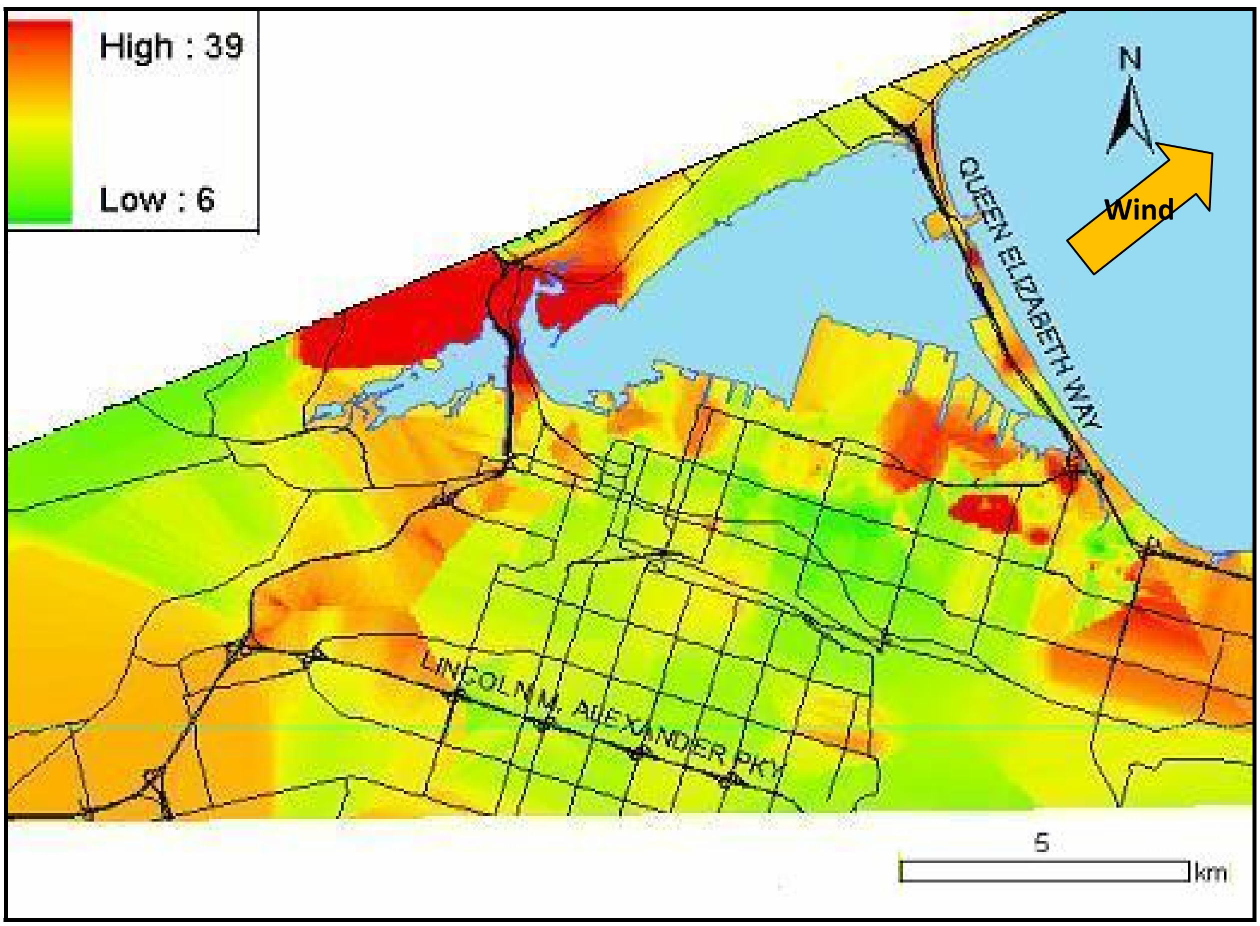
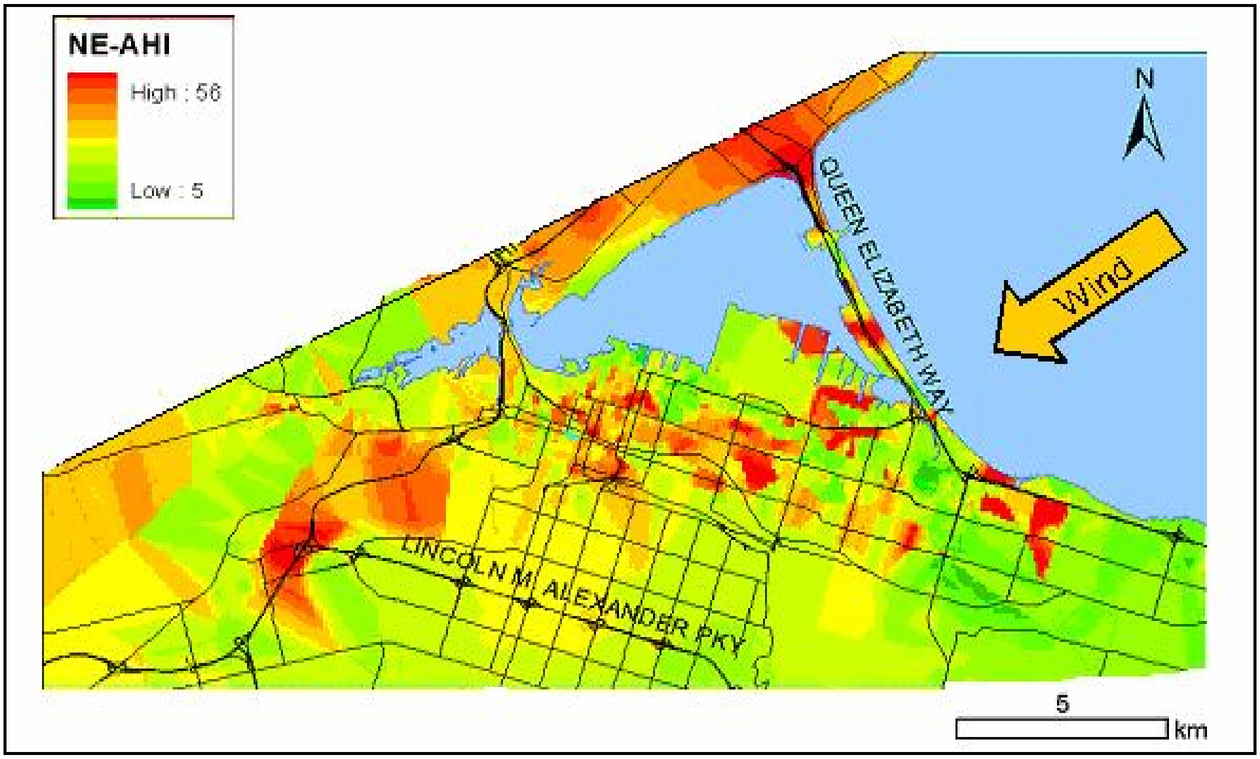


Figure 21: Inversion Day with Northeast Winds: Average Health Impacts



Figures 20 and 21 show the predicted health impacts across the City of Hamilton on two different types of wind days. **Figure 20** shows a composite of 15 sampling days under “normal” conditions, i.e. prevailing winds from the south west. **Figure 21** is a composite picture from 8 north east wind/inversion days with winds from the NE industrial area blowing back across the city. These maps are based on mobile monitoring data collected between 2005 and 2007. Clearly, during north east wind/inversion conditions there are significant impacts on much greater numbers of citizens and at higher health impact levels over wider areas. This also shows that both traffic and industry effects are significant under these atmospheric conditions of inversion days and all available means should be taken to reduce these effects.

Please note that these pictures are interpolation surfaces and not the result of detailed models. As a result, they need to be interpreted with caution, particularly at the edges where no sampling data are currently available, e.g. Burlington. In these cases the program may extrapolate to higher pollutant levels than actually exist and additional measurements would need to be made.

Note the relatively low levels of health impact on the Lincoln Alexander Parkway (the Linc), compared to Highway 403, despite the presence of numerous sections on the Linc with high berms at the roadside and presumably low dispersion. This is probably due to the low frequency of large truck traffic on the Lincoln Alexander, compared to the very heavy truck traffic on the 403. All these measurements were taken before the Red Hill Creek Expressway opened.

In addition the Highway 403 incorporates a steep grade so that diesels are under extra load. The Clean Air Task Force in the U.S. has published a series of videos on the internet which dramatically illustrate the localized air pollution impacts of different vehicles, particularly large diesels, see http://www.catf.us/projects/diesel/noescape/videos.php

An important part of the mobile monitoring study is to share these findings with the public and decision makers; our goal is to make the air pollutant data available to researchers and professionals involved in city-scale air quality modeling. It is important that decision makers realize that every planning decision that is made has an air quality impact associated with it. Thus, planning decisions need to take air quality issues into account in order for the air quality in Hamilton to improve in the future.

The mobile monitoring data and the recommendations arising from this project have been presented to a number of citizen groups, to decision makers and at air quality conferences and events, including: Clean Air Hamilton, the City's Economic Development and Planning Committee and the Committee of the Whole of Hamilton City Council, the Greater Toronto Clean Air Council, the Hamilton Wentworth District School Board, Ministry of Environment, City of Hamilton and Hamilton Health Sciences staff, Peel Region Health Unit, the Hamilton Industrial Environmental Association, the Canadian Institute of Public Health Inspectors, the Highway H_2O Conference, Municipal Equipment and Operations Association, City of Burlington equipment operators, and presentations were made at the City's Commuter Challenge, the McMaster University Spatial Analysis and Occupational Health Seminar series, the 2006 Fugitive Dust Abatement Workshop, and the 2006 and 2008 Upwind/Downwind Conferences.

5.0 Linkages between Climate Change and Air Quality

Climate Change refers to the long-term change in average weather patterns resulting from the release of substantial amounts of greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) into the atmosphere; these levels are over and above the natural levels of these substances. The increased levels of these infrared-absorbing substances results in an intensification of the earth's natural greenhouse effect. These chemicals absorb heat energy very efficiently and transfer this heat energy to the atmosphere, resulting in an increased warming of the atmosphere.

Climate change can be caused by natural processes, such as a change in the sun's strength, and by human activities. In 2007 the International Panel on Climate Change (IPCC) issued a series of reports which outlined the unanimous consensus of nearly 1000 scientists from around the world. This consensus was reached after thorough evaluation of all available evidence on climate change. The IPCC has declared that there is a very high probability that increases in the emissions of GHGs due to fossil fuel combustion, large-scale deforestation via the burning of forests and the intensification of agriculture have resulted in and will continue to cause a net increase in global mean temperatures with concomitant changes to climates around the world. Changes will be most profound in the extremes of the northern and southern hemispheres.

Increased awareness of climate change and its associated impacts such as extreme weather patterns are now widespread among the general public. The popular press gives little or no credence any longer to claims made by "climate change nay-sayers." Strangely, until very recently few if any governments in Canada recognized that there was a direct connection between climate change and air quality issues.

The **2008 Upwind/Downwind Air Quality Conference: Climate Change & Healthy Cities** (hosted by *Clean Air Hamilton* on February 25th and 26th, 2008) focussed on the linkages between climate change and air quality. Climate change and poor air quality are inextricably linked because both are driven to a large part by combustion emissions of carbonaceous fuels. The focus for climate change is on carbon dioxide, the principal greenhouse gas which is formed when carbonaceous fuels are burned as sources of energy and heat.

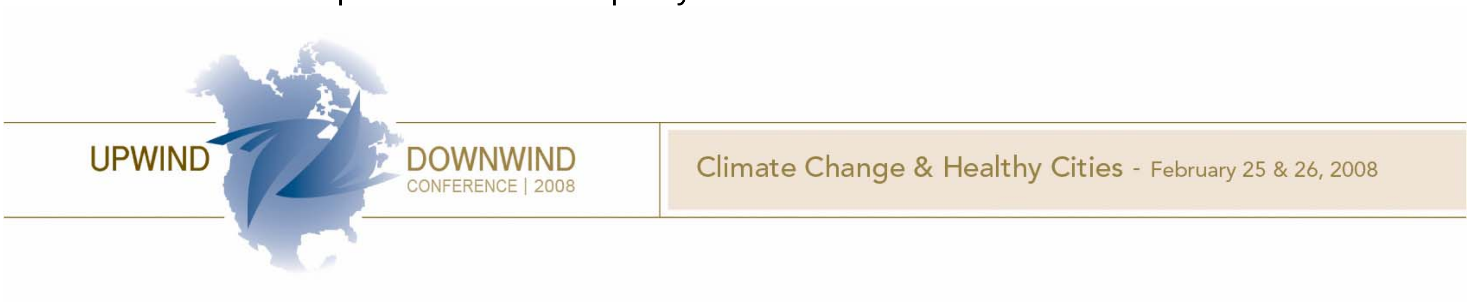
The focus for air quality is on the minor by-products of combustion, nitric oxide, sulphur dioxide, fine particulate matter, etc. which cause deleterious health effects in people. Higher temperatures due to climate change result in increasing demands for electricity (often coal-combustion generated electricity) for air conditioning; thus, on hot days the levels of air pollutants are sometimes driven higher by energy demands. If Canada could meet its Kyoto targets, fossil fuel consumption would be almost 25% lower than it is today; the average air quality would improve by about 25% due to reductions in combustion by-products.

Poor air quality, combined with heat stress from hotter weather, poses serious health challenges to the most vulnerable in society, the very young and the elderly. Planning decisions at the local level with regard to transportation and land use patterns will have dramatic, beneficial long-term impacts on local air quality.

6.0 *Clean Air Hamilton* Programs

6.1 2008 Upwind/Downwind Conference

Every two years *Clean Air Hamilton* hosts the Upwind/Downwind Conference, a two-day event which highlights (a) the latest in air quality research, particularly as it applies to the human health impacts of air pollution, and (b) strategies and activities to improve air quality on local, regional and national scales. The programs of these conferences have been designed to be accessible to the non-expert and are targeted to the identification of problems and the implementation of practical solutions to improve air quality and public health at the local level. Sessions in past conferences have been devoted to the health impacts of air pollution, urban planning and urban design strategies to reduce air pollution, energy efficient strategies for homes and industries and local initiatives and success stories from across North America that have led to real improvements in the quality of life of citizens.



The **2008 Upwind/Downwind Air Quality Conference: Climate Change & Healthy Cities** was held on February 25th and 26th, 2008 at the Hamilton Convention Centre. The two-day conference aimed to provide a forum to enable an improved understanding of air quality and climate change issues and the impacts to cities, human health and the economy.

The four themes of the 2008 conference were:

> "Air Quality, Climate Change & Public Health",
> "Urban and Transportation Planning",
> "The Science of Climate Change" and
> "Climate Change and Local Partnerships".

The 2008 conference invited 19 speakers from the fields of human health, urban planning, science, architecture, engineering, public policy, and municipal government and community initiatives. The conference provided an opportunity to discuss the types of actions governments, industries and citizens will need to take in order to make significant progress to address air quality improvements and climate change impacts. The 2008 conference attracted 288 attendees including decision makers and staff at the federal, provincial and municipal levels, health practitioners, planners, academics, university, college and high school students, community groups and non-governmental agencies.

The conference also engaged local citizens through a free public lecture on the evening of the first day on making vibrant urban cities through the encouragement of walking, cycling and public spaces. For the first time a Clean Air Fair was organized for both days which featured 45 exhibitors in areas of energy (solar, wind, geothermal), car sharing, light rail transit, electric vehicles, pesticides, municipal services, public health, waste management, and green spaces.

The Conference was covered by local radio stations (K-lite FM, Mohawk, McMaster), print media (Hamilton Spectator, H magazine, SNAP Hamilton), local television stations (Cable 14, CHCH News) and Internet media.

Appendix D provides details on the 2008 conference. Conference presentations are available at: www.cleanair.hamilton.ca/updown/udconf.asp

6.2 LIDAR Workshop

One of the long-standing air quality issues in the Hamilton air shed is the impact of black particulate material on residential properties in the east end of Hamilton. Locally, the term “black fallout” has been coined to refer generically to this issue.

Through the 1990’s Ministry of the Environment staff made some progress on using available tools to work with some companies to reduce their particulate emissions. A stakeholder group was formed and there was a general acceptance that the black fallout situation was improving. In the late 1990s, *Clean Air Hamilton* in collaboration with CresTech, an Ontario Center of Excellence then centred at York University, rose sufficient funding to conduct a brief test of the viability of this new and emerging technology called LIDAR to monitor pollution plumes and releases in Hamilton.

LIDAR is a laser-based technology that uses the back reflection of powerful laser beam pulses to detect industrial emissions. LIDAR can provide 3-dimensional images of plumes over time. The identification of entities based on the reflection of light is not new. RADAR (Radio Distance and Ranging) uses radio waves to detect objects; LIDAR (Light Distance and Ranging) is similar except that LIDAR uses a laser beam. There were a number of problems with the location of the LIDAR system and its ability to detect pollution releases under these conditions. LIDAR is very well suited to the detection of plumes at distances of 0.25 to 1.5 km; for a LIDAR application to be successful in Hamilton the distance requirements would be up to 4 km and the wide range of coverage needed was beyond the capability of the LIDAR technology at the time. We concluded that LIDAR would not provide value to abatement activities in Hamilton.

In the summer of 2006 the Ministry received increased numbers of reports of particulate impacts on residential properties in the East end of Hamilton. Depending upon the circumstances, Ministry staff were usually able to identify the source and take corrective action. On other occasions, however, due to the number of possible sources, local meteorological conditions and other factors, source identification was not possible. In December 2006, Ministry staff hosted a public meeting to update the community as to the Black Fallout situation and to set out next steps.

At the December 2006 meeting, a member of the audience proposed that use of LIDAR was the answer to the question of monitoring and source apportionment. Ministry staff noted the previous evaluation but did commit to re-evaluating the technology's application to the local setting.

In collaboration with Clean Air Hamilton the ministry organized a LIDAR workshop. The LIDAR workshop took place on April 25, 2007 in Hamilton. The workshop brought LIDAR experts together with Ministry staff, City staff and the public. The black fallout monitoring problem was described by the Ministry and then the experts reported on a range of LIDAR applications in other locations. The outcome of the workshop was to prepare a request for proposal (RFP) to develop a terms of reference for a test of concept. Once the test of concept is available, a further RFP could be issued to carry out the test plan.

6.3 Idling Awareness

In 2007, the City of Hamilton introduced an Anti–Idling Control By-law. In 2007, *Clean Air Hamilton*, Green Venture and city staff continued the idling awareness campaign, initiated in 2006, directed at the broader Hamilton community. The campaign encourages behavioural change among those who live and work in Hamilton, through education, awareness and commitment-seeking.

The campaign aims at reducing greenhouse gas emissions that contribute to climate change and reducing emissions that produce air quality concerns in localized areas. Serious impacts on air quality have been reported when vehicles are left idling near schools, nursing homes, hotels and various public places; reports of the most noticeable effects of the new By-law have been citizens' reports from these areas such as these. The components of the 2007 Idling Awareness campaign include: a community wide education campaign and engaging private fleets. Our campaign will be featured in a 2008 Natural Resources Canada Idle Free Zone Newsletter.

6.3.1 The *Idling Stinks* Campaign

The primary goal of the *Idling Stinks* Campaign is to raise awareness in the Hamilton community about the negative impacts of emissions from idling vehicles; these impacts include increased local air pollution, higher greenhouse gas production, wasted money and fuel and the health effects impacts of the resulting air pollution. In 2007, Green Venture implemented several methods of communicating the anti-idling message in their successful community awareness campaign, which included:

- Distribution of approximately 123 anti-idling awareness signs to schools, retirement and nursing centers, small business and driving schools. These signs were in addition to the 81 signs previously distributed in 2006 to schools, business and City Hall.

- Two of Hamilton's Business Improvement Areas (BIAs) were engaged in the 2007 education Campaign. In September, 46 anti-idling stickers were put up in shops along Concession Street and in Dundas.

- Five idling blitzes and interventions were undertaken in the 2007 campaign at 5 schools, engaging 64 drivers. Approximately 5 mock tickets were distributed during these blitzes and many more information cards were handed out to educate drivers about the impacts of idling vehicle emissions, particularly near schools.

- An informative anti-idling website was developed and can be found at: www.greenventure.ca/cc.asp?ID=161

6.3.2 Private Fleets - Fuel Management Workshop

Apart from individual vehicle owners, many businesses both small and large operate their own vehicle fleets. According to the Repair Our Air Fleet Challenge, fleet vehicles idle between 20-60% of their operating time. It is estimated that the average long-haul truck idles away $1,800 worth of fuel every year. A number of the large long-haul trucking firms are now encouraging their drivers to shut their engines off whenever feasible.

In Hamilton, apart from the *Idling Stinks* campaign, there are no anti-idling programs available to assist businesses, particularly small and medium-sized businesses. Some organizations have developed their own anti-idling policies while others are currently developing policies.

To engage private fleets in Hamilton, Green Venture and the City teamed up with Natural Resources Canada to deliver 2 Fleet Management 101 Workshops. Fleet Management 101 focuses on the basics of developing a fuel management plan including greenhouse gas reductions, and selling the plan to fleet managers. The workshop focuses on mixed fleets with a range of vehicles including light duty, heavy duty and equipment. These vehicles are more likely to be spotted idling on city streets and therefore be subject to an anti-idling by-law.

Overall 33 fleet managers attended the two workshops; these participants were based in Hamilton or had vehicles that visit Hamilton regularly and included the City of Hamilton, Hamilton International Airport, McMaster University, the Hamilton Conservation Authority, Hillfield-Strathallan College and John Ebos Fuels.

6.4 *Totally Transit* Program

The Bus Education pilot program "*Totally Transit*" is an initiative of Green Venture and Hamilton Street Railway (HSR). This project arose directly from an earlier air quality program exploring the possibility of providing air quality education to elementary school students in Hamilton. The purpose of the *Totally Transit* program introduces Grade 5 students to the ins and outs of the HSR and encourages students to feel confident about taking the bus as a means of transportation and educating them on air quality and climate change improvements related to transportation use.

Green Venture analyzed the Ontario school curriculum and concluded that Grade 5 students are the most promising candidates for the *Totally Transit* program. These students are at an age when taking transit is possible and they are seeking more independence from their parents. The curriculum has two relevant components: conservation of energy and human organ systems. Green Venture developed lesson plans for students including an on-bus component and follow-up activities for teachers

Green Venture tied the *Totally Transit* program to EcoHouse tours with the promise of taking part in 25 school tours by June 2008. The program will continue in 2008 with hopes of increasing the number of tours to 100.

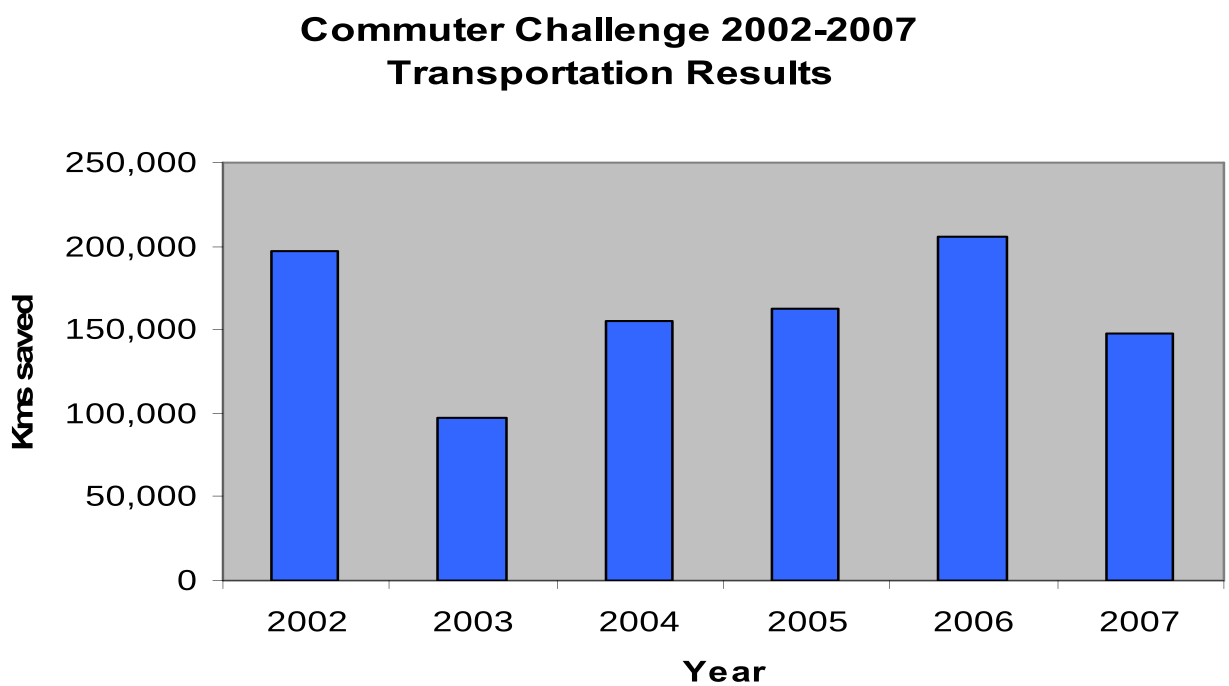
6.5 Commuter Challenge

The Commuter Challenge is a week-long, friendly competition between Canadian cities to reduce emissions by encouraging citizens to use active and sustainable modes of transportation. Participants make a commitment to walk, jog, cycle, rollerblade, take public transit, carpool or telecommute to work or school during *Environment Week* in June.

The Commuter Challenge promotes active and sustainable commuting and the personal, social and environmental cost/benefits of alternatives to the single occupant vehicle (SOV). The goal is to reduce the number of SOVs traveling on our roads thereby reducing the levels of emissions, improving air quality and slowing climate change. The Commuter Challenge raises awareness of alternative transportation choices and demonstrates how using these alternatives can result in improved air quality and reduced greenhouse gas emissions.

In 2007, The City of Hamilton's Public Works Department took over the responsibility and funding of this annual event. This was a logical fit as the City of Hamilton through Public Works was developing a plan to pursue transportation demand management (TDM) in partnership with the Smart Commute Association. Smart Commute Hamilton will take the benefits of the Commuter Challenge year round.

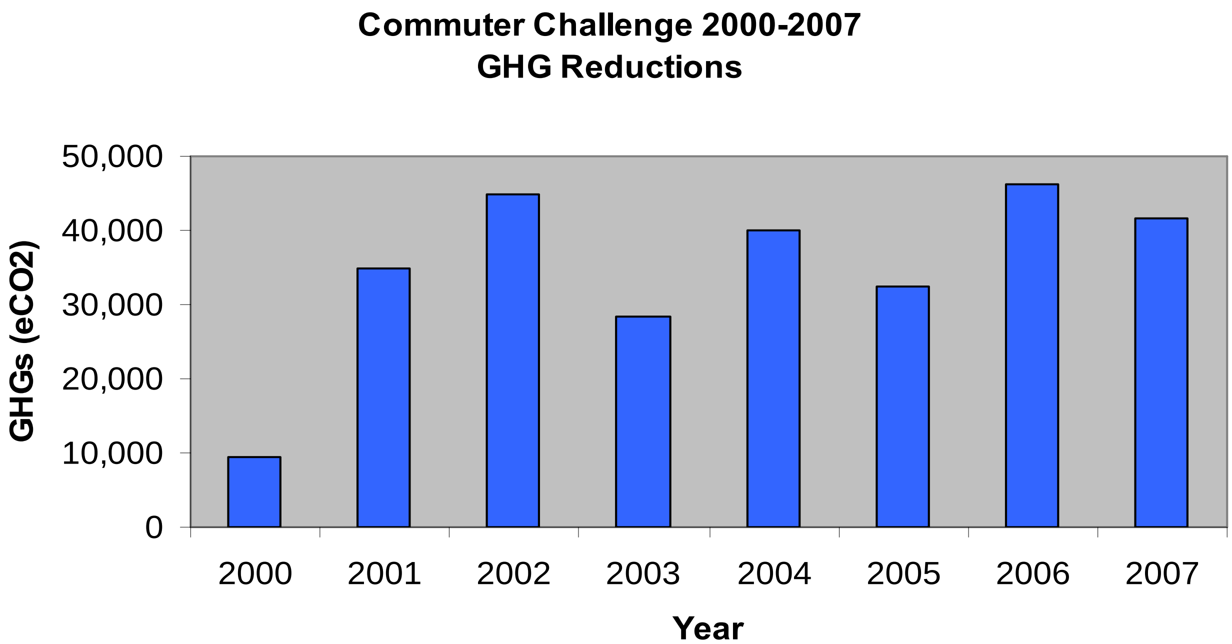
Figure 22: Reduction in Travel Distance by Single Occupancy Vehicles



In 2007 1,505 individuals at 51 organizations and businesses in the Hamilton area participated in the 2007 Commuter Challenge and saved a massive 148,042 km of single occupancy vehicle travel.

In terms of pollution and emissions reductions, the actions of participants in the Commuter Challenge saved 1.7 kilograms of fine particulate matter ($PM_{2.5}$) and 200 kilograms of nitrogen oxides. Participants also saved 41,450 kilograms of carbon dioxide equivalent (eCO_2); eCO_2 is a generalized measurement of the global warming impact of emissions based on the most common greenhouse gas, CO_2. Over the past 7 years, the Commuter Challenge in Hamilton has reduced greenhouse gas emissions by 277,640 kilograms of eCO_2. The Commuter Challenge demonstrates the measurable impact that active and sustainable transportation can have on our air quality and our climate.

Figure 23: Reductions in Greenhouse Gas Releases Due to the Commuter Challenge



Despite the successes of the Commuter Challenge, more still needs to be done to incubate, seek out and support employee trip reduction programs outside of Environment Week. One program that is attempting to achieve this goal is Smart Commute.

6.6 Smart Commute

Since January 1, 2008, the Smart Commute program, known for its online carpooling website and other Transportation Demand Management commuter services, has been recruited by Metrolinx, a new agency of the Ontario provincial government (formerly known as the Greater Toronto Transit Authority). The Smart Commute Association will compliment the activities of Metrolinx by continuing to work with local employers to improve commuter options like carpooling and transit as well many more Transportation Demand Management Initiatives. Metrolinx and the Greater Toronto and Hamilton Area (GTHA) municipalities will work together to make the region's transportation system greener and more sustainable.

What is Transportation Demand Management?

Travel (or transportation) demand management (TDM) is an approach to the study of transportation needs that helps us get the most efficient utilization of our transportation systems. TDM can help reduce traffic congestion, defer or eliminate the need for new vehicle transportation infrastructure, and improve air quality. The City of Hamilton has been active in the creation of the GTA Smart Commute Association that will implement a number of regional and local TDM measures. The overall goal of TDM is to reduce the burden of transportation-based pollution while improving transportation efficiencies and promoting sustainable alternatives of vehicle-based transportation.

TDM encourages:

- The use of alternative travel modes (e.g., walking, cycling, taking public transit and carpooling) that consume fewer resources and reduce traffic congestion, therefore reducing pollution emissions and greenhouse gases.

- Alternative work hours that allow employees to travel outside peak travel hours to avoid and reduce traffic congestion.

- Good trip planning to reduce travel distances by choosing closer destinations or combining several trips into one trip.

- Telework (working from home or from a remote location) arrangements between employers and employees to reduce the number of commuters and allow employers to reduce both office space and employee parking (thereby reducing real estate costs).

Smart Commute has helped commuters reduce their greenhouse gas emissions by more than 17,400 tonnes since 2004 - enough to fill the Rogers Centre almost six times. Nearly 1.3 million trips by lone drivers were saved through Smart Commute, resulting in 10,000 fewer cars on local roads and highways every day. More than 50 employers with 150,000 employees have signed on to the Smart Commute program. Members of the public can also access services like the Carpool Zone at www.smartcommute.ca as well as through the new Metrolinx web portal at www.metrolinx.com.

7.0 Conclusions and Recommendations

Air quality in Hamilton continues to be impacted by a number of factors that include:

- **Trans-boundary Air Pollution.** This pollution originates from sources in the mid-western United States. About 50% of all pollutants in Hamilton arrive by the prevailing winds from the southwest; in this respect, Hamilton is impacted in a manner similar to many other communities in south-western Ontario.
- **Transportation Sources.** The roads in and around Hamilton continue to be heavily used by automobiles and diesel trucks. The improved efficiencies of vehicles should result in significant reductions in tailpipe emissions; unfortunately, these improvements in fleet performance are offset by the increased numbers of vehicles, increased congestion and the increased numbers of miles driven by commuters. The continuing trend to "just-in-time" delivery has resulted in increased truck traffic throughout the region. The mobile monitoring studies have clearly demonstrated that emissions from transportation sources result in very high local levels of pollutants near major roads and highways, particularly areas downwind of major intersections.
- **Industrial Sources.** Hamilton is home to a large number of industries ranging from the large, integrated steel mills to medium-size and small industries. Emissions from stacks feature prominently in the public's view of major pollution contributors from industries; while this perception is largely correct for chemical contaminants, it is not correct for industrial particulate sources. Fugitive dusts from materials handling and storage piles, together with road dusts and track-out from industrial sites are the sources of over 80% of all air particulate produced by the industrial sector. Strategies to reduce contributions from these fugitive sources will have dramatic positive impacts on the air quality in the industrial area of the City.
- **Hamilton's Location and Topography.** The escarpment and the city's location at the western end of Lake Ontario, together with local weather conditions (e.g., thermal inversions) can result in higher levels of air pollutants in the downtown area. While there is nothing we can do to change topography and weather, we can make decisions with regard to development, transit, and other actions that will promote a sustainable economy and reduce air pollutant impacts in Hamilton.

Air quality improvements in the City of Hamilton will be incremental and will require actions on many fronts. We recommend that the City of Hamilton:

- Recognize the health impacts of transportation-based pollutants near major traffic corridors and take steps to implement this recognition into transportation planning and urban design.
- Work with local industries and the Ministry of the Environment to control both point sources and area sources of air particulate pollution, particularly road dusts, as well as reducing NO_x and SO_2 emissions.
- Promote an active lifestyle for its citizens by developing cycling/walking routes throughout Hamilton that are separated from traffic on heavily traveled roads.

- Support and encourage Hamiltonians to reduce their transportation-based emissions through the use of transportation alternatives including public transit, bicycles, hybrid vehicles, etc. The City of Hamilton needs to continue to lead by example through transportation demand management, transportation planning and fleet upgrades.

- Encourage physicians to caution patients with respiratory or cardiac difficulties to avoid areas of higher air pollution, e.g., along and near major city roads and highways with high levels of automobile and diesel truck traffic. Patients should be warned to take special precautions on smog days and smog advisory days, particularly when there are low dispersion conditions, whether these events are weather-related or result by virtue of valley-type effects.

- Take measures to reduce fugitive dusts in industrial sectors through education and action by encouraging local site operators to develop best practices to reduce track-out from industrial properties onto roadways.

- Continue to take a broad suite of actions to improve local air quality and to increase the level of dialogue with community groups on the health impacts of poor air quality and the actions and lifestyle changes that will lead to air quality improvements for all.

In 2008, *Clean Air Hamilton* will continue to address air quality issues and their relationships to public health outcomes. *Clean Air Hamilton* will continue to develop relationships with City staff to ensure that air quality goals are integrated into the decision-making processes across divisions within the City. *Clean Air Hamilton* will continue to expand its membership and to cultivate partnerships with organizations that have goals that are consistent with those of *Clean Air Hamilton* and the City.

Appendix A: 2008 Clean Air Hamilton Strategic Plan

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Partners	Research	Communication	Actions
Public Health Protection	Heat Alert, Corporate Smog Plan	Concern for the public health in regards to AQ; expand health base for AQI	Health Canada, Public Health Communications, School boards, Parks & Recreation; Green Venture,	Air Quality Health Index (AQHI)	How individuals can avoid health problems tie health based AQI	Introduce AQHI to Hamilton
					Create a standard package for the community and corporate areas so they know what know what to do to protect health during inversion or smog days	Community Smog Plan
					Special package alerts for physicians and health care providers	
			OPHA School boards, private schools, bus operators, bus associations	Get data together comparing PM release in old school buses to new ones		Retrofitting or replace school buses, workshop
Active & Sustainable Transportation	Commuter Challenge; Smart Commute; Transportation Demand Management (City); Active & Safe Routes to Schools (Public Health); GTTA;	Encourage the use of active and alternative means of healthy transportation, reduce emissions from personal transportation	Planning, Economic Development, Public Works, Cycling Committee	Feasibility to provide corporate telework; compressed work week/months; bicycle financing; cycling amenities; preferential carpool parking; insurance rate	Cycling workshops/events; overall promotion of alternatives; awareness of SOV negative environmental impacts	Best practices for Hamilton businesses on promoting active and sustainable transportation. Audits for businesses to gauge their level of support

		Reduced emissions from driving year round. Prioritize building on success and momentum.	Green Venture, Commuter Challenge participants, Chamber	reductions; transit pass programs	Smart driving communication program	Promote behavioural shift;
	Totally Transit	Transit -change drivers into riders, get young people before they become drivers, make sure riders stay as riders	HSR, School boards, Green Venture, EH	What would be the economic and air quality impacts of free transit, status quo, increased fares?		School bus education program at schools; promote behavioural shift
Smart Driver	Idling Stinks campaign, NRCan Idle free program, Idle By-law	Reduce unnecessary vehicle idling in Hamilton	GV, City of Hamilton		Information on idling and by-law	Promote behavioural shift
	Drive Clean; Smog Patrol; Mobile Monitoring	Local impacts of diesel truck traffic	MOE, MTO, Public Works	Get data on diesel emissions from vehicles (mobile monitoring)	Outreach with truck industries; Smog Patrol	Remove diesel engines. Have a form of regulation that would not allow dirty diesel engines within city boundaries.
		Reduce demand for vehicle ownership and therefore unnecessary trips	Guelph Car Share Coop, People's Car, GV, EH		Engage interested Hamiltonians	Car Share Coop organizing meeting
	Fleet Smart Fuel Management 101 workshop	Reduced emissions focused on fleets	NRCan, GV			Organizing fleet workshops

Air Monitoring	HAMN required for industries to monitor airshed.	All emitting industries should participate in HAMN	HAMN, MOE		Provide HAMN data on-line	Encourage MOE to undertake monitoring requirement in C of As
		Real time monitoring available to public	HAMN, MOE		Website	HAMN data available on CAH website
		New and emerging monitoring technology, LIDAR, DIAL	MOE	Examine technology and usage	Presentations, workshops	
		Mobile Monitoring	MOE, EC, City	Inversion days, health impacts data		Continue mobile monitoring
Air Quality Communication	CAH Annual Report; CAH website; Upwind/Downwind Conference; Displays; brochures	School boards involved; potentially get a representative on CAH committee	School boards	Indicators of local action on air quality that could be reported in addition to air quality parameters		School board rep on committee
		Educate the public-what are the problems, how does it effect you, what can you do.	GV			
	CAH website	Clean air Hamilton is effective and efficient -must maintain support	City, MOE, Environment Canada, Health Canada		Update material	Look at design, content, explore new server or hosting
		Update and current, user-friendly and informative	Planning & Econ, Dev			

Climate Change	Corporate AQ&CC Plan; Climate Challenge (Environment Hamilton)	The linkages to AQ	Environment Canada, MOE, McMaster	Research linkages to AQ (CO, NOx) and actions	Outreach on AQ & CC linkages	Create a Community Climate Change action plan
		Subcommittee to look at city-wide Climate Change issues	City, McMaster, Green Venture, Environment Hamilton, Conservation Authority			
Emissions Reductions		Get on Air Pollution Index with abatement and enforcement Develop tool that can trigger immediate action by industry in poor air quality situations; Drive action when needed; Protect health	MOE, City	Research best practices	Create a standard package for the community and corporate areas so they know what to do to reduce emissions during inversion or smog days	Community Smog Plan
	Mow down pollution programs, Leaf blower education	Reduce usage of two-stroke engines, tie in with pesticide education	GV, Home Depot, Lowes, Home Hardware			Summer carbon-neutral grass cutting and lawn maintenance; Leaf blower education
Energy Conservation	Horizon Utilities programs; Energy roundtable	Promotion / energy conservation & alternatives	Public Works, NRCan, Utilities, Green Venture			Promotion / energy conservation & alternatives
	Generation Conservation curriculum-based program for Grade 5 students	Create a generation of energy conservers who understand the consequences of the wasteful use of electricity and the connection to climate change.	Hamilton-Wentworth District School Board, Hamilton-Wentworth Catholic District School Board, of Niagara, Niagara		Teacher workshops, teacher guides, student workbooks, classroom materials, posters, flyers	

			Catholic District School Board, Hamilton Public Libraries			
	Light exchange/bulb	Promotion / energy conservation & alternatives	Horizon, Public Works, Green Venture, Environment Hamilton		Switch to CFL bulbs	
	Appliance exchange (a/c, fridge)		Horizon, Public Works			
	Energy Audits	Energy conservation and savings (low income neighbourhoods)	Green Venture			
Land use Planning	Official Plan review; Provincial Policy Statement;	Street design cycling lanes / parallel, pedestrian oriented streets, stop signs vs. roundabouts, driving patterns	Planning & Economic Development, Public Works, GV			Complete street audits
	Urban Heat Island (UHI)	Reduction of UHI in urban environments	Planning & Econ. Dev, Public Health, Public Works, GTA CAC, NRCan, MAH, Health Canada	Urban heat island strategies, green roofs, white roofs		
Tree Programs	Numerous tree planting programs in City (Red Hill Valley, Councillors, Street Planting, Earth Day, Ikea)	Trees improve air quality, fight climate change, lower heating and cooling costs, reduce water demand and store rainwater, increase happiness, slow traffic	GV, Conservation Authority, Public Works, Earth Day Hamilton, businesses	Develop a tree planting inventory for Hamilton; fill in gaps (i.e. low income neighbourhoods)		Develop a tree networking body--Tree Roundtable to consolidate efforts

Appendix B: Air Quality Indicators - Trends & Comparisons over the Past Ten Years

Air Quality Trends in Hamilton

The graphs in this Appendix illustrate trends in key air quality parameters in Hamilton over the past 10-16 years. Longer term trends from about 1970 to the mid-1990's can be found in the 1997 HAQI reports. Significant reductions were observed in all parameters between the 1970's and the mid-1990's because major industries installed pollution abatement equipment on a number of air pollution sources; see http://www.cleanair.hamilton.ca/downloads/HAQI-Environmental-Work-Group-Final-Report-Dec-97.pdf for this longer term perspective.

Since the mid-1990s, improvements have been less dramatic than had been achieved in the previous two decades. While additional improvements in industrial emissions are certainly possible, the costs of implementation of the best available technologies to achieve these goals are significantly greater than previous upgrades. Pollution abatement technologies and strategies continue to be implemented by companies within the industrial sector. During the past year there have been incidents of pollutant releases from some industrial facilities with older pollution abatement equipment. *Clean Air Hamilton* strongly recommends that all stakeholders evaluate their air pollution control equipment on a regular basis and make every effort to install the most efficient and non-polluting technologies when upgrading their pollution control equipment. Stakeholders are encouraged to identify and install the best available pollution abatement technologies when constructing new facilities or when retrofitting existing facilities.

Clean Air Hamilton recommends that all citizens critically evaluate the fuel and energy efficiencies of any energy-consuming appliances, passenger vehicles and trucks that they may be considering purchasing over the next few months. In most of the graphs below, one line represents the average ambient air levels in residential areas of the city, based on data from two or more air monitoring stations located at City Sites, while the other line represents the average ambient air levels near industrial sites, based on data from two or more air monitoring stations located near Industry Sites.

The air quality in Hamilton is affected by emissions and activities from both inside and outside our region. The 1997 Hamilton Air Quality Initiative (HAQI) reports stated that about 50% of the pollutants in Hamilton's airshed were due to sources outside the Hamilton region; indeed, the primary, non-local source was long-range, trans-boundary loadings of pollutants across south-western Ontario from sources in the mid-west region of the United States.

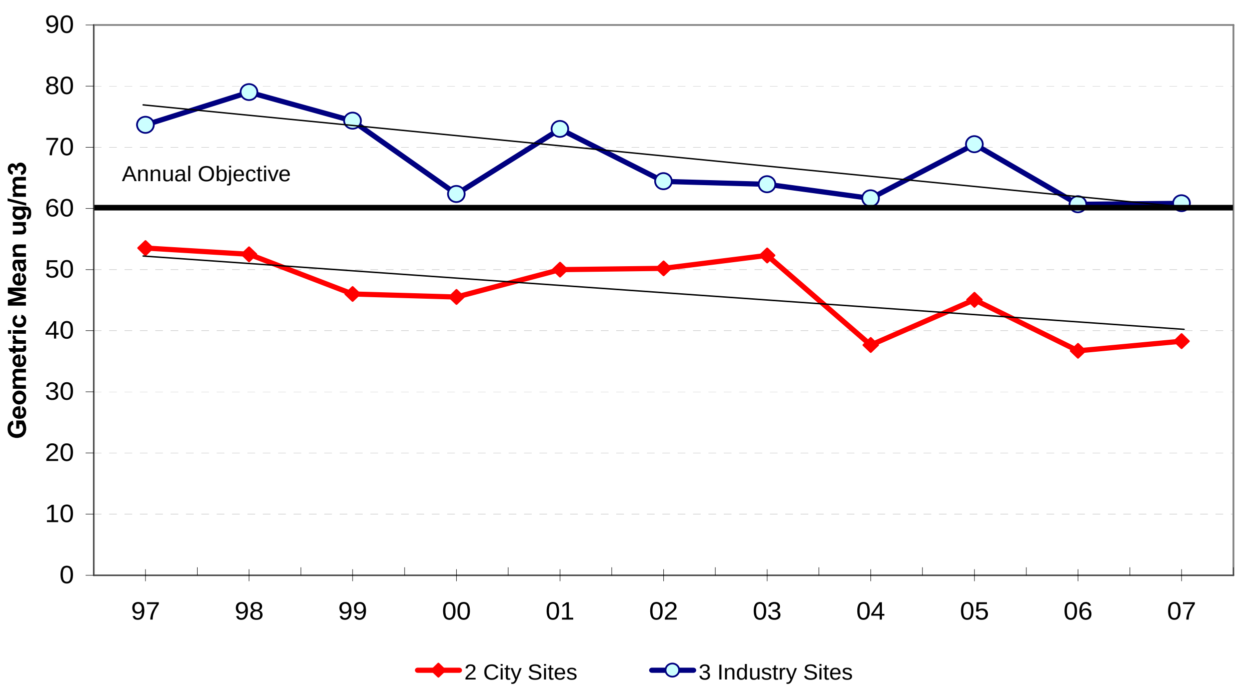
A recent report from the Ontario MOE (June 2005) showed the results of modeling estimates of the impacts of US sources on Canada. These estimates were based on the analysis of large-scale weather patterns and detailed estimates of emissions from sources in Midwestern US states. These results clearly demonstrated that about 50% of all contaminants in the air in Ontario (and in Hamilton) were the result of long-range transport from sources in the US. These sophisticated modeling studies were consistent with the estimates provided in the original HAQI Study reports.

Particulate Material: Total Suspended Particulate

Total suspended particulate (or TSP) includes all particulate material with diameters less than about 45 micrometers (µm). The largest portion of TSP with a diameter of 45 µm is similar to the diameter to a human hair and is just visible to the eye. Air levels of (TSP) in Hamilton have decreased about 20% since 1997. The city levels of TSP have decreased from about 50 µg/m^3 to about 40 µg/m^3 over the past decade. A substantial portion of TSP is composed of road dust, soil particles and emissions from industrial activities and transportation sources.

Included within the TSP category are Inhalable Particulates (PM_{10}) and Respirable Particulate ($PM_{2.5}$). By subtracting the PM_{10} or the $PM_{2.5}$ value from the TSP value it is possible to determine the net amount of particulate material in the air with sizes between about 45 µm and either 10 µm or 2.5 µm. The material in the air with diameters between 10 and 45 µm is due almost exclusively to fugitive industrial emissions and re-entrained road dust.

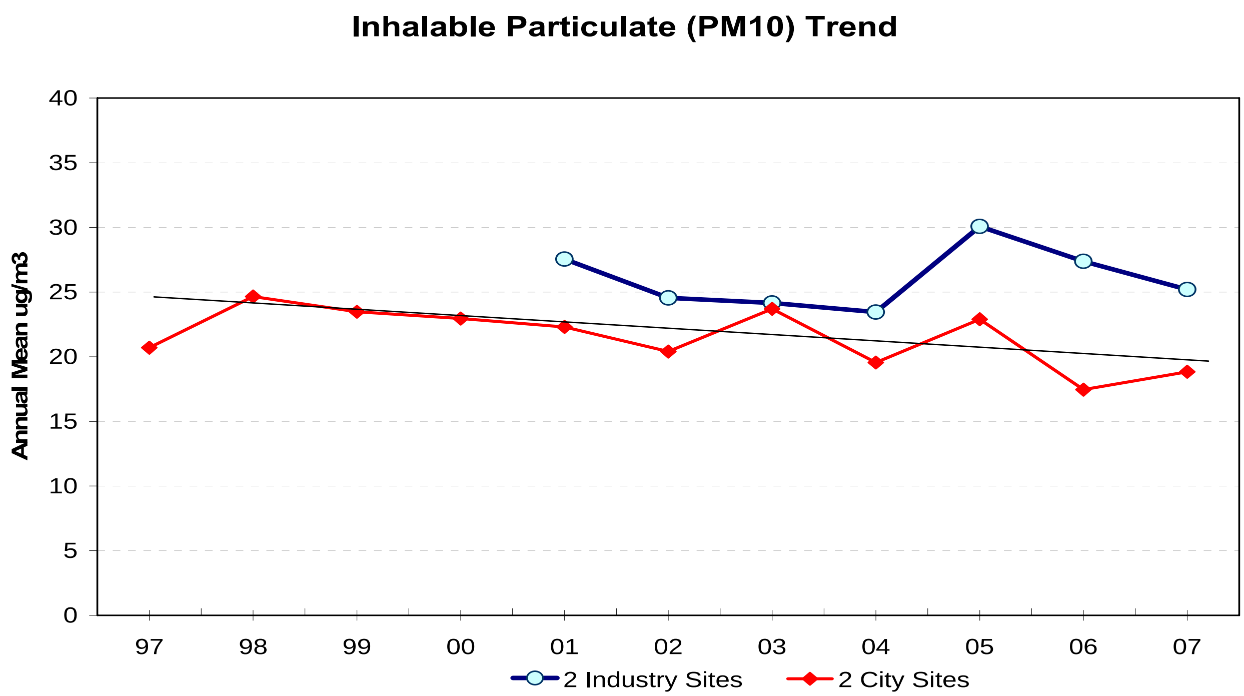
Suspended Particulate (TSP) Trend



Particulate Material: Inhalable Particulate Matter (PM_{10})

Inhalable particulate matter (PM_{10}), the airborne particles that have diameters of 10 µm or less, is a subset of TSP. PM_{10}, which often makes up about 40% of TSP, has been clearly and consistently linked to respiratory and cardiovascular health impacts in humans. As with the TSP trend discussed above, ambient levels of PM_{10} in the city have decreased about 20% over the past decade, from about 25 µg/m^3 to about 20 µg/m^3. In areas of the city near the industrial sectors, the levels of PM_{10} are greater than city levels, reflecting the additional contributions from industry-generated PM_{10}.

PM_{10} is derived primarily from vehicle exhaust emissions, industrial fugitive dusts, and the finer fraction of road dust. Car and truck traffic counts have remained constant in Hamilton in recent years; the deceasing trend in PM_{10} over the past decade at the city both sites is likely a reflection of a combination of better performance of the vehicle fleet mix over time and better street sweeping practices in the city. The vehicle fleet performance will have improved primarily due to the lower particulate emissions from modern engines and possibly due to the removal from service of some of the worst polluting vehicles under the provincial Drive Clean program. While the impact of the Drive Clean program is difficult to assess from an emissions perspective across a city, the removal of “smokers” from the road was certainly one of the expressed goals of the program in addition to ensuring that the Ontario vehicle fleet was performing as good as could be expected.



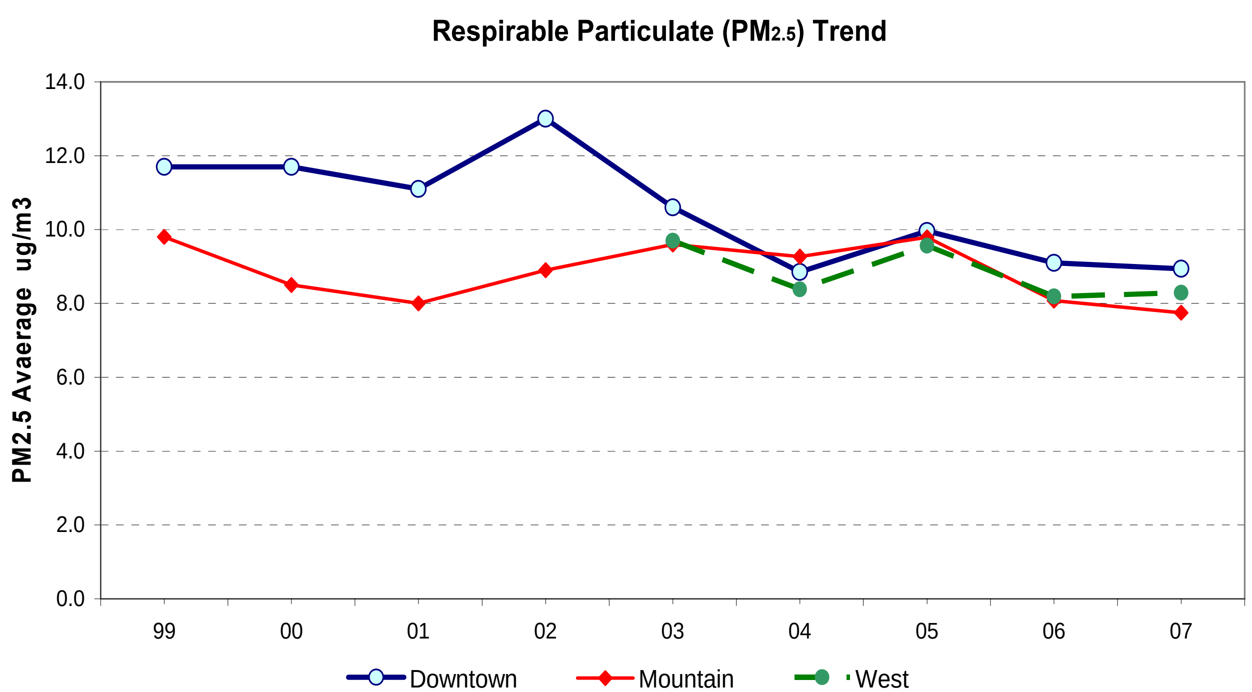
Particulate Matter: Respirable Particulate Matter ($PM_{2.5}$)

The Province of Ontario monitors respirable particulate matter ($PM_{2.5}$), airborne particles with a diameter of 2.5 µm or less. $PM_{2.5}$, which makes up about 60% of the PM_{10} in the air, has been more strongly linked to health impacts than PM_{10}. The Ontario government started measuring levels of $PM_{2.5}$ across Ontario in 1999; prior to this date there was little data on $PM_{2.5}$. In Hamilton $PM_{2.5}$ data is collected at the three AQI monitoring stations.

The trend in $PM_{2.5}$ has shown a decrease of about 20% since 1999 at the downtown site, consistent with the decreasing trends in TSP and PM_{10} in the city; the $PM_{2.5}$ levels decreased from about 12 µg/m^3 to a little below 10 µg/m^3.

The $PM_{2.5}$ fraction of air particulate is now recognized as being responsible for essentially all of the deleterious health effects associated with air particles. Most of the particles associated with automobile exhaust, diesel exhaust and cigarette smoke have particle sizes well below 1 µm with a size range between 0.1 and 0.3 µm; vehicle combustion sources constitute about 30-50% of the mass of $PM_{2.5}$.

There has been a scientific debate over just what causes the health impacts in humans due to exposure to the $PM_{2.5}$ fraction. It is recognized that the $PM_{2.5}$ fraction contains over 95% of all particle-bound organic compounds in the air. What has not been established conclusively is whether the observed health effects are due to exposure to the $PM_{2.5}$ particles alone, to exposure to the organic compounds associated with these particles or to some combination of the particles themselves and the organic substances. Most scientists now agree that exposure to the small particles and the organic substances is the likely cause of the observed respiratory and cardiovascular health impacts attributed to particulate material exposures.

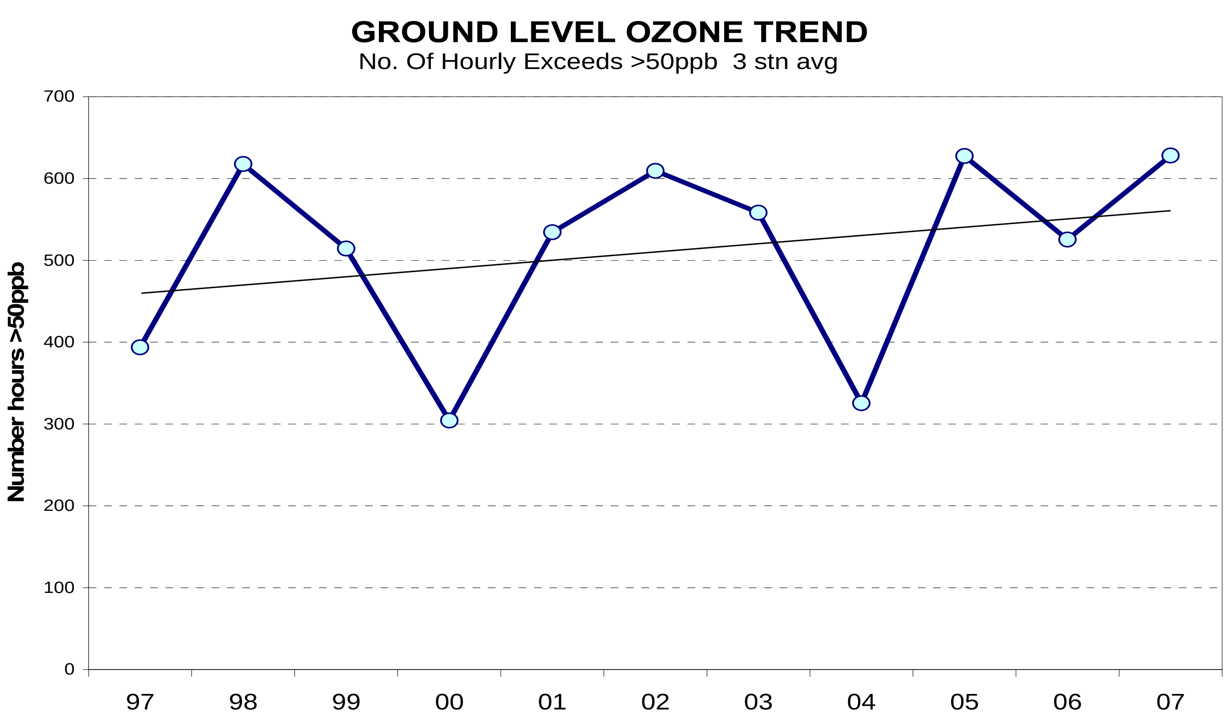


Ground Level Ozone

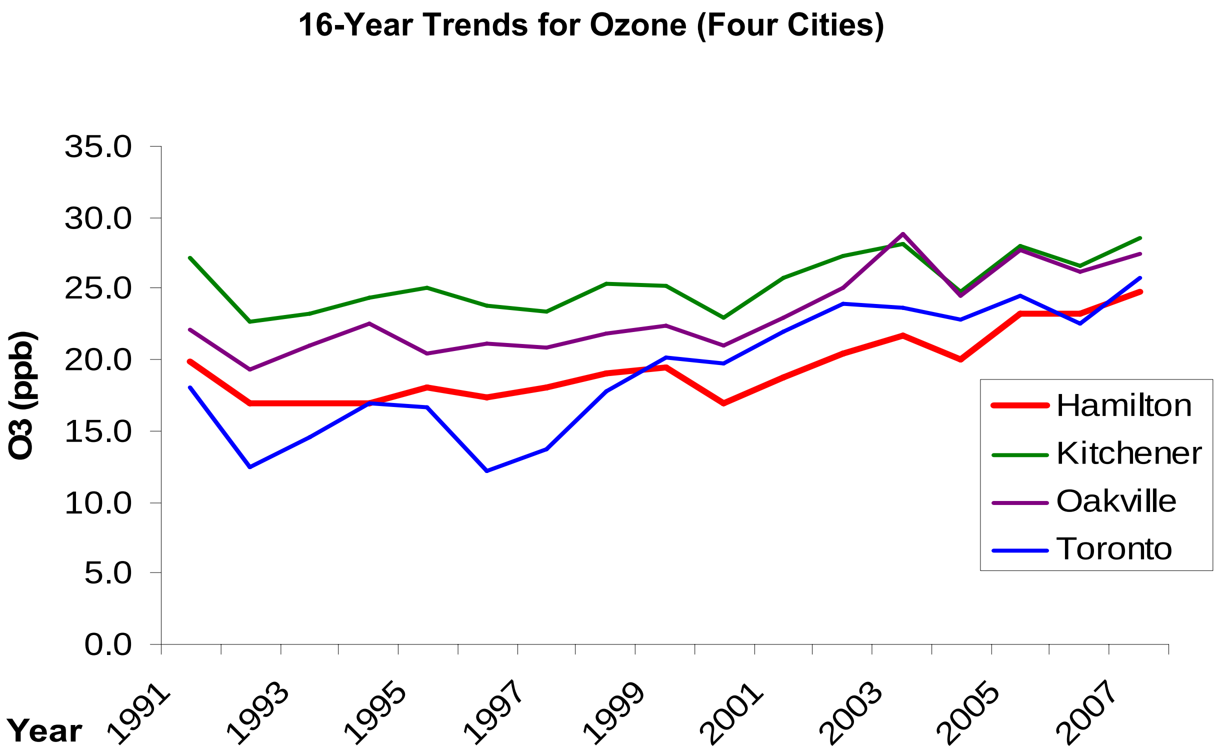
Ground level ozone is formed in the atmosphere when air pollutants such as nitrogen oxides (NO_X) and volatile organic compounds (VOC) react in the presence of sunlight. Air levels of ozone are higher in warmer seasons than in colder seasons because the sunlight is stronger in the summer and the temperatures are higher. The trend in ground-level ozone shows an increase of about 20% over the past decade, in contrast to the trends in many other pollutants.

Unlike all other pollutants none of the ozone measured in Hamilton was generated from Hamilton-based sources. The formation of ground level ozone takes several hours once the pollutants have been released to the atmosphere. Thus, the ozone measured in Hamilton was produced from emissions released from sources upwind of Hamilton. Conversely, emissions from sources within Hamilton will result in the formation of ground level ozone in areas downwind of Hamilton. A substantial portion of the ozone that affects southern Ontario during smog episodes in the summer months originates from distant, upwind sources in the United States, including releases from coal-fired power plants, vehicles and urban activities in those regions.

Ground level ozone should not be confused with stratospheric ozone in the so-called “ozone layer”. The ozone called “stratospheric ozone” is produced and destroyed in the stratosphere at an altitude of 30-60 km above the earth. The term “ozone depletion” refers to a decrease in the levels of stratospheric ozone due to man-made emissions, particularly halogenated refrigerants that have now been banned. Stratospheric ozone and changes in the “ozone layer” have not yet been linked to impacts of combustion emissions.



The trend in ground level ozone in Hamilton is mirrored at other locations in Ontario. Over the past 16 years the concentrations of ground level ozone across southern Ontario have increased between 10 and 30%, depending on the city. The increases seen in Hamilton during this period are similar to the trends observed in Oakville, Kitchener and Toronto.

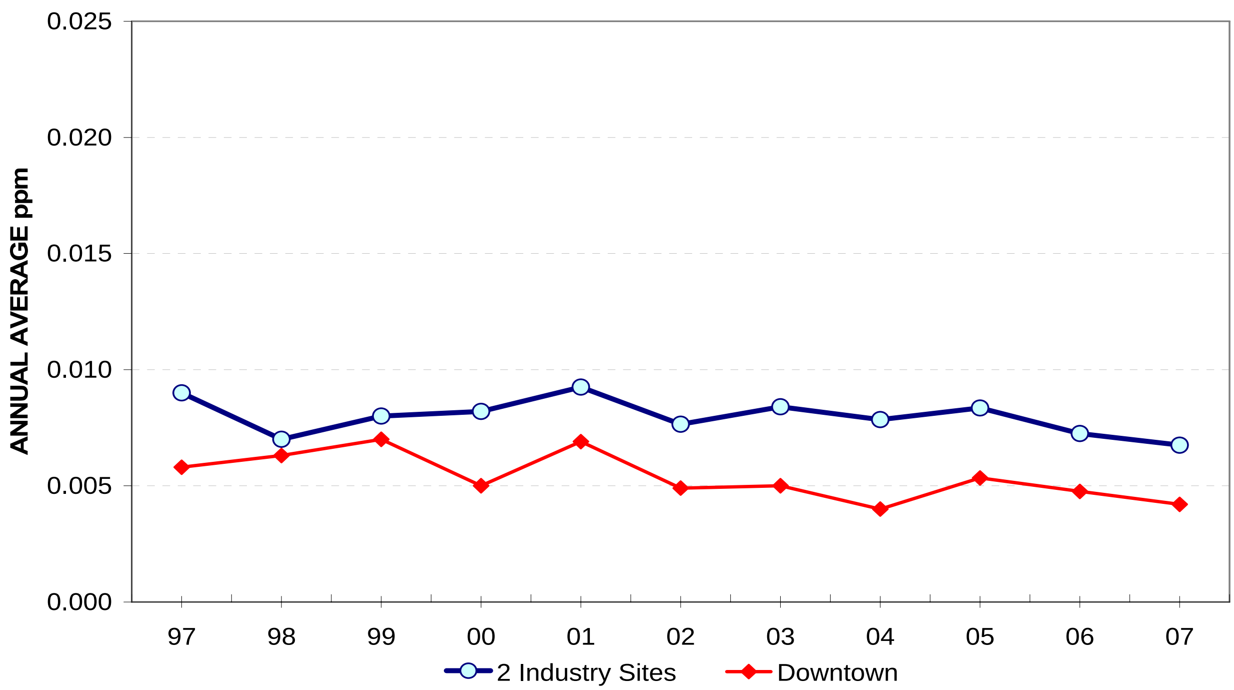


Sulphur Dioxide

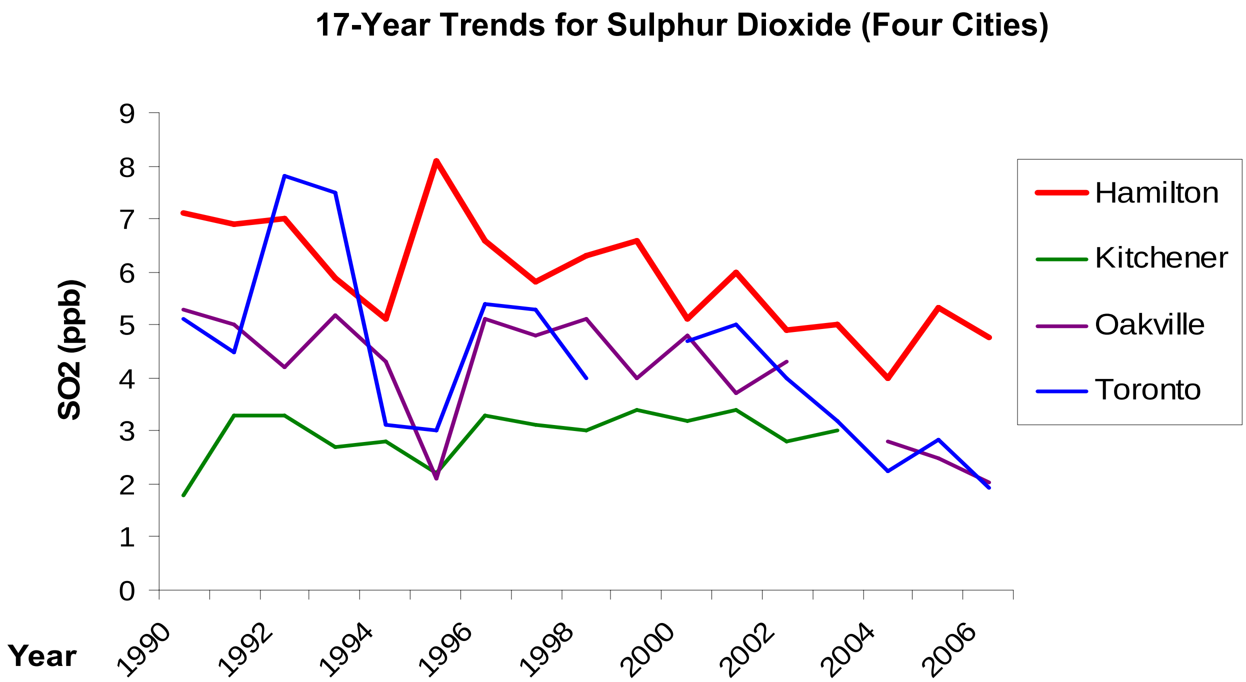
The principal sources of sulphur dioxide (SO_2) in Hamilton are industrial processes within the city. Significant improvements in air levels of sulphur dioxide were made in the 1970s and 1980s. Since 1995, there has been a gradual and continuous decline in air levels of SO_2. These reductions reflect actions taken to reduce SO_2 emissions from the steel industry. Combustion of fossil fuels containing sulphur is another major source of SO_2. The new federal regulations to limit the sulphur content in diesel fuel to 15 parts per million by 2007 should have a further impact on ambient SO_2 levels.

Sulphur dioxide is not only a respiratory irritant but this oxide is readily converted in the atmosphere to form sulphate particles. These particles average about 2 µm in diameter and constitute part of the respirable particulate fraction in the air. These particles tend to be acidic and also cause lung irritation when inhaled. Thus, the health concerns associated with sulphur dioxide exposures are linked to the gas itself as well as to the particulate material derived from it.

SULPHUR DIOXIDE TREND



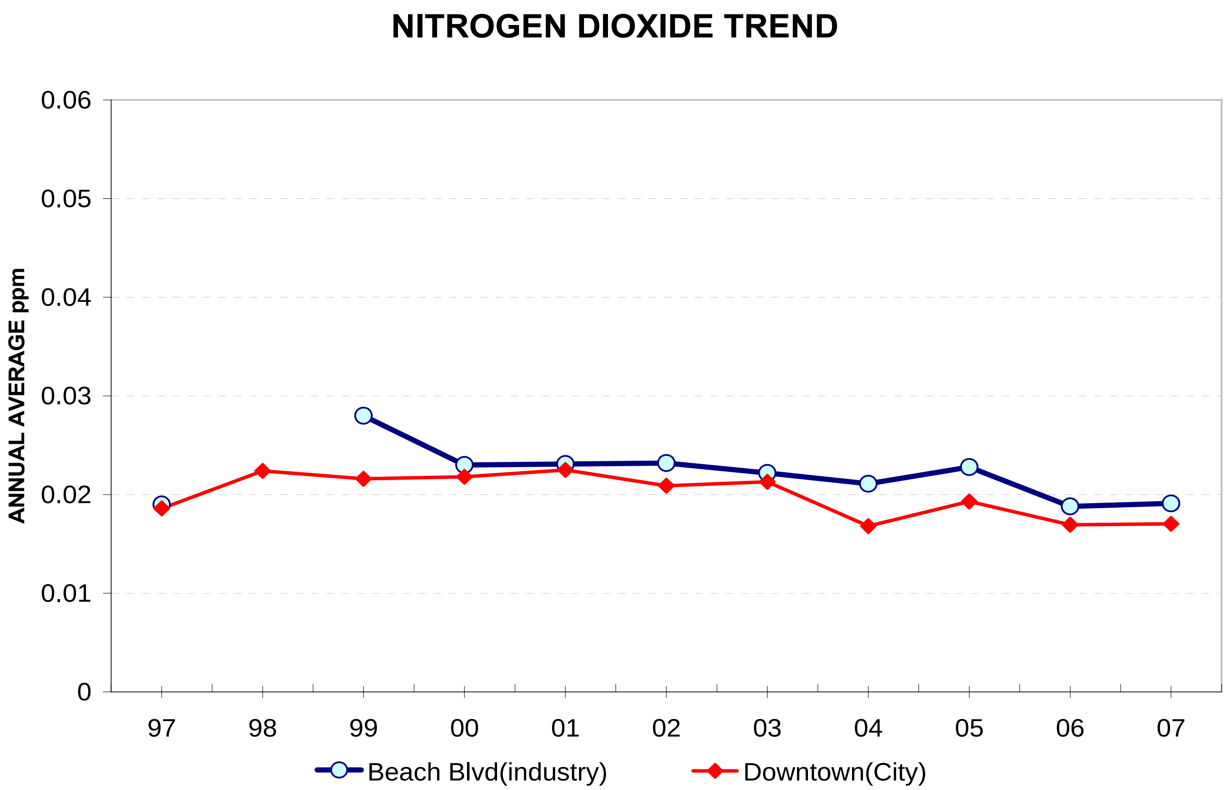
The graph below shows a comparison of the seventeen-year trends in sulphur dioxide levels in four southern Ontario cities. The levels in Hamilton are higher than the other cities due primarily to the industrial emissions that are unique to Hamilton. The sulphur dioxide levels in Oakville and Toronto are similar, reflecting similar compositions of local sources, primarily transportation sources.



Nitrogen Dioxide

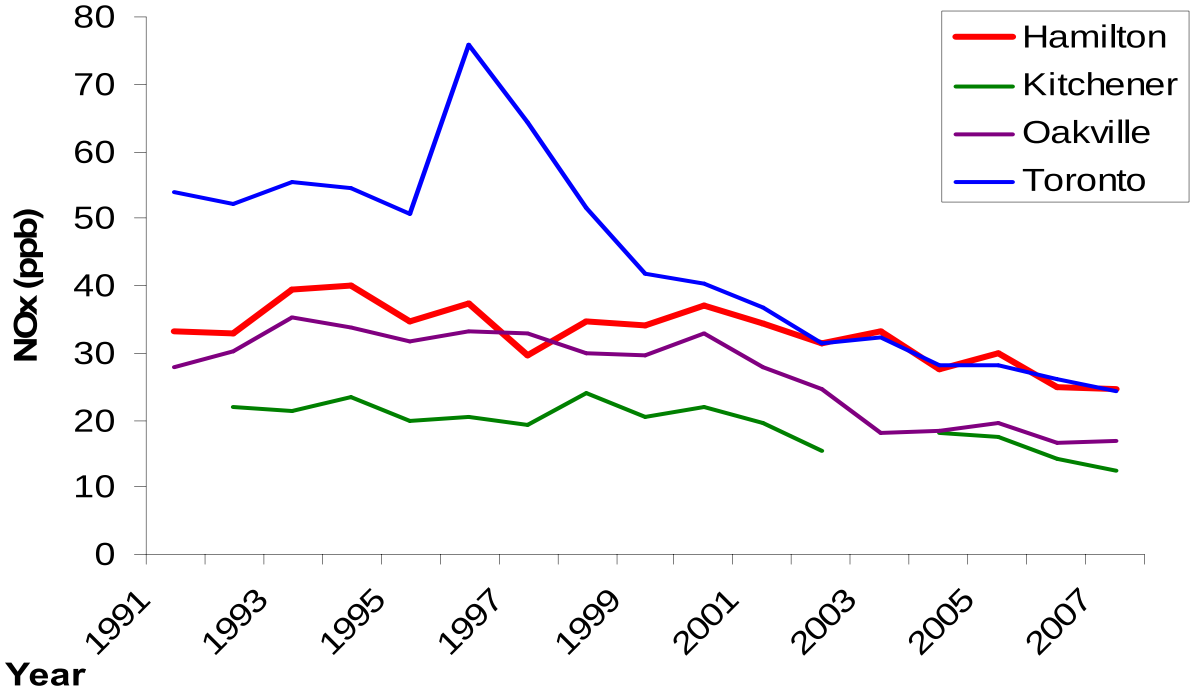
Nitrogen dioxide (NO_2) is responsible for a significant share of the air pollution-related health impacts in Hamilton. Little progress has been made to reduce air levels of NO_2 over the last decade. NO_2 is formed in the atmosphere from nitric oxide (NO) which is produced during the combustion of fuels such as gasoline, diesel, coal, wood, oil and natural gas. The leading sources of NO_2 in Hamilton are the transportation sector followed by the industrial sector.

Unfortunately, there has been essentially no change in the average levels of nitrogen dioxide in Hamilton over the past decade. The level of vehicle use has increased during this time; the overall improvements in vehicle emissions performance have been offset by the increased vehicle usage in and around Hamilton.



When we compare the 16-year trends in air levels of NO_x in Hamilton to NO_x levels in other Ontario cities we note that all cities have seen a decreasing trend. Toronto which has no significant industrial NO_x contributors but significant vehicular NO_x emissions shows the largest decrease. The NO_x levels in Hamilton have decreased more slowly than in cities such as Oakville and Toronto during this period due presumably to contributions from sources other than vehicles. The NO_x level is the sum of the levels of NO and NO_2. The decrease in the average NO_x levels is a reflection of improvements in emissions performance of the vehicle fleet in Ontario over the past decade.

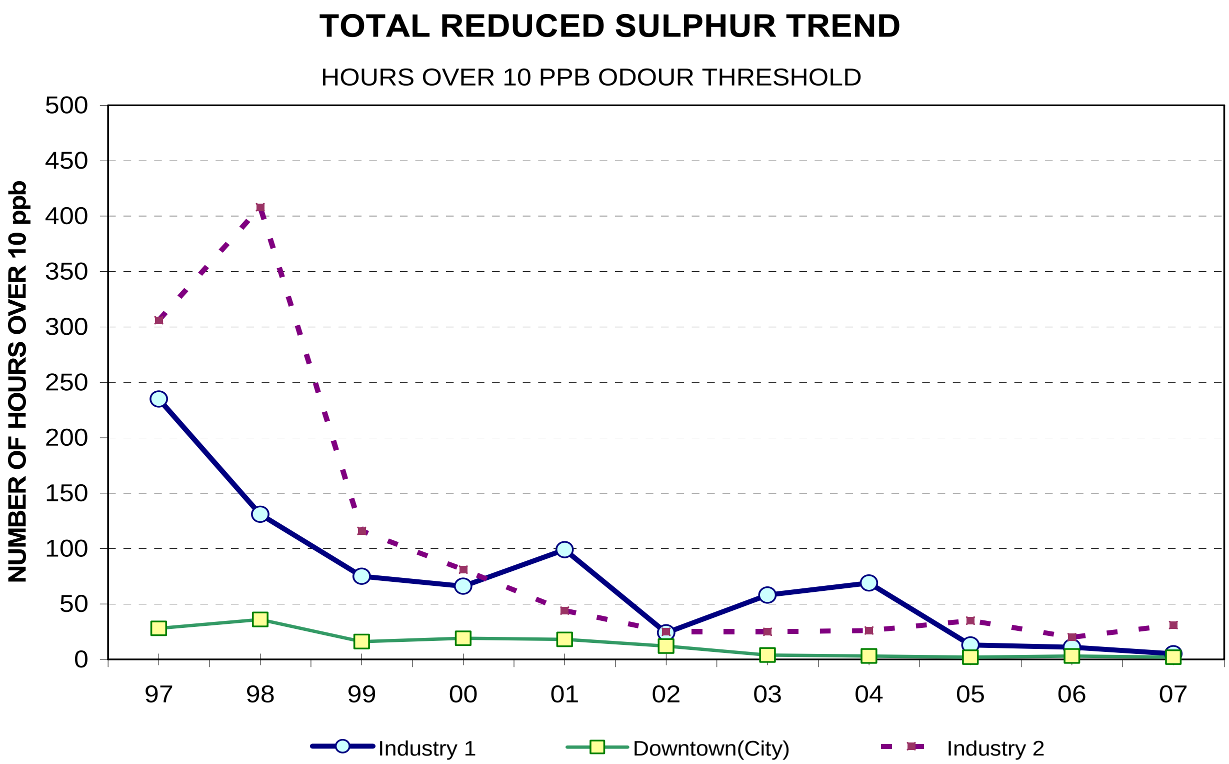
16-Year Trends for Nitrogen Oxides (Four Cities)



Total Reduced Sulphur

Total Reduced Sulphur (TRS) is a measure of the sulphur-containing compounds that are the basis of many of the odour complaints related to steel mill operations, particularly coke oven emissions, blast furnace emissions and slag quenching operations. At 10 parts per billion (ppb), many people can detect TRS as an odour similar to rotten eggs.

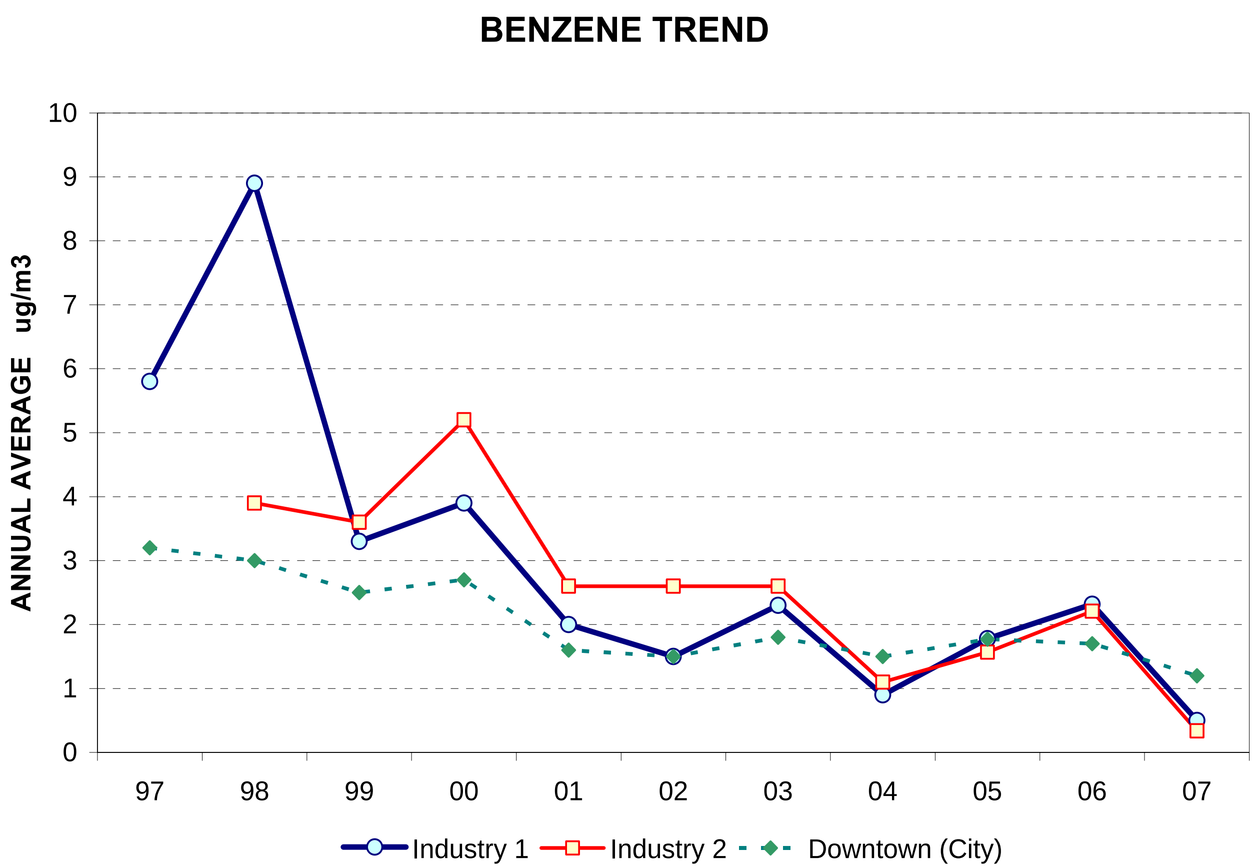
Hourly exceedances of the 10 ppb odour threshold have been reduced by between 70-90% since the mid-1990s due to significant changes in the management and operation of the coke ovens and blast furnaces. In particular, changes to slag procedures from quenching (using water) to pelletizing (using air cooling) have had the greatest effect on reducing odour-causing emissions from those operations.



Benzene

Benzene is a volatile pollutant that is capable of producing cancer in humans. Benzene is emitted from operations within the steel industry, specifically releases from the coking ovens and from coke oven by-product plant operations. Air levels of benzene have been reduced dramatically since the late 1990s due to significant upgrading of the coking plant operations, improved procedures and controls applied to the operations of the by-products plants run by both steel companies.

Benzene is a component of gasoline and is found wherever gasoline is used and distributed. Thus, all cities in Canada have low but measurable levels of benzene in the air. The levels of benzene in downtown Hamilton have now dropped to levels comparable to those in other Canadian and Ontario cities of comparable size.

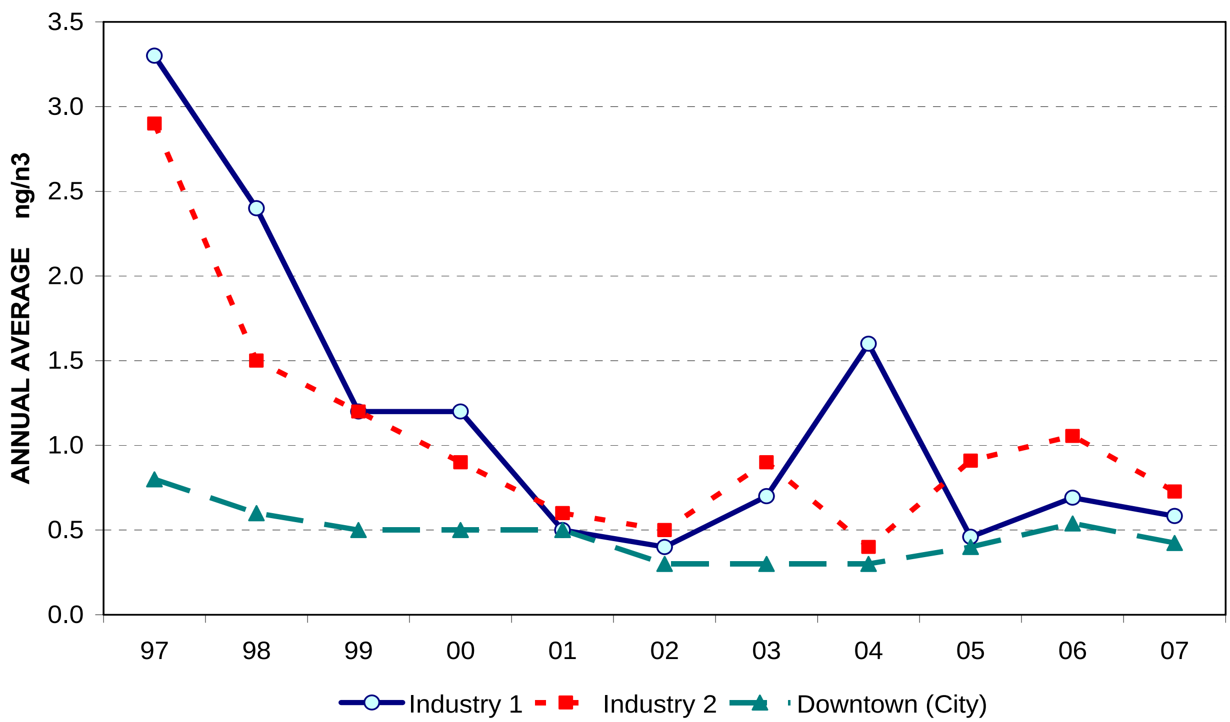


Benzo[a]pyrene

Benzo[a]pyrene (BaP) is a pollutant capable of causing cancer in animals and humans. BaP is one member of a large class of chemical compounds called polycyclic aromatic hydrocarbons (or PAH). PAH are emitted when carbon-based fuels such as coke, oil, wood, coal and diesel fuel are burned. The principal sources of BaP in Hamilton are releases from coke oven operations within the steel industry. The significant decreases in ambient benzo[a]pyrene levels since the late 1990's are the result of improvements to the infrastructure of coke ovens themselves and increased attention to the operation and maintenance procedures for proper operation of the coke ovens.

While benzo[a]pyrene is only one of many PAH released from coking operations, BaP is undoubtedly the most potent and most studied of all PAH carcinogens (cancer-causing agents) in the scientific literature. As a result of the extensive amount of chemical and toxicological research work and occupational exposure work done with this compound, BaP has become the primary PAH carcinogen by which to compare exposures to many PAH-containing mixtures, such as vehicular emissions, coke oven emissions, barbecued foods, coal tar exposures, etc.

BENZO(a)PYRENE TREND



Appendix C: Partnerships

Hamilton Air Monitoring Network (HAMN)

The Hamilton Air Monitoring Network is operated by a consortium of 22 companies in Hamilton. HAMN is responsible for operating, maintaining and upgrading all 19 industrial air monitors in Hamilton. The network must operate in accordance with the Ministry of the Environment's standards for quality and reliability. The Ministry of the Environment has direct, real-time access to all continuous monitoring data from the network.

HAMN supplies air quality monitoring reports to the Ministry of the Environment on a regular basis and all reports are audited by Ministry of the Environment staff to ensure a consistent and high quality of data. This monitoring network is a rather unique partnership in Ontario because of the diversity of the member companies and the broad range of contaminants monitored and reported.

The Hamilton Industrial Environment Association (HIEA)

The Hamilton Industrial Environment Association is a group of local industries that seeks to improve the local environment – air, land and water – through joint and individual activities, and by partnering with the community to enhance future understanding of environmental issues and help establish priorities for action. More information can be found at www.hiea.org.

The Greater Toronto Area Clean Air Council (GTA-CAC)

The City of Hamilton and *Clean Air Hamilton* are members of the Greater Toronto Area Clean Air Council. This provides Hamilton an opportunity to participate in a dialogue on air quality with other municipalities in southern Ontario. The Greater Toronto Area Clean Air Council is an intergovernmental working group that promotes the reduction of air pollution emissions and increased awareness of regional air quality issues in the Greater Toronto Area through the collective efforts of all levels of government. More information can be found at www.cleanairpartnership.org/gtacac.

Hamilton Area Eco-Network (Eco-Net)

The Hamilton Area Eco-Network (Eco-Net) is a non-profit organization created to network the area's environmental organizations and build their capacity. The purpose of the Eco-Net is to enhance and enable the work of member organizations that are committed to protecting, conserving, restoring and promoting a clean, healthy, sustainable environment for present and future generations. More information on Eco-Net and member organizations can be found at http://www.hamiltoneconet.ca/

Appendix D: Upwind/Downwind 2008 Conference – Report

Executive Summary

The 2008 Upwind/Downwind Conference was held in Hamilton Ontario on February 25th and 26th 2008 at the Hamilton Convention Center. The conference recognizes Hamilton as a leader in air, transboundary and climate initiatives, with elements (Free talk, Conference and Clean Air Fair) reported in all forms of local media (print, radio, television and Internet) Upwind/Downwind is hosted every two years by the City of Hamilton and Clean Air Hamilton. Upwind/Downwind generates many ideas and is an excellent opportunity for Hamilton and other communities to share practical solutions to air quality, transboundary and climate problems in the fields of health, planning, municipal action and partnerships. Approximately 288 planners, health promoters, high school and university/college students, environmental consultants, citizens, industry and government registrants participated in the 2008 Conference.

Introduction

The 2008 Upwind/Downwind Conference: Climate Change & Healthy Cities was the fifth biennial conference focusing on practical solutions to the air quality, transboundary air and climate change issues and impacts facing urban regions. The 2-day conference aimed to provide a forum to enable an improved understanding of air quality, transboundary air and climate change issues and human health impacts related to transboundary air movements, land use planning and transportation. Secondly, the conference highlighted the roles that industry, community groups and government can play in achieving air quality improvements and climate action.

Background

The Upwind/Downwind Conference is an important activity in Clean Air Hamilton's overall strategy to bring the best science in the air quality and climate change field to the attention of planning and health practioners, decision-makers, politicians and the public. The Conference is designed to develop continued awareness of air quality issues and to address new matters that relate to trans-boundary air pollution and climate change. The first Upwind/Downwind Conference was hosted in September 1999 by the former Region of Hamilton-Wentworth and the Hamilton –Wentworth Air Quality Initiative.

Conference Goals

The goal of a biennial conference is to build on the momentum and strong networks initiated by previous conferences in order to facilitate continuous discussion and improvements on clean air issues. The 2008 conference aimed to provide an information sharing forum to enable an improved understanding of air quality and climate change issues and impacts to cities, human health and the economy.

To achieve these goals, the themes of the first day of the 2008 conference were "Air Quality, Climate Change & Public Health" and "Urban and Transportation Planning". Themes for second day were "The Science of Climate Change" and "Climate Change and Local Partnerships".

Speakers included:

"Air Quality, Climate Change & Public Health" - Dr. Kenneth Chapman, University of Toronto, Dr. Michael Jerrett, University of California, Berkeley, and Dr. Peter Berry, Health Canada

"Urban and Transportation Planning" - Joanne McCallum, McCallum Sather Architects Inc., Blair McCarry, Stantec, Denis Corr, Rotek Environmental Inc., and Rob MacIsaac, Metrolinx/Greater Toronto Transportation Authority.

"The Science of Climate Change" - Dr. Gordon McBean, University of Western Ontario & The Institute of Catastrophic Loss Reduction, Dr. Quentin Chiotti, Pollution Probe, and Eva Ligetti and Jennifer Penney, GTA Clean Air Partnership.

"Climate Change and Local Partnerships" - Anne Evens – Chicago Centre for Neighbourhood Technology; David Noble – 2degreesC and municipal representation from The City of Burlington, Halton Region, The City of London, the City of Guelph, and the City of Hamilton.

A free public lecture supported by Environment Hamilton, Transportation for Liveable Communities and Clean Air Hamilton, was held on the evening of Monday February 25th at the Hamilton Convention Center. The featured speaker was Gil Penalosa, Executive Director, Walk & Bike for Life, who spoke on *Walking and Bicycling: Creating a Great Healthy City of Hamilton.* A panel discussion followed the presentation. Panellists included: Scott Stewart (City of Hamilton – Public Works), Nicole MacIntyre (The Hamilton Spectator), Thom Oommen (Transportation for Liveable Communities), and Ryan McGreal (Raise the Hammer). Attendance for the Monday Night talk was approximately 100 people.

In addition, a Clean Air Fair Exhibitor Showcase was held in tandem with the Conference for attendees and the general public to show new technologies and products that they can use first-hand, and talk to people who can give them the answers they seek on issues of air quality and climate change.

Clean Air Fair

39 Exhibitors in 46 spaces were in attendance for the Clean Air Fair Exhibition Show. The Clean Air Fair was an addition to the 2008 Conference in order to attract the general public to the event and to showcase partners, solutions and products that address air quality and climate change. The exhibitors ranged from businesses selling products that help reduce greenhouse gas emissions and improve air quality to government agencies and environmental organizations dealing with Climate Change and Air Quality. Approximately 100 individuals from the public attended the Clean Air Fair for both days.

The Clean Air fair was located withint the Convention centre and was out of the way for the general public. The Clean Air fair was well received and will likely be continued at future conferences; however, the venue need s to be more accessible and holding it on a day such as Sunday, would allow for more people, including families, to attend.

The 39 Exhibitors were:

- Health Canada
- Environment Canada
- Clean Air Hamilton
- Ontario Ministry of the Environment
- Canadian Mortgage and Housing Corporation
- City of Hamilton – Public Works
- City of Hamilton – Public Health Services
- City of Burlington
- Clean Air Foundation
- McMaster Institute of Environment & Health
- Tourism Hamilton
- Hamilton Industrial Environmental Association
- Green Venture
- Environment Hamilton
- Earth Day Hamilton
- Golder & Associates
- Liberty Energy Resources
- Smart Commute
- Hamilton Light Rail
- AutoShare Toronto
- Goelectric Inc.
- Medi-Air Inc.
- Ecolife Products
- Conserval Engineering
- Enwise Power Solutions
- SolarOntario.com Ltd.
- SkyPower Corp
- Tafcon Heating
- Xero-Floor Green Roofs
- Canadian Organics Growers
- Green T-Biz
- Hamilton Mountain Green Party
- Hamiltonians for Progressive Development
- The Hamilton Bay Area Restoration Council
- Hamilton Halton Watershed Stewardship
- Giant's Rib Discovery Centre
- Iroquoia Bruce Trail Club
- Hamilton Naturalists' Club
- Hamilton Waste Reduction Task Force

Conference Coordination

Conference planning for the 2008 event began in the spring of 2007 with a team of 18 representatives from Clean Air Hamilton, Environment Canada, Ontario Ministry of the Environment, City of Hamilton, City of Burlington, McMaster Institute of Environment and Health, Rotek Environmental Inc, McKibbon Wakefield Inc., Environment Hamilton, Green Venture, ArcelorMittal Dofasco and US Steel Canada (see **Table 2**). The City of Hamilton's Air Quality Coordinator within the Planning and Economic Development Department executed the planning activities. The inaugural meeting of the planning committee occurred on January 12, 2007.

Table 2: 2008 Upwind/Downwind Conference Planning Committee

Organization	Representative	Work Title
Clean Air Hamilton McMaster University	Brian McCarry	Chair
McMaster Institute of Environment and Health	Bruce Newbold	Director
City of Hamilton	Brian Montgomery	Clean Air Coordinator
	Maggie Janik	Assistant Environmental Planner (April – Aug. 2007)
	Meghann Kerr	Assistant Environmental Planner (Sept. – Dec. 2007)
	Kevin Friedrich	Assistant Environmental Planner (Jan. – April 2008)
	Steve Walsh	Public Health Services
	Natasha Mihas	Public Health Services
Environment Canada	Hossein Naghdianei	Environmental Protection Services
Ministry of the Environment	Carl Slater	Manager, Technical Support Section, West Central Region
Rotek Environmental Inc.	Denis Corr	Consultant
McKibbon Wakefield Inc.	George McKibbon	Consultant
ArcelorMittal Dofasco	Ed Cocchiarella	Manager, Environmental Management System
US Steel Canada/HEIA	Andrew Sebestyen	Environment Manager
City of Burlington	Fleur Storace-Hogan	Environmental Projects Coordinator
Green Venture	Thom Oommen	Air & Transportation Coordinator
	Laurel Harrison	Clean Air Fair Manager
Environment Hamilton	Don McLean	
Liberty Energy	Trevor Pettit	Consultant

Advertising and Promotions

The objectives for the promotion and advertising campaign of the 2008 Upwind/Downwind Air Quality in Hamilton were to expand the number of attendees and raise awareness of the event as an opportunity for the public and professionals to share best practices, to network, to learn from others and to increase international presence. In order to catch the attention of potential delegates internationally, nationally and locally, advertising of the 2008 conference began a year in advance of the Conference in February 2007.

An advertising strategy was developed in order to target interested parties. E-mail notifications and flyers were sent to previous Conference attendees, Ministry of the Environment, City of Hamilton and GTA Clean Air Partnership, Hamilton Chamber of Commerce e-mail lists ; Conference Notifications to the GTA Clean Air Partnership, the Federation of Canadian Municipalities, and the Association of Municipalities of Ontario; Conference event listings online at a number of websites that announce upcoming Conferences; Notices to non-government organizations, industry and governments in Southern Ontario, federally and in the states of Michigan, Ohio, New York, Pennsylvania and provinces of British Columbia and Alberta.

The Ontario Professional Planners Institute advertised the Conference through 2 Email blasts to members and through on-line listing of events; On-line notification on McMaster University MIEH website; Colleges and university students in Southern Ontario were notified by Email through contact at University Departments and Green NGO campus groups; High school students were notified though contacts at the Hamilton Wentworth Public School Board, the Hamilton Catholic School Board, the Hamilton Independent School Board, through a table at the Living for the Environment High school Conference at Mohawk College in April 2007, invitations were sent through school's courier systems, and presenting to the Catholic School Boards Social and Environmental Committee.

City Staff were notified by Employee Bulletin at the City of Hamilton; Councillors and local politicians were notified through Invitations; Councillor Bratina announced the Conference at Council and notices were posted on Councillor McHattie's and the mayor's websites; Advertisement appeared in the Hamilton Spectator and in the Brabant papers (Stoney Creek News, Ancaster News, Dundas Star News, Flamborough Review, Hamilton Mountain News, and Glanbrook Gazette), as well as H Magazine; Advertisement also appeared in SNAP Hamilton, and the events listings of View Magazine, Hamilton Magazine and the Hamilton Spectator.

Conference Posters were distributed to Municipal Centers, Arenas, and Libraries in Hamilton and in Burlington; Tables and displays on the Conference were held at the Canadian Institute of Public Health Inspectors Planning Conference in Sudbury in October 2007 and the Healthy Living Green Living Lifestyles show in Burlington in January 2008; and . Sandwich boards and advertising Signs were located in the lobby of 119 Main Street, in the City Center and on the corners of Main and King Street during the Conference.

Media notifications to H magazine View Magazine, Hamilton Magazine, Hamilton Spectator, the Brabant Papers, Cable 14, CHCH News, and the Canadian Newswire; Web ad on Natural Life Magazine website. H magazine and Raise the Hammer wrote articles on the Monday Night speaker; The Hamilton Spectator wrote three articles on the Conference and speakers; Television coverage by CHCH News and Rogers Cable 14; Radio coverage an interviews on K-LIte FM, CFMU, and CHMLAM.

Funding

The total cost of the 2008 Upwind/Downwind Conference was $52,000. Moreover, the total revenue was $59,715, which included $19,400 from registration fees, $815 from exhibitors and $39,500 from funding (see **Table 3**). City of Hamilton provided staff resources to procure sponsorship, coordinate logistics, facilitate meetings, process registration and promote the conference agenda. Planning Committee members helped confirm speakers and facilitate conference sessions. Volunteers helped on the registration desk during the conference.

Table 3: 2006 Upwind/Downwind Conference Funds/Grants

Organizations	Donation
Hamilton Public Health Services	$10,000
Environment Canada	$8,000
Golder Associates Inc.	$5,000
Ontario Ministry of the Environment	$5,000
Health Canada	$5,000
Ontario Provincial Planners Institute	$3,000 **in-kind**
Hamilton Industrial Environmental Association (HIEA)	$2,500
Mohawk Collage	$1,000
Liberty Energy	$1,000
Rotek Environmental Inc.	$500
McKibbon Wakefield Inc.	$500
McMaster Institute of Environment and Health	$500
RWDI Air Inc.	$500
Total	**$39,500**

Responses of Conference Attendees

The 2008 Upwind/Downwind Conference received very positive feedback. A total of 23 evaluations were submitted. When asked to rate their overall satisfaction with the conference, 10 individuals chose ‘satisfied” while 12 picked “very satisfied” and 1 individual was “somewhat satisfied”. Not one individual indicated they were “not at all satisfied”. For 19 respondents, the conference “met their expectations”; only 3 conference delegates did not feel that the conference met their expectations. One individual created their own category by stating that the conference “maybe” met their expectations. Poor Audio, more local topics and action orientated presentations were common complaints.

Appendix E: Glossary of Terms

Abatement – process of putting an end to, or reducing, the amount of harmful substances released into the environment.

Air Quality Health Index (AQHI) – a health protection tool that is designed to help you make decisions to protect your health by limiting short-term exposure to air pollution and adjusting your activity levels during increased levels of air pollution. The index is calculated based on the concentrations of selected air contaminants and their relative health impacts.

Air Quality Index (AQI) - an indicator of air quality, based on hourly pollutant measurements of some or all of four air pollutants: sulphur dioxide, ozone, nitrogen dioxide, and fine particulate matter. However, only the highest relative value of one these four is used to calculate the AQI by the Ministry of the Environment.

Asthma – a respiratory condition in which the airway constricts when triggered; go to The Asthma Society of Canada at www.asthma.ca / Canadian Lung Association at www.lung.ca for more information.

Benzene – a volatile organic compound (VOC) found in coke oven emissions and gasoline that is capable of producing cancer in humans.

Benzo[a]pyrene (BaP) – pollutant capable of causing cancer in animals and humans; BaP is one member of a large class of chemical compounds called polycyclic aromatic hydrocarbons (or PAH). BaP and other PAH are products of incomplete combustion of carbonaceous fuels such as wood, coal, oil, gasoline, diesel fuel, etc. BaP and PAH are major constituents of coal tar and coke oven emissions.

Black fallout – black particulate matter that has fallen to earth after being emitted into the air.

Carbonaceous fuels – fuels that are rich in carbon.

Cardiovascular – refers to the heart and associated blood vessels; see 'Backgrounder on Cardiovascular Disease' on page 8.

Climate change – refers to the long term change in average weather patterns resulting from the release of substantial amounts of greenhouse gases (GHGs), such as carbon dioxide, methane, nitrous oxide, etc. into the planet's atmosphere. These emissions alter the chemical composition of the atmosphere, resulting in intensification of the earth's natural greenhouse effect.

CO – carbon monoxide; a toxic, colourless, odourless, and tasteless gas; produced as a by-product from the combustion of carbon-containing compounds.

Criteria Air Contaminant (CAC) – an air pollutant such as PM_{10}, $PM_{2.5}$, SO_x, NO_x, VOC, CO, and NH_3 (Ammonia).

eCO_2 – a generalized measurement of the global warming impact of emissions based on the most common greenhouse gas, CO_2.

Fugitive dusts – dusts that arise from non-point sources including road dusts, agricultural dusts, dusts that arise from materials handling, construction operations, outdoor storage piles, etc.; fugitive dusts are significant sources of fine particulate matter.

Greenhouse gases (GHGs) – gases in the atmosphere that reduce the loss of heat into space and therefore contribute to increasing global temperatures through the greenhouse effect.

Idling – when vehicles are left running while parked; produces pollution which contributes to problems like climate change and smog.

Inversion – see 'Temperature Inversions, Traffic Emissions & Health Impacts' on page 29.

Micron – shortened term for micrometre; one millionth of a metre.

$\mu g/m^3$ – micrograms per cubic metre; a measure of the concentration of a chemical or substance in the air.

Mobile monitoring – air sampling protocol used to make continuous measurements of air levels of contaminants using monitoring equipment that is moveable or mobile. Traditional air monitoring uses air monitoring equipment that is fixed in one location. Mobile monitoring allows measurements of air emissions to be performed at various locations while traveling across a City or parts of a City. The mobile monitoring unit can also be parked to make longer term measurements at one or more locations.

MOE – Ministry of the Environment; for more information visit: www.ene.gov.on.ca

Mobile sources – vehicles (cars and trucks) that emit pollutants into the air.

National Pollutant Release Inventory (NPRI) – Canada's legislated, publicly-accessible inventory of pollutants released, disposed of and sent for recycling by facilities across the country; for more information visit www.ec.gc.ca/pdb/npri/npri_data_e.cfm.

NO_x – oxides of nitrogen; nitrogen dioxide (NO_2) and nitric oxide (NO) are the two nitrogen oxides that are classified as common air contaminants. NO is released directly by vehicles and can be used as a tracer for vehicle combustion emissions. NO is readily converted into NO_2 in the atmosphere.

O_3 – Ground-level ozone; component of smog; severe lung irritant; generated when combustion emissions such as oxides of nitrogen and volatile organic compounds react in the presence of sunlight, via a complex set of chemical reactions.

Plume – a form or shape of air pollutant emissions in the air (e.g., emissions from an industrial stack, vehicle exhaust form a tailpipe, etc.) that may be visible to the human eye or invisible depending on the mixture of air pollutants.

PM_{10} – inhalable particulate; airborne particles that have mean aerodynamic diameters of 10 µm (micrometres) or less; has been clearly and consistently linked to respiratory and cardiovascular health impacts in humans.

$PM_{2.5}$ – respirable particulate; airborne particles with mean aerodynamic diameters of 2.5 µm (micrometres) or less; has been more strongly linked to health impacts than PM_{10}.

PM_1 – very small particulate; airborne particles with mean aerodynamic diameters of 1 µm or less.

Point of impingement – A defined point or points on the ground or on a receptor, such as nearby buildings, set at a defined distance from a facility, located outside a company's property boundaries, at which a specific limit for air pollutants must be met.

Polychlorinated biphenyls (PCBs) – a class of organic compounds that was used in electrical transformers and capacitors until its use was banned in the 1970's due to the toxicity of PCBs.

Polycyclic aromatic hydrocarbons (PAH) – chemical compounds emitted when carbon-based fuels such as coke, oil, wood, coal and diesel fuel are burned. Some PAH are known to be carcinogens. PAH are also major constituents of coal tar and coke oven emissions.

Ppb – parts per billion; one part per billion is one weight unit of chemical in one billion (10^9) weight units of water, soil, etc. For example, if you added 10 drops of vodka to the water in an average backyard swimming pool (16 feet by 32 feet containing 80,000 litres of water), the concentration of ethanol in the pool would reach an average concentration of approximately 1 part per billion.

Prevailing winds – trends in speed and direction of wind over a particular point on the earth's surface; upwind is the direction the wind is coming from; downwind is the direction that the wind is blowing toward.

Smog –the brownish-yellow haze that typically hovers over urban areas during the summer. Its two main contaminants are ground level ozone (O_3) and small airborne particles; the word comes from a combination of the words 'smoke' and 'fog'. Smog events can occur during any season of the year particularly due to inversion events.

Smog advisory – see 'What is a Smog Advisory?' on page 12.

SO_2 – sulphur dioxide; a respiratory irritant principally emitted by industrial processes.

Telecommute – a work arrangement whereby a worker can work anywhere using telecommunication technologies and avoid the daily commute to a workplace.

Total Reduced Sulphur (TRS) – a measure of the sulphur-containing compounds that are the basis of many of the odour complaints related to steel mill operations, particularly coke oven emissions, blast furnace emissions and slag quenching operations. At 10 parts per billion (ppb), many people can detect TRS as an odour similar to rotten eggs.

Total Suspended Particulate (TSP) – includes all particulate material with aerodynamic diameters less than about 45 micrometres (µm).

Trans-boundary air pollution – originating from sources in the mid-western United States, pollutants are brought to Ontario by prevailing winds.

Transportation Demand Management (TDM) – see 'What is Transportation Demand Management?' on page 42.

VOCs – volatile organic compounds; organic chemical compounds, some of which may have long or short term health effects. Sources of VOCs include enamel paints, solvents, spray cans, gasoline, etc.; major sources of VOCs are plants and trees.

Walkability – the measure of the overall walking conditions in an area; factors affecting walkability include, but are not limited to: land use mix, street connectivity, and residential density.

***Clean Air Hamilton*, June 2008**

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