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CleanAir HAMILTON

AIR QUALITY PROGRESS REPORT 2010

June 2011

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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.
- Over the past ten years, there have been constant improvements in air quality in Hamilton. These improvements have contributed to better health for citizens as well as improved perceptions of the City.
- Since the mid-1990s, decreases in the levels of all pollutants in Hamilton (except for the long-range pollutant, ozone) have been steady year over year. The percentage decreases over this time are significant in many pollutant categories as measured at the downtown air monitoring site; these include a 34% reduction in Total Suspended Particulate (TSP) levels, 9% in Inhalable Particulate Matter (PM_{10}), 34% in Respirable Particulate Matter ($PM_{2.5}$), 41% in Nitrogen Dioxide (NO_2), 50% in Sulphur Dioxide (SO_2), 99% in Total Reduced Sulphur odours, 69% in Benzene and 55% in PAH (Benzo[a]pyrene).
- Emissions from mobile sources (personal and commercial vehicles), home and industrial heating, road dust re-entrainment and fugitive dusts are the major local sources of pollutants to the air. Reductions in these sources must also be realized if we are to continue to make meaningful improvements to local air quality.
- Significant reductions in industrial emissions have been realized over the years but more needs to be done to achieve emissions levels that are in line with international best practices.
- Mobile air monitoring studies conducted in Hamilton have shown that higher pollutant exposures occur along arterial roads and major highways and at major intersections due to emissions from cars, light duty trucks and heavy-duty trucks. These studies have also shown that residential areas have much lower levels of pollutants from mobile sources.
- Air monitoring near the Red Hill Valley Expressway showed that vehicular emissions were localized along the expressway corridor; a mobile air monitoring study conducted in the neighbourhood surrounding the expressway showed no indications of impacts of emissions from vehicles using the expressway over and above the background levels experienced in that area of Hamilton.

- Expansion of the network of fixed air monitoring stations combined with continued mobile air monitoring is useful for identifying community "hot spots" in Hamilton and for enhancing our knowledge of local air emission sources and their impacts. This monitoring work assists in the development of policies and initiatives to reduce local emissions in communities and neighbourhoods.
- Health impacts of transportation-related pollutants should be considered in transportation planning, urban design and the location of parks and bicycle lanes in the City.
- The integration of air quality and land use planning is a complex issue. Awareness and understanding of issues around air quality, public health and land use are emerging. In Ontario, there is a lack of clear public policies and guidelines at the local or provincial levels to assist urban planners, developers, municipal officials and councillors in planning sustainable, energy-efficient, healthy communities.
- A well-conceived air quality health index provides the public with useful information about air quality conditions and strategies citizens can use to reduce their exposures to pollutants. Hamilton's Public Health Services in partnership with Clean Air Hamilton and Health Canada are piloting an air quality health index in Hamilton in the summer of 2011.
- Comprehensive Airshed Management areas have been proposed as strategies for improving air quality in communities across Canada. *Clean Air Hamilton* is interested in engaging with the Province to partner in the development of a place-based airshed management strategy for Hamilton.
- There are a number of sustainable transportation initiatives in the City. These range from car sharing, carpooling and driver and transit education to increased active transportation initiatives such as policies that encourage cycling and walking which help reduce air emissions and improve individual health. These initiatives should be encourages as they promote healthy lifestyles and reduce air emissions from transportation.
- Community greenhouse gas (GHG) emissions in 2008 were 12 million tonnes in Hamilton. Land use and transportation planning decisions should be made that are consistent with reductions in GHG emissions. Municipal and community involvement in reducing emissions of GHGs (from commercial and personal transportation sources, commercial and residential energy sources, etc.) is necessary to reduce climate change impacts.
- The City needs to maintain support for strategies and actions that will improve local air quality, reduce greenhouse gas emissions, and increase energy conservation. These strategies should be aimed at increasing the level of dialogue between and within community groups on the health impacts of poor air quality on society and the actions and lifestyle changes that will result in 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 greenhouse gas emissions, 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 2010 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 2010 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.

Over the past ten years, there have been dramatic improvements in air quality in Hamilton. These changes will have contributed to better health for citizens as well as improved perceptions of the City.

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.

In 1997, the HAQI made 25 recommendations to improve air quality in Hamilton. Over the past 11 years, *Clean Air Hamilton* and partners have made significant progress in addressing and responding to these, recommendations (see the **2008 Clean Air Hamilton Report Appendix A** for a detailed review).

Air quality reports prepared and published by the HAQI in 1997 and 1998, as well as the collection of *Clean Air Hamilton* Annual Reports from 2000 to 2009 are available here: www.cleanair.hamilton.ca/default.asp?id=71

1.2 Impact

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 (**www.cleanair.hamilton.ca**) receives over 1,500 hits a week, and inquiries about *Clean Air Hamilton's* activities are received regularly from organizations and individuals in Ontario, Canada, the U.S. and from around the world. Many innovative projects have emerged, directly and indirectly, from *Clean Air Hamilton*.

On October 2009, the *Clean Air Hamilton* website was relaunched and redesigned to allow easier access for individuals seeking information on air quality, health impacts, climate change, community activities and research on air quality. The website is updated on a regular basis to provide current information and news to the community on air quality. In 2010, new information on the website included topics on wood burning stoves, electric vehicles, odour reporting and protecting your health was added to the web site.

On Monday, February 22, 2010, 243 delegates attended the 2010 Upwind Downwind Conference. The Conference was hosted by *Clean Air Hamilton* and the City of Hamilton, and was held at the Hamilton Convention Centre. The Conference title, “Air Knows No Boundaries” aptly reflected the Conference goals of sharing practical solutions for air quality improvement, discussing transboundary pollution issues and highlighting the potential impacts of climate change in the fields of health, planning, municipal action and partnerships. A free exhibition called the “Green Solutions Marketplace” was organized to accompany the Conference. This exhibition was also open on Sunday, February 21, 2010 and featured a number of speakers including Jay Ingram, co-host of the Discovery Channel’s ‘Daily Planet.’

Members of *Clean Air Hamilton* have provided City Council, City Staff and the community with science-based information to help them make better decisions that protect air quality. Clean Air Hamilton has provided support for issues important to our community including transportation (e.g., Eco driver, Totally Transit, Hamilton Truck Route Study, Rapid Transit), planning (e.g., mobile monitoring, Urban Official Plan), air monitoring (e.g., mobile monitoring, Hamilton Air Monitoring Network), and air quality education and awareness (e.g., 2010 Upwind Downwind Conference, High School Heroes, and the *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 of *Clean Air Hamilton*

Clean Air Hamilton has identified the following goals as a guide for future actions:

- To improve air quality throughout the City and 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 galvanize broad-based support for a process and an action plan to improve air quality;
- To provide information and advice that decision-makers value;
- To influence decision-makers to choose sustainable practices and alternatives; and
- To affect behavioural changes to improve air quality.

2.3 *Clean Air Hamilton* Membership 2010

Dr. Brian McCarry (Chair)	McMaster University
Paul Barrett	Green Venture
Stephen Brotherston	Citizen
Michael Brown	ArcelorMittal Dofasco
Tom Chessman	Public Works, City of Hamilton
Dr. Denis Corr	Corr Research/Rotek Environmental
Heather Donison	Planning & Economic Development, City of Hamilton
Jordan Fysh	Green Venture
Frank Harrison	US Steel Canada
Chris Hill	Public Works, City of Hamilton
Bill Janssen	Planning & Economic Development, City of Hamilton
Zobia Jawed	Ontario Ministry of the Environment
James Kaspersetz	Citizen
Alan Kirkpatrick	Public Works, City of Hamilton
Mathew Lawson	Public Health Services, City of Hamilton
Brian Lennie	Horizon Energy Solutions Inc.
Karen Logan	Hamilton Industrial Environmental Association
Lynda Lukasik	Environment Hamilton
Samantha Lundy	Horizon Utilities
Dr. Ted Mitchell	Citizen
Brian Montgomery	Planning & Economic Development, City of Hamilton
Hossein Naghdianei	Environment Canada
Sally Radisic	Public Health Services, City of Hamilton
Andrew Sebestyen	US Steel Canada

Carl Slater	Ontario Ministry of the Environment
Mark Smithson	Ontario Ministry of the Environment
Peter Topalovic	Public Works, City of Hamilton
Lorraine Vanderzwet	Mohawk College
Julie Wallace	Citizen
Steve Walsh	Public Health Services, City of Hamilton
Pete Wobschall	Green Venture
Anna Yusa	Health Canada

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 undertake research 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: cleanair@hamilton.ca

2.4 Strategic Activities - 2011 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; produce 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 in energy efficiency and renewable energy, and by encouraging reductions in wasteful use of electricity. This promotion will assist the public and decision-makers to make the connection between climate change mitigation and air quality improvements.
- **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.

The 2010 *Clean Air Hamilton* Report presents the actions undertaken in 2010 by members of *Clean Air Hamilton* and our partners to address these strategic issues. Details of these activities can be found in **Appendix A**.

2.5 Financial and In-Kind Contributions

The City of Hamilton currently provides an annual contribution of $80,000/year in support of *Clean Air Hamilton* and its activities. This money is leveraged by the funding provided by partner institutions and by the in-kind support of community volunteers who donate their time and expertise. In 2010, *Clean Air Hamilton*'s partners and volunteers provided $192,350 in in-kind and financial support. *Clean Air Hamilton*'s 2010 financial report is available in **Appendix B**.

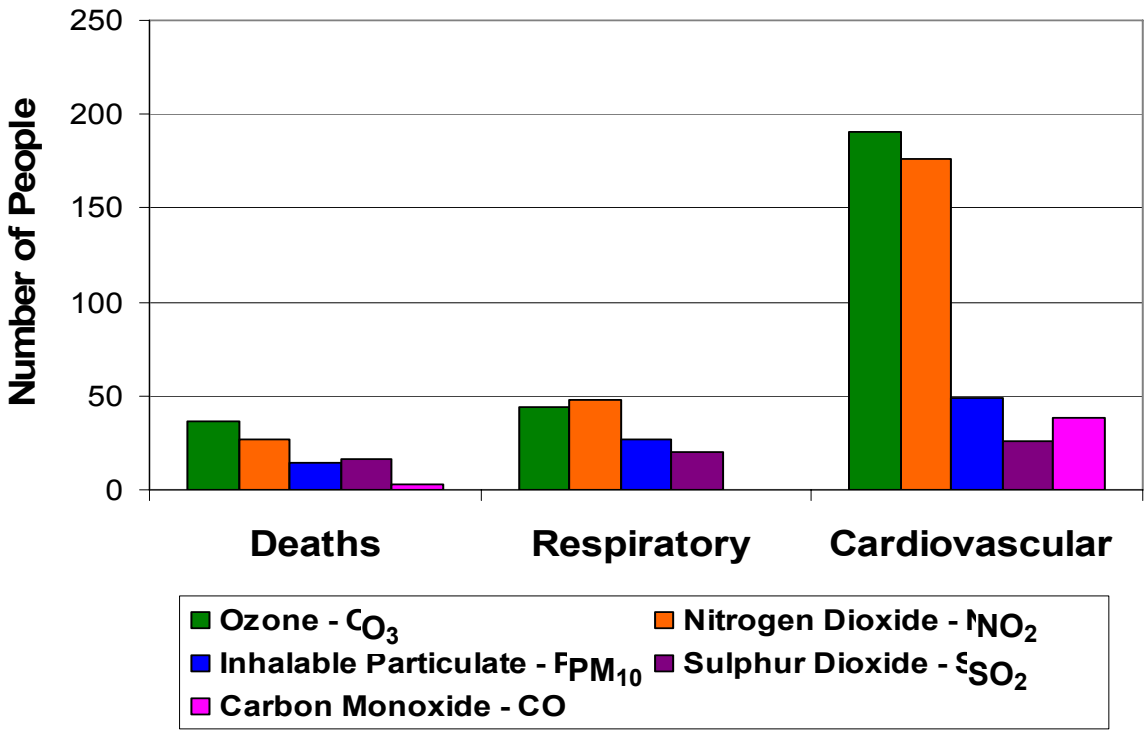
3.0 Air Quality in Hamilton

3.1 Air Pollution Health Impacts – Hamilton and Ontario

While the correlation between exposure to air pollution and related mortality is well established (OMA, 2005), current research is seeking to better understand and quantify the impacts on a range of targeted health risks and their association with specific air contaminants.

Poor air quality is associated with a range of health impacts including eye, nose and throat irritation, breathing difficulties, and cardiovascular disease (refer to the **2007 Clean Air Hamilton Report Section 3.1** for a detailed review). *Clean Air Hamilton*'s 2003 Air Quality Health Assessment Study estimated that 5 key air pollutants – nitrogen dioxide (NO_2), ground level ozone (O_3), fine particulate matter (PM), sulphur dioxide (SO_2) and carbon monoxide (CO) contribute to approximately 100 premature deaths and 620 hospital admissions in Hamilton each year.

Figure 1: Health Impacts by Pollutant in Hamilton, 2003

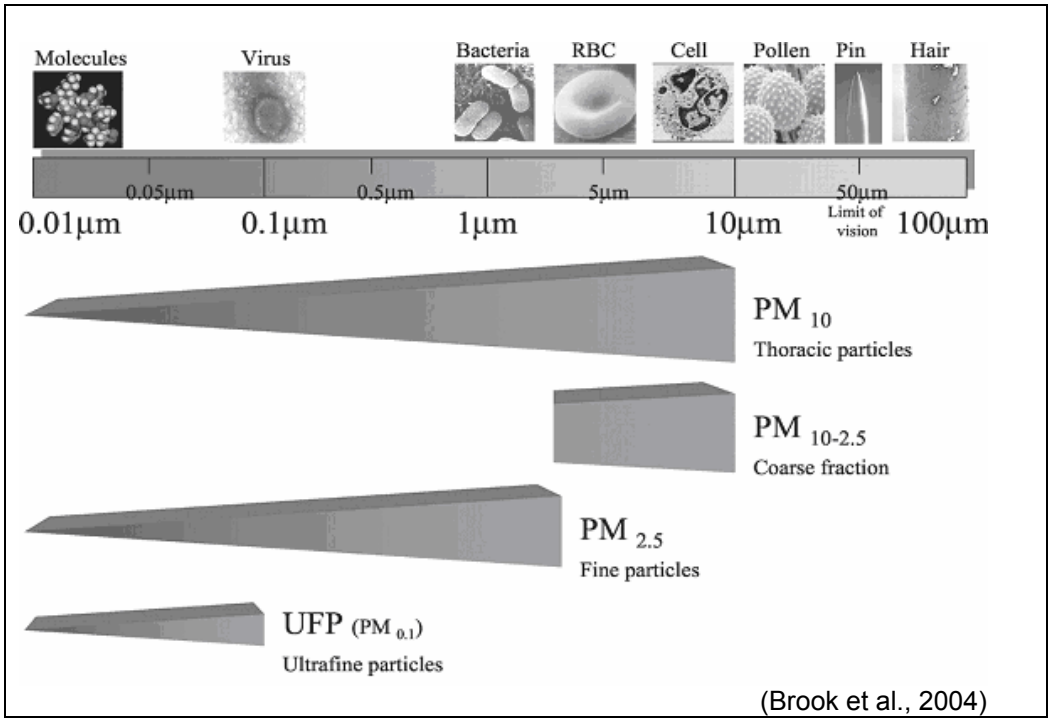


There has been a renewed interest of late in the health impacts of fine particulate matter (PM) and recent research has demonstrated how particle size and the chemicals associated with these particles are linked with specific health effects outcomes (Haynes, 2010). However, notwithstanding the renewed focus on PM exposures, it is important not to lose sight of the fact that PM is responsible for only about a portion of the health impacts associated with ambient air exposures in humans. It is also worth remembering that both gaseous pollutants, NO_x (NO plus NO_2) and SO_2, undergo chemical conversions in the atmosphere to afford nitrate and sulphate particulate; indeed, during the summer months about one-half of all fine particulate in the air is composed of nitrate and sulphate salts. The health effects of these salt particulates are considered as particulate health effects, not gaseous health effects.

Particulate matter (PM) is a general term used to describe a heterogeneous mixture of liquid and solid particles smaller than 45 µm (micrometers). Unlike other criteria air pollutants (NO_2, SO_2, CO, O_3), PM is qualified by its size rather than by its chemical composition. To understand the associated health effects, PM is classified based on the upper limit of the mean aerodynamic diameter of the particles. The term "Total Suspended Particulate" (TSP) refers to all particles with mean diameters less than 45 µm. 45 µm is just about the smallest particles size we can observe with the naked eye. Particles with mean sizes of 10 µm or less are classified as PM_{10}. PM_{10} is a subset of TSP and usually constitutes 40-50% of the mass of TSP. Similarly, particles with mean diameters less than 2.5 µm, 1 µm and 0.1 µm are identified as $PM_{2.5}$, PM_1 and $PM_{0.1}$, respectively (see **Figure 2**). Within size categories of PM (for example, PM_{10} vs. $PM_{2.5}$), it is important to remember that chemical composition still plays a role with regards to health outcomes.

PM can originate from dusts and soil particles, smoke, and pollen. Significant anthropogenic sources of PM_{10} include re-suspended road dusts and dusts associated with unpaved industrial work sites while particles from sources such as vehicles, other combustion sources and fires fall in the finer classifications $PM_{2.5}$ and even PM_1 (Newbold, 2009). The origins of the fine particles in urban areas tend to be anthropogenic combustion sources, primarily gasoline and diesel fuel combustion emissions (Abelsohn, 2002). This finding was recently corroborated by Guo et al. (2010), who concluded, "outdoor $PM_{2.5}$ reflected the impact of vehicular emissions".

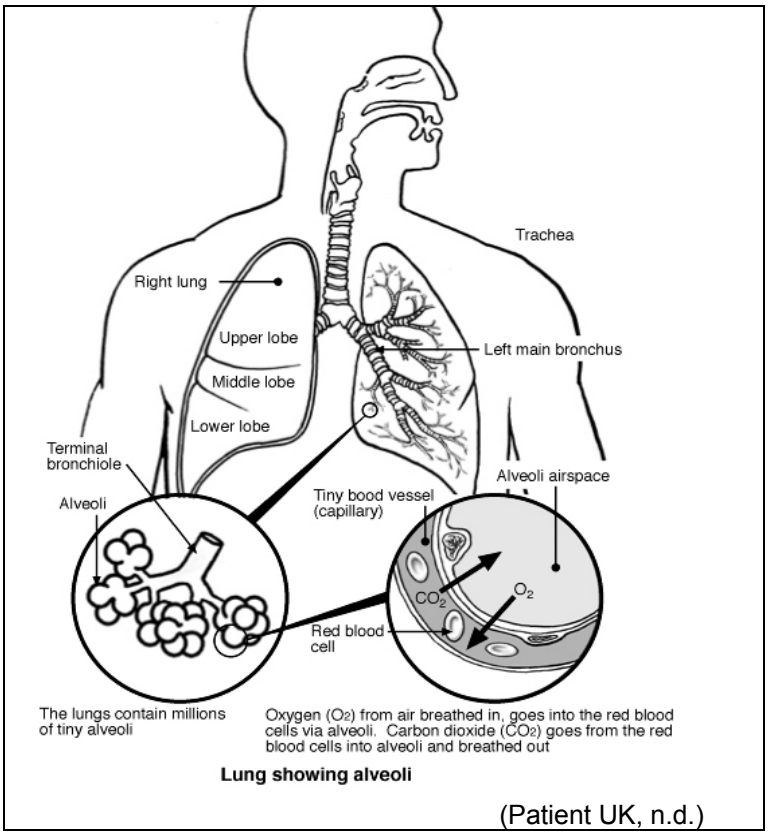
Figure 2: Comparison of Relative Sizes of Particles



(Brook et al., 2004)

PM_{10} are sufficiently small that they can be inhaled and this size range is called 'inhalable particulate.' $PM_{2.5}$, also often called 'fine particulate' or 'respiratory particulate,' when inhaled, travels deeply into the lung, reaching the alveoli, the air-blood gas exchange sacs throughout the lung (refer to **Figure 3**). Lastly, ultra-fine particles (or $PM_{0.1}$) readily pass through the alveoli and enter the bloodstream (HPHS, 2009).

Figure 3: Lung Deposition of Particulates



(Patient UK, n.d.)

Recent research findings suggest that the fine particulate fraction ($PM_{2.5}$) is more strongly associated with cardiovascular disease (Laumbach & Wood, 2010), and lower birth weights in newborns (HPHS, 2009), whereas PM_{10} (and SO_2) is more closely associated with the risk of childhood asthma (Clark et al, 2010). Exposure to the coarser fraction of PM_{10} (i.e., $PM_{10-2.5}$) can weaken natural immune responses, resulting in higher rates of respiratory infections (HPHS, 2009). The particle size does not, however, exclusively influence the health effects. The different fraction sizes (PM_{10} & $PM_{2.5}$) generally have different chemical properties, and different exposure patterns (Lippmann, 2010). One recent study found a stronger association between $PM_{2.5}$ and cardiovascular disease when the constituents of the PM were organic carbon or sulphates (Haynes, 2010). Carbon-based PM may also carry carcinogenic chemicals like benzo[a]pyrene, and trace metals like lead, cadmium and nickel are more concentrated in the fine fraction of PM (Newbold, 2009) than the coarser fraction. A number of studies conducted in different geographic locations have detected differential health impacts from PM depending on chemical composition (Brook, 2010). Further research regarding the chemical components of PM and their potential health effects is needed. It is becoming clearer that the specific chemical composition of PM as well as its particle size, may have varied and differential impacts for health status. (Lippmann, 2010).

Despite the fact that air quality has steadily improved across Ontario over the past 15+ years (Air Quality Ontario, 2010), measurable health impacts of ambient air exposures are projected to increase, largely due to the increased knowledge about these health effects and aging of the population (Canadian Medical Association, 2008). Public Health Services (PHS) has a critical role to play with regards to evidence-based education, advocacy and ensuring targeted messaging is available and accessible. Consequently, it is important for Public Health departments not only to advocate for policies that can reduce emissions, but also to identify the most vulnerable populations, and to ensure these individuals are educated on adaptive behaviours that can minimize individual exposures to all pollutants, including PM.

3.2 Air Monitoring - Hamilton

Air monitors collect outdoor air quality data across the City of Hamilton and these data are compared to provincial and federal air quality standards. Other uses of these data are to identify sources of air pollutants, and to evaluate the potential impacts of air emissions on human health.

Traditional air quality monitors are located at fixed locations across the City. In Hamilton, there are two fixed air monitoring networks: (i) the Provincial Air Quality Index (AQI) monitoring stations (situated in West Hamilton, on the Mountain and Downtown), which are operated and maintained by the Ontario Ministry of the Environment (MOE), and (ii) the Hamilton Air Monitoring Network (HAMN) stations, which are part of an industry-funded network with monitoring stations located in the industrial area of Hamilton. Two of the MOE's AQI sites also provide space for equipment owned by Environment Canada as part of its National Air Pollution Surveillance Station (NAPS) network.

Hamilton is the pioneer in Canada in undertaking a program of mobile air quality monitoring. The mobile monitoring van can roam city-wide to measure local air quality conditions at street level. Mobile monitoring began in Hamilton in 2004 as a pilot project funded by the City and *Clean Air Hamilton*. The van and equipment are the result of a partnership between Clean Air Hamilton, MOE, Environment Canada and Rotek Environmental.

Additional air monitoring is conducted by the local MOE Office and includes routine particulate monitoring and short-term survey work. The MOE continued to assess particulate impacts around two operations, one in Flamborough and one on the South Mountain. The MOE also funded continuous particulate monitors to the Hamilton Air Monitoring Network (HAMN).

Air monitoring in Hamilton tends to be focussed on the east end industrial sector. Through mobile monitoring in 2005, additional industrial areas in Hamilton were identified (see **Section 3.5**) that are not actively monitored or connected to the existing monitoring network. In addition, mobile monitoring and health research (see **Section 5.1**) have identified gaps in the capturing of air pollution data and associated health impacts in neighbourhoods and transportation corridors across Hamilton. There is recognition that expansion of the fixed network combined with continued mobile monitoring can identify community "hot spots" in Hamilton and enhance the knowledge of local air emission sources, as well as, their impacts, and assist in the development of policies and initiatives to reduce local emission sources in the community.

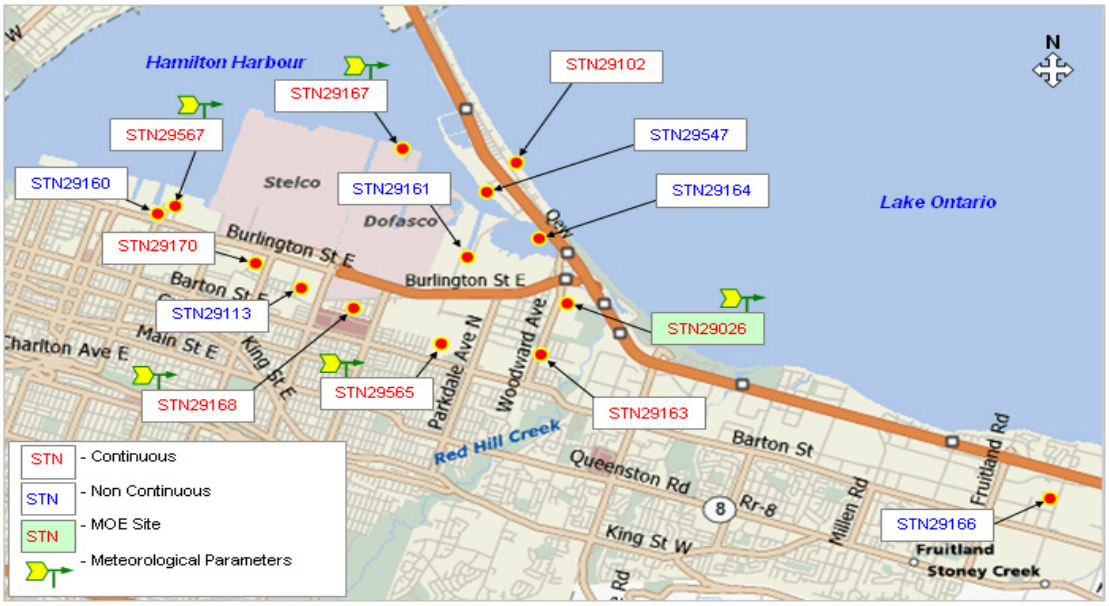
The air quality data from the MOE's three AQI stations are available here:
www.airqualityontario.com/reports/summary.cfm

The Hamilton Air Monitoring Network (HAMN) is an industry-funded, local air monitoring network, comprised of 22 local companies who have committed to the assessment of air quality in Hamilton on a regular basis (**Table 1**). A map of the air monitor network is shown in **Figure 4**. On-going operating costs and expenses related to the upgrading of air monitoring equipment and instruments are borne by industries within the network. The network provides air quality reports to the Ontario Ministry of the Environment (MOE) on a regular basis. All air quality data and reports are audited by the MOE to ensure a consistent and high quality data. The MOE also conducts regular audits of the equipment at the HAMN sampling sites.

Table 1: HAMN Participating Industries

Bartek Ingredients	MultiServ- ArcelorMittal Dofasco Inc.	Liberty Energy Inc.
Baycoat Ltd.	MultiServ- U.S. Steel Canada	U.S. Steel Canada – Hamilton Works
Bung Canada	Lafarge Canada – Jones Road	ArcelorMittal Hamilton East
City of Hamilton	Lafarge Canada - Victoria	Ruetgers Canada
Shell Canada Ltd.	Lafarge Hamilton Slag	Vopak Terminals of Canada Inc.
ArcelorMittal Dofasco Inc.	Triple M Metal LP	Columbia Chemicals Canada ULC
Federal Marine Terminals	Newalta	Westway Terminal Canada
Biox Canada Ltd.		

Figure 4: Map featuring the Hamilton Air Monitoring Network



In June 2009, a website providing the public access to real-time air monitoring data collected by the HAMN was launched (**www.HAMNair.ca**). This website was developed as a partnership between *Clean Air Hamilton*, HAMN, the City and the MOE.

3.2.2 Mobile Monitoring

Between late 2004 and 2009, mobile monitoring surveys were undertaken for *Clean Air Hamilton* to obtain a comprehensive picture of the air quality across the City of Hamilton. In particular, air quality and health impacts due to traffic emissions and atmospheric inversions conditions were studied (see **Section 5.1**). Recent mobile monitoring studies from around the world have shown that the short-term peak exposures experienced near air emission sources can have serious detrimental health impacts in some individuals.

Mobile monitoring data differs significantly from data collected at fixed air monitoring stations. Mobile monitoring vans can roam city-wide or measure local air quality conditions on the 'micro' scale; for example, emissions from cars and trucks along major roads and at traffic intersections result in significantly elevated levels of pollutants compared to levels measured on side streets or in residential areas. Mobile monitoring is very useful in gathering air quality data at locations with specific air quality issues. In other words, mobile air sampling at the "street level" reflects the exposures of individuals to these pollutants at ground level. Conversely, fixed air monitoring stations are deliberately located well away from major roads and known emission sources to avoid undue influence on the data by such sources. Fixed air monitoring stations give an accurate measure of the air quality at that location; these data are also meant to give a good indication of the ambient air quality throughout the local area.

The mobile monitoring vehicle is outfitted with a Global Positioning System (GPS) detector and modified to support a data acquisition system and a data storage system. Data can be collected using various real-time monitors on board the vehicle to measure nitrogen oxides (NO_x), sulphur dioxide (SO_2), airborne particulate matter (PM), and carbon monoxide (CO) simultaneously. **Figure 5** shows the mobile unit outfitted with the real-time air monitors. The data collection system is capable of simultaneously storing air pollutant data and GPS data. The GPS data is used in collaboration with an enhanced geographic information system (GIS) program to allow the mapping of air pollutant data locations.

Figure 5: Mobile Air Monitoring Unit and the Real-time Display on a Laptop Computer

3.2.3 Certificates of Approval and the Alternative Standards Process –

Ontario Regulation 419/05: Air Pollution – Local Air Quality (O. Reg. 419/05) is a key component of Ontario's plan to reduce industrial emissions of harmful pollutants and is the cornerstone of the Ministry of Environment's (MOE) efforts to protect local air quality. The regulation establishes air standard concentration limits for contaminants against which an industrial facility's emissions are assessed using air dispersion models and/or ambient monitoring. Ontario currently has air standards for 124 contaminants and guidelines for over 200 more. As decisions on new air standards are made, the regulation is amended to give them the force of law. Proposed standards for an additional eight contaminants – uranium, nickel, chromium and their compounds, benzene, polycyclic aromatic hydrocarbons (PAH), 1,3-butadiene, dioxins and dioxin-like compounds, and manganese and its compounds - were posted to Ontario's Environmental Registry in July 2009.

Certificates of Approval (CofA) are the main tool that the Ministry of the Environment uses to control emissions of contaminants into the air by industrial facilities. An approval is granted based on the specific facility and the controls proposed for the air emissions. This approval is issued if the facility and the controls are expected to only emit contaminants into the air below the concentration limits set out in O.Reg 419/05. Since a CofA is required before a facility can be built, the assessment and approval is often based on the modeling of air emissions to determine the air quality at any point off-property. Unless explicitly exempted, most industrial processes and equipment that discharge to the air require a CofA in order to operate.

What is a contaminant?

The term 'contaminant' is defined under the Environmental Protection Act as any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that causes or may cause an adverse effect. The definition of a contaminant is very broad. Examples include particulate emissions from a process, solvent emissions from a painting line, nitrogen oxides from combustion sources, or sound and vibration from a metal stamping operation. The Ministry of the Environment does not require that compounds have published criteria to be considered contaminants. Unless explicitly exempted, most industrial processes and equipment, and modifications to industrial processes and equipment that discharge contaminants require approval. Under O. Reg 419/05 heat, sound and vibration are now excluded.

While the CofA is based on the modeled prediction that air standards will be met, there could be circumstances where the operation of the facility or equipment is not able to demonstrate compliance with applicable air standards. If air standards are not met or if conditions on the CofA are not met, the Ministry of the Environment will take action to require that corrective measures be taken to bring the operation into compliance with air standards and CofA conditions.

For further information on air regulation and standards visit:
www.ene.gov.on.ca/en/air/ministry/index.php#ts

For information on Certificates of Approval (Air) visit:
www.ene.gov.on.ca/en/business/cofa/airnoise.php

Under O. Reg. 419/05, new or more stringent standards are phased in over time. The first of set of new or more stringent air quality standards for industrial facilities in Ontario took effect on February 1, 2010, with the next set to phase in on February 1, 2013. A facility that is not able to meet the standards within the prescribed timeline may request approval for a site-specific alteration of the air standards, while it implements an Action Plan of projects to reduce emissions and continuously improve. The MOE introduced the alteration of air standard (or alternative standards) process to acknowledge time, technical, and economic factors related to the significant adjustments and investments needed to comply with the standards (MOE, 2007). An altered air standard may be approved for a period of up to five years, or up to ten years in extenuating circumstances. Furthermore, O. Reg. 419/05 provides that a facility may also re-apply for site specific altered air standard.

According to Ontario's Environmental Registry (April 2010), 6 companies have requested altered air standards for a total of 8 facilities under the EPA, O. Reg. 419 for eight separate facilities (see **Table 2**).

Table 2: Ontario Companies who have Requested Alterations to an Air Standard under O.Reg. 419/05

Organization	Date of Request	City	Status
Royal Polymers Limited	December 2006	Sarnia	Plant closed during 2008. File closed.
Oxy Vinyls Canada Inc.	March 2007	Niagara Falls	Approval issued January 2009.
Vale Inco Limited	October 2008	Sudbury	Decision proposal posted in January 2011. Final decision pending.
ArcelorMittal Dofasco Inc.	October 2008 (updated September 2009)	Hamilton	Approval issued July 2010.
U.S. Steel Canada Inc.	October 2008 (to be updated with further information)	Hamilton	Decision on hold due to previous production stoppages and current labour issues.
U.S. Steel Canada Inc.	October 2008 (to be updated with further information)	Nanticoke	Efforts currently underway to update request. Final request application expected during 2011.
Xstrata Canada Corporation (Xstrata Copper Canada - Kidd Metallurgical)	October 2008	Timmins	Approval issued February 2010.
Xstrata Canada Corporation (Xstrata Nickel)	January 2011	Falconbridge	Application is under review.

A request for the alteration of an air standard must (at a minimum) include the following information:

- **Emission Summary and Dispersion Modeling (ESDM) Report** -results from a modeling/monitoring study, and an assessment of the magnitude and frequency of exceedence of the standards.
- **Technology Benchmarking Report (TBR)** -assessment and ranking of technical methods for reductions in contaminant concentrations and provide an assessment of feasible technologies.

- **Action Plan** -schedule of dates/timelines.
- **Public Consultation Report** – summary of the mandatory public meeting with the local community.

The request may also include:

- **Economic Feasibility Analysis (Optional)** -cost of technically feasible mitigation options, and comparison to the cost of reductions in off-property concentration of various options.

An important element of the alteration of standards process is public transparency. Therefore, the requestor for an alteration to an air standard must engage in public consultation efforts to ensure that:

- Stakeholders are aware of the barriers to the facility's ability to meet an air standard and any potential incremental health or environmental risks associated with altering the standard.
- Community members are given an opportunity to understand the barriers for the facility in meeting an air standards at this time.
- Stakeholders/Community members are given an opportunity to review the proposed Action Plan.
- Community members understand the regulatory framework and have an opportunity to comment on the proposal by the facility for an altered standard and the outcome reached by the facility in terms of corrective actions to address the issue, through the Environmental Registry.
- The community is given an opportunity to provide input into the risk-based, decision-making process.
- Stakeholders know where information is available and whom to contact for answers to their questions.

Both ArcelorMittal Dofasco Inc. and U. S. Steel Canada Inc. established community liaison committees (CLCs) in 2010. The CLCs include representatives from the Ontario Ministry of the Environment and Hamilton-area stakeholder organizations, and individual community members.

ArcelorMittal Dofasco's CLC began to meet quarterly to keep the community informed of the environmental implications (air, water, waste) of their operations. The CLCs include representatives of the Ontario Ministry of the Environment and Hamilton-area stakeholder organizations and individual community members. Meetings focus on advising on the alteration of standards process, the progress of the Action Plans proposed by the company to reduce emissions, and addressing concerns of the community.

Although U. S. Steel Canada's site-specific standard activities have been delayed as a result of production outages, its CLC began meeting to discuss actions to reduce emissions being taken under its Environmental Performance Agreement with the Ministry of the Environment as well as concerns raised by the community.

These CLCs are separate from the Hamilton Industrial Environmental Association's (HIEA) Community Advisory Panel (CAP) that has met since 1998 and acts as a direct link between industry, neighbourhood groups and individuals and local environmental community-based initiatives. HIEA represents twelve companies, including ArcelorMittal Dofasco and U.S. Steel Canada Inc., that aim 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.

For further information on ArcelorMittal Dofasco's CLC visit:
http://www.arcelormittal.com/hamilton/dofasco/bins/content_page.asp?cid=315910-1852-341131

For further information on HIEA Community Advisory Panel visit:
http://www.hiea.org/community-advisory-panel.aspx

In summary, if a facility receives approval for the alteration of an air standard, the facility is operating in compliance with O. Reg. 419/05. The altered standard becomes the legally enforceable standard for that facility for the time period of the approval. The decision on whether or not to approve a site-specific altered standard includes an extensive technology benchmarking assessment which compares the facility to other facilities and evaluates best available technologies or practices to minimize emissions. A site-specific altered standard approval can also include conditions relating to actions to be undertaken by the company to reduce emissions over the duration of the approval. O. Reg. 419 states that the altered air standard is only in effect if the facility is complying with the conditions imposed in the approval. There is also authority to issue a notice that revokes the approval of the altered air standard. Compliance and/or enforcement action is also possible. Ultimately, the goal of the air standard regime set out in O.Reg. 419 is continuous improvement of emissions that will occur as new technologies become available or economic circumstances change.

In 2011, the Ministry of Environment posted a notice on the Environmental Bill Registry proposing to replace the term "altered standard" with "site-specific standard". The Ministry feels the term "site-specific standard" more accurately reflects the basis of the standard and facilitates communication to stakeholders.

For further information on Alternative Air Standards visit:
www.ene.gov.on.ca/en/air/ministry/index.php#alt

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

Examination of the trends in ambient air quality in Hamilton over the last decade or so (see **Appendix C**) shows that there have been large reductions in the airborne levels of some pollutants. The ambient levels of pollutants, such as particulate material (PM_{10} and $PM_{2.5}$), nitrogen oxides (NO_x) and sulphur dioxide (SO_2) have decreased steadily over the past couple of decades. These reductions are the result of improved emissions performance of the vehicle fleet and of actions taken by companies within the industrial sector in Hamilton to reduce their emissions. Levels of other pollutants have seen real but more modest reductions over the last decade; for example, total suspended particulate material arising from transportation sources, the roadway system due to road dust resuspension and various other sources of fugitive dusts (refer to **Section 3.7**) has not shown as large a decrease as some other parameters. While year-to-year changes have often been incremental and have shown both increases and decreases, the overall trends since the mid 1990's have shown a decreasing trend.

The levels of Total Reduced Sulphur, Benzene and Benzo[a]pyrene showed increases in 2010 when compared to levels reported in 2009; however, the current concentrations are still well below the levels measured in the mid-1990s. The upward swing observed in the 2010 data may be attributed to increased activities in the industrial facilities in 2010 as the economic recovery came into play. Finally, the levels of ground level ozone (O_3) during the summer months have shown an upward trend. Essentially all of the O_3 measured in Hamilton is the result of emissions in the US Midwest; the O_3 created following release of these pollutants arrives in southern Ontario via long-range transport of pollutants from a number of US states.

When comparing recent levels of air pollutants in Hamilton to levels of the same pollutants in other southern Ontario communities over the past 16-20 years (see **Appendix C**), one notes that:

- The levels of nitrogen oxides (NO_x) in Hamilton have decreased in recent years and are now similar to other cities in southern Ontario but are not the highest;
- The levels of ground-level ozone (O_3) in southern Ontario during the summer months have varied significantly from year to year depending on the weather conditions in a given summer. Overall, there is an increasing trend over the past decade, primarily due to long-range transport from the US. O_3 levels in Hamilton are usually about the same as or lower than levels in other southern Ontario cities. Some rural areas of Ontario can experience rather high ozone levels; the highest levels of ground-level O_3 in Ontario are often observed at sites adjacent to large lakes, including Turkey Point, Simcoe and the Bay of Quinte;
- The levels of sulphur dioxide (SO_2) in Hamilton tend to be higher than in other southern Ontario communities due to higher emissions from 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 diesel-powered transport trucks;
- Hamilton is home to a large number of small, medium and large industries;

- Hamilton is located at the west end of Lake Ontario and is surrounded by the escarpment, a combination that brings unique meteorological challenges to the area. The local topography (i.e., the escarpment) and prevailing weather conditions contribute to conditions where air pollution levels are usually higher below the escarpment where there are more industries and higher density urban development. A few times a year certain unusual meteorological conditions can give rise to atmospheric inversion events, which may last from 2 to 12 hours. During these events, pollutant levels can rise dramatically for a short time. These events are most common in the spring and fall;
- Hamilton is also affected by transboundary air pollution (primarily ground-level ozone and air particulates from sources in the mid-western United States). In this respect, Hamilton is no different from many other urban areas, small communities and rural areas in southwestern Ontario.

3.4 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 that 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.

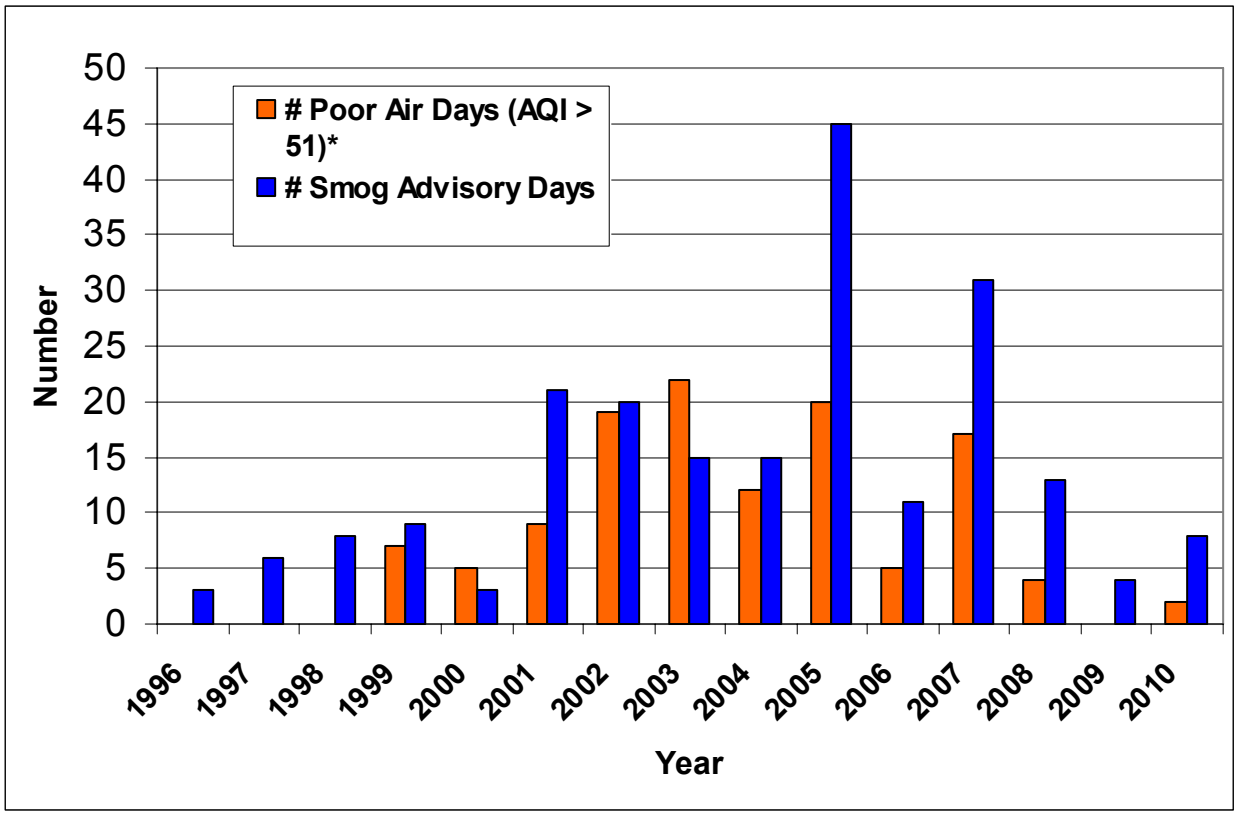
The AQI is determined based on the highest value of any one of six key air health-related contaminants – fine particulate matter ($PM_{2.5}$,) nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), total reduced sulphur compounds and ground-level ozone (O_3). In the summer months, smog days and air quality advisories are usually issued based on high ozone levels due to regional and long-range pollution sources whereas in the spring and fall smog alerts are issued primarily due to high levels of particulate matter due to local pollution sources.

Gaseous air pollutants such as nitrogen oxides and volatile organic compounds (NO_X, VOCs) can react under the influence of sunlight to afford a complex mixture of chemical products, including ground-level ozone (O_3). 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 2010, 8 smog advisory days were declared by the Ontario Ministry of Environment (MOE) for the City of Hamilton (see **Figure 6**). Only 2 of these smog advisory days were considered a poor air quality days (i.e., when the AQI > 51). One event was observed during the early evening of July 8, 2010 when ground level ozone was high for 5 hours in the Hamilton mountain area. During the November 12, 2010 event, particulate matter levels were high in the west and downtown Hamilton area for 2 to 5 hours.

Figure 6 below shows the numbers of smog advisory days and poor air quality days in Hamilton over the past eleven years. Poor air quality days are defined as days where the Air Quality Index (AQI) was greater than 51 for at least 1 hour during the day.

Figure 6: Number of Poor Air Quality Days and Smog Advisory Days in Hamilton between 1996 and 2010



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 (AQI). Prior to this date, smog advisories were issued only for exceedances in ground-level ozone levels.

Table 3: AQI Ranges (MOE)

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 AQI 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.
- The AQI scale consists of 5 categories. This categorization does not imply that air quality health effects should be viewed as increasing as discreet steps between the AQI categories. Rather, AQI values should be viewed as a continuum scale increasing from category to category. For example, an AQI value of 16 is different from an AQI value of 31; both values are in the 'good' category. However, an AQI value of 32 (in the moderate category) is marginally different from an AQI value of 31. Likewise, an AQI value of 49 reflects air quality that is much poorer than an AQI value of 32.

For further information, consult the MOE's Air Quality site: www.airqualityontario.com

3.4.1 Smog Response

When a smog advisory is declared, the Ministry of the Environment (MOE) notifies the City, who reduces its corporate emissions according to the Corporate Smog Response Plan. Actions undertaken by the City include encouraging staff to take transit, to car pool, and to walk or cycle to work. The City also notifies all contractors of the smog advisory and encourages them to adjust their work schedules accordingly, to reduce the use of cleaners, solvents and oil-based paints, to reduce the use of gas-powered equipment and vehicles, and employees may work from home where permitted.

There are also examples of local industries taking action to reduce their emissions on smog days throughout the year as members of the Hamilton Industry Environmental Association (HIEA). Many industries have smog action plans that notify their employees when a smog advisory has been called and to cut back production where required. In addition, some industries promote anti-idling of fleet and employee vehicles, encourage employees to bike or take transit to work where possible, reduce air-borne dust through increased sweeping and washing on site, and have energy conservation plans in place to improve air quality.

For more information on actions that individuals and employers can undertake to reduce emissions and improve local air quality, visit: www.cleanair.hamilton.ca/default.asp?id=23

3.4.2 Air Quality Health Index

Clean Air Hamilton and Hamilton Public Health Services have 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.

The Government of Canada has developed an Air Quality Health Index (AQHI) and has piloted this index in selected cities across Canada starting in 2008. Daily AQHI readings for Hamilton will be piloted on Environment Canada's website in June 2011. The Government of 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 MOE's AQI currently takes into account 6 pollutants: fine particulate matter ($PM_{2.5}$,) nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), total reduced sulphur (TRS) compounds and ground-level ozone (O_3). The AQI value is calculated based only on one of these six pollutants depending on which pollutant has the highest value on its scale. During the summer months when levels of ozone tend to be high, the hourly AQI value (which is reported by the MOE) will usually be determined by the concentration of ozone in the air. In the spring and the fall, the AQI level is driven by levels of $PM_{2.5}$.

We have known for many years that the impacts of air pollutants are additive. The AQI values cannot reflect these additive effects because the AQI is based on the single, highest pollutant only. A new air quality index was needed that could provide information on the cumulative health impacts of ambient air on the population.

The AQHI is calculated using a formula that combines the concentration and the relative health impacts of three pollutants: ground-level ozone (O_3), particulate matter ($PM_{2.5}/PM_{10}$) and nitrogen dioxide (NO_2). According to the Government of Canada, sulphur dioxide (SO_2) and carbon monoxide (CO) were removed from the formula as they were not associated with additional health risks once the three pollutants were taken into account. It makes sense to use multiple pollutant contributors in determining health effects impacts. This latter approach has been used in *Clean Air Hamilton*'s health studies.

Federal, provincial and municipal governments collaborated in order to develop the AQHI as a numeric tool that could be used by health professionals and the public to determine the health risks related to air quality at a given time. In **Figure 7** the AQHI scale is shown as a continuous, open-ended scale that ranges from low risk levels (one to three), moderate risk levels (four to six), high risk levels (seven to ten) and very high risk levels (greater than ten).

Figure 7: Air Quality Health Index Scale

(Source: Environment Canada, 2010)

Health messages are directed at two distinct populations – the "at risk" population and the general population (see Figure 8). The "at risk" population includes individuals at increased risk due to age or a variety of conditions; these include young children, the elderly, people with existing respiratory conditions (e.g., asthma, chronic obstructive pulmonary disease (COPD), including bronchitis, emphysema and lung cancer) and people with existing cardiovascular conditions (e.g., angina, previous heart attack, congestive heart failure, arrhythmia or irregular heartbeat). The 'general population' includes all other individuals who do not fall under the "at risk" population (Environment Canada, 2010).

Those in the "at risk" category are encouraged to monitor the AQHI more regularly since they are more sensitive to air pollution. These individuals are encouraged to develop their own self-calibration points on the AQHI scale. Most people understand how to use temperature, wind chill, UV Index and Humidex values prior to going outdoors and to make decisions based on these parameters. The AQHI value is another factor that individuals will need to calibrate themselves to in the near future.

Figure 8: Air Quality Health Index Health Messaging

Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population*	General Population
Low	**1 - 3**	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate	**4 - 6**	**Consider reducing** or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	**7 - 10**	**Reduce** or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	**Consider reducing** or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	**Above 10**	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce** or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation

(Source: Environment Canada, 2010)

The AQHI has already been piloted in the City of Toronto and the Halton, Peel, York and Durham Regions. The AQHI pilot was launched in the City of Hamilton in June 2011.

For further information on The Government of Canada's AQHI visit www.airhealth.ca

In the 2008 Clean Air Hamilton Report, the need to develop a community health smog plan was identified to increase communication to more vulnerable members of the community on smog days. The Smog Plan would provide physicians with information so that they could alert patients with respiratory or cardiac difficulties to take special precautions on smog days and smog advisory days. Hamilton Public Health Services has developed and implemented a smog communications plan and smog information campaign.

The campaign was divided into two phases over two years. Phase 1 of the campaign took place between May and December, 2010 and consisted of communication and promotion of health information to high-risk residents of the City of Hamilton about the health effects of exposure to air pollution. These communications provide general information about smog and its health significance, as well as, clear direction on actions that can be taken by individuals to help protect themselves from the effects during poor air quality events. Phase 1 included the development of partnerships with stakeholder organizations and the media and the development of print resources to be distributed to physician offices. On the public relations side, a website was launched. An advertising campaign that involving billboard and bus shelter ads, HSR ads, radio advertisements on Hamilton radio stations and newspaper ads designed to get this important message to the citizens of Hamilton was conducted.

Phase 2 of the campaign began in June 2011. The launch of the daily Air Quality Health Index (AQHI) readings for Hamilton on Environment Canada's website was the highlight event. A communications package on the AQHI was provided to answer questions (who, what, where, when, why and how) about the AQHI in plain language that citizens can understand and apply to their particular situation. This second phase will run through 2011 and seeks to leverage partnerships with local stakeholder organizations and the media; an advertising campaign and additional resources such as print; website, etc. will be used to continue to build an overall awareness and understanding of the AQHI with the citizens of Hamilton.

3.4.3 Local Poor Air Quality Notification

The Ministry of the Environment (MOE) has taken action to improve local air quality through having roughly 30 industries curtail emissions and control dust-generating activities on days when local air quality is poor, due to certain types of particles in the air (fine particulate matter) above a certain level. This system was developed by the MOE in partnership with the City of Hamilton Public Health Services, McMaster University Institute of Environment and Health, *Clean Air Hamilton* and the Hamilton Industrial Environmental Association (HIEA). Participating companies would be told when local air quality is poor due to fine particulate matter above a certain level. The companies then implement their plans to reduce local sources of fine particulate matter. This would help the local situation even though it will not change what is coming in from elsewhere (transportation, cross border/long range sources, upwind sources, etc.).

This action was put in place because it is possible for local air quality to be poor even if other areas are not. The main reason for this is a weather event known as a "temperature inversion". Normally, higher air is cooler than air near the ground. In a temperature inversion, higher air is warmer and acts as a cap over the ground level air. In this condition the air is usually very still. So due to the cap and the still air, any local emissions from industry, transportation or other sources tend to build up more than usual.

Inversions can be caused by very still air combined with the unique local geography of a sharp rise in elevation (the Niagara Escarpment), and the lake breeze from Lake Ontario. They are most likely to occur in spring and fall. In a typical year, Hamilton experiences 1-3 such events lasting 1-2 days; although events lasting up to 5 days have been known to occur.

The system of reporting on and taking action for local poor air quality is different from the MOE's Air Quality Index (AQI). The MOE's existing province-wide system of smog alerts is based on the AQI.

During a Local Poor Air Quality Event, industries would be asked to voluntarily undertake control measures and curtail activities with a strong focus on reducing emissions of particulate matter to air. This could include wetting or covering materials piles (e.g., coal, gravel), postponing materials-handling, increasing property and road cleaning, and curtailing some production processes. In 2010, a poor air quality event notification took place in Hamilton on November 12; this local poor air quality event lasted 5 hours.

The focus of the notification system is on fine particulate matter (PM) because there is a significant amount that is locally-generated. Therefore, any local efforts to reduce air pollution in general will be beneficial since all forms of locally-generated air pollution are trapped during inversions. When fine PM goes over a certain level, and when the forecast predicts inversion conditions will last for at least 6 hours, and when wind direction is such that emissions from the industrial core are being blown toward populated areas of the city, participating industries would be notified to implement their plans to reduce local sources of fine PM.

3.5 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 in the National Pollutant Release Inventory (NPRI). 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.

Figure 9: The Air Pollution Picture

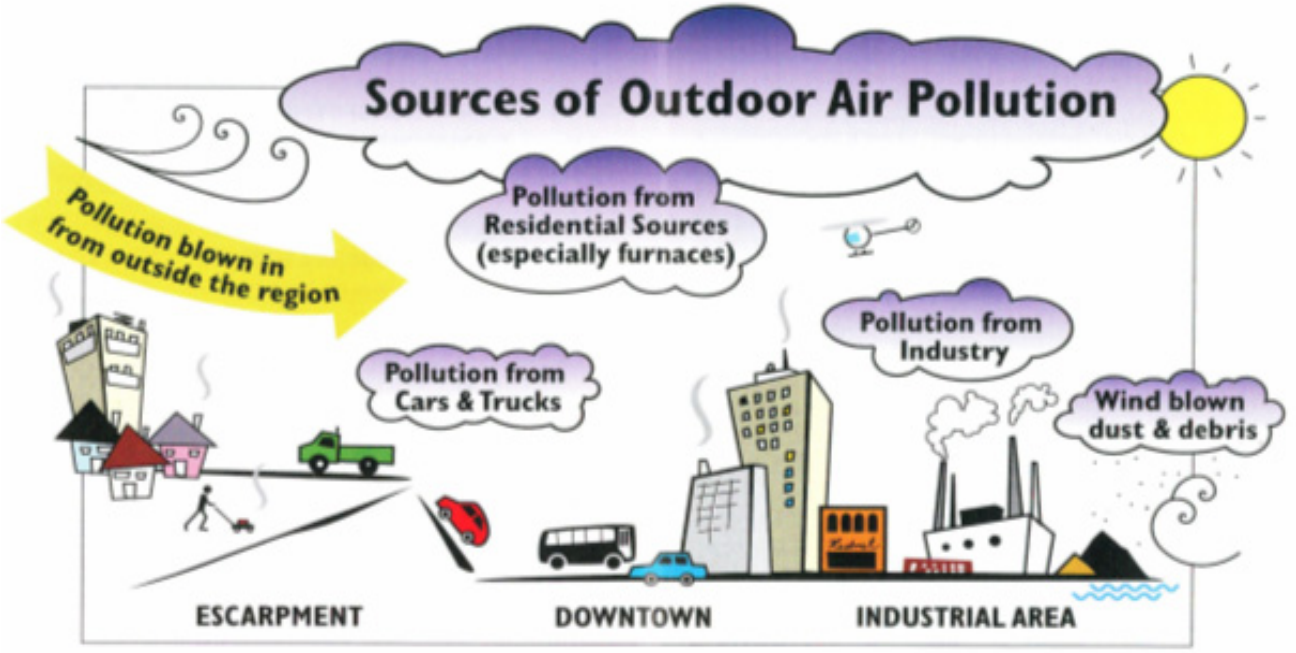


Table 4: NPRI Total Emissions by Source Category for Hamilton (2006)

Source Category	CO	SO_x	NO_x	PM_{10}	$PM_{2.5}$	VOC
Industrial	32,226	15,485	10,610	2,934	2,084	2,175
Fuel Combustion	7,387	428	1,513	1,135	1,119	1,498
Transportation	186,278	417	22,230	1,017	804	11,501
Incineration	39	24	11	0	0	7
Miscellaneous	37	0	0	138	138	6,495
Open Sources	54	19	36	69,452	8,917	611
Total Tonnes	**226,021**	**16,373**	**34,400**	**74,676**	**13,062**	**22,287**

Figure 10: NPRI Total Emissions by Contaminant and Source (2006)

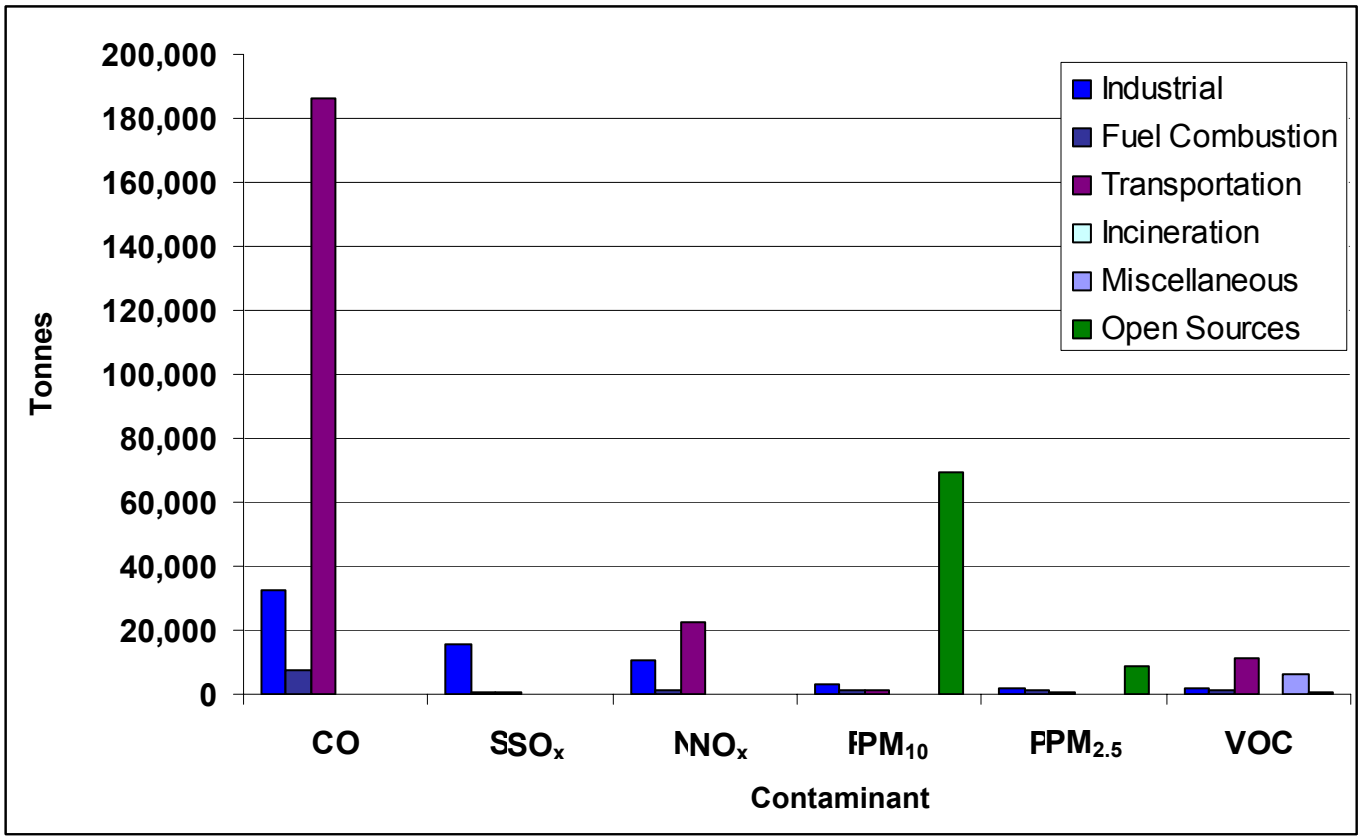
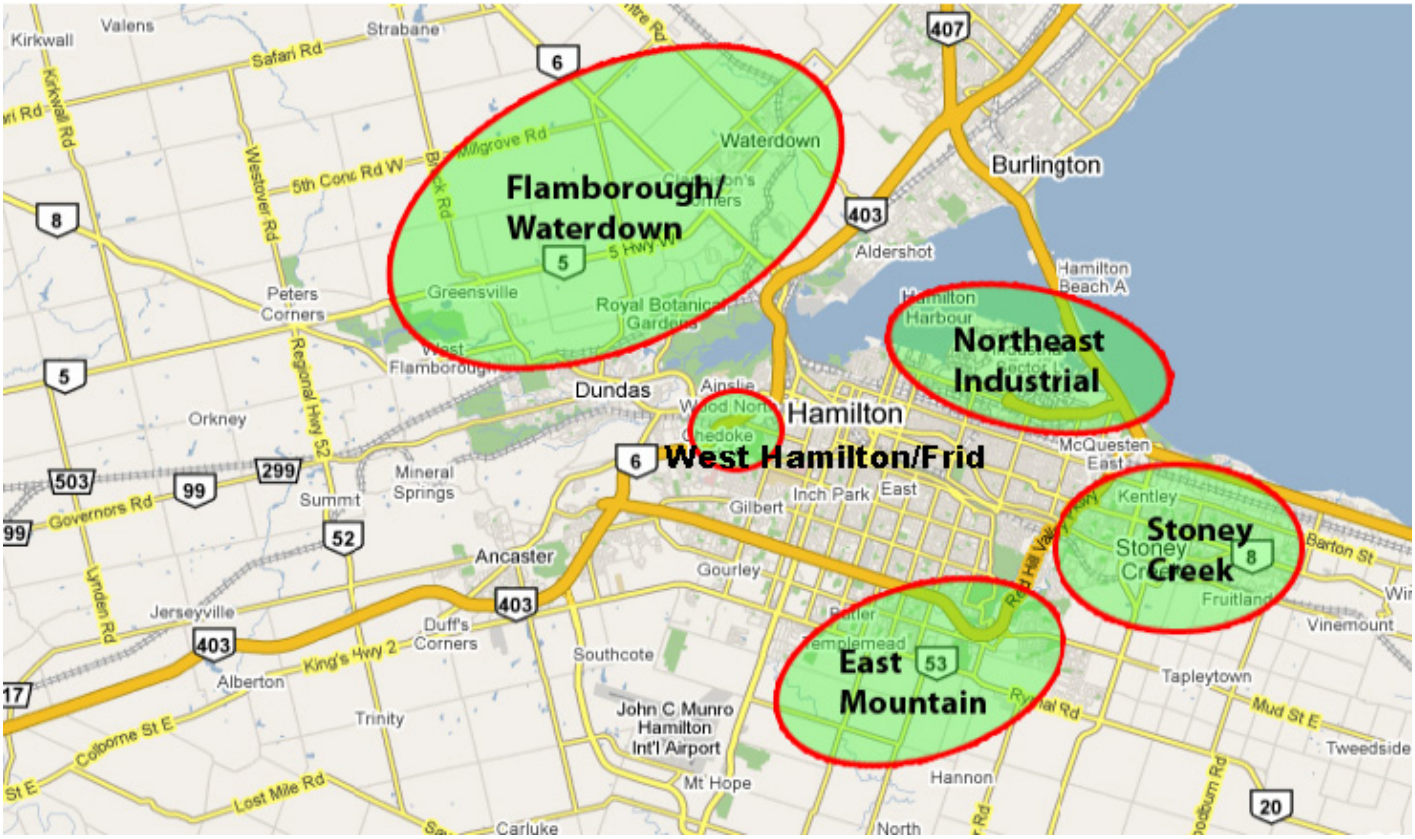


Table 4 and **Figure 10** show the total emissions data from the NPRI, broken down by source category; these data show that carbon monoxide (CO) is the air pollutant with the largest emissions. Based on available emissions inventory data from the Ministry of the Environment and Environment Canada, it is possible to conclude that:

- The transportation sector (i.e., mobile sources, such as cars and trucks) is the leading source of nitrogen oxide (NO_x) emissions within the City of Hamilton, followed closely by the industrial sector;
- Road dust, construction activities and area sources, such as fireplaces and home heating are primary sources of $PM_{2.5}$ and PM_{10} in Hamilton, followed closely emissions from by the industrial sector;
- The industrial sector is the leading source of sulphur dioxide (SO_2) in Hamilton (~90%); and
- The transportation sector is the leading source (~60%) of volatile organic compounds (VOCs); the remaining VOCs are releases due to general solvent use by companies and individuals.

Five separate industrial areas have been identified in the greater Hamilton area from mobile air monitoring (**Section 5.1, Figure 11)**: Flamborough/Waterdown (aggregates industries), East Mountain (aggregates industries), West Hamilton/Frid (mixed industrial and University), Northeast Industrial Area (heavy and mixed industrial activities) and Stoney Creek (mixed industrial activities and aggregates industries).

Figure 11: Emission Sources by Region in the Hamilton Area



Mobile air monitoring studies were performed by driving a van outfitted with air monitoring equipment in traverses across the City, through selected industrial areas, and at selected major traffic intersections. The monitored industrial point sources included large integrated steel industries, steel by-products processors, recycling/scrap operations, foundries, chemical plants, companies with large storage piles, agricultural materials processing plants, a brick manufacturing operation, university operations, a vegetable oil processing plant, a carbon black manufacturing plant, a rail shunting yard and truck transfer station and a cogeneration natural gas plant.

These mobile air monitoring studies found that overall, the highest concentrations of pollutants were observed near major road intersections and along heavily used roads, particularly roads affected by dirt track-out from industrial sites throughout the City. These high levels of pollutants are attributed to the impacts of traffic emissions from automobiles, light trucks and heavy trucks. Industrial sources made significant contributions, particularly for SO_2, but these contributions were often overwhelmed by local traffic emissions.

Details of these studies are described in previous Clean Air Hamilton reports and can be downloaded from the Clean Air Hamilton web site – www.cleanair.hamilton.ca.

3.6 Idling Vehicles

Idling vehicles, whether at traffic lights or elsewhere, not only waste fuel but also contribute significantly to elevated levels of pollutants. On June 2008, the City of Hamilton's Anti–Idling Control By-law (By-Law 07-160) came into effect. The idling by-law applies to government fleets, and all personal and private commercial vehicles operating in and through the City of Hamilton. In 2010, the City's By-Law Enforcement received 44 calls regarding idling vehicles. 6 received verbal warnings, 29 were not in violation of the by-law and 9 were unresolved as the vehicle could not be found.

Between 2006 and 2008, C*lean Air Hamilton*, Green Venture and City staff undertook an idling awareness campaign, entitled Idling Stinks, directed at the broader Hamilton community. The campaign encouraged behavioural change amongst those who live and work in Hamilton, through education, awareness and commitments.

Program highlights included:

- Distribution of 483 'turn engine off' anti-idling awareness signs to schools, recreational facilities, libraries, municipal service centres, individuals and businesses, homes, driving schools and City Hall.

- Distribution of approximately 90 posters to libraries, community centres, community policing centres, City of Hamilton municipal service centres, and Hamilton's Emergency Medical Services (EMS) stations.

- Engagement of over 350 drivers at anti-idling interventions at several schools, McMaster sports camps, the Hamilton GO station and Mohawk College where two/thirds pledged to turn off their engine instead of idling.

- Outreach to fleet managers, through Green Venture hosted Natural Resources Canada Fleet Management 101 Workshops. Attendees in 2007 and 2008 totalled forty-seven (47) representatives of commercial fleets based in Hamilton or operating vehicles that visit Hamilton including, the City of Hamilton, Hamilton International Airport, McMaster University, the Hamilton Conservation Authority, Hillfield-Strathallan College, and John Ebos Fuels.

- Distribution of approximately 1000 "turn it off" information cards, mock tickets and decals that attach to car windshields as a reminder to turn the key off.

- Designation of Idle Free Areas in the Stoney Creek and Ottawa Street Business Improvement Areas.

- Media attention from local print, radio and television outlets.

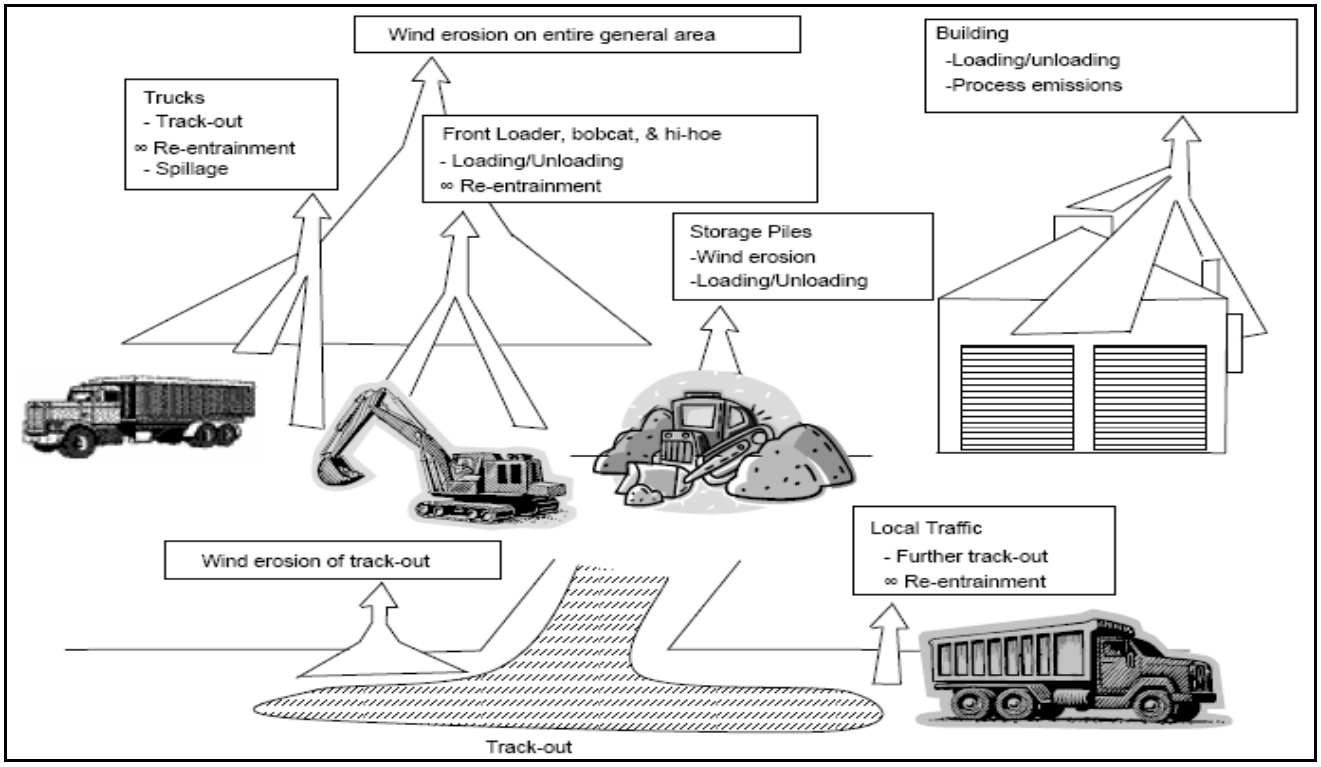
The issue of vehicle idling continues to resonate with the public. School's hold their own anti-idling campaigns and continue to contact Green Venture for signs, communication pieces and anti-idling resources, (available at www.greenventure.ca). Idling personal vehicles is also a component in the EcoDriver education program (see **Section 5.3.1**) that helps drivers of light duty cars and trucks decrease their fuel use. The City receives calls on a monthly basis with idling vehicle complaints and enquires on enforcement of the Idling by-law.

3.7 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 15**). The compositions of fugitive dusts and road dusts vary depending on the materials used or stored, adjacent land uses, local emission sources and traffic loads.

Only recently has it been realized that re-suspended road dusts are a very significant source of inhalable particulate (PM_{10}) and respirable particulate ($PM_{2.5}$) 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 15: Common Sources of Fugitive Dusts



(MOE, 2006)

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 $\mu g/m^3$), respirable particulate ($PM_{2.5}$, up to 300 $\mu g/m^3$) and very small particles (PM_1, up to 125 $\mu g/m^3$).

Road dusts have traditionally been regarded simply as nuisances and of little impact except for the need to wash vehicles. Data from the mobile monitoring survey clearly shows that road dusts have the potential for serious health 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.

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 have 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.

3.8 Wood Burning

When burned properly, sustainably harvested wood from well-managed woodlots can be an effective fuel for home heating. However, poor practice and older inefficient burning appliances rarely allow for complete combustion and a by-product is unburned fuel or wood smoke.

Wood smoke is made up of a complex mixture of air harming chemical substances including PM_{10}, $PM_{2.5}$, volatile organic compounds (VOCs), sulphur oxides (SO_x), nitrogen oxides (NO_X), carbon monoxide (CO), carcinogenic compounds (polycyclic aromatic hydrocarbons, benzene, formaldehyde, dioxins), carbon dioxide (CO_2) and water vapour. Toronto Public Health (2002) estimated that residential wood burning accounts for 11 percent of the $PM_{2.5}$ found in Ontario's air, 0.8 percent of the total particulate matter (TPM) and 15 percent of the VOCs.

A number of Canadian and U.S. jurisdictions are reviewing the practice of wood burning for residential heating. The City of Montréal has adopted a by-law banning the installation of wood burning appliances in new or existing buildings, except for wood pellet burners.

In 2009, in an effort to reduce harmful air emissions from residential burning in Hamilton, Green Venture initiated Wood Burning 101. This education program provides current information to the public on wood burning issues including a review of standards, the law, advanced technology appliances, proper maintenance and best wood burning practices.

Wood burning is subject to a variety of laws, regulations and standards depending upon jurisdiction:

- Federal – safety standards for appliances sold in Canada by the Canadian Standards Association (CSA); standards for low emission appliances developed by U.S. Environmental Protection Agency (EPA)
- Fire Protection and Prevention Act giving rise to the Ontario Fire Code regulates indoor appliances and installation and open air burning (O. Reg.213/07 Article 2.6.3.4.)
- Ontario Building Code – regulates construction of fireplaces, indoor appliances and installation
- Municipal By-Laws – regulate the use of indoor appliances

The most efficient wood/pellet burning appliances utilize advanced combustion technology and are rated as low emissions by the CSA/EPA. There have been great improvements on traditional conventional fireplaces and wood stoves manufactured since 1990 as evidenced in the accompanying **Table 5**.

Table 5: Wood Burning Appliance Emission Factors (kg/tonne)

Appliance	CO	NO_x	SO_x	VOC	TPM	PM_{10}	$PM_{2.5}$
Fireplace; Advanced Technology	70.4	1.4	0.2	7.0	5.1	4.8	4.8
Fireplace; Conventional Without Glass Doors	77.7	1.4	0.2	6.5	19.3	18.5	18.4
Fireplace; Conventional With Glass Doors	98.6	1.4	0.2	21.0	13.5	13.0	12.9
Central Furnace/Boiler (inside)	68.5	1.4	0.2	21.3	14.1	13.3	13.3
Central Furnace/Boiler	68.5	1.4	0.2	21.3	14.1	13.3	13.3
Central Furnace/Boiler (outside)	68.5	1.4	0.2	21.3	14.1	13.3	13.3
Fireplace Insert; Advanced Technology	70.4	1.4	0.2	7.0	5.1	4.8	4.8
Fireplace Insert; Catalytic	70.4	1.4	0.2	7.0	5.1	4.8	4.8
Fireplace Insert; Conventional	115.4	1.4	0.2	21.3	14.4	13.6	13.6
Woodstove; Advanced Technology	70.4	1.4	0.2	7.0	5.1	4.8	4.8
Woodstove; Catalytic	70.4	1.4	0.2	7.0	5.1	4.8	4.8
Woodstove; Conventional	100.0	1.4	0.2	35.5	24.6	23.2	23.2
Woodstove; Conventional, Not Air-Tight	100.0	1.4	0.2	35.5	24.6	23.2	23.2
Woodstove; Conventional, Air-Tight	115.4	1.4	0.2	21.3	14.4	13.6	13.6
Other Equipment	115.4	1.4	0.2	21.3	14.4	13.6	13.6
Pellet Stove	8.8	1.4	0.2	1.5	1.2	1.1	1.1

(WLAP, 2005)

Even advanced, efficient and cleaner burning appliances will result in harmful emissions when improperly installed, maintained or operated. Ultimately, the fuel wood itself must be clean and properly seasoned.

The related issue of outdoor 'open air' or backyard burning was also addressed in Wood Burning 101. Despite strict controls by the City of Hamilton, Open Air Burning By-Law #02-283, inefficient, highly polluting and sometimes illegal open air burning still occurs in the community.

For information on Wood Burning visit:
www.air.greenventure.ca/woodburning-101

3.9 Small Engines

Small engine powered equipment, such as lawn mowers, string trimmers and leaf blowers are widely used in Hamilton to maintain landscaped areas. Emissions from older two-stroke gasoline engines contribute to poor air quality and produce significant amounts of greenhouse gases. In one hour, the average gas powered lawn mower produces harmful air emissions equivalent to those emitted by a new personal vehicle traveling 550 km.

In 2010 Green Venture's Small Engine Powered Equipment program began to raise public awareness on cleaner alternatives to highly polluting older gas-powered equipment.

Public awareness is the precursor to upcoming 2011 spring pilot events that will incentivize the public to properly recycle higher emitting lawn mowers. On April 30 and May 14, 2011 Green Venture will hold lawnmower exchange events in conjunction with two Hamilton RONA stores. People who trade in their old lawnmower to be de-commissioned and recycled will receive a coupon offering a discount on new, less polluting equipment.

Hamilton's Home Depots have perennially participated in a national lawn mower recycling program- Mow Down Pollution. This Green Venture lawnmower exchange will offer Hamiltonians another avenue to participate and help reduce harmful air emissions.

3.10 Odours

Managing odours is difficult. The impacts of an odour event, including the number of complaints arising from the event, can be influenced by five factors – frequency (F), intensity (I), duration (D), offensiveness (O) and location (L) of the event (FIDOL). People will tolerate an odour for only about 10 minutes before complaining.

Operations that commonly cause odours include: iron and steel production, oil refineries, foundries, rendering and food processing, landfills, sewers, and paint and printing operations. These pollutants can also react with other pollutants to create odorous by-products. Odour is typically caused by a mixture of compounds, which is why odour is often so difficult to describe. Moreover the intensity of odours varies with industry location, size, and type, production practices, season, temperature, humidity, time of day, and wind speed and direction. The presence of other odours, e.g., exhaust fumes or smoke, can also intensify an odour or mask an odour.

Human reactions to industrial odours are influenced by personal preferences, opinions, experiences, and olfactory system sensitivity. One person's perception of odour can be quite different from another person's and can vary over time. People can become less sensitive after repeated exposures to an odour, while others, more sensitive. Furthermore, some people may enjoy a particular odour, e.g., roasting coffee, while others may find the same odour annoying.

Schedule 3 of O. Reg. 419/05 was amended to include 10-minute odour-based standards for Total Reduced Sulphur (TRS), hydrogen sulphide (H_2S) and mercaptans that were calculated using 50 per cent Odour Detection Threshold (ODT). Facilities will be required to comply with the new standards by 2013 unless they have been phased in earlier or have been approved to use another standard.

To report an odour complaint in Hamilton, contact the Ministry of the Environment at 905-521-7650 or the 24-hour Spills Action Centre at 1-800-268-6060. Be Prepared to: indicate your location, the time of day the problem is observed, and describe the smell and possible direction.

3.11 Air Quality Management Systems (AQMS)

In April 2010, The Canadian Council of Ministers of the Environment (CCME) received a proposal for a Comprehensive Air Management System (CAMS) for Canada. The CCME endorsed the CAMS on October 20, 2010. The goal of developing a CAMS is to improve air quality across Canada.

The proposed CAMS reflects a new approach to air quality management for Canada built on intergovernmental collaboration and active participation of health and environment organizations and industry. The CAMS is comprised of three integrated elements: 1) Canadian ambient air quality standards, 2) airshed and air zone-based air quality management, and 3) base level industrial emission requirements.

CAMS includes the concept of establishing air zones across the country. Air zones are regions within a province or territory that could be defined according to local conditions to support effective air quality management. Their purpose as proposed within the CAMS would be to provide a framework for effective action to address local air quality issues. Air zones would be led by provinces and Ministers have directed that implementation should begin by 2013.

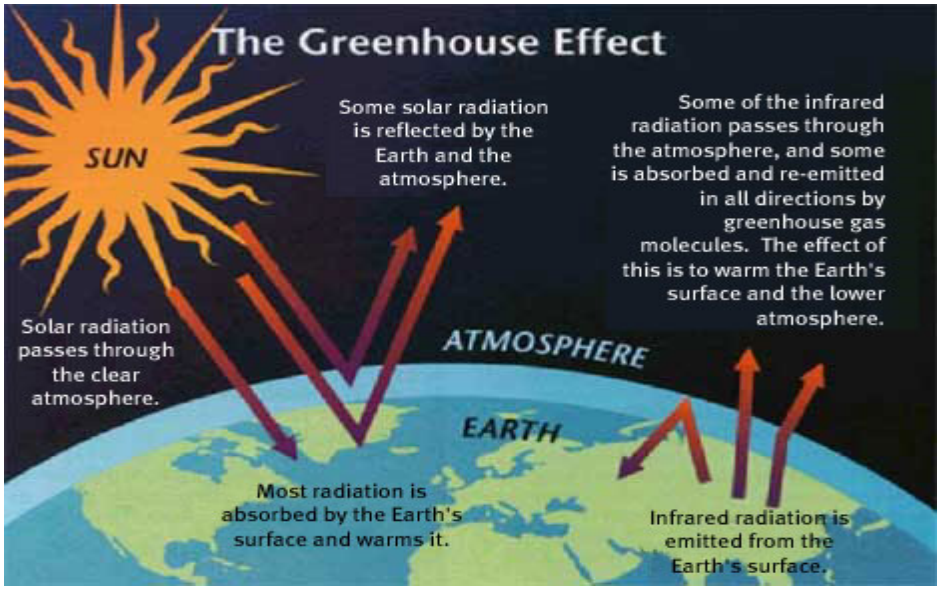
Under CAMS, the goal of place-based air zone management (AZM) is to achieve the Canadian Ambient Air Quality Standards (CAAQS). CAAQS will initially be set for $PM_{2.5}$ and ozone (O_3). The eventual standard may be marginally more stringent than the current Canada Wide Standard (CWS). Ontario currently meets the CWS for $PM_{2.5}$ with most areas well below the CWS. Ontario does not meet the ozone (O_3) CWS.

Details of AZM governance and management (cost/funding, description, performance measures) are still being developed. To inform this development ministry staff plan to meet with selected communities that have some form of existing community engagement on air quality and draw on their experience with local air quality initiatives.

4.0 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.

Figure 16: The Greenhouse Effect



Climate change can be caused by natural processes, such as a change in the sun's strength, and by human activities. Dramatic changes in climate and weather patterns over the past 25 years are a direct result of human activities and the release of carbon dioxide due to the combustion of fossil fuels for transportation, manufacturing, heating, cooling and generation of electricity. This use alone is responsible for 70-90% of greenhouse gasses, with the rest coming from land uses such as agriculture and forestry.

In 2007, the Intergovernmental 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.

Table 6: Air Pollutants, Sources and Pollutant Lifetimes in the Atmosphere

Air Pollutant	Sources	Approx. Lifetime in the Atmosphere
Nitrogen oxides (NO_x)	Burning fossil fuels for transportation and building heating/cooling	A few days
Sulphur dioxide/sulphur oxides (SO_2/SO_x)	Burning sulphur-containing fossil fuels for transportation and industrial processes	A few days
Particulate material ($PM_{2.5}$ and PM_{10})	Primary PM emitted directly as dust, carbon from fossil fuels. Secondary PM arises from reactions of SO_2, NO_x, NH_3 and VOCs in the atmosphere.	Up to 10 days
Carbon monoxide (CO)	Burning fossil fuels for transportation	A few months
Tropospheric ozone (O_3)	Product resulting from reactions between NOx, VOCs, CO, CH_4, oxygen and sunlight in the atmosphere	Hours to days
Volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)	Industrial process emissions; solvent use (both home and industrial)	A few days
Methane (CH_4)	Livestock farming Landfill/Waste Management	12 years
Black carbon (BC) and organic carbon (OC)	Burning wood or biomass; burning fossil fuels	About a week
Ammonia (NH_3)	Livestock farming and use of fertilizers	A few days

Table 7: Greenhouse Gases: Sources and Lifetimes in the Atmosphere

Greenhouse Gas	Sources	Approx. Lifetime in the Atmosphere
Carbon dioxide (CO_2)	Fossil fuel combustion product	100 years
Methane (CH_4)	Livestock farming; landfill/Waste Management	12 years
Nitrous oxide (N_2O)	Synthetic Fertilizers	115 years
Nitrogen trifluoride (NF_3)	Microelectronics production	600 years
Sulphur hexafluoride (SF_6)	Used in magnesium production industry, and by electrical utilities and electronics manufacturers	3,200 years
Halocarbons and other GHGs (fluorocarbons - HFCs, CFCs, PFCs)	Use of CFCs in refrigeration and in industrial processes[1]	50,000 years
Tropospheric ozone (O_3)	Product resulting from reactions between NOx, VOCs, CO, CH_4, oxygen and sunlight in the atmosphere	Hours to days
Water vapour (H_2O)	Naturally occurring in the atmosphere, and absorbs more heat caused by the other GHGs from human activities.	9 days

Air pollutants influence climate change because many air pollutants have atmospheric warming or cooling effects, which are often comparable to many traditional greenhouse gases. Recent evidence suggest that behind carbon dioxide, the most powerful warming gas in the atmosphere (besides water vapour) are black carbon and tropospheric ozone – consider as air pollutants (NOAA, 2009, Ramanathan & Carmichael, 2008, Reid, 2007, NASA, 2004).

Air pollutants affect climate change because many of them cause radiative forcing – they either absorb heat from the sun or act as a greenhouse gas- causing warming- or they reflect solar radiation away and cause a cooling effect (see **Table 8**). Short-lived climate change forcers are substances such as methane, black carbon, tropospheric ozone, and many hydrofluorocarbons that have a significant impact on climate change, and a relatively short lifespan in the atmosphere compared to CO_2 and other longer-lived gases.

[1] Many Ozone depleting Substances are potent greenhouse gases ("GHGs"), their phase-out under the Montreal Protocol is providing a bonus for climate change reductions.

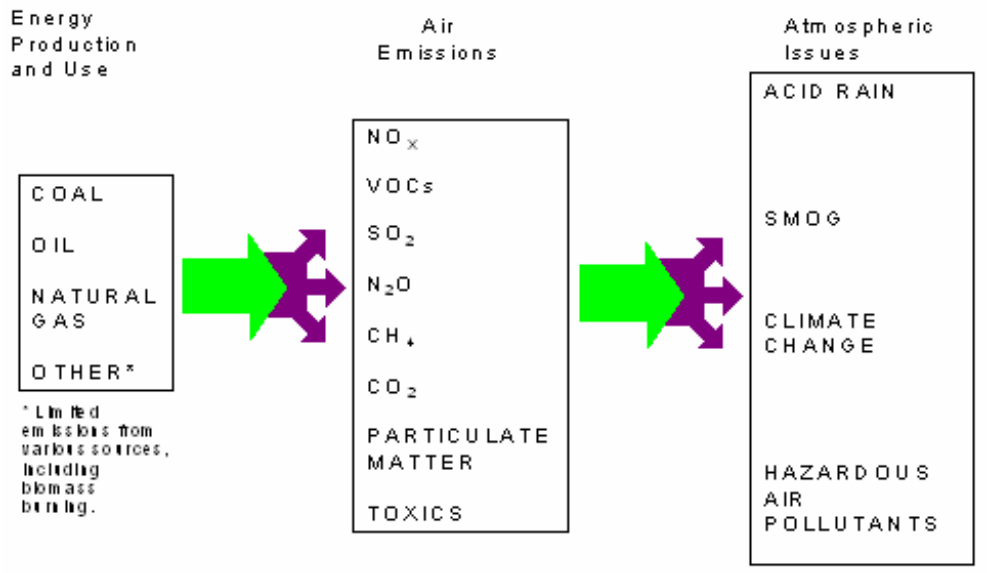
Table 8: Radiative Forcing of Air Pollutants

Air Pollutant	Effect on Climate	Radiative Forcing
Nitrogen oxides (NO_x)	Promotes the formation of nitrate salt aerosol, which has a cooling effect: a primary driver of ozone formation.	Both negative and positive
Sulphur dioxide/sulphur oxides (SO_2/SO_x)	Primary driver of the formation of sulphate salt aerosol, which has a cooling effect.	Negative
Particulate material ($PM_{2.5}$ and PM_{10})	Absorbs and reflects incoming solar radiation depending on composition.	Either negative or positive
Carbon monoxide (CO)	Contributes to ozone formation, which has a warming effect.	Positive
Tropospheric ozone (O_3)	A greenhouse gas reduces the uptake of carbon dioxide by plants.	Positive
Volatile organic compounds (VOCs) and hazardous air pollutants (HAPs)	Contributes to ozone formation having a warming effect and the formation of secondary aerosols, which have a cooling effect.	Both negative and positive
Methane (CH_4)	A greenhouse gas that contributes to ozone formation.	Positive
Ammonia (NH_3)	Promotes the formation of nitrate and sulphate aerosols, both of which have cooling effects.	Negative
Black carbon (BC)	Absorbs incoming solar radiation	Positive
Organic carbon (OC)	Reflects incoming solar radiation	Negative

Climate change will also affect the severity of air pollution. Changing climate conditions such as temperature increases will exacerbate air pollution through increased chemical reaction rates in the atmosphere and the more regular creation of ideal conditions for smog formation. Climate change may affect air pollution by changing ambient tropospheric levels of ozone (O_3) and $PM_{2.5}$, two of the primary components of smog. Despite the limitations of modelling and the need for more information around PM relationships, Health Canada (2008) demonstrated through climate modeling that in a warmer Canada the health impacts due to these changes were related primarily to changes in concentrations of O_3 and $PM_{2.5}$.

The most important linkage between climate change and air pollution is the combustion of fossil fuels (see **Figure 17**). The burning of fossil fuels for energy (e.g., in heating and cooling buildings, in personal and commercial transportation, for lighting, etc.) results in emissions of carbon dioxide, sulphur dioxide, nitrogen oxides, volatile organic compounds, black carbon, organic carbon, and particulate matter.

Figure 17: Combustion of Fossil Fuels for Electricity, Home Energy, Transportation, Industry, and Municipalities Results in Air Emissions and Atmospheric Issues



(Chiotti, 2003)

Higher temperatures result in increasing demands for electricity for air conditioning; thus, on hot days the levels of air pollutants are driven higher by emissions to satisfy energy demands. If Canada had met its Kyoto targets, fossil fuel consumption would have decreased by almost 25% compared to today; thus, the average air quality would be about 25% better today had we realized this reduction from combustion sources.

Poor air quality, combined with heat stress during hotter weather, poses serious health challenges to the most vulnerable people in society, the very young and the elderly. Climate change is predicted to have significant impacts on human health. In 2008 Health Canada (2008) identified eight significant health concerns related to Climate Change (**Table 9**). They include health effects from increased smog episodes, illnesses and deaths caused by heat and cold waves, water-borne and food-borne contamination, diseases transmitted by insects, health effects of stratospheric ozone depletion and an increased number of extreme weather events.

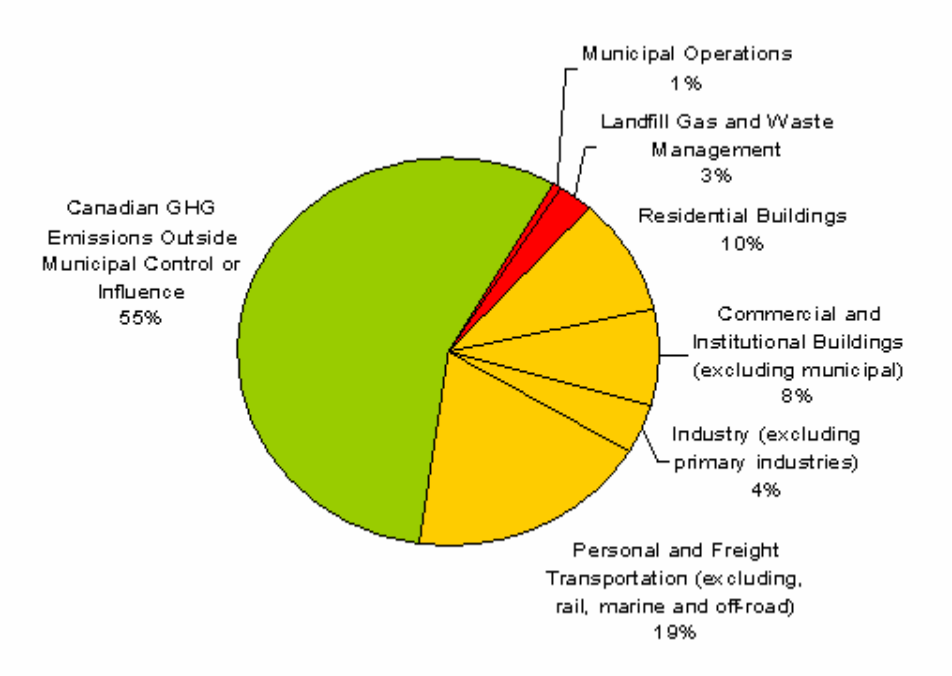
Table 9: Health Impacts from Climate Change and Variability (Health Canada, 2008)

Health Issues	Examples of Health Vulnerabilities
Temperature-related morbidity and mortality	Cold and heat related illnesses, mental health, respiratory and cardiovascular stress, occupational health stress.
Health effects of extreme weather events	Social and mental health stress due to disasters, injuries, preparedness and population displacements, damaged public health infrastructure, occupational health hazards.
Air pollution related health effects	Respiratory diseases, cardiovascular diseases, cancer, allergens and asthma, changed exposure to outdoor and indoor air pollutants and allergens.
Water and food borne contamination	Enteric diseases.
Vector-borne infections and diseases	Changed patterns of diseases caused by bacteria, viruses and other pathogens carried by mosquitoes, ticks and other vectors.
Health effects of stratospheric ozone depletion	Cancer, cataracts, immune suppression.
Population vulnerabilities in cities and communities	Rural and urban health, seniors, children, homeless and low income, traditional cultures, disabled, immigrant populations.
Health and socio-economic impacts	Loss of income and productivity, social disruption, diminished quality of life, Increased costs to health care.

Adapted from http://www.hc-sc.gc.ca

According to the Federation of Canadian Municipalities (FCM), just less than half of Canada's 2006 greenhouse gas emissions (315 Mt or million tonnes) are under the direct or indirect control or influence of municipal governments. Municipalities directly control decisions that produce some 24 Mt of greenhouse gas emissions from municipal operations, residential waste, and landfill sites. Greenhouse gas emissions under the indirect control (regulatory, public policy, and community awareness) of municipal governments total 291 Mt (see **Figure 18**).

Figure 18: Canadian GHG Emissions Directly & Indirectly Controlled by Municipalities Compared to Total National Emissions (2006)



(Federation of Canadian Municipalities, 2009)

4.1 City's Climate Change Inventory

In 2008, the City of Hamilton approved an Air Quality and Climate Change Strategic Plan to undertake actions to meet corporate emission targets of 10% reduction of 2005 greenhouse gases levels by 2012, followed by a 20% reduction of 2005 greenhouse gases levels by 2020. Community targets were recommended of 10% reduction of 2006 greenhouse gases levels by 2012, followed by a 20% reduction of 2005 greenhouse gases levels by 2020.

In 2009, the City of Hamilton undertook a greenhouse gas emissions inventory for its operations and the community as part of the FCM Partners for Climate Protection Program. The inventory was also undertaken to measure how the City was doing in reducing its greenhouse gas emissions compared to the emissions targets

In 2009, the Corporation reduced its greenhouse gas emissions to 127,690 tonnes, a 5.4% reduction of emissions from the 2005 baseline of 135,052 tonnes and is on course for achieving the 10% reduction target of 121,534 tonnes by 2012. The reductions in corporate greenhouse gas emissions have risen from increased energy and fuel conservation efforts by City operations and City staff through buildings, lighting, fleets and employee travel. Municipal operations contribute to only 1% of our community's GHG emissions **(Figure 19)**. However, municipal policies influence GHG emissions from waste, transportation, and residential and commercial buildings and to some aspects of industrial emissions.

The total greenhouse gas emissions for Hamilton in 2008 were 11,928,322 tonnes, a reduction of 6.5% since 2006. **Figure 19** shows a breakdown of the percentages of greenhouse gas sources in Hamilton; **Figure 20** shows the changes in community emissions since 2006.

Figure 19: Total Greenhouse Gas Emissions Corporate and Community (2008)

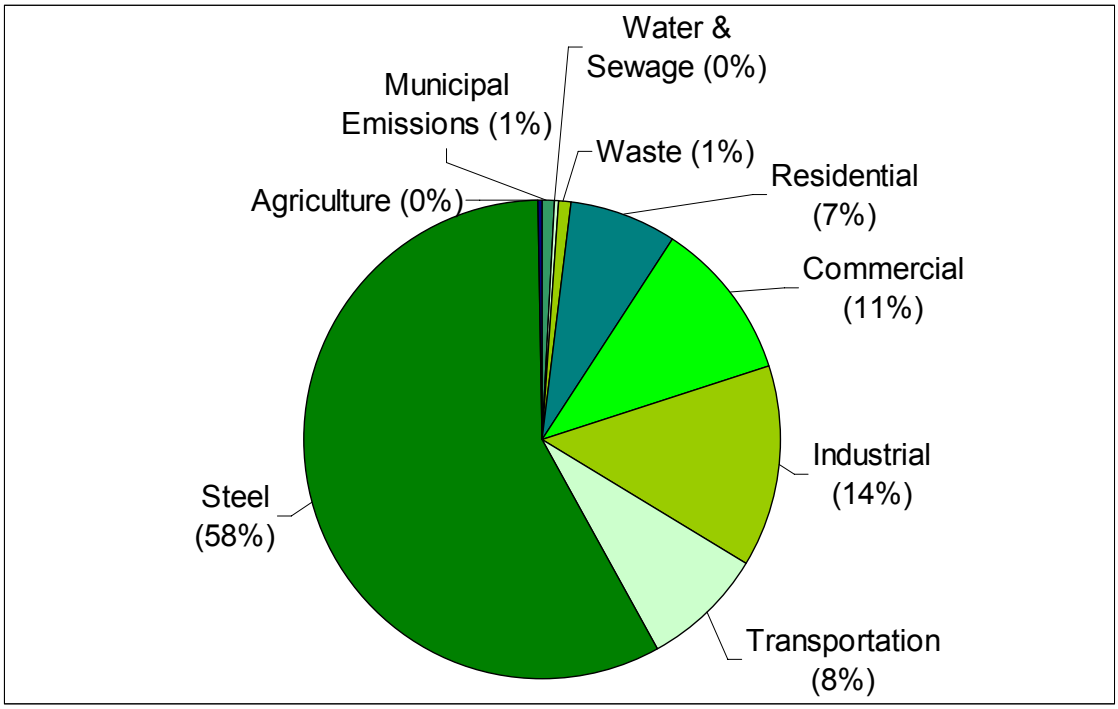
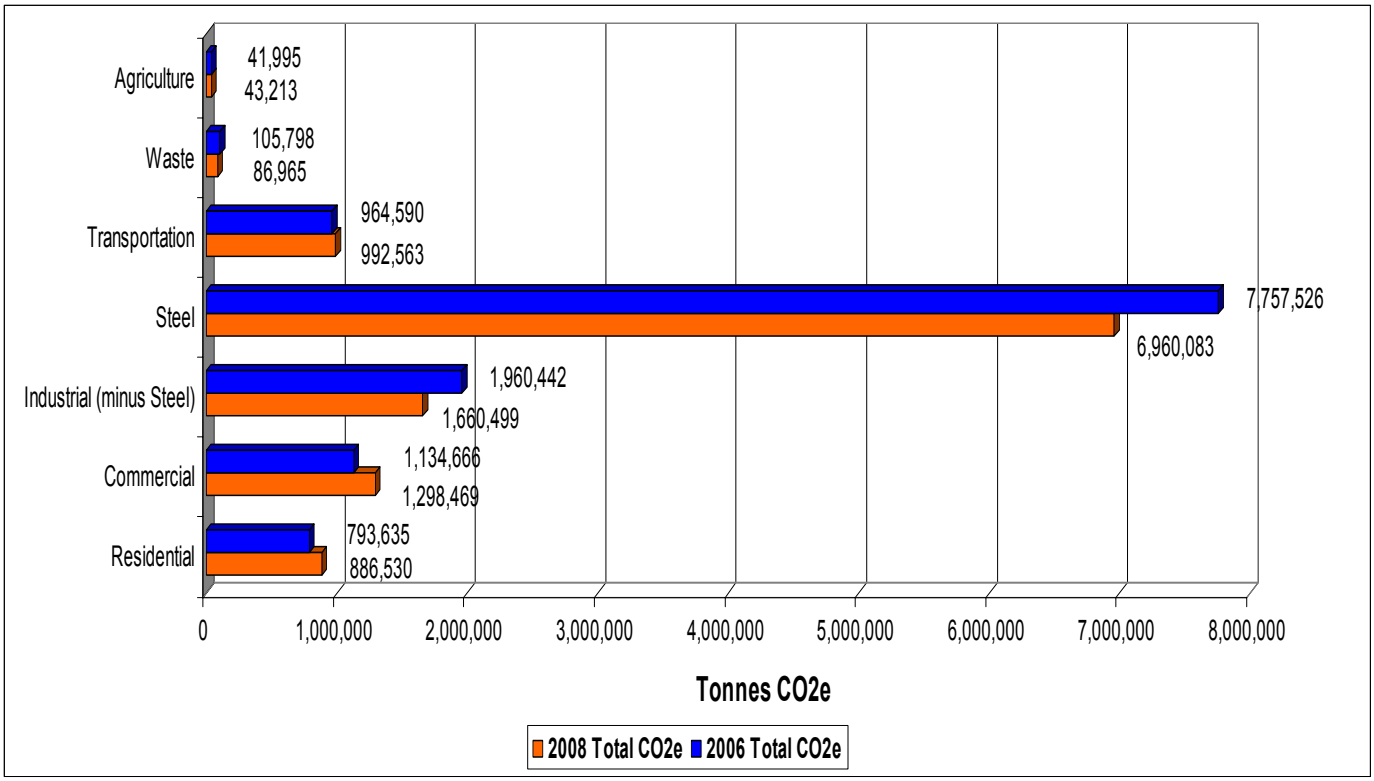


Figure 20: Community CO_2e Emissions in Hamilton in 2006 and 2008



The greenhouse gas (GHG) emissions from the industrial and steel sectors dropped by 1,097,436 tonnes or 11% through energy conservation and decreased production due to the downturn in the economy. It is not clear if this industrial reduction is a permanent change. GHG emissions from waste dropped by 18,833 tonnes or 18%. This is a permanent change effected by waste management through waste reduction and capture of landfill methane emissions. Unfortunately, these emission reductions are offset by increases of 11.7% and 14.4% in emissions from the residential and commercial sectors respectively. These increases are partially due to Ontario's energy mixture shifting slightly away from oil and natural gas towards increased coal production (a 2% increase) between 2005 and 2008[2]. In addition, 2008 was a cooler year compared to 2006 and 2007 in Hamilton and heating of residential and commercial buildings increased. Transportation sources are also a significant source of GHG and air pollutant emissions and continue to increase in Hamilton.

Municipal and community involvement in reducing sources of GHG emissions – commercial and personal transportation, commercial and residential energy usage, land-use development – in Hamilton is critical. Provincial policies on phasing out coal-fired electricity and encouraging renewable alternative energy in the provincial energy mix and the MoveOntario 2020 Rapid Transit Action Plan will also affect the reductions in Hamilton's emissions.

To read the City's actions on Climate Change visit: www.hamilton.ca/climatechange

[2] From 2005 to 2006, the average emission factor associated with the generation of electricity in the Province decreased from 0.00021 to 0.00018 t CO2e/kWh. From 2006 to 2008, this emission factor increased from 0.00018 to 0.00022 t CO2e/kWh. On an annual basis, these emission factors can change substantially. Therefore, these changes must be considered when interpreting the changes in emissions from year to year for sources consuming electricity.

4.2 Hamilton High School Heroes

Hamilton high school students, and the teachers that support them, continue to take environmental action in their schools and communities. In 2010, the Hamilton High School Heroes program connected students with credible information sources and resources and provided opportunities for their involvement in activities that promote air quality and climate change issues

Green Venture's "What You Can Do" presentation challenged students to take local action on climate change and air quality issues and motivated students were engaged at student forums and conferences.

Winning poster submissions: Shannon Guo, Annie Fu, Soomin Lee, 2011

The "Fighting Climate Change" poster contest was launched and invited high school students to submit original artistic posters. The contest reached out to all Hamilton high schools and the forty (40) submissions will be exhibited in 2011 to inspire the artists' peers to take action on climate change.

5.0 Transportation Emissions - Linkages to Air Quality and Human Health

5.1 Mobile Air Monitoring Research

Mobile air monitoring surveys have been undertaken through funding provided to *Clean Air Hamilton* starting in 2004; these studies continue as additional funds become available for more research work. The original motivation for undertaking these studies was to provide a 'street-level' view of air quality in the city and to compare the air quality in different areas and neighbourhoods across the city. Data from previous mobile surveys has been presented in previous *Clean Air Hamilton* reports (please see the 2005 to 2009 reports). Some recent findings are included in this 2010 report.

The reason for undertaking mobile air monitoring surveys is be able to take modern air monitoring equipment to areas and sites where one could never set up a traditional fixed air monitoring site, such as at a street corner, in a neighbourhood, right outside a school or along the length of a street. The mobile van can drive slowly from place to place or be set up in one or more locations for periods of time. In this report the monitoring of neighbourhoods is featured; the mobile capabilities of the van allows one to be able to collect air quality data at sites throughout the neighbourhood, allowing comparisons of ambient levels of pollutants throughout the neighbourhood.

For complete information on the mobile monitoring research, please visit:
www.cleanair.hamilton.ca/default.asp?id=26

5.1.1 The Red Hill Valley Air Quality Monitoring

The City of Hamilton was required as part of the Ontario Ministry of the Environment's Environmental Assessment of the parkway project to perform air monitoring at a site near the Red Hill Valley Parkway before construction and after construction of the parkway. The purpose of this monitoring was to determine whether there were any changes to the air quality within the Red Hill Valley as a result of construction of the Parkway.

An evaluation of potential monitoring sites within the Red Hill Valley was conducted by RWDI well prior to construction of the parkway. Based on their analysis a site near King St. and Greenhill Rd. was identified as an excellent site to obtain vehicular emissions data in the valley; in 1998 a set of air samples and air quality data was collected over a period of 8 months.

Following construction of the parkway, Rotek Environmental Inc. was retained by the City to perform the six-month post-construction ambient air quality survey. This work involved setting up an air monitoring site overlooking the parkway at the King St. exit from the parkway. The data collected included real-time measurements of a number of parameters and the collection of discrete samples for subsequent chemical analyses. A meteorological station provided continuous data on wind speed and wind direction. The air monitoring survey took place from May 1 to October 31, 2009.

The MOE required the following pollutants to be monitored: carbon monoxide (CO), oxides of nitrogen (NO_X), total suspended particulate (TSP), inhalable particulate (PM_{10}), airborne metals, polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOCs) and meteorological parameters, including wind speed, wind direction, ambient temperature, relative humidity and solar radiation. Since other areas of the city and the Province had moved to monitoring respirable particulate ($PM_{2.5}$), this parameter was voluntarily added by the City to allow for comparisons with current Ministry data. Data analysis compared current, post-construction levels of pollutants with pre-construction levels of pollutants data; these date show that the levels of four pollutant were about the same as (PM_{10}) or much lower than values observed in the late 1990's (see **Figure 24**).

Figure 24: Pre- and Post-Construction Comparison for CO, NO, NO_2 and PM_{10}

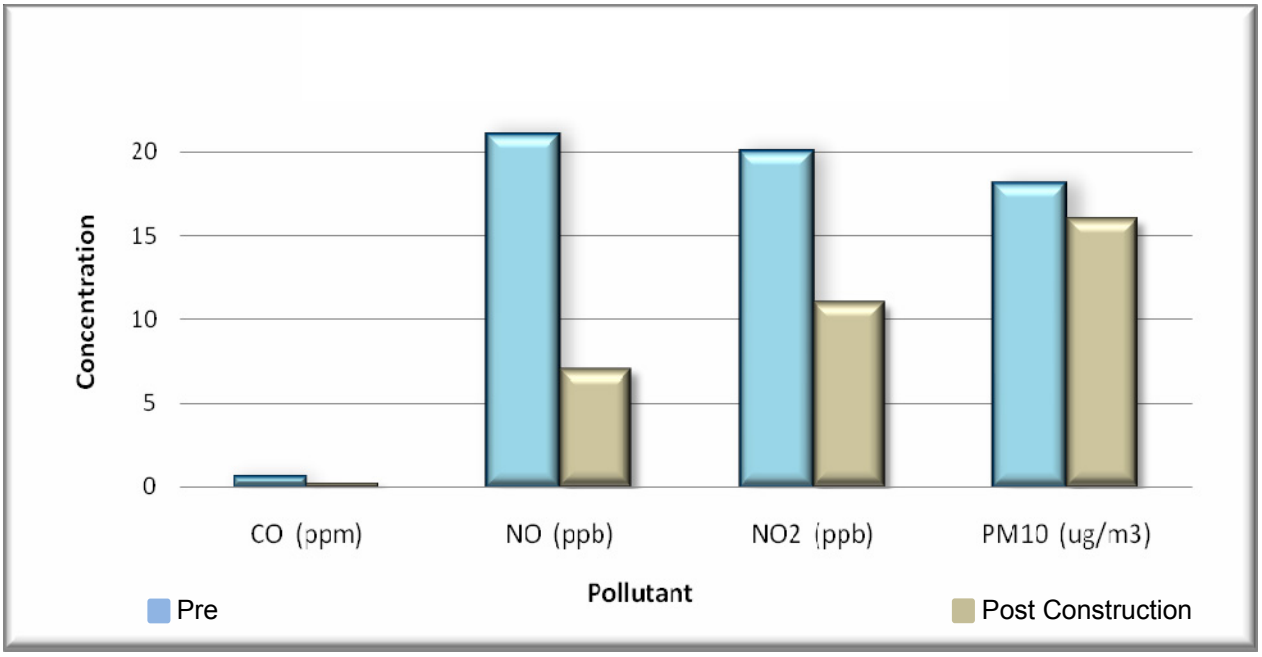
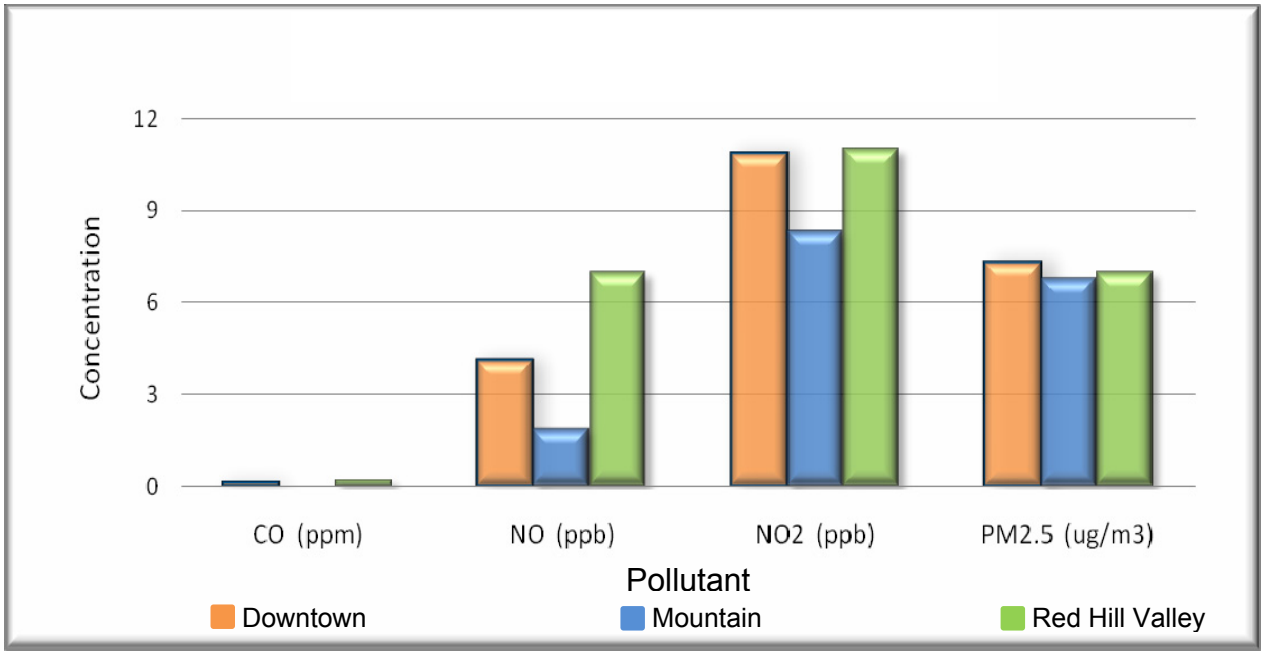


Figure 25: Red Hill Valley Parkway vs. City Comparison - CO, NO, NO_2, $PM_{2.5}$



The 2009 air monitoring survey showed that the Parkway did not cause any exceedences of Ministry of the Environment AAQCs at the sampling site within the Red Hill Valley. Comparisons of the Red Hill Valley data with data from other air monitoring sites in the city (see **Figure 25;** Downtown, Mountain and West End sites) showed that air quality in the Red Hill Valley area was comparable in quality to other areas of Hamilton, and well within the AAQCs.

It was reasonable to expect that emissions from vehicles driving on the Parkway would impact areas close to the roadway. Surprisingly, pollutant levels were now significantly lower with the Parkway in operation compared to the 1998 data. It had been postulated that the new parkway would reduce the overall burden of air pollution on arterial roads in Hamilton's east end but not necessarily within the Red Hill Valley itself. An air quality health evaluation of areas near the parkway predicted that health impacts from modeled air pollutant levels would not show any measurable increase once the parkway was completed. However, many local residents and environmental groups expressed their reservations about this study; they were especially concerned about air pollution impacts. The current data should help to allay these concerns.

There are several factors which have been advanced to explain why the air quality in the red Hill Valley has improved since the time of pre-construction survey.

- There has been a significant improvement in air quality parameters across the City (and across southern Ontario) during the intervening years. Significant reductions in vehicular emissions coupled with concerted actions by individuals, organizations, industries, the City of Hamilton and other levels of government have resulted in about a 30-40 percent decline in the concentrations of key pollutants across the City (with the singular exception of ozone).

- Improved traffic patterns and reduced stop-and-go traffic have reduced transportation-based emissions in the area.

- Analysis of six months of continuous meteorological data showed that winds tend to blow up and down the length of the valley almost exclusively. This channeling effect of the valley, in combination with the southwest prevailing winds, tend to move vehicle emissions in the direction of the parkway with little tendency for lateral dispersion of pollutants into residential areas bordering the parkway.

- Some fraction of the decline in NO_x levels may be due to seasonal differences. The pre-construction survey was conducted during the home heating season from December 1997 to June1998, while the post-construction survey took place from May to October, 2009.

5.1.2 Red Hill Valley Parkway Neighbourhoods Air Quality Study

Citizens living in neighbourhoods along the parkway route expressed their concerns to city officials on many occasions that they were very concerned that emissions from vehicles travelling along the parkway were adversely affecting their health. The City of Hamilton's Public Health Services retained Rotek Environmental to conduct a mobile air monitoring survey to determine whether there were air quality impacts in neighbourhoods immediately adjacent to the Red Hill Valley Parkway.

Mobile air monitoring techniques were used to evaluate levels of carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), inhalable particulate (particulate matter less than 10 microns aerodynamic diameter, PM_{10}) and respirable particulate (particulate matter less than 2.5 microns aerodynamic diameter, $PM_{2.5}$).

Air quality data were collected on ten sampling days between November 2009 and March 2010. Regional wind directions were measured at the main Hamilton meteorological tower on Woodward Avenue. GPS monitors were used to specify monitoring locations and GIS (Geographic Information System) techniques were used to evaluate the data. On each of the sampling days air quality data was collected in neighbourhoods to the west and to the east of the parkway so as to have data from upwind of the parkway and downwind of the parkway on each day. The upwind side data would provide the background air quality data for that day while the downwind values would be expected to be similar to the upwind values plus any pollutant contributions from other sources such as the parkway.

All measurements in neighbourhoods close to the Red Hill Valley Parkway showed that pollutant levels were well below Ministry Ambient Air Quality Criteria (AAQC). Analysis of the upwind vs. the downwind data showed very little difference between these data. In other words, there was no evidence for any effect of vehicle emissions from the Red Hill Parkway on neighbouring air quality. It is proposed that the channeling effects of the valley, in combination with the southwest prevailing winds, tend to keep vehicle emissions within the valley with little tendency for these pollutants to disperse laterally into bordering residential areas.

In order to examine the upwind and downwind data from each sampling day more carefully, data from each sampling day were classified into upwind and downwind according to the wind direction on that day. Upwind data each day were combined to give an upwind average value for each parameter; likewise downwind data were combined to give a downwind average value for each parameter. Comparing these averages should give information on Parkway effects.

Table 10 shows the average values for each of the five pollutants; none of these exceeded the AAQC during this study. Upwind and downwind average levels were nearly identical. The upwind averages were slightly higher than the corresponding downwind averages; clearly, there are no significant impacts of the parkway on neighbours who live close to the parkway, contrary to the expectations of many residents that the Red Hill Parkway was adversely impacting their health.

Table 10: Average Upwind and Downwind Pollutant Concentrations

Pollutant	CO	NO_2	SO_2	$PM_{2.5}$	PM_{10}
Units	ppm	ppb	ppb	$\mu g/m^3$	$\mu g/m^3$
AAQC values	30	200	250	30	50
Upwind Averages	0.92	12.4	5.93	11.6	27.1
Downwind Averages	0.86	10.5	5.57	11.4	22.7

It had been expected that there would be measurable impacts due to poor air quality in the neighbourhoods immediately adjacent to the parkway; even if traffic patterns and air quality had been shown to improve over a wider area. Before the parkway was constructed, mathematical modeling had predicted increases in concentrations of pollutant levels close to the parkway, relative to the local background levels. However these mobile monitoring data are consistent with the post-construction air monitoring data collected at the King St. interchange which showed dramatic improvements in the levels of airborne contaminants in the vicinity of the parkway, see http://www.hamilton.ca/CityDepart ments/PublicWorks/RedHill/.

In conclusion, steady reductions in air pollution year-by-year across the city have resulted in dramatic long-term improvements in overall air quality in Hamilton. It is proposed that winds tend to channel pollutants and keep them within the Red Hill valley, resulting in little lateral dispersion of parkway-associated pollutants into neighbourhoods adjacent to the valley.

5.1.3. GO Train Lakeshore West Layover Facility Air Quality Study

Neighbourhood residents in the Corktown area had expressed concerns related to poor air quality resulting from GO Trains in GO Transit's Lakeshore West Hamilton Layover Facility. A mobile monitoring study was conducted to address these concerns by measuring the concentrations of common air pollutants associated with rail traffic upwind and downwind of the train tracks. The City of Hamilton Public Health Services retained Rotek Environmental to perform a short mobile monitoring study to determine whether there were significant air quality impacts due to idling train engines. Mobile Air Monitoring techniques were used to evaluate levels of carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), inhalable particulate (particulate matter less than 10 microns aerodynamic diameter, PM_{10}) and respirable particulate (particulate matter less than 2.5 microns aerodynamic diameter, $PM_{2.5}$). Regional wind directions were measured at the main Hamilton meteorological tower on Woodward Avenue. GPS monitors were used to specify monitoring locations and GIS (Geographic Information System) techniques were used to evaluate the data. Upwind and downwind measurements were made over three days in March 2010 in the presence and absence of moving and parked trains in the area.

Measurements showed that pollutant levels were well below Ministry Ambient Air Quality Criteria (AAQC); the comparison of upwind and downwind air data showed no measurable patterns of emissions resulting from parked GO Trains on neighbouring air quality.

5.1.4 Neighbourhood Monitoring

Beginning in the Fall of 2010, Clean Air Hamilton in partnership with Green Venture began a mobile monitoring project identifying emissions sources and potential health impacts in the neighbourhoods of Hamilton. Funding for the project was provided by ArcelorMittal Dofasco to help build the capacity of mobile monitoring in Hamilton and identifying sources in local neighbourhoods. Neighbourhoods were encouraged to identify their desire for monitoring through a local media release sent to local media and neighbourhood associations. The Hamilton Community News (Mountain News, Stoney Creek News, Ancaster News, and Dundas Star) and the Hamilton Spectator. A parallel social media campaign was also launched through ArcelorMittal Dofasco's Community Strength blog posted an entry about the program which was promoted on the ArcelorMittal Dofasco's Community Strength and Green Venture Twitter and Facebook accounts).

Requests for monitoring came in from over 20 neighbourhoods in Hamilton, with 10 neighbourhoods and sites being selected at this time based on resource limitations. These neighbourhoods and sites included Dundas, Delta, McAnulty Boulevard, Northwest End, Beach Boulevard/Eastport Drive, Jones Road/Arvin Avenue, the Eva Rothwell Centre, Limeridge Mall, the Mountain, and Lawrence Avenue to Burlington Street. The results of the neighbourhood monitoring will be reported in the 2011 Clean Air Hamilton report as monitoring and analysis of the data presently continues.

5.2 Active & Sustainable Transportation

5.2.1 Smart Commute and Transportation Demand Management (TDM)

Smart Commute Hamilton and the City of Hamilton's Public Works Transportation Demand Management (TDM) office were very active with a variety of new programs underway in 2011 (see **Table 11**) . The programs vary in nature from new incentive programs for carpooling, TDM Guidelines for land use and bike parking infrastructure projects to education, communications and event planning. The office continues to develop and improve relationships with partner organizations including Clean Air Hamilton, Public Health, Green Venture, Environment Hamilton, McMaster University, Hamilton Health Sciences, St. Joseph's Healthcare, Horizon Utilities, School Boards, Federal and Provincial offices, Workers Safety and Insurance Board, the Hamilton Chamber of Commerce and Arcelor-Mittal Dofasco:

- From November 20 From November 2010 to March 2011, the City of Hamilton doubled the number of carpools formed in the CarpoolZone.ca ride-matching web tool, seeing a 77% increase, the largest increase amongst the 11 Transportation Management Associations in the Greater Toronto and Hamilton area (www.carpoolzone.ca).

- Expanded the Smart Commute Hamilton Transportation Management Association, forming new partnerships with McMaster Innovation Park, McMaster Downtown Centre, Horizon Utilities Corporation, CAA South Central Ontario (Hamilton) and ILR Industries. (www.smartcommutehamilton.ca/en/members).

- Awarded the "Most participants to log sustainable commutes" prize in the Over 5000 Employees category (City of Hamilton) and the 2500 – 5000 Employees category (McMaster University) for the Pollution Probe Clean Air Commute Competition which occurred between June 14-18, 2010, across the Greater Toronto and Hamilton Area.

- Organized the third annual Transportation Summit themed "Taking Back the Streets", which explored pedestrian issues and culture in Hamilton. The summit had a record 80 attendees and Francois Lagard, as the keynote speaker. (www.smartcommutehamilton.ca/en/events/transportationsummit2010)

- Performed baseline TDM surveys, site analysis, and employer travel plans for St. Joseph's Hospital, Mohawk College and Horizon Utilities Corporation.

Table 11: 2009 TDM Program Descriptions and Status

Activity	Description	Status
Hamilton Car Share Expansion	Provide Hamilton Car Share with a $150,000 revolving line of credit from the City of Hamilton to expand CarSharing in Hamilton and establish it as a sustainable mode of convenient transportation	Data gathered and report developed in 2010. Recommendations will be presented to council in 2011.
Secure Bike Parking	Opened a facility in the City Hall Parking Lot for 32 bikes in October 2010 and planning another facility at Mohawk College, holding 60 bikes.	Ongoing construction of new facilities.
2010 Transportation Summit	Annual event hosted at Liuna Station on April 30, 2010 themed “Taking Back the Streets” and exploring pedestrian issues in Hamilton.	Evaluation and Report Complete, 2012 Summit Planning has begun.
Expanded Subsidised Employer Commuter (EC) Pass program	TransitZone.ca will be used to manage employee requests for subsidised passes from various employers as a one year pilot for 2011.	Pending Council approval.
Open Streets Hamilton	Two events were held which aimed to create an urban park, closed to car traffic for 2 Sundays per year (June and September) to support sustainable transportation and healthy communities.	Events were held on June 6 and Sept. 26, 2010 events on James Street North from Cannon (or York) to Burlington Street. 12,500 people attended the two events
TDM Framework and Communications Plan	IBI Group and Urban Trans will complete a strategy to communicate TDM principles to various groups, wards and communities in Hamilton, along with social marketing programs for communities	Ongoing

Activity	Description	Status
Transportation Management Association (TMA)	Meets monthly to engage community groups, city departments and engaged employers & institutions	McMaster Innovation Park, McMaster Downtown Centre, Horizon Utilities Corporation, CAA South Central Ontario (Hamilton) and ILR Industries joined in 2010
Active and Safe Routes to School	Undertaking inventories/audits/ walkabouts and assisting in trip/route planning	10 Pilot School Site Analysis were completed in 2010.
Bike Share Implementation Study and Business Plan	Held a workshop with Bixi and B-Cycle public bike share systems and collected feedback from stakeholders on a plan to have a public bike share system in Hamilton.	Feasibility Study completed in 2010 and a business plan to be compiled in 2011. Potential implementation in 2011-2012
Emergency Ride Home program (See TDM)	Program to provide employees with the security that they can get home for an emergency and their taxi fee can be recovered.	Advertising the program internally and evaluating its success
Rural Roots	Transportation and Food Linkages – using public transit to access farms for food education and purchasing	Once per month bus service to local area farms with 5 farms visited in 2010 and over 300 participants.
CAN Bike Instruction to Hamilton	Work with Public Health and Recreation to establish CAN Bike Courses at various Recreation Centres	Planning for 2010 failed to attract instructors. The program is under review.
Metrolinx Partnership	Work with Metrolinx to deliver Smart Commute Programs including: Carpoolzone.ca Transitzone.ca Active Transportation Promotion GTHA-based Events	Ongoing work to plan events, work with employers, recruit employers, and report successes through surveys and statistical analysis.

For more information on Smart Commute Hamilton , visit: www.smartcommutehamilton.ca

5.2.2 Totally Transit

Since 2007, Green Venture has partnered with the Hamilton Street Railway (HSR) to deliver "Totally Transit" to elementary school-aged students. Totally Transit is bus education that teaches Hamilton elementary school-aged students how to properly use the HSR bus network while making the connection between air quality, climate change and transportation. Through hands-on experience this one-of-a-kind program empowers students to feel confident about choosing transit and other forms of sustainable and active transportation.

In 2010, Totally Transit was delivered to enthusiastic audiences in combination with an EcoHouse Sustainability Tour as a half-day program (Option 1); as a full-day partnership program with Hamilton's Museum of Steam and Technology (Option 2); and as a standalone lesson held at schools and community venues (Option 3).

Since 2007, Green Venture has presented Totally Transit to over 2,700 students from fifty (50) Hamilton schools. Another 820 students have received mini-Totally Transit Presentations at several school environmental fairs. Over 70% of these presentations included a chartered HSR bus to transport students and as a classroom for lesson delivery.

Totally Transit continues to receive very positive reviews from participant teachers and students alike. Teachers remain supportive of linking real-life skills to health and environmental education.

For more information on Totally Transit, visit: air.greenventure.ca/totally-transit

5.3 Smart Driver

5.3.1 EcoDriver

Green Venture's EcoDriver program aims to help drivers of light duty cars and trucks decrease their fuel use. EcoDriver was developed in tandem with Green Communities Canada and was originally funded by Ontario's Ministry of the Environment 'Go Green Fund'. In 2009 and 2010, Green Venture's EcoDriver activities were supported with funding from Natural Resources Canada (NRCan), and Clean Air Hamilton.

Driving produces tailpipe emissions that reduce air quality and contribute to climate change. EcoDriver encourages drivers to reduce the number of vehicle trips and choose sustainable transportation modes as often as possible. EcoDriver also recognizes that, since people will continue to drive, it is imperative that drivers learn and practice behaviour that will reduce their fuel usage and thereby reduce their vehicles' emissions and impacts on local air quality and global climate change. Through presentations, workshops, tire pressure clinics, media and communication materials, the program educates and encourages drivers to achieve fuel savings by promoting the following three core messages: Drive Fuel-Efficiently, Buy Fuel-Efficiently and Drive Less. The program also has a strong anti-idling component which is consistent with Hamilton's Idling Stinks Campaign (2006-2008) message that idling for more than 10 seconds requires more fuel than turning off and restarting the engine.

EcoDriver Tips:

- Try to be 100% fuel-efficient by walking, cycling and using transit.
- Turn the engine off when you will be stopped for more than 10 seconds.
- Leave a three-second buffer between you and the next vehicle to maintain a steady speed.
- Anticipate traffic speed changes and coast to decelerate.
- Find the recommended cold tire pressures on your vehicle information placard.
- Drive the speed limit on the highway for best fuel economy.
- Get in the carpool zone.

In 2009 and 2010, a total of thirty-three (33) presentations were made to groups; 583 Hamiltonians attended these sessions and over 60% made specific EcoDriving commitments. These participants included one hundred and eleven (111) City of Hamilton employees. Attendees of Green Venture EcoDriver presentations together saved an estimated 50 tonnes of CO_2 emissions from January 2009-March 2010 by EcoDriving. Face-to-face outreach at public events has delivered the EcoDriving message to a further 1000 people. Awareness of the EcoDriving program was communicated through public events, media announcements and eight segments on Cable 14's Hamilton Life program. Funding from Clean Air Hamilton and other support enabled Green Venture to exceed Ministry targets.

One EcoDriver takeaway message is that underinflated tires increase resistance and require a vehicle to burn more fuel. EcoDriver 'Tire Pressure Clinics' are designed to teach drivers how to check and maintain vehicle tire pressure properly for the best fuel efficiency. Holding EcoDriver clinics in public places attracts the public's attention and garners good attention from media. On August 21, 2010 Green Venture partnered with Canadian Tire at the Centre Mall for a second annual GV Tire Pressure Clinic. Green Venture demonstrated tire pressure checking techniques to eighty-three (83) members of the public and engaged thirty-one (31) other drivers in EcoDriver messaging. Hugh Turner, Manager of Canadian Tire's Automotive Service and his staff continued to be great partners on the day's events. Clean Air Hamilton's funding of the EcoDriver program enabled Green Venture to present a concurrent clinic at a separate location on August 21st. This tire pressure clinic was held at the Stoney Creek Municipal Service Centre, during a community open house and reached a further thirty-four (34) drivers.

Natural Resources Canada states that "by adopting a few simple driving techniques, the average driver could save $500 per year in fuel costs and prevent more than 1000 kg of CO_2 from needlessly entering the atmosphere." These simple techniques are what EcoDriver messaging espouses.

6.0 Urban Planning – Linkages to Air Quality

Hamilton's air quality is improving, thanks to the efforts of many companies and individuals, including stakeholders represented on Clean Air Hamilton. But the "low hanging fruit" of air quality improvements have already been picked; future air quality improvements will be much more difficult to achieve because many are associated with personal preferences, application of community land use by-laws and transportation choices by citizens, corporations and municipalities. This section examines the challenges involved in achieving air quality improvements through the co-ordination of land use planning and transportation-planning regulations.

The Planning Act was developed at a time when the terms 'urban planning' and 'urban form' were not commonly used in the same sentence with 'air quality.' We now understand that there is a very direct linkage between urban planning decisions and air quality in cities. Unfortunately, many policies and regulations governing urban planning decisions were crafted without specific reference to air quality considerations.

The by-laws that are related to air quality management strategies within the regulatory framework of a given municipality are the only public policy instruments available to municipalities. Municipalities in Ontario remain challenged to develop modern air quality improvement strategies in light of the planning tools available at their disposal.

Planners have always considered air quality in their plans. But their approaches have varied as the science and the regulatory and policy environments have evolved. This section reviews the evolution of planning policies as they affect air quality and makes recommendations on how best to achieve Clean Air Hamilton's multiple air quality strategic goals and objectives in light of the planning instruments available to municipalities.

6.1 Hamilton Urban Planning History:

Noulan Cauchon pioneered planning in Hamilton in the early years of the 20th century. He worked for the Hamilton Parks Board often under the direction of Thomas McQueston. His understanding of the relationships between air quality, public health science, urban development and planning led him to provide green spaces in Hamilton where the residents could recreate in the clean air associated with the Niagara Escarpment and the Beach Strip. Parks were a respite from industrial emissions, noise and the growing industrial activities associated with the port.

Early city master planning encompassed park planning and the separation of uses as methods addressing poor air quality and land use compatibility related to proximity to heavy industry. One of Hamilton's first residential suburbs, Westdale, serviced initially by commuter rail and automobile, was designed in part to provide respite and separation from industry for Westdale residents and McMaster University.

Hamilton's first master plan (1948), prepared by Eugene Faludi, extended this understanding with a recommended green belt comprised of the harbour, Beach Strip, Red Hill Creek Valley, the Niagara Escarpment and the Chedoke Valley. This combination of parks and open spaces built on the McQueston/Cauchon vision for Hamilton and helped preserve many of the natural areas and trails we enjoy today!

Faludi also recommended a program of removing electric rail facilities from Hamilton streets in order to enable more efficient automobile traffic. In 1963, a local engineering firm, C. C. Parker, together with Parsons, Brinkerhoff Ltd. using detailed computer modelling, completed a transportation master plan that affirmed the primacy of the automobile and truck traffic as major transportation modes.

More recently, downtown Hamilton urban renewal projects in the 50's and 60's sought to separate pedestrian traffic from vehicular street level traffic in part to address air quality issues. Urban blocks were consolidated and rooftop pedestrian facilities were constructed above Jackson Square's mall with second floor entrances and pedestrian passageways in the Library, Art Gallery of Hamilton, Ellen Fairclough Building and Convention Centre. Not every plan works! Costly and difficult changes have been and are needed to retrofit this innovation, work that remains incomplete.

Early zoning bylaws also regulated land use by prohibiting a category of uses known as 'obnoxious uses.' These prohibited uses included activities such as blood boiling, rendering and the like; these activities were prohibited in large part because of environmental and air quality concerns. With the introduction of air quality regulations, outright prohibition evolved to the application of performance and design standards intended to combine source regulation with land use separation.

6.2 The Land Use Compatibility Guidelines:

With the Environmental Protection Act and the introduction of governmental regulatory systems to address emissions in the 1960s, planning approaches to air quality began to evolve. In 1981, the Ministry of the Environment adopted the first of what became the D Series Guidelines addressing land use compatibility where industrial emissions sources exist. The Guidelines support the Ministry's regulatory system by providing separation between sensitive land uses, primarily residential uses, and industrial uses.

The D Series Guidelines began as Provincial policy and were used by Ministry of the Environment staff when planning applications were reviewed. These policies have been updated periodically over the years. A list of the current D Series policies can be found at: http://www.ene.gov.on.ca/environment/en/resources/results/index.htm?txtSearchType=library&txtSearchValue=D-Series%20Guidelines%20[Land-Use%20Policy]]

- D-1 Land Use and Compatibility
- D-1-1 Land Use Compatibility: Procedure for Implementation
- D-1-2 Land Use Compatibility: Specific Applications
- D-1-3 Land Use Compatibility Guidelines: Definitions
- D-2 Separation between Sewage Treatment and Sensitive Land Uses
- D-3 Environmental Considerations for Gas or Oil Pipelines and Facilities
- D-4 Land Use On or Neat Landfills and Dumps

- D-4-2 Environmental Warnings/Restrictions
- D-6 Compatibility between Industrial Facilities
- D-6-1 Industrial Categorization Criteria
- D-6-3 Separation Distances

Where industrial uses exist, the Guidelines are intended to ensure that sensitive land uses are properly set back from industrial facilities depending upon the industrial class, potential emissions and potential for adverse effects on more sensitive uses. These policies also enable reasonable use of adjoining lands with compatible uses.

Over the years, the Guidelines have remained largely unchanged except for the addition of more specific policies addressing noise. Whereas the Guidelines do not employ mitigation measures to address land use compatibility, the land use planning approaches to noise use an array of engineered mitigation measures.

The Guidelines place the onus of ensuring land use compatibility on the proponent of new development. "When a change in land use will place sensitive land use(s) within the influence area/potential influence area of one or more facilities, Ministry staff shall expect the proponent, along with the approval authority, to prevent land use conflicts.[3]"

For class three heavy industrial facilities, a potential separation distance of 1000 m is required unless detailed studies demonstrate a lesser distance will be sufficient. The lesser distance cannot be less than 300 m. Similarly for class 1 and class 2 lighter industrial facilities, potential separation distances of 70 to 300 m apply unless detailed studies can demonstrate that lesser distances will be sufficient. These reduced distances cannot be less than 20 m for class 1 facilities and 70 m for class 2 facilities.

The D Series standards are based in large measure on the accumulated experience of Ministry staff in implementing the Environmental Protection Act; the absence of that experience or access to persons with relevant experience hinders the effective implementation of the Guidelines in planning decisions.

The Guidelines, and their application, have their shortcomings. For example, where two or more industrial activities exist, cumulative potential effects of the emissions from both plants are not considered in any decision-making processes under the Guidelines. Moreover, ambient air quality issues (i.e., the background air quality that would exist if the major industrial plants did not exist) are not addressed in the analysis. Other important emissions sources such as tail pipe emissions, dusts from vehicle brakes or road dusts, especially along major roads such as along the 400 series highways and heavily used arterial streets are not considered in these analyses.

[3] Ministry of the Environment, Procedure D-1-1, Land Use Compatibility: Implementation, page 1.

6.3 Policy Development:

Planning Act decisions must be consistent with the Provincial Policy Statement 2005 (PPS). The latest PPS revisions were made in 2005 (see **Appendix D** for how air quality and climate change issues are addressed in the 2005 PPS). Otherwise, the document dates to 1997, the last occasion when it was significantly amended. Understanding how some policies were included, which policies weren't included, is important to understanding how the PPS addresses air quality.

Over time, several ministries (e.g., the Ministries of Agriculture and Food, Natural Resources) developed policy to apply in municipal planning decisions. The Comay Planning Act Review of the Planning Act (1977) considered this practice and recommended a series of Provincial Policy Statements that would be used by the Ministry of Municipal Affairs and Housing to address these policies in the Planning Act administration. The Act was amended to include Provincial Policy Statements. After public consultation, individual policies were approved for wetlands, housing and mineral aggregates.

Curiously, the D Series policies, which originated in 1981, were not elevated to Provincial policy statement status under the Planning Act whereas the Food Land Guidelines, which pre-existed the Comay Report, were. In 1993, the Sewell Report recommended that existing Policy Statements be integrated with other Ministry land use policy into a Comprehensive Policy Statement supported with technical manuals prescribing how policies were to be implemented.

The D Series policies were then downgraded from Provincial policy to guidelines and the Comprehensive Policy Statement was amended to include a policy on land use compatibility in an omnibus section addressing economic development issues. The technical documentation needed to implement this policy was included in the PPS technical manuals. Then the Planning Act was amended to require planning decisions to be consistent with these new policies.

The Province modified this approach in 1997. The Act was amended to require planning decisions to have regard to the PPS. Less clarity was provided as to the status of the technical manuals used to implement the PPS. In 2005, the Act was again amended to require decisions to be consistent with the PPS.

6.4 Planning Act Administration:

The Planning Act administration changed as the PPS evolved in two ways:

- a "one window" approach was initiated which made it more difficult for Ministry of the Environment staff to provide assistance when issues arising from application of the D Series guidelines were at issue; and

- larger urban municipalities, regions and counties were delegated Planning Act authority subject to a memorandum of understanding between the Minister of Municipal Affairs and local elected officials putting further distance between Ministry of the Environment staff and frontline planners.

These memoranda provide for technical training for municipal staff who administer the Guidelines. But often this training involved covering many topics and complex technical matters in a relatively short training period. As a result, D Series guidelines training and implementation often suffer in comparison to the training provided for other policies of the government. Municipal staff across the province are challenged to know how to apply these complex guidelines in the context of specific planning situations.

The Ontario Municipal Board hears appeals from municipal Planning Act decisions. As a practical matter, if municipal decisions are not supported by Provincial policy and/or good science isn't available to decision makers, these decisions are vulnerable to be overturned.

On the one hand the PPS, and its administration, provides thoughtful direction to municipal decision makers on important Provincial policy. However, it also sets boundaries for Planning Act decisions. The scope of decision making can be limited, especially where the emerging body of public health science on land use is concerned. All things considered, the administration of the Planning Act is fettered where emerging science is concerned because there aren't clear requirements in the legislation or PPS to address this science in decision-making.

6.5 Emerging Considerations:

6.5.1 The D-6 Guidelines:

The D Series Guidelines have not been systematically reviewed since their creation. Amendments have added new policies and wording revisions. The most significant change to these Guidelines has been the removal and development of separate guidelines for noise. Earlier editions of the Guidelines had addressed noise as well as air quality and odour issues.

With the introduction of Ontario Regulation 419, stricter air quality standards were set; however, provisions for alternative standard setting were also provided. Alternative standards can be developed when a given facility cannot meet the O. Reg. 419 guidelines all of the time. In Hamilton both of the large steel companies are developing or have developed alternative air quality standards in consultation with the Ministry of the Environment and stakeholders. The alternative standards procedure has significant implications on the application of the Guidelines where air quality is concerned.

Previously, the administration of Ontario Regulations 346 and then 419 identified the property boundary as the 'point of impingement' (POI) where the required air quality standards must be met. Alternative standard setting requires greater attention to sensitive uses beyond the property boundary because the regulated air quality standards are met at points outside the facility's property boundary. This situation isn't addressed in the Guidelines.

In addition, the earlier concerns identified with the cumulative effects of emissions from multiple facilities, the ambient air quality and emissions from major transportation corridors also need to be addressed in the future if we wish to have meaningful policy that reflects the realities in the built environment.

6.5.2 Emerging Issues:

The Canadian Committee of Environment Ministers (CCME) recently reached agreement on a new framework for a new Comprehensive Air Management System (discussed elsewhere in this report, see **Section 3.11**) and the development of new legislative and policy frameworks to address air shed and air zone management. These recent changes in policy support initiatives developed and championed by Clean Air Hamilton over the years.

New municipal and Provincial land use and transportation policies will be needed to support the administration of these new frameworks, especially where mandated air shed and air zone air quality standards are not met. These policy changes are very significant developments and will drive future land use policy and transportation innovation.

Clean Air Hamilton has championed the importance of the relationship between air quality and public health over the years through funding initiatives and through presentations at the biannual Upwind/Downwind Conference. Clean Air Hamilton has also stressed the close relationship between energy conservation and climate change and has highlighted these as topics of significant concern for the future. Transportation emissions are a major source of airborne contaminants and are a significant determinant of local air quality as well as a major source of greenhouse gases.

There is also a considerable body of public health research on the relationship between increasing obesity and decreasing physical activity among the population across North America; moreover, several chronic diseases are more prevalent in low housing density, automobile-reliant areas such as suburbs. The 'sprawl' and automobile-reliant styles of urban development either helps cause these diseases, exacerbates existing conditions or makes their treatment more difficult or both. Greater emphasis on pedestrian and cycling mobility in land use planning and transportation systems planning is needed. The Urban Public Health Network (representing Medical Officers of Health from across the country), together with important research funders and disease-based agencies like Heart and Stroke Canada and the Canadian Partnership against Cancer are among the principal advocates generating this research and seeking its application in the planning of urban environments.

Similarly, the Province has developed a climate change action plan using work from the United Nations, Federal Departments like Natural Resources Canada and university researchers. In November 2009, the Premier's Expert Panel on Climate Change Adaptation reported with a number of recommendations. The Ministry of the Environment is co-ordinating a Provincial response to these recommendations presently.

Unfortunately, this emerging science has made little impact on the Ministries traditionally involved in the PPS and Planning Act administration. Moreover, a strong body of research has been developed addressing the built environment, transportation planning and physical activity; the goal of this research is to develop approaches to the design of more active, sustainable built environments and transportation systems that serve these environments.

The Canadian Green Building Council is adapting the US-developed LEED Neighbourhood Design (LEED ND) standard in Canada. The wide-spread application of LEED ND will address many concerns raised in this section. These energy efficiency standards are currently being used in the United States and will be available in Canada later this year. The availability of LEED ND standards will be a significant step forward for Hamilton residents as well as for the home building industry and home buyers.

In the near future Peel Region will produce a public health checklist to be applied to new developments. This checklist will also address many of the concerns addressed in this section. Halton Region is also developing separation distance standards to address air emissions associated with vehicular traffic on 400 Series Highways and major arterial roadways.

These efforts deserve support and, where possible, application in the City of Hamilton.

After the Walkerton Inquiry, Provincial Ministries responsible for implementing the Inquiry's recommendations began drafting new legislation and policy to implement the Inquiry's recommendations. The Nutrient Management and Clean Water Acts are of particular interest. The matters addressed by the Nutrient Management Act are exempted from Planning Act considerations. Alternatively, Planning Act decisions must be either consistent with or have regard to some decisions made under the Clean Water Act.

The Green Energy Act, an important initiative under the Province's Climate Change Action Plan, exempts approvals of green energy projects from the Planning Act. The enabling legislation bill also provides for an amended Environmental Bill of Rights requiring the Environmental Commissioner to report annually to the legislature on greenhouse gas emissions and actions to reduce these emissions. The Act will also require public institutions to prepare energy conservation plans in the future. The provisions for conservation plans were amended by the Water Opportunities Act to also include water as a topic along with energy conservation.

The Province appears to be addressing the shortcomings of the Planning Act and the PPS by stepping outside the Planning Act where new legislation and policy is needed to address environmental, public health and conservation concerns. There may be opportunity for the City of Hamilton to do likewise, especially where City infrastructure and property is concerned.

The application of public health science evidence-based land use design will be important if Clean Air Hamilton's multiple air quality goals and objectives are to be achieved. Land use design is especially important where active and sustainable transportation strategies are concerned. The built environment elements critical to a sustainable and safe pedestrian environment can be characterized as follows:

- Proximity to interesting streets with a mix of institutional and commercial uses fronting onto streets (Floor area ratios, patios, front and side yards, parking requirements and the ratio between the building heights and the street right of way are particularly important)

- Provision of shade trees and the organization of the public realm with storefronts such as grocery stores and patios, pedestrian plazas

- Traffic volumes and speeds together with the street context, i.e., right of way design, sidewalk width, cycling facilities and provisions

- Formal and informal programs that support and promote physical activity and the use of public transportation

- Residential and employment densities

- Street connectivity, intersection density and block length (i.e., pre and post WW2)

- Either proximity to employment or proximity to effective, higher order public transit

- Proximity to green space can work two ways

- Proximity to public and private physical activity facilities and parks

- Socio-economic and demographic status

These elements can be reconstituted to apply in land use and transportation design in the following manner:

- Neighbourhood planning should characterize the health related attributes (such as the demographic profile) of their residents in order to calibrate the overall age friendly land use and transportation approaches needed. Once set, the following physical design measures can be considered.

- Design of the travelled portion of the street or road to accommodate pedestrian, cyclist and vehicular traffic in an interesting and safe manner so each mode can meet travel needs.

- Context sensitive design is needed to provide amenities within the right of way that make public transit, pedestrian movement and cycling effective alternative transportation modes including better access to interesting destinations is needed, such as shade, differing sidewalk widths, pedestrian plazas etc.

- Surrounding land use patterns must be better oriented to streets by using planning policies including higher floor area ratios, lowered parking standards, minimum side yard and front yard setbacks together with provisions for patios and sidewalk displays such as produce where grocery stores exist.

- Supportive policy addressing matters such as urban Braille, transportation demand management, walking to school programs and age sensitive design are also needed to address the demographic variations of neighbourhood residents.

Many of these measures can be pursued on City right of ways/infrastructure and provide direction for planning decisions.

Clean Air Hamilton can make important contributions to the research needed to support efforts designed to implement these measures. Direction is needed on how the air quality health index can be used as a supportive policy. Further clarity is also needed on how the mobile air monitoring program and results can be used in decision making to implement this framework. A balance needs to be found between active transportation and vehicular and goods movement where inhalable and respirable particulate is concerned.

6.6 Recommendations:

1. There needs to be a comprehensive air quality management policy, preferably in the City Official Plan, addressing how the many factors discussed in this section will be addressed and co-ordinated with other municipal policy goals and objectives.

2. Clean Air Hamilton should provide direction to City Departments on how the new air quality health index (AQHI) can be used in other municipal programs, policies and plans.

3. Clean Air Hamilton should provide direction as to how the results from mobile monitoring program research can be integrated into municipal decision making.

4. A balance needs to be found between active transportation and vehicular and goods movement where inhalable and respirable particulate is concerned.

7.0 *Clean Air Hamilton* Programs and Strategic Activities

7.1 Upwind Downwind 2010 Conference

Every 2 years *Clean Air Hamilton* hosts the Upwind Downwind Conference, a 2-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 2010 Upwind Downwind Conference: Air Knows No Boundaries (Conference) was held on Monday, February 22nd 2010 at the Hamilton Convention Centre. The one-day conference aimed to provide a forum to enable an improved understanding of air quality and climate change issues and the impacts on communities, human health and the economy. To achieve these goals, the themes of the conference were “Transboundary (Cross border) Air Issues” and “Innovative and Practical Solutions” with adjoining themes of “Innovative Energy Future” and “The Carbon Neutral Future.”

The Conference invited 19 speakers from the fields of human health, science, public policy, federal and provincial government and community initiatives. Featured speakers included the Environmental Commissioner of Ontario, the Northeast States for Coordinated Air Use Management (NESCAUM), the National Aeronautics and Space Administration (NASA), the Canadian Urban Institute, and the Town of Eden Mills.

The 2010 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 in the areas of cross border air policy, energy and carbon neutral living. The Conference attracted 243 attendees including staff at the federal, provincial and municipal levels, health practitioners, planners, academics, university, college and high school students, community groups and non-governmental agencies.

A 2-day Hamilton Green Solutions Marketplace (Marketplace) on Sunday, February 21, 2010 and Monday, February 22, 2010 was also a feature of the 2010 Conference. The Marketplace was free for the public to attend and featured 53 exhibitors who offered information, products and solutions to issues of air quality and climate change.

A prominent feature of the Marketplace was the Green Solutions Stage on Sunday, February 21, 2010. The Stage was a free venue for the public that featured topics on eco buildings and energy savings, local food cooking demonstrations, Cool Climate Science with Jay Ingram of the Discovery Channel’s “Daily Planet”, and a RevWear Fashion Show finale. Approximately 745 individuals from the public attended the Marketplace.

Conference presentations are available at: www.cleanair.hamilton.ca/default.asp?id=47

7.2 Community Energy & Energy Mapping

As the City of Hamilton engaged in planning for growth in 2005, questions arose about the impact of peak oil and possible steep increases in the prices of oil and natural gas on plans for the community. Peak Oil refers to the point at which total global oil production cannot grow any further and begins to decline[4]. Oil is a fundamental building block of our industrial economy. Our industries, businesses, homes and cities have been built with the assumption that oil will be readily available at affordable prices. However, world oil supply and demand are rapidly changing and the price and on-going supply has become uncertain. In 2005, the City of Hamilton prepare d a study on Peak Oil.

Hamilton's Peak Oil report can be accessed at:
http://www.ibiblio.org/tcrp/lib/hamilton_peak_oil_report.pdf

Upon receipt of this report, Council directed staff to undertake a series of actions that will help Hamilton prepare for the threats posed by increasingly limited oil supplies. The City of Hamilton has established a number of policies that will reduce the City's risk of exposure to increasing and fluctuating oil prices. These include the Corporate Energy Policy and the City's Green Fleet Policy. The City has also established some policies that will help to protect the community from the risks of oil supply constraint. These policies include the Hamilton Transportation Master Plan (HTMP) and the "LEEDING the Way Community Improvement Project"

The Hamilton Community Energy Collaborative was established with the purpose of evaluating City-wide vulnerabilities by examining the most recent predictions with respect to peak oil and evaluating Hamilton's energy profile. Vulnerable people, services, geographic areas or sectors will be identified as well as challenges and opportunities provided by the predicted changes in oil availability and price. The Collaborative will examine challenges and opportunities in terms of four themes:

- Growth and Sustainable Urban Planning;
- Economic Sustainability;
- Social Sustainability; and,
- Environmental Sustainability.

In 2010, as part of an initiative funded by the Ontario Power Authority, four Ontario communities (Guelph, Hamilton, Barrie and London) participated in energy mapping pilots. In a partnership between Horizon, Union Gas and the City of Hamilton, data was gathered to evaluate energy reduction opportunities for new and existing buildings, review the application of cost-effective alternative technologies and renewable fuels and to assess the potential to reduce the impact of transportation-related energy use. Baseline data from 2006 was used to create the energy maps. The mapping data will be useful for assessing the impact of land-use and transportation decisions and for linking population and employment growth and housing objectives with energy consumption and supply concerns.

[4] Daniel Lerch Post Carbon Cities: Planning for Energy and Climate Uncertainty 2007

Hamilton Energy Mapping Final report can be accessed at: http://www.canurb.org/energymapping

7.3 Energy Conservation

7.3.1 Horizon Holdings / Horizon Utilities / Horizon Energy Solutions

Horizon Holdings Inc. is the owner of Horizon Utilities Corporation, the municipally-owned local electric distribution company, and Horizon Energy Solutions Inc., an energy services company. The company continued its sustainable development leadership focus in 2010, building on being awarded Company of the Year by the Ontario Energy Association (OEA) in 2009. This was for being the first electricity company in Ontario to publish its annual report as a Sustainability-Based Annual Report and make a Global Reporting Initiative™ (GRI) filing.

In 2010, Horizon completed its second Sustainability-Based Annual Report and also sought and received "external assurance" of its GRI filing from Ernst and Young, furthering its commitment and transparency. The sustainability-based annual report focuses on the social, environmental and economic dimensions of the company's business and the GRI filing benchmarks its performance on these metrics against the rigorous of this international standard for sustainable development.

Horizon Utilities remains the only company in the Ontario electricity sector to report to the GRI standard and publish its annual report as a sustainability-based annual report.

Horizon Utilities' Sustainability-Based Annual Report can be read at:
http://www.horizonutilities.com/HHSC/html/leadership/sustainableDevelopment.jsp

7.3.2 Horizon Energy Solutions Inc.

Horizon Energy Solutions has been an affiliate business of Horizon Utilities for the past 3 years. Prior to the introduction of the Green Energy Act, its primary operation focus was being one of the few accredited wholesale market metering services providers in Ontario, but with other interests in sentinel lighting and water heater rentals.

In 2010, Horizon expanded its offering to full turnkey solar PV rooftop installations for customers in Ontario. Solar PV is a zero-emission power generation process. As more systems continue to be installed in Hamilton and the whole of Ontario over the next 2 to 3 years, the provincial reliance on greenhouse gas producing forms of power generation will lessen. Horizon is proud to be at the forefront of this policy shift.

For more information, visit:
http://www.horizonenergysolutionsinc.com

7.3.3 Horizon Utilities Internal Emissions Reporting

In 2010, Horizon took the bold step of publishing all of its corporate (facilities and vehicles) emissions data. Doing so now provides Horizon with the baseline figures from which to reduce its overall corporate emissions. Since transportation and equipment are some of Horizon's largest emission sources, Horizon has taken a proactive emissions reduction approach.

With regards to transportation, Horizon now has 13 hybrid service vehicles. The biggest new development is that Horizon took possession of its first double axle, single bucket plug-in hybrid truck, which is also one of the first in Ontario. This truck is unique because, not only does the hybrid capability move the vehicle, it can operate the truck's boom, emergency lights, and heating and cooling are operated by batteries for up to 8 hours without the diesel engine running. Horizon also took possession of its second single axle, single bucket hybrid truck and, in addition to its existing fleet of 8 hybrids, Horizon procured two more Ford Escape hybrid trucks to complement its overall fleet.

Some additional transportation highlights:

- In the past year, Horizon developed and rolled out a Corporate Vehicles and Equipment Idling Policy and a Vehicle Emissions Plan.
- Horizon acquired four splice vans equipped with separate interior and exterior cooling units, reducing the need to for engine idling.
- Odyssey Batteries were installed on all service vehicles. The batteries allow many of the equipment and emergency lighting to operate without the use of the engine, thus reducing idling.

Within Horizon's facilities, a number of initiatives were taken to reduce emissions. The temperature in service rooms was decreased to 14.4°C from 15.6 °C during the winter months. In addition, three rooftop air/heating units were replaced with energy efficient units.

Horizon was involved in tree planting around the community. In 2010, Horizon employees volunteered their time to plant 350 indigenous trees and shrubs.

Horizon Utilities' Facilities Emissions Report can be accessed here:
http://www.horizonutilities.com/pdf/susDev/HHI2009FacilitiesEmissions.pdf

7.3.4 Conservation and Demand Management

In partnership with the Ontario Power Authority, Horizon Utilities is committed to ensuring its customers have a reliable and cost-effective electricity system.

Horizon Utilities, in conjunction with the Ontario Power Authority (OPA), makes it simple for residents to conserve energy and ease the strain on the electricity system during summer peak demand times. The *peaksaver*® programmable thermostat allows residential and small commercial customers of Horizon Utilities with central air conditioning to help reduce the demands on Ontario's electricity system. During critical times of peak electricity demand (typically on hot summer days), a signal can be remotely sent by the OPA to cycle the central air conditioner's compressor (15 minutes on, then 15 minutes off) over a 4-hour period, to reduce the amount of electricity it uses. In 2010, 1,603 *peaksaver*® programmable thermostats were installed in Hamilton.

To book an appointment call peaksaver® at 1-866-323-0206
For information on the *peaksaver*® Program or to sign up, visit:
www.horizonutilities.com/HHSC/html/conservation/con_OPApeaksaver.jsp

The Power Savings Blitz program provides up to $1,000 worth of installed electricity-saving products (primarily lighting), offered free of charge, to small business customers with loads under 50 kW. Customers are not obliged to purchase any equipment or pay any assessment fees in order to receive program-specific energy upgrades.

In 2010, a total of 1,524 small businesses in Hamilton had received retrofit upgrades for improved indoor lighting with some customers reducing lighting expenditures by up to 50 per cent.

For information on the Power Savings Blitz Program or to sign up, visit:
http://www.horizonutilities.com/HHSC/html/conservation/con_PowerSavingsBlitz.jsp

The Electricity Retrofit Incentive Program (ERIP) is for larger customers and focuses on retrofitting an existing facility with newer more energy efficient equipment. Technological improvements often make newer equipment more efficient and effective than old equipment.

ERIP is of the greatest assistance on the energy use areas of lighting, motors, heating, ventilation and air conditioning, and overall electricity systems. These areas cover the majority of and most important electricity upgrades businesses undertake. By taking advantage of this program, businesses can contribute to a cleaner environment and benefit from incentives and lowered operating costs.

In 2010, Horizon Utilities' customers contributed 2882 kW in peak demand reduction in Hamilton through the ERIP program. Horizon awarded Hamilton Health Sciences the largest rebate in Ontario in 2010 amounting to $639,138.

For information on ERIP, visit: https://saveonenergy.ca/Business.aspx

7.4 Tree Programs

7.4.1 Hamilton ReLeaf Network

ReLeaf Hamilton was established in 2008 to facilitate and encourage collaboration among organizations and individuals interested in greening Hamilton's landscapes. Operating as a network, the group developed out of a Tree Symposium initiated by the Hamilton-Wentworth Stewardship Council, an event that brought together more than 50 people from different perspectives who all shared an interest in the well-being of Hamilton's urban forests.

The vision of the Hamilton ReLeaf Network is "Greening Hamilton's Future" The Hamilton ReLeaf Network aims to facilitate and encourage the collaboration of partners in the greening of Hamilton's natural landscapes. ReLeaf Hamilton wishes to develop and make widely available resources and tools for strategic planning related to Hamilton's natural heritage systems.

ReLeaf Hamilton is working towards completing a Natural Heritage System modelling exercise so that the model is available and useful for all its members and the wider public; Providing resources for maintaining & improving natural heritage systems in Hamilton; and, educating the public about the value of natural heritage systems in Hamilton.

Table 12: ReLeaf Hamilton Partners

Conservation Halton	Hamilton Naturalists Club	Kayanase
Royal Botanical Gardens	Hamilton-Halton Watershed Stewardship	Environment Hamilton
City of Hamilton	Ontario Ministry of Natural Resources	Hamilton-Wentworth Stewardship Council
Hamilton Conservation Authority	Hamilton Industrial Environmental Association	Environment Hamilton
Clean Air Hamilton	Grand River Conservation Authority	Earth Day Hamilton
McMaster University	Niagara Peninsula Authority	Carolinian Canada Coalition

For more information on ReLeaf Hamilton visit: www.releafhamilton.ca

8.0 Conclusions and Recommendations

Over the past ten years, there have been dramatic improvements in air quality in Hamilton. These changes will have contributed to better health for citizens as well as improved perceptions of the City. The long-term downward trend in air emissions continues due to the concerted actions of individuals, organizations, industries, the City of Hamilton and other levels of government.

Clean Air Hamilton has had long-standing concerns about the relationship between air quality and public health. Energy conservation and climate change have been highlighted as topics of significant concern for the future. Transportation emissions are a major source of airborne contaminants and are a substantial determinant of local air quality as well as being a significant source of green house gases.

- Health research continues to identify new impacts of exposures to air pollutants ($PM_{2.5,}$ PM_{10}, NO_x, and SO_2) on the health of citizens. The *Clean Air Hamilton* 2003 Health Study is being updated to reflect the current level of knowledge in air quality health research and to identify the monetary costs resulting from exposures to local air pollutants (both health care costs and costs due to lost productivity). The results of this work will be reported in 2011.

- Air monitoring allows for the collection of outdoor air quality data; these data can then be used to identify local sources of air emissions and to evaluate the potential health impacts on humans due to these exposures. Hamilton has a limited network of fixed air monitors at present; many areas of the city and a number of emissions sources are not adequately monitored, creating gaps in local knowledge of air quality and air emissions. *Clean Air Hamilton* has had as a long-term goal the expansion of the fixed air monitoring network in the city. When combined with data from mobile monitoring, the monitoring of new areas of the city and the identification of any community "hot spots" will be the result. This monitoring will also enhance the knowledge of local air emission sources and their impacts. This information will assist decision-makers in the development of policies and initiatives to reduce local emissions within the community and thereby the exposures of citizens.

- The Government of Canada has developed an Air Quality Health Index (AQHI). *Clean Air Hamilton* has encouraged government agencies to bring the AQHI reporting system to Hamilton. The AQHI is being piloted in Hamilton as of June 2011.

- Comprehensive Airshed Management has been proposed for improving air quality across Canada. *Clean Air Hamilton* is interested in engaging with the Province to partner and inform the development of a place-based airshed management system for 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 their transportation planning and urban design practices. A balance needs to be found between active transportation, vehicular and goods movement where Particulate Matter (PM_{10} and $PM_{2.5}$) is concerned.

- 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, from stationary and mobile sources.

- Undertake partnerships and enhance air monitoring in Hamilton to increase coverage of local sources throughout Hamilton through fixed stations, portable monitors, and increased mobile monitoring.

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

- Take measures to reduce energy consumption in City buildings and fleets. Educate and encourage the community to reduce their energy consumption at home, business and on the road.

- Take a broad suite of actions to improve local air quality and combat climate change 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 2011, *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 cultivate partnerships with organizations that have goals that are consistent with those of *Clean Air Hamilton* and the City.

Appendix A: 2010-2013 *Clean Air Hamilton* Strategic Plan

CAH = *Clean Air Hamilton*; City = City of Hamilton; EC = Environment Canada; EH = Environment Hamilton; GV = Green Venture; HAMN = Hamilton Air Monitoring Network; HC = Health Canada; Horizon = Horizon Utilities; HSR = Hamilton Street Railway; McMaster = McMaster University; Rotek = Rotek Environmental; MOE = Ministry of the Environment; NRCan = Natural Resources Canada; PH = Public Health; TDM = Transportation Demand Management; UHI = Urban Heat island

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
Public Health Protection	Heat Alert, Corporate Smog Plan	Concern for the public health in regards to air quality; expand health base for Air Quality Index (AQI)	HC, PH	Air Quality Health Index (AQHI)	How individuals can avoid health problems tie health based AQI	Introduce AQHI to Hamilton	2010- 2012
			HC, PH, school boards, Parks & Recreation; GV		Create a standard package for the community and corporate areas so they know what to do to protect health during inversion or smog days	Community Smog Plan	2010- 2012
			HC, PH, McMaster, Rotek, MOE, City	Air Quality Health Mapping		Air Quality Health Mapping on website, collaborate data with existing air monitors and mobile monitoring with health qualifiers	2012- 2013
	Health Impacts		HC, PH, McMaster, Hospitals		Special package alerts for physicians and health care providers	Community Smog Plan	2010- 2012

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
			PH, McMaster	Update 2003 CAH Health Study			Underway, to be completed 2011
Active & Sustainable Transportation	Smart Commute Hamilton; Transportation Management Association; TDM (City); Active & Safe Routes to Schools (PH); Metrolinx; Events: Open Streets Hamilton, Clean Air Commute, Transportation Fair, Walk and Bike to Work Day, Car Free Day, Carpool Week, Carpool Incentive Program	Encourage the use of active and sustainable means of healthy transportation, reduce emissions from personal transportation, increase the liveability of the city and citizen health by integrating exercise into daily routines through active transportation	Planning & Economic Development, Public Works (TDM), Cycling Committee, Public Health, Metrolinx, Smart Commute, local industry and businesses, local schools, institutional partners: McMaster, Mohawk College, Hamilton Health Sciences, St. Joe's Hospital, as well as: Horizon Utilities, CAA, McMaster Innovation Park, ILR Industries and others.	Bike Share Feasibility Study; Car Share Expansion Program; Feasibility to provide corporate telework; secure bike parking construction, cycling racks & amenities; preferential carpool parking; insurance rate reductions; subsidised transit pass programs; emergency ride home programs; TDM and Land use research and workshops; Environmental Pricing Reform	Event Promotions, Transportation Fair, Community Information Booths, Open Streets Hamilton; Transportation Summit, Cycling workshops/event; overall promotion of sustainable mobility options; education and awareness of single occupancy vehicles, negative environmental impacts; use of the web including the promotion of carpoolzone.ca, emergency ride home program and EC transit pass promotions	Establish a Local TDM Association – Best practices for Hamilton businesses and schools on promoting active and sustainable transportation; Travel Demand Analysis for workplaces using an employee survey and customized demand management plans; Policy Analysis and Advocacy; Events and Programs to reduce SOV use; education programs including Stepping It Up	On-going

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
		Reduced emissions from driving year round. Prioritize building on success and momentum.	GV, Commuter Challenge participants, Chamber of Commerce, HSR, School boards, GV, EH		Smart driving communication program- EcoDriver	Promote behavioural shift	2010 – 2012
	Cycling	Encourage cycling in Hamilton	Hamilton Cycling Committee, Hamilton Cycling Master Plan, GV, City		Letters of support for cycling lanes implemented under Hamilton Cycling Master Plan	Hamilton Bike Share	2011-2012
	Totally Transit	Transit -change drivers into riders, get young people before they become drivers, make sure riders stay as riders	HSR, School boards, GV, EH			School bus education program at schools; promote behavioural shift	2008 - 2011
	Electric bikes and vehicles	Ebikes and vehicles already coming in the market, but confusion around rules and usage.	Public Works, Province, Hamilton Police, GV	What are electric bikes and vehicles? What are the rules around usage?			2011-2012

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
Smart Driver	Idling Stinks campaign, NRCan Idle free program, Idle by-law	Reduce unnecessary vehicle idling in Hamilton	GV, City		Information on idling and by-law	Promote behavioural shift. Enforcement needed	On-going
	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	Smog Patrol Enforcement Blitz, remove diesel engines, have a form of regulation that would not allow dirty diesel engines within city boundaries	On-going
	Hamilton CarShare	Reduce demand for vehicle ownership and therefore unnecessary trips	Guelph CarShare Co-op, People's Car, GV, EH		Engage interested Hamiltonians	Hamilton CarShare Co-op	Completed. Car Share launched in 2009
	Eco-driver	Promote green driving habits to drivers	GV, City, Green Communities		Green driving tips	Eco-driver program	2009- 2011

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
Air Monitoring	HAMN required for industries to monitor airshed	All emitting industries should participate in HAMN	HAMN, MOE		Provide HAMN data online	Encourage MOE to undertake monitoring requirement in CofA	On-going
		Mobile Monitoring	MOE, EC, City	Inversion days, health impacts data, health mapping, construction and fugitive dust		Continue mobile monitoring- health mapping, begin Neighbourhood Air Monitoring 2010-2011 Look into funding for more monitoring.	2004-2008, 2009-2012
	Air Zone Management	Pilot an airshed zone management approach in Hamilton.	MOE, City, Public Health, Public Works			Work with MOE to pilot approach. More air monitors in Hamilton.	2011-2013
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, Mohawk, Reedemer	Indicators of local action on air quality that could be reported in addition to air quality parameters	Work that Clean Air Hamilton and partners undertake, air quality data to students for projects.	School board and Mohawk rep on committee. Upwind Downwind 2012	Underway 2010 - 2012
		Educate the public: what are the problems? How do they affect you? What can you do?	GV				On-going

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
		CAH is effective and efficient –must maintain support	City, MOE, EC, HC		Meetings, displays, presentations	Seek awards, seek funding, orientate local politicians and councillors of work.	On-going
	CAH website	Update and current, user-friendly and informative	Planning & Economic Development		Update material		On-going.
Climate Change	Corporate Air Quality (AQ) & Climate Change (CC) Plan; Climate Challenge (EH)	The linkages to AQ	Environment Canada, MOE, McMaster	Research linkages to AQ (CO, NO_x) and actions	Outreach on AQ & CC linkages	Air Pollutant and GHG Inventory	On-going Inventory undertaken in 2009
		Subcommittee to look at city-wide CC issues	City, McMaster, GV, EH, Conservation Authority		Presentations, Discussion Papers, Meetings with stakeholders.	Create a Community CC Action Plan	Underway 2010-2012

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
Emissions Reductions		Develop Local Poor Air Quality Notification system that can trigger immediate action by industry in poor air quality situations; Drive action when needed; Protect health			Local Poor Air Quality Notification System (MOE)	Local Poor Air Quality Notification System (MOE)	On-going, Notification system began in 2010
	Fugitive dust - construction areas	Addressing construction sources and industrial sources of fugitive dust	City, MOE, Rotek, Hamilton Construction and Development Associations	What are others doing? Mobile monitoring	Website	Dust Abatement Workshop II	2012-2013
	Mow down pollution programs, Leaf blower education	Reduce usage of two-stroke engines, tie in with pesticide education	GV, Home Depot, Lowes, Home Hardware	Impacts of small engines	Small engine alternatives	Encourage alternatives to small engines, small engines exchange program	2010- 2012
	Odour complaints	Communication of what to do on Odour complaints	MOE, City		What do you do when you smell an odour associated with poor air quality?	Webpage to communicate actions and where to complain	Completed in 2010
	Burn It Smart, City Burning By-law	Educate the public on wood burning stoves, emissions and health	NRCan, EC, GV, City		Website - Wood Burning Stoves and applications in Hamilton	Website - Wood Burning Stoves and applications in Hamilton	Completed in 2009

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
Energy Conservation	Horizon programs; Energy roundtable	Promotion / energy conservation & alternatives	Public Works, NRCan, Horizon, GV			Promotion / energy conservation & alternatives	On-going
	Energy Audits	Energy conservation and savings (low income neighbourhood)	GV				On-going
Land Use Planning	Urban Official Plan; Provincial Policy Statement; Places to Grow; Greenbelt	Density, infilling, community planning, air quality impacts.	Planning & Economic Development, Public Works, GV	Impacts on air quality of infilling and development		Guidelines, Planning directions for development to mitigate impacts. Require air quality monitors and air quality to be factored into development - industrial, commercial , residential	2012-2013
	Hamilton Community Energy Collaborative	Energy mapping in the community					2010- 2011 Energy mapping completed 2011

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2010 Update
	Urban Heat Islands	Reduction of UHI in urban environments	Planning & Econ. Dev, PH, Public Works, GTA Clean Air Council, NRCan, MAH, HC	UHI strategies, green roofs, white roofs, mapping hot spots in Hamilton			2012-2013
Tree Programs	Numerous tree planting programs in City (Red Hill Valley, Councillors, Street Planting, Earth Day, Ikea), Hamilton ReLeaf Committee	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 neighbourhood)		Develop a tree networking body --Tree Roundtable to consolidate efforts = Hamilton ReLeaf Network	On-going Hamilton ReLeaf Network formed in 2008

Appendix B: 2010 *Clean Air Hamilton* Financials

In 2010, the Air Quality Budget for the City of Hamilton and *Clean Air Hamilton* was $80,000. Financial contributions for other sources was $63,500. In-kind contributions including volunteer time and advisory role of *Clean Air Hamilton* members on programs was $129,350.

2010 *Clean Air Hamilton* Financial Report				
Project/Program	**Clean Air Hamilton Contribution ($)**	**Other Contribution ($)**		**Total ($)**
		Financial	**In-Kind**	
Eco Driver	$11,000	$13,000 – Natural Resources Canada	$1,200– volunteer time	$25,200
Totally Transit	$6,000		$3150 - Hamilton Street Railway service and $150 - volunteer time	$9,300
Small Engines	$5,000		$450 – volunteer time	$5,450
High school Heroes	$9,000		$200 – volunteer time	$9,200
Clean Air Hamilton Events and Communications	$9,000		$200 – volunteer time	$9,200
Neighbourhood Monitoring	$10,000	$50,000 – ArcelorMittal Community Grant	$30,000 – MOE use of vehicle $15,000 – Rotek Env Inc. $10,000 – Corr & Associates	$115,000
Advisory			$69,000 – Members	$69,000
TOTALS	**$50,000**	**$63,000**	**$129,350**	**$242,350**

On February 21 and 22, 2010, *Clean Air Hamilton* and the City hosted the 2010 Upwind Downwind Conference: Air Knows No Boundaries, and the Hamilton Green Solutions Marketplace at the Hamilton Convention Centre. The total cost of the 2010 Upwind Downwind Conference and Green Solutions Marketplace was $57,950. The total revenue was $45,075, which included $10,840 from registration fees, $3,735 from exhibitors and $30,500 from funding. City of Hamilton provided staff resources to procure sponsorship, coordinate logistics, facilitate meetings, process registrations and promote the Conference agenda ($50,000). In addition, the Ontario Professional Planners Institute assisted in distributing notices about the Conference ($3,000). Planning Committee members helped confirm speakers and facilitate Conference sessions. Volunteers helped on the registration desk during the Conference.

2010 Upwind Downwind Conference Funds/Grants

Organizations	Donation
Hamilton Planning Department	$50,000 **in-kind**
Hamilton Public Health Services	$10,000
Environment Canada	$8,000
Ontario Ministry of the Environment	$5,000
Ontario Professional Planners Institute	$3,000 **in-kind**
Health Canada	$2,500
Hamilton Industrial Environmental Association (HIEA)	$1,000
Rotek Environmental Inc.	$1,000
Horizon Utilities	$1,000
ArcelorMittal Dofasco	$1,000
McKibbon Wakefield Inc.	$500
McMaster Institute of Environment and Health	$500
TOTAL – CASH	$30,500
TOTAL – IN-KIND*	$53,000*
Total	**$83,500**

The revenues generated at the Upwind Downwind Conference are used in the planning and administration of future Conferences by Clean Air Hamilton.

Appendix C: 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 10-20 years. Longer term trends from about 1970 to the mid-1990s can be found in the 1997 HAQI reports.

For the longer term perspective, visit: www.cleanair.hamilton.ca/downloads/HAQI-Environmental-Work-Group-Final-Report-Dec-97.pdf

Since the mid-1990s, decreases in the levels of all pollutants in Hamilton (except for the long-range pollutant, ozone) have been steady year over year. The percentage decreases over this time are significant in many pollutant categories as measured at the downtown air monitoring site; these include a 34% reduction in Total Suspended Particulate (TSP) levels, 9% in Inhalable Particulate Matter (PM_{10}), 34% in Respirable Particulate Matter ($PM_{2.5}$), 41% in Nitrogen Dioxide ($(N)O_2$), 50% in Sulphur Dioxide (SO_2), 99% in Total Reduced Sulphur odours, 69% in Benzene and 55% in PAH (Benzo[a]pyrene).

Pollution abatement technologies and strategies continue to be implemented by companies within the industrial sector. *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 technologies when upgrading their pollution control equipment, when constructing new facilities or when retrofitting existing facilities. The goal should be to achieve or exceed the highest international standards. *Clean Air Hamilton* recommends that all citizens critically evaluate the fuel and energy efficiencies of any energy-consuming appliances, passenger vehicles and trucks when they are making these purchases.

In most of the graphs in **Appendix C**, 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. 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. Also included are data which compares Hamilton to other cities in Canada and around the world.

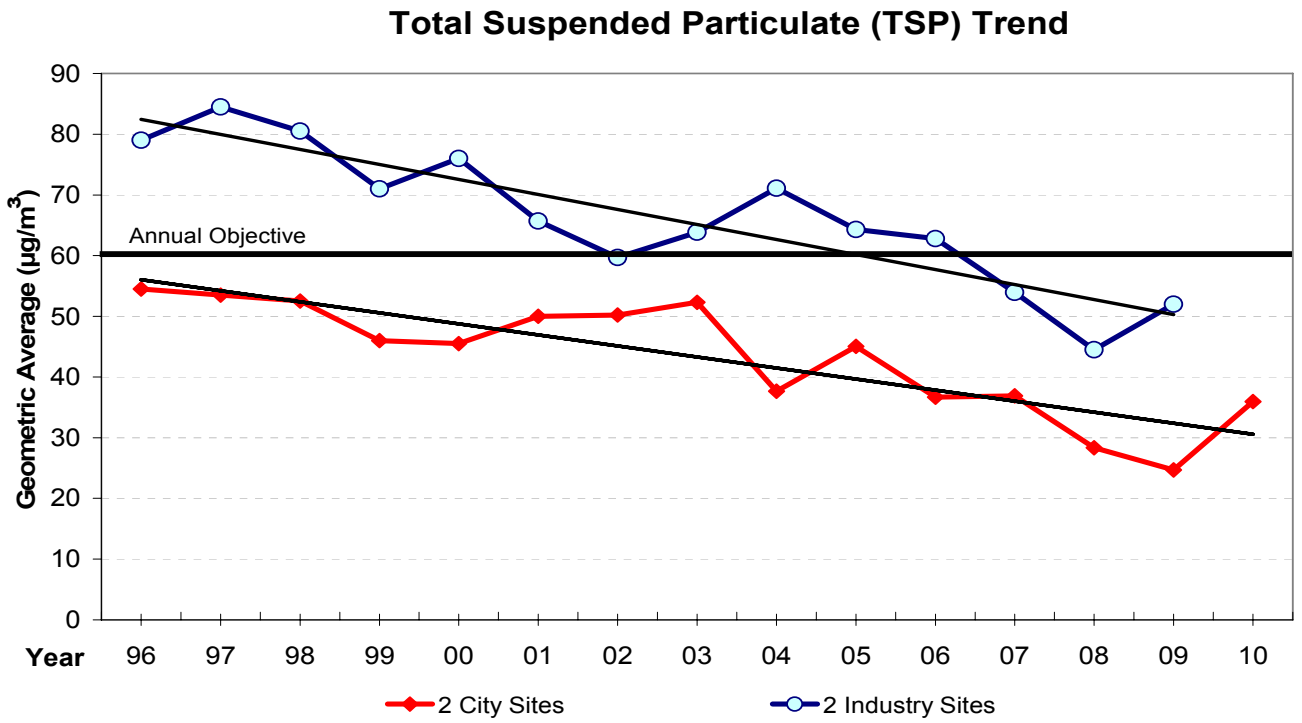
A 2005 report from the Ontario Ministry of the Environment showed the results of modeling estimates of the impacts of U.S. sources on Canada. These estimates were based on the analysis of large-scale weather patterns and detailed estimates of emissions from sources in mid-western U.S. states. These results 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 U.S. These sophisticated modeling studies were consistent with the estimates provided in the original HAQI study reports and to estimates done by Clean Air Hamilton more recently.

Particulate Material: Total Suspended Particulate (TSP)

Total suspended particulate (TSP) includes all particulate material with diameters less than about 45 micrometers (µm). A substantial portion of TSP is composed of road dust, soil particles and emissions from industrial activities and transportation sources. TSP levels have been decreasing steadily since the mid-1970s. Over the past decade, the TSP levels have decreased, on average, by about 3 µg/m^3 per year in the industrial areas and by about 2.3 µg/m^3 per year within the City. These decreases correspond to reductions between 40% and 45% over the past decade alone. These reductions have been realized due to a range of activities directed toward the reduction of industrial dusts, road dusts, track out from industries with unpaved sites, etc.

Included within the TSP category are inhalable particulates (PM_{10}) and respirable particulates ($PM_{2.5}$). 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, by subtracting the PM_{10} or the $PM_{2.5}$ value respectively, from the TSP value. 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.

The particulate levels in some cities around the world are significantly higher than Hamilton. For example, the average weekly TSP level at a site in southeastern Beijing between August 2005 and August 2007 was 370 µg/m^3! In the late autumn and winter during the dust storms, the TSP levels averaged about 500 µg/m^3 while the summer had the lowest TSP levels at about 250 µg/m^3. By contrast, Hamilton in 2006 had TSP levels of about 40 and 60 µg/m^3 at the downtown site and at an industrial site, levels that are about 6 and 9-fold lower than the Beijing annual average. The mean annual TSP value in an industrial area of Rio de Janeiro was 87 µg/m^3.

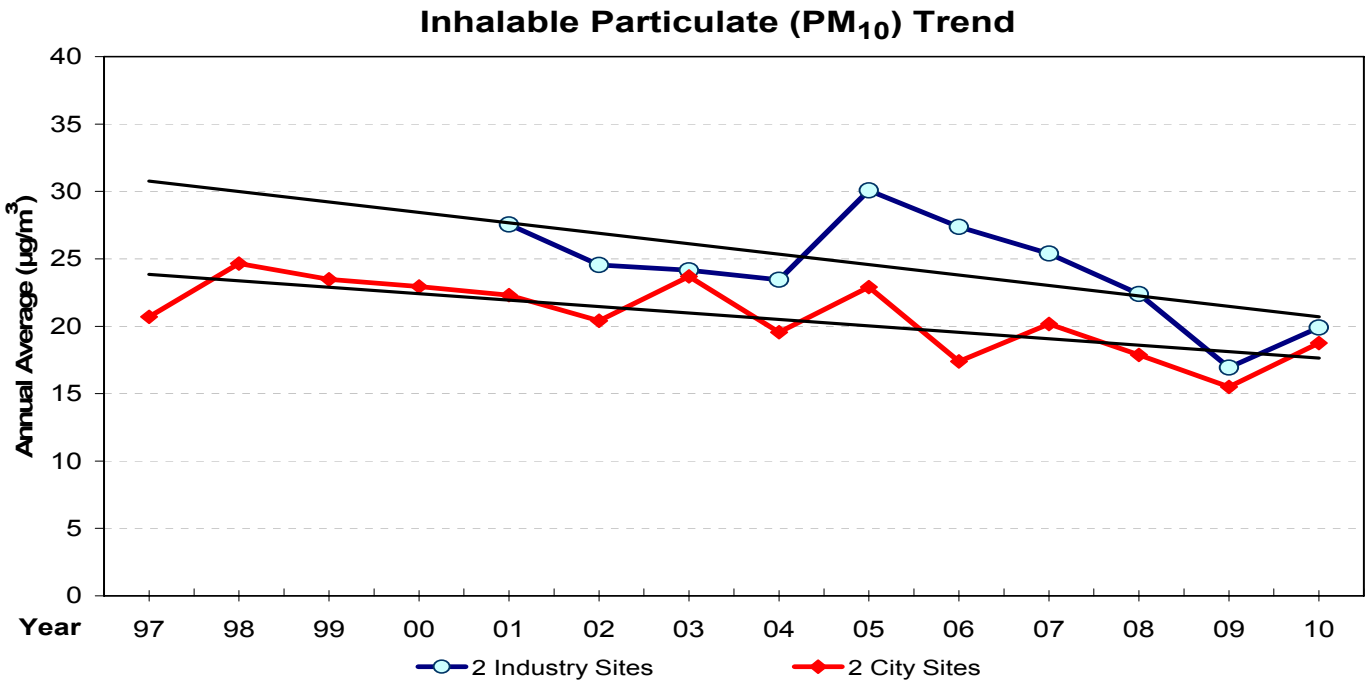


Particulate Material: Inhalable Particulate Matter (PM_{10})

Inhalable particulate matter (PM_{10}), the airborne particles that have diameters of 10 µm or less, is a portion of total suspended particulate (TSP). PM_{10}, which makes up about 40-50% of TSP in Hamilton, has been linked to respiratory, cardiovascular and other health impacts in humans. As with the TSP trend discussed above, ambient levels of PM_{10} at the City sites have decreased about 30% over the past decade, from about 25 µg/m^3 to about 15 µg/m^3. In areas near the industrial sectors, the levels of PM_{10}, while higher than in the downtown area, have shown the same steady decrease areas as in the downtown area.

PM_{10} is derived primarily from vehicle exhaust emissions, industrial fugitive dusts, and the finer fraction of re-entrained road dust. While car and truck traffic counts have remained roughly constant over the past decade the deceasing trend of PM_{10} is likely the result of a combination of better performance of the vehicle fleet, better management of dust track-out by industries, and the use of better street sweepers and street sweeping practices by the City. The vehicle fleet performance will have improved primarily due to lower particulate emissions from modern engines and the removal 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 a local emissions perspective, the removal of "smoking vehicles" from the road is one of the expressed goals of the program, in addition to ensuring that the Ontario vehicle fleet is performing efficiently.

As a point of comparison to Hamilton, the PM_{10} levels in non-industrial city of Porto, Portugal in 2004 were reported between 35 and 50 µg/m^3 at four 'urban traffic' and two 'suburban background' sites. These levels are roughly double those in Hamilton; moreover, all site experienced between 73 and 136 days a year when 24-hour PM_{10} levels exceeded 50 µg/m^3.

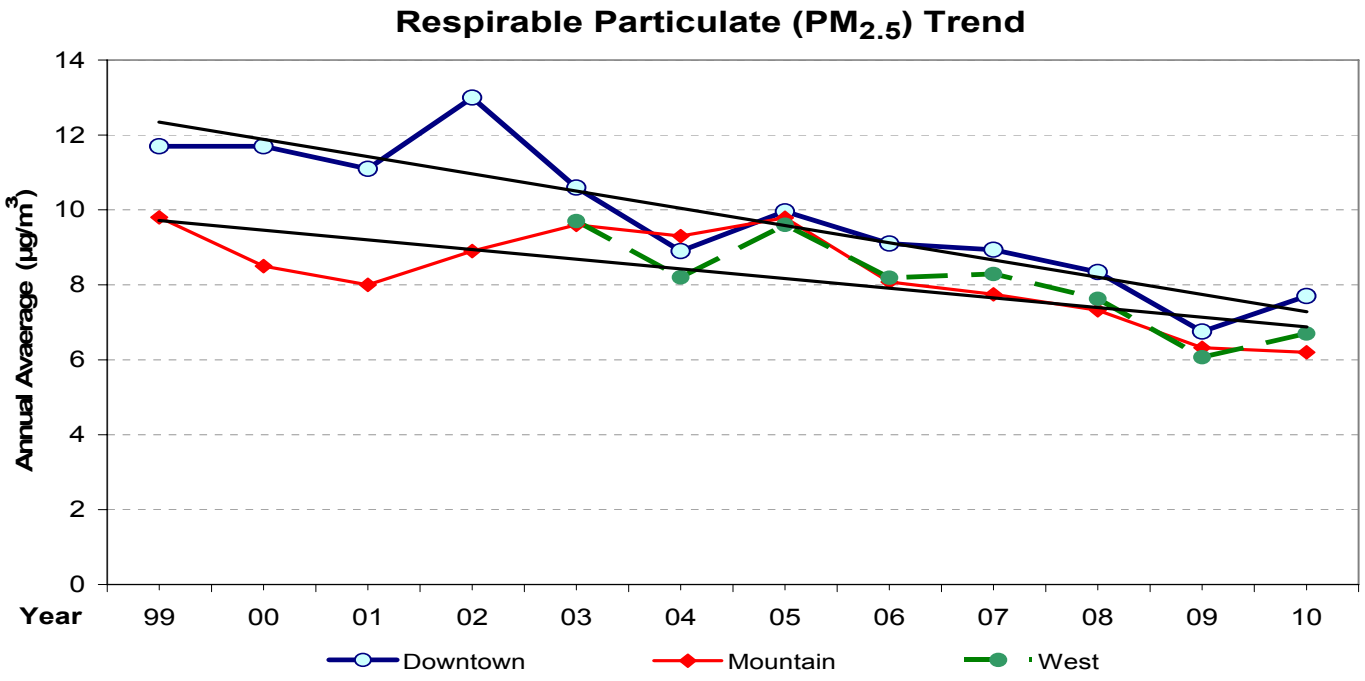


Particulate Matter: Respirable Particulate Matter ($PM_{2.5}$)

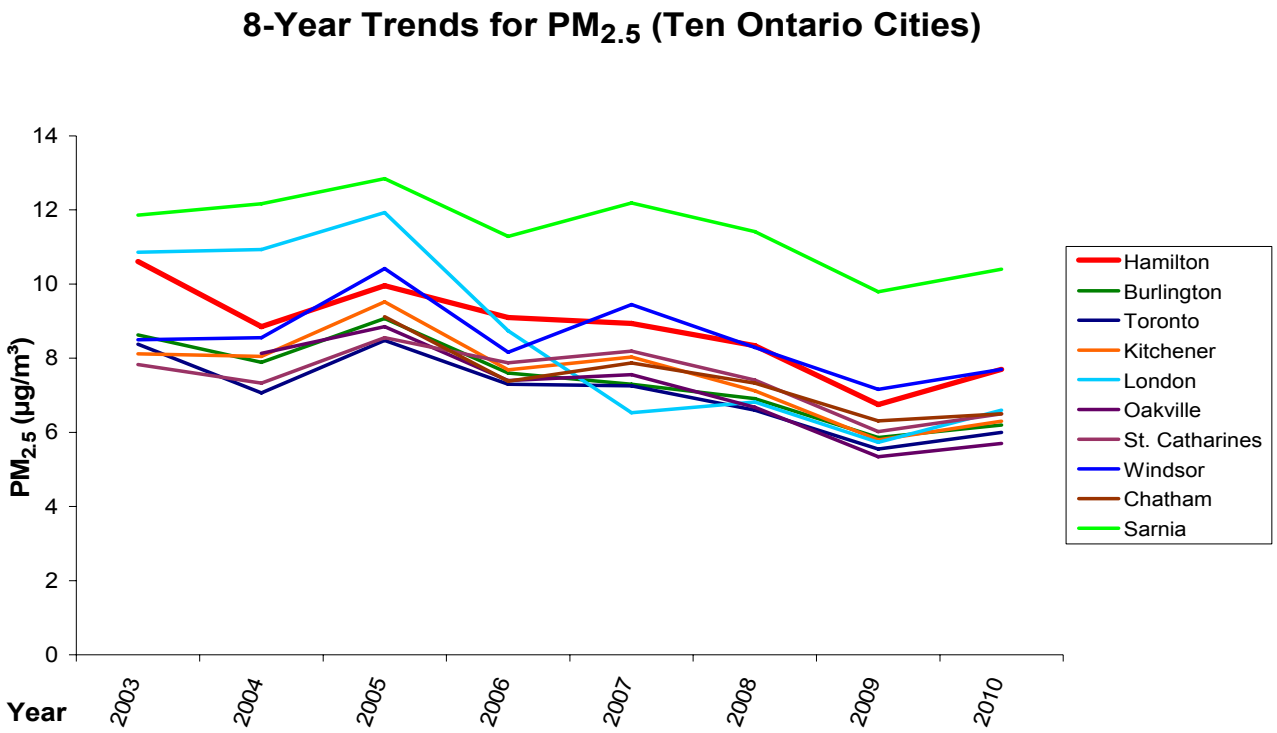
The Province of Ontario monitors respirable particulate matter ($PM_{2.5}$), airborne particles with a diameter of 2.5 µm or less. $PM_{2.5}$, which makes up about 60% of the PM_{10} in the air, has been more strongly linked to health impacts than PM_{10}. The Ontario government started measuring levels 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 Air Quality Index (AQI) monitoring stations.

The trend in $PM_{2.5}$ has shown a decrease of about 35% since 1999 at the downtown and mountain AQI sites (consistent with the decreasing trends in TSP and PM_{10}), and corresponding to a steady decrease of about 3.5% per year. The $PM_{2.5}$ fraction of air particulate matter is recognized as being responsible for essentially all of the deleterious health effects associated with air particles. $PM_{2.5}$ has been declared a "toxic substance" under CEPA (Canadian Environmental Protection Act). Particulate matter associated with automobile exhaust, diesel exhaust and cigarette smoke have particle sizes between 0.1 and 0.3 µm; vehicle combustion sources constitute about 30-50% of the mass of $PM_{2.5}$.

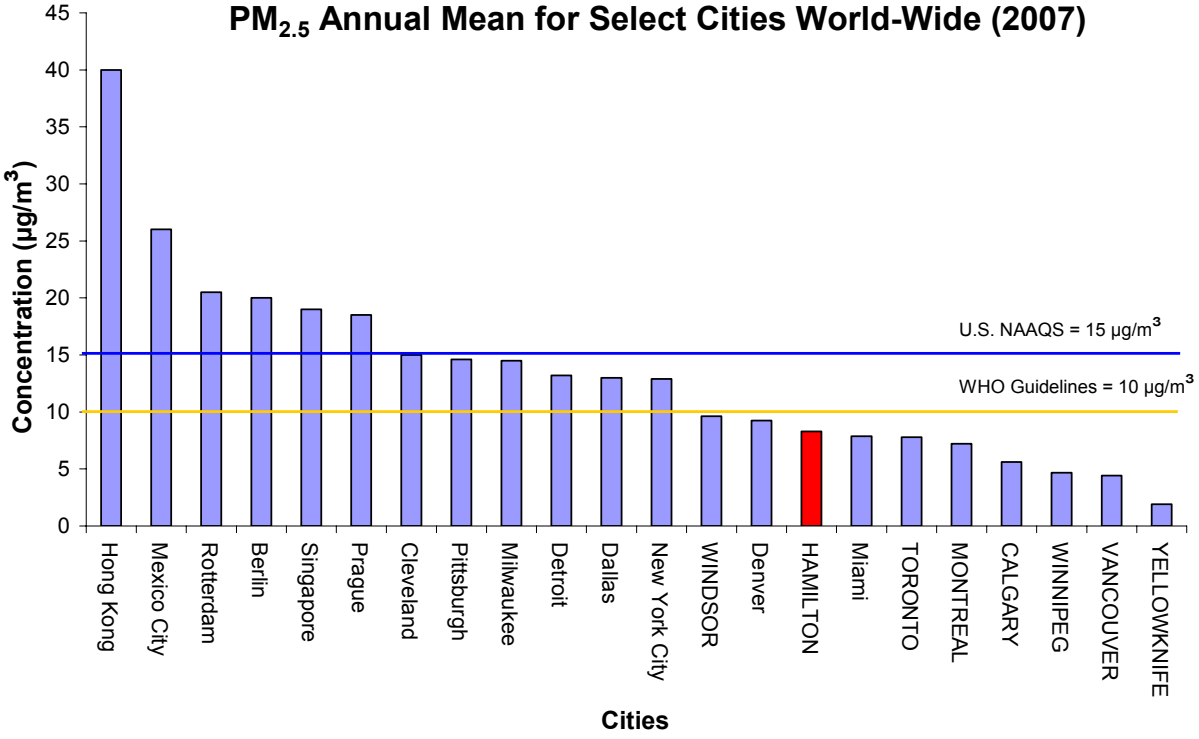
There has been a scientific debate over just what causes the health impacts in humans due to exposure to the $PM_{2.5}$ fraction – the particles themselves or the chemicals on these particles. It is known that the $PM_{2.5}$ fraction contains over 95% of all particle-bound organic compounds in the air along with a substantial burden of metals. 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.



The graph below shows a comparison of eight-year trends in respirable particluate matter ($PM_{2.5}$) levels in ten Ontario cities. The decreasing trend in $PM_{2.5}$ in Hamilton is mirrored at other locations across southern Ontario.



The figure below compares the annual mean levels of $PM_{2.5}$ in Hamilton with 21 other Canadian and global cities for 2007. Of the Canadian cities compared, Hamilton registered the second highest $PM_{2.5}$ annual mean reading, with only Windsor registering a higher reading. While higher than most Canadian cities, Hamilton's annual mean levels of $PM_{2.5}$ remain below the World Heath Organization (WHO) air quality guidelines and the U.S. National Ambient Air Quality Standards (NAAQS). Out of the 22 cities compared, the five lowest annual mean levels of $PM_{2.5}$ were recorded in Canadian cities. The $PM_{2.5}$ levels in Hamilton, Toronto and Montreal are comparable, and are about one-half the levels in non-industrial European cities such as Prague and Berlin. The data used for this figure were provided by the Ontario Ministry of Environment.

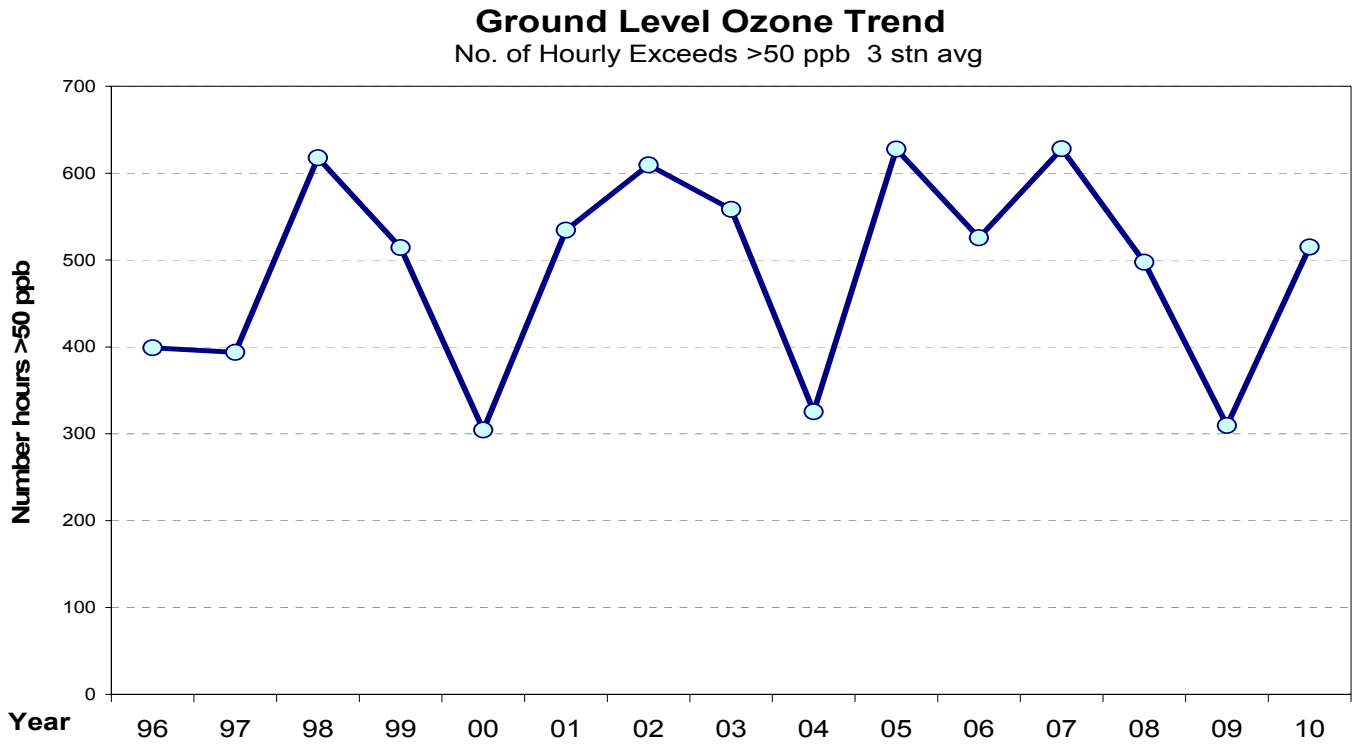

PM2.5 Annual Mean for Select Cities World-Wide (2007)
Concentration (µg/m3)
45
40
35
30
25
20
15
10
5
0
U.S. NAAQS = 15 µg/m3
WHO Guidelines = 10 µg/m3
Hong Kong
Mexico City
Rotterdam
Berlin
Singapore
Prague
Cleveland
Pittsburgh
Milwaukee
Detroit
Dallas
New York City
WINDSOR
Denver
HAMILTON
Miami
TORONTO
MONTREAL
CALGARY
WINNIPEG
VANCOUVER
YELLOWKNIFE
Cities

Ground Level Ozone (O_3)

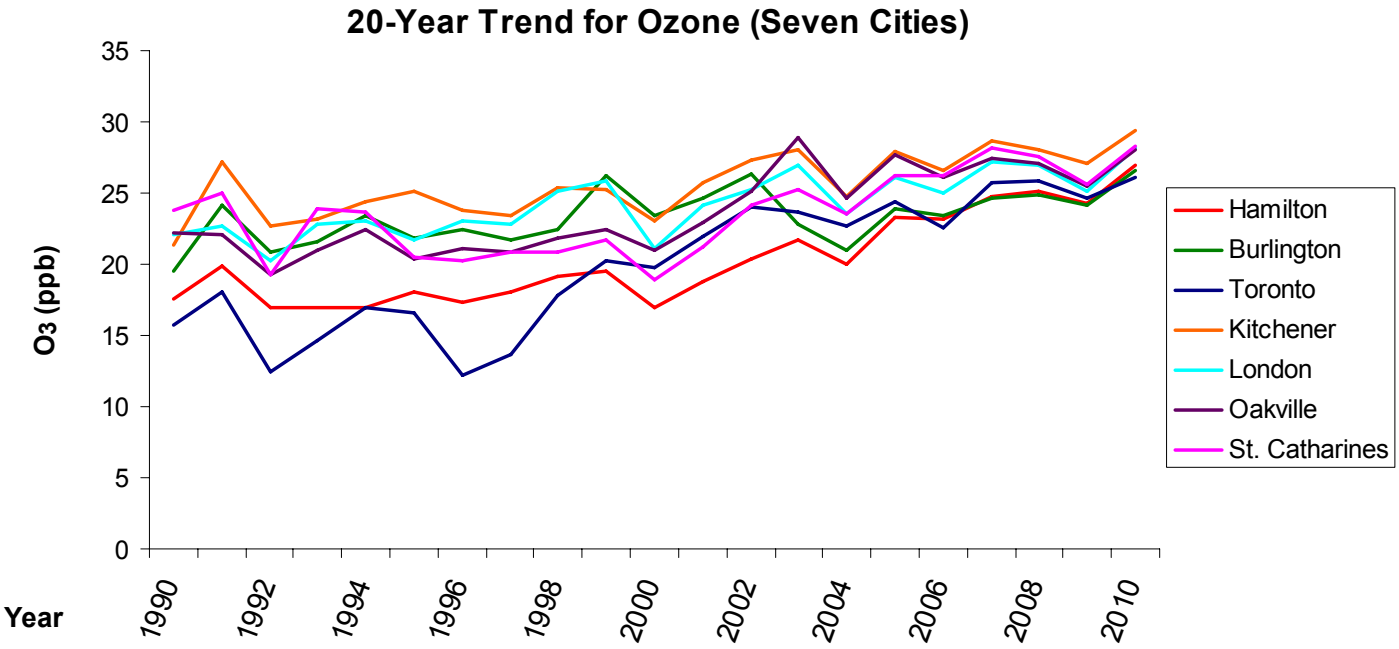
Ground level ozone (O_3 or tropospheric ozone) is formed in the atmosphere when air pollutants such as nitrogen oxides (NO_X) and volatile organic compounds (VOC) react in the presence of sunlight. Air levels of O_3 are higher in warmer seasons than in cooler seasons because the sunlight is more intense in the summer and the temperatures are higher. The trend in O_3 shows an increase has been highly variable over the past 10 years. Overall, the trend line for this period is roughly flat, in contrast to the steadily decreasing trends in the other pollutants.

Unlike all other pollutants none of the O_3 measured in Hamilton was generated from Hamilton-based sources. The formation of O_3 takes several hours once the pollutants have been released to the atmosphere. Thus, the O_3 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 O_3 in areas downwind of Hamilton. A substantial portion of the O_3 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” or “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 stratospheric ozone is commonly known as the ozone layer because over 91% of the ozone in Earth’s atmosphere is present here. 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.

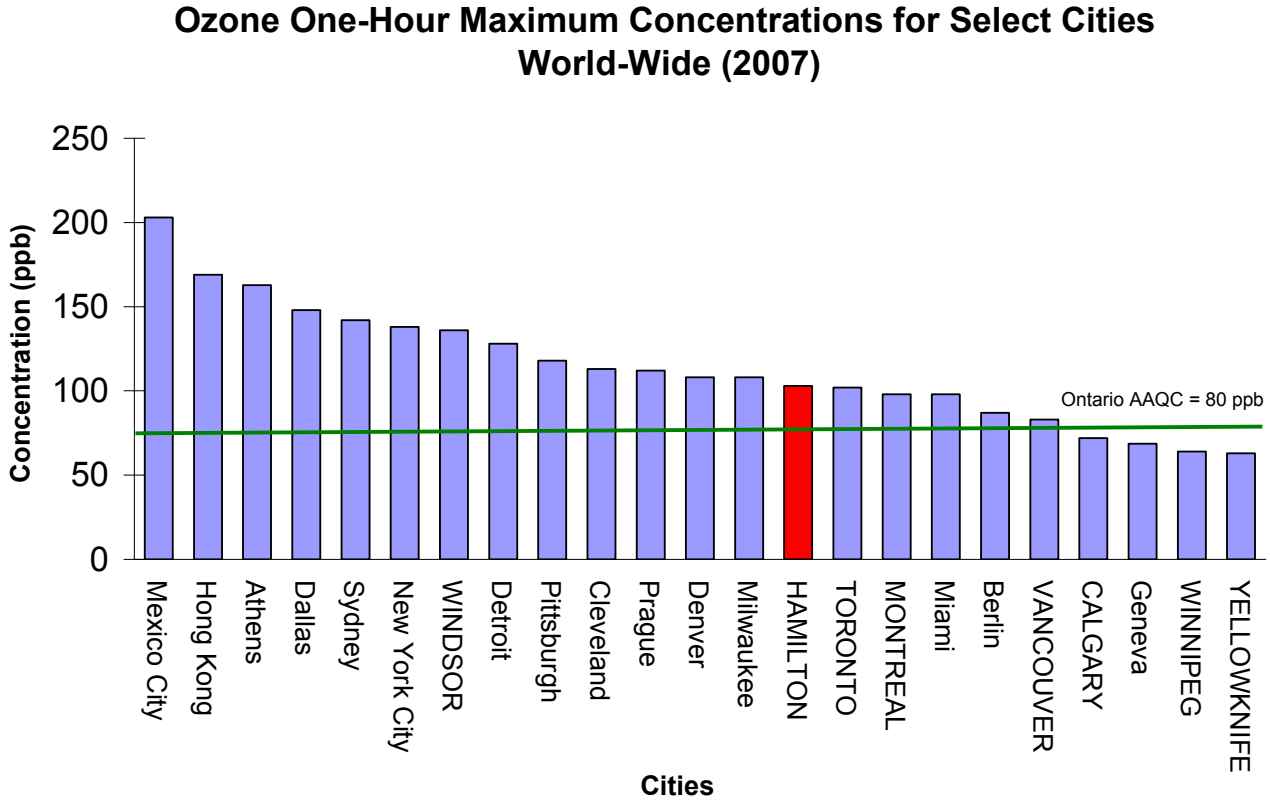


The trend in O_3 in Hamilton is mirrored at other locations across southern Ontario. Over the past 20 years the concentrations of O_3 across southern Ontario have increased between 10 and 30%, depending on the city. The levels of O_3 observed across southern Ontario in recent years are consistently higher and more similar than what was observed one and two decades ago. This trend is somewhat worrisome given the increase in health effects impacts associated with increased O_3 exposures.



As discussed previously, the formation of O_3 results from pollutants generated outside Hamilton and southern Ontario. In the figure below, the cities with higher ozone one-hour maximum concentrations (e.g., Windsor, Detroit, and Cleveland) are located near the Ontario/US border. These higher levels are indicative that transboundary pollution has a significant role in O_3 formation. The Ontario Ambient Air Quality Criteria (AAQC) of 80 ppb for O_3 has been unmet by the three Ontario cities compared below. Only four of the 23 cities compared were able to meet these criteria. Addressing O_3 pollution in cities will be a challenge and will require collaborations between countries.

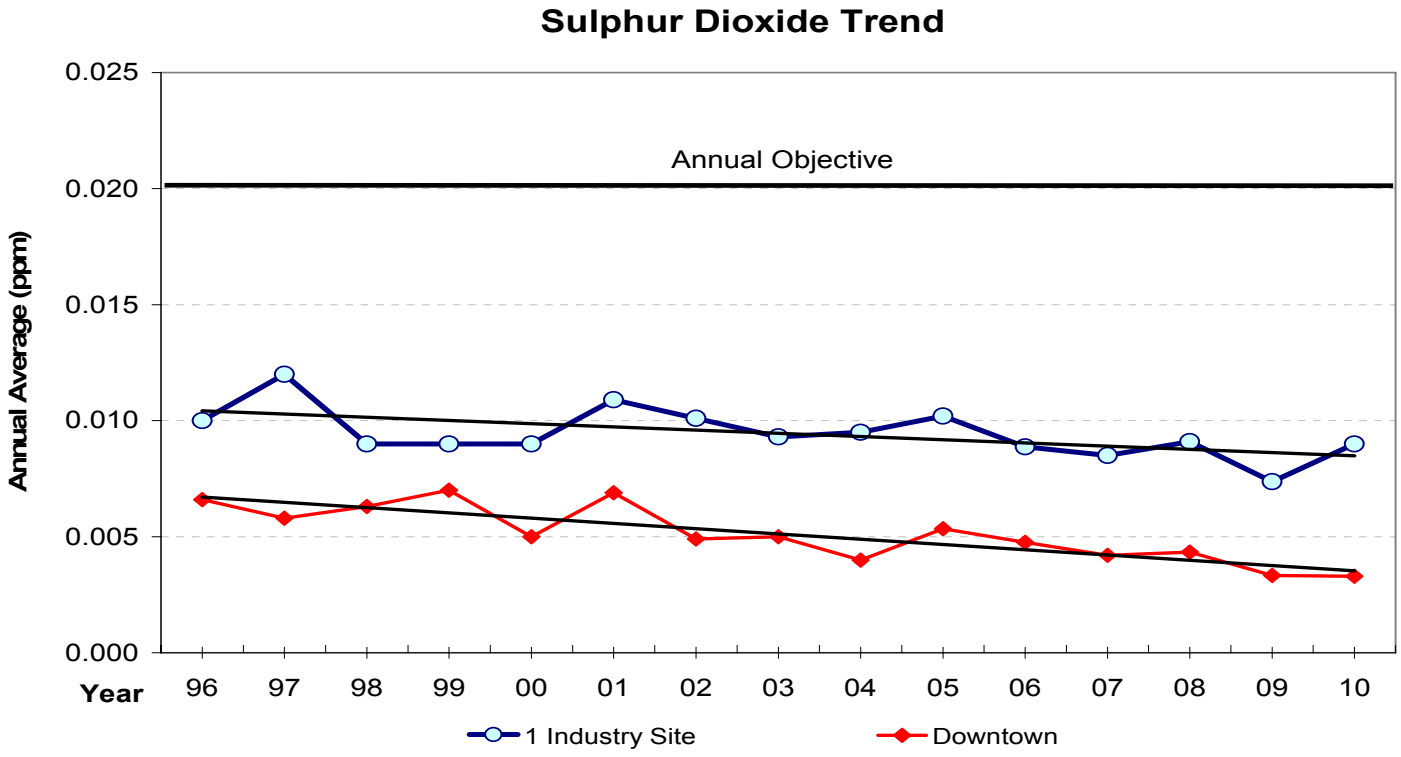
Interestingly, Vancouver just exceeds the Ontario AAQC guideline; however, all of the O_3 measured in Vancouver is generated from local emissions sources, not from long-range-transport. The take-home message for southern Ontario is that about one-half of the O_3 in southern Ontario is generated from locally generated emissions, of which we have control. The data used for this figure was provided by Ontario Ministry of Environment.



Sulphur Dioxide (SO_2)

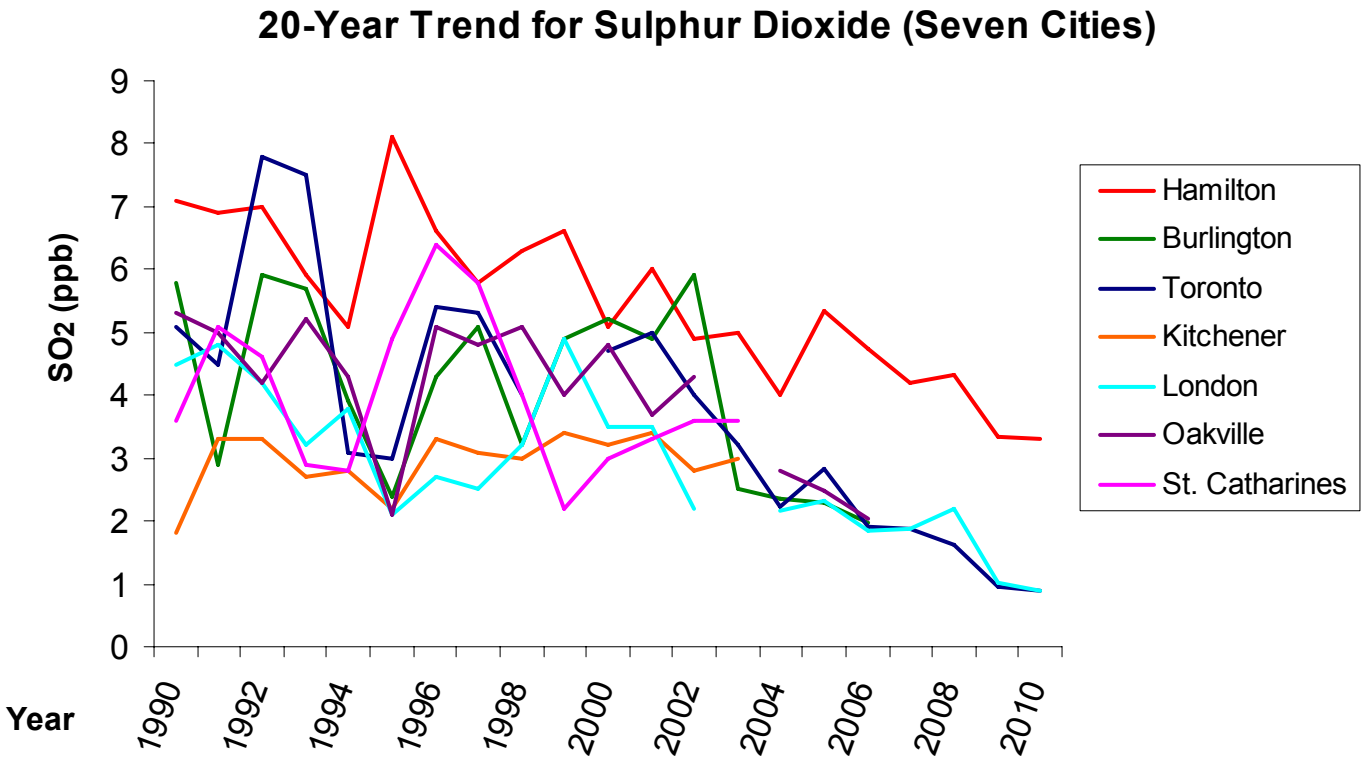
Over 90% of the sulphur dioxide (SO_2) in Hamilton is the result of industrial processes within the City. Significant improvements in air levels of SO_2 were made in the 1970s and 1980s. Since 1998, there has been a gradual and continuous decline in air levels of SO_2. During this period SO_2 levels have decreased by about 40% in the downtown area and by about 30% in the industrial areas. These reductions reflect actions taken to reduce SO_2 emissions from the steel industry. Combustion of fossil fuels (particularly diesel fuel) containing sulphur was a major source of SO_2 in Canada until federal regulations enacted in 2007 reduced the sulphur content in diesel fuel to 15 parts per million (ppm) from the former average sulphur content of about 350 ppm.

Sulphur dioxide is not only a respiratory irritant but this oxide is converted in the atmosphere over several hours to sulphuric acid (H_2SO_4), which is then converted into sulphate particles (SO_4). These particles average about 2 µm in diameter and constitute part of the respirable particulate fraction ($PM_{2.5}$) in the air. These particles tend to be acidic in nature and cause lung irritation when inhaled. Thus, the health concerns associated with SO_2 exposures are linked to the gas itself as well as to the particulate material derived from it. During the summer months, about 25% of the mass of $PM_{2.5}$ in the air in southern Ontario is SO_4.

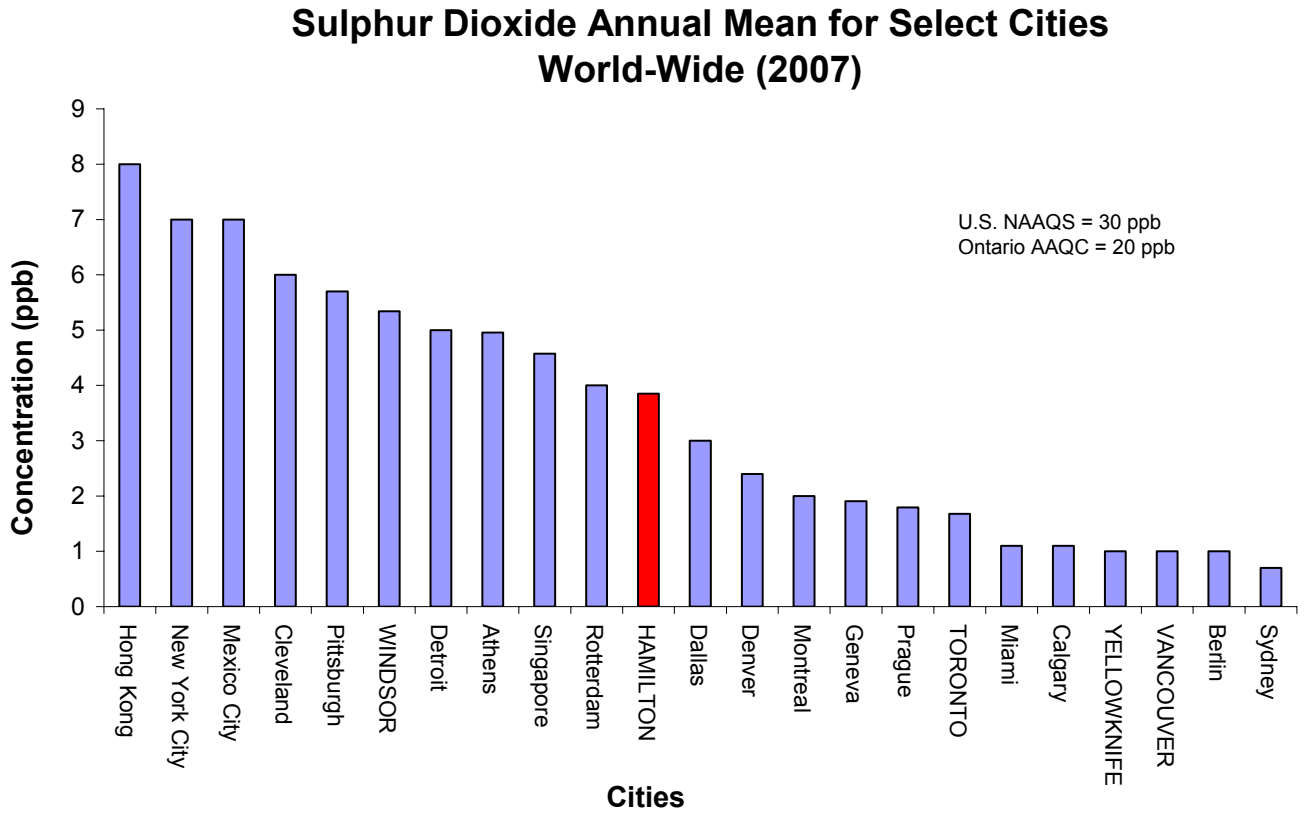


The graph below shows a comparison of the 20-year trends in SO_2 levels in seven southern Ontario cities. There have been dramatic decreases in SO_2 levels across southern Ontario over the past two decades. These reductions reflect the actions to reduce sulphur levels in diesel fuel (since 2007), the closure of local coal-fired power plants and the steady reduction of sulphur in combustion materials. The SO_2 levels in Hamilton are higher than the other southern Ontario cities due to the industrial sources that are unique to Hamilton.

When viewing the figure below, please note that some data points contain values based on a partial year. These data may not be as representative of annual SO_2 levels. Please view this figure as an approximate representation of SO_2 data from these cities.



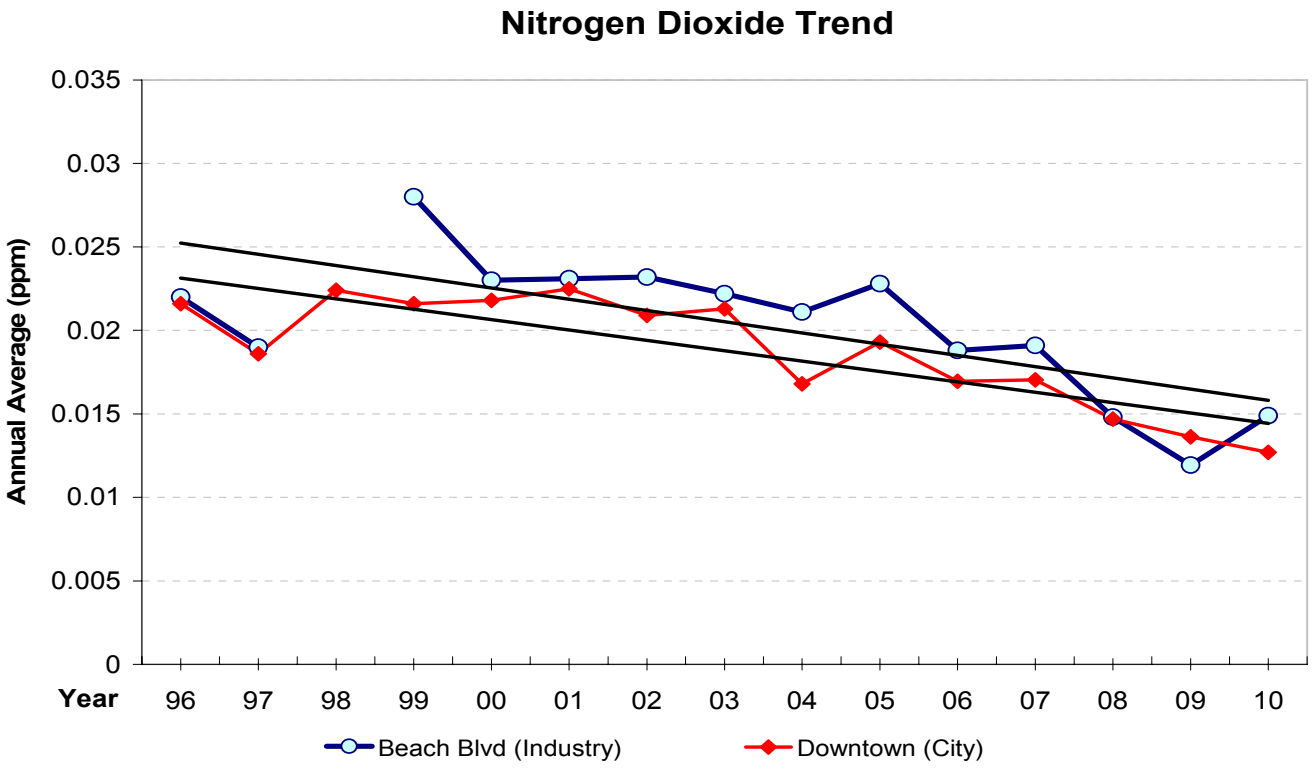
As discussed previously, Hamilton's industrial processes contributed to higher levels of SO_2 in the air. Hamilton recorded the second highest annual mean reading of SO_2 when compared to the other Canadian cities. Other cities, with a similar industrial base as Hamilton, such as Cleveland, Pittsburgh, Windsor and Detroit also recorded annual means values which were higher than most of the other cities. This demonstrates the significant effect industrial emissions have on air levels of SO_2. Despite having higher air levels of SO_2 in comparison with other cities, Hamilton's continual improvement in reducing SO_2 emissions have resulted in 2007 air levels of SO_2, which are well below Ontario Ambient Air Quality Criterion of 20 parts per billion (ppb) and even further below the U.S. National Ambient Air Quality Standard of 30 ppb. All 23 cities had 2007 annual means of SO_2 that were considerably below Ontario and U.S. SO_2 ambient air standards.



Nitrogen Dioxide (NO_2)

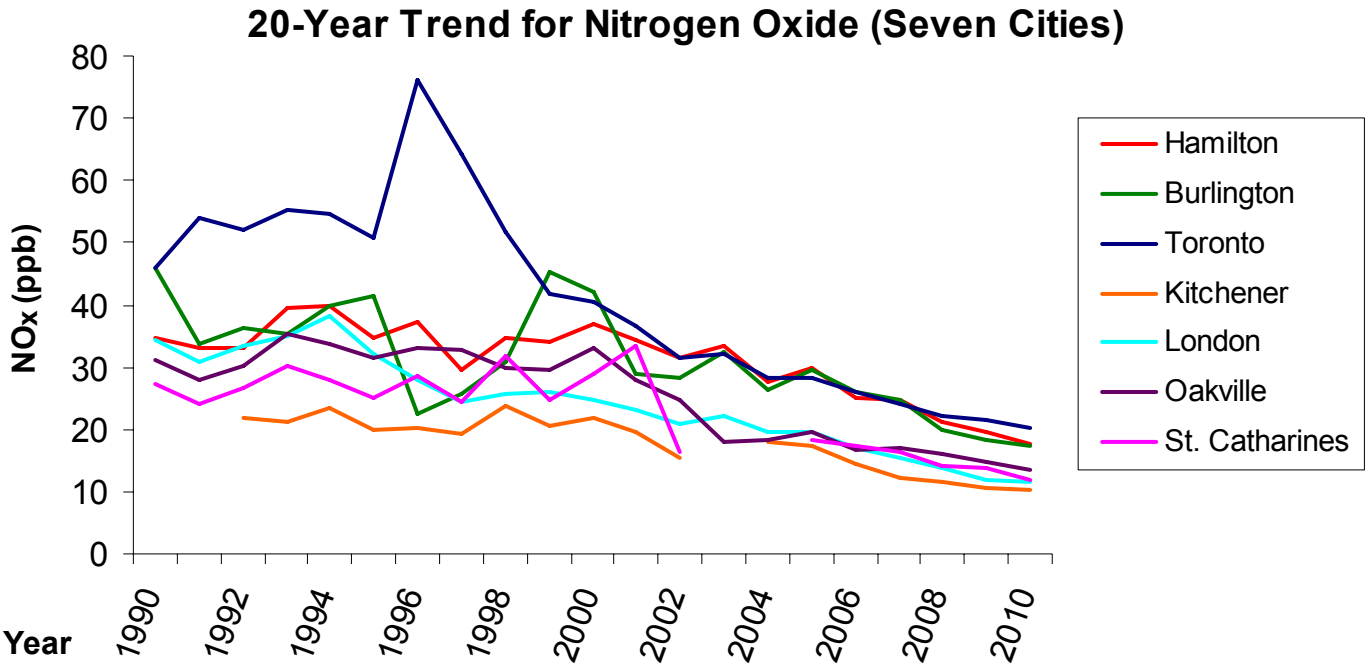
Nitrogen dioxide (NO_2) is responsible for a significant share of the air pollution-related health impacts in Hamilton. NO_2 is formed in the atmosphere from nitric oxide (NO) which is produced during the combustion of fuels such as gasoline, diesel, coal, wood, oil and natural gas. The leading sources of NO_2 in Hamilton are the transportation sector followed by the industrial sector. The level of vehicle use across Hamilton has increased slightly during the past decade, while the overall emissions of NO_2 from new vehicles has decreased.

There has been a steady decline in the annual average levels of NO_2 in Hamilton over the past decade, both at the downtown site and at a site downwind of the industries. Overall, improvements in vehicle emissions performance coupled with better industrial practices have resulted in an overall improvement in NO_2 levels of about 40%. For example, within the City the annual average NO_2 level was 22 parts per billion (ppb) a decade ago; today the annual average is 13 ppb.

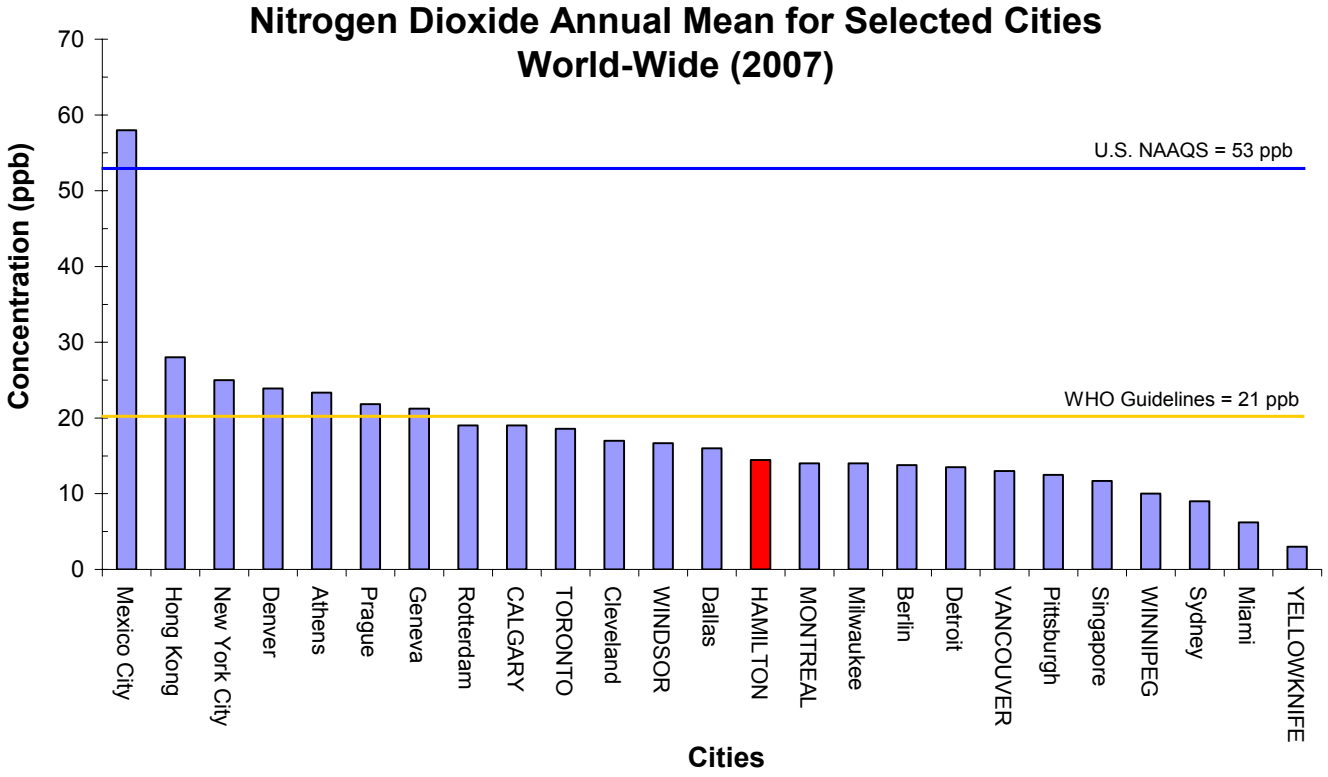


When we compare the 20-year trends in air levels of NO_x in Hamilton to NO_x levels in other Ontario cities we note that all cities have seen a steadily decreasing trend over the past decade. Toronto, which has no significant industrial NO_x contributors but significant vehicular NO_x emissions, has shown the largest decrease. Since the 1990's both Toronto and London have seen reductions in NO_x levels of approximately 60%. Hamilton's NO_x levels have decreased by approximately 46% since 1990. The NO_x levels in Hamilton have decreased more slowly than in cities such as London 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.

When viewing the figure below, please note that some data points contain values based on a partial year. This data may not be as representative of annual NO_x levels. Please view this figure as an approximate representation of NO_x data from these cities.



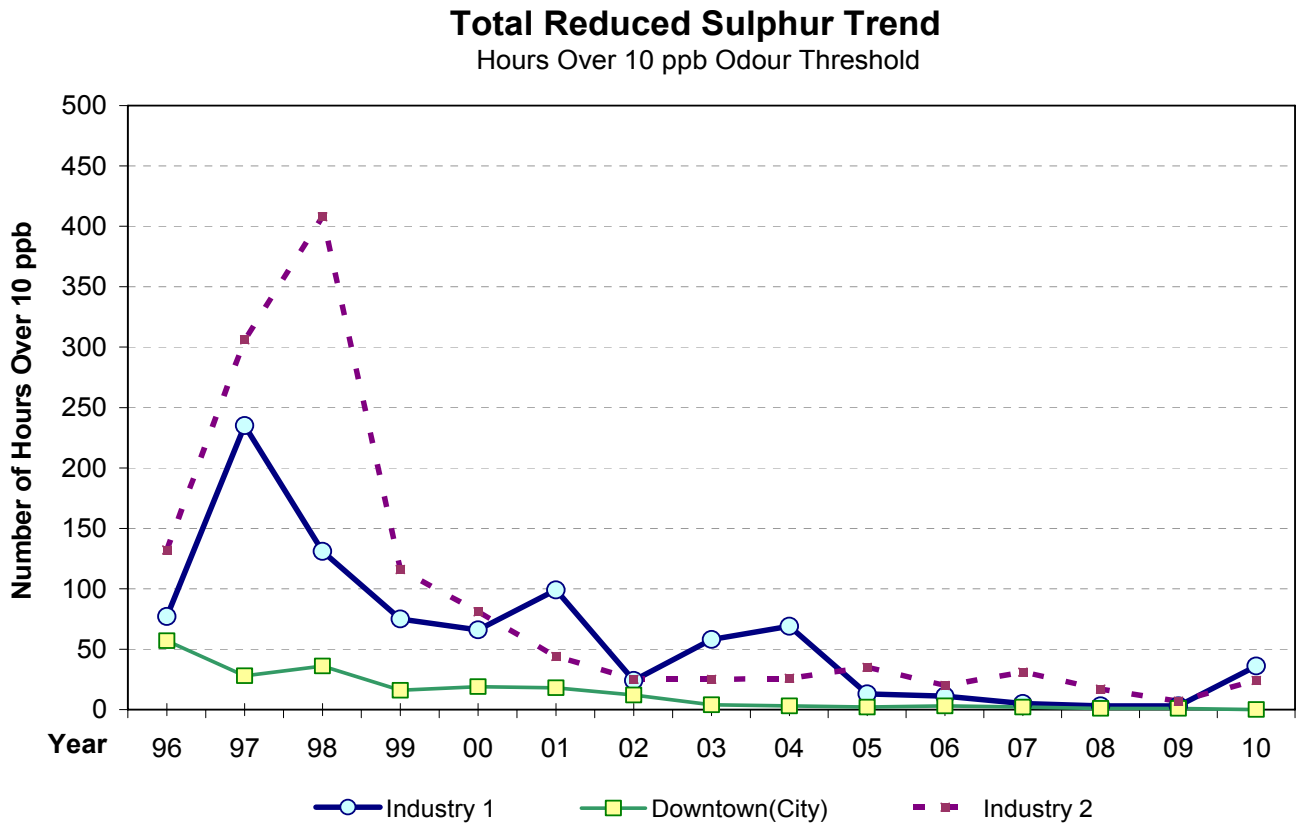
The figure below compares the annual mean levels of NO_2 levels in Hamilton with 24 Canadian and other cities around the world. Hamilton had the fourth highest NO_2 annual mean reading compared with other Canadian cities. Calgary, Toronto and Windsor were the three Canadian cities with higher NO_2 annual mean values. Hamilton's annual mean levels of NO_2 remain below the World Health Organization air quality guidelines and the U.S. National Ambient Air Quality Standards. Despite being below these guidelines, Hamilton has recorded higher NO_2 annual means in comparison with cities with a similar industrial base, such as Milwaukee, Detroit and Pittsburgh.



Total Reduced Sulphur (TRS)

Total Reduced Sulphur (TRS) is a measure of the volatile, 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. An odour threshold has been set at 10 parts per billion (ppb) TRS because at this level about one-half of any group of people can detect an odour similar to the smell of rotten eggs. There is a wide range of sensitivities to odours among the population. A common measure of odour impact on the population is the number of hours per year that TRS levels exceed the 10 ppb threshold level.

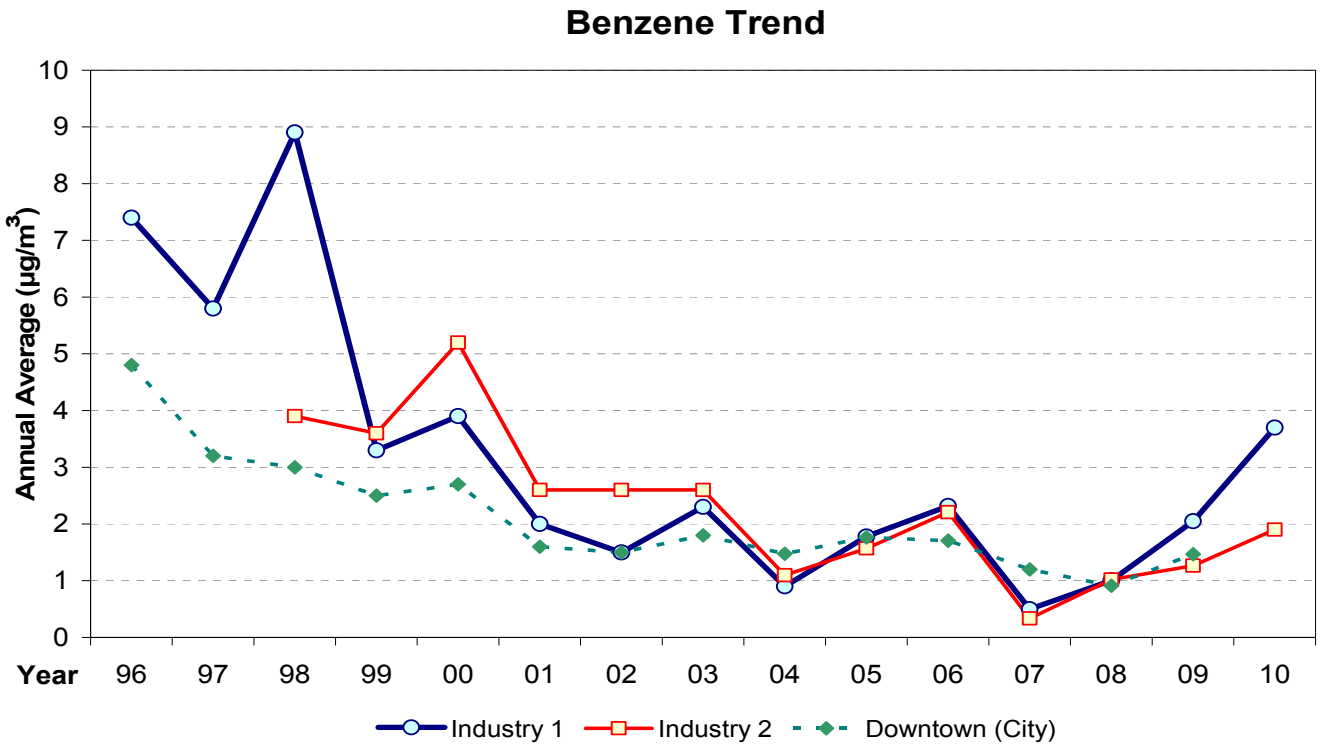
Hourly exceedances of the 10 ppb odour threshold have been reduced by over 90% since the mid-1990s due to significant changes in the management and operation of the coke ovens and blast furnaces. In particular, changes to slag procedures from quenching (using water) to pelletizing (using air cooling) have had a dramatic effect on reducing odour-causing emissions from slag handling operations. Odour threshold exceedances have been below 10 hours per year in the downtown area over the past 8 years.



Benzene

Benzene is a volatile pollutant that is capable of producing cancer in humans. Benzene is emitted from some operations within the steel industry, specifically from the releases of 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 operating procedures at the coke plants, and improved control of release of benzene vapour from the coke by-products plants.

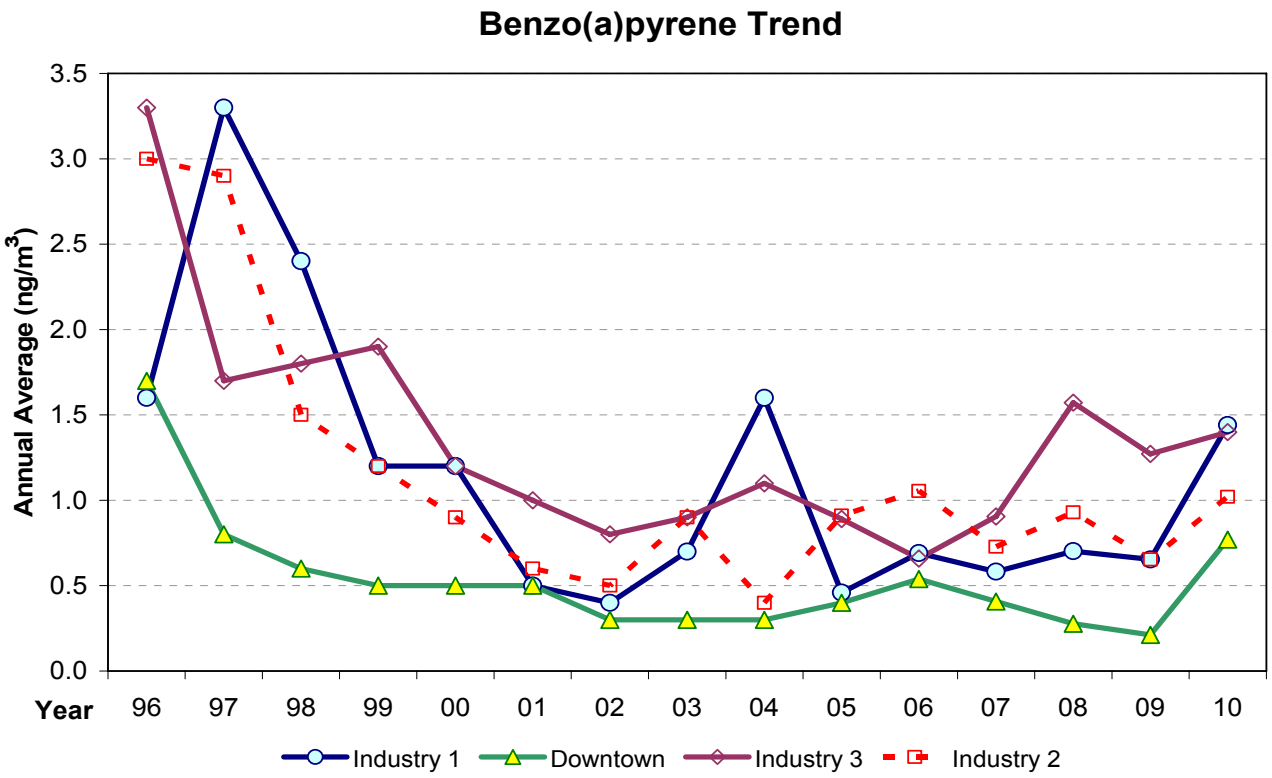
Benzene is also a component of gasoline; benzene concentrations in this fuel can up to 5%. In other words, since benzene is volatile, benzene vapours can be detected in the air in areas where gasoline is pumped and distributed. Thus, all cities in Canada have low but measurable levels of benzene in the air primarily due to the pumping of gasoline; whenever a person fills a gasoline tank, the gasoline vapours in the tank (which contain benzene) are displaced out of the tank into the atmosphere, potentially exposing anyone near the filled tank. The levels of benzene in downtown Hamilton have now dropped to levels comparable to those in other Canadian and Ontario cities of similar size, which do not have coking operations but do pump gasoline.



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 (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 BaP levels since the late 1990s 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.

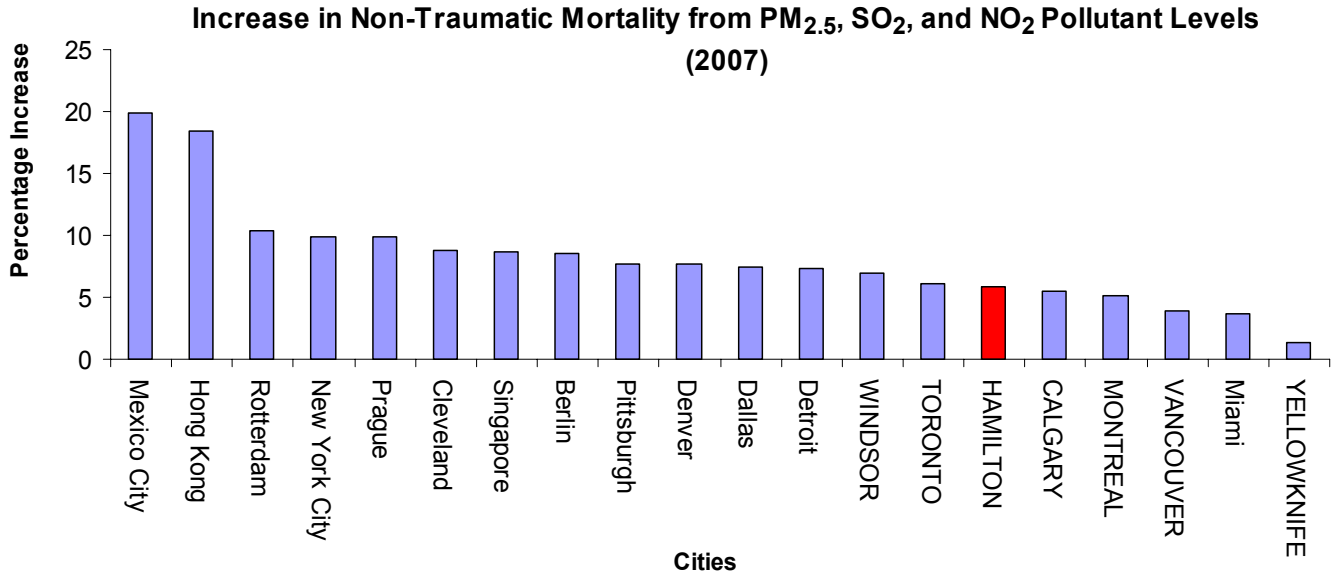
While BaP is only one of many PAH released from coking operations, BaP is undoubtedly the most potent and most studied of all PAH carcinogens (cancer-causing agents) in the scientific literature. As a result of the extensive amount of chemical and toxicological research work and occupational exposure 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.



Projected Increase of Non-Traumatic Mortality due to Exposure to Air Pollutants

Poor air quality is associated with a range of health impacts, with increased mortality rates being one of them. The Ontario Medical Association report (OMA, 2005) on health impacts of poor air quality in Ontario estimated 5,800 premature deaths in 2005 were associated with poor air quality. Also included in this report, OMA estimated that there were 290 premature deaths associated with air pollution in the Hamilton-Wentworth region in 2005; this number is projected to increase to 500 premature deaths in 2026. Three years later, in 2008, the OMA's updated Illness Costs of Air Pollution (ICAP) model concluded that air pollution (specifically smog) is responsible for 9,500 premature deaths in Ontario each year, and 445 premature deaths in the Hamilton-Wentworth Region are associated with increased air pollution (OMA, 2008). Alarmingly, OMA's initial projection of 445 premature deaths from air pollution in 2026 was already reached in 2008.

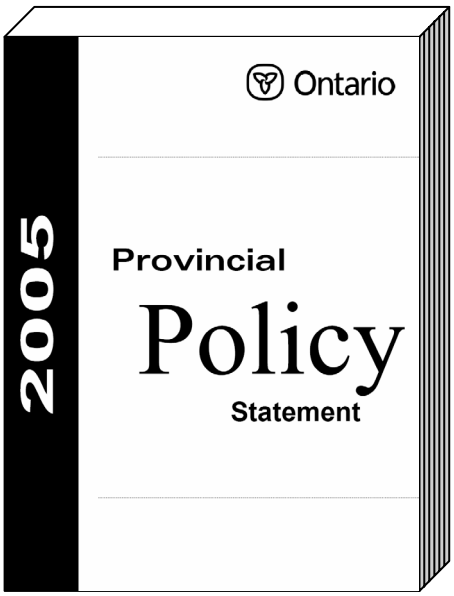
In the *Clean Air Hamilton*'s 2003 Air Quality Health Assessment Study, a metric to calculate the percent increase of non-traumatic mortality associated with air pollutants was developed. This metric calculated the percent change in non-traumatic mortality per 10-unit of air pollutants and was applied to the following five air pollutants: respirable particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), and carbon monoxide (CO) (Jerrett & Sahsuvaroglu, 2003). Using this metric, the figure below presents the cumulative percentage increase in non-traumatic mortality resulting from air levels of $PM_{2.5}$, SO_2, and NO_2 in several cities world-wide. Please take in consideration, that these values were calculated using simple arithmetic addition and should be considered a rough indicator of the effects air pollutants have on rates of non-traumatic mortality. This figure also does not account for the health impacts resulting from synergistic effects of air pollutants (e.g., SO_2 and $PM_{2.5}$).



APPENDIX D: THE ONTARIO PROVINCIAL POLICY STATEMENT, AIR QUALITY & CLIMATE CHANGE

"Globally we have been facing challenges with climate change, water and air pollution, and over-consumption of natural resources. … Ontario is building on the existing system [of policies and practices] to create a comprehensive planning framework for Ontario with the introduction of the new Provincial Policy Statement…"

- Ministry of Municipal Affairs and Housing



The Ontario Provincial Policy Statement (PPS) came into effect March 1, 2005. It provides policy direction on matters of provincial interest related to land use planning and development. The PPS provides a framework for comprehensive, integrated and long-term planning that supports and integrates the principles of strong communities, a clean and healthy environment and economic growth. It is intended to be read in its entirety and the relevant policies are to be applied to each situation. Air quality & climate change effects of planning decisions are two of the many factors that need to be evaluated in the decision-making process.

In order to ensure that provincial interests remain an essential part of decision-making in land use planning, the government has chosen the "*shall be consistent with*" standard as a stronger means for implementing the policy statement.

Most climate change strategies inherently comply with the direction set out in the PPS. This is because they have direct impacts on improving public health, the environment and in most cases, long term economic prosperity. Many of the policies laid out in the PPS can be directly implemented through climate change strategies. The PPS is a potentially valuable tool for influencing the adoption of these strategies by demonstrating their supplementary benefits.

Note: Section 1.1.3.2(a)(3) of the PPS makes specific mention of the importance of minimizing impacts to climate change and promoting energy efficiency.

In Hamilton: The PPS is a pivotal part of the framework that is being built into Hamilton's 30-year Growth Related Integrated Development Strategy (GRIDS) and new Official Plan, which will direct the city towards its Vision 2020 sustainable community goals. Through the GRIDS planning process and the Transportation Master Plan the city is implementing the policies of the PPS into Hamilton's long range decision-making processes and developing strategies that will help to reduce emissions and adapt to climate change.

To find out more about Climate Change, visit any of the following:

City of Hamilton:
www.hamilton.ca/climatechange

Government of Canada:
http://www.climatechange.gc.ca/

Environment Canada:
http://www.ec.gc.ca/

Ontario Ministry of the Environment:
http://www.ene.gov.on.ca/

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The following land use, transportation, urban design & energy conservation policies from the PPS relate directly to Climate Change Strategies:

1.1.3.2 Land use patterns within *settlement areas* shall be based on:

a) densities and a mix of land uses which:
   1. efficiently use land and resources;
   2. are appropriate for, and efficiently use, the *infrastructure* and *public service facilities* which are planned or available, and avoid the need for their unjustified and/or uneconomical expansion;
   3. minimize negative impacts to air quality and climate change, and promote energy efficiency in accordance with policy 1.8; and

b) a range of uses and opportunities for *intensification* and *redevelopment* in accordance with the criteria in policy 1.1.3.3.

1.5.1 Healthy, active communities should be promoted by:

a) planning public streets, spaces and facilities to be safe, meet the needs of pedestrians, and facilitate pedestrian and non-motorized movement, including but not limited to, walking and cycling;

b) providing for a full range and equitable distribution of publicly-accessible built and natural settings for *recreation*, including facilities, parklands, open space areas, trails and, where practical, water-based resources;

c) providing opportunities for public access to shorelines; and

d) considering the impacts of planning decisions on provincial parks, conservation reserves and conservation areas.

1.6.5.1 *Transportation systems* should be provided which are safe, energy efficient, facilitate the movement of people and goods, and are appropriate to address projected needs.

1.6.5.4 A land use pattern, density and mix of uses should be promoted that minimize the length and number of vehicle trips and support the development of viable choices and plans for public transit and other alternative transportation modes, including commuter rail and bus.

1.7.1 Long-term economic prosperity should be supported by:

d) providing for an efficient, cost-effective, reliable *multi-modal transportation system* that is integrated with adjacent systems and those of other jurisdictions, and is appropriate to address projected needs;

h) providing opportunities for increased energy generation, supply and conservation, including *alternative energy systems* and *renewable energy systems*.

1.8 ENERGY AND AIR QUALITY

1.8.1 Planning authorities shall support energy efficiency and improved air quality through land use and development patterns which:

a) promote compact form and a structure of nodes and corridors;

b) promote the use of public transit and other alternative transportation modes in and between residential, employment (including commercial, industrial and institutional uses) and other areas where these exist or are to be developed;

c) focus major employment, commercial and other travel-intensive land uses on sites which are well served by public transit where this exists or is to be developed, or designing these to facilitate the establishment of public transit in the future;

d) improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion; and

e) promote design and orientation which maximize the use of alternative or renewable energy, such as solar and wind energy, and the mitigating effects of vegetation.

1.8.2 Increased energy supply should be promoted by providing opportunities for energy generation facilities to accommodate current and projected needs, and the use of *renewable energy systems* and *alternative energy systems*, where feasible.

1.8.3 *Alternative energy systems* and *renewable energy systems* shall be permitted in *settlement areas, rural areas* and *prime agricultural areas* in accordance with *provincial and federal requirements*. In *rural areas* and *prime agricultural areas*, these systems should be designed and constructed to minimize impacts on agricultural operations.

Appendix E: 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. More information can be found at **www.HAMNair.ca**

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**

The Southwestern Ontario Clean Air Council (SWO-CAC)

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

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 **www.hamiltoneconet.ca/**

Appendix F: 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 national health protection tool designed to help you make decisions to protect your health by limiting short-term exposure to air pollution and adjusting activity levels during episodes of increased air pollution. The AQHI is presented on a 10-point scale to indicate the level of health risk associated with air quality. It is calculated based on the relative health risk presented by a mixture of three air contaminants, ground-level ozone, particulate matter, and nitrogen dioxide. The AQHI provides specific advice for at-risk populations as well as the general public. For more information visit: www.ec.gc.ca/cas-aghi/default.asp?land=En&n=065BE995-1

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. For more information visit: www.airqualityontario.com or http://www.ene.gov.on.ca/environment/en/subject/air_quality/STDPROD_076121.html

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.

Carbonaceous Fuels – fuels that are rich in carbon.

Cardiovascular – refers to the heart and associated blood vessels.

CarShare – a model of car rental where people rent cars for short periods of time, often by the hour. They are attractive to customers who make only occasional use of a vehicle, as well as others who would like occasional access to a vehicle of a different type than they use day-to-day. The organization renting the cars may be a commercial business or the users may be organized as a democratically-controlled public agency, cooperative, or *ad hoc* grouping.

CarPool - is the shared use of a car by the driver and one or more passengers, usually for commuting. Carpoolers use member's private cars, or a jointly hired vehicle, for private shared commuting to and from work or appointments. The vehicle is not used in a general public transport capacity such as in car shares, shared taxis or taxicabs.

Climate Change – refers to the long term change in average weather patterns resulting from the release of substantial amounts of greenhouse gases, 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_2e – carbon dioxide equivalent; a unit of measurement used to compare the relative climate impact of the different greenhouse gases. The CO_2e quantity of any greenhouse gas is the amount of carbon dioxide that would produce the equivalent global warming potential.

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

Contaminant – refer to "What is a Contaminant" on page 17.

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

Environmental Registry (EBR) – an electronic filing cabinet (www.ebr.gov.on.ca) containing "public notices" about environmental matters being proposed by all government ministries covered by the Environmental Bill of Rights (i.e., new laws, regulations, programs, proposals, etc.). Each notice allows users to comment. When final decisions are made, the EBR will tell users what kind of comments were made, as well as the impact, if any, the comments had on the decision. The user will also be told whether and how they can appeal and challenge the decision.

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.

Geographic Information System – a collection of computer hardware, software, geographic data, methods, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

Global Positioning System – a navigational system involving satellites and computers that can determine the latitude and longitude of a receiver on Earth by computing the time difference for signals from different satellites to reach the receiver.

Global Warming Potential (GWP) – an index for estimating relative global warming contribution due to atmospheric emission of a kilogram (kg) of a particular greenhouse gas compared to the emission of a kg of carbon dioxide (refer to CO_2e). GWP is calculated for different time horizons and shows the effects of atmospheric lifetimes of the different gases.

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.

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 Ambient Air Quality Standards (NAAQS) – established by the United States Environmental Protection Agency under authority of the 1970 Clean Air Act that address outdoor air; for more information visit: www.epa.gov/air/criteria.html

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 – nitrogen oxides; 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. Reg. 419/05 – Ontario Regulation 419/05. In 2005, the Province of Ontario enacted Regulation 419/05 as the new framework for local air quality. This regulation is an 'effects-based' standard which incorporated more sophisticated dispersion modeling to determine the health and environmental impacts of a given pollutant source. The regulation replaced Regulation 346. See http://www.ecoissues.ca/index.php/Ontario_Regulation_419/05_%28Air_Pollution_%E2%80%93_Local_Air_Quality%29 for more details.

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

PM_{10} – inhalable particulate; airborne particles that have mean aerodynamic diameters of 10 µm (micrometers) 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 (micrometers) 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.

$PM_{0.1}$ – ultra-fine particulate; airborne particles with mean aerodynamic diameters of 0.1 µm or less. $PM_{0.1}$ is currently being studied for links to health impacts.

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. This term is used in conjunction with Ontario Regulation 419/05.

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.

ppm – parts per million; one part per million is one weight unit of chemical in one million (10^6) weight units of water, soil, etc. This is equivalent to one drop of water diluted into 50 liters (roughly the fuel tank capacity of a compact car).

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 19.

Stratospheric Ozone – also known as the ozone layer; see the Ground Level Ozone analysis of Appendix C on page 74.

SO_2 – sulphur dioxide; a respiratory irritant principally emitted by industrial processes that combust sulphur or sulphur-containing compounds.

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

Temperature Inversion – state in which cooler, denser air underlies warmer, lighter air and is thus prevented by gravity from vertical mixing and dispersion. Such a condition acts to trap air pollutants near the ground.

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 micrometers (μm).

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

Transportation Demand Management (TDM) – see Section 5.2.1

Urban Heat Island - a metropolitan area which is significantly warmer than its surrounding rural areas. Heat islands form as vegetation is replaced by asphalt and concrete for roads, buildings, and other structures necessary to accommodate growing populations. These surfaces absorb - rather than reflect - the sun's heat, causing surface temperatures and overall ambient temperatures to rise.

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 natural 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.

World Health Organization (WHO) – a United Nations agency to coordinate international health activities and to help governments improve health services. For more information visit: www.who.int/en/

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