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CleanAir HAMILTON

AIR QUALITY PROGRESS REPORT 2013

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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, citizens and different levels of government. *Clean Air Hamilton* continues to receive regional, national and international recognition 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. 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.
- Initiated in 1998, *Clean Air Hamilton* members work together to improve air quality throughout the City of Hamilton and meet all ambient air quality criteria by:
    - Initiating research on air quality;
    - Providing information and advice that decision-makers value;
    - Raising *Clean Air Hamilton*'s visibility in the community and being recognized as the authoritative voice on local air quality issues;
    - Galvanizing broad-based support for actions to improve air quality;
    - Encouraging emission reductions by individuals and companies operating in Hamilton;
    - Influencing decision-makers to choose sustainable practices; and
    - Promoting behavioural changes in companies, government, institutions and individuals in Hamilton that will improve air quality.
- *Clean Air Hamilton* has identified ten strategic issues related to air quality improvements and climate change issues to focus on over the next two to three years. These include; public health protection, risk communication, active and sustainable transportation, smart drivers, land use planning, air monitoring, emission reduction strategies, climate change, energy conservation, and communication.
- The annual percentage reductions in pollutant levels since the mid-1990s as measured at the downtown air monitoring site (MOE Station 29000) are: total suspended particulate (TSP) levels, 2.8% per year (total 55%); inhalable particulate matter (PM_{10}), 1.7% per year (total 32%); respirable particulate matter ($PM_{2.5}$), 2.5% per year (total 32%): nitrogen dioxide (NO_2), 2.8% per year (total 47%); sulphur dioxide (SO_2), 2.2% per year (total 38%); total reduced sulphur odours, 6.0% per year (total 99%); benzene, 5.4% per year (total 78%); and PAH (measured as benzo[a]pyrene), 4.9% per year(total 87%).
- It is estimated that the six key air pollutants - nitrogen dioxide (NO_2), ground-level ozone (O_3), inhalable particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2), and carbon monoxide (CO) - contribute to about 186 premature deaths, 395 respiratory hospital admissions and 322 cardiovascular hospital admissions each year in Hamilton (2011 Air Quality Health Assessment Study).
- In 2013, *Clean Air Hamilton* formed an Air Quality Task Force (AQTF) as requested by the City of Hamilton Board of Health to investigate and make recommendations: "actions that can be taken by the City to reduce air pollution in Hamilton". The AQTF responded with an Action Plan in 2013 with recommendations in the areas of air modelling and monitoring, planning, education and outreach, green infrastructure, and updating of municipal by-laws

aimed at decreasing particulate matter in the environment. The full AQTF Action Plan approved by the Board of Health can be found in **Appendix D**.

- Increased air monitoring through expanded fixed air monitoring stations combined with continued mobile air monitoring is useful for identifying air pollution "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, strategies for abatement and initiatives to reduce local emissions in communities and neighbourhoods. The introduction of the East End Air Monitor Pilot Program in Sam Manson Park, the "Fresh Air Kids" school air quality outreach and air monitoring, and continuation of neighbourhood mobile air monitoring in 2014 are examples of the recent expansion of the air monitoring network in Hamilton.
- Emissions from vehicles (cars and trucks) produce more air pollutants than all other sources. The roads in and around Hamilton are heavily used by local citizens, commuters passing through Hamilton and long-distance traffic. Consequently, air quality is adversely impacted by the mobile emissions generated by gasoline-powered vehicles and diesel-powered transport trucks. In Hamilton, transportation accounts for approximately 4% of local generated greenhouse gas emissions and 50% of air pollutants.
- *Clean Air Hamilton* continues to support the need for sustainable, low emissions and active forms of local transportation in Hamilton as a key area for actions to reduce air and climate emissions. Air monitoring at the street level highlights the need for continued actions in transportation including supporting complete streets policy, educating drivers, supporting policies and infrastructure that allows for multi modes of transportation and active movement in the City to reduce emissions and health exposures.
- Community greenhouse gas (GHG) emissions in 2011 were just below 18 million tonnes in Hamilton, a reduction of 23.1% from 2006 emissions levels that exceeds the City's 2020 targets. Hamilton has made progress in reducing greenhouse gas emissions through actions on energy and transportation. Hamilton is experiencing warmer temperatures and increased precipitation influenced by climate change. Municipal and community involvement in reducing emissions of GHGs (from commercial and personal transportation sources, commercial and residential energy sources, etc.) and preparing for climate change impacts such as extreme weather is still necessary to address the impacts of climate change locally and met the City's new emission reduction targets of 80% by 2050.
- Recognizing the linkages between air quality and climate change, *Clean Air Hamilton* has begun to examine and expand its work in the area of climate change. In 2013, *Clean Air Hamilton* established a climate change working group to work on educating and engaging with local partners and resources to address climate change locally, and support Hamilton's undertaking of a Community Climate Change Plan in 2014.
- *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* continues to cultivate partnerships with organizations that have air quality and climate change 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 2013 Progress Report on Air Quality to Hamilton Board of Health and Hamilton City Council. This report presents information on local air quality trends and the activities undertaken by *Clean Air Hamilton* and its members in 2013 to improve air quality and address climate change in the City of Hamilton. This report gives an update on new programs and initiatives and about on-going activities.

1.1 Dr. Brian McCarry

In 2013, the passing of Dr. Brian McCarry saddened the community of Hamilton *and Clean Air Hamilton*.

Dr. Brian McCarry (1946 – 2013) served as Chair of *Clean Air Hamilton* since 2000. Under his leadership, this innovative multi-stakeholder committee dedicated to improving local air quality expanded its membership and led innovative studies in health and air quality and local air monitoring. Dr. McCarry also served as Chair of the Hamilton Air Monitoring Network and the Upwind Downwind Conference.

Dr. McCarry taught at the Department of Chemistry at McMaster University for 37 years and held the Stephen A. Jarislowsky Chair in Environment and Health since 1999. His international reputation in environmental chemistry and toxicology was mirrored by his reputation in the Hamilton area for his tireless efforts on behalf of the local community and its environment.

Among his many accolades, he was a recipient of the Canadian Environment Award in 2005, which is bestowed on Canada's environmental leaders by the Government of Canada and Canadian Geographic magazine. He was named the 26th recipient of the Dr. Victor Cecilioni Hamilton Environmentalist of the Year Award in 2004, presented in recognition of outstanding contribution to environmental activity and leadership in Hamilton.

1.2 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, HAQI made 25 recommendations to improve air quality in Hamilton. Over the past 15 years, *Clean Air Hamilton* and its partners have made significant progress in addressing and responding to these recommendations (see the **2008 Clean Air Hamilton Report Appendix A** for a detailed list of these recommendations).

The original air quality reports prepared by HAQI in 1997 and 1998, together with the complete collection of *Clean Air Hamilton* Annual Reports from 2000 to 2012 are available and can be downloaded at: www.cleanair.hamilton.ca/default.asp?id=71

1.3 Impact

Clean Air Hamilton continues to receive regional, national and international recognition 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. 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's* and partners' activities. *Clean Air Hamilton* is viewed as an organization that is a model of how to affect change and enhance understanding on air quality at the local level.

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 promote and protect air quality and address climate change. *Clean Air Hamilton* has provided support for issues important to our community including transportation (e.g., EcoDriver, Totally Transit), air monitoring (e.g., mobile monitoring, "Fresh Air Kids" school monitoring, Hamilton Air Monitoring Network, Sam Manson Air Monitor pilot project), and air quality education and awareness (e.g., 2014 Upwind Downwind Conference and the *Clean Air Hamilton* website).

Recognizing the linkages between air quality and climate change (e.g. Upwind Downwind Conference, supporting the Hamilton Climate Change Charter); *Clean Air Hamilton* began to examine and expand its work in the area of climate change. In 2013, *Clean Air Hamilton* established a climate change working group to work on educating and engaging with local partners and resources to address climate change locally, and support Hamilton's undertaking of a Community Climate Change Plan in 2014.

On February 24, 2014, 170 delegates attended the 2014 Upwind Downwind Conference: Built Environment - Foundation for Cleaner Air. The conference was hosted by *Clean Air Hamilton* and the City of Hamilton, and was held at the Sheraton Hotel in downtown Hamilton. The conference title, "Built Form", reflected the progress that many cities have begun to realize that through improving the built environment, air quality, community health, and local transportation are improved. A free public talk featuring Dr. Stephen Kellert from Yale University on "Biophilia connecting cities with nature" was held on Sunday, February 23, 2012 at the Art Gallery of Hamilton. Biophilia is the inherent need to connect to and benefit from Nature. The talk attracted 140 people. More information about the Conference can be found in **Appendix G**.

1.4 Air Quality Task Force

In December 2012, Hamilton Board of Health requested that *Clean Air Hamilton* establish an Air Quality Task Force (AQTF) to investigate and make recommendations to the City on actions that can be taken to reduce air pollution in Hamilton.

The Vision of the AQTF Action Plan was developed the collective involvement of citizens, community and municipal government in the City of Hamilton. The AQTF supports: "*actions that can be taken by the City to reduce air pollution in Hamilton"* and that have the potential to result in:

- A higher quality of life for individuals who live and/or work in the City of Hamilton.
- Improved human health due to decreased exposure to air pollutants.

- A sustainable environment, which has fewer and lower emissions, that produces less detriment to the local airshed.

- A legacy for future generations that includes a cleaner environment.

The AQTF consisted of members of *Clean Air Hamilton* representing community, industry, and municipal government stakeholders who met monthly between January to July, 2013, and prepared 10 recommendations in an Action Plan that were reviewed by all members of *Clean Air Hamilton*. The AQTF consulted with members of the community or other stakeholders for providing recommendations to the Board of Health on what actions should be taken to improve air quality.

The AQTF Action Plan was presented to Board of Health in December 2013 and included recommendations in the areas of air modelling and monitoring, planning, education and outreach, green infrastructure, and updating of municipal by-laws aimed at decreasing particulate matter in the environment. **Section 4.0** of this report highlights and summarizes the recommendations of the AQTF Action Plan. The full AQTF Action Plan approved by the Board of Health can be found in **Appendix D.**

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* Terms of Reference

In the fall of 2011, *Clean Air Hamilton* created and approved Terms of Reference that address the administration, decision-making and membership components of the group. A copy of the approved Terms of Reference can be found on the *Clean Air Hamilton* website – www.cleanair.hamilton.ca

2.4 *Clean Air Hamilton* Membership 2013

Dr. Brian McCarry (Chair)	McMaster University
Brian Montgomery (Interim Chair)	Public Health Services, City of Hamilton
Carolyn Barnes	ArcelorMittal Dofasco*
Hazel Breton	Hamilton Conservation Authority
David Carson	Dundas in Transition
Peter Chernets	Citizen
Tom Chessman	Public Works, City of Hamilton
Robert Clackett	Planning & Economic Development, City of Hamilton
Dr. Denis Corr	Corr Research / Rotek Environmental
Deirdre Connell	Green Venture*
Heather Donison	Community & Emergency Services, City of Hamilton*
Robert Hall	Public Health Services, City of Hamilton*
Jennifer Haan	Planning & Economic Development, City of Hamilton
Dr. Frank Harrison	U.S. Steel Canada*
James Kaspersetz	Citizen
Mathew Lawson	Public Health Services, City of Hamilton
Brian Lennie	Horizon Utilities

Karen Logan	Hamilton Industrial Environmental Association
Dr. Lynda Lukasik	Environment Hamilton
Marie McKeary	McMaster Institute of Environment & Health
George McKibbon	McKibbon & Wakefield Inc.
Sally Radisic	Public Health Services, City of Hamilton*
Andrew Sebestyen	U.S. Steel Canada
Carl Slater	Ontario Ministry of the Environment
Mark Smithson	Ontario Ministry of the Environment*
Jim Stirling	ArcelorMittal Dofasco
Peter Topalovic	Public Works, City of Hamilton
Lorraine Vanderzwet	Mohawk College*
Steve Walsh	Public Health Services, City of Hamilton*
Pete Wobschall	Green Venture
Anna Yusa	Health Canada*

*Corresponding members

Clean Air Hamilton is dependent upon the voluntary contributions of its members. In order to continue to make air quality improvements and address climate change 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 partnering with organizations and individuals who have the time, expertise and interest in air quality and climate issues to work in a committee-based format to find ways to improve air quality and address climate change in the City. *Clean Air Hamilton* is particularly interested in engaging with committed individuals and organizations who want to undertake research to improve air quality and address climate change in Hamilton. *Clean Air Hamilton* is interested in working with individuals and with representatives from industries, government, 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

2.5 Strategic Activities - 2013 and Beyond

Clean Air Hamilton has identified ten strategic issues related to air quality improvements and climate change issues that the committee wishes to focus on over the next two to three years. *Clean Air Hamilton* has identified these issues for research, communication and program activities in collaboration with our partners:

- **Public Health Protection:** With an Air Quality Health Index (AQHI) now in Hamilton, encourage widespread use of the AQHI and produce communications to aid citizens in understanding what actions they can take to mitigate the health effects of poor air quality, particularly on smog days and inversion days.
- **Risk Communication:** Aid citizens in understanding the health risk implications of poor air quality.

- **Active and 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.
- **Land Use Planning:** Encourage actions by the City through land use policies to promote reductions of emissions and improvements in air quality and climate change through better planning tools.
- **Air Monitoring:** Monitor local air quality, sources and health conditions to identify sources and track progress. Introduce an airshed approach to Hamilton to model sources and emissions in the local airshed.
- **Emission Reductions Strategies:** Identify and reduce sources of local fugitive dust. Encourage actions to reduce emissions from small, medium and large-scale sources in Hamilton.
- **Climate Change:** Provide a forum to discuss the linkages between climate change and air quality and encourage strategies and actions that industries, government and citizens can take to reduce emissions and climate change impacts in Hamilton.
- **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.
- **Communication:** Continue to communicate on the impacts and sources of poor air quality and climate change, encourage behavioural changes, and increase support for the work of *Clean Air Hamilton*.

The 2013 *Clean Air Hamilton* Report presents the actions undertaken in 2013 by members of *Clean Air Hamilton* and our partners to address these strategic issues. Details of these activities can be found in **Appendix A**.

2.6 Financial and In-Kind Contributions

The City of Hamilton currently provides an annual contribution of $56,000/year in support of *Clean Air Hamilton* and its activities. This money is leveraged significantly in two ways: first, *Clean Air Hamilton* uses these funds in partnership with funds provided by other agencies and institutions to develop programs related to air quality and climate change; second, since many of the members of *Clean Air Hamilton* are community volunteers who donate their time and expertise, there is a significant amount of in-kind support provided to *Clean Air Hamilton*. In 2013, it is estimated that *Clean Air Hamilton*'s partners and volunteers provided $88,885 in in-kind support. *Clean Air Hamilton*'s 2013 financial report is available in **Appendix B**.

3.0 Air Quality in Hamilton

3.1 Air Pollution Health Impacts – Hamilton

While the correlation between exposure to air pollution and illnesses and mortality related to these exposures is well established (OMA, 2014),[1] current research efforts are seeking to understand and quantify the impacts on a range of specific health outcomes with specific air contaminants and overall risks to the public.

Poor air quality has been associated with a range of health impacts including eye, nose and throat irritation, breathing difficulties, and cardiovascular disease. These insights come from increasingly sophisticated statistical analyses of large-scale epidemiological data sets linking air quality data and health outcomes.

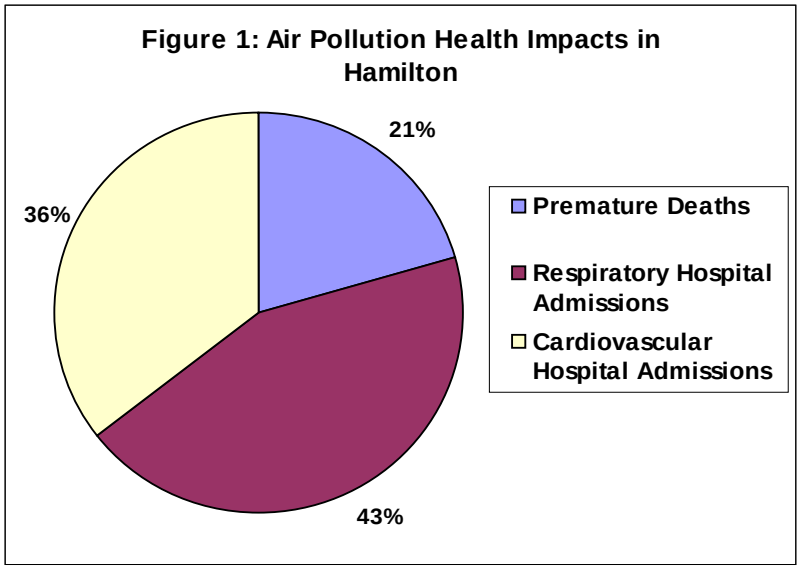
In 2011, *Clean Air Hamilton* in partnership with Hamilton Public Health Services decided that it was time to update the two previous health studies that had been undertaken by *Clean Air Hamilton* and reported in 1997 (as part of HAQI reports) and in 2003. SENES Consulting agreed to undertake the task of providing a comprehensive review and update of the scientific literature linking air pollutants and health effects and to use ambient air data from Hamilton to determine the health impacts of air pollution in Hamilton based on the most recent air quality-health reports.

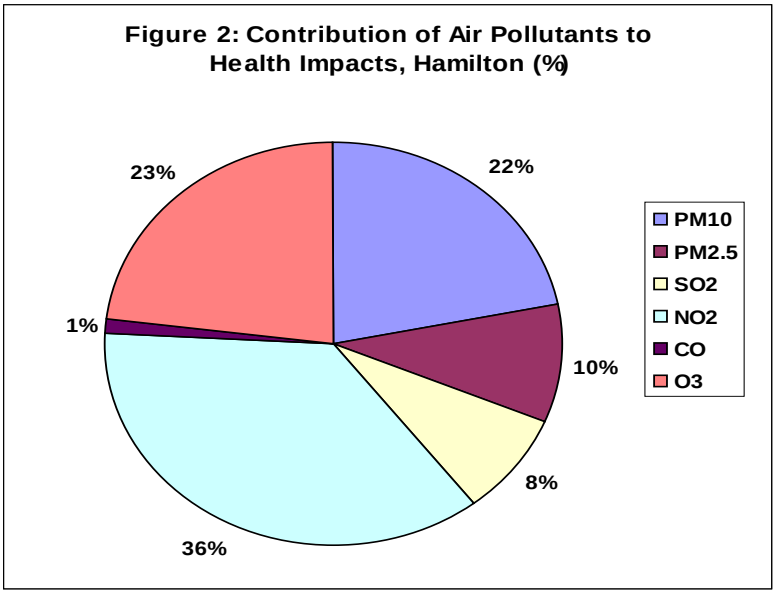
This study updated the health risks (primarily cardiovascular and respiratory impacts) associated with exposures to air pollutants (specifically, particulate matter, nitrogen oxides, ground-level ozone, sulphur dioxide and carbon monoxide). This report provides the clearest picture to date of the health impacts associated with poor air quality in our City. Due to improvements in air quality in Hamilton over the last 10 years, there was interest to see if the associated health impacts had also been reduced.

The 2011 Air Quality Health Assessment Study prepared by SENES Consulting Inc. estimated that the six key air pollutants - nitrogen dioxide (NO_2), ground-level ozone (O_3), inhalable particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2), and carbon monoxide (CO) - contribute to about 186 premature deaths, 395 respiratory hospital admissions and 322 cardiovascular hospital admissions each year in Hamilton (see **Figure 1**)[2].

All of these air pollutants contribute to health effects outcomes; however, some health outcomes are linked to exposures to specific air contaminants. For example, the main air pollutants contributing to respiratory admissions to hospitals are ground-level ozone, sulphur dioxide and nitrogen oxides. On the other hand, particulate matter (both PM_{10} and $PM_{2.5}$) and carbon monoxide (CO) were major contributors to cardiovascular admissions to hospitals. **Figure 2** below outlines the relative contributions of air pollutants to health impacts in Hamilton.

[1] Ontario Medical Association of Health (2014), Retrived from https://www.oma.org/HealthPromotion/Pages/Smog.aspx
[2] SENES Consulting Ltd. (2011). Health Impacts Exposure to Outdoor Air Pollution in Hamilton, Ontario . Retrieved from www.cleanair.hamilton.ca/downloads/2011%20Clean%20Air%20Hamilton%20-%20Health%20Impacts%20FINAL%20.pdf





Overall, with the average measured air quality for the Hamilton region improving, the number of hospital admissions associated with respiratory ailments has remained unchanged since the 2003 study; however, hospital admissions associated with cardiovascular effects have decreased significantly since 2003. Overall, deaths due to air pollution decreased from 229 in 2003 to 186 in 2012.[3]

In 2013, the International Agency for Research on Cancer, IARC, under the World Health Organization placed outdoor air pollution in Group 1, a category used only when "there is sufficient evidence of carcinogenicity in humans. Particulate matter, a major component of outdoor air pollution, was evaluated separately and was classified as carcinogenic to humans. World experts concluded that there is an increasing risk of lung cancer with increasing levels of exposure to particulate matter and air pollution after independently reviewing more than 1,000 scientific papers

[3] Not corrected for a 10% population increase in Hamilton since 2003.

from studies on five continents. The reviewed studies analyze the carcinogenicity of pollutants present in outdoor air pollution, especially particulate matter and transportation-related pollution.

The complete 2011 Health Impacts Study of Air Pollutants in Hamilton can be read online at the *Clean Air Hamilton* website – www.cleanair.hamilton.ca

3.2 Air Monitoring - Hamilton

Air monitors collect information about outdoor air quality data across the City of Hamilton and these data can be compared to provincial and federal air quality standards and to levels at cities across Canada and around the world (see **Appendix C**). Other uses of these data are to identify sources of air pollutants, and to evaluate the potential impacts of air emissions on human health.

Air quality monitors are located at a number of locations across the City. The air quality monitors are operated by four different organizations – Ontario Ministry of the Environment, Environment Canada, the Hamilton Air Monitoring Network and the City of Hamilton. The Ontario Ministry of the Environment (MOE) operates a network of three fixed air monitoring stations that serve as Provincial Air Quality Index (AQI) monitoring stations; these stations are situated in West Hamilton, on the Mountain and just east of downtown. Two of the MOE's AQI sites serve as sites for equipment owned by Environment Canada as part of Environment Canada's National Air Pollution Surveillance Station (NAPS) network. The Hamilton Air Monitoring Network (HAMN) operates a network of 15 stations that serve to monitor air quality in the industrial sector of Hamilton (see **Section 3.2.1**). This network is fully funded by local industry member companies. The locations of these stations, the pollutants monitored at each station and the data quality are overseen by the local Ministry of the Environment (MOE).

For years, mobile air monitoring was limited to the MOE's Trace Atmospheric Gas Monitoring units of the Environmental Monitoring and Reporting Branch, and mobile monitoring vehicles operated by Environment Canada. By partnering with the MOE's regional office, the City of Hamilton has become a Canadian pioneer in undertaking a program of mobile air quality monitoring. The MOEs mobile monitoring van can roam city-wide and can measure ambient air quality conditions on a minute-by-minute basis at street level. This type of monitoring affords a real-time picture of the changing exposures people experience. The first mobile air monitoring program in Hamilton was conducted in 2004 as a pilot project funded by the City and *Clean Air Hamilton*. The monitoring van and the monitoring equipment were brought together through a partnership between *Clean Air Hamilton*, the 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. In 2013, the local Ministry of the Environment staff continued to conduct air monitoring focused on airborne particulates at seven locations across greater Hamilton.

Air monitoring resources in Hamilton tend to be focussed on the east end industrial sector of the City. As a result of mobile monitoring activities in 2005, additional industrial areas in Hamilton were identified (see **Section 3.8**) that are not actively monitored or connected to the existing monitoring network. In addition, mobile monitoring and health research 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

3.2.1 Hamilton Air Monitoring Network (HAMN)

The Hamilton Air Monitoring Network (HAMN) is an industry-funded, local air monitoring network, comprised of 18 local companies who have committed to the assessment of air quality in Hamilton on a regular basis (**Table 1**). A map of the air monitoring network is shown in **Figure 3.** On-going operating costs and expenses related to the upgrading of air monitoring equipment and instruments are borne by the corporate members of the network. The network provides air quality reports to the MOE on a regular basis and to *Clean Air Hamilton*. All air quality data and reports are audited by the MOE to ensure consistent and high quality data. The MOE also conducts regular audits of the equipment at the HAMN sampling sites.

Table 1: Companies Participating in HAMN

Bartek Ingredients	Harsco Metals Canada	Federal Marine Terminals
Baycoat Ltd.	Lafarge Canada – Jones Road	U. S. Steel Canada – Hamilton Works
Bunge Canada	Lafarge Hamilton Slag	ArcelorMittal Hamilton East
City of Hamilton	Triple M Metal LP	Rütgers Canada Inc.
Shell Canada Ltd.	Birla Carbon	Newalta
ArcelorMittal Dofasco Inc.	Westway Terminal Canada	Biox Canada Ltd.

Figure 3: Map showing locations of air monitors in the Hamilton Air Monitoring Network

Since June 2009, the real-time air monitoring data collected by HAMN has been made available to the public through the network website (www.HAMNair.ca). This website was developed as a partnership between *Clean Air Hamilton*, HAMN, the City and the MOE.

To access the real-time air monitoring data collected by HAMN visit: www.HAMNair.ca

3.2.2 East End Air Monitor

As scientific knowledge about the health impacts of poor air quality has increased, Public Health Services of the City of Hamilton has assumed an increasingly active role in assessing local health effects of air quality, motivating stakeholders to improve air quality and performing citizen outreach to inform about risks and provide tools to reduce personal exposures. As part of this overall strategy, Public Health Services retained Rotek Environmental Inc. to operate an Air Quality Health Index (AQHI) station for one year in the eastern part of Hamilton so as to address public concerns about air quality in that area of the City.

Between 1985 and 1996, the MOE operated an air monitoring station in Ward 5 at Sam Manson Park. The monitor was named the "East Hamilton AQI Station" and it measured coefficient of haze, ozone (O_3), sulphur dioxide (SO_2), and total suspended particulates (TSP). AQI stands for Air Quality Index.

The MOE reported that the former East Hamilton AQI Station was removed in 1996 because the other three Hamilton AQI stations were sufficient to measure smog and long-range pollutants. The decision to remove the East Hamilton AQI station upset many area residents who felt that the east end was no longer being represented by way of air monitoring.

To address this concern, an air monitoring pilot project was initiated and a portable air monitoring system called an "Airpointer" was installed on November 21, 2012 in Sam Manson Park near Barton Street/ Nash Road (**Figure 6**). The location at Sam Manson Park was selected for three primary reasons: 1) this site satisfies the criterion of being located in Hamilton's east end, 2) the former East Hamilton AQI Station operated from 1985 to 1996 at this site, which allows for

comparison of some historical air quality data to newly acquired data and 3) this site already had the electrical power needed to operate the Airpointer.

This enabled data comparisons to be made and long term trends assessed. The air monitoring was conducted for one year from December 2012 to November 2013.

Figure 4 shows the station location with respect to the existing MOE AQI locations, **Figure 5** shows a close up map of the station site and **Figure 6** shows a photo of the air monitoring station.

Figure 4: Map of East Hamilton Sam Manson Park 29105 and MOE Station Locations

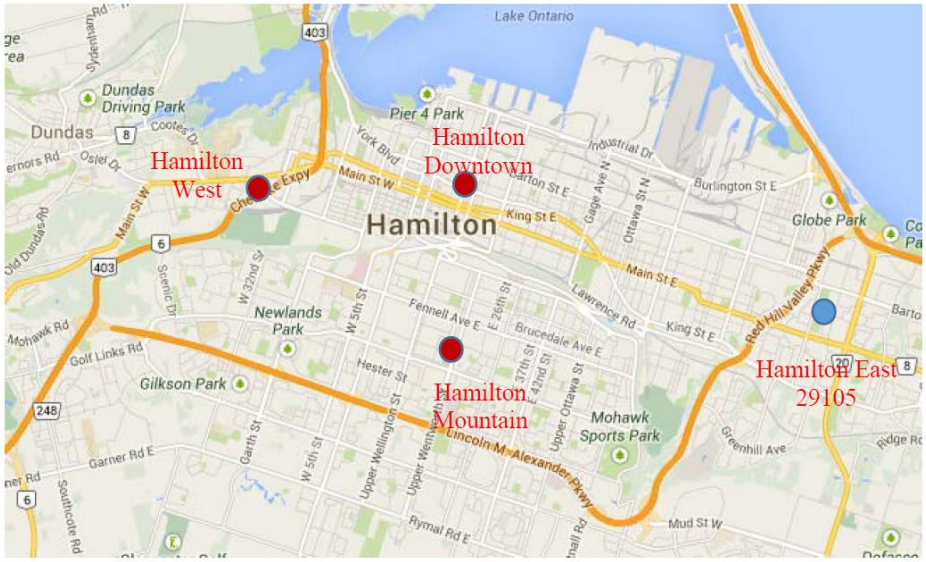


Figure 5: Detailed Map of East Hamilton Sam Manson Park 29105 Location

Figure 6: Sam Manson Park Pilot Air Monitor

A full suite of pollutants and meteorological parameters was measured, including:

- Air Quality Health Index (AQHI)
- Sulphur Dioxide (SO_2)
- Ozone (O_3)
- Respirable Particulate, less than 2.5 microns ($PM_{2.5}$)
- Carbon Monoxide (CO)
- Nitric Oxide (NO)
- Nitrogen Dioxide (NO_2)
- Oxides of Nitrogen (NO_X)
- Wind Speed (WS)
- Wind Direction (WD)
- Barometric Pressure (BP)
- Ambient Temperature (AMT)
- Relative Humidity (RH)
- Rainfall (Rain)

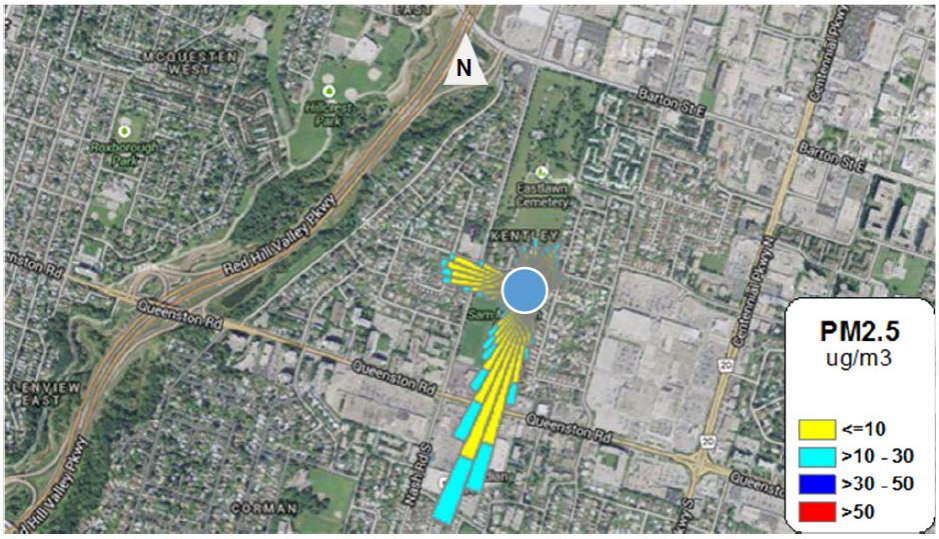
The results of this study showed the following.

Prevailing winds at this site were from the South/South West, next most frequent winds were from North West, with a small component from the North East.

Directional analyses indicated that the highest pollutant impacts were from the South/South West direction, i.e., from the rest of the City and from long range transport of air pollutants, see **Figures 7 and 8.**

While it might be expected that higher particulate levels may come from the Red Hill Valley Parkway, in fact there are less frequent > 10 µg/m^3 levels recorded from that direction. These data are in agreement with previous fixed station and mobile monitoring in the area. The previous studies showed that channeling of winds along the valley seemed to reduce impacts on neighbouring residential areas.

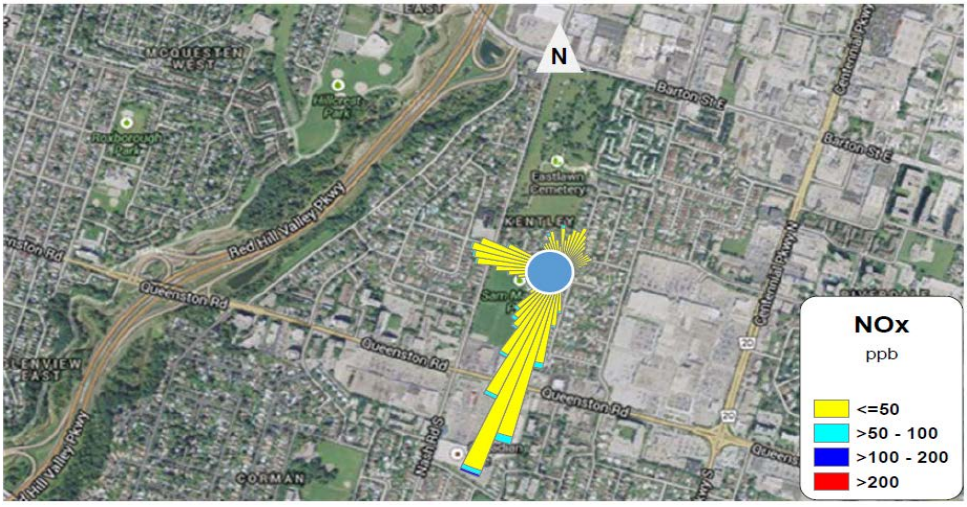
Figure 7: $PM_{2.5}$ Pollution Rose, AirPointer East Hamilton Sam Manson Park Station 29105



Similar results were obtained with NOx directional analyses.

While it might be expected that higher NOx levels may come from the Red Hill Valley Parkway, in fact there are less frequent > 50 ppb levels recorded from that direction.

Figure 8: NOx Pollution Rose, AirPointer East Hamilton Sam Manson Park STN 29105



Air Quality Health Index (AQHI) values, seen in **Figure 9**, showed the station site to have generally good air quality with 6947 hours in the Low Risk category, 1206 hours in the Moderate Risk category and no High or Very High values.

Figure 9 shows the relative number of hours of different AQHI levels experienced at Station 29105. The great majority of hours are in Low Risk, less in Moderate Risk, only two hours in High Risk and none in the Very High Risk categories. These values are compared to AQHI values at the air monitoring stations in Hamilton as seen in Table 2. Please note Table 2 refers to Jan – Nov while this figure refers to Dec –Nov, one full year, so hour totals may differ slightly.

Figure 9: Number of Hours in Different AQHI Categories, AirPointer East Hamilton Sam Manson Park Station 29105

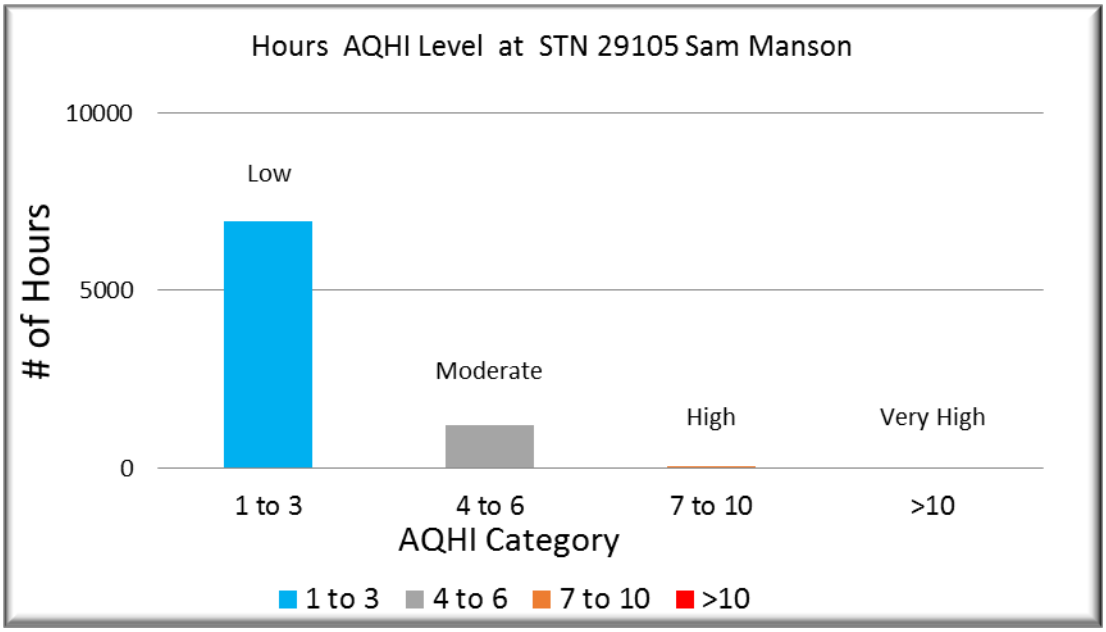


Table 2: AQHI Values of East End Monitor compared to other Hamilton Air Monitors

Station		AQHI Summary (Jan-Nov 2013)	
Sam Manson 29105		# hours	% time
LOW	1-3	6997	86
MODERATE	4-6	1124	14
HIGH	7-10	2	0.02
VERY HIGH	>10	0	0.00
29000 Downtown		# hours	% time
LOW	1-3	6207	80
MODERATE	4-6	1561	20
HIGH	7-10	10	0.13
VERY HIGH	>10	0	0.00
29114 Mountain		# hours	% time
LOW	1-3	6324	85
MODERATE	4-6	1110	15
HIGH	7-10	10	0.13
VERY HIGH	>10	0	0.00
29118 West End		# hours	% time
LOW	1-3	6439	83
MODERATE	4-6	1294	17
HIGH	7-10	1	0.01
VERY HIGH	>10	0	0.00

Variation of pollutants with time of day (diurnal analyses) showed that NOx had a marked peak during morning rush hour which flattened out in the afternoon and evening, as has been measured in other areas. O_3 normally peaks in the afternoon and drops off at night and this pattern was also observed at this station. See **Figures 10 and 11**.

Figure 10: NO_2/NOx Diurnal Variation

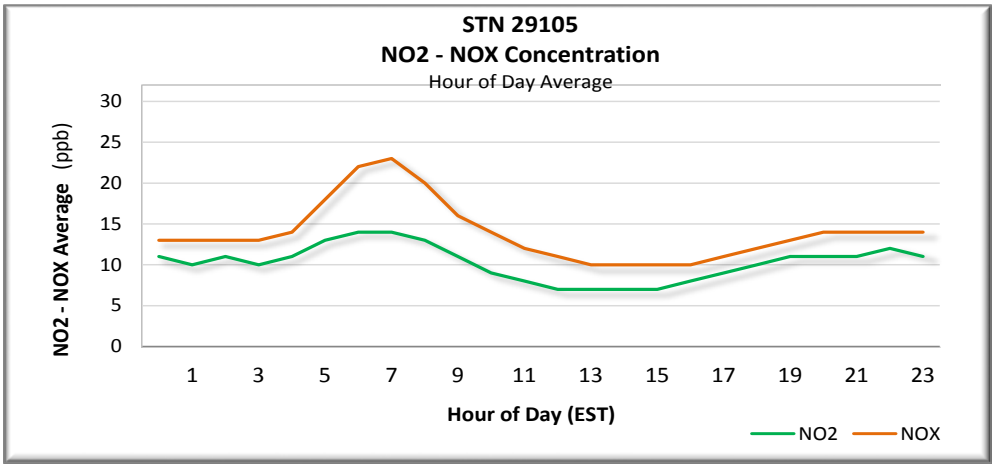
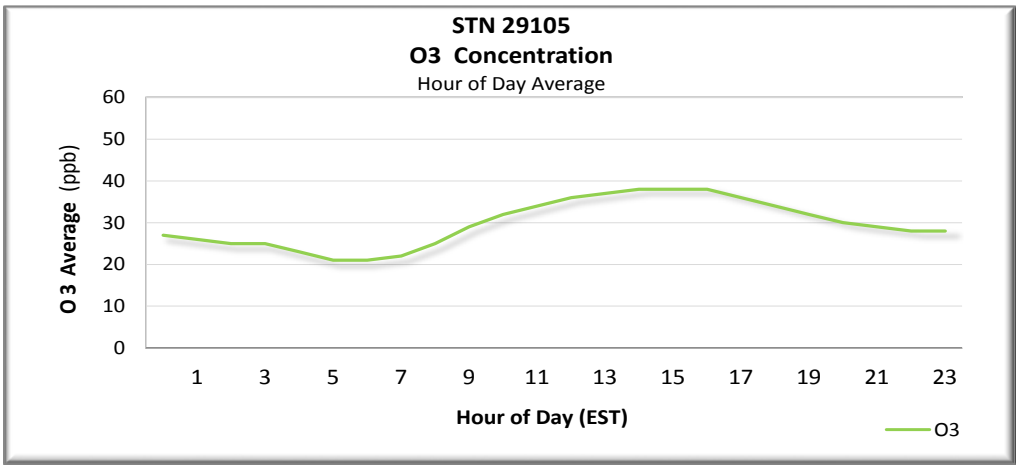


Figure 11: O_3 Diurnal Variation



Comparisons with the three MOE stations in the City determined that the Hamilton East/Sam Manson site had the lowest $PM_{2.5}$ and SO_2 concentrations, Hamilton Mountain had the lowest NO_2 concentrations and Hamilton Downtown had the lowest O_3 concentrations.

The reason for the lower O_3 levels in the downtown area is that ozone levels are reduced by chemical interactions with other pollutants. Locations such as the Downtown and West stations which have higher levels of other pollutants will have correspondingly lower O_3 levels.

Historical trends in air pollutants were only available for SO_2 and O_3 due to limitations in previous monitoring at this site. **Figures 12 and 13** show that SO_2 levels (locally emitted) have declined dramatically while ozone levels (long range transport) have increased.

Figure 12: Historical Trend of SO_2

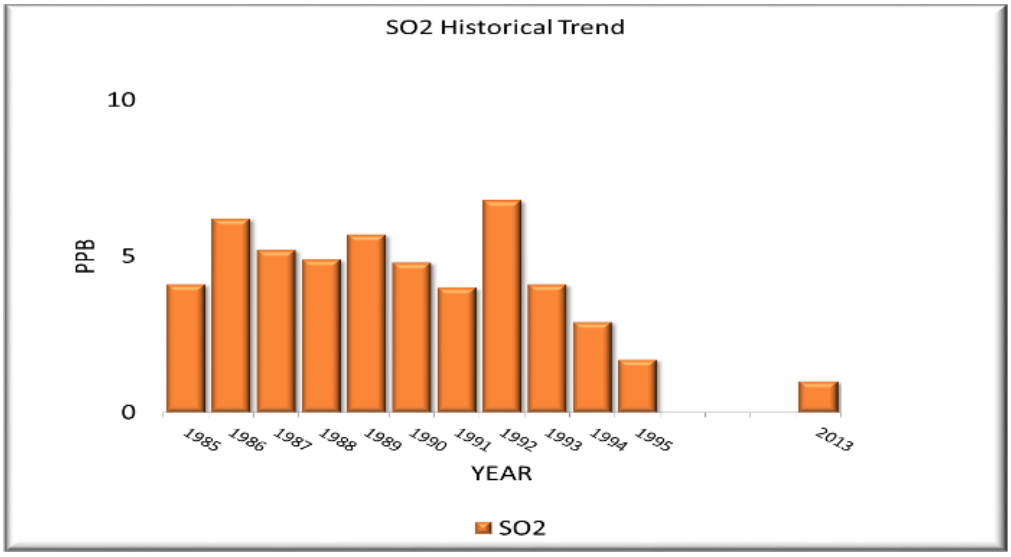
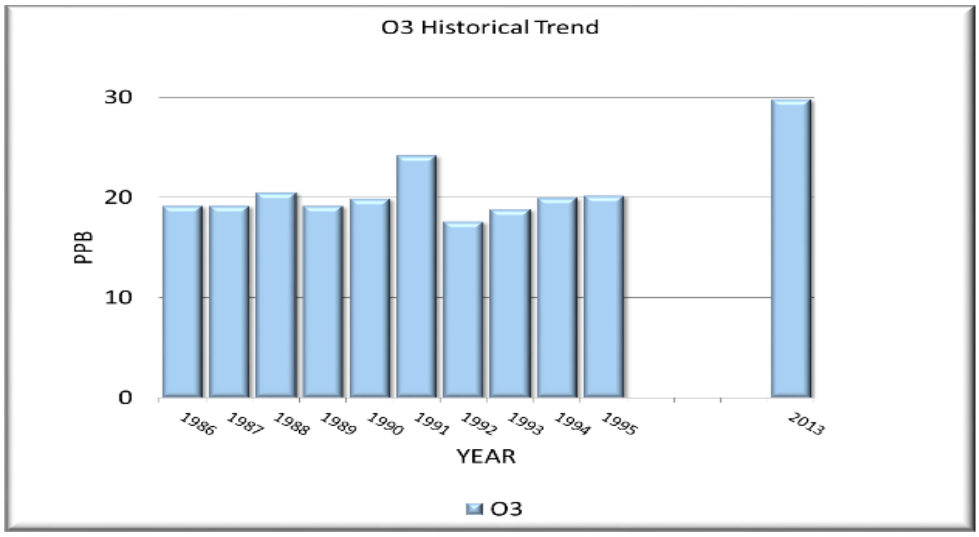


Figure 13: Historical Trend of O_3



Exceedances of Standards or Guidelines at Sam Manson Park.

- There were no exceedances of the Carbon Monoxide (CO), Sulphur Dioxide (SO_2) or Oxides of Nitrogen (NO_X) Ontario Ministry of the Environment Ambient Air Quality Criteria (AAQC). SO_2 exceeded the World Health Organization guideline once in October, 2013.

- There were twelve Ozone (O_3) exceedances of the 80 ppb hourly AAQC, one in May, 2013 and eleven in July, 2013 during regional smog episodes in the East End. The Mountain and Downtown air monitors showed five and three exceedances in July, 2013.

- Three years of data are required to calculate the $PM_{2.5}$ Canada Wide Standard of 30 µg/m^3 (three year community average, 98th percentile). Only one year of data is available from this station, however, the 98th percentile value is 24 µg/m^3, which would be well below the standard.

- A $PM_{2.5}$ MOE Reference level of 30 µg/m^3 was exceeded twice in July, 2013 and the $PM_{2.5}$ World Health Organization guideline of 25 µg/m^3 was exceeded three times in July, 2013.

3.2.3 Mobile Air Monitoring

Mobile air monitoring surveys have been undertaken through funding provided by and 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 earlier mobile air surveys has been presented in previous *Clean Air Hamilton* reports (please see **the 2005 through the 2012 Clean Air Hamilton Annual Reports**).

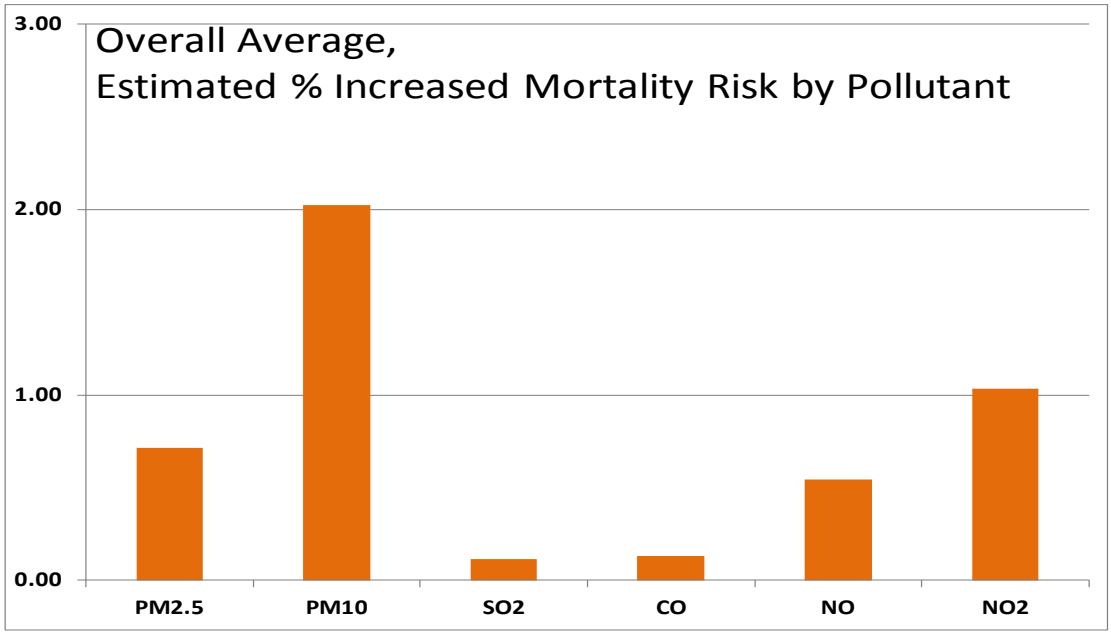
The reason for undertaking mobile air monitoring surveys is be able to get high quality air monitoring data from sites such as a street corner, a neighbourhood, outside a school, along the length of a street or next to a highway. The idea was quite simple: outfit a van with the same air monitoring equipment that would normally only be available in a fully outfitted fixed air monitoring station and drive the air monitoring van to areas that people live, work and travel. The mobile van, owned by the Ontario Ministry of Environment, West Central Region, can be driven while it is making measurements or it can be set up in fixed locations for periods of time. In this report the monitoring of neighbourhoods across the City 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 and the City.

From 2010 to 2011, *Clean Air Hamilton* in partnership with Green Venture began a mobile monitoring project to measure ambient air quality, to identify potential emissions sources and to determine the potential health impacts of ambient air in various neighbourhoods across Hamilton. Funding for the 2010 project was provided by a grant from ArcelorMittal Dofasco to help build the capacity for mobile monitoring in Hamilton and to identify local sources of pollution in neighbourhoods. Neighbourhood groups were encouraged to identify their desire for monitoring through a media release sent to local media and via neighbourhood association announcements. It was planned to monitor 5 neighbourhoods.

Requests for monitoring greatly exceeded expectations. 26 neighbourhoods in Hamilton requested monitoring; 11 neighbourhoods and sites were selected for the first air monitoring campaign, based on limitations of resources and time. The neighbourhoods mobile air monitoring study included Dundas, the area near Limeridge Mall, Red Hill neighbourhoods, Delta, Lawrence Ave. to Burlington St, North West End, Wentworth North, McAnulty Blvd, Beach Blvd/Eastport Drive, and Jones Rd/Arvin Ave. In 2012 Ward One Councillor Brian McHattie requested a mobile air monitoring survey of three neighbourhoods in the west end of Hamilton, namely Kirkendall South, Kirkendall North and Strathcona.

Citizens tend to be most interested in the overall health impacts of air pollution, rather than details of the levels of individual pollutants. To provide the most meaningful results for neighbourhood residents concerned about health effects, as well as for government officials pursuing air pollution control actions, total health effects due to air pollution exposures were calculated for each neighbourhood, using the most recently available risk values from the SENES 2011 Health Study report (see **Section 3.1**). These total health impact values were then further structured into values for each individual pollutant (**Figure 14**), allowing assessment of the health impacts of each contaminant on the health of citizens in each neighbourhood.

Figure 14: Overall Average Estimated Percent Increased Mortality Risk by Pollutant for the City of Hamilton



The overall average increased mortality risk due to exposure to air pollution in Hamilton was determined to be 4.6% (total of risks in **Figure 14**). Of the 11 neighbourhoods monitored, all showed air pollution impacts, with risks ranging from 2.5% to 7.7% increased mortality risk. The majority of these health impacts were due to particulate matter (PM) and oxides of nitrogen (NOx), primarily from transportation sources.

Explanatory Note Concerning the Term "Increased Estimated Percent Risk of Mortality":

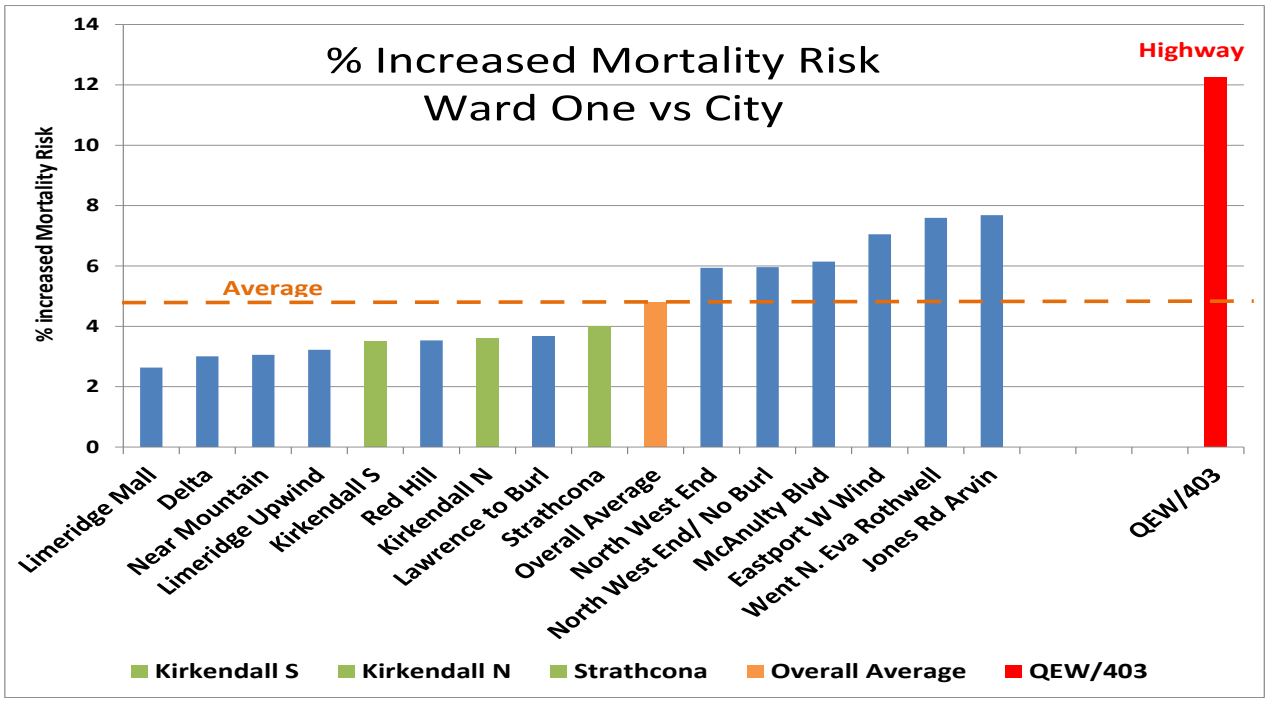
The "mortality calculations" represent the increased risk of mortality due to exposures to air pollutants above a true "zero exposure" to air pollutants. However, even the most remote sites on earth have low but measureable levels of airborne pollutants, notably fine particulate material. In other words, remote sites have low (but non-zero) increased risks of mortality due to exposures to pollutants. These increased risk numbers should be interpreted as general aids to decision-making because they provide comparisons of relative risks between different areas and between different pollutants; increased risk values should not be interpreted as exact representations of the burden of illness due to air pollutants. The 'health risk values' for individuals are influenced by additional factors including air pollutants not measured, personal lifestyle choices, diet, physical fitness and by a variety of personal health conditions that cannot be considered in such general estimates. In addition, mobile monitoring data only provide short-term "snapshots" of localized pollutant concentrations; at any location, pollutant concentrations can vary considerably.

As a "reality check" the overall average derived from mobile monitoring of 4.6% increased mortality risk due to air pollution in Hamilton was applied to the base rate of approximately 4000 deaths per year, resulting in a calculated mortality rate of 184 deaths per year; this value compares favourably with the number derived from fixed station monitoring, i.e., a 186 mortality rate determined by SENES in their February 2012 report "Health Impacts Exposure to Outdoor Air Pollution in Hamilton, Ontario". The Ontario Medical Association estimate for premature deaths due to air

pollution in Hamilton in 2008 was 445 deaths per year; however, this latter number includes long-term health effects as well as the acute effects estimated above[4].

The results of the health evaluations of the neighbourhoods monitored are combined in **Figure 15** to show a city-wide ranking of health impacts. Five neighbourhoods showed above average levels of air pollution effects. The "Overall Average" number in **Figure 15** refers to the average of the data from the neighbourhoods studied as part of the neighbourhood mobile monitoring study; this average does not include the 'Highway' value nor does it include any data from any other sites in Hamilton.

Figure 15: Percentage Increased Mortality Risk by Neighbourhood vs. the Mean of Risks Associated with Exposures along Six-lane Highways in Hamilton



The five neighbourhoods that were above the city average were the McAnulty Blvd. area, North West End, Jones Rd./Arvin Ave., Eastport Dr. and Wentworth North. The Jones Rd/Arvin Ave, McAnulty Blvd, North West end, Wentworth N. and Eastport Dr. areas all showed increased particulate effects above city averages, while the North West end, Wentworth N and Eastport Dr. areas showed increased nitrogen oxides impacts.

The "Highway" data in **Figure 15** was the average value obtained while driving on the Queen Elizabeth Way and Highway 403; these data reflect typical exposures drivers and passengers experience within a vehicle on a major highway; the highway exposure is nearly three times the neighbourhood average. Clearly, highway exposures (i.e., exposures to air pollutants while driving on the highway) are far above any neighbourhood exposures.

[4] Canadian Medical Association. (2008). No breathing room; National illness costs of air pollution (NICAP) summary report. Retrieved from www.cma.ca/index.php/ci_id/86830/la_id/1.htm

Previous mobile monitoring studies in Stoney Creek had shown the significant impacts of pollutant exposures along the Queen Elizabeth Way, a six-lane 400-series highway, and at distances up to 200 metres downwind of the highway. This work had also shown that noise reduction barriers significantly reduced pollutant impacts for residents who lived along the highway. It has been requested that the effects of emissions from vehicles on Highway 403 highway in Ward 1 be examined to see if there would be benefit from additional noise barriers in the area.

In 2014, mobile monitoring of the remaining neighbourhoods and areas identified from the 2011 study will be undertaken.

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

The full report and the individual neighbourhood reports can be found on *the Clean Air Hamilton* website: http://www.cleanair.hamilton.ca/default.asp?id=72

3.2.4 Regulating Air Contaminants

Ontario's local air quality regulation (O. Reg. 419/05: Air Pollution – Local Air Quality) works within the province's air management framework by regulating air contaminants released into communities by various sources, including local industrial and commercial facilities. The regulation aims to limit exposure to substances released into air that can affect human health and the environment, while allowing industry to operate responsibly under a set of rules that are publicly transparent.

Provincial air standards are set based on science and therefore, may not be achievable by a facility or a sector due to unique technical or economic limitations. Instead of making the air standard less stringent, the regulation allows facilities or sectors to exceed the air standard as long as they are working to reduce their air emissions as much as possible with technology-based solutions and best practices. The Ministry of the Environment closely oversees their progress using a framework for managing risk that was developed in cooperation with public health units in Ontario and other stakeholders.

The regulation includes three compliance approaches for industry to demonstrate environmental performance, and make improvements when required. Industry can meet an air standard, request and meet a site-specific standard or register and meet the requirements under a technical standard (if available). All three approaches are allowable under the regulation. Some facilities may never meet the general air standard and instead will be regulated under one of the other compliance approaches.

Provincial air standards are used to assess a facility's individual contribution of a contaminant to air. They are set based solely on science and may not be achievable by a facility or a sector due to unique technical or economic limitations. In these cases, industries or sectors look to technology and best practices to improve their environmental performance and comply with the regulation. In 2011, MOE set new or updated air standards for an additional nine contaminants – uranium and uranium compounds (PM_{10} fraction), nickel and nickel compounds, chromium and chromium compounds, hexavalent chromium, benzene, benzo[a]pyrene (as a surrogate for polycyclic

aromatic hydrocarbons), 1,3-butadiene, dioxins and dioxin-like compounds, and manganese and manganese compounds. These standards come into effect on July 1, 2016.

In September 2011, the ministry introduced a modernized approach for issuing instruments formerly called Certificates of Approval (CofA). There are now two streams to obtain approval. One stream is to electronically register for certain discharges that are established through regulation. These are known as Environmental Activity Sector Registrations (EASR). The initial phase of EASR covered certain low risk emission sources such as certain auto repair and finishing and standby electricity generators. Other low risk sources are planned for phase in. The second stream of approval is for Environmental Compliance Approvals (ECA). These are the higher risk, significant source or complex approvals that require careful, thorough assessment and detailed technical review. ECA includes large sewage systems, landfills and waste transfer sites, and many air emissions. For an air ECA application, 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 air standards set out in O.Reg 419/05. Since an ECA is required before a facility can be built, the assessment and approval is often based on the modeling of air emissions to determine the point of impingement that are then compared against the standards and guidelines. Unless explicitly exempted, most industrial processes and equipment that discharge to the air require an ECA 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 excluded.

While the ECA is based on the modelled prediction that guidelines, air standards or a site-specific standard 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 or site-specific standard. If standards are not met or if conditions on the ECA are not met, the Ministry of the Environment can take action to require that corrective measures be taken to bring the operation into compliance with the regulation and/or ECA conditions.

For further information on air regulation and standards or Environmental Compliance Approvals visit: http://www.ontario.ca/ministry-environment

Site Specific Standards

Under O. Reg. 419/05, new or more stringent standards are phased in over time. The first set of new or more stringent air quality standards for industrial facilities in Ontario took effect on February 1, 2010, with the next set phased in on February 1, 2013: the next set is on July 1, 2016. A facility that is not able to meet the standards within the prescribed timeline may request approval for a site-specific air standard. A site-specific standard is an air concentration approved by a director of the Ministry of the Environment for an individual facility that is challenged in meeting the air standard. This compliance approach focuses on actions an individual facility can take to reduce emissions to air as much as possible, considering the technology that is available and best operational practices. Economic factors may also be considered. The MOE introduced the site-specific standard process to acknowledge the significant investments that may be needed to keep pace with new or updated regulatory requirements. A site- specific air standard may be approved for a period of five years to ten years. Furthermore, O. Reg. 419/05 provides that a facility may also apply for renewal of a site-specific air standard.

Approvals Issued:

- Oxy Vinyls, Niagara: Approved from Jan 2009 to Feb 2017 [Vinyl Chloride]
- ArcelorMittal Dofasco, Hamilton: Approved from July 2010 to Feb 2015 [Suspended Particulate Matter; Total Reduced Sulphur; included review of Benzo-a-pyrene (BaP) and Benzene].
- Xstrata-Copper, Timmins; Approved from Feb 2010 to Feb 2014 [Sulphur Dioxide; Lead]
- Vale, Sudbury: Approved from December 2011 to December 2021 [Nickel]
- Vale, Sudbury: Approved from December 2012 to December 2017 [Sulphur Dioxide]
- Xstrata-Nickel (now Glencore), Sudbury: Approved from August 2012 to December 2022 [Sulphur Dioxide]
- Xstrata-Nickel (now Glencore), Sudbury: Approved from January 2012 to December 2018 [Cadmium]
- Archer Daniels Midland, Windsor: Approved from November 2013 to December 2018 [Suspended Particulate Matter]

Requests Submitted and Under Review:

- U.S. Steel Canada, Hamilton Works: Suspended Particulate Matter; Benzo-a-pyrene (BaP) (as a surrogate for polycyclic aromatic hydrocarbons) and Benzene (updated October 2013)
- U.S. Steel Canada, Lake Erie Works – Nanticoke: Suspended Particulate Matter; Sulphur Dioxide; Benzo-a-pyrene (BaP) (as a surrogate for polycyclic aromatic hydrocarbons); and Benzene (updated September 2012)
- ArcelorMittal Dofasco, Hamilton: Approved from July 2010 to February 2015] [request to extend timelines and amend above approval] [Suspended Particulate Matter; Total Reduced Sulphur]
- Essar Steel, Sault Ste Marie: Suspended Particulate Matter
- Harsco, Nanticoke: Suspended Particulate Matter (operates on same site as US Steel, Nanticoke)

A request for the site specific air standard must (at a minimum) include the following information:

- **Emission Summary and Dispersion Modeling (ESDM) Report** –which includes 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 site-specific standards process is public transparency. Therefore, the requestor for a site-specific air standard must engage in public consultation efforts to ensure that:

- Community members are given an opportunity to understand the barriers for the facility in meeting an air standard 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 a site- specific standard and the outcome reached by the facility in terms of corrective actions to address the issue, through the Environmental Registry.
- 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, City of Hamilton,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.

U. S. Steel Canada’s 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., which 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 (see **Section 8.1**).

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 U.S. Steel Canada's Hamilton Works CLC visit:
http://www.ourcommunityourfuture.com/our-committees/

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

A site-specific standard is an air concentration approved by an appointed director of the Ministry of the Environment for an individual facility that is challenged in meeting the air standard. This compliance approach focuses on actions an individual facility can take to reduce emissions to air as much as possible, considering the technology that is available and best operational practices. Economic factors may also be considered.

Under this compliance approach, the individual facility would continue to assess compliance using modelling and/or a combination of modelling and measurement against a site-specific concentration for a particular contaminant.

The site-specific standard approval process follows the ministry's framework for risk management, which was developed in consultation with Ontario public health agencies and other stakeholders. The process sets out the need for timely action to be taken to reduce emissions, where necessary, from key sources of a contaminant, thereby reducing risks to local communities.

Sometimes significant investments may be needed to keep pace with new or updated regulatory requirements. If so, the site-specific standard approved by the ministry allows a facility the time needed to assess and implement technology or operational adjustments to improve their environmental performance within a timeframe approved by the Ministry of the Environment.

In summary, if a facility receives approval for a site-specific air standard, the facility is operating in compliance with O. Reg. 419/05. The site-specific 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 standard includes an extensive technology benchmarking assessment which compares the facility to other facilities and evaluates best available technologies or practices to minimize air emissions. A site-specific standard approval may 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 site-specific 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 site-specific air standard. Compliance and/or enforcement action is also possible.

Technical Standards

A technical standard is a technology-based solution designed for two or more facilities in a sector that may not be able to meet an air standard due to technical or economic limitations. This approach can include technology, operation, monitoring and reporting requirements. Once established, any facility in the sector (that may or may not meet the air standard) may request to be registered under the technical standard.

Technical standards can be used to manage air emissions for multiple facilities within one or more sectors and can include a wide range of contaminants.

When the ministry develops a technical standard, representative facilities in the sector are compared to what other facilities around the world are required or capable of achieving to determine whether or not the same can be required of Ontario facilities.

Development of a technical standard includes a better understanding of the specific sources of contaminants for that sector, benchmarking technology to address the sources of contaminants, and consideration of economic issues that relate to the sector.

The goal is to have a more efficient tool to better manage air emissions and reduce overall exposure from various industrial and commercial facilities in a sector.

There are two types of technical standards:

- Industry Standards regulate all sources of a specified contaminant(s) within an industry sector.

- Equipment Standards address a source of contaminant, but may apply to one or multiple industry sectors.

A facility that meets its obligations under a technical standard is in compliance with the regulation for the registered contaminants.

There are currently two technical standards in place: the Foundry - Industry Standard and the Forest Products - Industry Standard. The following sectors have also requested a proposed technical standard compliance approach:

- Pulp and Paper: Industry Standard
- Foundries: Update to Foundries Industry Standard
- Integrated Iron and Steel Mills
- Metal Finishers (includes chrome plating)
- Petroleum refineries
- Petrochemical
- Mine Sites
- Fibreglass Insulation Manufacturing

- Non-integrated steel producers (mini-mills)
- Hot Mix Asphalt Plants

For further information on Site-Specific Standards visit:

http://www.ontario.ca/ministry-environment

3.3 Hamilton Air Quality – Trends and Comparisons

Examination of the trends in ambient air quality in Hamilton since the mid-1990's (see **Appendix C**) shows that there have been large reductions in the airborne levels of some pollutants.

The annual percentage reductions in pollutant over this time period as measured at the downtown air monitoring site (MOE Station 29000) are: total suspended particulate (TSP) levels, 2.8% per year (total 55%); inhalable particulate matter (PM_{10}), 1.7% per year (total 32%); respirable particulate matter ($PM_{2.5}$), 2.5% per year (total 32%): nitrogen dioxide (NO_2), 2.8% per year (total 47%); sulphur dioxide (SO_2), 2.2% per year (total 38%); total reduced sulphur odours, 6.0% per year (total 99%); benzene, 5.4% per year (total 78%); and PAH (measured as benzo[a]pyrene), 4.9% per year(total 87%).

The ambient levels of particulate material (TSP, PM_{10} and $PM_{2.5}$), nitrogen oxides (NO_x) and sulphur dioxide (SO_2) have decreased steadily over the past 20 years. These reductions are the result of improved emissions performance of the vehicle fleet (both cars and trucks), the reduction of re-suspended material from roadways and various sources of fugitive dust, and of actions taken by companies in Hamilton to reduce their emissions. *Clean Air Hamilton* does note that air quality can be variable at a local neighbourhood level and some areas of Hamilton can be impacted more than others by air pollutants.

However, over the past three to six years, the downward trends in some air pollutant levels either have levelled off or have shown modest increases. The only pollutant that continues to decline steadily is NO_2. The annual values for SO_2, benzene and benzo[a]pyrene all have shown modest increases over the past three to six years. Additionally, in the industrial areas of Hamilton, the 2013 levels of benzene and benzo[a]pyrene levels have increased slightly over the past five or six years. However, concentrations of these pollutants in recent years are well below levels measured in the mid-1990s and in 2013 appear to be decreasing again.

The province continues to work on improving air quality in Ontario. New standards set out in O. Regulation 419/5 for a number of air pollutants in Ontario including benzo(a)pyrene and benzene come into effect in 2016. These new standards significantly tighten the current benchmarks for air quality. *Clean Air Hamilton* supports and encourages the continued efforts of the Ministry and Industry to reduce air borne contaminants in the City of Hamilton and the Province of Ontario.

The levels of ground level ozone (O_3) during the summer months have shown an upward trend since 1990. Essentially all of the ozone measured in Hamilton is the result of long-range transport of emissions from sources in the US Midwest. Ozone is created when sunlight reacts with air pollutants. Air masses containing ozone arrive in southern Ontario due to the long-range transport of pollutants from the Ohio Valley region of the US. Air pollutant levels in Hamilton are compared to levels of the same pollutants in other southern Ontario communities over the past 10-20 years (see **Appendix C**). From examination of these graphs, 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;
- 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 has been an increasing trend in ozone levels across Ontario over the past decade. Ozone levels in Hamilton are usually about the same as or lower than levels in the other southern Ontario cities. Some rural areas of Ontario experience high ozone levels relative to urban sites; the highest levels of ground-level ozone 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.

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 car and truck 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 features 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 than above the escarpment.
- A few times a year unusual meteorological conditions can occur that give rise to atmospheric inversion events, which may last from 2 to 12 hours or longer. 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. It has been estimated that about 50% of the air pollution in Hamilton air comes from long-range transport; the remainder are locally generated emissions.

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 at each site.

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 (typically in summer months) and/or particulate matter (typically in the fall and spring). Local smog advisories may be issued just for Hamilton, if local emissions are expected to result in AQI values of 50 or higher usually due to particulate matter.

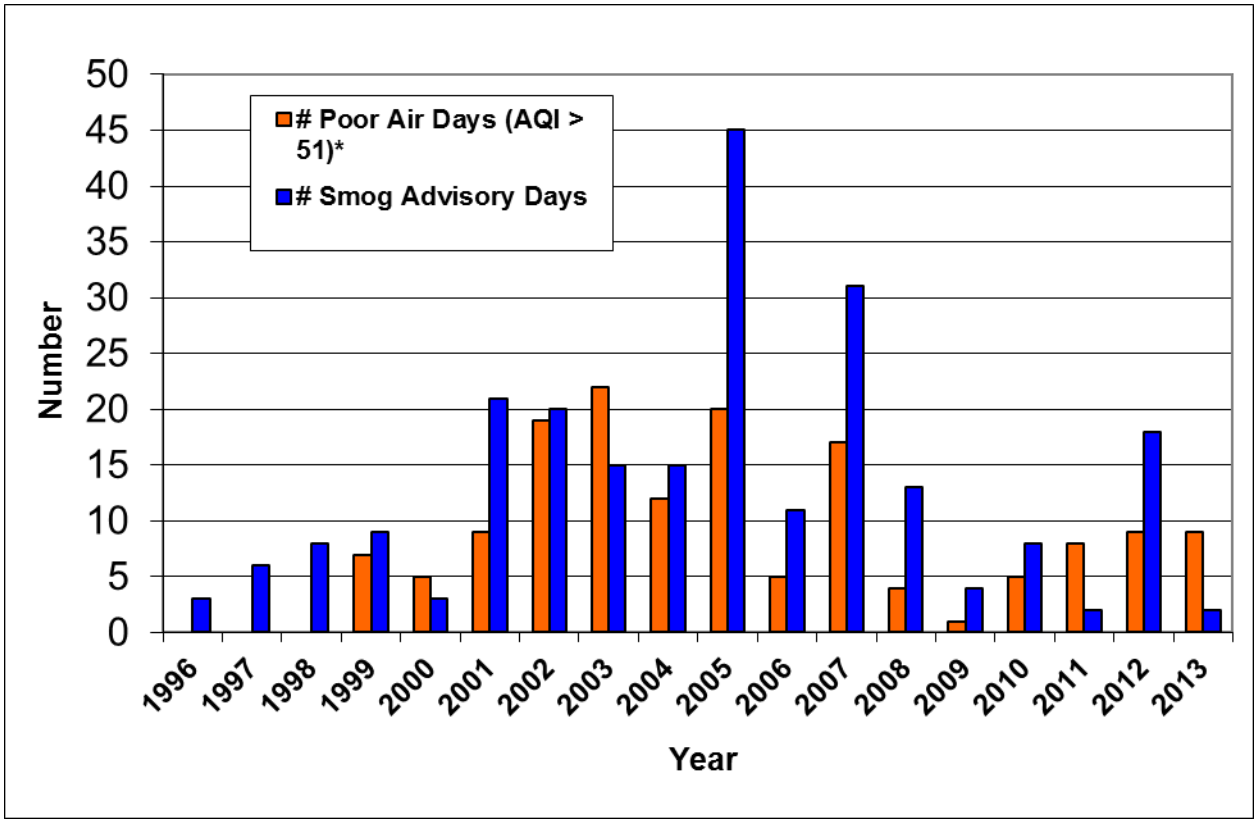
The AQI is determined based on the highest single value of any one of six key air health-related contaminants – fine particulate matter ($PM_{2.5}$,) nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), total reduced sulphur compounds and ground-level ozone (O_3). In the summer months, 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 layer in the stratosphere (i.e., the ozone which is found about 20-40 km above the earth's surface); stratospheric ozone is important in absorbing harmful ultraviolet radiation from the sun and thereby reducing the intensity of ultraviolet light that reaches 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, can cause dramatic impacts on the lungs of susceptible individuals, such as the elderly, the young and those with asthma.

There were nine days in 2013 when the air quality was considered to be poor (i.e., an AQI of 50 or greater for at least 1 hour). In 2013, two smog advisory days were declared by the Ontario Ministry of Environment (MOE) for the City of Hamilton (see **Figure 16**).

Figure 16 below shows the numbers of smog advisory days and poor air quality days in Hamilton over the past sixteen years. Poor air quality days are defined as days when the Air Quality Index (AQI) was greater than or equal to 50 for at least 1 hour during the day.

Figure 16: Number of Poor Air Quality Days and Smog Advisory Days in Hamilton between 1996 and 2013



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.

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

3.5 Air Quality Health Index

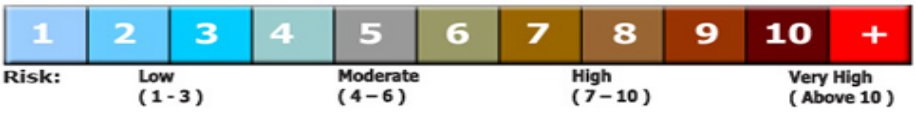
Clean Air Hamilton and Hamilton Public Health Services have advocated for the development and widespread use of a health-based Air Quality Index; a well-conceived health index would provide the public with useful information about current air quality conditions and provide the public with strategies they can use to reduce their exposures. A few years ago, the Government of Canada developed an Air Quality Health Index (AQHI) and piloted this index in selected cities across Canada. Environment Canada began to report daily AQHI reporting for Hamilton on its website in July 2011.

The Government of Canada's AQHI is calculated in a different manner compared to the MOE's Air Quality Index (AQI). While the MOE's AQI currently takes into account 6 air 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 on **only one** of these six pollutants, depending on which pollutant has the highest value on its own scale.

It has been known for many years that the impacts of individual air pollutants on humans are additive; in other words an air quality index should be based on the contributions of the health effects of all pollutants measured. The MOE's AQI values do not reflect these additive effects. The Government of Canada's AQHI is calculated using a formula that combines the concentrations and the relative health impacts of three air 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 AQHI formula because in most of Canada these components were not associated with explaining additional health risks in many areas of Canada. They were not associated with additional health risk once the effects of ozone, nitrogen dioxide and particulate matter were taken into account.

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 17** 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 17: Air Quality Health Index Scale



(Source: Environment Canada, 2013)[5]

Associated with the AQHI are health messages that are directed at two distinct populations – the "at risk" population and the "general" population (see **Table 3**).
The "at risk" population includes individuals at increased risk due to age or a variety of health conditions; the "at risk" population includes 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 history of heart attack, congestive heart failure, heart arrhythmia or irregular heartbeat). The 'general population' includes all other individuals who do not fall under the "at risk" population (Environment Canada, 2013).

Those in the "at risk" category are encouraged to monitor the AQHI regularly since they are more sensitive to air pollution. Individuals are encouraged to develop their own self-calibration points on the AQHI scale. Most people now 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 yet another factor that individuals will need to calibrate themselves against.

[5] Environment Canada (2013). AQHI website. Retrieved from www.ec.gc.ca/casaqhi/default.asp?lang=En&n=065BE995-

Table 3: 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, 2013)

AQHI outreach in the community engaging the general population took place at City of Hamilton special events between the months of June to October 2011 and 2012. In 2013, AQHI outreach focused on the “at risk” population with pre-existing respiratory conditions. Health professionals in the City of Hamilton including those at the Firestone Clinic, North Hamilton Community Health Centre and Hamilton Family Health were provided with the AQHI poster shown in **Figure 18**.

This poster was designed by the Ontario Lung Association as a step-by-step tool that could be used by health professional to help patients with respiratory conditions understand how to monitor AQHI and implement AQHI health messages. Focusing on each of the “at risk” populations, independently, is critical in terms of raising AQHI awareness and increasing adoption of the tool amongst each specific “at risk” populations.

Figure 18: AQHI Teaching Poster

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

3.6 Local Poor Air Quality Notification

The local office of the Ontario Ministry of the Environment (MOE) has put in place a program whereby about 30 companies are asked to curtail emissions and to control dust-generating activities on days when local air quality is considered to be poor. 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). The system of reporting on and taking action for local poor air quality is exclusive to Hamilton. The protocol is not based on the MOE's Air Quality Index (AQI) in the way that the MOE's current province-wide system of smog alerts is based on the AQI.

Participating local companies are told by the MOE when local air quality is already poor or is likely to become poor due to increased levels of fine particulate matter ($PM_{2.5}$). Participating companies have plans and protocols in place to implement that will reduce emissions of fine particulate matter from their operations. Such notifications serve to help the local air quality situation during poor air events. These notifications do not have any effect on levels of pollutants that arrive in Hamilton due to long-range transport from sources outside Canada.

This poor air quality notification process was put in place because it is possible to decrease the impacts of poor air quality on a local basis even if other areas do not have poor air quality at that time. One of the main reasons for these "Hamilton-specific" poor air quality events is a weather event known as a "temperature inversion". Normally, air near the ground is warmer compared to air at higher altitudes since air temperature decreases with increasing altitude. During the special conditions leading to a temperature inversion, a layer of warm air lies on top of a layer of cooler air and acts as a 'cap' over the cooler ground level air.

During these events the air is usually very still. The 'cap' caused by the warm air traps emissions from industry, transportation or other local emissions sources under the 'cap' and does not allow these emissions to disperse readily as they would normally. The result is that the concentrations of locally generated pollutants build up rapidly in the air underneath the inversion layer or 'cap.' Pollutant levels rise very quickly, often to poor or even dangerous levels. These inversions are unstable and tend to last only a short time before they break up and the pollutants disperse. During an inversion $PM_{2.5}$ levels have reached and exceeded 100 micrograms per cubic metre.

Temperature inversions happen in Hamilton primarily in the fall and spring due in part to the unique local geography of the Niagara Escarpment and the lake breeze effects from Lake Ontario. In a typical year, Hamilton experiences 1-3 such events lasting hours to a couple of days; however, inversion events lasting up to 5 days have been known to occur.

During a Local Poor Air Quality Event, industries are asked to voluntarily undertake control measures and curtail activities with a strong focus on reducing emissions of particulate matter to the air. Actions to accomplish could include wetting or covering materials piles (e.g., coal, gravel), postponing materials handling activities, increasing property and road cleaning, and curtailing some production processes.

The focus of the notification system is on fine particulate matter ($PM_{2.5}$) because there is a significant amount of $PM_{2.5}$ that is locally-generated. Therefore, any local efforts to reduce air pollution in general will be beneficial. When fine particulate matter 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 may be notified to implement their plans to reduce local sources of fine particulate matter.

In 2013 the MOE did not activate the Local Poor Air Quality Notification protocol in response to meteorological and air quality conditions.

3.7 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 can 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.

3.8 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 not accounted 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 emissions report.

Figure 19: The Air Pollution Picture

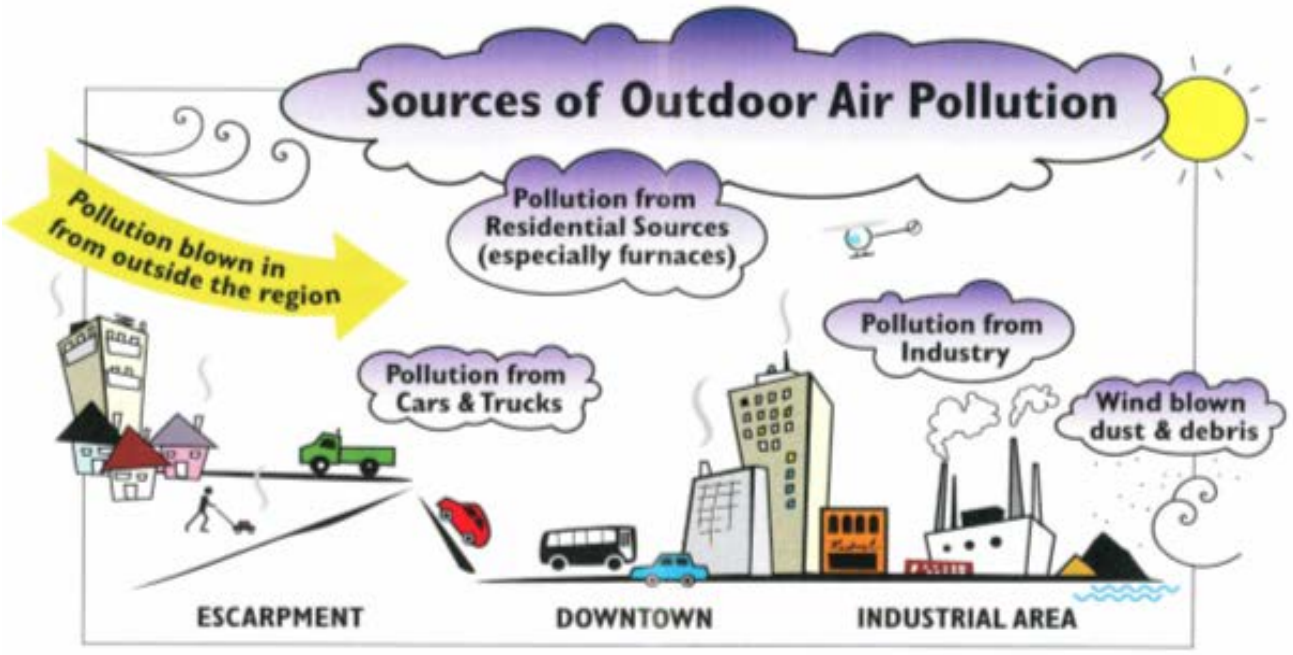


Table 4: NPRI Total Emissions by Source Category for Hamilton (2008)

Source Category	CO	SO_x	NO_x	PM_{10}	$PM_{2.5}$	VOC
Industrial	18,490	16,589	9,585	2,414	1,711	2,019
Fuel Combustion	7,271	415	1,558	1,120	1,104	1,483
Transportation	99,680	76	10,415	604	502	6,732
Incineration	22	20	6	0	0	6
Miscellaneous	56	0	0	144	144	8,333
Open Sources	147	18	75	37,672	7,891	792
Total Tonnes	**125,666**	**17,118**	**21,639**	**41,954**	**11,352**	**19,365**

Figure 20: NPRI Total Emissions by Contaminant and Source (2008)

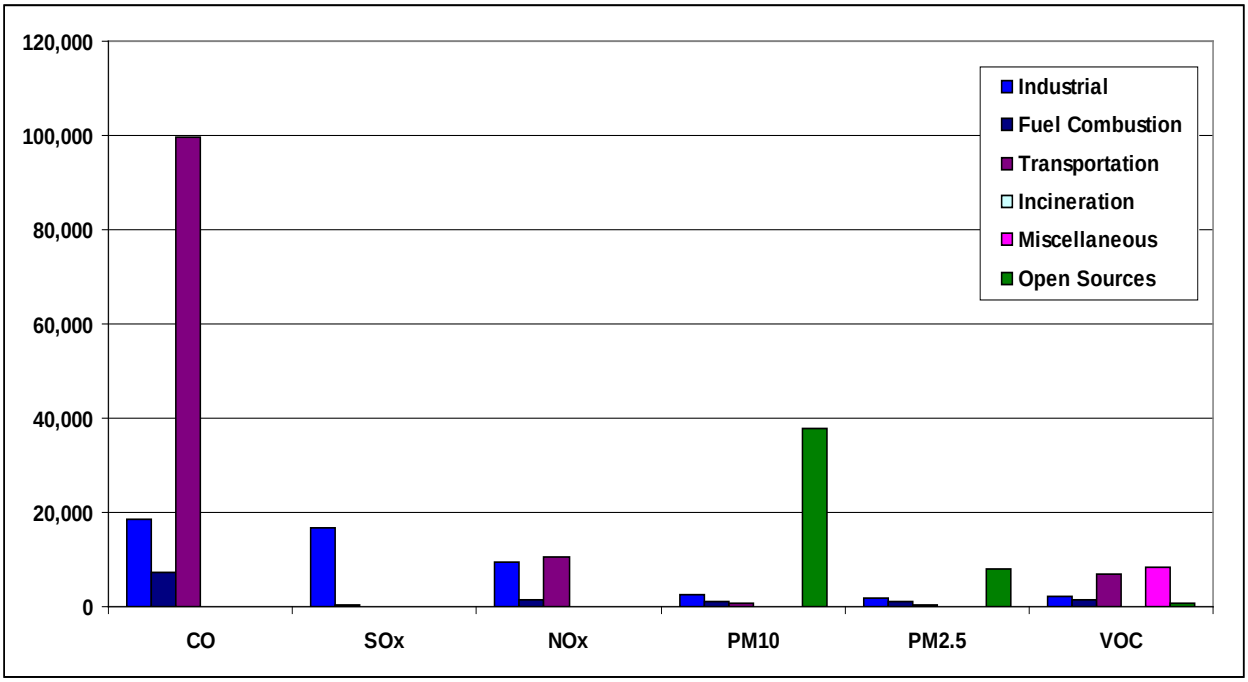


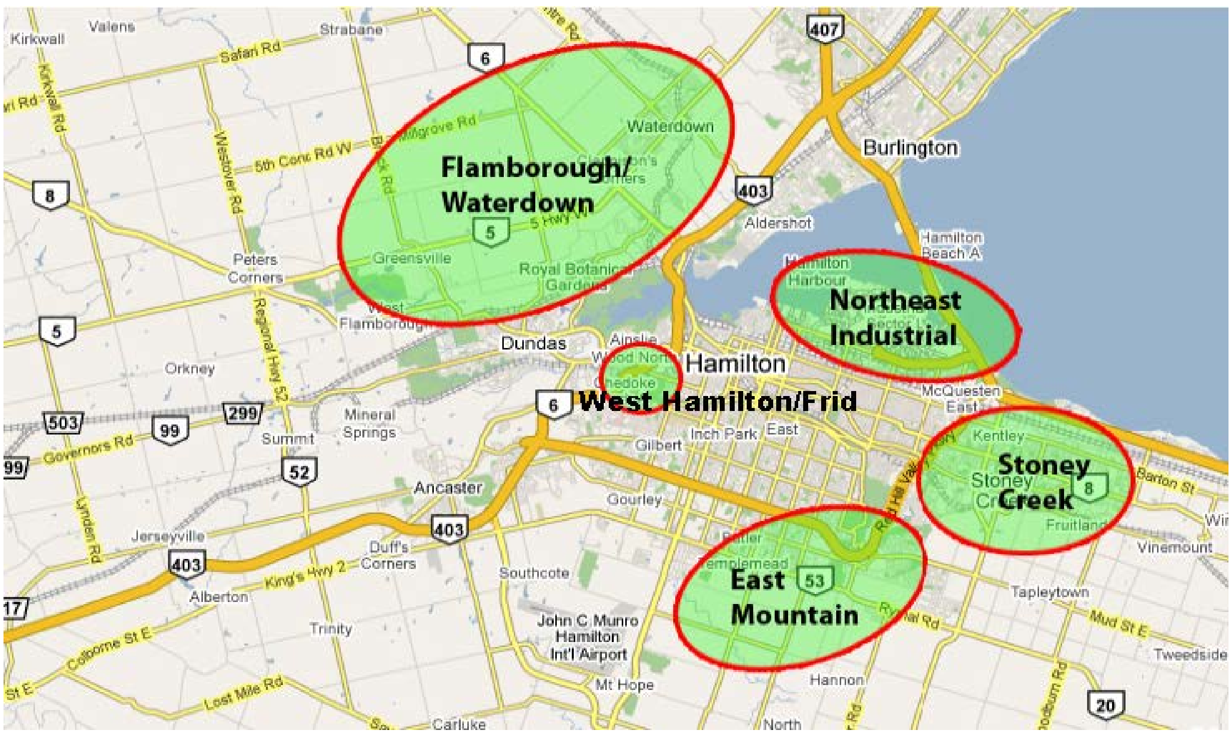
Table 4 and **Figure 20** show the total emissions data from the NPRI, broken down by source category for 2008; these data show that carbon monoxide (CO) is the air pollutant with the largest emissions. Based on available emissions inventory data from the Ministry of the Environment and Environment Canada, 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 by emissions from the industrial sector;

- The industrial sector is the leading source of sulphur dioxide (SO_2) in Hamilton (~90%);
- The transportation sector is the leading source of carbon monoxide (CO) emissions within Hamilton; and
- The transportation sector is the leading source (~60%) of volatile organic compounds (VOCs); the remaining VOCs are releases due to by-product operations by companies and general solvent use by companies and individuals.

Five separate industrial areas have been identified in the greater Hamilton area from mobile air monitoring (**Figure 21)**: 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 21: Emission Sources by Region in the Hamilton Area



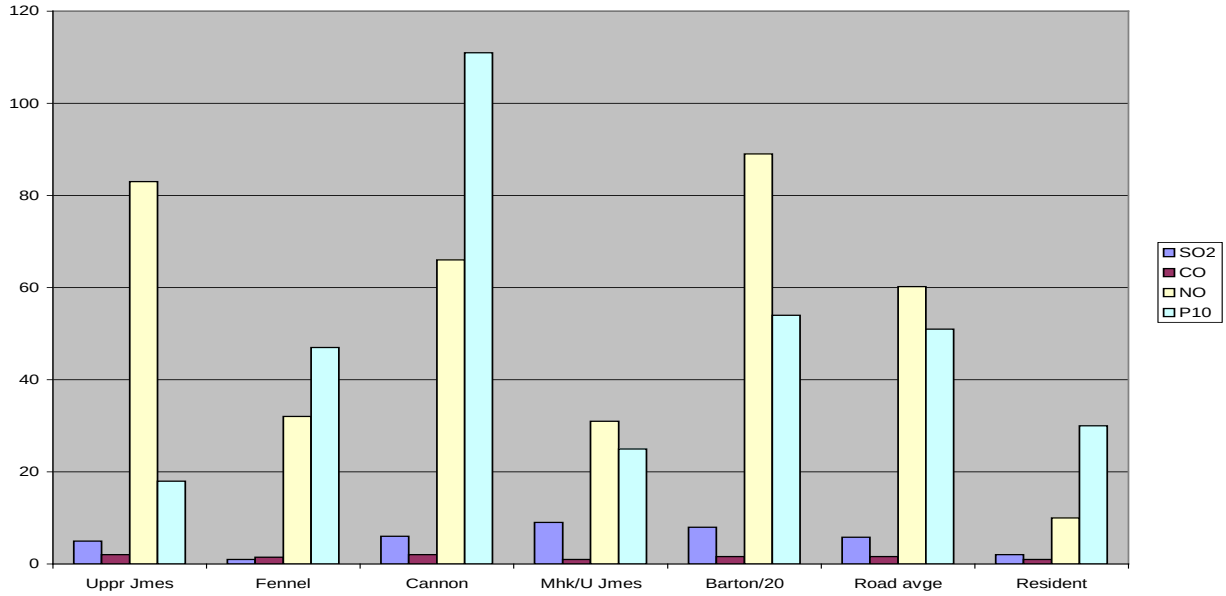
Mobile air monitoring studies were performed by driving a van outfitted with air monitoring equipment in traverses across the City, through selected industrial areas, and at selected major traffic intersections. The industrial point sources monitored included large integrated steel industries, steel 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.

Figure 22 shows the levels of four important air contaminants (sulphur dioxide SO_2, carbon monoxide CO; nitric oxide NO and inhalable particulate material PM_{10}) at seven road locations in Hamilton. The first five (on the left in the figure) are values obtained along major roads or at major intersections; the remaining data are the average for all roads in Hamilton (called "Road avge.") and a typical example of data from a street in a residential area of Hamilton; residential areas are at a distance from major roads but are usually within 200-500 m of such roads.

Figure 22: Mobile Monitoring Study - Levels of Four Air Contaminants (2005)



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.**

3.9 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 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)[6] 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.

[6] Toronto Public Health (2002). Air Pollution from Woodburning Fireplaces and Stoves. Retrieved from http://air.greenventure.ca/webfm_send/40

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.

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 emitters 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.

3.10 Air Quality Management Systems (AQMS)

From 2007 to 2011, federal, provincial and territorial governments and stakeholders developed a framework for a Canada-wide system to protect and improve air quality. The proposal was presented to the Canadian Council of Ministers of the Environment on October 11, 2012. All provinces, with the exception of Québec, agreed to begin implementing a Canada-wide air quality management system.

Founded on the concepts of accountability and collaboration, the Air Quality Management System (the System) is a Canada-wide framework for managing air quality and protecting human health and the environment. The System consists of five key elements:

- **Canadian Ambient Air Quality Standards (CAAQS)** – new outdoor air quality targets that "set the bar" for air quality actions across the country. The CAAQS set a goal that jurisdictions will use to assess the need for action, and the kinds of actions, to drive air quality improvement.
- **Air Zone Management (AZM)** – an approach that looks to all major sources of emissions and supports actions to improve air quality and keep clean areas clean.
- **Airshed Coordination** – to facilitate action when air pollution crosses a provincial or international border.
- **Base Level Industrial Emissions Requirements (BLIERs)** – are intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, meet a good base-level of performance. BLIERs are quantitative or qualitative emissions requirements proposed for new and existing major industrial sectors and some equipment types. These requirements are based on what leading jurisdictions inside or outside Canada are requiring of industry in "attainment areas," adjusted for Canadian circumstances. BLIERs are focused on NOx, SO2, VOCs, and particulate matter.
- **Mobile Sources Working Group** – a cross-Canada inter-governmental forum to identify opportunities to reduce emissions from the transportation sector and other mobile sources.

3.10.1 Air Zone Management

The System proposes that provinces or territories delineate air zones in a way that best suits their specific environmental needs. The System uses the CAAQS as a benchmark and provides guidance on different levels of management depending on the air quality within an air zone. Ontario's approach to air zone management is still under development.

Clean Air Hamilton has always worked within an air zone construct and is interested in participating in the development of air zone management systems within the Greater Toronto Area, across Ontario and across Canada. A *Clean Air Hamilton* delegate sits on the Canada wide AQMS Stakeholder Advisory Group, which met on November 26, 2013 and will meet at least annually and more often as required.

4.0 Air Quality Task Force

On December 3rd, 2012, the Hamilton Board of Health passed a motion that received and approved the following recommendation: "*That Clean Air Hamilton establishes a working group to investigate and make recommendations to the City on actions that can be taken to reduce air pollution in Hamilton.*" Members of *Clean Air Hamilton* were informed of the motion passed by the Board of Health, mandating that *Clean Air Hamilton* form a task force to investigate and bring forward recommendations on actions that can be taken to reduce air pollution in Hamilton.

Participation on this task force was open to interested members of *Clean Air Hamilton*. The task force Chairperson, a member of *Clean Air Hamilton*, led the group toward satisfying the mandate from the Board of Health. The Air Quality Task Force (AQTF) met on a monthly basis in 2013. Members of the AQTF included; Denis Corr, Matthew Lawson, Karen Logan, Lynda Lukasik, George McKibbon, Brian Montgomery, Sally Radisic, and Andrew Sebestyen.

The AQTF brought forward 10 recommendations "*on actions that can be taken to reduce air pollution in Hamilton*" (**Table 6**). The 10 recommendations - built upon air monitoring and modelling, planning, education and outreach, green infrastructure and municipal action – are expected to work synergistically to achieve air pollution reductions in the City of Hamilton.

These recommendations were organized from one to ten with each recommendation building on the previous one thereby creating an integrated and comprehensive approach to air pollution reduction for the City of Hamilton to apply. Therefore, ordering of recommendations has been done in a systematic manner rather than one of priority.

Table 6: Recommendations of the Hamilton AQTF

Component	Recommendation #	Description
Air Monitoring and Modelling	1	Commit to partnerships with interested stakeholders to fund the development of an advanced air model for the City of Hamilton.
	2	Strengthen air monitoring activities through additional: a. neighbourhood mobile monitoring surveys; b. number and location of air monitors; c. monitoring stations and technologies.
Planning	3	Develop appropriate air quality related guidelines for new and redeveloping neighbourhood land use planning. These guidelines should consider the potential impacts of personal transportation, arterial roads, 400 series highways and site specific and technical standards for industrial emissions.

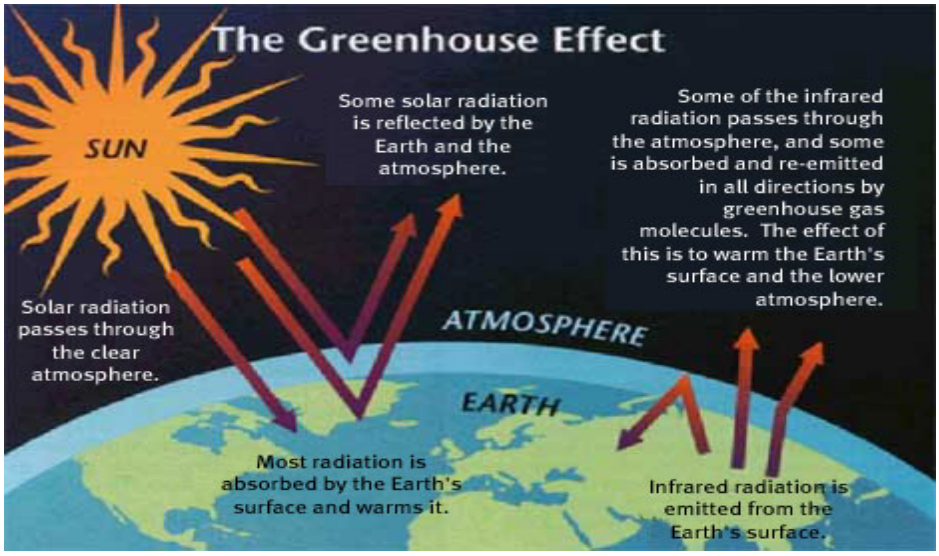
	4	Promote green infrastructure (i.e. green roofs, street shading) to be supported by citizens, organizations and government.
Education & Outreach	5	Provide individuals with tools to minimize their personal exposure. These tools should include a real-time map of air quality conditions in the City of Hamilton to encourage alternative modes of transportation such that citizens have the opportunity to select pedestrian and cycling routes which would minimize their personal exposure to air pollution.
	6	Develop and conduct particulate matter control workshops in partnership with the Ontario Ministry of the Environment for local businesses and industries.
	7	Expand the Air Quality Outreach Program within Hamilton schools such that air quality curriculum (i.e. benefits of anti-idling, active transportation commuting routes) is promoted.
	8	Promote programs that encourage community-based environmental monitoring and engagement within the City of Hamilton.
Municipal Action	9	Support the revision, updating and enforcement of existing bylaws to minimize the generation and dispersion of airborne particulate matter.
	10	Implement strategies to improve street cleaning by taking into account factors such as cleaning schedules and equipment effectiveness.

On December 2, 2013, recommendations put forward at Hamilton Board of Health by the AQTF were carried. The full AQTF report can be found in **Appendix D.**

5.0 Climate Change

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 result in an intensification of the earth's natural greenhouse effect (**Figure 23**). These chemicals absorb heat energy very efficiently and transfer this heat energy to the atmosphere, resulting in an increased warming of the atmosphere.

Figure 23: 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 produced by humans, with the rest coming from land uses such as agriculture and forestry.

According to the most recent Intergovernmental Panel on Climate Change reports (2014)[7], human influence on the climate is clear. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

[7] Intergovernmental Panel on Climate Change (2014) Fifth Assessment Report. Retrieved from http://www.ipcc.ch/report/ar5/

The safe level of carbon dioxide (CO_2) in the atmosphere has been shown to be 350 parts per million (ppm)[8]. In 2013, the global average of CO2 reached 400 ppm and 2 ppm of CO2 is added every year. Almost every government in the world through the Intergovernmental Panel on Climate Change (IPCC) has agreed that any warming above a 2°C (3.6°F) (or 450 ppm) rise would be unsafe. Global temperatures have already risen 0.8°C and that has caused more impacts than scientists expected. Scientists estimate that 565 gigatons of carbon dioxide can be added into the atmosphere with reasonable hope of staying below 2°C (450 ppm). At current rates, about 31 gigatons of carbon are used a year globally and those levels are increasing. 565 gigatons of carbon will be reached in 16 years.

Public perception of greenhouse gas emissions and their impact is difficult as greenhouse gases are transparent and at concentrations found in the atmosphere not directly harmful to human health, unlike air pollutants which can be visible as photochemical smog in the atmosphere and at concentrations that are linked to a range of health problems including heart, lung and respiratory diseases and even cancer.

Greenhouse gases also have a significantly longer lifetime in the atmosphere **(Table 7)** as opposed to air pollutants **(Table 8)** that have a shorter lifetime and tend to be removed from the atmosphere within a few days or weeks by winds, rain or chemical reactions.

Air pollutants do 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 – considered as air pollutants (NOAA, 2009)[9]

[8] Hansen, James, et al. Target Atmospheric CO2: Where Should Humanity Aim? Submitted April 7, 2008.
[9] National Oceanic and Atmospheric Administration (2009, August 28). Nitrous Oxide Now Top Ozone-depleting Emission. Science daily. Retrieved from http://www.sciencedaily.com/releases/2009/08/090827141344.htm

Table 7: 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 8: Greenhouse Gases: Sources and Lifetimes in the Atmosphere

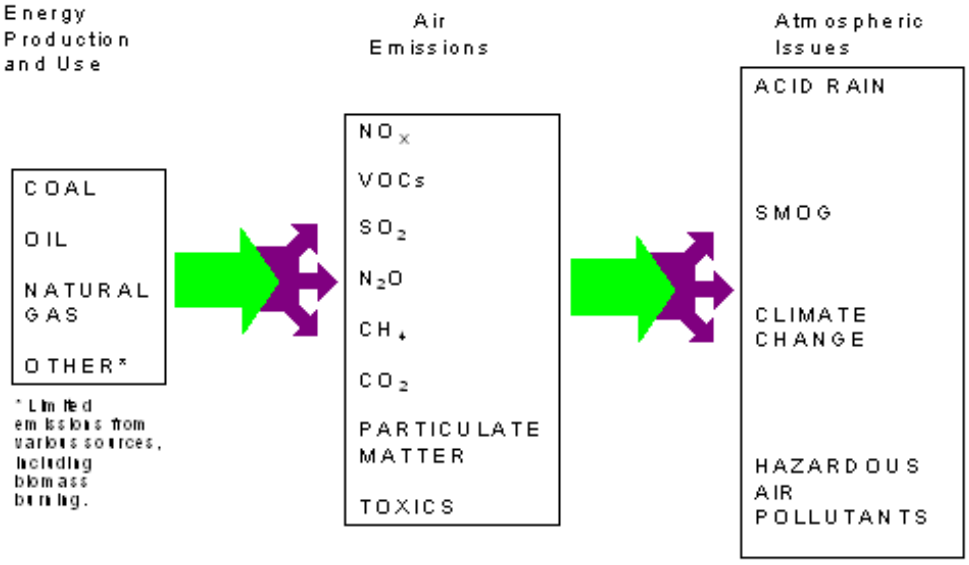
Greenhouse Gas	Sources	Approx. Lifetime in the Atmosphere
Carbon dioxide (CO_2)	Fossil fuel combustion product	100 years
Methane (CH_4)	Livestock farming; landfill/Waste Management	12 years
Nitrous oxide (N_2O)	Synthetic Fertilizers	115 years
Nitrogen trifluoride (NF_3)	Microelectronics production	600 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[10]	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

Climate change will affect the severity of air pollution. Increased temperatures will exacerbate air pollution through increased chemical reaction rates in the atmosphere and increased smog formation. Climate change may affect air pollution by changing ambient ground-level concentrations of ozone (O_3) and particulate matter ($PM_{2.5}$), two of the primary components of smog.

The most important linkage between climate change and air pollution is the combustion of fossil fuels (see **Figure 24**). Fossil fuels supply 81 percent of the world's primary energy, account for two-thirds of greenhouse gas emissions, and are the main source of outdoor air pollutants worldwide.

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

Figure 24: Combustion of Fossil Fuels for Electricity, Home Energy, Transportation, Industry, and Municipalities Results in Air Emissions and Atmospheric Issues



(Chiotti, 2003)[11]

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, all of which contribute to air pollution and the health effects due to air pollution. In other words, reductions in emissions of the major greenhouse gas (carbon dioxide) will result in a commensurate reduction in the other combustion by-products that contribute to and cause air pollution.

5.1 Co-benefits of Action

Many of the co-benefits of action on climate change and air quality are focused on the reduction of the use of fossil fuels which produce 65 percent of man-made greenhouse gases.

Co-benefits of action include an increased healthy and active population, reduced hospital admissions, increased green space and recreational opportunities, improved watersheds and protecting local water quantity and quality, reduced crop damage, improved business practices and efficiency, energy security, business continuity, reduction of waste, improved sustainable and active transportation options.

[11] Chiotti, Q. (2003). *Pollution Probe* (presentation to GTA Clean Air Forum) [PowerPoint Slides]. Retrieved from York University.

A number of policies can tackle both climate change and air pollution at the same time. These actions include:

- Cutting energy consumption through energy-efficient technology and energy-saving behaviour, reducing transportation and improving active modes of transportation;
- Diversifying energy sources to include natural gas and renewable energy;
- Emission controls to cut air pollutants, carbon black and oxides of nitrogen from vehicles;
- Cutting methane emissions from agriculture, landfills and fossil fuel production; and,
- Increase forest cover and greenspace.

Air quality benefits can provide a stronger incentive for climate action because benefits are seen as immediate and local. However, these actions also have a global component as greenhouse gas emissions and certain air pollutants can travel the globe from where they originated. Recent studies show that emissions from United States travel to China and emissions from China travel to the United States. Even at the Arctic and Antarctic poles, one can find greenhouse gas emissions and air pollutants in the atmosphere.

5.2 Risk of Climate Impacts

According to the Intergovernmental Panel on Climate Change (IPCC), climate change is underway and the impacts of climate change will be severe. Even if worldwide greenhouse gas emissions were radically reduced immediately, global temperatures will continue to increase.

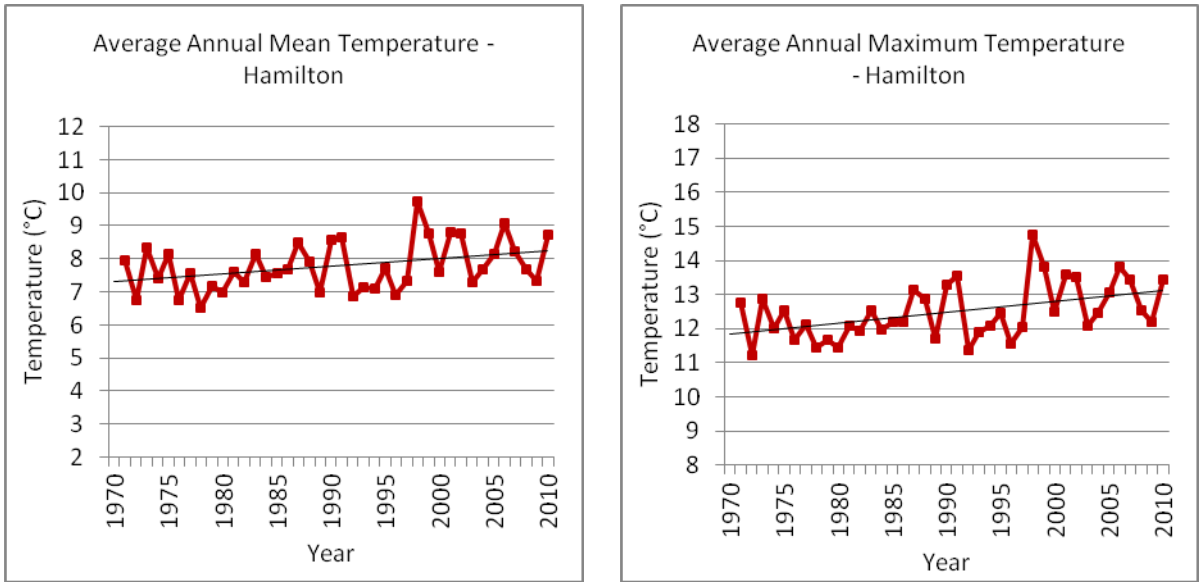
In Hamilton, potential impacts include extreme weather events, flooding, droughts, and increased temperatures leading to increased health risks and financial costs. The potential impacts of climate change and increasing greenhouse gases include:

- Vulnerability of infrastructure (water, roads, energy) to various types of extreme weather events, including droughts, intense precipitation, extreme temperature episodes, high winds, and severe storms for which we are currently unprepared;
- Increasing burden on insurance and reinsurance industries that may increase liability costs or remove coverage as the risk associated with investment in property, infrastructure and resource-based industries increases;
- Decreasing and variable average water levels in the Great Lakes resulting in impacts on water supply, erosion and quality (groundwater and surface water);
- Increasing frequency of severe storms and associated safety risks;
- Changes in precipitation and temperature that will affect water levels in waterways and wetlands, thereby affecting their function in flood protection, water cleansing, and waterfowl/wildlife habit and their use in recreational pursuits (fishing, camping, and boating);
- Increasing temperatures, especially extreme heat, which contributes to greater heat stress in the elderly and ill;
- Increasing demand of air conditioning in buildings, resulting in higher energy consumption, greenhouse gas emissions and air pollution, and potential energy fluctuations;
- Creating favourable conditions for pests (insects, rodents, disease vectors) and increases in weeds and pollen, resulting in increases in asthma attacks in individuals;

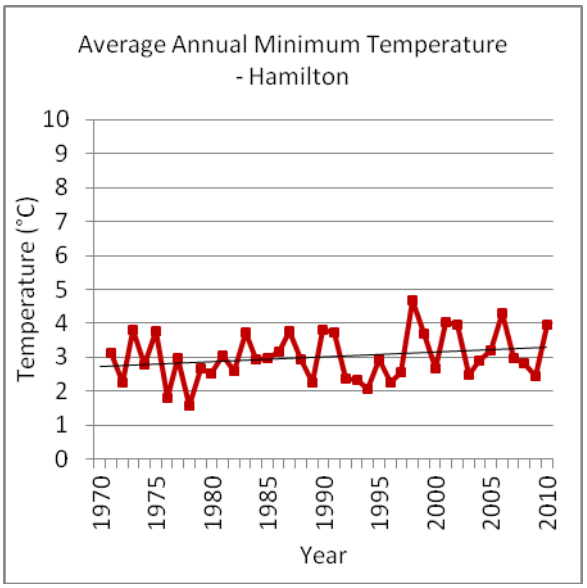
- Changes in temperatures resulting in increased maintenance costs for transportation infrastructure, with variable freeze-thaw cycles, increased pavement buckling due to longer periods of intense heat and shifts from less snow to more freezing rain; and,
- Changes in agriculture (extreme droughts, floods, changing crop patterns produce, weeds and insects) affecting the supply of foods.

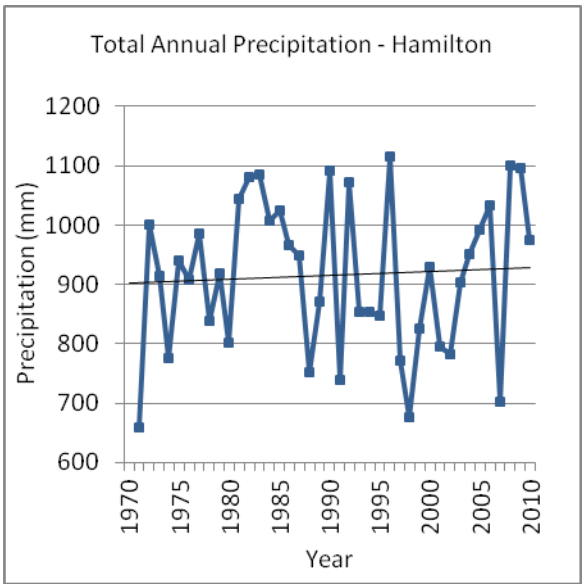
Hamilton is already experiencing warmer temperatures and increased precipitation influenced by climate change. **Figure 25** below shows average annual mean, maximum and minimum temperatures (°C) and total annual precipitation (mm) from 1970 to 2010 in Hamilton. According to recorded climate data the average annual mean temperature has increased 0.9 °C, average annual maximum temperature has increased 1.3°C, average annual minimum temperature has increased 0.5°C and total annual precipitation increased 26 mm over the 41 years of record.[12]

Figure 25: Annual Temperature and Precipitation (1970 – 2010)



[12] Hamilton Conservation Authority(2011). Final Report Climate Change Impacts and Adaptation in the Hamilton Conservation Authority Watersheds. Retrieved from: http://www.conservationhamilton.ca/documents/pdf/Hamilton%20Conservation%20Authority%20Workshop%20Final%20Report.pdf





(Hamilton Conservation Authority, 2011)

The Hamilton area is warmer and wetter than it was 40 years ago, except in the winter when it is warmer and drier. In the last eight years, the city has endured 17 rain storms severe enough to flood homes, at least six of which appear to have exceeded the once-in-50-year standard, including a 100-year-plus deluge in July 2009 that damaged over 7000 homes and caused up to $300 million in insured losses alone.

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 identified eight significant health concerns related to Climate Change (**Table 9**)[13]. 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.

An abnormally cold trend began in December 2013, a weak polar vortex resulted in outbreaks of severe cold in the Northern Hemisphere. A polar vortex is a persistent, large-scale cyclone located near the north and south poles. The reason behind the weakening of the polar vortex has been linked to sea ice decline and reduced snow cover in the Arctic which in turn has been linked to climate change and the warming of the Arctic region. This abnormally cold trend continued well into 2014.

[13] Health Canada (2008). Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity. Retrieved from http://hc-sc.gc.ca/ewh-semt/climat/eval/index-eng.php

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, and 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

5.3 Cities and Climate Change

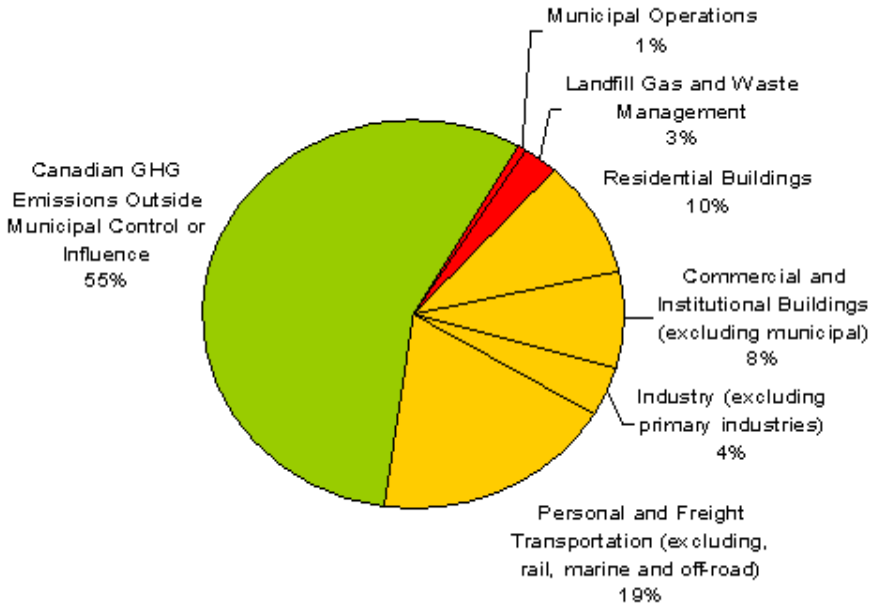
Cities are major contributors of carbon emissions. According to the Organisation for Economic Co-operation and Development, cities are home to more than 50% of the world population, contribute to about 70% of worldwide emissions, and use 2/3 of the total energy worldwide. Urbanisation can be seen as a driver for emissions on a per-capita and total greenhouse gas emissions.

Urban households, industries, transportation, and infrastructures within cities are key sources of greenhouse gases. Urban areas concentrate populations, economic activities and built environments, thus increasing the risk of events that could adversely impact public health. Examples of these events include, but are not limited to: floods and droughts; heat waves; and increased production of secondary air pollutants that can lead to increased smog. These environmental conditions can lead to increases in adverse health effects such as increased vector-borne and food-borne diseases in the case of floods and droughts; increased heat stress on the cardiovascular system in the case of heat waves, and; increased respiratory disease exacerbations in the case of smog.

According to the Federation of Canadian Municipalities (FCM), less than half of Canada's 2006 greenhouse gas emissions (315 Mt or 315 million tonnes) are under the control or influence of Canadian municipal governments. Municipalities directly control policies, regulations and decisions that result in 24 Mt of greenhouse gas emissions. Emissions from municipal operations, residential waste, and landfill sites; municipalities contribute 7.6% of Canada's 2006 greenhouse gas emissions.

The remaining 93.4% of Canada's 2006 greenhouse gas emissions (or 291 Mt) are under the direct control or influence of the Provincial and Federal level of government, communities and individuals (see **Figure 26**). Actions on climate change require all levels of government, communities and individuals working together.

Figure 26: Canadian GHG Emissions Directly & Indirectly Controlled by Municipalities Compared to Total National Emissions (2006)

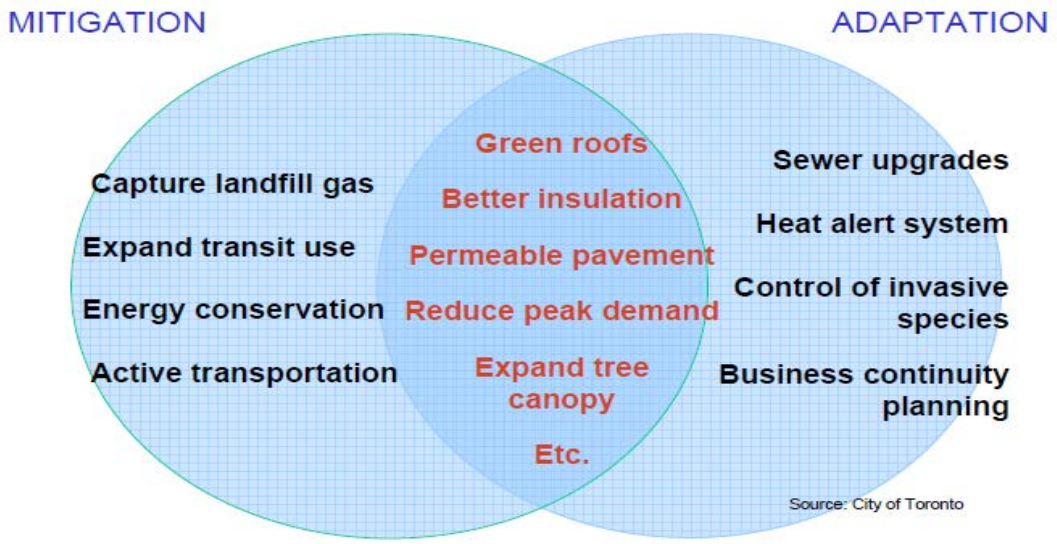


(Federation of Canadian Municipalities, 2009)[14]

Addressing climate change requires two types of actions: adaptation and mitigation. Adaptation involves actions or planning to minimize citizens or infrastructure's vulnerabilities to the impacts of climate change. Mitigation involves actions aimed at reducing greenhouse gases. Adaptation and mitigative actions are complementary (**Figure 27**).

[14] Federation of Canadian Municipalities. (2009). Act locally: The municipal role in fighting climate change. Retrieved from www.fcm.ca/CMFiles/FCM_Climate_En_Final1RSG-1272009-2598.pdf

Figure 27: Actions towards Climate Change



To date, responses to reducing (mitigating) climate change in cities globally can be grouped into five sectors:

1. Urban Development and Design (e.g. land-use planning, regeneration and re-use of lands and buildings, increased density to reduce mobility demand, and promote walking and cycling);
2. The Built Environment (e.g. energy efficient materials and design, retrofitting, energy demand reduction, alternative energy promotion);
3. Transportation (e.g. mass transportation using transit, energy efficient hybrid and electric vehicles);
4. Urban Infrastructures (e.g. renewable and low carbon energy sources, waste recycling); and,
5. Carbon Sequestration (e.g. tree planting and maintenance, protection of wetlands).

A few global cites have begun to undertake risk management or adaptive actions towards climate change impacts such as extreme weather events.

Key sectors for an urban risk management approach to climate change include:

1. Infrastructure and Settlements (e.g. drainage, storm surge barriers, wetland protection);
2. Water Management (e.g. storage and conservation because of expected shortage of clean water);
3. Transport (e.g. improved design and safety standards);
4. Energy (e.g. infrastructure strengthening, source diversification);
5. Health (e.g. Heat alerts, Air Quality Health Index); and,
6. Emergency Response.

Cities are considered the drivers of action on addressing climate change through municipal practices and regulations in their own operations and the services they provide to their communities. Cities are economic engines and climate change will influence those activities from innovation on actions and solutions to energy, transportation, buildings, health, air quality and climate.

Successful cities recognize the synergy between economic growth and climate change is strongest at the local level. Cities that address greenhouse gas emissions also curb local pollution and energy demands – while metro regions that continue to pollute risk becoming less attractive for investment. Similarly, cities that build resilience into their climate change and energy actions, increase the security of local populations to extreme weather events, which can enhance local safety, health and the quality of life of citizens.

5.4 Climate Change Emissions 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 a 10% reduction of 2005 greenhouse gas levels by 2012, followed by a further 20% reduction of 2005 greenhouse gases levels by 2020. Community targets were recommended as a 10% reduction of 2006 greenhouse gases levels by 2012, followed by a further 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 (PCP) Program. The inventory was also undertaken to measure how the City was doing in reducing its greenhouse gas emissions compared to the emissions targets.

The Partners for Climate Protection (PCP) program is a network of Canadian municipal governments that have committed to reducing greenhouse gases and acting on climate change. There are five milestones that must be reached in order to fulfill the commitment to this initiative.

1. Creating a greenhouse gas emissions inventory and forecast;
2. Setting an emissions reductions plan;
3. Developing a local action plan;
4. Implementing the local action plan or a set of activities; and
5. Monitoring progress and reporting results.

In 2013, the City achieved recognition by the FCM as a Milestone 5 City under the PCP program.

In 2012, the Corporation reduced its greenhouse gas emissions to 108,433 tonnes, a 19.7% reduction of emissions from the 2005 baseline of 135,038 tonnes, and achieved the 2020 reduction targets of 20%. The City has established a new target of 80% emission reductions by 2050. The reductions in corporate greenhouse gas emissions have arisen from increased energy and fuel conservation efforts by City operations and City staff through buildings, lighting, water and wastewater. Municipal operations contributed only 1% of our community's greenhouse gas (GHG) emissions in 2010 **(Figure 28)**. 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 2011 were estimated to be just under 20 million tonnes, a reduction of 20% from 2006 emissions levels (estimated at 23.4 million tonnes), and achieved the city-wide 2020 reduction targets of 20%. The City has established a new community target of 80% emission reductions by 2050.

These improvements occurred due to reduced energy demand, improved energy efficiencies, conservation actions, and the shift away from coal as a source of electricity generation as part of the Province's phase out of coal in Ontario's energy sources by 2014. Ontario's elimination of coal-fired electricity is the single largest greenhouse gas reduction initiative in North America. The Province states that Ontario's coal-fired power plants cost the people of Ontario an estimated $4.4 billion per year in health, environmental, and financial damages.

Overall in Ontario total energy demand, measured in TWh = terawatt hour or 10^{12}, was - 0.14% (141.3 TWh) in 2012 and -0.35% (141.5 TWh) in 2010 compared to -3.8% (151 TWh) in 2006. The 2012 Provincial energy mixtures showed coal generated energy dropping to 2.8% compared to 14.5% in 2008 resulting in reduced emissions from Ontario's energy sources. Compared to 2006, coal-generated energy is decreasing while nuclear, hydro, natural gas, wind and other sources are increasing resulting in reductions of air pollutants and greenhouse gas emissions.

Figure 29 shows the changes in community emissions since 2006.

Figure 28: Total Greenhouse Gas Emissions Corporate and Community (2011)

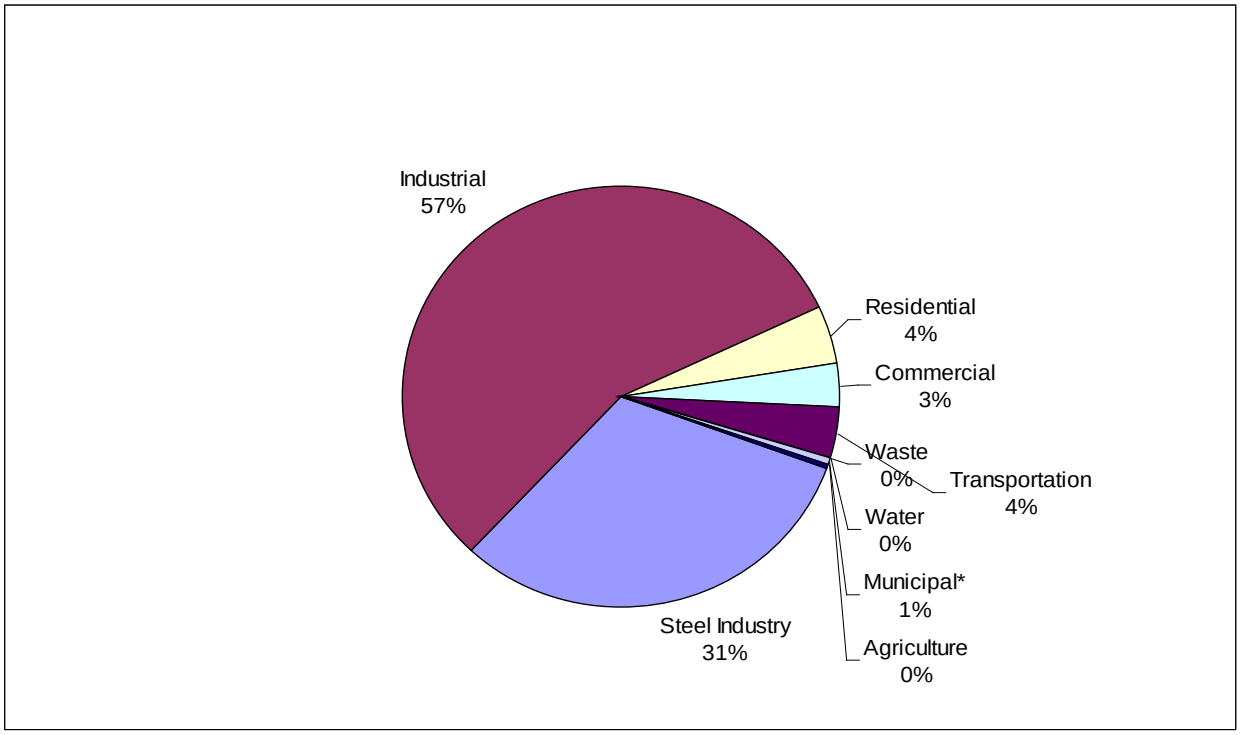
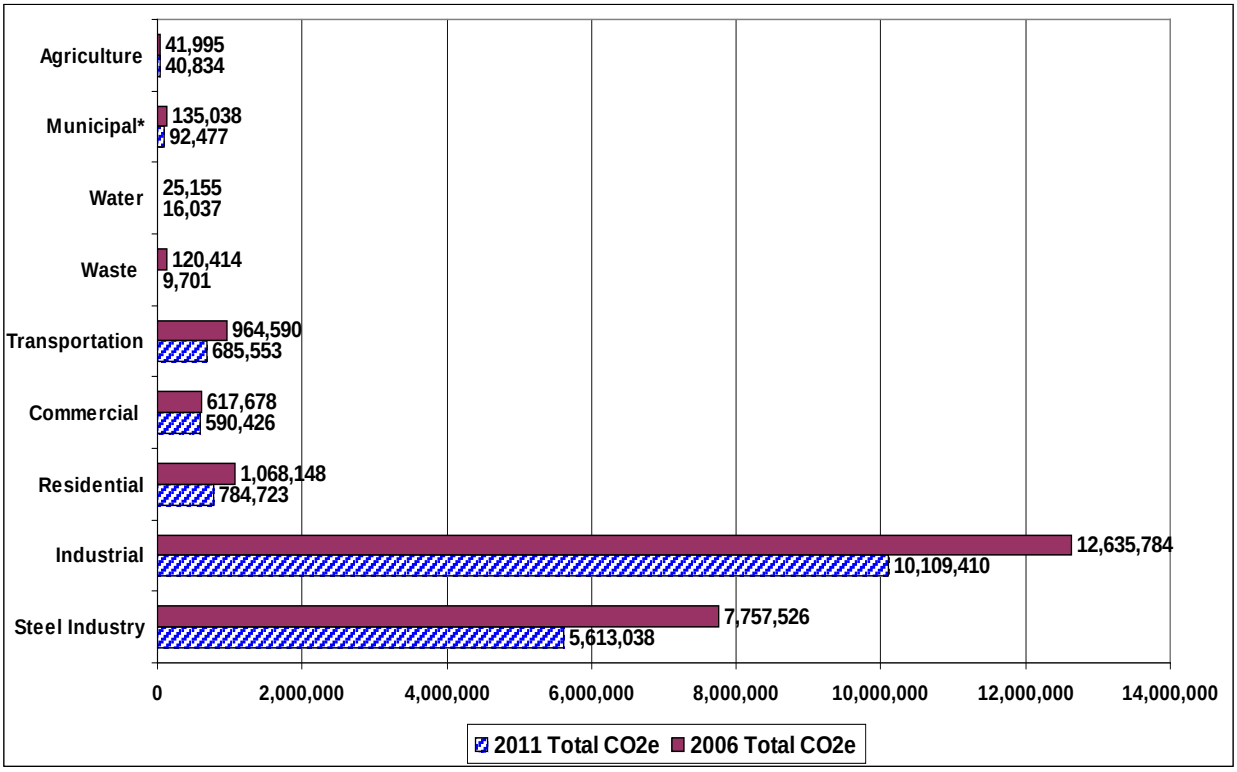


Figure 29: Community CO_2e Emissions in Hamilton in 2006 and 2011



Municipal and community involvement in reducing sources of GHG emissions – commercial and personal transportation, commercial and residential energy usage, land-use development – and adapting to climate risks – flooding, increased heat, extreme weather - in Hamilton is critical.

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

5.4.1 City Energy Efficiency, Air Quality and Climate Change

Consuming less energy equates to producing less greenhouse gas, which equates to improved air quality. The City of Hamilton contributes towards improving air quality by taking an active role in energy conservation, renewable energy, and corporate environmental sustainability through initiatives delivered through the cooperation of all City departments.

The City of Hamilton set itself apart from other Municipalities in 2007 by being one of the first to establish a Corporate Energy Policy (CEP). The CEP sets Energy reduction targets and provides guidance to all City Departments on how to partake in achieving the targeted energy reduction goals. The policy also promotes incorporating energy conservation into project planning, sets standards of performance for operations and provides guidance on monitoring and reporting energy use for performance tracking.

The key to the success of the City's energy management program has been the creation of a vision through a strong CEP that mandates measurable and achievable targets for both long-term energy conservation and demand management (CDM). To date the City Corporation has made great progress in terms of targeted reductions. 2013 marked another consecutive year in energy intensity reductions. Corporate facilities recorded a 20% reduction over the base year of 2005 achieving an established 2020 target.

As energy markets and technology are continually evolving, it is befitting to revise the CEP. The first revision since 2007 will be released in 2014 and then updated every five (5) years thereafter. As there has been increasing evidence pointing to the effects of emissions on climate change, emission reduction targets have been introduced in the 2014 revision of the policy with Energy and Emission Reduction Targets that will be applied across each City Department and Division. The newly established Corporate Emission Reduction target for 2050 from a 2011 baseline is 80%, which aligns with the City of Hamilton's greenhouse gas target of 80% by 2050. The Energy Reduction Targets are 45% reduction for the interim target year of 2030 and 60% for 2050.

Emissions reductions will be evaluated in terms of equivalent tonnes of Carbon Dioxide or CO2e complying with the accredited Greenhouse Gas Protocol developed by the World Resource Institute and the World Business Council for Sustainable Development. Energy Intensity will be evaluated in terms of the total energy use per square foot of usable building area for a given period of time and will vary by the energy type consumed.

Meeting these targets demonstrates the commitment and cooperation from all City Staff as these goals were achieved through a combination of implementing energy efficient capital works projects, optimizing energy use, renewable energy generation, and monitoring energy consumption to mitigate energy waste. The Office of Energy Initiatives (OEI) continues to work with all City departments to advance and promote the activities that have led to these results. The City of Hamilton has implemented technologies and systems that capture emissions that were previously released into the atmosphere from our Waste Water and Landfill operations. The City is today utilizing more energy from waste, which has a direct impact on lowering emissions. The Biogas purification unit at the Woodward Waste Water Treatment Facility captured over 1,000 tonnes of CO2e in 2013.

Some of the measures that were implemented in 2013 to reduce City energy use include the following:

- Energy efficient exterior lighting for fire halls
- Variable Speed Drives for air handling systems at Hamilton Place and Hamilton Convention Center
- Central Composting Facility lighting and controls
- Central Library lighting controls
- Solar PV Project

Future energy initiatives include the following:

- Stoney Creek City Hall Building Automation System to optimize building energy performance
- Chiller Performance Analyzer – to optimize chiller performance at City Arenas and other facility chiller plants.
- Macassa Lodge Cogeneration – utilization of engine heat and power to simultaneously generate electricity and useful heat.

5.4.2 Ontario Green Energy Act

2013 was the first year the City of Hamilton had to comply with the Province's Green Energy Act (GEA) (397/11) reporting requirements. Energy consumption and the related emissions (tonnes CO2e) generated are the metrics reported. This reporting standard forms a basis to not only meet regulatory requirements, but also set a focused path forward in developing and achieving the goals and targets of the Corporate Energy Policy and City of Hamilton Energy Management Plan (EMP). This will also align with the goals, targets and spirit of Vision 2020 and the City of Hamilton's vision of a strong, healthy, sustainable future under the City Strategic Plan.

Specific to municipalities, the GEA states the requirement for an Energy Conservation and Demand Management (CDM) plan by July 1, 2014. The plan must contain two key items including a summary of annual consumption and greenhouse gas emissions along with descriptions of previous, current and proposed measures for conserving energy and finally a forecast of expected results. The plan is set on a 5-year revision cycle up to 2019. Through this plan, the City will identify best practices and energy-saving opportunities, evaluate results, and measure improvement over time by establishing benchmarks and setting goals. The plan will create momentum in building a continuous improvement process for energy efficiency. The City of Hamilton Corporate Energy Policy and reporting requirements included many of these requirements and the revised Policy will ensure these requirements are fully met going forward.

5.5 Hamilton Community Climate Change Actions

5.5.1 Hamilton Community Climate Change Action Charter

In 2011, Hamilton became the first municipality in Ontario to enact a community Climate Change Action Charter. The purpose of the community Climate Change Action Charter is to engage Hamilton organizations, businesses and individuals in taking individual and collective action and leadership on climate change.

The Hamilton Climate Change Action Charter is a voluntary agreement that states clearly that action on climate change is needed. The Charter builds awareness and communication within Hamilton on climate change issues; the Charter can be used by individual citizens, by organizations and by businesses of all types and sizes.

Signing the Hamilton Climate Change Action Charter is a way to show commitment to tackle the causes and consequences of climate change. It represents a broad public statement that any Hamilton individual or organization can make. Many organizations and corporations in the Hamilton area have already developed their own climate change and sustainability programs. Since 2011, 48 organizations and 335 individuals have signed the Charter committing to taking local action on climate change.

In 2013, the following organizations endorsed and signed Hamilton's Climate Change Action Charter:

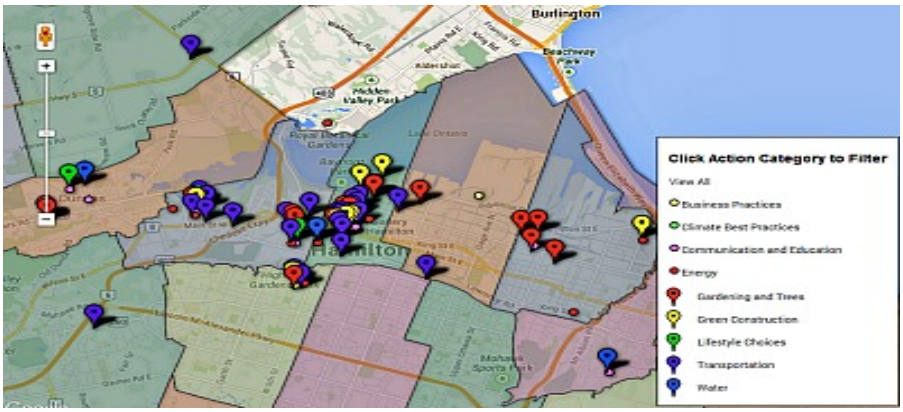
- Bay Area Restoration Council
- Castleview Home Inspection
- Daisy Energy
- Golden Horseshoe Green Tech
- Permaculture Hamilton

To learn more about or to sign the Charter visit: http://climatechangehamilton.ca/

5.5.2 Hamilton Climate Change Map

In 2013, the McMaster Centre for Climate Change in collaboration with community partners under the Hamilton Climate Change Action Charter developed and launched a community Hamilton Climate Change Map (**Figure 30).** The purpose of the Map is to engage and record actions taken in the community to address climate change and impacts the community may have felt concerning climate change.

Figure 30: The Hamilton Climate Change Map



The Hamilton Carbon Map provides a visual record of the community that encourages the undertaking and sharing of actions in Hamilton by individuals and organizations. The Map increases the awareness, support and the ability for increased local action in areas such as energy, transportation, business practices, buildings, water, and buildings.

The Map features an action of the month and a slide show of the images submitted and uploaded to the site.

Since its launch in 2013, over 110 actions have been listed on the maps.

To learn more about or to submit and action to the Map visit:
http://www.mapclimatechange.ca/

6.0 Built Form and Green Infrastructure

6.1 Introduction:

Charles Abrams defines "*infrastructure*" to mean "*the basic equipment, utilities, productive enterprises, installations, services essential for the development, operation, and growth of an organization, a city, or a nation*."[15] Where green infrastructure services are concerned, "*ecological services can be divided into four major categories: provisioning, regulating, cultural and supporting.*"[16]

"*Provisioning services are the products obtained from ecosystems and include foods and medicines. Regulating services are the benefits people obtain from ecosystem controls of climate, plant pests and pathogens, animal diseases (including those that affect humans) water quality, soil erosion, and much more. Cultural services are the nonmaterial benefits that people obtain from ecosystems: recreational, aesthetic, spiritual, and intellectual. And supporting services are those necessary for the production of all other ecosystem services and include the production of new organic matter by plants through photosynthesis and the cycling of life essential nutrients such as carbon, nitrogen, phosphorus, and other elements required for the chemistry of life.*"[17]

Understanding the many ways we rely on these provisioning, regulating, cultural and supporting services requires an exploration of the infinite ways humanity is intertwined with nature and relies upon the non-human. Edward O. Wilson develops this understanding through use of the term: "Biophilia," in a book by that name.[18]

"*It is time to invent a moral reasoning of a new and more powerful kind, to look at the very roots of motivation and understand why, in what circumstances and on which occasions, we cherish and protect life. The elements from which a deep conservation ethic might be constructed include the impulses and biased forms of learning loosely classified as biophilia. Ranging from awe of the serpent to the idealization of the savanna and the hunter's mystique, and undoubtedly including others yet to be explored, they are poles toward which the developing mind comfortably moves. And as the mind moves, picking its way through the vast number of choices made during a lifetime, it grows into a form true to its long, unique evolutionary history*[19]*.*

Several governments and organizations have taken this understanding and given substance to the term: biophilia, through green infrastructure definitions. Here is a sample of the variety of definitions being applied.

> "*Green infrastructure is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits and support sustainable communities. Unlike single-purpose gray stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not*

[15] Abrams, Charles, The Language of Cities,: A Glossary of Terms. The Viking Press, New York, 1971. Page 151
[16] Melillo, Jerry., Sala, Osvaldo., "*Ecosystem Services*", in Sustaining Life: How Human Health depends on Biodiversity, edited by Eric Chivian and Aaron Bernstein, Oxford University Press, New York, 2008, page 76.
[17] Ibid, Melillo, 2008, page 76.
[18] Wilson, Edward O., Biophilia: The Human Bond with other Species, Harvard University Press, Cambridge Massachusetts, 1984.
[19] Ibid, Wilson, 1984, pages 138/9.

only stormwater management, but also flood mitigation, air quality management, and much more."[20]

"*Green Infrastructure (GI) is a network of high quality green and blue spaces and other environmental features. It needs to be planned and delivered at all spatial scales from national to neighbourhood levels. The greatest benefits will be gained when it is designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits (ecosystem services) for local communities. Green Infrastructure includes parks, open spaces, playing fields, woodlands, wetlands, grasslands, river and canal corridors allotments and private gardens."*[21]

"*A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations. (Source: Benedict & McMahon 2006)"*[22]

Infrastructure Canada includes new and renewed infrastructure projects like wastewater treatment facilities, green energy generation and transmission, solid waste facilities and carbon transmission and storage as green infrastructure.[23]

"*Green Infrastructure can be broadly defined as a strategically planned network of high quality and semi-natural area with both the environmental features which is designed an damaged to provide a wide range of ecosystem services and protect biodiversity in both rural and urban settings. More specifically green infrastructure, being a spatial structure providing benefits from nature to people aims to enhance nature's ability to deliver multiple valuable ecosystem goods and services such as clean air and water*." [24]

"*Green infrastructure is defined as natural vegetation, vegetation systems, soil in volumes and quantities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate ecosystem functions*." [25]

Finally Ontario's Provincial Policy Statement 2014 includes a new definition of green infrastructure:

"*Green Infrastructure means natural and human-made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands storm-water management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs*."[26]

[20] United States Environmental Protection Agency, http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm April 9, 2014.
[21] Natural England, http://www.naturalengland.org.uk/ourwork/planningdevelopment/greeninfrastructure/ April 9, 2014
[22] The Conservation Fund, http://www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/ April 9, 2014.
[23] Infrastructure Canada, http://www.infrastructure.gc.ca/prog/gif-fiv-eng.html April 9, 2014.
[24] European Community, http://ec.europa.eu/environment/nature/ecosystems/ April 9, 2014
[25] Green Infrastructure Ontario Coalition and ecojustice, Health Prosperity and Sustainability: The Case for Green Infrastructure in Ontario, March 2012, page vi
[26] Province of Ontario, Provincial Policy Statement 2014, Ministry of Municipal Affairs and Housing, Queens Park, 2014, page 42

6.2 How we understand the term and apply Green Infrastructure?

Where Wilson refers to "*awe of the serpent and idealization of the savanna*"[27] he is describing the instinctual responses humans have to the environment that have accumulated over humanity's evolution.

"*Our brain's perceptual apparatus has fine-tuning for a range of attention that has paid off in human survival*." [28] Alternatively, we have "*zero neutral radar for the threats to the global systems that support human life. They are too macro or micro for us to notice directly. So when we are faced with news of global threats, our attention circuits tend to shrug*." The application of green infrastructure requires an effort to expand our design thinking to encompass a systems understanding of ecosystem services which we are just beginning to appreciate.

For example, in a recent issue of the American Journal of Preventative Medicine[29], researchers documented and compared the spread of the emerald ash borer across several American States. The Borer infects and kills all North American ash species. Ash species contribute to significant average forest canopy coverage ranging from 1.5% in Virginia to 7.9% in New York State. The Borer also affects the ash canopy in Ontario.

"*While a substantial body of work exists showing the beneficial effects of vegetation on healing and health, less evidence exists demonstrating the converse relationship. This study examined the relationship between environmental deterioration and…. illness. It is a significant contribution to our understanding of how environmental deterioration may impact public health*."[30]

"*Tree loss from the spread of the emerald ash borer is associated with increased mortality related to cardiovascular and lower respiratory systems. The relationship is particularly strong in counties with above average household income*."[31]

Equally interesting was a finding of a researcher on immune system regulation. Graham Rook found that "*the beneficial effects of proximity to the natural environment are particularly prominent in individuals of low socioeconomic status."*[32]

The author's finding is that "*the beneficial effects of exposure to natural environments are likely to have two separate but interacting components."*[33] Recreational green space provides opportunities for psychological renewal. But the second less well known benefit is "*the evolved need for the immune system to receive inputs provided by microbial biodiversity, and in particular, by organisms that need to be tolerated, and therefore have coevolved roles as inducers of immunoregulatory pathways. These immunoregulatory pathways help to stop chronic*

[27] Ibid, Wilson, 1984, pages 138/9
[28] Goleman, Daniel., Focus: The Human Driver of Excellence, Harper Collins, New York, 2013, page 148.
[29] Donavan, G.H., Butry, D.T., Michael, Y.L., Prestemon, J.P., Liebhold, A.M., and Mao M.Y., "*The relationship between trees and human health: evidence from the spread of the emerald ash borer."* In AM J Prev Med 2013 Feb; 44(2): 139-145.
[30] McKibbon, George., Spady, Donald., Graham, Kelly., and Dixon, Kelly., "*Green Infrastructure and Human Health: Understanding our affinity to nature".* In the Ontario Planning Journal, May/June 2013, Vol. 28, No. 3.
[31] Ibid, McKibbon et al, 2013, page 10.
[32] Rook, Graham A., "*Regulation of the immune system by biodiversity from the natural environment: An ecosystem service essential to health*." In PNAS November 12 2013, Vol. 110, No. 46, page 1830.
[33] Ibid, Rook, 2013, page 18366.

inflammation and its associated chronic inflammatory diseases, cardiovascular problems and depression."[34]

On February 23 2014, Dr. Stephen Kellert spoke at *Clean Air Hamilton*'s Upwind Downwind 2014 public lecture at the Art Gallery of Hamilton. In his lecture, he focused on practical ways we can integrate these ecological services into land use and building design by concentrating on the following biophilic elements:

- "*Environmental features*
- *Natural shapes and forms;*
- *Natural patterns and processes;*
- *Light and space;*
- *Place-based connections; and*
- *Evolved relationships to nature*."[35]

We need to work with these elements in our green space and building designs so as to maximize their beneficial effects and so that the health benefits from green infrastructures can be realized.[36] "*There needs to be an emphasis on the promotion of experimentation through diverse projects and the use of trial and error to increase the understanding of how best to improve urban health outcomes in specific contexts. Localized projects can be sensitive to local circumstances and organizations to effectively deliver their goals. Urban planners need to be actively looking for windows of opportunity to promote such projects*."[37]

This experimentation may facilitated in Hamilton by application of the new Hamilton Official Plan.

6.3 Provincial Policy Statement (2014)

Provincial Policy Statement (2014)

The Province recently released the updated Provincial Policy Statement (2014) which is effective as of April 30, 2014, and applies to planning decisions made on or after that date.

The Province's Vision for Ontario's Land Use Planning System has continued emphasis on creating healthy, liveable and safe communities which promote and enhance human health and social well-being, are economically and environmentally sound, and are resilient to climate change. The PPS also continues to place a strong importance on the preservation and wise use of the Province's natural heritage resources over the long term. The Province seeks to ensure that its resources are managed in a sustainable way to conserve biodiversity, protect essential ecological processes, and protect public health and safety.

[34] Ibid, Rook, 2013, page 18365.
[35] Dr. Kellert., Stephen., Birthright: People and Nature in the Modern World, a public lecture at the Art Gallery of Hamilton, February 23 2014.
[36] Ibid, Rook, 2013, page 18361.
[37] Rydin, Yvonne, et al., "*Shaping cities for health: complexity and the planning of urban environments in the 21st Century*" in The Lancet, Vol. 379, June 2 2012, page 2079.

Building upon the 2005 PPS, two notable additions to the PPS (2014) include the promotion of "green infrastructure", and stronger stormwater management requirements. The PPS (2014) includes a new definition for "*Green Infrastructure*", which is defined as follows:

> "means natural and human-made elements that provide ecological and hydrological functions and processes. *Green Infrastructure* can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs."

The importance of having regard for air quality and climate change is highlighted in Section 1.8 and also woven through various aspects of the Provincial Policy Statement, including development and land use, parks and open spaces, infrastructure and the economy (see **Appendix E**). Many of the policies related to air quality and climate change use enabling and supportive language such as "promote" and "encourage". For example, Policy 1.6.2 states that "Planning Authorities should promote "*green infrastructure"* to complement "*infrastructure""*. While other policies, such as Policy 1.6.6.7 related to stormwater management planning, use strong directive language.

> "Planning for stormwater management shall:
>
> a) Minimize, or, where possible, prevent increases in contaminant loads;
>
> b) Minimize changes in water balance and erosion;
>
> c) Not increase risks to human health and safety and property damage;
>
> d) Maximize the extent and function of vegetative and pervious surfaces; and
>
> e) Promote stormwater management best practices, including stormwater attenuation and re-use, and low impact development."

6.4 Urban Hamilton Official Plan (March 2014 consolidation)

The majority of policies in the City's Urban Hamilton Official Plan came into force and effect on August 16, 2013.

The Urban Hamilton Official Plan (UHOP) contains a section on Air Quality and Climate Change (Policy B.3.6.2) which highlight the policy goals of the City to improve air quality and address climate change through mitigation and adaptation. These goals are highlighted throughout the Plan and include:

a) promoting compact, mixed use urban communities;

b) integrating the transportation network to include all modes of transportation;

c) promoting walking, cycling, and use of public transit;

d) achieving a natural heritage ecosystem through the protection and enhancement of natural heritage features and functions;

e) implementing urban design features to reduce fugitive dust;

f) enhancing vegetative cover; and,

g) reducing the heat island effect through the use of reflective roofs, green roofs, natural landscaping, and increasing the tree canopy.

In addition, the Implementation Section of the Plan also includes targets for reduction of greenhouse gas levels in order to improve air quality over the life of the Plan (F.3.4.5, Volume 1).

Although the Urban Hamilton Official Plan does not specifically reference “green infrastructure”, there are policies that promote various actions that meet the definition of “green infrastructure”. For example, Section B.3.3 – Urban Design Policies contains policy direction to promote environmental sustainability by integrating environmental features and landscapes in building and site design, encouraging on-site storm water management and infiltration, promoting the use of green roofs and vegetated swales, as well as the planting of street trees and use of permeable pavement (B.3.3.2.8, B.3.3.2.10, B.3.3.10.8, C.5.4, Volume 1). All of these measures that would be considered to support the human-made elements of green infrastructure.

In addition, the UHOP also contains strong policies to protect and enhance the natural heritage system across the City through stewardship, education and awareness, land use planning policies, habitat restoration and management, and acquisition. The Implementation Section of the Plan contains targets to expand the City’s natural cover to restore the natural heritage system (F.3.4.4). These policies reinforce the natural elements of green infrastructure.

A list of notable UHOP policies is contained in **Appendix F.**

6.5 Recommendations:

One avenue to pursue may be follow up on an Information Report provided to Hamilton City Council on June 13 2011 on Green Roofs and Living Walls. Using this or other green infrastructure policies, it is recommended that the City systematically begin to measure the benefits and costs associated with individual classes of green infrastructure with the intent of providing policy and program incentives to successful initiatives as it as it implements the Air Quality Task Force Recommendation #4.

7.0 Transportation Emissions and Programs

Emissions from everyday vehicles (cars and trucks) produce more air pollutants than all other sources. The roads in and around Hamilton are heavily used by local citizens, commuters passing through Hamilton and long-distance traffic. As a consequence, air quality is adversely impacted by the mobile emissions generated by gasoline-powered vehicles and diesel-powered transport trucks.

A car in Ontario will be driven an average 16,000 km per year, creating almost 4 tonnes of greenhouse gases (GHGs). Based on 2010 data from Environment Canada, almost a third (27%) of all greenhouse gas emissions in Ontario are attributed to road transportation. As a subsector of the transportations sector, road transportation includes gasoline and diesel fuelled cars and trucks; propane and natural gas fuelled cars; and motorcycles. It is important to decrease the large amount of pollution created by our dependence on vehicles as much as possible. The breakdown of national transportation emissions is approximately 21% of nitrogen oxide emissions, approximately 51% of volatile organic compound emissions, and approximately 4% of fine particulate matter emissions.

In Hamilton, transportation accounts for approximately 4% of local generated greenhouse gas emissions and 50% of air pollutants. Ways to reduce emissions from local transportation sources includes encouraging urban design and denser connected land use to support more walking, cycling and transit to closer destinations, facilitate teleconferencing or working from home, implement trip-reduction incentives, increase efficiency of transportation through more transit, car sharing, or carpooling, improve fuel efficiency in vehicles and switching to lower to zero emissions vehicles such as electric vehicles or fuels such as natural gas or propane, implement fuel-saving devices, such as aerodynamic improvements, speed limiters, and anti-idling devices, promoting awareness of transportation impacts and encouraging driving skills that reduce these emissions, reduce vehicle idling, mandatory vehicle testing and maintenance such as Drive Clean, increasing emissions standards and fuel regulations, shifting goods movement to rail or water, improving vehicle and transportation corridors design, improved freight movement logistics (load, space utilization, scheduling, supply-chain, consolidated shipments), encourage more inter-city rail, transit, cycling and ride sharing.

Since its inception, *Clean Air Hamilton* has supported the need for sustainable, low emissions and active forms of local transportation in Hamilton as a key area for actions to reduce air and climate emissions. Past programs by *Clean Air Hamilton* and increasing air monitoring at the street level highlight the need for continued action in this area.

7.1 “Fresh Air Kids” School Air Quality Outreach/Mobile Monitoring

The school air quality program, “Fresh Air Kids”, aims to raise awareness of the Air Quality Health Index (AQHI) among school-age children, to educate these children about air quality issues and to assist children to develop walking routes to school that would have the lowest pollutant exposures. Another aspect of the program is to encourage students to use active modes of transportation and develop a lifelong commitment to exercise. This innovative program was undertaken in 2013 at three Hamilton schools - Holy Name of Jesus, St. Lawrence and St. Marguerite d’Youville Catholic Elementary Schools.

Videos for all three schools are available in which the children explain the program, what they learned and how they have changed as a result.

For Holy Name of Jesus School
http://www.youtube.com/watch?v=bAIhVs_sEpk
For St. Lawrence School
http://www.youtube.com/watch?v=ZD7sBkQ9PsY
For St. Marguerite d'Youville School
https://drive.google.com/file/d/0B9cLr4RaDExwX0gxdE1EMUxSQ2s/edit?usp=sharing

The program was delivered as a partnership between Green Venture, Rotek Environmental, the Ontario Ministry of the Environment, West Central Region and Corr Research.

Clean Air Hamilton, Public Health Services, Hamilton, Environment Canada's Green Communities Canada program and the Ontario Government's Healthy Community Fund provided funding. The Ontario Ministry of the Environment, West Central Region, volunteered use of its mobile monitoring unit for this project.

Initial presentations were made to the Grade 5 class at Holy Name of Jesus School, Grade 5/6 and 7/8 classes at St Lawrence School and Grades 2/4/5 at St. Marguerite d'Youville School in Hamilton.

These interactive presentations included explanations of the AQHI, discussions of sources of air pollution, the need for air quality improvements, the importance of personal actions and using active modes of transportation. Students played an air quality game called Clean Air Shuffle (an air quality version of musical chairs; **Figure 31**) developed by Environment Hamilton.

Figure 31: Clean Air Shuffle

The first part of the program helped make students aware of the importance of developing an active lifestyle as well as air quality information. One of the key features was teaching students to look at potential barriers to active transportation that may enhance or restrict their physical activity.

Students were taken on short walks around their neighbourhoods and filled out a questionnaire (walkability survey) to encourage them to see public spaces from a viewpoint that would encourage them to walk, bike or skateboard to school.

In the second part of the program, students personally participated in particulate air monitoring. Levitt Safety kindly provided at no cost a hand held particulate monitor for this project. The Dust Trak instrument provided measurements of PM2.5 and PM10 and this proved to be an excellent tool for student engagement.

After performing a mini survey of their school neighbourhood, the children plotted graphs of particulate variation on their commuting routes and identified pollution sources, **Figures 32 and 33**.

Figure 32: Particulate Mini Survey

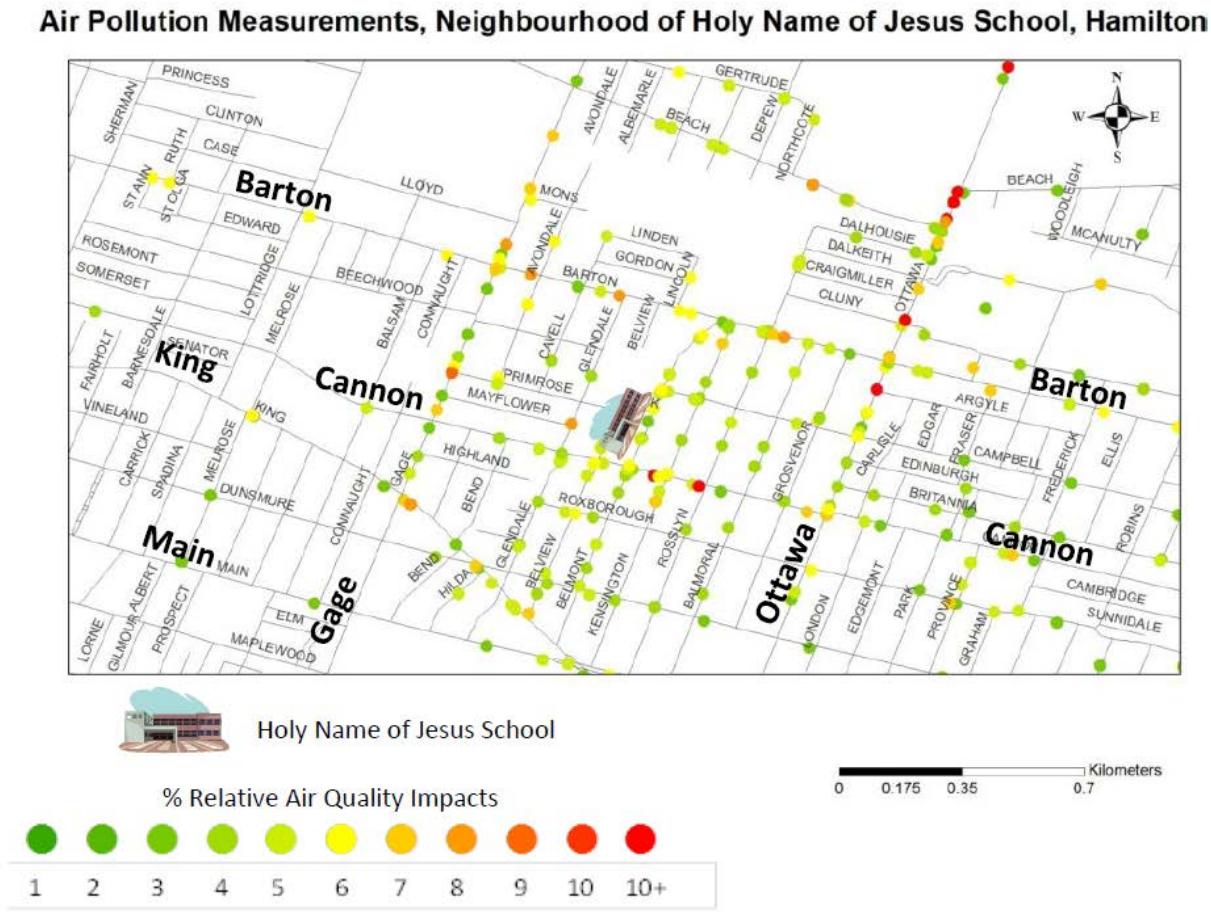
Figure 33: Graphing Results

The third portion of the program involved using the mobile air quality monitoring van to monitor air quality in the neighbourhoods of the schools. Students were given tours of the van and MOE staff explained how the van collects air monitoring data, **Figure 34**.

Figure 34: MOE Air Monitoring Van

After monitoring the student commuting routes around each school, the data were analyzed geographically. Each student was then provided with an air pollution map of his or her school and the surrounding neighbourhood (**Figure 35)** based on the data collected by the mobile air monitoring van. This exercise introduced students to GIS (geographic information system) mapping concepts and how GIS can aid in air pollution monitoring. Students were asked to identify the location of their home on the map and to draw the 'best' and 'worst' routes to school based on the air quality data.

Figure 35: Best and Worst Commuting Routes to School Exercise Example



Students were also asked what actions they could take to reduce air pollution and what actions they could take to reduce their personal exposures. Some of the student answers included ; Ride my bike more, check AQHI, walk more, not drive a car, skateboard, plant trees, not to idle.

Finally, different schools made visits to Ministry of Environment offices, an air monitoring station and a local air monitoring company, Rotek Environmental Inc.

The teachers and project team at one school have now developed anti-idling programs at one school resulting in a major reduction of vehicle idling. Thank you notes signed by participating students were then handed out to non-idling vehicles near the school during drop off and pick up times.

Overall, the program became an empowerment and future career option exercise for the students involved. School staff recommended that the program should be extended to additional schools.

7.2 Active & Sustainable Transportation

7.2.1 Complete Streets

Complete Streets are streets for everyone. They are designed and operated to enable safe access for all users. Pedestrians, bicyclists, transit riders, goods movement operators and motorists of all ages and abilities must be able to safely move along and across a complete street. Complete Streets deliver an acceptable level of service for all modes of transportation using the roadway and does not favour one mode over the other in terms of delivering that service.

There is no singular design prescription for Complete Streets; each one is unique. A complete street may be designed using a variety of design techniques. This Complete Streets design 'toolbox' includes pedestrian amenities such as wider sidewalks and safe crossing opportunities, integrated bicycle infrastructure, specialized bus lanes, and lush landscaping for aesthetic and storm water mitigation purposes.

City Staff already have the capacity and training required to build Complete Streets and understand the 'toolbox' of items necessary to improve mobility for all road users. Hamilton has incorporated some of the elements of complete streets designs in sections of York Boulevard, King Street East, Wilson Street (Ancaster), Stonechurch Road, Dundurn Street South of Main and North of King.

For example, York Blvd in Hamilton recently went on a 'road diet' which took away 5 lanes of one-way traffic, converted it to a two-way, and took away 2 of the extraneous lanes to be filled with a bike lane on each side and wider sidewalks. This made cycling and walking along the street much more comfortable as well as less time spent crossing the street at crosswalks. Landscaping improvements were also made to create a greater buffer between pedestrians and automobiles while providing natural habitats and greenery.

The City-wide Transportation Master Plan 5-year Review will have a Complete Street focus to support multi-modal complete street and complete community designs. Three recommendations that we have to achieve complete streets in the city are:

- Provide pedestrian amenities in places where people need them most;
- Complete cycling infrastructure projects that intuitively link gaps in the network; and,
- Integrate all modes with local transit to serve the needs of all demographics.

7.2.2 Smart Commute Hamilton

Smart Commute Hamilton and the City of Hamilton's Public Works Transportation Demand Management (TDM) team were very active with a variety of programs in 2013. The programs vary in nature from new incentive programs for carpooling and TDM Guidelines for Land Use, to education and citywide events, to end of trip facilities such as bike parking, bikesharing and carsharing. The team continues to develop and improve relationships with partner organizations. Relationships with these partners have led to a variety of successes in 2013 including provincial awards and engaging programs.

The following categories outline key elements and highlights of the Transportation Demand Management and Smart Commute Hamilton Program:

- Smart Commute Employer Programs
    - 3 new employers for a total of 17 employers and 89,000 employees in the Hamilton network
- Sustainable Transportation Events
    - These included the Open Streets Program and Bike to Work Day, which engaged 15,000 residents in varying outreaches.
- Transportation Summit Series
    - In 2012, the National Sustainable Mobility Summit was hosted in partnership with ACT Canada. This sixth annual conference was the biggest the network has hosted and featured international speakers.
- Cycling Programs
    - A bike valet pilot was run for the first time with over 300 bikes parked at four pilot events
    - A public bike share system was developed and will be implemented in 2014
- School Travel Planning
    - The Active and Safe School Travel Certification program was piloted at 3 schools to certify them as sustainable transportation schools. More schools are planned for certification in 2014.
- Transit Programs
    - Mohawk College piloted a Discounted Transit Pass Program with 100 participants in the program over 8 months. Almost 20% of participants were primarily car commuters.
- Ridesharing and Carpooling Programs
    - Carpool Zone grew by 400% for new registrants and carpools formed. This was a large increased over 2012.
- Community-based Social Marketing Pilot
    - Programs to aid with mitigating traffic issues on and around the Queen Street Escarpment Access engaged 57,000 households with about 1500 households participating in the program and 600 households receiving customized travel plans to avoid construction issues during the summer of 2013.
- Car Sharing Programs
    - The citywide program grew by 5 vehicles and 200 members in 2013 for a total of 10 vehicles and 300 members.

In 2014, the City expects to see growth in many TDM and Smart Commute indicators. Central to this growth will be the inclusion of more corporate partners in the Smart Commute program, coupled with new programs to improve travel demand and modal split at these workplaces. Additional follow-up surveys are planned to monitor performance along key TDM metrics including percentage of those carpooling, taking transit, cycling and walking. Further to these initiatives, the construction of additional bike parking and the development of a public bikesharing program will further strengthen these connections and transit ridership in particular.

7.2.3 Totally Transit

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

In 2013, 33 Totally Transit lessons were delivered to 1661 students from 17 Hamilton area schools (primarily Grades 4-8). All of these presentations involved using a chartered HSR bus to transport students and to be used as a classroom for lesson delivery.

Three lesson options are available for teachers to choose from and each is closely linked to Ontario school board curriculum:

- **Option 1**: Totally Transit in combination with Green Venture's EcoHouse Sustainability Tours. A chartered HSR bus and a Green Venture staff person meet a class on-site at their school and provide the Totally Transit lesson before departing to, and during transportation to, EcoHouse. After completing a 2-hour EcoHouse Tour of their choice, the HSR bus returns the class to their school.

- **Option 2**: Green Venture offers Totally Transit as part of a full day of programming in conjunction with the Hamilton Museum of Steam and Technology. A chartered HSR bus is used as transportation to and from school, and between the two venues. This option allows for schools to take advantage of a successful educational-based partnership between Green Venture and the Hamilton Museum of Steam and Technology. Both organizations offer quality curriculum-based educational programming and the Totally Transit program facilitates a full day of activities in addition to adding the valuable Totally Transit piece to the students' learning experience.

- **Option 3**: Green Venture offers Totally Transit by bringing a chartered HSR bus to a school or other community venue. This option involves delivering the Totally Transit program on-site and allows for multiple classes to experience the program with no associated transportation costs.

The Totally Transit program continues to resonate with teachers and students alike as it provides hands-on experience to address some of the barriers facing young people (and their families) to choosing transit as their sustainable transportation mode.

Since 2007, Green Venture has delivered Totally Transit to more than 4,200 students in 60 Hamilton schools and reached an additional 2,700 students with similar bus education in mini-presentations at school environmental fairs.

Totally Transit for Older Adults 2013 Expansion

In 2012/2013, funding from Metrolinx was received to pilot the expansion of the Totally Transit program from school-aged students to older adults.

The Totally Transit for Older Adults education program, also called “I Ride the HSR!” will help build the confidence our fastest growing demographic and highlight the independence and cost-effectiveness that public transportation can offer (**Figure 36**).

4 Workshops took place in 2013 with over 70 older adults participating. Workshops included information on public transit services catered to older adults. Information on effective trip planning is also covered and volunteer-led guided trips are offered to popular destinations to provide hands-on confidence building.

One deliverable of this pilot program is to develop a handbook to provide step-by-step instructions on planning and implementing a similar public transit program for older adults in other regions of the Province.

Figure 36: Total Transit for Older Adults

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

7.2.4 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'. Funding from *Clean Air Hamilton* and significant in-kind support from Human Resources and Skills Development Canada's Summer Jobs program ensured that the important messages of this program continued to be delivered through 2013.

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 behaviours that will reduce their fuel usage and thereby reduce their vehicles' emissions and impacts on local air quality and global climate change. Through tire pressure clinics, media, static displays, and communication materials, the program encourages drivers to achieve fuel savings and reduce vehicle emissions by promoting the following three core messages:

- Drive Fuel-Efficiently
- Buy Fuel-Efficiently
- Drive Less

The program also has a strong anti-idling component that is consistent with Hamilton's Idling Stinks Campaign (2006-2008) message: engine 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 whenever possible.
- 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.

To drive home the message that underinflated tires waste fuel and create unnecessary emissions, Green Venture partnered with Canadian Tire Auto Services on Barton Street, Upper James Street, Ancaster and Main St. E. to host a series of four public Tire Pressure Check Clinics (see **Figure 37**). Each of these locations were a home base for Green Venture's Clean Air Ambassadors who engaged 315 store visitors and demonstrated how to check tire pressure on their cars.

Green Venture conducted tire inspections on 77 vehicles in total and added approximately 385 PSI of air pressure to the inspected vehicles. The PSI added should garner a long-term fuel savings of approximately 3840 L. annually. This fuel savings in turn can be equated to green house gas (GHG) reductions of 8500 kg of carbon annually.

Figure 37: Eco Driver Tire Pressure Check Clinic, 2013

Green Venture has found that most drivers have some level of understanding of the need to maintain tire pressures. Safety is the primary reason given, but fuel efficiency is not far behind. The largest barrier remains a lack of knowledge about how to determine efficient tire pressure levels, either through the identification location (inside doors, etc.) or by a lack of knowledge of how to check the pressure (gauge).

Green Venture also delivered education materials to two schools (St John the Baptist CES and Holy Name of Mary CES) in 2013 regarding the anti-idling program and distributed educational material indirectly to an estimated 1000 families. Both schools also erected anti-idling signs around their property.

In November 2013, the EcoDriver program was also presented at the ArcelorMittal Dofasco Lifestyles Fair where 400 employees of the company were directly engaged on idling and vehicles.

Local newspaper articles in the Hamilton Spectator, and SNAP Media helped further spread the Eco Driver message. Social media also played a strong role in raising awareness of EcoDriver including 15 Twitter tweets, 15 Facebook posts, and 2 WordPress blog posts. Social media was used to promote EcoDriver messaging including the YouTube videos, which focused primarily on winter driving techniques.

Natural Resources Canada states, “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 communicates.

For more information on EcoDriver, visit: http://www.ecodriver.org/

7.2.5 Vehicle Emissions Enforcement Program (VEEP)

Environmental Officers with Ontario's Vehicle Emissions Enforcement Programs conduct roadside inspections of heavy duty and light duty vehicles to ensure compliance with Ontario's motor vehicle emission standards and waste carrier regulations. Officers also conduct inspections on waste carriers to ensure compliance with the provinces waste regulations. This is known as the Vehicle Inspection Program (VIP).

Officers regularly work in partnership with local Police, Ontario Provincial Police (OPP), Royal Canadian Mounted Police (RCMP), Ontario Ministry of Transportation (MTO), Ontario Ministry of Finance (MOF), Ontario Ministry of Natural Resources (MNR), Transport Canada and other agencies to conduct various inspection blitzes across the province. One of the benefits of these multiple agency inspection blitzes is that with a single vehicle stop officers can determine if a vehicle is an environmental health and/or safety risk to the community.

In 2013 the following inspections (**Table 10**) were undertaken in the City of Hamilton

Table 10: Vehicle Inspections in Hamilton (2013)

Vehicle Class	Fail	Pass	Grand Total
Heavy Duty	**2**	**1**	**3**
Light Duty	**69**	**110**	**179**
Grand Total	**71**	**111**	**182**

8.0 Industrial Partners and Actions in Hamilton

8.1 Hamilton Industrial Environmental Association (HIEA)

The Hamilton Industrial Environmental Association (HIEA) is a registered non-profit association with a Board of Directors made up of senior managers from each member company HIEA's mandate is "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."

HIEA has a strong history of connecting with local neighbourhood associations and working with the community to fulfill HIEA's mandate. HIEA's Community Advisory Panel (CAP) includes local neighbourhood representatives and environmental advocates who are dedicated to improving Hamilton's environment through their volunteer efforts. The CAP acts as a link between industry, neighbourhood groups and individuals, and local environmental community-based initiatives. Regular meetings allow CAP participants and representatives of the HIEA member companies to exchange information and discuss issues of greatest concern to the community. The CAP mandate is: To identify environmental concerns and provide support to the Hamilton Industrial Environmental Association in their pursuit of a cleaner and healthier environment for the residents of the City of Hamilton.

HIEA has received a number of local awards recognizing their work. In the fall of 2003, Hamilton's VISION 2020 honoured the Community Advisory Panel with a Sustainable Community Recognition Award. In 2006 HIEA received the Bay Area Restoration Council's 12th "Annual Implementation Award" recognizing groups that have made a significant contribution to the restoration of Hamilton Harbour and its watershed. In her citation to the organization, Marilyn Baxter wrote, "HIEA is recognized for improving the local environment through its collective actions, and through individual member company's efforts, and for partnering with the community. HIEA's corporate leadership has enhanced the understanding of environmental issues, set priorities for action and has achieved results in pursuit of a cleaner and healthier environment for the residents of Hamilton. As Bay Area Restoration Council prepares its report on Hamilton Harbour water quality, it has become apparent that the pollution controls put in place, and the continued annual efforts by local industry have made a dramatic improvement to the Harbour since the 1960's and continues to make improvements is a praiseworthy accomplishment." HIEA has also received 6 Millennium awards for local community projects.

The 12 current members of HIEA are: Air Liquide, ArcelorMittal Dofasco, ArcelorMittal Hamilton East Inc., Bitumar (Hamilton) Inc., Bunge Canada, Columbian Chemicals Ltd., Lafarge, Sanimax, Triple M Metal LP, U. S. Steel Canada – Hamilton Works, Ruetgers Canada Inc. and Westway Terminal Canada Ltd. In 2012 HIEA member companies collectively employed almost 7,000 people and paid over $24 million in municipal taxes.

HIEA has established an organizational structure that includes:

- A Board of Directors – made up of senior operating managers from each member company who meet twice each year to establish the annual budget and priorities for the organization;
- An Executive Committee – made up of the chair, vice chair, treasurer and technical committee chair who meet on an as-needed basis to address arising questions;

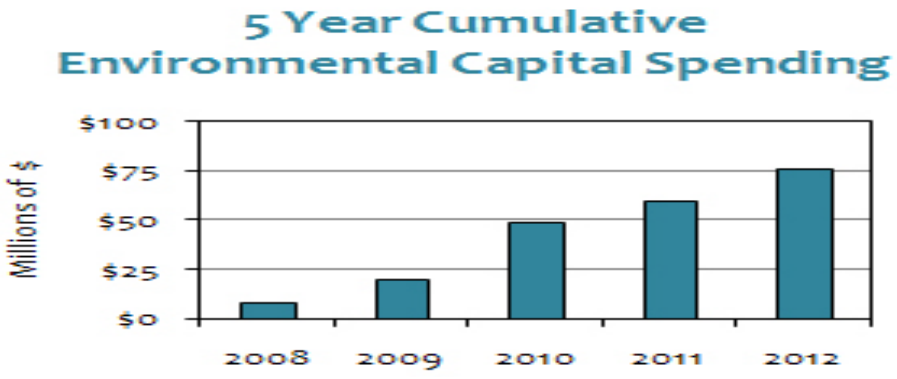
- A Technical Committee – made up of key staff from member companies with environmental responsibilities who meet throughout the year to develop projects and initiatives; share best practices; strengthen communication networks and develop strategies to advance HIEA's mandate;
- A Community Advisory Panel – made up of local neighbourhood representatives and environmental advocates dedicated to improving Hamilton's environment through their volunteer efforts who meet regularly to provide a forum for industry, individuals, neighbourhood groups, regulators and local environmental community-based initiatives to exchange information and discuss issues of concern.

HIEA member companies are committed to the conservation and protection of our natural environment and commit to:

- operating our facilities in a safe, responsible and environmentally responsible manner;
- monitoring our environmental performance, meeting key performance metric targets;
- transparent and open communications regarding environmental performance;
- responsiveness to community enquires, and;
- working in partnership with community stakeholders to promote environmental awareness.

HIEA member companies are also committed to improving their environmental performance and the maintenance of their facilities. Many member companies are ISO 14001 certified and all members follow a prepared environmental management improvement program. These programs have been developed to assist their organization to: (a) minimize how their operations (processes etc.) affect the environment; (b) comply with applicable laws, regulations, and other environmentally oriented requirements, and (c) continually improve. Companies are regularly audited by independent third-party organizations to ensure they are meeting the requirements set out in their improvement programs. HIEA members work closely with provincial and municipal regulators to ensure all reasonable steps are taken to improve their processes and remain in compliance.

Collectively, HIEA member companies have invested over $76 million on environmental capital expenses in the last 5 years — an average $15.2 million per year in environmental capital projects.



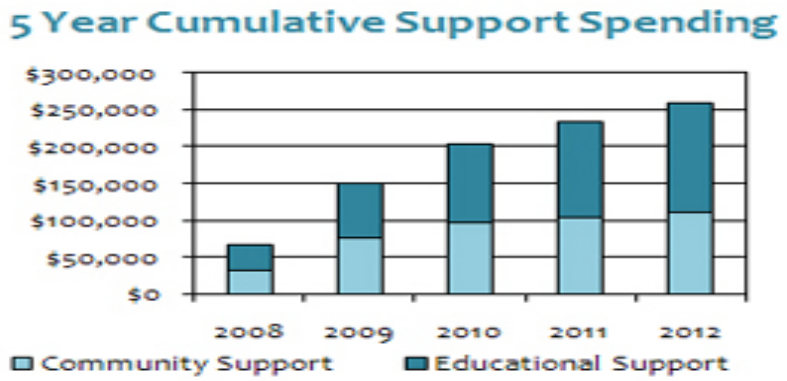
Each of these projects were developed and implemented specifically to have a positive impact on the environment and to reduce emissions or discharges.

Examples of company-specific infrastructure investments are described on the HIEA website: www.hiea.org.

Each year, HIEA collects member-company data on environmental performance which is compiled and assessed against a base year of 1997 to evaluate environmental trends. The following are examples of their collective performance related to air in 2012:

- Greenhouse gas (GHG) emissions from HIEA member companies were 38% lower than 1997 levels and 19% lower than 2008 levels. GHG emission reductions are the result of energy conservation, increased waste energy recovery, increased process yields and efficiencies and operational changes;
- Total Particulate Matter emissions are 69% below those reported in 1997, and 31% lower than those in 2008. Numerous programs are in place to reduce particulate emissions, including point source controls, improved operating practices, paving of roads and yards, greenbelting, and shutdown of obsolete equipment. HIEA has also contributed almost $134,000 to local tree planting programs since 1999 to assist in managing particulate emissions;
- Polycyclic Aromatic Hydrocarbons (PAH) emissions have been reduced by 81% since 1997 and are 20% lower than 2008 levels. These reductions have been achieved primarily by improving coke oven operations;
- NO_x emissions have been reduced by 31% since 1997 primarily through the installation of advanced combustion technology (low-NO_x burners) and shutdown of obsolete equipment;
- SO_2 emissions are 14% lower than 1997 levels through switching to lower sulphur fuels and feedstocks, and shutting down obsolete equipment.
- HIEA members have also worked together and individually on projects to significantly reduce the impact of transportation on the Hamilton community. Examples of company-specific initiatives that consolidated or improved shipping and transportation of goods, reducing traffic on local Hamilton roads and therefore improving air quality are described on the HIEA website: www.hiea.org.

By working in partnership with residents and community associations, HIEA provides financial support to initiatives that enhance and protect our local environment. In 2013, HIEA continued its support of local environmental activities by sponsoring various programs including the Bay Area Restoration Council, the Hamilton Children's Water Festival, the Hamilton-Burlington Earth Day Eco-Festival, the Hamilton Conservation Authority and the Hamilton Naturalist Club. Through its post-secondary scholarship program at Mohawk College, HIEA awarded bursaries to 3 students studying in various Environmental Studies Programs in 2013.



HIEA members view all residents of the city as stakeholders and therefore use many different ways to engage the community. HIEA maintains an email contact list of interested community members and utilizes this list to send regular e-communications to inform the community of activities and information from our members. Each year HIEA produces an annual report to the community which provides details of the year's activities and the previous year's environmental performance. This report is available in hard copy upon request, distributed electronically and posted on the HIEA website. Each year HIEA hosts an annual general meeting that is open to the public where the community is encouraged to come out and meet HIEA member representatives and other interested community members. This meeting also provides an opportunity to showcase many of the projects that are being undertaken by local environmental organizations within the community.

HIEA and its members also provide support and experience through participation in local organizations to encourage improvement in the Hamilton community. They either volunteer their expertise or are sought out by various organizations including:

- The City of Hamilton – 2013 Environmental Summit - HIEA's Chair provided opening remarks, and HIEA's Communications Coordinator assisted on the organizing committee and facilitated one of the discussion groups;
- The City of Hamilton – *Clean Air Hamilton* – HIEA and its members are members of CAH and actively participate in several committees including: the Air Quality Task Force; the CAH Structure and Planning Committee; the Upwind/Downwind Conference and the Chair Search Committee;
- Hamilton Harbour Remedial Action Plan (RAP) – HIEA and its members regularly participate in a number of initiatives coordinated by the RAP including the annual workshop series and the RAP Stakeholder Forum;
- Hamilton Area EcoNet – HIEA is an active supporting member of this group that engages all environmental organizations within the Hamilton area;
- Sustainable Hamilton – HIEA has financially supported Sustainable Hamilton since 2012, is a reporting partner and regular attendee at Sustainable Hamilton's workshops;
- HIEA and its member company representatives sit on Boards and committees for various local environmental organizations

8.2 Horizon Holdings / Horizon Utilities / Horizon Energy Solutions Inc.

Horizon Holdings Inc. is the owner of Horizon Utilities Corporation, the municipally-owned local electric distribution company, and Horizon Energy Solutions Inc., a multi-disciplined energy services company. Horizon Holdings continues to improve its sustainable development leadership each year. It is owned via holding companies by the City of Hamilton (78.9%) and the City of St. Catharines (21.1%).

In 2013, Horizon Utilities was named the first Canadian Electricity Association Sustainable Electricity Company. This designation, which is externally audited and verified, was given to Horizon for its overall sustainable development leadership and innovation. Horizon is the first local distribution company (LDC) in Canada to undertake a comprehensive sustainability initiative. Horizon is ISO 14001 certified and ISO 26000 compliant. Horizon is the first LDC in Canada to adopt ISO 26000.

Horizon published its fifth Sustainability-Based Annual Report in 2012 and received "external assurance" of its Global Reporting Initiative (GRI) filing, achieving an A+ rating level. The report focuses on the social, environmental and economic dimensions of Horizon's business while the GRI filing benchmarks its performance against the international standard for sustainability.

Horizon Utilities' Sustainability-Based Annual Report can be read at:
http://www.horizonutilities.com/ourCompany/sustainability/Pages/Sustainability-Reports.aspx

8.2.1 Conservation and Demand Management

Horizon Utilities, utilizing Ontario Power Authority (OPA) programs, makes it simple for residents and businesses to conserve energy, which reduces Ontario's need to source electricity from non-renewable, non-nuclear generation types, furthering emission reductions. The following are some of Horizon's Conservation Demand Management (CDM) program highlights for 2012:

- Fridge and Freezer Pickup had successful uptake in 2013 with 878 old fridges and freezers being picked up.
- In 2012, a total of 385 small businesses received retrofit upgrades for improved indoor lighting under the Small Business Lighting program.
- The saveONenergy^{OM} Retrofit program focuses on lighting, motors, heating, ventilation and air conditioning, and overall electricity systems. In 2013, Horizon Utilities customers achieved a total of 2.519 MW in reductions through the Retrofit program.

For more information on Horizon's CDM initiatives, please visit:

http://www.horizonutilities.com/Conservation/business-conservation/Pages/default.aspx

and

http://www.horizonutilities.com/Conservation/home-conservation/Pages/default.aspx

8.2.2 Energy Mapping

In 2012, Horizon Utilities became the first Ontario LDC to begin correlating its electricity consumption data with MPAC building attributes and Teranet geospatial property data, through a geographic information system (GIS). The project, known as Energy Mapping, has an objective to improve the targeting, effectiveness, and deployment of CDM programs in Horizon's service territory, which encompasses the urban portion of the City of Hamilton and all of the City of St. Catharines.

CDM programs focus on helping Ontario electricity customers reduce their demand for power both overall and at typical peak periods of consumption. All sectors are targeted for CDM – residential, commercial, institutional, and industrial. Lowering this demand helps to improve the air quality of the province overall. Approximately 18% of Ontario's electricity generation in 2012 came from non-renewable, non-nuclear emission sources. Lowering demand helps to lessen these emissions.

The learnings from the project, slated to be fully operational by the end of 2014, will be applicable to all Ontario LDCs and will support and enhance the success of the OPA's CDM initiatives and Ontario's Long-Term Energy Plan. This project was made possible through the financial support of the Ontario Power Authority's Conservation Fund.

Information on Horizon's Energy Mapping project can be found at:
http://www.horizonutilities.com/Conservation/Documents/HorizonUtilities_OPA_CaseStudy_2013_June20_2013.pdf

8.2.3 Horizon Energy Solutions Inc.

Horizon Energy Solutions Inc. (HESI) is an affiliate business to Horizon Utilities that offers a suite of energy services that allow customers to better manage their energy. HESI's main business lines include:

- Metering services
- Streetlight maintenance and upgrades
- CDM services
- Renewable power generation

Located in Hamilton, HESI's central location allows easy access to customer sites across Ontario. HESI's Measurement Canada accredited meter shop is one of the most advanced and has recently undergone extensive refurbishment. Its client base is comprised of numerous large manufacturing companies, LDCs, and generators located across Ontario. HESI provides full Independent Electricity System Operator (IESO) registration and ongoing site maintenance.

In 2011, HESI expanded its service offering to provide turnkey CDM services to Ontario-based LDCs. The CDM program delivery services are conducted on a white-label basis using the OPA's saveONenergy^{OM} programs. HESI helps LDCs attain their mandated conservation goals while their customers may qualify for financial incentives that can offset energy retrofit capital costs.

As of the end of 2013, HESI completed construction on seven solar PV rooftop generation installations on commercial buildings, for a combined generation capability of 1.3 MW AC. These systems are emission-free and provide enough energy to power approximately 120 homes, reducing Ontario's dependence on fossil fuel generation improving air quality across Ontario. In 2014 HESI will continue to construct solar PV installations and further its work in CDM, metering and streetlight services.

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

9.0 Conclusions and Recommendations

There continue to be dramatic improvements in air quality in Hamilton. These changes will contribute to better health for citizens as well as improved perceptions of the City.

The annual percentage reductions in pollutant levels since the mid-1990s as measured at the downtown air monitoring site (MOE Station 29000) are: total suspended particulate (TSP) levels, 2.8% per year (total 55%); inhalable particulate matter (PM_{10}), 1.7% per year (total 32%); respirable particulate matter ($PM_{2.5}$), 2.5% per year (total 32%): nitrogen dioxide (NO_2), 2.8% per year (total 47%); sulphur dioxide (SO_2), 2.2% per year (total 38%); total reduced sulphur odours, 6.0% per year (total 99%); benzene, 5.4% per year (total 78%); and PAH (measured as benzo[a]pyrene), 4.9% per year(total 87%).

Work has also begun in Hamilton to reduce and address greenhouse gas emissions. Community greenhouse gas (GHG) emissions in 2011 were just below 18 million tonnes in Hamilton, a reduction of 23.1% from 2006 emissions levels, surpassing the community's 2020 targets. Hamilton has made progress in reducing greenhouse gas emissions through actions on energy and transportation including Provincial initiatives and industrial reductions. Despite these reductions, Hamilton is already experiencing warmer temperatures and increased precipitation influenced by changes in climate. Hamilton should prepare itself for future changes and prepare actions to address the potential impacts of a changing climate locally.

Air quality improvements and reductions of greenhouse gas emissions in the City of Hamilton continue to be incremental and require actions on many fronts and continued, concerted actions of individuals, organizations, industries, the City of Hamilton and other levels of government.

Clean Air Hamilton is interested in improving the personal health exposure of citizens to air pollutants and supports the recommendations of the Air Quality Task Force (**Appendix D**) in the provision of tools to inform individual actions to reduce personal exposures.

Clean Air Hamilton and its members continue to recognize the relationships between air quality, public health, climate change, transportation, land use planning, and energy. 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 greenhouse gases.

- Health research continues to confirm that exposure to air borne pollutants ($PM_{2.5,}$ PM_{10}, NO_x, and SO_2) may adversely impact human health. The 2011 SENES Health Study undertaken for *Clean Air Hamilton* reflects the current knowledge of the relationship between air quality and public health and the increased health care costs associated with the exposure to increased health care costs to air pollutants in Hamilton.

- Recognizing the linkages between air quality and climate change, *Clean Air Hamilton* has begun to examine and expand its work in the area of climate change. In 2013, *Clean Air Hamilton* established a climate change working group to work on educating and engaging with local partners and resources to address climate change locally, and support Hamilton's undertaking of a Community Climate Change Plan in 2014.

- *Clean Air Hamilton* continues to support programs that encourage Hamiltonians to reduce their transportation-based emissions and protect their health. Totally Transit is a program

that educates school children and older adults on the use of public transportation and "Fresh Air Kids " is a program to educate children about air quality issues and assists them in developing walking routes to school that would have the lowest pollutant exposures are examples of such programs. These programs also support the City's goal of improved Transportation Demand Management in Hamilton.

- In 2013, *Clean Air Hamilton* formed an Air Quality Task Force to make recommendations on actions that can be undertaken at the municipal level in improving local air quality (**Appendix D**). *Clean Air Hamilton* supports all the recommendations of the Air Quality Task Force in the areas of air modelling and monitoring, planning, education and outreach, green infrastructure, and updating of municipal by-laws aimed at decreasing particulate matter in the environment.

- Comprehensive Airshed Management has been proposed for improving air quality across Canada. *Clean Air Hamilton* will continue to work with partners including the Ontario Ministry of the Environment, Environment Canada and the City of Hamilton to provide input towards the development of an airshed management system for Hamilton.

This report focuses on the actions of *Clean Air Hamilton* and its members in 2013 and makes the following recommendations for the City of Hamilton to focus on:

- 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 NOx, SO_2, benzene and B(a)P emissions, from stationary and mobile sources.

- Undertake the recommendations identified by the Air Quality Task Force (**Appendix D**) in the areas of air modelling and monitoring, planning, education and outreach, green infrastructure, and updating of municipal by-laws aimed at decreasing particulate matter in the environment.

- Continue to support the expansion of air monitoring efforts to capture new emission source currently not covered. The information for an expanded air monitoring network further enhance the capabilities of decision-makers at all levels in the development of policies and initiatives to reduce local emissions within the community and thereby the exposures of citizens. The introduction of the East End Air Monitor pilot project and the continuation of mobile air monitoring are examples of the expansion of air monitoring in Hamilton.

- Continue to support and encourage Hamiltonians to reduce their transportation-based emissions through the use of transportation alternatives including public transit, bicycles, walking, hybrid vehicles, etc. and in supportive policies such as complete streets and transportation demand management.

- Begin to examine and measure the benefits and costs associated with green infrastructure in Hamilton with the intent of providing policy and program incentives.

- Continue to encourage the reduction of greenhouse gas emissions in Hamilton, and consider the implications and risks of climate change to improve the quality of life in Hamilton through climate adaptation policies and planning.

Appendix A: 2013-2015 *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; PH = Public Health; TDM = Transportation Demand Management;

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 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	On-going
			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	2014
	Health Impacts		PH, McMaster, Hospitals		Special package alerts for physicians and health care providers	Community Smog Plan	On-going
Risk Communication		Risk communication on air pollutants and health impacts	PH		Locally directed messaging - what is it? How does it impact my health?		2014

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Active & Sustainable Transportation		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	On-going
	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	On-going
	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 - 2013
	Complete Streets				Encourage a Complete streets policy for City		Begun
	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?			Under Review

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Smart Driver	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
	Eco-driver	Promote green driving habits to drivers Reduce unnecessary vehicle idling in Hamilton	GV, City, Green Communities		Information on idling and by-law Green driving tips	Eco-driver program. Promote behavioural shift.	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 developmen t	Provincial Policy Statement Review	Guidelines, Planning directions for development to mitigate impacts. Require air quality monitors and air quality to be factored into development - industrial, commercial,, residential	On-going

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Air Monitoring	HAMN required for industries to monitor industrial area of airshed	All emitting industries should participate in HAMN	HAMN, MOE		Provide HAMN data online via HAMN web site, HAMNair.ca	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 Work continues in 2014
	Neighbourhood air monitors		HAMN, MOE, City	Look into investing in new air monitors		Introduce East End Monitor (2013)	On-going
		Airshed Model for the City	EC, HC, HIEA	Development of an airshed model, assessment tool, decision-making tool for Hamilton.			2014
	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.	On-going

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Emissions Reductions		Develop Local Poor Air Quality Notification system that can trigger immediate actions by industries 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
	Dust Abatement	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	Air Quality Task Force (2013)
	Technical Standards	Technical standards under Reg 419 are intended to lead to further reductions from sources	MOE		Awareness and communication of these standards		On-going

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Climate Change	Corporate Air Quality (AQ) & Climate Change (CC) Plan; Hamilton Climate Charter; Climate Change Champions	Subcommittee/working group to look at city-wide Climate Change issues and develop community plan	City, McMaster, Green Venture, Environment Hamilton, Conservation Authority	Mitigation and climate adaptation responses in cities	Outreach on climate change and impacts and actions under a plan	Get members, form group, outreach and develop a Community Climate Change action plan	Undertaking approved by Council in 2013, work is underway in 2014
	Community GHG Inventory, Hamilton Community Charter	Hamilton Community Action Charter			Promote the Hamilton Charter and encourage signatories		On-going
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

Strategic Issue	Activity in the Community	Purpose, Opportunities, Pressures	Proposed Partners	Research	Communication	Actions	2013 Update
Air Quality Communication	CAH Annual Report; CAH website; Upwind Downwind Conference; Displays; brochures	Educate the public: what are the problems? How do they affect you? What can you do?		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.	Maintain and update website; continue annual reporting	On-going
		CAH is effective and efficient –must maintain support	City, MOE, EC, HC		Meetings, Displays, Presentations	Seek awards, seek funding, orientate councillors and local politicians about work.	On-going
	Upwind Downwind Conference	Biennual conference that brings forth and makes science of air quality issues accessible to citizens and groups.			Advertise, share program on-line and presentations, continue dialogue after Conference, make accessible to public	Develop program, seek speakers, seek funding/support, attract attendees, host Conference	2014

Appendix B: 2013 *Clean Air Hamilton* Financial Report

In 2013, the Air Quality Budget for the City of Hamilton and *Clean Air Hamilton* was $56,000. In-kind contributions including volunteer time and advisory role of *Clean Air Hamilton* members on programs was $88,885.

2013 *Clean Air Hamilton* Financial Report				
Project/Program	**Clean Air Hamilton Contribution ($)**	**Other Contribution ($)**		**Total ($)**
		Financial	**In-Kind**	
Eco-Driver	$2,000	$3,371 -Shell Canada Fuelling Change	$150 - Volunteers	$5,521
Totally Transit	$5,500		$3,150 - Hamilton Street Railway service and $150 - volunteer time $5,000- Hamilton Street Railway service	$13,800
***Clean Air Hamilton* Events and Communications**	$500	$205 - Human Resources and Skills Development Canada	$60 - Volunteers	$765
Mobile Monitoring "Fresh Air Kids"	$12,000		$6,000 – Ministry of the Environment mobile monitoring vehicle and equipment. Corr Research- $5,000 in-kind time planning program and conducting data collection and analysis.	$23,000

Climate Change Champions	$20,000		$120 – Volunteers $200 gift card from Mountain Equipment Coop's Community Involvement Fund, $15 in gift cards from Homegrown Hamilton, and $40 worth of coffee from coffeecology as prizes in Carbon Challenge.	$20,375
Advisory			$69,000 – Members	$69,000
TOTALS	**$40,000**	**$3,576**	**$88,885**	**$132,461**

On February 24 2014, *Clean Air Hamilton* and the City hosted the 2014 Upwind Downwind Conference: Built Environment – Foundation for Cleaner Air at the Hamilton Sheraton hotel in downtown Hamilton. The total cost of the 2014 Upwind Downwind Conference was $32,000. The total revenue was $25,400 that included $11,400 from registration fees and $14,000 from funding (see **Table 3**). A sum of $6,600 was drawn from the $18,000 Upwind Downwind Conference Reserve Fund to cover the difference. This Reserve Fund was established through revenues accrued from previous Conferences and can be used to cover any shortfalls that may arise in future Conferences. City of Hamilton provided staff resources to procure sponsorship, coordinate logistics, facilitate meetings, process registrations and promote the Conference agenda ($30,000). Planning Committee members helped confirm speakers and facilitate Conference sessions. OPPI provided $2,500 of in-kind service to advertise and promote the Conference. Volunteers helped on the registration desk during the conference.

2014 Upwind Downwind Conference Funds/Grants

Organizations	Support
Hamilton Public Health Services	$30,000 **in-kind**
Hamilton Industrial Environmental Association	$5,000
Health Canada	$2,500 *exhibitor booth*
Ontario Professional Planner's Institute	$2,500 **in-kind**
Mohawk College	$1,000
RWDI Inc.	$1,000
LURA Consulting	$1,000
McKibbon Wakefield Inc.	$500
McMaster Institute of Environment and Health	$500
TOTAL – CASH	$14,000
TOTAL – IN-KIND*	$32,500
Total	**$42,000**

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

Appendix C: Air Quality Indicators - Trends and Comparisons over Time

Air Quality Trends in Hamilton

The graphs in this Appendix illustrate trends in key air quality parameters in Hamilton over the past 11 to 24 years. Earlier long term trends from about 1970 (when air quality measurements were first made in Hamilton) to the mid-1990s can be found in the 1997 HAQI reports.

For information on Hamilton air quality from 1970 to the mid-1990s, visit:
www.cleanair.hamilton.ca/downloads/HAQI-Environmental-Work-Group-Final-Report-Dec-97.pdf

Since the mid-1990s, the levels of air pollutants in Hamilton (except for the long-range air pollutant, ozone) have shown steady downward trends year over year. The annual percentage reductions in pollutant levels over this time period as measured at the downtown air monitoring site (Station 29000) are: total suspended particulate (TSP) levels, 2.8% per year; inhalable particulate matter (PM_{10}), 1.7% per year; respirable particulate matter ($PM_{2.5}$), 2.5% per year: nitrogen dioxide (NO_2), 2.8% per year; sulphur dioxide (SO_2), 2.2% per year; total reduced sulphur odours, 6.0% per year; benzene, 5.4% per year; and PAH (measured as benzo[a]pyrene), 4.9% per year

Clean Air Hamilton is concerned that over the past three to six years the downward trends in some air pollutant levels either have levelled off or have shown modest increases. The only pollutant that continues to decline steadily is NO_2. The annual values for SO_2, benzene and benzo[a]pyrene all have shown increases over the past three to six years. The province has passed new standards for benzo(a)pyrene and benzene to come into effect in 2016 and current ambient concentrations in Hamilton are far above these standards. 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 of best practice. *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 purchases of appliances and vehicles.

In most of the graphs in **Appendix D**, 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 that compares Hamilton to other cities in Canada and around the world.

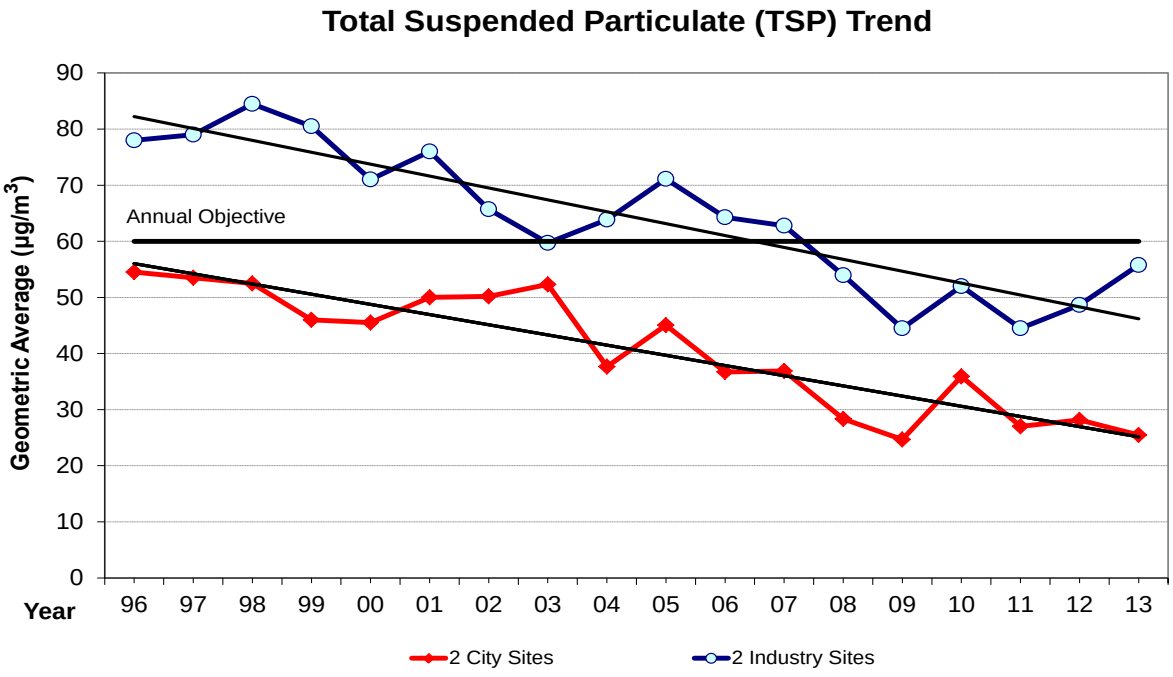
A 2005 report from the Ontario Ministry of the Environment showed the results of modeling estimates of the impacts of U.S. sources on Canada. These estimates were based on the analysis of large-scale weather patterns and detailed estimates of emissions from sources in mid-western U.S. states. These results clearly demonstrated that about 50% of all contaminants in the air in southern and southwestern 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 with 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 2 µg/m^3 per year in the industrial areas and by about 1.6 µg/m^3 per year within the City. These decreases correspond to reductions between 31% and 38% 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 road dust re-entrained by car and truck traffic.

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.

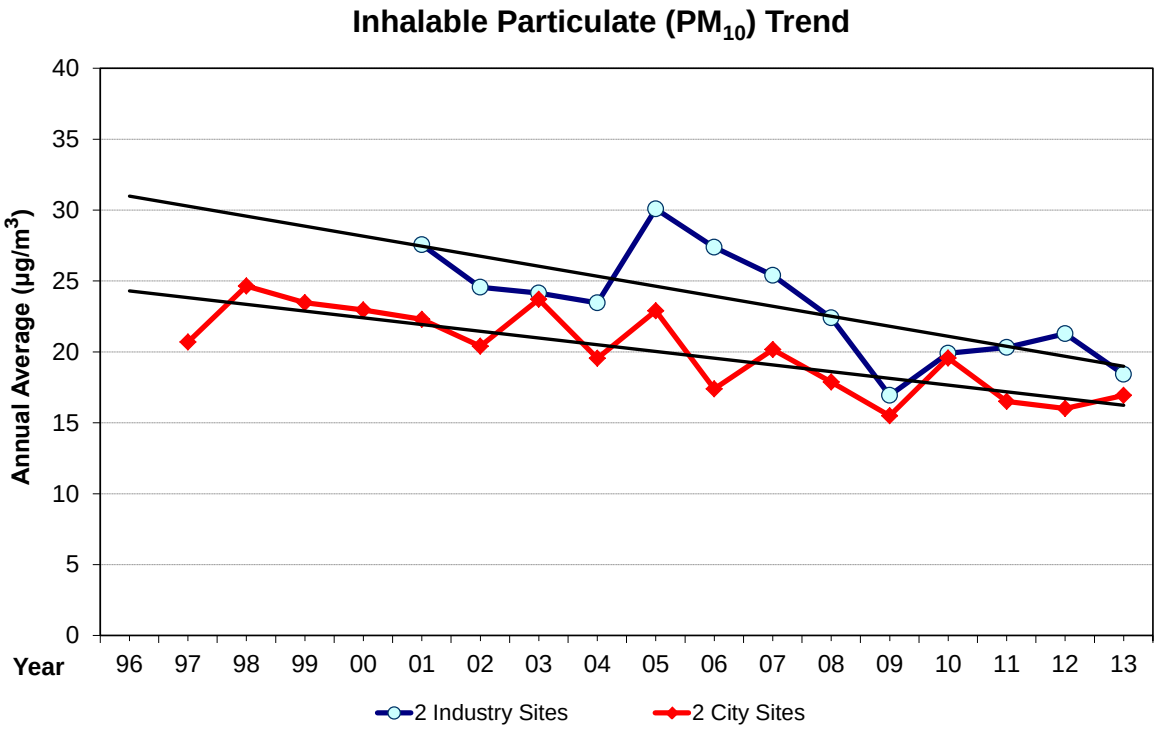


Particulate Material: Inhalable Particulate Matter (PM_{10})

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 21% over the past decade, from about 21 µg/m^3 to about 16 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 sites experienced between 73 and 136 days a year when 24-hour PM_{10} levels exceeded 50 µg/m^3.

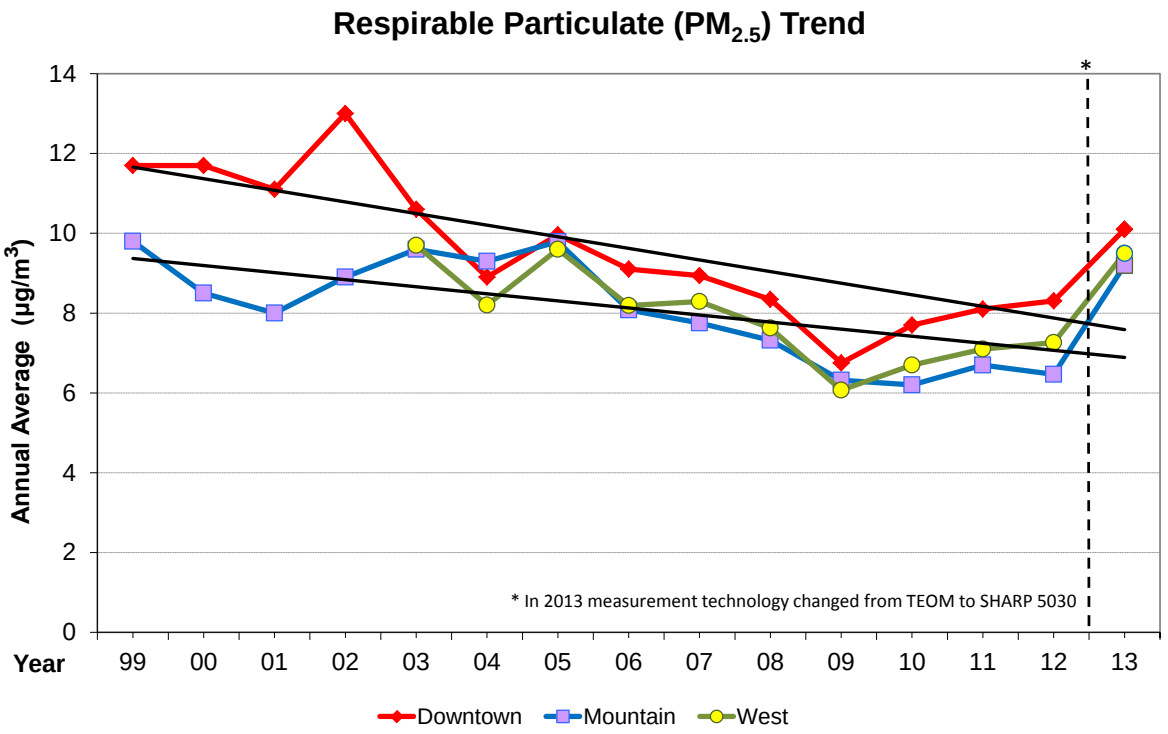


Particulate Matter: Respirable Particulate Matter ($PM_{2.5}$)

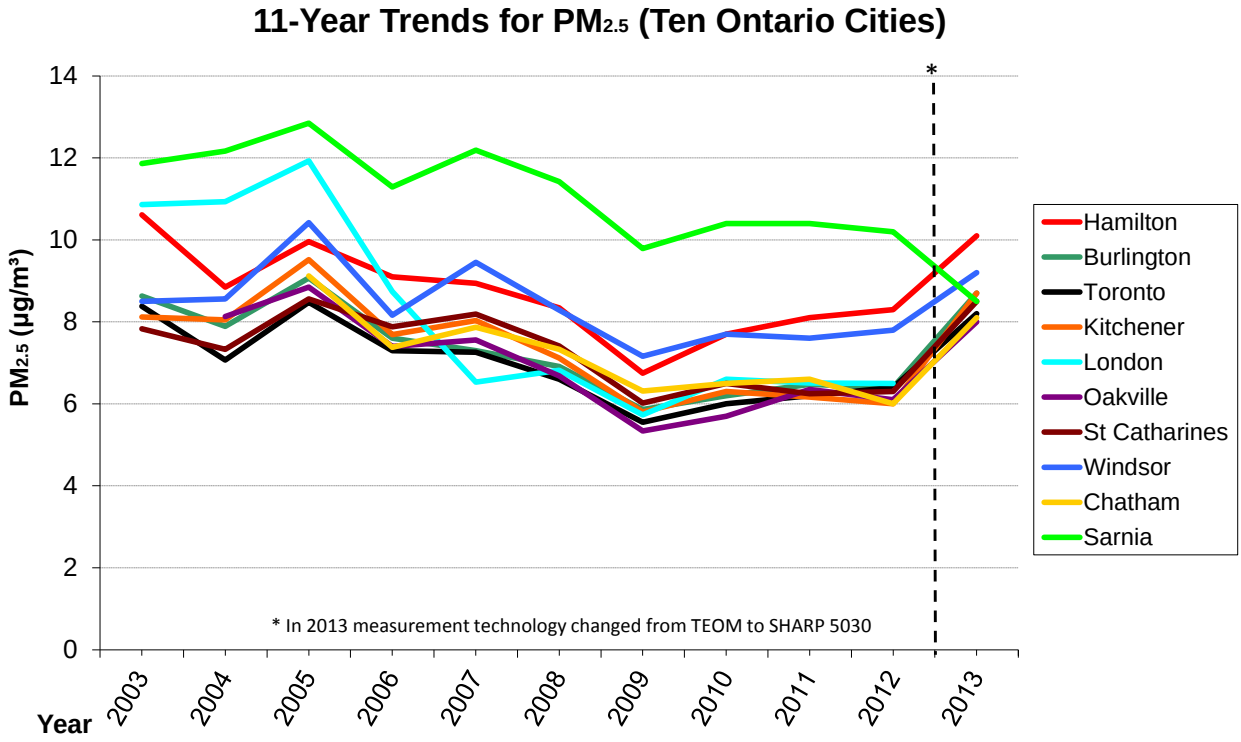
The Province of Ontario monitors respirable particulate matter ($PM_{2.5}$), airborne particles with a diameter of 2.5 µm or less. $PM_{2.5}$, which makes up about 60% of the PM_{10} in the air, has been more strongly linked to health impacts than PM_{10}. The Ontario government started measuring levels 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. In 2013 these stations were upgraded as part of an Environment Canada funded national initiative to standardize $PM_{2.5}$ monitoring methods across Canada and ensure data comparability. The objective is to have all jurisdictions operating federally approved $PM_{2.5}$ monitors by 2013. The Ministry reported real-time $PM_{2.5}$ with the Thermo Scientific TEOM 1400AB/SES until December 31, 2012. Continuous $PM_{2.5}$ monitoring technologies have evolved dramatically over the last decade. The Ministry is now reporting real-time $PM_{2.5}$ concentrations using Thermo Scientific SHARP 5030, an approved Class III Federal Equivalent Method designated by the United States Environmental Protection Agency in 2009. The new SHARP monitor is able to detect additional components of $PM_{2.5}$, especially during cold weather. As a result of this improvement in monitoring technology, there is potential of reporting higher $PM_{2.5}$ concentrations during the winter months. This is a reflection of more accurate measurements and does not necessarily mean that the air quality is changing. The change in technology can be seen in the systemic increase of $PM_{2.5}$ values reported for all Hamilton stations for 2013 and for other cities across Ontario. The trend in $PM_{2.5}$ showed a 3.5% per year decrease from 1999 until 2009 at the downtown and mountain AQI sites (consistent with decreasing trends in TSP and PM_{10} levels). Over the past three or four years, however, these levels have remained relatively unchanged. The apparent increase in 2013 is not reflective of a change in air quality but is result of the change in PM2.5 monitoring technology.

In general the $PM_{2.5}$ levels in cities across Ontario have remained unchanged over the past four years following several years of steadily declining levels. Again the apparent increase in $PM_{2.5}$ values can be attributed to the transition to more sensitive instrumentation. Since most of the $PM_{2.5}$ in cities is derived primarily from vehicular emissions, it appears that the increased distances being driven in Ontario are offset by the improvements in emissions from the vehicle fleet.

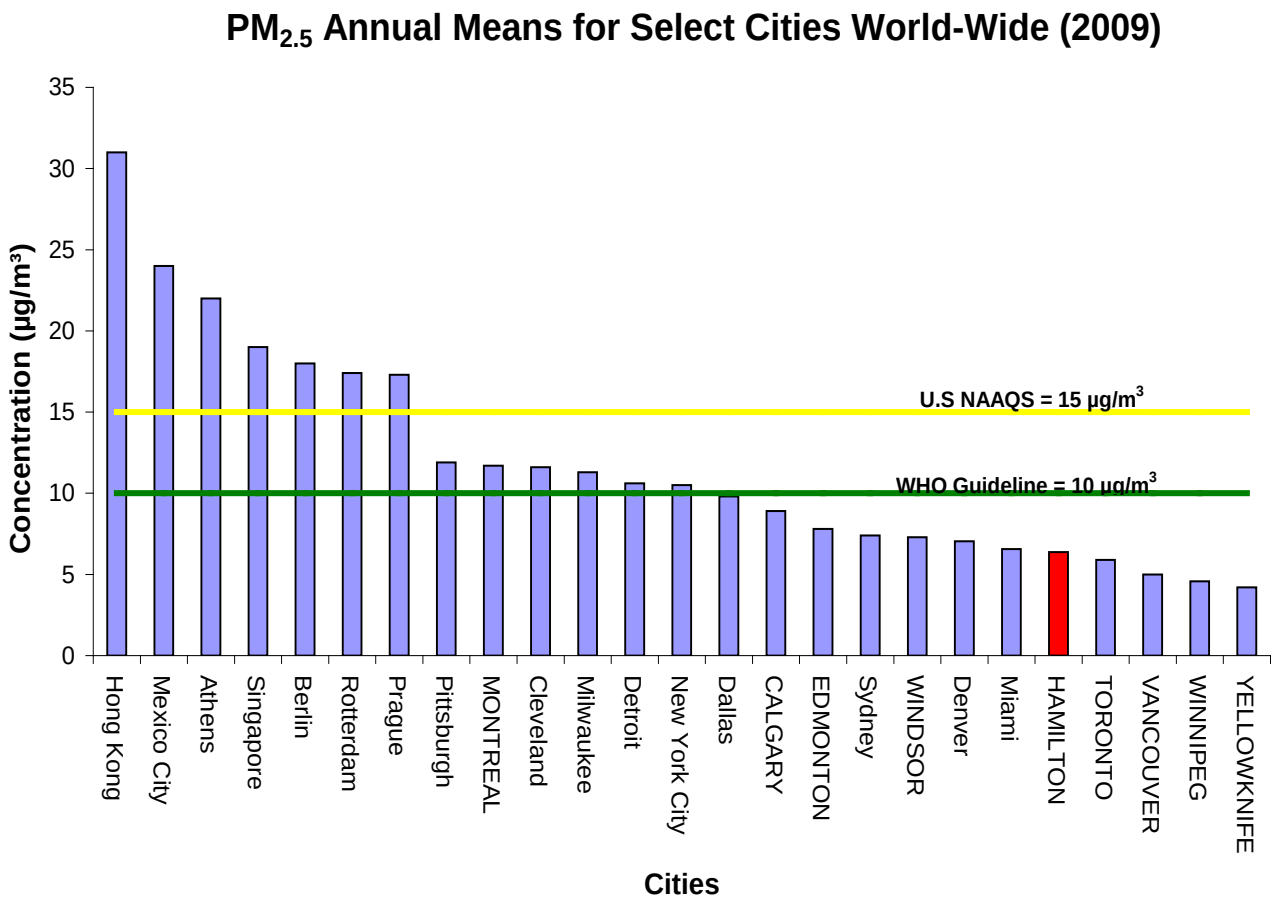
There has been a scientific debate over just what causes the health impacts in humans due to exposure to the $PM_{2.5}$ fraction – the particles themselves or the chemicals on these particles. It is known that the $PM_{2.5}$ fraction contains over 95% of all particle-bound organic compounds in the air 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 ten-year trends in respirable particulate 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 25 other Canadian and global cities for 2009. Of the Canadian cities compared, Hamilton registered the fifth highest $PM_{2.5}$ annual mean reading, with Windsor, Edmonton, Calgary and Montreal registering higher readings. 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 25 cities compared, the five lowest annual mean levels of $PM_{2.5}$ were recorded in Canadian cities including Hamilton. The $PM_{2.5}$ levels in Hamilton and Toronto 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.

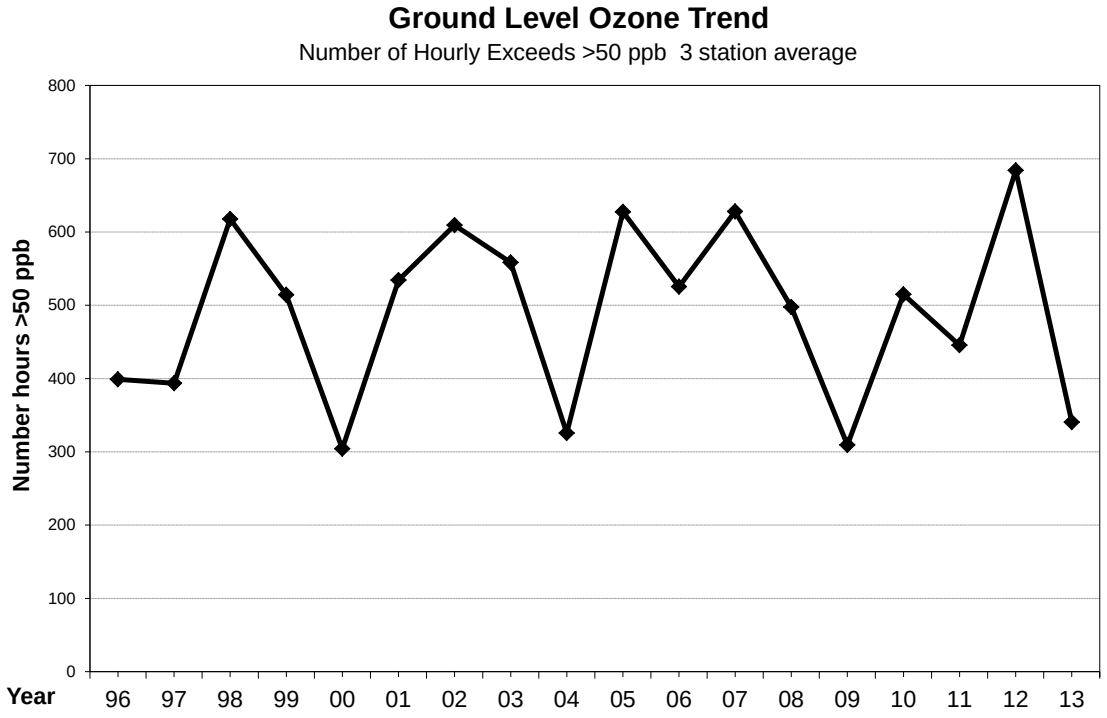

PM2.5 Annual Means for Select Cities World-Wide (2009)
Concentration (µg/m³)
35
30
25
20
15
10
5
0
U.S NAAQS = 15 µg/m3
WHO Guideline = 10 µg/m3
Hong Kong
Mexico City
Athens
Singapore
Berlin
Rotterdam
Prague
Pittsburgh
MONTREAL
Cleveland
Milwaukee
Detroit
New York City
Dallas
CALGARY
EDMONTON
Sydney
WINDSOR
Denver
Miami
HAMILTON
TORONTO
VANCOUVER
WINNIPEG
YELLOWKNIFE
Cities

Ground Level Ozone (O_3)

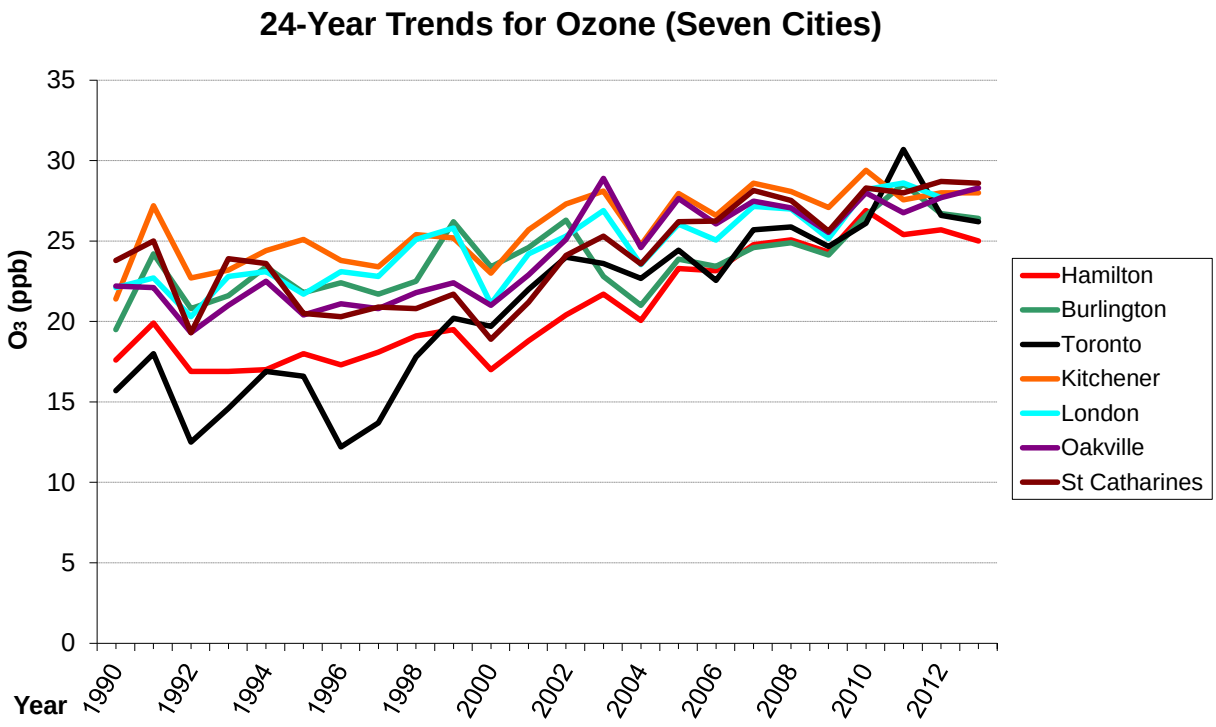
Ground level ozone (O_3 or tropospheric ozone) is formed in the atmosphere when air pollutants such as nitrogen oxides (NO_X) and volatile organic compounds (VOC) react in the presence of sunlight. Air levels of O_3 are higher in warmer seasons than in cooler seasons because the sunlight is more intense in the summer and the temperatures are higher. The trend in O_3 shows that the concentration have been highly variable over the past 10 years. Overall, the trend line for ozone is flat or increasing slightly.

Unlike all other pollutants almost none of the O_3 measured in Hamilton was generated from Hamilton-based pollution 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 is known to originate from sources in the United States, primarily from coal-fired power plants, vehicles and urban activities in the Ohio Valley region in the Midwest.

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

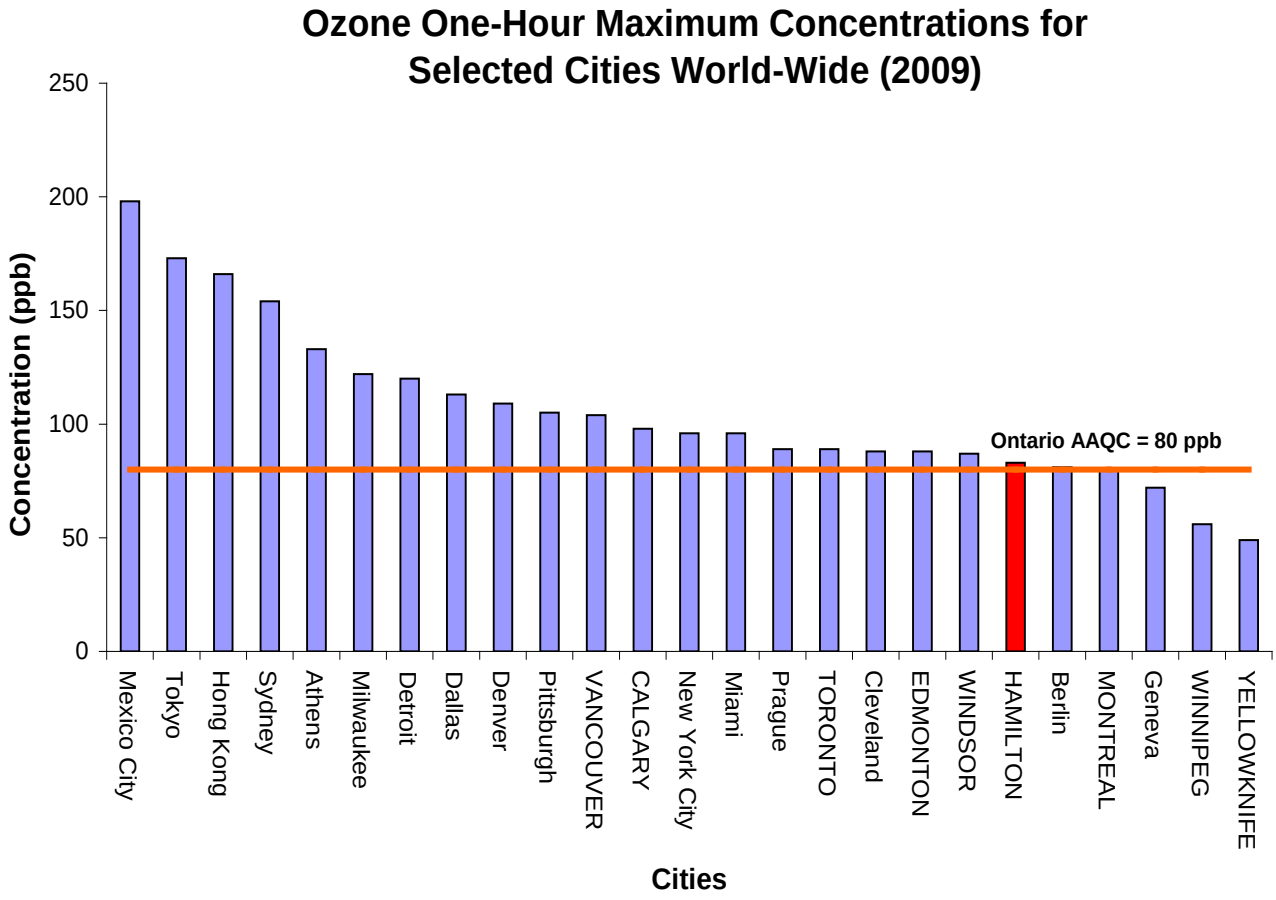


The trend in O_3 in Hamilton is mirrored at other locations across southern Ontario. Over the past 24 years, the concentrations of O_3 across southern Ontario have increased between 10 and 30%, depending on the city. The levels of O_3 observed across southern Ontario in recent years are consistently higher and more similar than what was observed one and two decades ago. This trend is somewhat worrisome given the detrimental health effects impacts associated with increased O_3 exposures.



As discussed previously, the formation of O_3 results from chemical transformations of pollutants generated outside Hamilton and southern Ontario. Pollutants generated within Hamilton contribute to ozone levels in areas downwind of Hamilton. In the figure below, the cities with higher one-hour maximum ozone concentrations (e.g., Windsor, Detroit, and Cleveland) are located near the Ontario/US border. These higher levels are consistent with sources in the Midwest of the U.S. as being significant contributors to O_3 levels in cities and areas proximate to the US-Canada border. 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 25 cities compared were able to meet these criteria. Addressing O_3 pollution in cities remains a significant air quality challenge and will require serious collaborative efforts between Canada and the U.S.

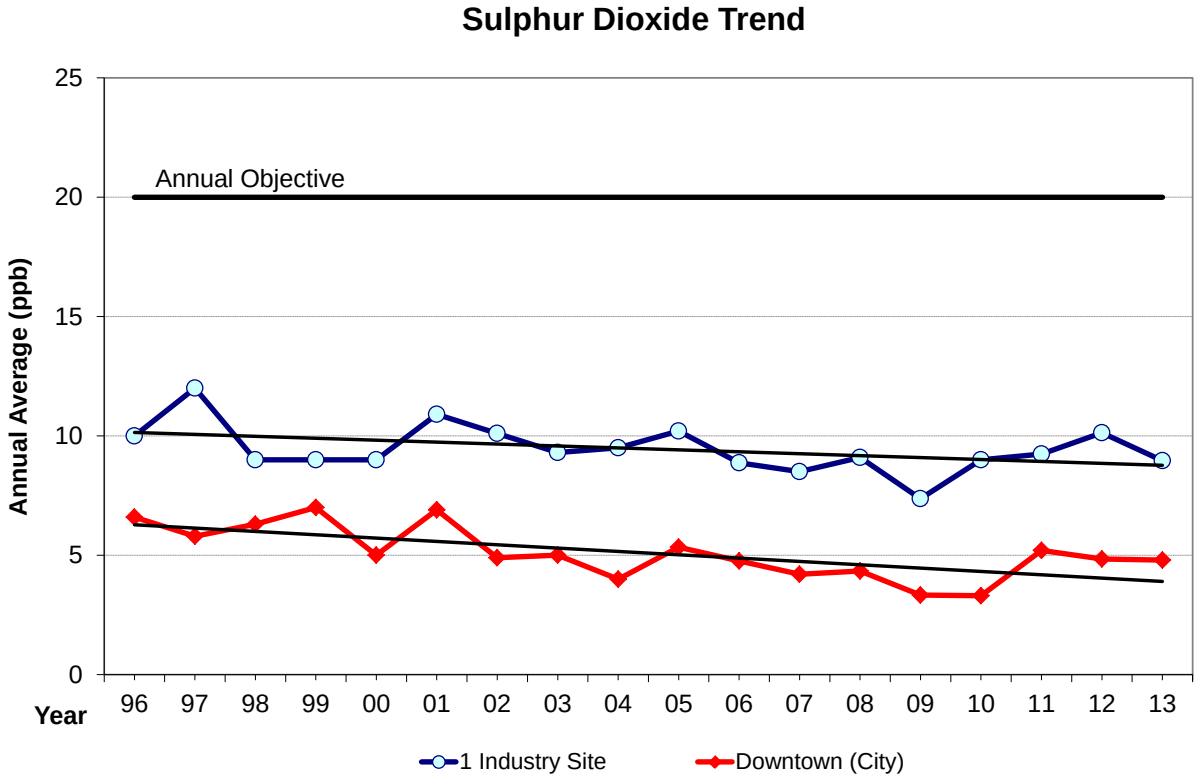
Interestingly, Vancouver, Calgary and Edmonton exceed the Ontario AAQC guideline; however, all of the O_3 measured in Vancouver and Calgary is generated from local emissions sources, not from long-range- transport. The take-home message for southern Ontario is that about one-half of the O_3 in southern Ontario is generated from local sources, i.e., sources over which we have some control. The data used for this figure were provided by Ontario Ministry of Environment.



Sulphur Dioxide (SO_2)

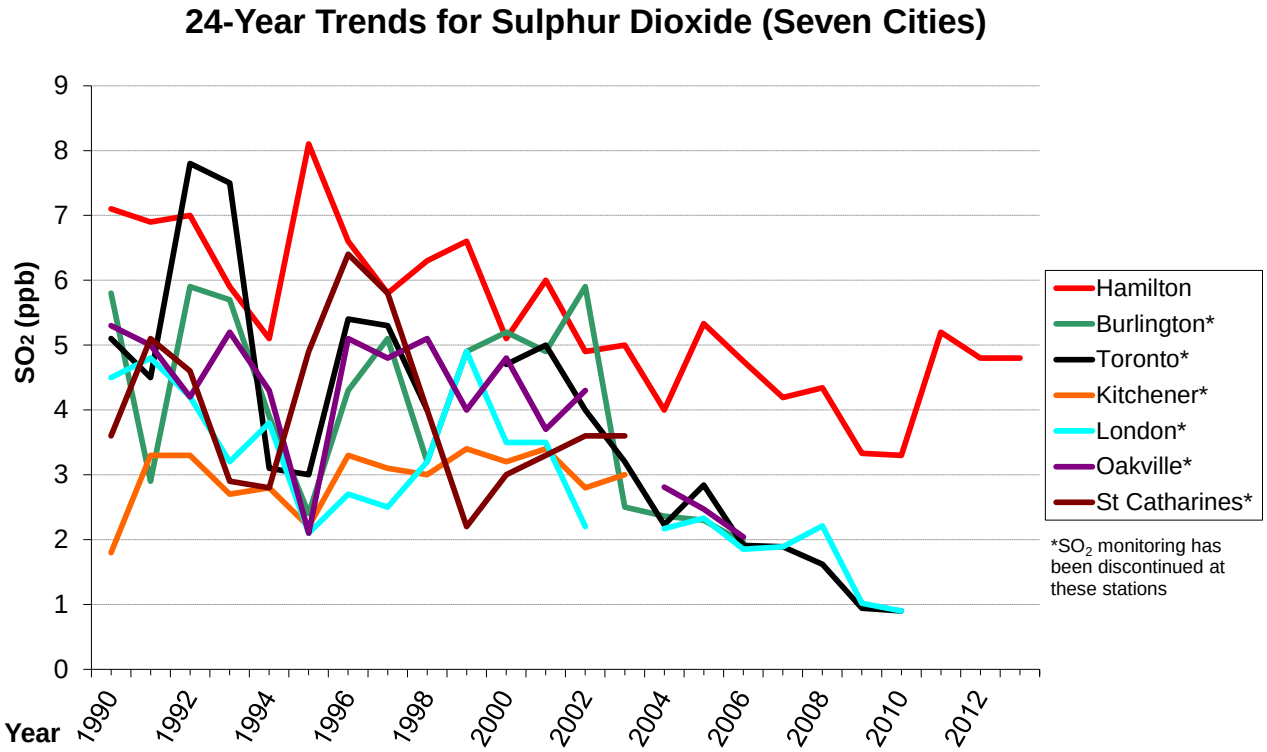
Over 90% of the sulphur dioxide (SO_2) in the air in Hamilton is the product of industrial activities within the City. The only other city in Ontario that has sulphur dioxide issues is Sudbury where nickel sulphide smelting emissions are the primary pollutant. Significant reductions in air levels of 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. However, in the past three years, there have been some increases in the sulphur dioxide levels; *Clean Air Hamilton* would like to see the levels of sulphur dioxide return to the decreasing trend observed previously. Prior to the past three years SO_2 levels had decreased by about 40% in the downtown area and by about 30% in the industrial areas over a 15-year period. These reductions reflect actions taken to reduce SO_2 emissions from the steel industry. Combustion of diesel fuel and home heating oil was a major source of SO_2 in Canada until federal regulations enacted in 2007 reduced the sulphur content in diesel fuel and home heating oil to 15 parts per million (ppm) from average sulphur contents of about 350 ppm prior to 2007.

Sulphur dioxide is not only a respiratory irritant but is converted in the atmosphere over several hours to sulphuric acid (H_2SO_4), which is then converted into sulphate particles. 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 sulphate particulate derived from it. During summer months, about 25% of the mass of $PM_{2.5}$ in the air in southern Ontario is sulphate particulate. Another 25% of the $PM_{2.5}$ mass are nitrate salt particulates.

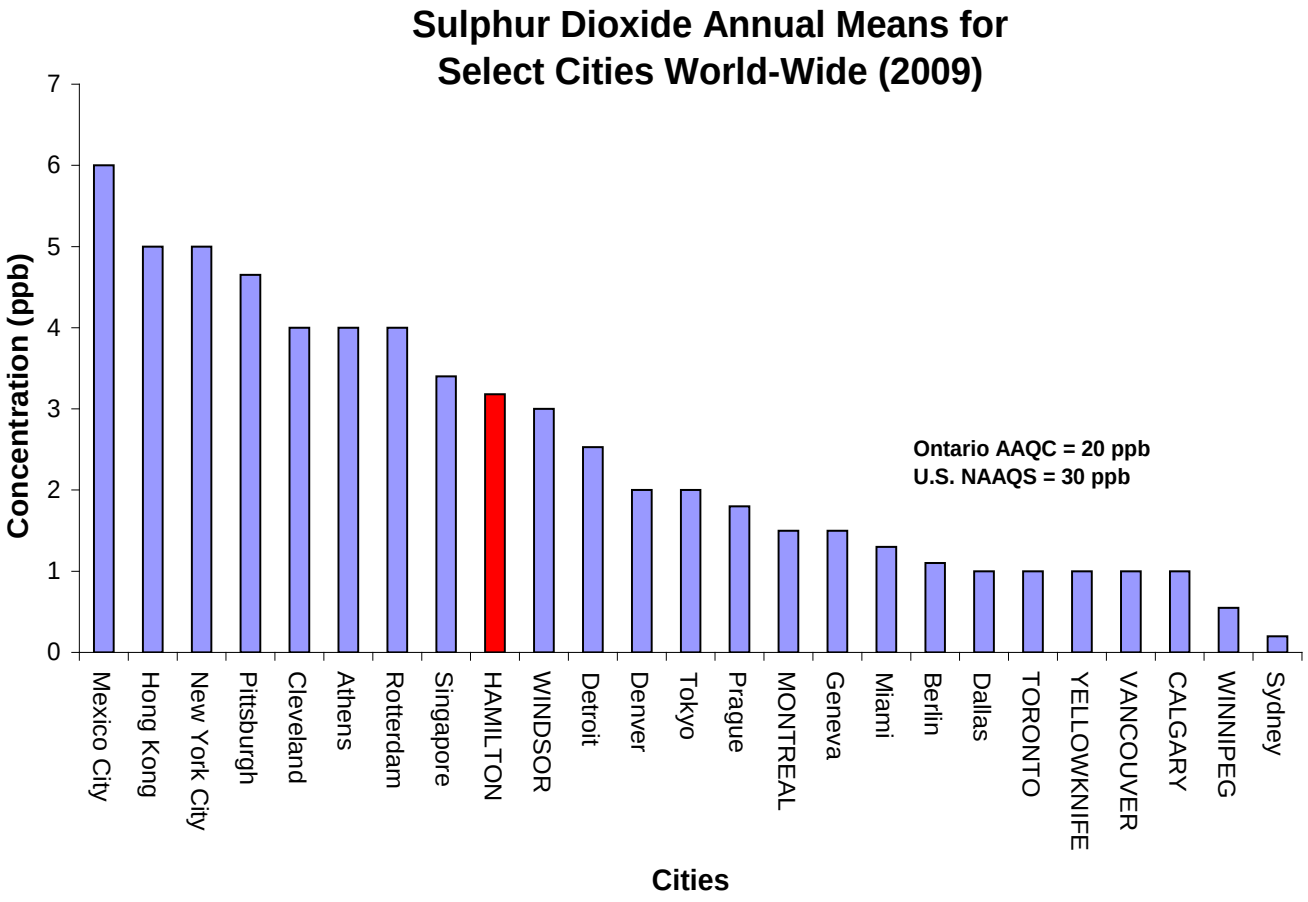


The graph below shows a comparison of the 24-year trends in SO_2 levels in seven southern Ontario cities. There have been dramatic decreases in SO_2 levels across southern Ontario over the past two decades. These reductions reflect the actions to reduce sulphur levels in diesel fuel (since 2007), the 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.



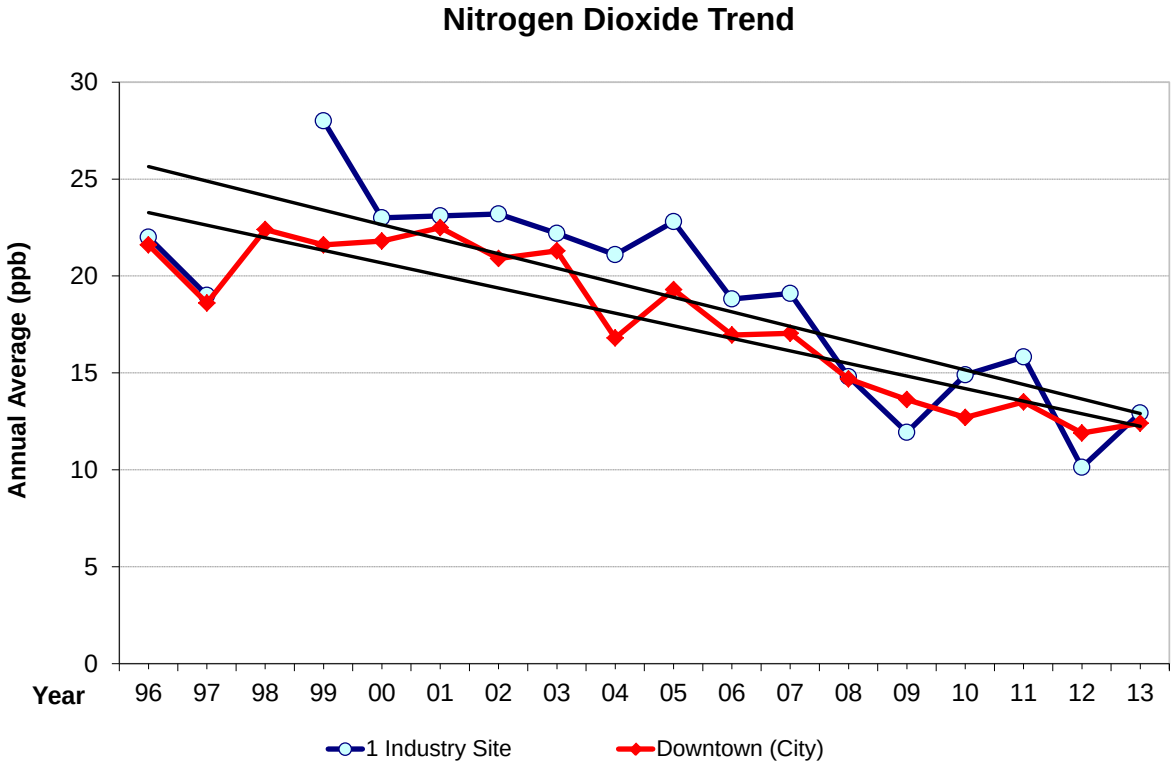
As discussed previously, Hamilton's industrial processes contributed to higher levels of SO_2 in the air. Hamilton recorded the highest annual mean reading of SO_2 in 2009 when compared to the other Canadian cities. Other cities, with a similar industrial base as Hamilton, such as Cleveland, Pittsburgh and Windsor 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 2009 air levels of SO_2, which are well below the 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 25 cities had 2009 annual means of SO_2 that were considerably below Ontario and U.S. SO_2 ambient air standards.


Sulphur Dioxide Annual Means for
Select Cities World-Wide (2009)
Concentration (ppb)
0
1
2
3
4
5
6
7
Ontario AAQC = 20 ppb
U.S. NAAQS = 30 ppb
Mexico City
Hong Kong
New York City
Pittsburgh
Cleveland
Athens
Rotterdam
Singapore
HAMILTON
WINDSOR
Detroit
Denver
Tokyo
Prague
MONTREAL
Geneva
Miami
Berlin
Dallas
TORONTO
YELLOWKNIFE
VANCOUVER
CALGARY
WINNIPEG
Sydney
Cities

Nitrogen Dioxide (NO_2)

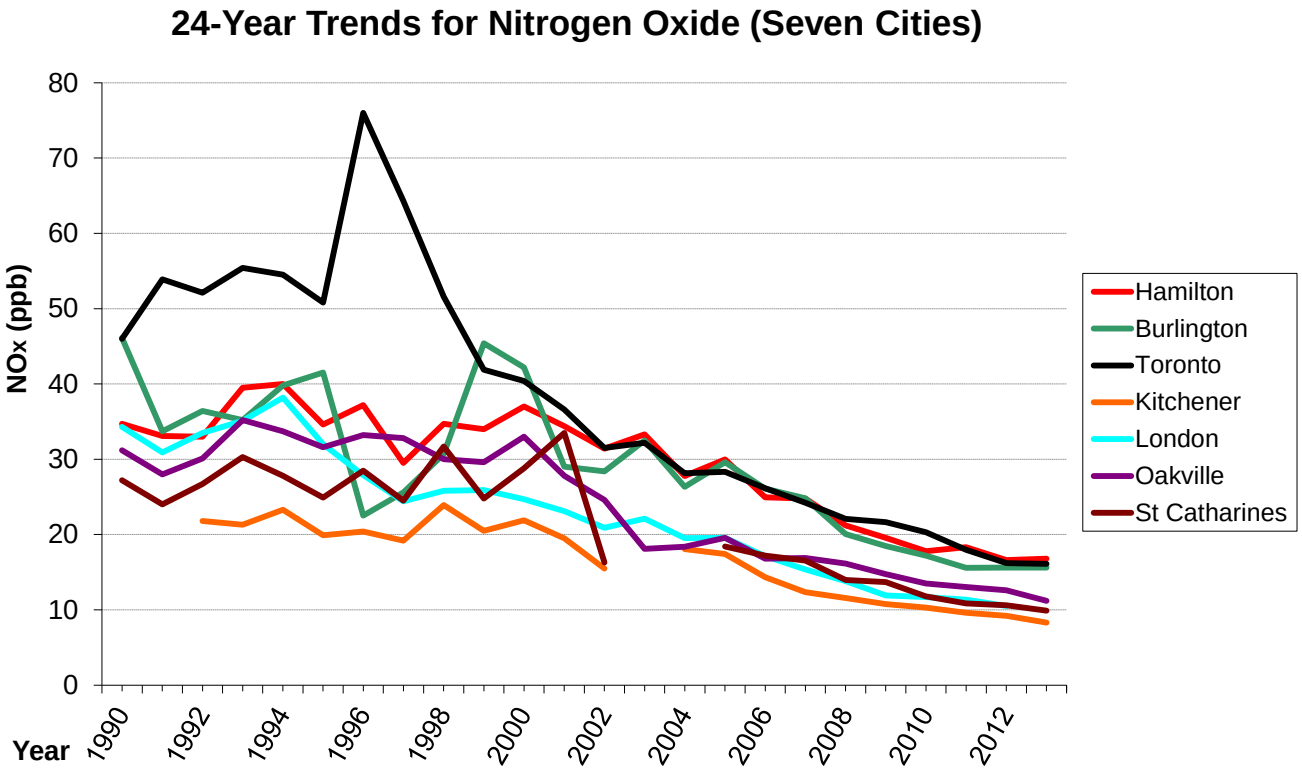
Nitrogen dioxide (NO_2) is responsible for a significant share of the air pollution-related health impacts in Hamilton. NO_2 is formed in the atmosphere from nitric oxide (NO) that is produced during the combustion of fuels such as gasoline, diesel, coal, wood, oil and natural gas. The leading sources 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 (and hence NO_2) from new vehicles continue to decrease due to improved engine technologies. Since NO is the precursor of NO_2, both NO and NO_2 are routinely measured and their sum is reported as NO_x to reflect the presence of both species in urban areas. All of the NO is ultimately converted into NO_2. The NO_2 ultimately reacts with water in the atmosphere to produce nitric and nitrous acids (HNO_3 and HNO_2, respectively); these acids are converted into nitrate salts that constitute about 25% of the mass of fine particulate material or $PM_{2.5}$. The fact that 25% of the $PM_{2.5}$ mass in urban centres is due to nitrate salts is a clear testament to the impacts of auto and diesel exhaust emissions on the atmosphere.

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% over the past ten years. For example, within the City the annual average NO_2 level was 17 parts per billion (ppb) a decade ago; today the annual average is 12 ppb.

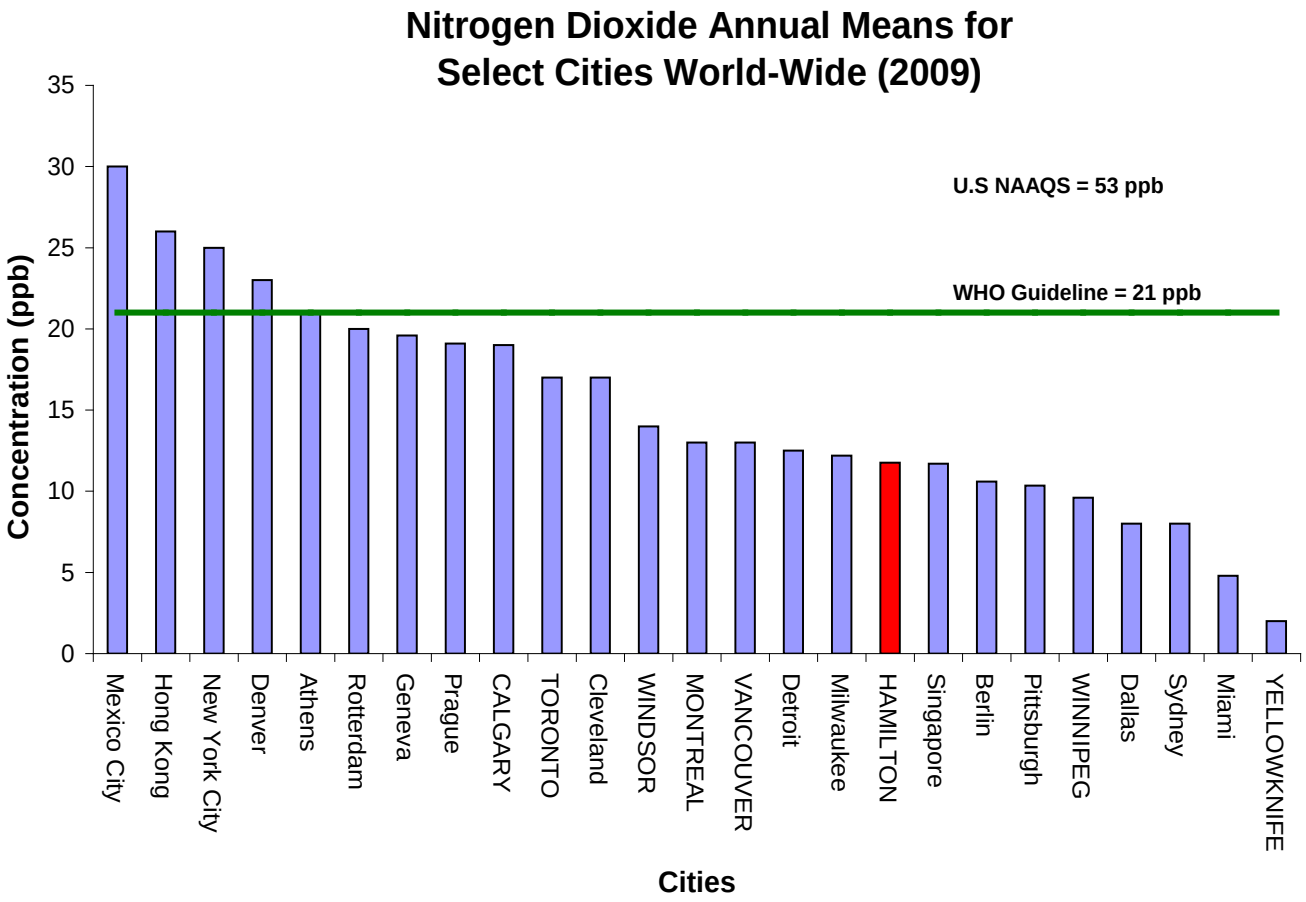


When we compare the 24-year trends in air levels of NO_x in Hamilton to NO_x levels in other Ontario cities, we note that all cities have seen a steadily decreasing trend over the past decade. Toronto, which has no significant industrial NO_x contributors but significant vehicular NO_x emissions, has 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.



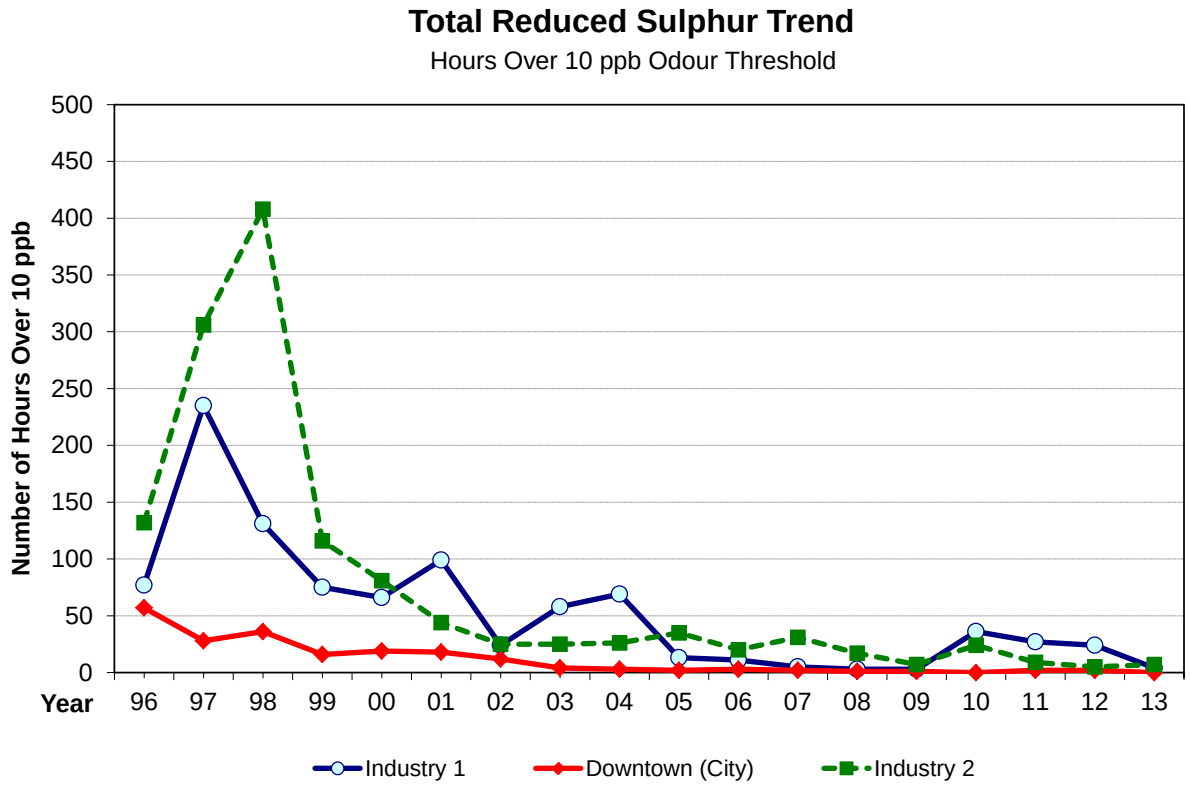
The figure below compares the annual mean levels of NO_2 levels in Hamilton with 25 Canadian and other cities around the world in 2009. Hamilton had the sixth highest NO_2 annual mean reading compared with other Canadian cities. Calgary, Toronto, Windsor, Montreal and Vancouver were the three Canadian 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.


Nitrogen Dioxide Annual Means for
Select Cities World-Wide (2009)
Concentration (ppb)
35
30
25
20
15
10
5
0
U.S NAAQS = 53 ppb
WHO Guideline = 21 ppb
Mexico City
Hong Kong
New York City
Denver
Athens
Rotterdam
Geneva
Prague
CALGARY
TORONTO
Cleveland
WINDSOR
MONTREAL
VANCOUVER
Detroit
Milwaukee
HAMILTON
Singapore
Berlin
Pittsburgh
WINNIPEG
Dallas
Sydney
Miami
YELLOWKNIFE
Cities

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 within 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 (parts per billion) threshold level.

The number of hours per year during which there were exceedences 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, blast furnaces and slag quenching operations. 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 exceedences have been below 10 hours per year in the downtown area over the past 11 years. Between 2010 and 2012at the industrial site that is closest to the slag quenching operation, the number of hours of odour exceedences rose from less than 5 hours to 20-30 hours per year, but has dropped below 5 hours again in 2013.

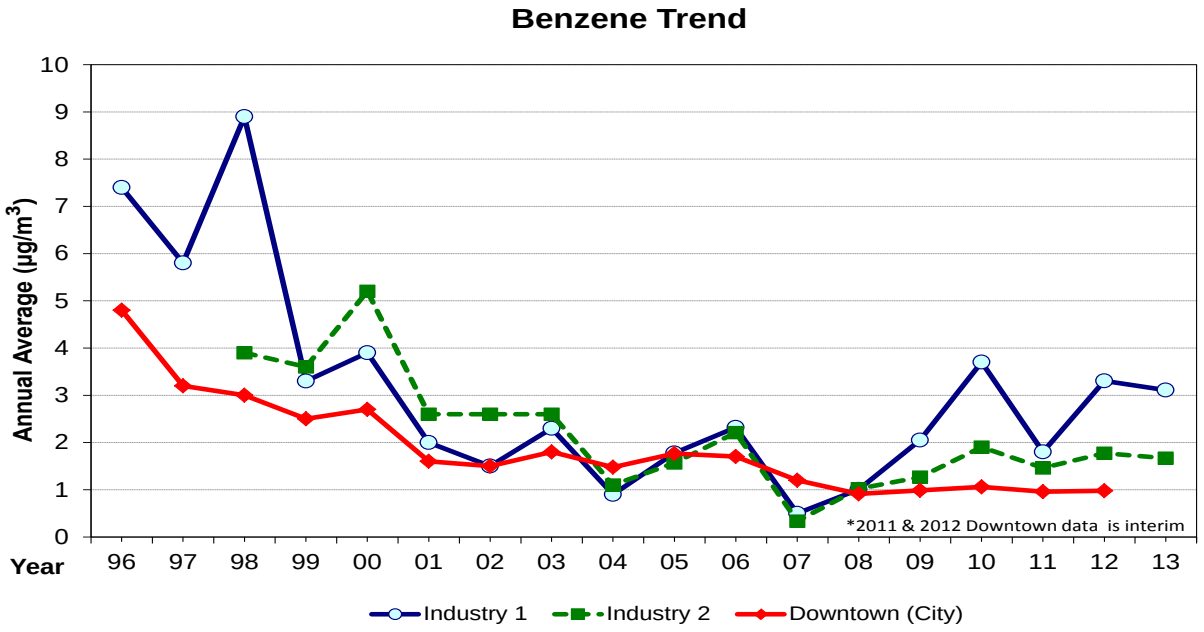


Benzene

Benzene is a volatile organic pollutant that is capable of producing cancers in humans, particularly leukemias. Benzene is emitted from some operations within the steel industry, specifically releases from 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 vapours from the coke by-products plants.

Benzene is also a significant component of gasoline; benzene concentrations in gasoline can be 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 State of California has had a system for many years on all gasoline and diesel pumps at filling stations whereby the displaced vapours from the gas tank during filling are transferred back to the in-ground tank from which the gas or diesel fuel has been pumped. The reductions in volatile organics emissions (including benzene) to the air in California due to this practice are enormous. The levels of benzene in the air at the downtown Hamilton air monitoring site have now dropped to levels comparable to those in other Canadian and Ontario cities of similar size; these other cities do not have coking operations but do have gasoline stations that produce benzene emissions.

Significant reductions in benzene concentrations have been realized. More work remains to be done to improve ambient air quality and reduce industrial emissions. The MOE has set out a new annual average air concentration for benzene of 0.45 µg/m^3 to come into force on July 1, 2016. Current ambient air levels in Hamilton and in other urban areas are above this new standard.



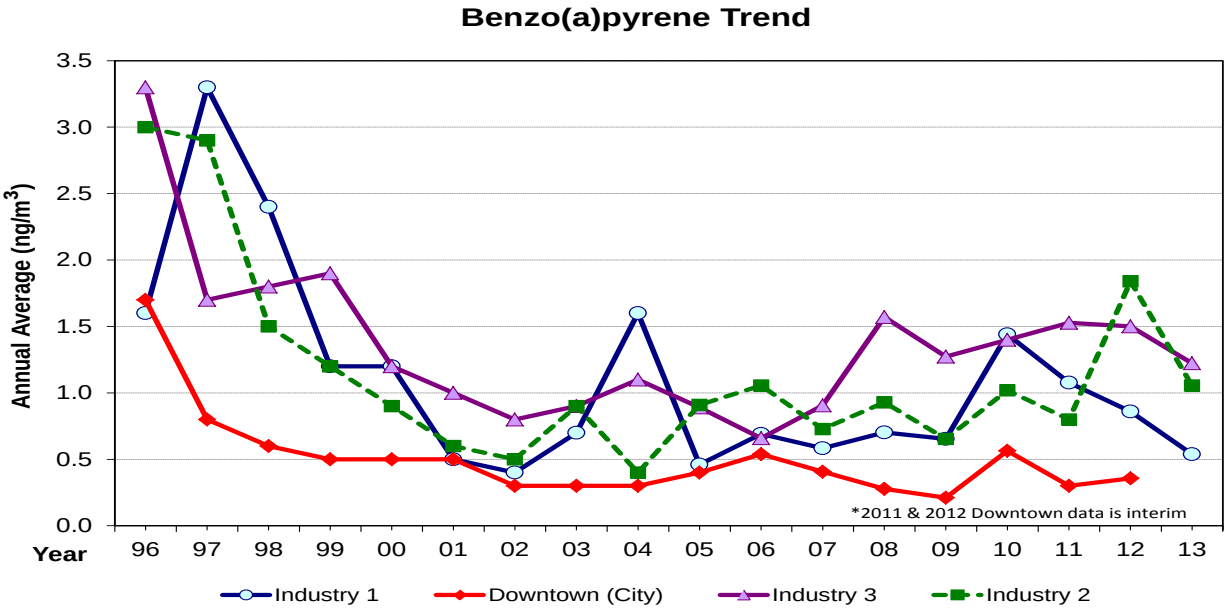
Benzo[a]pyrene

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 the most potent single PAH in the air and the most thoroughly studied of all PAH carcinogens (cancer-causing agents) in the scientific literature. As a result of the extensive amount of chemical analysis, toxicological research and occupational exposure research done with this compound, BaP has become the primary PAH carcinogen by which exposures to many PAH-containing mixtures, such as vehicular emissions, coke oven emissions, barbecued foods, coal tar exposures, etc. are measured.

Increases in BaP levels at the three industrial sites in 2010 and 2011 relative to levels observed at the same sites in 2005 and 2006 was of some concern. In the decade prior to 2005-2007, considerable progress had been made and levels decreased below MOE guideline for BaP of 1.1 ng/m3. In 2012 and 2013 levels appear to have shown a drop in trends.

More work remains to be done to continue to improve ambient air quality and reduce industrial emissions. The new provincial standard established by the MOE- under *O. Reg. 419/05 – Local Air Quality* for benzo(a)pyrene of 0.01 ng/m3 comes into force on July 1, 2016. Reducing benzo (a) pyrene concentrations is a priority for the Ministry. The MOE continues to–work closely with industries across the province and locally to reduce benzo(a)pyrene concentrations in ambient air.



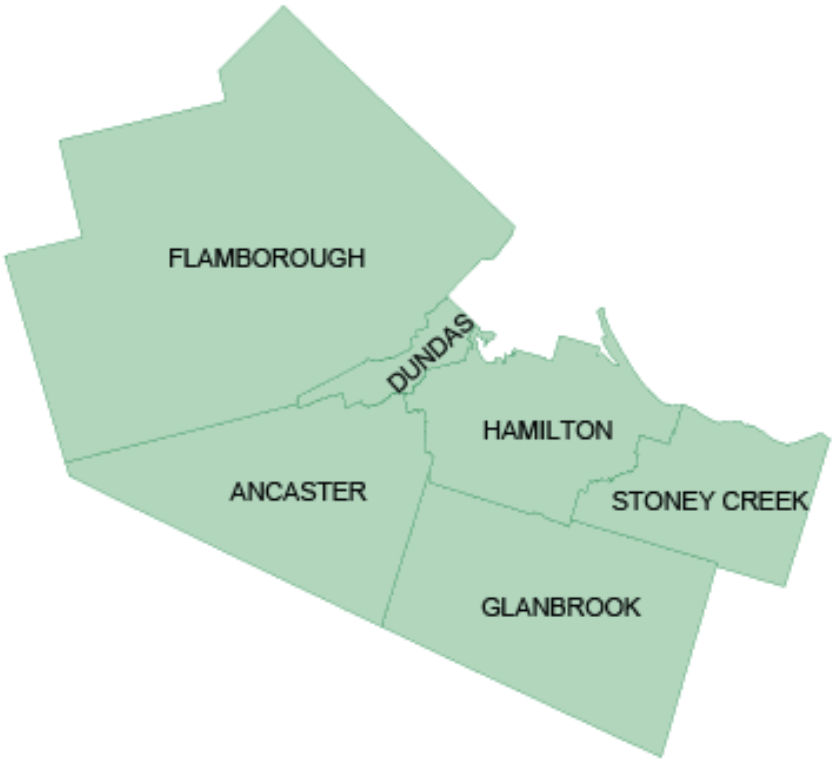
Appendix D – Air Quality Task Force Report, 2013

ACTION PLAN

Report of the Air Quality Task Force (AQTF)

Hamilton Area Airshed

December 2013



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Executive Summary

The Air Quality Task Force (AQTF) working group consisted of members from *Clean Air Hamilton* (CAH) who since 1998 have been working to improve air quality throughout the City of Hamilton. For well over a decade, CAH has provided City Council, City staff and the community with science-based information essential for better decision-making in the promotion and protection of air quality. The AQTF was established as a result of the motion passed on December 3rd, 2012 by the Hamilton Board of Health with the mandate to: "…*investigate and make recommendations to the City on actions that can be taken to reduce air pollution in Hamilton*." This motion was brought forth as a result of local citizen concern about: "…residing in neighbourhoods in close proximity to Hamilton's industrial core as they relate to air quality" (City of Hamilton Public Health Services BOH 12035, 2012).

Therefore, with their collective and extensive knowledge of air quality issues in the City of Hamilton, the AQTF developed a list of 10 recommendations: "*on actions that can be taken to reduce air pollution in Hamilton*" (Appendix A).

The AQTF believes an effective response going forward will include a suite of different actions intended to address the complicated interaction of Hamilton's unique geography, multiple sources of air pollution and the distribution of various land uses and transportation infrastructure within the City of Hamilton.

Further, many of the efforts to date have involved simple actions which have resulted in significant air quality improvements. However, further improvements in air quality may be dependent on more complex strategies required to address the complexity of Hamilton's airshed.

Air quality in the City of Hamilton is influenced by pollution coming into the City from long-range trans-boundary sources, local emissions generated from energy use, industrial releases, emissions from transportation sources and by meteorological conditions and atmospheric processes (CAH, 2013). Therefore, it is important to stress that air pollution issues in the City of Hamilton are complex with multiple sources generated by different contributors impacting local air quality; accordingly measures to reduce air pollution must take into account this complexity.

The AQTF emphasizes the importance of providing City of Hamilton residents with the tools to inform individual actions to reduce personal exposures. In order to be able to provide the public with such information, the AQTF recognizes the important role of air quality modeling as a tool designed to provide the information required to guide individual choices.

There have been numerous studies from all over the world confirming the adverse effects of air pollution on the health of a population (Kunzli and Perez, 2009). Short spikes or peaks in air pollution have been linked to school and work absenteeism, asthma symptoms, hospital admissions and emergency department visits for heart and lung conditions, and premature deaths. Furthermore, increases in heart and lung cancer and reduced life expectancy have been statistically linked to chronic $PM_{2.5}$ exposure (Pope et al., 2002).

In Ontario, it is estimated that short-term and long-term exposure to air pollution contributes to more than 5,800 premature deaths, 16,000 hospital admissions, 60,000 emergency room visits and at least 29 million minor illness days per year (Ontario Medical Association, 2005). In addition, long-term exposure to $PM_{2.5}$ is estimated to contribute to approximately 9,500 premature deaths across Canada (Canadian Medical Association, 2008).

In Hamilton, it is estimated that air pollution contributes to approximately 186 premature deaths, 395 respiratory hospital admissions and 322 cardiovascular hospital admissions each year (SENES, 2012).

Clean Air Hamilton (2013) reports that despite long-term reductions over recent decades, the annual values for pollutants known to be hazardous to human health - PM_{10}, $PM_{2.5}$, SO_2, benzene and benzo[a]pyrene - have all shown modest increases over the past three to four years. Moreover, in Hamilton, mobile air monitoring studies report that higher pollutant exposures were measured along arterial roads, major highways and intersections due to emissions from automobiles, light-duty and heavy-duty trucks (CAH, 2013). Therefore, monitoring has been instrumental in providing helpful information on key air pollutant types and sources in the City of Hamilton.

This report presents and describes components of an action plan that looks to the individual, community, and all levels of government to take steps toward a comprehensive approach to air pollution reduction in the City of Hamilton.

Background

On December 3rd, 2012, the Hamilton Board of Health passed a motion that received and approved the following recommendation: "*That Clean Air Hamilton establishes a working group to investigate and make recommendations to the City on actions that can be taken to reduce air pollution in Hamilton.*" Members of *Clean Air Hamilton* (CAH) were informed of the motion passed by the Board of Health, mandating that CAH form a task force to investigate and bring forward recommendations on actions that can be taken to reduce air pollution in Hamilton.

Air Quality Task Force (AQTF)

Participation on this task force was open to interested members of *Clean Air Hamilton*. The task force Chairperson, a member of *Clean Air Hamilton*, led the group toward satisfying the mandate from the Board of Health. The Air Quality Task Force (AQTF) met on a monthly basis in 2013.

The AQTF consulted with stakeholders in order to develop its recommendations to the Board of Health about what actions should be taken to improve air quality.

The AQTF developed this action plan that contains recommendations in the following areas:

i. Air monitoring and modelling;
ii. Planning;
iii. Education & outreach; and
iv. Municipal action

Vision

Through the collective involvement of citizens, community and government in the City of Hamilton (Figure 1), the AQTF supports: "*actions that can be taken to reduce air pollution in Hamilton"* and that have the potential to result in:

- Improved human health due to decreased exposure to air pollutants
- A sustainable environment which receives fewer and lower emissions and produces less detriment to the local airshed
- A higher quality of life for individuals who live and/or work in the City of Hamilton
- A legacy for future generations that includes a cleaner environment

Airshed Management System

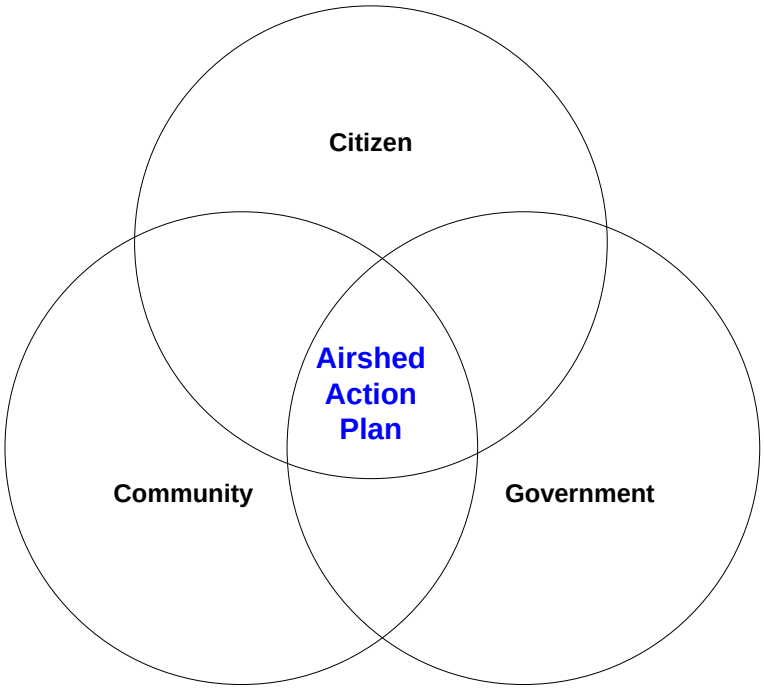
An airshed has been described as: "a defined physical geographical area which is covered by a volume of air that has similar characteristics and into which air pollutants are deposited and often remain for a period of time" (Balsillie, 2010). It is important to note that the area may be made up of many jurisdictions since emissions from one jurisdiction have the potential to impact air quality in other jurisdictions.

It is recognized that multiple emission sources, including those from the transportation, industrial and residential sectors, all contribute to air pollution concerns and will only increase with population growth. In order to address these multiple emission sources, an integrated approach with multi-stakeholder participation is essential.

Stakeholder engagement and involvement with respect to control actions taken in response to evidence-based results, air monitoring and modeling, education and outreach, as well as planning are all critical to improving air quality in the City of Hamilton.

The AQTF brings forward 10 recommendations "*on actions that can be taken to reduce air pollution in Hamilton*" (Appendix A). The 10 recommendations have been organized from one to ten with each recommendation building on the previous one thereby creating an integrated and comprehensive approach to air pollution reduction for the City of Hamilton to apply. Therefore, ordering of recommendations has been done in a systematic manner rather than one of priority.

Figure 1. Collaborative partnership to reduce air pollution in Hamilton



Components of the Action Plan

i) Air Modelling and Monitoring

There are now advanced air quality models available that can be used to determine the contribution of air pollution to the geographical distribution of ambient air concentrations that residents are exposed to right down to a neighbourhood level. Emissions from multiple sources including transportation, industry, agriculture/biogenic emissions, community and residential and long-range sources (i.e. transboundary) can be accounted for in these air quality models. Moreover, existing inventories and data including those from the US EPA, Environment Canada, Ministry of Environment, the Hamilton Air Monitoring Network (HAMN) and Ministry of Transportation will be incorporated into the air quality modelling system.

Air quality modelling is an essential tool since it not only explains current air quality conditions, it can also predict air quality using forecast conditions. Air quality models use data on emission sources and data on atmospheric processes and terrain characteristics to forecast ambient air quality and the contribution of different sectors to local air quality. Therefore, numerous potential future scenarios such as new policy implementation and/or proposed new sources of emissions can be estimated beforehand with the use of air quality modelling to inform effective mitigation strategies. With the use of advanced air quality modelling, the City of Hamilton could gain a better understanding of the contribution of emissions from different sectors and would be able to predict potential impacts of policies pertaining to new development, land use and transportation on air quality. Members of the Hamilton Industrial Environmental Association (HIEA) have already

expressed readiness to invest in an advanced airshed model. The great value of advanced airshed modelling has already been recognized by neighbouring municipalities such as Halton and Peel Region, which have put such systems in place. Therefore, the AQTF brings forward:

RECOMMENDATION 1

Commit to partnerships with interested stakeholders to fund the development of an advanced air model for the City of Hamilton.

Because air modelling is dependent on air monitoring data, the AQTF brings forward:

RECOMMENDATION 2

Strengthen air monitoring activities through additional:

a. Neighbourhood mobile monitoring surveys;
b. Number and location of air monitors;
c. Monitoring strategies and technologies.

ii) Planning

Land-use planning is critical for managing air quality levels in the City of Hamilton. By considering land-use planning early on in the process, future localized air quality issues impacting sensitive land uses can be avoided or minimized. The importance of this early involvement in land-use planning has been recognized and outlined by Halton Region in two draft reports.

The first includes the Draft Air Quality Assessment Guidelines (Appendix B) which provide a framework for the municipal decision-making practice pertaining to sensitive land uses and residential, industrial, transportation and utility development applications in order to uncover the potential for harmful impacts to air quality.

The second includes the Draft Land Use Compatibility Guidelines (Appendix C) which are set out to protect and improve the health and quality of life of people within the area by endorsing the implementation of Regional Official Plan Amendment 38 (ROPA 38) policies on land use compatibility. This policy aims to minimize the negative impacts of air pollution from industrial, transportation and utility sources on sensitive land uses. Therefore, guidance is offered to developers with respect to land use compatibility issues via the planning and development approval process such that appropriate development is advanced and factors such as intensification, mixed use communities, and transit supportive urban form are taken into consideration.

Therefore, the AQTF brings forward:

RECOMMENDATION 3

Develop appropriate air quality related guidelines for new and redeveloping neighbourhood land use planning. These guidelines should consider the potential impacts of personal transportation, arterial roads, 400 series highways and site specific and technical standards for industrial emissions.

In addition, the US EPA (2013) reports that vegetation can reduce ground level ozone by reducing air temperatures, reducing power plant emissions associated with air conditioning, and removing air pollutants. It is noted that green infrastructure features can reduce particulate matter by absorbing and filtering it. Moreover, a study on the benefits of green infrastructure conducted in the City of Philadelphia has found green infrastructure has the potential to reduce ozone and particulate pollution levels significantly enough to reduce mortality, hospital admissions, and work loss days (Stratus Consulting Inc., 2009). Not only do green roofs reduce air pollution but they also reduce urban heat-island impact, control storm water runoff and lower energy consumption (City of Hamilton, 2011). The City of Toronto has recognized the importance of green roofs and street shading by implementing supportive bylaws. Therefore, the AQTF brings forward:

RECOMMENDATION 4

Promote green infrastructure (i.e. green roofs, street shading) to be supported by citizens, organizations and government.

iii) Education & Outreach

Air quality data must be shared with key stakeholders, including community members and government, effectively such that knowledge and awareness of air quality conditions in the City of Hamilton can be increased and collective air pollution reduction and risk management strategies can be undertaken. Paying careful attention to the manner in which environmental health information is presented will allow citizens to incorporate important information into their health decision-making processes (Peters, Hibbard, Slovic, Dieckmann, 2007).

Therefore, the AQTF brings forward:

RECOMMENDATION 5

Provide individuals with tools to minimize their personal exposure. These tools should include a real-time map of air quality conditions in the City of Hamilton to encourage alternative modes of transportation such that citizens have the opportunity to select

pedestrian and cycling routes which would minimize their personal exposure to air pollution.

Since previous engagement with local business operators about fugitive dusts and environmental impacts has fostered air pollution reduction measures (CAH, 2010), the AQTF brings forward:

RECOMMENDATION 6

Develop and conduct particulate matter control workshops in partnership with the Ontario Ministry of the Environment for local businesses and industries.

Because health decision-making processes in adulthood are shaped by early life course experiences (Umberson, Crosnoe, Reczek, 2010), the AQTF brings forward:

RECOMMENDATION 7

Expand the Air Quality Outreach Program within Hamilton schools such that air quality curriculum (i.e., benefits of anti-idling, active transportation commuting routes, etc.) is promoted.

In view of the fact that community-based environmental monitoring empowers community members with respect to influencing air quality and striving for change (Ottinger, 2010), the AQTF brings forward:

RECOMMENDATION 8

Promote programs that encourage community-based environmental monitoring and engagement within the City of Hamilton.

iv) Municipal Actions

As noted earlier in the report, $PM_{2.5}$ levels have shown modest increases over the past three to four years in Hamilton (CAH, 2013). Research has found that fine particulate matter is harmful to human health (Pope et al., 2002). This increase in $PM_{2.5}$ suggests that further opportunities for improvement are needed. Recognizing that $PM_{2.5}$ comes from many different sources, the AQTF brings forward:

RECOMMENDATION 9

Support the revision, updating and enforcement of existing bylaws to minimize the generation and dispersion of airborne particulate matter.

Given that street washing has been identified as an effective strategy to mitigate curb side particulate matter (Amato et. al., 2009). The AQTF brings forward:

RECOMMEDATION 10

Implement strategies to improve street cleaning by taking into account factors such as cleaning schedules and equipment effectiveness.

Conclusion

Although there has been a downward trend in pollutant levels since the mid-1990s, recent (3-4 year) increases in PM_{10}, $PM_{2.5}$, SO_2, benzene and benzo[a]pyrene are of concern and require direct attention. The AQTF was mandated to investigate and bring forward recommendations on actions that can be taken to reduce air pollution in Hamilton. Since multiple emission sources including those from the transportation, industrial and residential sectors contribute to air pollution in Hamilton, an integrated approach with citizens, community and government is essential. After consulting with stakeholders, the AQTF has brought forward 10 recommendations in this action plan to reduce air pollution in Hamilton. These 10 recommendations - built upon air monitoring and modelling, planning, education and outreach, green infrastructure and municipal action - are expected to work synergistically to achieve air pollution reductions in the City of Hamilton. Careful consideration of each recommendation in ascending order is necessary to understand the benefits of an integrated and comprehensive action plan to address air pollution in the City of Hamilton.

Appendix A AQTF Recommendations

Component	Recommendation #	Description	Preliminary Cost Estimates ($)	Timeframe
Air Monitoring and Modelling	**1**	**Commit to partnerships with interested stakeholders to fund the development of an advanced air model for the City of Hamilton.**	**250 000/3**	**over 2 year period**
	2	**Strengthen air monitoring activities through additional: a. neighbourhood mobile monitoring surveys; b. number and location of air monitors; c. monitoring stations and technologies.**	**100 000**	**1 year**
Planning	**3**	**Develop appropriate air quality related guidelines for new and redeveloping neighbourhood land use planning. These guidelines should consider the potential impacts of personal transportation, arterial roads, 400 series highways and site specific and technical standards for industrial emissions.**	**50 000**	**1 year**

	4	**Promote green infrastructure (i.e. green roofs, street shading) to be supported by citizens, organizations and government.**		
Education & Outreach	**5**	**Provide individuals with tools to minimize their personal exposure. These tools should include a real-time map of air quality conditions in the City of Hamilton to encourage alternative modes of transportation such that citizens have the opportunity to select pedestrian and cycling routes which would minimize their personal exposure to air pollution.**	**10 000 15 000**	**1st year every year after**
	6	**Develop and conduct particulate matter control workshops in partnership with the Ontario Ministry of the Environment for local businesses and industries.**	**8 000**	
	7	**Expand the Air Quality Outreach Program within Hamilton schools such that air quality curriculum (i.e. benefits of anti-idling, active transportation commuting routes) is promoted.**	**12 000**	

	8	**Promote programs that encourage community-based environmental monitoring and engagement within the City of Hamilton.**	**20 000**	
Municipal Action	**9**	**Support the revision, updating and enforcement of existing bylaws to minimize the generation and dispersion of airborne particulate matter.**		
	10	**Implement strategies to improve street cleaning by taking into account factors such as cleaning schedules and equipment effectiveness.**	**20 000 - 66000**	**1 year**
TOTAL				

Appendix B Draft Air Quality Assessment Guidelines

Retrieved from:
www.halton.ca/common/pages/UserFile.aspx?fileId=94341

Appendix C Draft Land Use Compatibility Guidelines

Retrieved from:
http://www.halton.ca/common/pages/UserFile.aspx?fileId=94338

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Appendix E – List of Applicable policies from Provincial Policy Statement (2014)

1.1 Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns

1.1.1 Healthy, liveable and safe communities are sustained by:

c) avoiding development and land use patterns which may cause environmental or public health and safety concerns;

h) promoting development and land use patterns that conserve biodiversity and consider the impacts of a changing climate.

1.1.3 Settlement Areas

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

a) densities and a mix of land uses which:

3. minimize negative impacts to air quality and climate change, and promote energy efficiency;

1.1.4 Rural Areas in Municipalities

1.1.4.1 Healthy, integrated and viable *rural areas* should be supported by:

h) conserving biodiversity and considering the ecological benefits provided by nature;

1.5 Public Spaces, Recreation, Parks, Trails and Open Space

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, foster social interaction and facilitate *active transportation* and community connectivity;

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

c) providing opportunities for public access to shorelines; and

d) recognizing provincial parks, conservation reserves, and other protected areas, and minimizing negative impacts on these areas.

1.6 Infrastructure and Public Service Facilities

1.6.2 Planning authorities should promote *green infrastructure* to complement *infrastructure.*

1.6.6 Sewage, Water and Stormwater

1.6.6.7 Planning for stormwater management shall:

a) minimize, or, where possible, prevent increases in contaminant loads;

b) minimize changes in water balance and erosion;

c) not increase risks to human health and safety and property damage;

d) maximize the extent and function of vegetative and pervious surfaces; and,

e) promote stormwater management best practices, including stormwater attenuation and re-use, and low impact development.

1.7 Long-Term Economic Prosperity

1.7.1 Long-term economic prosperity should be supported by:

j) minimizing negative impacts from a changing climate and considering the ecological benefits provided by nature;

1.8 Energy Conservation, Air Quality and Climate Change

1.8.1 Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and climate change adaptation through land use and development patterns which:

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

b) promote the use of *active transportation* and transit in and between residential, employment (including commercial and industrial) and institutional uses and other areas;

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

d) focus freight-intensive land uses to areas well served by major highways, *airports*, *rail facilities* and *marine facilities*;

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

f) promote design and orientation which:
   1. maximizes energy efficiency and conservation, and considers the mitigating effects of vegetation; and
   2. maximizes opportunities for the use of *renewable energy systems* and *alternative energy systems*; and

g) maximize vegetation within *settlement areas*, where feasible.

3.0 Protecting Public Health and Safety

3.1.3 Planning authorities shall consider the potential impacts of climate change that may increase the risk associated with natural hazards.

Appendix F - List of Applicable Policies in the Urban Hamilton Official Plan (March 2014 consolidation)

B.3.6 Health and Public Safety Policies

B.3.6.2 Air Quality and Climate Change

Air quality and climate change have significant direct and indirect impacts on community health, the environment, and the economy of Hamilton. Local sources of air pollutants that can compromise clean air include personal and commercial vehicles, industry, and energy sources used for heating and cooling.

Climate change can be caused by natural processes and human activities. Increased fossil fuel use and permanent forest loss has increased the concentrations of greenhouse gases, leading to accelerated changes in our climate. A high concentration of heavy industries and transportation corridors are contributing local sources of greenhouse gases in the City.

Addressing climate change requires two complementary actions: mitigation (i.e. reduction) and adaptation. Mitigation involves actions to reduce greenhouse gases or actions to avoid or delay climate change. Adaptation involves actions or planning to minimize a city's vulnerabilities to the impacts of climate change.

Several goals and policies of this Plan, both directly and indirectly contribute to the improvement of air quality and reduce greenhouse gases:

a) promoting compact, mixed use urban communities;

b) integrating the transportation network to include all modes of transportation;

c) promoting walking, cycling, and use of public transit;

d) achieving a natural heritage ecosystem through the protection and enhancement of natural heritage features and functions;

e) implementing urban design features to reduce fugitive dust;

f) enhancing vegetative cover; and,

g) reducing the heat island effect through the use of reflective roofs, green roofs, natural landscaping, and increasing the tree canopy.

Many of these goals and policies also contribute to the adaptation to climate change by minimizing vulnerabilities to climate impacts. Prohibiting new *development* on *hazard lands*, and incorporating urban design features that reduce climate impacts on public works and urban infrastructure - roads and

associated infrastructure, bridges, water and waste water systems, and energy distribution, are climate change adaptation strategies.

Partnerships

B.3.6.2.1 The City shall partner with community groups, such as Clean Air Hamilton, to develop actions to reduce air pollutants and improve air quality.

B.3.6.2.2 The City shall partner and work with other levels of governments, other municipalities, academics, community groups, and local industries to develop:

a) actions that reduce air pollutants and greenhouse gases, improve air quality, reduce and respond to the impacts of climate change in the City; and,

b) a Hamilton Air Quality and Climate Change Plan.

B.3.6.2.3 The City shall promote and support public and private education and awareness of air quality and climate change, associated health impacts, and linkages to transportation and land use *development* in the City.

Monitoring

B.3.6.2.4 The City shall undertake an air pollutant and greenhouse gas emissions inventory and assess the conditions of Hamilton's local air quality and climate to inform actions to reduce emissions of air pollutants and greenhouse gases generated in the City.

B.3.6.2.5 The City may partner with other organizations to monitor, track, and assess the conditions of Hamilton's local air quality and climate to identify local emission sources and take action to reduce air pollutant and greenhouse gas emissions at these sources.

B.3.6.2.6 The City shall monitor and reduce air pollutants and greenhouse gases generated by the City's corporate activities and services to achieve the targets set out in the Corporate Air Quality and Climate Change Strategic Plan.

B.3.6.2.7 The City shall prepare an annual Air Quality and Climate Change report to monitor the City's progress toward its goals and to increase awareness of air quality and climate change.

B.3.7 Energy and Environmental Design

Complete communities require a mix of land uses including housing, uses which provide goods and services, and a range of transportation modes including public transit, all of which depend on energy. Energy efficiency, environmental design, and increasing the supply of energy through *renewable energy systems* and *alternative energy systems*, benefits human and environmental health, protects the global climate, and reduces the

demand for energy resources and the infrastructure needed for its production and distribution.

B.3.7.2 The City shall support energy efficient and environmental designed *development* through:

e) designs which minimize building heat loss and capture or retain solar heat energy in winter, and minimize solar heat penetration in summer. Consideration shall be given to such measures as green roofs or reflective roofs, discouraging excessive surface parking, allowing direct access to sunlight, and effective landscaping;

f) building or structure orientations that maximize solar or wind energy;

g) designs that encourage sustainable forms of transportation, including *active transportation*, transit, and energy conserving vehicles;

j) water and storm water conservation/management practices such as green roofs, water recycling systems, urban storm water swales, etc.;

B.3.3 Urban Design Policies

B.3.3.2.8 Urban design should promote environmental sustainability by:

a) achieving compact *development* and resulting built forms;

b) integrating, protecting, and enhancing environmental features and landscapes, including existing topography, forest and vegetative cover, green spaces and corridors through building and site design;

c) encouraging on-site storm water management and infiltration through the use of techniques and technologies, including storm water management ponds, green roofs, and vegetated swales;

d) encouraging the use of Leadership in Energy and Environmental Design (LEED) or other environmental building rating tools for buildings and infrastructure for all *development* and *redevelopment*;

e) encouraging the reduction of resource consumption in building and site development and avoiding the release of contaminants into the environment; and,

f) encouraging energy efficiency in neighbourhood design and *development* as set out in Section B.3.7.1.

B.3.3.2.10 Streets shall be designed not only as a transportation network but also as important public spaces and shall include, where appropriate:

c) landscaping such as street trees and landscaped boulevards;

B.3.3.10 Parking

B.3.3.10.8 Parking lots shall be paved with hard surfaces to reduce dust and promote improved air quality. The use of permeable pavement systems or other low impact development practices is encouraged for storm water management, when technically possible.

C.5.4 Storm Water Management Facilities

The City shall ensure that appropriate storm water management facilities are built and maintained to provide a safe and secure system for storm water.

C.5.4.2 Any new *development* that occurs shall be responsible for submitting a detailed storm water management plan prior to *development* to properly address on site drainage and to ensure that new *development* has no negative impact on off
site drainage.

C.5.4.6 The City shall not permit any new development which would interfere with, or reduce, the drainage capacity of any natural watercourse or result in drainage problems along watercourses and their tributaries.

C.5.4.7 The City shall encourage the use of measures that will enable the City to control and reduce storm water run-off and to maintain the receiving watercourses in a more natural condition.

C.5.4.8 Where feasible, storm water management facilities shall be designed to provide a benefit to the Natural Heritage System.

C.5.4.9 All land designated on Schedule E-1 – Urban Land Use Designations shall meet the following conditions:

a) *development* and/or *redevelopment* shall be connected to, or serviced by, a storm water drainage system or other appropriate system such as ditches, or any other techniques acceptable to the City, Conservation Authorities, or the Province and/or detailed in a Storm Water Master Plan or other relevant study;

b) *development* shall be in accordance with the system capacity for drainage and storm water management and where relevant, will conform to stormwater site management plans, a Storm Water Master Plan, site plans and/to other relevant studies, guidelines or regulations; and,

c) storm water systems shall be designed and constructed, in accordance with the City' standards and guidelines, provincial guidelines, storm water master plans, master drainage plans and any other relevant study or legislation.

C.5.4.10 The City shall endeavour to recover the full lifecycle cost of providing sustainable municipal storm water services as required by applicable municipal and provincial legislation.

F.3.0 Other Implementation Tools

F.3.4.4 Natural Heritage System Monitoring and Performance

Targets for Natural Cover

F.3.4.4.5 It is a City objective is to expand and reinforce the existing natural heritage system in the long term by encouraging and undertaking ecological restoration towards locally established targets.

F.3.4.4.6 The City-wide targets for Hamilton, shown in Table F.3.4.1 - Habitat Restoration Targets, are based on Environment Canada's (2004) report, "A Framework for Guiding Habitat Restoration in Great Lakes Areas of Concern".

F.3.4.4.7 The City shall develop a Natural Heritage System Restoration Strategy to identify implementation activities intended to achieve the desired natural heritage system.

F.3.4.4.8 The City shall monitor the foregoing policies for progress in achieving the following City-wide and general targets for the purposes of reviewing the Official Plan pursuant to the Planning Act.

Table F.3.4.1: City-Wide Habitat Restoration Targets

Natural Cover Type	Existing Percentage Cover	City-Wide Target Percentage
Forest Cover	17.7%	30%
Interior Forest Cover (100 metres inside from edge)	4.2%	10%
Interior Forest Cover (200 metres inside from edge)	1.4%	5%
Riparian Vegetation greater than 30 metres wide	34.7%	75% stream length should be naturally vegetated
Wetland Cover	8.3%	10%

F.3.4.5 Targets for Air Quality

F.3.4.5.1 The City's objective is to increase the number of good air quality days, where the Province's Air Quality Index (AQI) is less than 30, over the lifetime of this Plan, by encouraging and undertaking actions to reduce greenhouse gas emissions towards the following locally established targets.

Table F.3.4.2: City Air Pollutants and Greenhouse Gas Emission Targets

2012	2020
10% reduction of 2005 emission levels	20% reduction of 2005 emission levels

Appendix G: Upwind Downwind Conference 2014

Executive Summary

The 2014 Upwind Downwind Conference was held in Hamilton, Ontario on Monday, February 24th 2014 at the Sheraton hotel in downtown Hamilton. The Conference recognizes Hamilton as a leader in air, transboundary and climate initiatives, with elements focusing on health, transportation and the built form. The Conference is hosted every two years by the City of Hamilton and *Clean Air Hamilton*. The Conference generates many ideas and is an excellent opportunity for Hamilton and other communities to share practical solutions for air quality, transboundary and climate problems in the fields of health, planning, municipal action and partnerships. Approximately 166 health promoters, planners, university/college students, environmental consultants, industry, municipal, provincial and federal staff, retirees and citizens participated in the one-day 2014 Conference. This resulted in a nice balance and mixture between the ages and experiences of the participants at the conference from young professionals and students to retirees and senior professionals.

A free afternoon talk was also a feature of the 2014 Upwind Downwind Conference. On February 23rd, 2014 a free talk by Yale University professor and author Dr. Stephen Kellert was held at the Art Gallery of Hamilton. The focus of the talk was on the concept of “biophilia”- the inherent need to connect to and benefit from nature. The free public talk attracted 140 individuals.

Introduction

The 2014 Upwind Downwind Conference: Built Environment – Foundation for Cleaner Air was the eighth biennial conference focusing on practical solutions to the air quality, transboundary air and climate change issues and impacts facing urban regions. The one-day Conference aimed to provide a forum to enable an improved understanding of these issues in relation to the built environment, climate change and air quality policy.

Background Information

In the mid-1990s *Clean Air Hamilton* (formerly known as Hamilton Air Quality Initiative or HAQI) studied the sources and impacts of air pollution in the Hamilton area and found that as much as 70% of the airborne particulates come from sources outside the community. The Conference is a key strategy of *Clean Air Hamilton* and is designed to promote continued awareness of air quality issues and to address new matters that relate to transboundary air pollution and climate change.

The first Upwind Downwind Conference: *A Practical Conference on Improving Air Quality* was hosted in Hamilton during September 1999 by the former Region of Hamilton-Wentworth. The meeting was followed by a HAQI health assessment replica in Toronto and the establishment of a community network, known as the Southern Ontario Clean Airshed Network Initiative (SOCANI) that exchanges information via workshops, electronic mail, and website links.

In 2002, the City of Hamilton and *Clean Air Hamilton* hosted the second biennial Upwind Downwind Conference: *A Practical Conference on Improving Air Quality* on February 25th and 26th, 2002, at the Hamilton Sheraton Hotel.

In 2004, the City of Hamilton and *Clean Air Hamilton* hosted the third biennial Upwind Downwind Conference: *A Practical Conference on Improving Air Quality* on March 29th and 30th, 2004, at the Hamilton Convention Centre. The Conference brought together 115 delegates, many of them environmental managers, planners, non-profit project managers, citizens from across Southern Ontario, and from the United States.

In 2006, the City of Hamilton, *Clean Air Hamilton* and the McMaster Institute of Environment and Health hosted the fourth biennial Upwind Downwind Conference: *Cities, Air and Health* on February 27th and 28th, 2006, at the Hamilton Convention Centre. The Conference brought together 132 delegates, many of them environmental managers, planners, non-profit project managers, citizens from across Ontario, and from the United States.

In 2008, the City of Hamilton and *Clean Air Hamilton* hosted the fifth biennial Upwind Downwind Conference: *Climate Change & Healthy Cities* on February 25th and 26th, 2008, at the Hamilton Convention Centre. The Conference brought together 288 delegates, many of them environmental managers, planners, non-profit project managers, citizens from across Ontario, and from the United States. In addition, the Conference held its first Clean Air Fair that featured 39 exhibitors in 46 spaces. The Clean Air Fair was an addition to the 2008 Conference in order to attract the general public to the event and to showcase partners, solutions and products that address air quality and climate change.

In 2010, the City of Hamilton and *Clean Air Hamilton* hosted the sixth biennial Upwind Downwind Conference: Air Knows No Boundaries on Monday, February 22nd 2010 at the Hamilton Convention Centre. The Conference brought together 243 delegates, many of them environmental managers, planners, non-profit project managers, high school and university/college students citizens from across Ontario. In addition, the Conference held a two-day Hamilton Green Solutions Marketplace on Sunday, February 21st and Monday, February 22nd 2010 at the Hamilton Convention Centre. 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. The Marketplace attracted 745 individuals.

In 2012, the City of Hamilton and *Clean Air Hamilton* hosted the seventh biennial Upwind Downwind Conference: Unlikely Partnerships on Monday February 27th, 2012 at the Sheraton hotel. The Conference focused on unlikely partners and provided a forum to enable an improved understanding of partnerships in relation to air quality policy and creating partnerships and understanding amongst groups. Approximately 148 planners, health promoters, industry representatives, university/college students, environmental consultants, and citizens participated in the 2012 Conference. A free afternoon talk was also a featured of the 2012 Conference. On Sunday, February 26th, 2012 a free talk by author Jay Walljasper was held at the Art Gallery of Hamilton. The focus of the talk was on the concept of “the commons”. The free public talk attracted 75 individuals.

Conference Goals

The goal of a biennial conference is to build on the momentum and strong networks initiated by previous conferences, in order to facilitate continuous discussion and improvements on clean air issues. The 20142 Upwind Downwind Conference aimed to provide an information-sharing forum to enable an improved understanding of air quality and climate change issues and impacts to cities, human health and the economy.

To achieve these goals, the theme of the one-day 2014 Conference was ”Built Environment” to focus on the built environment and its role in shaping and influencing healthy communities, transportation, improved air quality, climate change and changes in policy and action. The speakers for the Conference are listed in **Table 1**.

Table 1: 2014 Upwind Downwind Conference Speakers

Built Form, Health, Transportation, Community
• Dr Karen Lee – Integrating Health, Land Use Planning and Transportation • Mike Lyndon - How Tactical Urbanism is Changing the North American City
Air Quality Management & Planning with Climate Change and Sustainability
• Dr. Paolo Zannetti – A Cost-Benefit Optimization Approach to Air Quality Management • *Municipal Panel:* • Stev Andis – Integrating Climate Change Adaptation into Ajax’s Official Plan • Tony Iacobelli – Measuring Sustainability Performance of New Development in Brampton, Richmond Hill and Vaughn. • Michelle Dobbie – Implementing Green Development Standards, Richmond Hill’s Experiences • Brian Kelly – Community Climate Adaptation Planning – Durham Region’s Emergent Approach
Transportation & Complete Streets
• Norma Moores – Welcome and Workshop Agenda • Peter Topalovic – Complete Streets: From Policy to Implementation • Steve Molloy – Step Forward: Pedestrian Mobility Plan • Justin Jones – Yes We Cannon • Sara Mayo – Building a Framework • *Complete Streets Workshop*

Conference Coordination

Conference planning for the 2014 event began in the summer of 2013 with a team of 10 representatives from *Clean Air Hamilton*, City of Hamilton, Ontario Ministry of the Environment, Corr Research, McKibbon Wakefield Inc., LURA, AECOM, the Hamilton Industrial Environmental Association, and Green Venture (see Table 2). The City of Hamilton's Air Quality Co-Ordinator within Hamilton Public Health Services executed the planning activities. The inaugural meeting of the planning committee occurred on June 25th, 2013.

Table 2: 2014 Upwind Downwind Conference Planning Committee

Organization	Representative	Work Title
City of Hamilton	Brian Montgomery	Clean Air Coordinator
	Sally Radisic	Public Health Services
	Peter Topalovic	Public Works
Ministry of the Environment	Mark Smithson	Manager, Technical Support Section, West Central Region
Corr Research.	Denis Corr	Consultant
McKibbon Wakefield Inc.	George McKibbon	Consultant
Green Venture	Deirdre Connell	
Hamilton Industrial Environmental Association	Karen Logan	HIEA Coordinator
LURA Consulting	Jamie McHardy	
AECOM	Mark van de Woerd	

Advertising and Promotions

The objectives for the promotion and advertising campaign of the 2014 Upwind Downwind Conference was to expand the number of attendees, and raise awareness of the event as an opportunity for the public and professionals to share best practices, network, learn from others and increase international presence.

In order to catch the attention of potential delegates internationally, nationally and locally, advertising of the Conference began six months in advance of the Conference in September 2013. The advertising campaign included:

- E-mail notifications were sent to previous Conference attendees and potential new attendees, which included members of the Ministry of the Environment, City of Hamilton, GTA Clean Air Partnership, the Federation of Canadian Municipalities, Hamilton Chamber of Commerce, the Association of Municipalities of Ontario, members of the Hamilton Community Energy Collaborative, Air and waste management Association, youth groups and, other non-government organizations, industry and government.
- Conference event listings submitted online at: Green pages.ca, Hamilton Eco-Network, People & Planet Friendly, Green Ontario, Yahoo, Go for Green, Facebook, Linked In, Google, McMaster University, Mohawk College, Canada Events, Halton Environmental Network and a range of other online sites.
- Online notifications were posted on the McMaster University MIEH and Sustainability Office website and Mohawk College Sustainability Website.
- Media notifications to Hamilton Spectator, the Hamilton Community Newspapers, Cable 14, CHCH News, and the Canadian Newswire
- Advertisements were purchased: 6 ads in the Hamilton Community Newspapers (Stoney Creek News, Ancaster News, Dundas Star News, Flamborough Review, Hamilton Mountain News, and Glanbrook Gazette). These ads ran the weeks of February 12th, 2014 and February 19th, 2014.
- 200 posters were distributed to various locations by Conference Planning Committee, such as public posting areas provide by the City in Dundas, Westdale and downtown Hamilton and the Hamilton Central Library.

Costs and Funding

The total cost of the 2014 Upwind Downwind Conference was $32,000. The total revenue was $25,400 which included $11,400 from registration fees and $14,000 from funding (see Table 3). $6,600 was drawn from the $18,000 Upwind Downwind Conference Reserve Fund to cover the financial gap. This Reserve Fund was established for the Conference through revenues from previous Conferences to cover any financial gaps that arose in future Conferences. City of Hamilton provided staff resources to procure sponsorship, coordinate logistics, facilitate meetings, process registrations and promote the Conference agenda ($30,000). Planning Committee members helped confirm speakers and facilitate Conference sessions. OPPI provided $2,500 of in-kind service to advertise and promote the Conference. Volunteers helped on the registration desk during the conference.

Table 3: 2012 Upwind Downwind Conference Funds/Grants

Organizations	Donation
Hamilton Public Health Services	$30,000 **in-
Hamilton Industrial Environmental Association	$5,000
Health Canada	$2,500 *exhibit booth*
Ontario Professional Planner's Institute	$2,500 **in-kind**
Mohawk College	$1,000
RWDI Inc.	$1,000
LURA Consulting	$1,000
McKibbon Wakefield Inc.	$500
McMaster Institute of Environment and Health	$500
TOTAL – CASH	$14,000
TOTAL – IN-KIND*	$32,500
Total	**$42,000**

The cost of the 2014 Upwind Downwind Conference was $32,000 which included Audio Visual, Food, Room Rental, Promotions, Speaker Costs and Conference Materials. Revenue for the Conference was $21,500 which included $14,000 from partners and exhibitors and $11,400 from registration fees. $6,600 was drawn from the $18,000 Upwind Downwind Conference Reserve Fund to cover the financial gap.

Venue

The 2014 Upwind Downwind Conference was held on the second floor of the Sheraton Hotel in downtown Hamilton. Morning and afternoon presentations were held in the Grand Ballroom (Centre and East Ballroom). A Transportation Session and Workshop was held in the afternoon in the South and West Ballroom. Breakfast, Breaks and Lunch were provide in the Ballroom Foyer. The food and beverages provided by the Convention Centre were excellent.

About 11 exhibitors had displays for attendees in the Ballroom Foyer and the Centre and East Ballroom.

Hamilton Industrial Environmental Association
Hamilton Public Health Services
Health Canada
Smart Commute Hamilton
RWDI Air Inc.
Clean Air Hamilton
Green Venture
Hamilton CarShare
Mohawk College
LURA Consulting
McKibbon & Wakefield Inc.

The Sheraton Hotel in downtown Hamilton was chosen as the official conference hotel. 6 individuals took advantage of the Conference rate offered by the Sheraton.

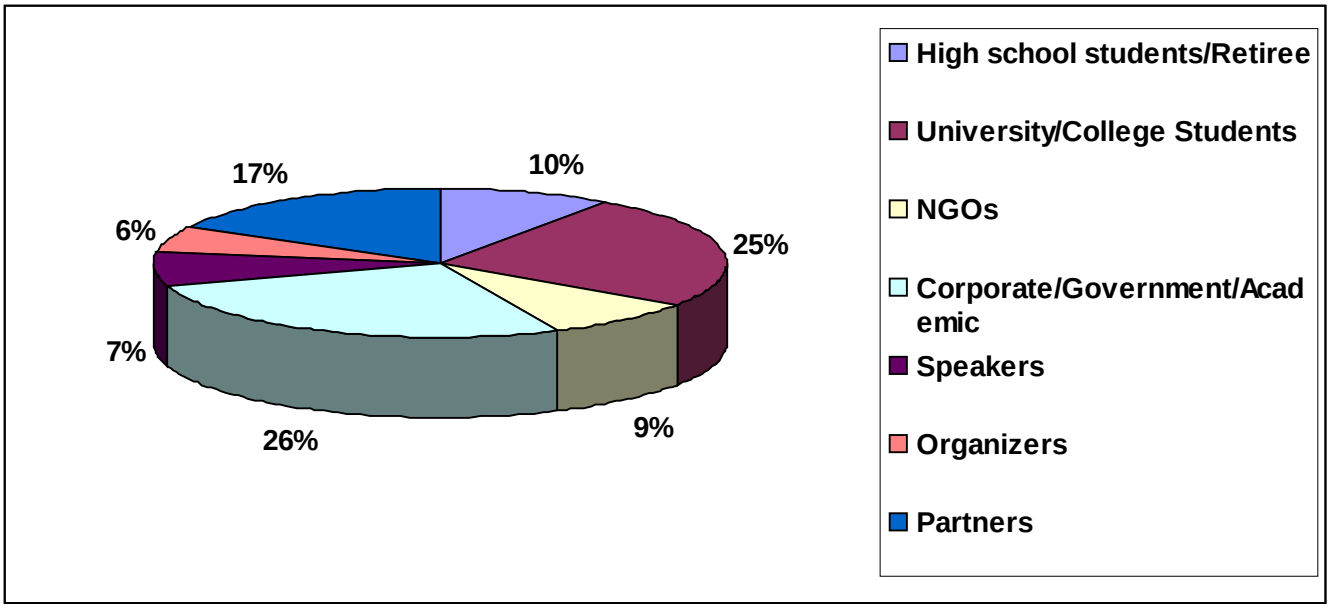
Attendees' Breakdown

Approximately 166 planners, health promoters, university/college students, environmental consultants, retirees and citizens participated in the one-day 2014 Conference. This resulted in a nice balance and mixture between the ages and experiences of the participants at the conference from young professionals and students to retirees and senior professionals. A free afternoon talk was also a feature of the 2014 Upwind Downwind Conference which attracted 140 individuals. On February 23rd, 2014 a free talk by Yale University professor and author Dr. Stephen Kellert was held at the Art Gallery of Hamilton.

Table 4: Upwind Downwind 2014 Conference Attendees

High school students/Retiree	**16**
University/College Students	**41**
NGOs	**15**
Corporate/Government/Academic	**44**
Speakers	**12**
Organizers	**10**
Partners	**28**
TOTAL	**166**

Figure 1: Upwind Downwind 2014 Conference Attendees Breakdown



Attendees' Responses

The 2014 Upwind Downwind Conference received very positive feedback (refer to Appendix 1). A total of 19 evaluations were submitted. When asked to rate their overall satisfaction with the conference, 5 individuals chose "satisfied" while 14 picked "very satisfied". Not one individual indicated they were "not at all satisfied". For 17 respondents, the Conference "met their expectations"; 2 delegates did not feel that the Conference met their expectations.

11 respondents felt the information at the Conference was useful to their work or interest was "very useful", 8 respondents felt it was "somewhat useful".

Respondents at the Conference were very interested in learning more about the air quality trends in Hamilton and the work being undertaken in Hamilton on air quality and climate change. This is a good idea to implement in Conferences moving forward.

Appendix H: Glossary of Terms

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

Acute effects - An adverse health effect that is caused suddenly, rapidly or within a short timeframe after exposure.

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 scale from 1 to 10+ 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 for the general public as to what actions they should take based on the value of the AQHI. For more information visit: www.airhealth.ca

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 pollutants 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.

BaP – See benzo[a]pyrene

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.

Chronic Obstructive Pulmonary Disease (COPD) - a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing. The more familiar terms 'chronic bronchitis' and 'emphysema' are no longer used, but are now included within the COPD diagnosis.

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 – stands for "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 19.

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

Enteric Diseases – are infections caused by viruses and bacteria that enter the body through the mouth or intestinal system, primarily a result of eating, drinking and digesting contaminated foods or liquids.

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.

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, often abbreviated as "µm".

$\mu g/m^3$ – 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.

Morbidity - A measure of illnesses within a geographic area (can be a numerical count or a calculated rate).

Mortality - A measure of deaths within a geographic area (can be a numerical count or a calculated rate).

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. Nitrogen dioxide (NO_2) reacts with water in the atmosphere to create nitric and nitrous acids. These acids are converted into their respective salts in the atmosphere. Nitrate salts can account for up to one-quarter of the mass of PM_{10} in Hamilton during summer months. These salts, along with sulphate salts, constitute the majority of the chemicals that come to Hamilton *via* long-range transport from the Midwest of the US.

Non-traumatic mortality - Death not causing, caused by, or associated with trauma and especially traumatic injury.

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 its 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 (40% ethanol) 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 when fully dispersed in the pool would be 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 added to 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 35

Stratospheric Ozone – also known as the ozone layer; see the Ground Level Ozone analysis of Appendix C on page 111.

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

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. Temperature inversions are inherently unstable and tend to last only for short periods such a two to twelve hours and rarely longer than a day.

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), most people can detect an odour similar to the smell of rotten eggs.

Total Suspended Particulate (TSP) – includes all particulate material with aerodynamic diameters less than about 45 micrometers (45 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) – a wide range of policies, programs, services and products that influence how, why, when and where people travel to make travel behaviours more sustainable. See **Section 7.2.2**

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

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/

***Clean Air Hamilton*, June 2014**

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