

INFORMATION REPORT

TO:	Mayor and Members Board of Health
COMMITTEE DATE:	March 20, 2023
SUBJECT/REPORT NO:	Modelling Morbidity and Mortality using the Hamilton Airshed Modelling System (BOH18016(a)) (City Wide) (Outstanding Business List Item)
WARD(S) AFFECTED:	City Wide
PREPARED BY:	Dr. Sally Radisic (905) 546-2424 Ext. 5549
SUBMITTED BY:	Kevin McDonald Director, Healthy Environments Division Public Health Services
SIGNATURE:	

COUNCIL DIRECTION

This report is in response to direction approved by Council at the April 16, 2018 Board of Health meeting:

Hamilton Airshed Modelling System (BOH18016) (City Wide) (Item 7.1)

- (b) That staff examine the feasibility of using Hamilton Airshed Modelling System to estimate morbidity and mortality outcomes associated with air pollution and report back to Board of Health, if applicable;

INFORMATION

In 2018, Golder & Associates developed the Hamilton Airshed Modelling System (HAMS) in an effort to better understand air pollution impacts in Hamilton. HAMS was developed using emissions and meteorology data which helped increase understanding of both the types and place of origin of emissions contributing to Hamilton's airshed.¹

¹ Kelly J and Ciccone A. Hamilton Airshed Modelling System. Upwind Downwind Conference February 22, 2016. Available from: <http://cleanairhamilton.ca/wp-content/uploads/2017/05/6-Ciccone-and-Kelly.pdf>

There is robust evidence associating air pollution exposure with morbidity and mortality globally.^{2,3,4} In Hamilton, Health Check (2018) reports that in 2012, 90 deaths of Hamiltonians were attributed to air pollution, approximately 45 deaths due to ischemic heart disease, 21 deaths due to chronic obstructive pulmonary disease (COPD), and 13 deaths due to lung cancer.⁵

Morbidity and mortality outcomes are typically generated from models such as Health Canada's Air Quality Benefits Assessment Tool (AQBAT).⁴ Golder & Associates has indicated that AQBAT is appropriate for application in the City of Hamilton's estimate of air pollution-attributed morbidity and mortality.

Model Overview

AQBAT is designed to consider morbidity and mortality outcomes including cost implications based upon changes in atmospheric concentrations of six criteria air contaminants (CAC) commonly associated with urban air pollution, specifically:

- Carbon monoxide;
- Nitrogen dioxide;
- Ozone;
- Sulphur dioxide;
- Particulate matter (PM₁₀); and,
- Fine particulate matter (PM_{2.5}).

The changes in CAC concentrations, within a specific geographic area, are then correlated to expected changes in health outcomes such as cardiovascular disease or respiratory disease using contaminant-specific concentration response functions (CRF). Each CRF is derived based upon epidemiological data from the scientific literature in which health data are correlated with air quality monitoring data. Essentially, each unit

² Fuller R, Landrigan PJ, Balakrishnan K, et al. Pollution and Health: a progress update. Lancet Planet Health 2022; 6: e535-47.

³ World Health Organization (WHO). Exposure and health impacts of air pollution. 2022. Available from: <https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/exposure-air-pollution>

⁴ Health Canada. Health Impacts of Air Pollution in Canada: estimates of premature deaths and non-fatal outcomes 2021 Report. Available from: <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/2021-health-effects-indoor-air-pollution/hia-report-eng.pdf>

⁵ City of Hamilton (Epidemiology and Evaluation - Health and Safe Communities-Public Health Services). Health Check: Assessing the local burden of disease in the City of Hamilton. 2018. Available: <https://www.hamilton.ca/people-programs/public-health/diseases-conditions>

change in atmospheric concentration is related to a potential change in frequency of health outcomes observed in the analyzed population.

General Inputs

There are several inputs related to the assessed population that are required to be input as part of the AQBAT model which include:

- **Baseline:** A baseline population size and distribution is selected, which can be based upon the most recent census data for Hamilton;
- **Scenario Years:** The model requires the selection of the number of years for the model scenarios to run. This can be based upon air quality re-modelling that would be undertaken by Golder & Associates under separate cover;
- **Location:** Locations can be selected from a drop-down list and include most urban centres across Canada, including Hamilton;
- **Population projection:** The changes that the population may encounter within the modelled scenario years is selected, which includes considerations such as fertility, mortality, immigration, and interprovincial migration rates. Varying ranges in the rates of these inputs can be considered (low, moderate, high); and,
- **Pollutants:** The pollutants (i.e., CACs) and averaging times (e.g., hourly, 24-hour, annual) are selected.

Concentrations of Criteria Air Contaminants

The concentrations of pollutants (i.e., CACs) would be input from the air quality re-modelling (i.e., HAMS re-modelling/updating) that would be undertaken by Golder & Associates under separate cover.

Health Outcomes

There are many health outcomes considered in the AQBAT model, and most are related to respiratory or cardiac outcomes as these are the most common health effects associated with CACs. Health outcomes that are available include:

- Acute Respiratory Symptom Days;
- Adult Chronic Bronchitis Cases;
- Asthma Symptom Days;
- Cardiac Emergency Room Visits;
- Cardiac Hospital Admissions;
- Child Acute Bronchitis Episodes;
- Chronic Exposure Mortality;

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OUR Mission: To provide high quality cost conscious public services that contribute to a healthy, safe and prosperous community, in a sustainable manner.

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- Respiratory Emergency Room Visits;
- Respiratory Hospital Admissions; and,
- Restricted Activity Days.

Considerations

Although Golder & Associates has indicated that HAMS outputs could be used in the AQBAT model to estimate morbidity and mortality, the process would involve the initial re-modelling /updating of HAMS which may take substantial time, estimated to be at least six months and financial investments, estimated to be at least \$100,000. Additionally, the model would require continual review of general inputs (i.e., population size and distribution; pollutant sources and emissions) to reflect current air quality conditions impacting morbidity and mortality in Hamilton which may require continuous HAMS re-modelling/updating and increased investment over time.

Moving Forward

Hamilton Public Health Services continues to work with partners such as Clean Air Hamilton to improve air quality in the City of Hamilton and protect population health. There is robust evidence identifying an association of adverse health outcomes attributed to air pollution exposure globally. Existing reporting and data sources provided by Health Canada and the City of Hamilton's Epidemiology and Evaluation Program via Health Check can be used to estimate air pollution-attributed morbidity and mortality in Hamilton.

APPENDICES AND SCHEDULES ATTACHED

Not Applicable.