



# TORONTO STAFF REPORT

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October 4, 2004

To: Board of Health  
From: Dr. David McKeown, Medical Officer of Health  
Subject: Impact of the Toronto Pearson International Airport on Air Quality in Toronto

Purpose:

To report on the impact of the Toronto Pearson International Airport on air quality in Toronto.

Financial Implications and Impact Statement:

There are no direct financial implications associated with this report.

Recommendations:

It is recommended that:

- (1) the Board of Health request the Ontario Ministry of the Environment to:
  - (a) conduct community-based air quality monitoring of nitrogen oxides, carbon monoxide, particulate matter and other pollutants of concern identified in this report in those residential areas around the Toronto Pearson International Airport with the greatest predicted impact;
  - (b) develop an emissions inventory for the community surrounding the airport for pollutants of concern identified in this report, including carbonyl compounds, especially acrolein;
- (2) the Board of Health request Environment Canada to expand the National Air Pollutant Surveillance program by establishing a monitoring station to monitor for carbonyl compounds, particularly acrolein, in those residential areas with the greatest predicted impact;

- (3) the Board of Health request the Greater Toronto Airport Authority (GTAA), in consultation with the Medical Officers of Health for the City of Toronto and the Region of Peel, Transport Canada, the Ontario Ministry of Environment and Environment Canada, to:
  - (a) ensure that, at a minimum, the future air monitoring program at the Toronto Pearson International Airport includes assessment of nitrogen oxides, carbon monoxide, particulate matter and carbonyl compounds, particularly acrolein;
  - (b) maintain the Airport ambient air monitoring program for at least 15 years over the period of the airport expansion to assess the potential air quality impacts associated with changes in Toronto Pearson International Airport operations;
  - (c) report annually on the results of the monitoring program to the GTAA Noise Management Committee Air Quality Subcommittee and the Medical Officers of Health for the City of Toronto and Peel Region;
  - (d) commission a human health risk assessment for particulate matter when the aviation related emissions models are revised; and
  - (e) implement ongoing measures to reduce on-site nitrogen oxide emissions such as working with the airline companies to make emissions reduction a priority, particularly in considering the purchase of new aircraft;
- (4) the Board of Health forward this report to Peel Regional Council for information;
- (5) the Board of Health forward this report to the Region of Peel and City of Toronto councillors representing wards adjacent to Pearson Airport; and
- (6) the appropriate City Officials be authorized and directed to take the necessary action to give effect thereto.

Background:

At its meeting on April 8, 2002, the Board of Health requested the Medical Officer of Health to report back on the impact of the Greater Toronto Airport Authority (GTAA) operations on air quality in Toronto.

The GTAA had commissioned an air quality study for TPIA which would estimate the emissions from airport operations, the resulting level of the pollutants in the air on the airport property and in the surrounding area, and assess the potential impact on health from these emissions. Therefore, Toronto Public Health waited for the results of this study before reporting back to the Board of Health. The air quality study reports are available from the GTAA website at [www.gtaa.com](http://www.gtaa.com).

The GTAA have retained RWDI Consulting Engineers to undertake an air quality study for its operations and planned expansion at the Toronto Pearson International Airport (TPIA). In consultation with the Noise Management Committee, the GTAA established an Air Quality Subcommittee to act in an advisory capacity on this study. Toronto Public Health, the Region of Peel Health Department, the Ministry of the Environment, Environment Canada, the City of Mississauga and resident representatives were invited to participate on the subcommittee. The Noise Management Committee acts as a community liaison committee. It was first established to address noise issues arising from airport operations. It recently expanded its scope to address air quality issues.

This report highlights the results of the last component of the air quality study: “Phase 5 - Human Health Risk Assessment (HHRA) of Air Emissions from the Toronto Pearson International Airport (TPIA)” conducted by Cantox Environmental Inc. (CEI).

#### Comments:

##### (1) Human Health Risk Assessment (HHRA)

The objective of this HHRA was to determine any potential health risks associated with TPIA emissions taking into consideration airport expansion plans over 15 years. In addition, health risks predicted to be associated with airport emissions alone were compared to the health risks predicted to be associated with non-airport emissions generated in the area around the airport. The study area, 7.5 km radius around the airport, captures commercial and residential areas in the City of Toronto and the Region of Peel.

TPIA emissions for the years 2000, 2005, 2010 and 2015 were estimated and the resultant level of various pollutants within the study area was modelled. The emissions related to normal TPIA operations included aircraft movements and emissions from supporting ground operations. Similarly, the level of pollutants resulting from off-site emissions was modelled for the year 2000. Off-site emissions included industrial and transportation sources. Airport and non-airport emissions were then modelled together to estimate the combined impact of all known sources on the air quality in the study area.

The HHRA assessed 21 chemicals/groups of chemicals (see Attachment 1). They included volatile organic compounds (VOCs), carbonyl compounds (e.g. formaldehyde, acrolein), polycyclic aromatic hydrocarbons, carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>) and sulphur dioxide (SO<sub>2</sub>). Small particulate matter (PM<sub>10</sub>), while expected to be an important issue with respect to aircraft emissions, could not be assessed because of the lack of data.

The HHRA compared the chemical concentration predicted for specific locations in the study area to available exposure limits which have been established to protect health. Eight commercial and residential locations were selected to represent points in the community where people work and live (see Attachment 2). In general, the commercial locations were closer to the TPIA property line. In addition, the location of the predicted maximum off-site concentration, which varies with the chemical, was also assessed.

The HHRA was conducted using standard and acceptable risk assessment methods. However, a complete review of all the exposure assumptions used in the risk assessment for all the chemicals was not possible because not all the assumptions were provided. Within these limitations, Toronto Public Health believes that this HHRA provides a reasonable estimate of the potential health risks associated with the pollutants assessed.

(2) Predicted Health Risks Associated with TPIA emissions

The HHRA concluded that, when emissions of the TPIA are considered alone, the levels of the different cancer causing pollutants emitted from the airport operations would not exceed the health benchmark of one excess cancer case in one million people. However, it did find that emissions of some of the other non-cancer causing pollutants - acrolein (a carbonyl compound), nitrogen dioxide, and carbon monoxide - could exceed existing acceptable health levels. As the frequency of these predicted exceedances is not known, the magnitude of the impact cannot be estimated.

The predicted risk levels in the study area are based primarily on modelling that estimate a pollutant concentration at a specific location at ground level. Emissions estimates and ambient air monitoring data inform these models, where it exists. However, the conclusions of the assessment require validation with air quality monitoring conducted on the TPIA property and in the community for NO<sub>2</sub>, CO, PM<sub>10</sub> and carbonyl compounds, particularly acrolein. While the emissions modelling captured anticipated future emissions, monitoring needs to take place over the airport expansion period (15 years) in order to evaluate the air quality impact of expansion activities. The GTAA has informed Toronto Public Health that they are presently working with Transport Canada on developing an on-site monitoring program.

(3) Pollutants of Concern Emitted by the Airport Operations

Acrolein:

Acrolein exposure is predicted to exceed the Health Canada guidelines at the point of maximum off-site concentration throughout the 15-year period for sources from the airport alone. The location of the maximum concentration varies but tends to be situated close to the TPIA property-line. In the case of residential locations, exposure to acrolein from TPIA operations were predicted to be within the allowable exposure limit. The most impacted residential location is in Peel Region, north of the TPIA property line.

Symptoms of acute exposure to acrolein include eye, throat and respiratory irritation. Acrolein normally exists in a mixture with aldehydes and mixtures have been found to be more severe in inducing respiratory effects in animals (Ministry of Environment, 2004).

Lack of information on emissions of acrolein from the other sources around the airport meant that the impact associated with off-site emissions or the combined sources of emissions could not be estimated. Since the TPIA emissions represent a significant portion of the allowable limit, in

order to assess the overall health risk associated with acrolein exposure, an emission inventory and an air quality monitoring program in the community are needed.

#### Nitrogen Dioxide (NO<sub>2</sub>):

NO<sub>2</sub> emissions from TPIA alone were predicted to result in consistent exceedances of the 1-hour NO<sub>2</sub> limit at commercial locations and at one residential location in Etobicoke. Emissions from sources around the airport alone were also estimated to exceed exposure limits. Higher levels of NO<sub>2</sub> are estimated when the emissions from the TPIA and the surrounding community are combined. The HHRA concluded that TPIA operations would result in increased risk for short-term health effects due to exposure to NO<sub>2</sub>. This is of particular concern for those with asthma because there is an increased risk of exacerbation of asthma symptoms.

There is greater confidence in the NO<sub>2</sub> modelling estimates because there is more data available with which to make comparisons resulting in less need to validate the modelling results. Therefore, the GTAA should move ahead with measures to reduce NO<sub>2</sub> emissions and work with the industry to make emissions reductions a priority, particularly when airlines are purchasing new aircraft. For example, the GTAA could consider providing incentives for the use of cleaner aircraft. The results of the modelling also points to the need to address NO<sub>2</sub> emissions from the community around the airport, a large portion of which come from the transportation sector. In previous reports to the Board, Toronto Public Health has already identified the need for reducing emissions from this sector in Toronto as a whole.

#### Carbon Monoxide (CO):

One slight exceedance was predicted for the 1-hour CO exposure limit at the maximum off-site concentration location when considering TPIA emissions alone. However, all commercial and residential locations were within the 1-hour allowable limit. Similar estimates were obtained when both airport and surrounding community sources were modelled together. The HHRA concluded that the TPIA CO emissions are not predicted to result in increased community health impact.

Notwithstanding the fact that the TPIA is not anticipated to increase the risk of CO-related health effects, increases in cardiac hospital admissions in people with existing cardiovascular conditions have been reported at high CO levels that are still within the regulatory limits in Ontario. The HHRA notes, however, that the effects associated with CO cannot be separated from the PM-related effects. This highlights the need for the Ministry of Environment (MOE) to regularly review the evidence to ensure that regulatory limits are based on the most current evidence.

#### Small Particulate Matter (PM<sub>10</sub>):

Airport operations, aircraft in particular, are emission sources of small particulate matter (PM<sub>10</sub>). PM<sub>10</sub> has been estimated to result in both respiratory and cardiovascular hospital admissions. Currently the aviation-related emissions models do not include PM<sub>10</sub>. According to RWDI, the U.S. Federal Aviation Authority (FAA) is working on revising the models to include PM<sub>10</sub>.

Therefore, the health risk associated with emissions of PM<sub>10</sub> related to airport activities needs to be evaluated once these updated models are available.

#### (4) Predicted Health Risks Associated with Off-site Emissions

The airport is situated within a commercial-industrial zone and next to an important road transport corridor in the Toronto area. The study estimated that, on their own, emissions from the community surrounding the airport could have an impact on air quality. Predicted cancer risks associated with emissions from the area surrounding the airport showed a risk in excess of one in one million for benzene and 1-3 butadiene at all receptor locations. In its report to the Board in April 2002 entitled "Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure", Toronto Public Health had identified these two chemicals as being of potential concern. Levels of these pollutants are typically elevated in urban areas in large part due to transportation sources.

In addition, non-cancer risks associated with emissions of 1-3 butadiene, naphthalene and 1,2,4-trimethylbenzene from sources around the airport are predicted to exceed the exposure limits for all residential receptors. The residential location most impacted is Site 4 (Etobicoke) in the City of Toronto. Estimated levels of 1,2,4-trimethylbenzene also exceeded health limits at one commercial location.

Given that these are predicted levels, it will be necessary for the MOE to compile an inventory of sources and conduct air monitoring in the community, especially for the pollutants that are estimated to reach levels of concern.

#### Conclusions:

The HHRA concluded that airport emissions of most of the chemicals assessed are predicted to be within allowable limits. However, TPIA emissions of acrolein, NO<sub>2</sub>, and CO are predicted to exceed their respective acceptable health limits. Small particulate matter (PM<sub>10</sub>), which is also emitted from airport operations, could not be assessed at this time. In addition, the TPIA Air Quality Study showed that emissions from sources surrounding the airport are significant contributors to pollutant levels in the community.

This study was based on computer modelling of emissions, and there is limited data on quantities of pollutants emitted, especially from sources around the airport, therefore conclusions of the HHRA require validation with air quality monitoring. This monitoring should be conducted on the TPIA property and in the surrounding community, especially for the pollutants of potential concern. The monitoring program needs to be in place over the airport expansion period (15 years) in order to evaluate the air quality impact of expansion activities.

Notwithstanding the need to validate the predicted ground level concentrations of the pollutants assessed, there is greater confidence in the results for NO<sub>2</sub> because there is more monitoring data available with which to make some comparisons. Therefore, the GTAA should move ahead with

measures to reduce TPIA emissions of NO<sub>2</sub>. This study also reinforces the need for continued efforts to reduce emissions from the transportation sector in the Greater Toronto Area.

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List of Attachments:

Attachment 1: Table 1 - Chemicals Assessed and the Sources Considered  
Attachment 2: Table 2 - Receptor Locations for the HHRA

References:

CanTox Environmental Inc. (2003) Phase 5 – Human Health Risk Assessment of Air Emissions from the Toronto Pearson International Airport (TPIA) (Draft Final Report, December 17, 2003).

Ministry of Environment (2004) Draft Rationale for the Development of Ontario Air Standards for Acrolein. Ontario Ministry of the Environment, Toronto.

RWDI (2003) Phases 1 to 3 – Predicted Impacts – Air Quality Study Toronto Pearson International Airport. Project Number 01-630A (Revised Draft, August 20, 2003).

RWDI (2003) Phase 4 – Ambient Air Quality Monitoring – Air Quality Study Toronto Pearson International Airport. Project Number 01-630C (Revised Draft, May 16, 2003).

Toronto Public Health (2002) Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure. City of Toronto, Toronto.

Toronto Public Health (2004) Air Pollution Burden of Illness in Toronto: 2004 Summary. City of Toronto, Toronto.

Attachment 1

Table 1: Chemicals Assessed and the Sources Considered\*

Chemicals	On-site sources	Off-site sources
Acetaldehyde	✓	
Acetone	✓	
Acrolein (including methacrolein)	✓	
Benzo(a)pyrene	✓	
Formaldehyde	✓	
Methyl ethyl ketone	✓	
1-3 butadiene	✓	✓
Hexane and related compounds	✓	✓
Cyclohexane and related compounds	✓	✓
Styrene	✓	✓
Benzene	✓	✓
Toluene	✓	✓
Trimethylbenzenes and related compounds	✓	✓
Ethyl benzene and related compounds	✓	✓
n-butylbenzene and related compounds	✓	✓
Xylenes	✓	✓
Naphthalene	✓	✓
Alkanes (butane to dodecane – excluding hexane)	✓	✓
Carbon monoxide (CO)	✓	✓
Nitrogen dioxide (NO <sub>2</sub> )	✓	✓
Sulphur dioxide (SO <sub>2</sub> )	✓	✓

\*At the request of the City of Toronto, trichloroethylene, vinyl chloride and dioxins and furans were added to the initial chemical list. No emissions were detected or predicted as a result of TPIA operations. Therefore, they were not included in the final assessment.

Attachment 2

Table 2: Receptor Locations for the HHRA

Site #	Receptor Site	Commercial Receptor	Residential Receptor
1	Maximum off-site concentration (location varies depending on the chemical)	-	-
2	Maximum at Hwy 427 and Dixon Road, Etobicoke	✓	
3	Maximum at Hotel Strip Dixon Road, Etobicoke	✓	
4	Longbourne Drive & Willowbridge Road, Etobicoke		✓
5	Centennial Park Road (School), Etobicoke		✓
6	Audubon Blvd, Mississauga		✓
7	County Court Road, Brampton		✓
8	Cattrick Street, Malton		✓