

Toronto Pearson Air Quality Study Human Health Risk Assessment

Phase 4 Summary



Glenn Ferguson, Ph.D.

Intrinsic Environmental Sciences Inc.

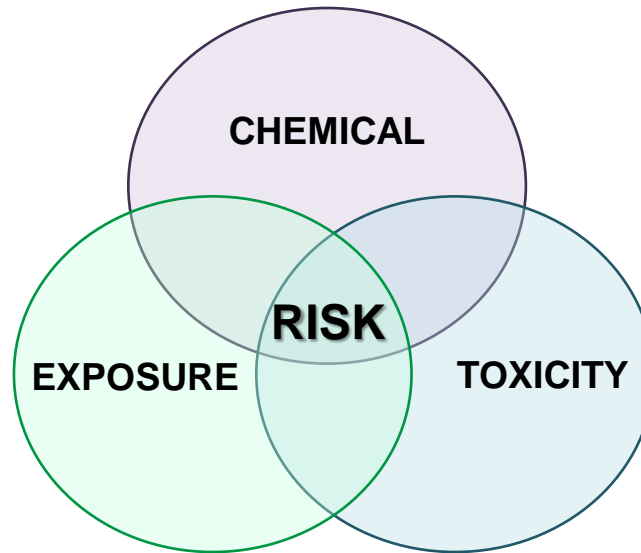
*Presentation to the GTAA Community Environment & Noise Advisory Committee
(CENAC)*

December 2, 2015

Presentation Overview

- What is human health risk assessment (HHRA)?
- How was the HHRA conducted?
- What were the results of the HHRA?
- How do the results of this HHRA differ from the HHRA completed in 2003?
- Conclusions

What is Risk Assessment?



- Risk Assessment (RA) is a tool that can be used for estimating the potential for adverse effects that could arise from exposures to environmental contaminants from a facility or property
- The HHRA framework used provides a health context for the air quality and dispersion modelling completed in previous Phases of the project by Golder Associates.

Risk Assessment Framework

Problem Formulation

Are there chemicals in the environment that could adversely impact the health of people?
Who is present and how might they be exposed?

Exposure Assessment

How are people exposed to the chemicals and to what degree are they exposed?

Toxicity Assessment

At what concentrations are chemicals associated with health impacts to people?

Risk Characterization

Based on the predicted exposure and regulatory exposure limits, are elevated health risks predicted?
What needs to be done to reduce these risks?

Problem Formulation

Scenarios Considered in HHRA

- **Baseline Case:** assessment of existing and estimated background conditions in the absence of Toronto Pearson using recent regional air quality data (*i.e.*, Phase 2).
- **Airport Alone Case:** assessment of estimated emissions from Toronto Pearson alone (*i.e.*, Phase 1).
- **Cumulative Effects Case:** assessment of the cumulative effects of the Baseline Case *plus* the Airport Alone Case for each year.

Selected Chemicals of concern (COCs):

- 5 Criteria Air Contaminants (CACs)
- 22 Keystone COCs representative of 98 chemicals
- EDMS outputs a total of 186 chemicals or chemical groupings which were accounted for in these 22 COCs.

Receptor Locations



 Toronto
Pearson

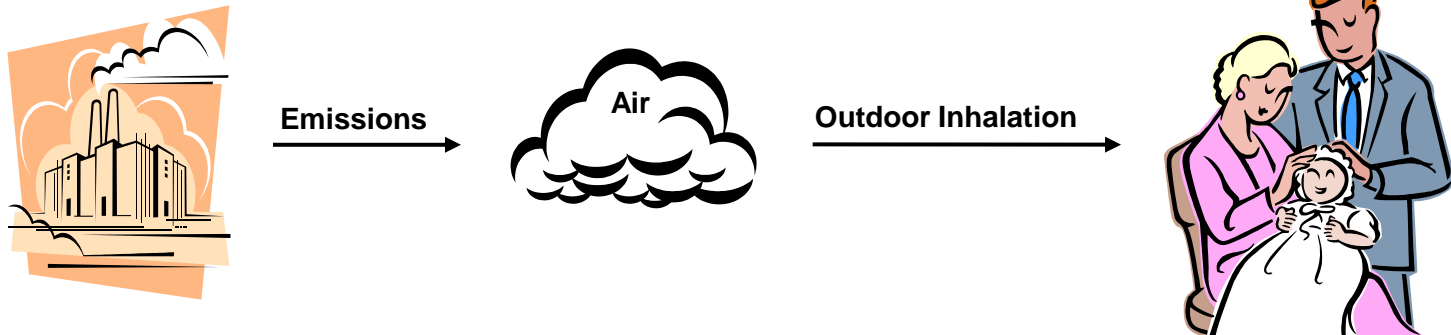
 Receptor
Location

 New
Receptor
Location

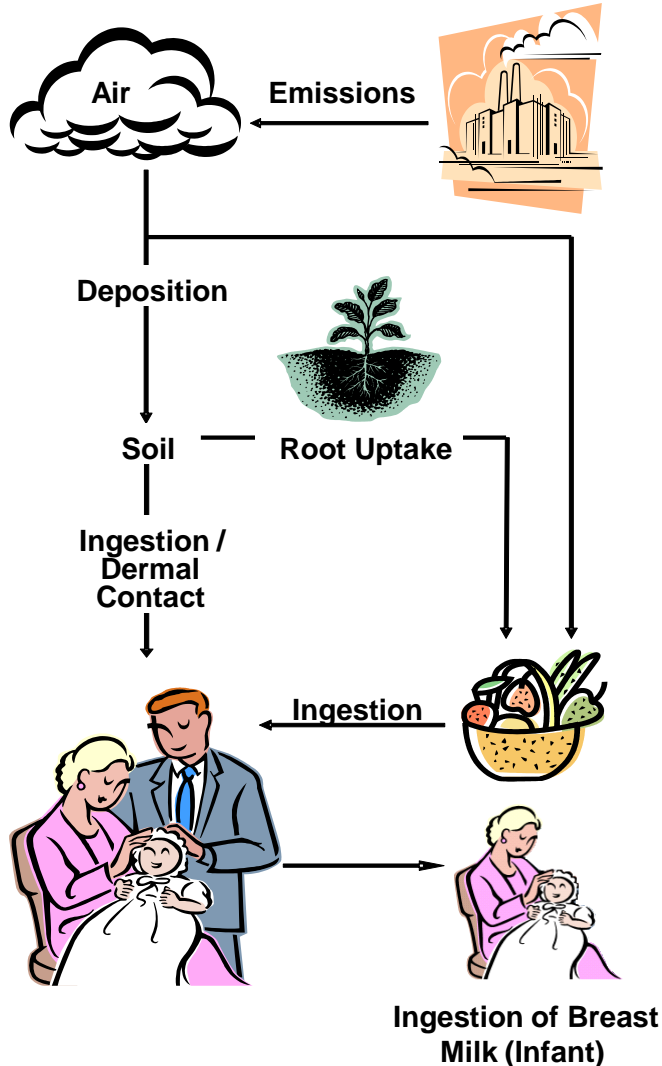
Exposure Assessment

Inhalation Assessment:

- Estimated inhalation of vapour and particulate concentrations
 - Short-term (acute): Maximum 1-hour and 24-hour concentrations
 - Long-term (chronic): Annual time-weighted average concentration



Exposure Assessment



Multi-media Assessment:

- Annual average air concentration and deposition data (provided by Golder) are used to predict chemical concentrations in:
 - Soil/dust (*via* atmospheric deposition)
 - Home-grown produce (*via* atmospheric deposition, vapour uptake, and root uptake)
 - Breast milk (*via* mother's chemical intake)
- The total estimated daily intake of chemicals by individuals from direct and indirect exposure routes is calculated using ingestion rates and physical characteristics

Toxicity Assessment

Problem Formulation

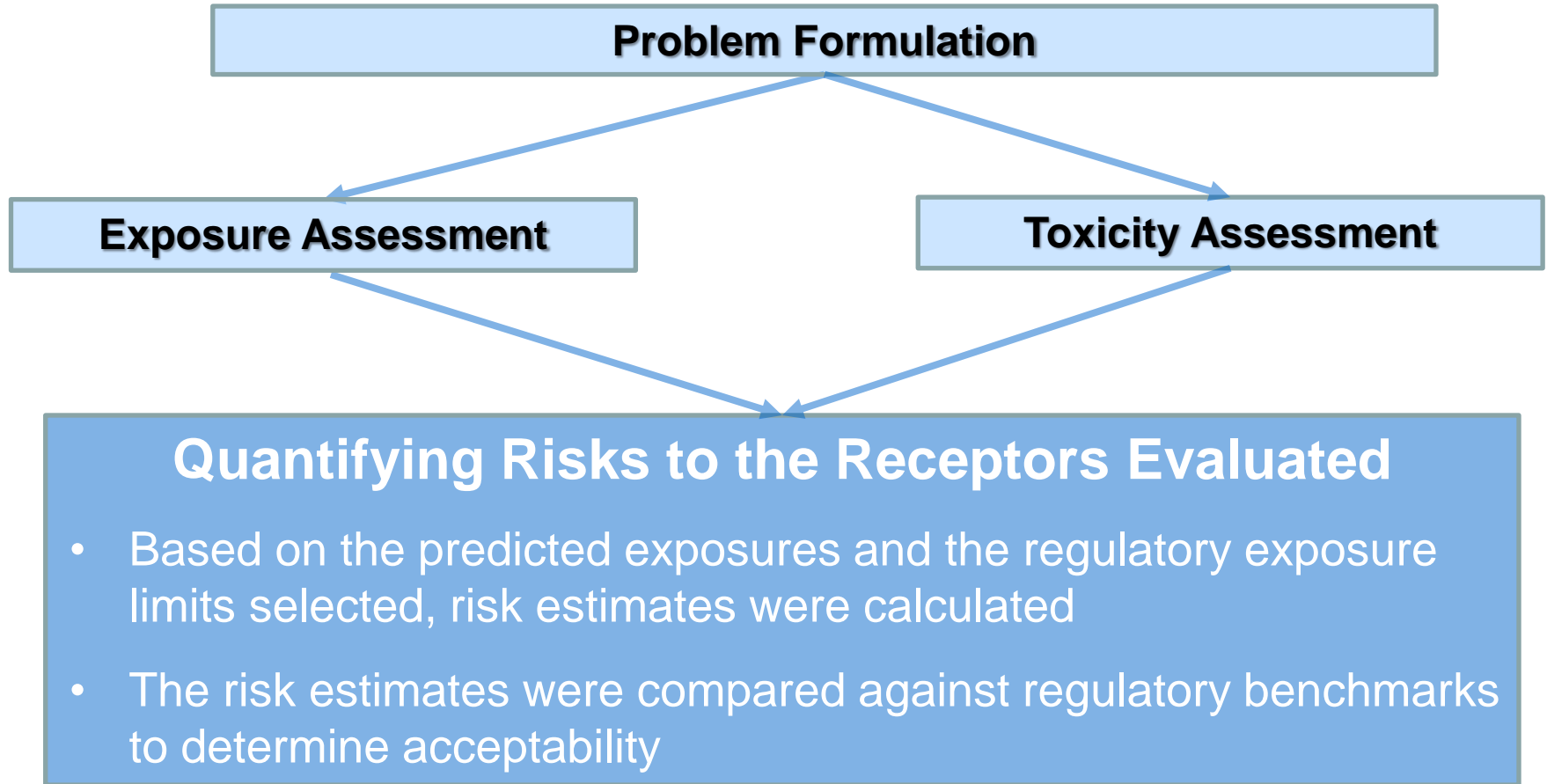
Exposure Assessment

Finding appropriate exposure limits

- Selected from reputable regulatory agencies
- Exposure limits protective of:
 - Short-term inhalation
 - Long-term inhalation
 - Long-term ingestion/skin contact

Risk Characterization

Risk Characterization



Acceptable Risk Levels

Threshold chemicals (“Non-Carcinogens”)

- Short-term and long-term exposures
- $CR \leq 1$ (*i.e.*, exposure \leq exposure limit)
- Sometimes $CR = 0.2$ (to account for other exposures to chemicals)

Non-threshold chemicals (“Carcinogens”)

- Long-term exposure only
- Depending on jurisdiction; acceptable ranges from 1-in-10,000 and 1-to-1,000,000
- In Ontario, the acceptable excess lifetime cancer risk is 1-in-1,000,000 (1-in-1 million)

Summary of Results

- Year 2032 represents the expected period with the greatest amount of air traffic volume and air impact
- Elevated risk levels were predicted from 4 of the 27 COCs in air at commercial and residential locations
- The frequency at which air concentrations of COCs exceeded health benchmarks indicate the general population is not likely at risk of adverse health effects
- Highly exaggerated and protective assumptions were used within HHRA and are the main contributor for elevated health risks. General population is not likely at risk of adverse health effects
- No unacceptable risks from long-term exposures to soil and dust, home-grown food, and breast milk ingestion

Chemicals of Potential Concern

- **Acrolein**
 - Formed from the burning of organic matter including tobacco, or fuels such as gasoline or oils. Vehicle emissions are a significant source.
 - Short-term and long-term exposure limits are protective of mild eye and nose irritation
 - Long-term exposure limit is highly protective (1,000-fold reduction from observed effects in animals)
- **Formaldehyde**
 - Present in cigarette smoke, off gassing from consumer products, power plants, manufacturing facilities, and vehicle exhaust
 - Short-term exposure limit is protective of mild eye and nose irritation
 - Long-term exposure limits are protective of carcinogenic effects
- **Benzene**
 - Found in air from emissions from burning coal and oil, gasoline service stations, and vehicle exhaust
 - Long-term exposure limits are protective of carcinogenic effects

Short-Term Assessment Results

1-hour Exposure Period (Maximum over 43,848 1-hour periods)

<i>Chemicals of Concern</i>	<i>Receptor Location of Concern</i>			
	<i>Commercial (R2)</i>		<i>Residential (R7)</i>	
	<i>Maximum Risk</i>	<i>% Exceedances</i>	<i>Maximum Risk</i>	<i>% Exceedances</i>
Acrolein	<u>6.2</u>	0.5%	<u>3.5</u>	0.3%
Formaldehyde	<u>1.5</u>	0.02%	0.99	0%
Sulphur Dioxide	<u>1.2*</u>	0.009%	0.64	0%

24-hour Exposure Period (maximum over 1,827 days)

<i>Chemicals of Concern</i>	<i>Receptor Location of Concern</i>			
	<i>Commercial (R2)</i>		<i>Residential (R7)</i>	
	<i>Maximum Risk</i>	<i>% Exceedances</i>	<i>Maximum Risk</i>	<i>% Exceedances</i>
Acrolein	<u>3.1</u>	4.3%	<u>1.7</u>	0.6%

Long-Term Assessment Results

Annual Average Exposure Period (maximum over 5 years)

<i>Chemicals of Concern</i>	<i>Receptor Location of Concern</i>			
	<i>Commercial (R2)</i>		<i>Residential (R7)</i>	
	<i>Risk (Non-Cancer)</i>	<i>Risk (Cancer)</i>	<i>Risk (Non-Cancer)</i>	<i>Risk (Cancer)</i>
Acrolein	<u>1.6</u>	-	<u>2.7</u>	-
Benzene	-	0.33-in-1,000,000	-	<u>1.3-in-1,000,000</u>
Formaldehyde	-	0.46-in-1,000,000	-	<u>1.8-in-1,000,000</u>

Risk estimates for Residential receptors assume that a resident does not leave the worst-case location during their lifetime.

What Are The Odds?

The likelihood of dying from any of the following activities or situations in ONE-IN-A-MILLION

- Travelling 700 miles by air
- Travelling 60 miles by automobile
- Riding 10 miles by bicycle
- Smoking from one to three cigarettes
- Drinking 1/2 litre of wine
- Rock climbing for 1.5 minutes
- 20 minutes being a man aged 60

How Do The Results Compare Against The 2003 HHRA?

- The results from the current HHRA and the 2003 HHRA are largely the same
- Most chemicals do not pose any elevated risks to human health despite use of highly exaggerated assumptions
- Occasional incidences where concentrations exceed short-term benchmarks
- Additional elevated long-term risk predictions were predicted resulting from the use of recently revised TRVs
 - Acrolein long-term TRV is 20-fold more conservative
 - Benzene cancer TRV is 4-fold more conservative
 - Formaldehyde cancer TRV is 31,000-fold more conservative

Conclusions

- Year 2032 represents the expected period with the greatest amount of air traffic volume and air impact
- Most chemicals do not pose any unacceptable risks to human health despite highly protective assumptions (*i.e.*, health benchmarks with significant safety factors; worst case and likely unrealistic exposure conditions, *etc.*).
- General population is not likely at risk of adverse health effects due to infrequency of exceedances and highly protective nature of the assessment

Any Questions?

For further information, contact:

Dr. Glenn Ferguson

Toronto Pearson Air Quality Study HHRA Lead

Phone: (905) 364-7800 x206

gferguson@intrinsik.com

www.intrinsik.com