Regional Municipality of York

Appendix 3C-1c
Air Quality

Prepared by:	Project #	Date:
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1. Introduction

This report provides an overview of the existing air quality conditions associated with the Western Vaughan Transportation Improvements Individual Environmental Assessment (IEA). The approved Terms of Reference (ToR) included a preliminary description of the existing Study Area environment with the commitment that the description would be expanded upon in the IEA. With this in mind, the following investigative studies are proposed for the purposes of generating a more detailed description and understanding of the environment for use in the screening, assessment, and evaluation of alternatives during the IEA:

- Natural Environment;
- Land Use;
- Built Heritage;
- Archaeological;
- Socio-Economic;
- Noise; and
- Air Quality.

The results from undertaking each of these overviews will be documented in separate stand-alone reports during the IEA. In each case, a draft will be prepared and circulated to the Review Agency and Community Stakeholder Advisory Committees and will be posted on the project website for comment. The final Existing Conditions Report will form a chapter of the EA Report with each of the stand-alone reports becoming supporting documents to the EA Report.

1.1 Air Quality Study Team

The RWDI AIR Inc. air quality study team consists of engineers, scientists and technologists. The Project Manager is supported technically by the Technical Director and the Study Team, but has no managerial responsibilities.

- **Scott Shayko, Hon. B. Comm., B.Sc., Senior Project Manager/Associate**
  Scott is the Project Manager for the air quality and environmental noise studies and is responsible for the day-to-day operation and management of the project. He also serves as the primary interface between the client and the project team.
- **Scott Penton, P.Eng., Technical Director/Associate**
  Scott is the Technical Director for the air quality and environmental noise studies and is responsible for the technical quality of the studies. He is a Specialist in the fields of air quality, noise and vibration with more than 12 years of experience. Before joining RWDI, Scott completed his degree in System Design Engineering at the University of Waterloo, specializing in environmental systems modelling.

2. Western Vaughan Study Area

In accordance with the approved ToR, the present Study Area for the Western Vaughan Transportation Improvements IEA includes the western portion of the City of Vaughan from Highway 400 to the east, to Highway 50 in the west, Highway 407 to the south and an area above Teston Road to the north (North of Teston Road, South of Kirby Road) (see **Figure 1**.)

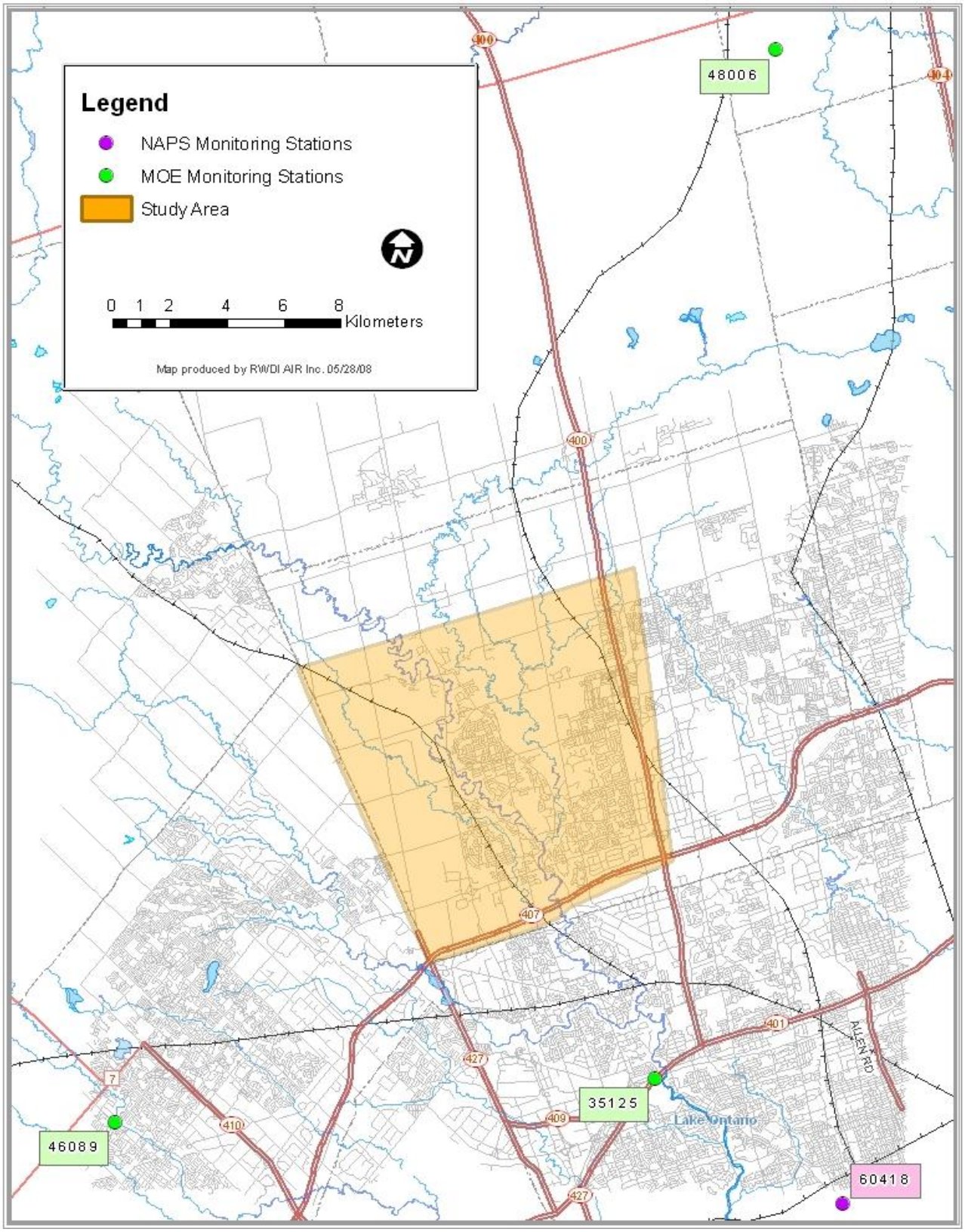

Figure 1. Study Area and Monitoring Stations

3. Methodology

3.1 Available Secondary Source Information Collection and Review

With this current Study Area in mind, available secondary sources of information were collected and reviewed by the Air Quality Study Team to determine existing air quality conditions. The following sources of secondary information were collected and reviewed:

- Ontario Ministry of the Environment. *Summary of O.Reg 419/05 Standards and Point of Impingement Guidelines & Ambient Air Quality Criteria (AAQCs). February 2008.*
  Provincial Ambient Air Quality Criteria Guidelines for contaminants of interest. The Ontario Ministry of the Environment (MOE) has developed Ambient Air Quality Criteria (AAQCs) for numerous contaminants, including those that are typically emitted from vehicular traffic and are known to have the potential to cause harmful effects on human health or cause degradation to the environment. In general, these guidelines represent desirable or acceptable ambient contaminant levels.
- Canadian Council of Ministers of the Environment. *Canada-Wide Standards of Particulate Matter and Ozone. Endorsed by CCME Council of Ministers, June 5-6, 2000, Quebec City.*
  The Canadian Council of Ministers of the Environment (CCME) created a Canada Wide Standard (CWS) for $PM_{2.5}$.
- Ontario Ministry of the Environment. *Air Quality in Ontario – 2006 Report. http://www.ene.gov.on.ca/en/publications/air/index.php#9a.*
  Provides ambient air quality measurements for MOE monitoring stations surrounding the Study Area.
- Ontario Ministry of the Environment. *Transboundary Air Pollution in Ontario – 2005 Report. http://www.ene.gov.on.ca/envision/techdocs/5158e_index.htm.*
- Provides a current review of transboundary air pollution impacts from an Ontario perspective.
- Environment Canada. *Year 2006 Hourly Ambient Air Measurements for NAPS Stations, provided by Environment Canada to RWDI. April 25, 2008.*
  Provides ambient air quality measurements for NAPS monitoring stations surrounding the Study Area.

3.2 Process Undertaken

1. Reviewed the Study Area;
2. Identified MOE monitoring stations in the vicinity of the Study Area;
3. Summarized contaminants of interest using provincial and federal ambient air measurements; and
4. Selected the appropriate ambient air quality criteria.

4. Existing Air Quality Conditions

4.1 Air Quality Guidelines

The Ontario Ministry of the Environment (MOE) has developed Ambient Air Quality Criteria (AAQCs) for numerous contaminants, including those that are typically emitted from vehicular traffic and are known to have the potential to cause harmful effects on human health or cause degradation to the environment [1]. In general, these guidelines represent desirable or acceptable ambient contaminant levels. The Canadian Council of Ministers of the Environment (CCME) created a Canada Wide Standard (CWS) for respirable particulate matter ($PM_{2.5}$) [2]. An AAQC for total VOCs, benzene, and 1,3-butadiene do not currently exist; however, 24-hour criteria do exist for acetaldehyde, acrolein and formaldehyde.

Table 1 presents the guidelines for the contaminants that have been measured in the Study Area.

Table 1. Summary of Relevant Air Quality Guidelines [in :g/m^3]

Contaminant	Averaging Period	Current AAQC
CO	1 hour 8 hour	30 ppm 13 ppm
NO_x	1 hour 24 hour	200 ppb 100 ppb
$PM_{2.5}$ [1]	24 hour	30 μg/m^3
Acetaldehyde	24 hour	500 μg/m^3
Acrolein	24 hour	0.08 μg/m^3
Formaldehyde	24 hour	65 μg/m^3

Notes: [1] Canada Wide Standard for $PM_{2.5}$ established for the year 2010 based on the 98th percentile ambient measurement annually averaged over three consecutive years.
ppm, ppb, and μg/m^3 stand for parts per million, parts per billion, and microgram per cubic metre, respectively.

The limiting effect for the ambient air quality guidelines listed in **Table 1** is human health. Below is a brief description of the potential health effects associated with these air contaminants:

- **Carbon Monoxide**
  CO is a colourless, odourless, tasteless, and potentially poisonous gas produced primarily by incomplete combustion of fossil fuels. Exposure to high levels of CO is linked with impairment of vision, work capacity, learning ability, and performance of difficult tasks [3].

- **Nitrogen Dioxide**
  All combustion in air produces oxides of nitrogen (NO_X), of which nitrogen dioxide (NO_2) is a component. NO_2 is a reddish brown gas with a pungent and irritating odour. It transforms in the air to form gaseous nitric acid and toxic organic nitrates. NO_2 also plays a major role in atmospheric reactions that produce ground level ozone, a major component of smog.

  It is also a precursor to nitrates, which contribute to increased respirable particle levels in the atmosphere. Exposure to high levels can irritate the lungs and lower resistance to respiratory infection. People with asthma and bronchitis have increased sensitivity [3].

- **Particulate Matter**
  Particulate matter is the general term used for a mixture of solid particles and liquid droplets found in the air. These particles, which come in a wide range of sizes, are emitted directly from

sources or formed in the atmosphere by the transformation of gaseous emissions into secondary pollutants. Inhalable particulate matter, or PM_{10}, refers to the fraction of PM having a diameter less than or equal to 10 microns. Respirable particulate matter, or $PM_{2.5}$, refers to the fraction of PM having a diameter less than or equal to 2.5 microns. The smaller the particle size, the farther the particle can penetrate into the lungs. Therefore, smaller particles pose the greatest potential for human health effects. The greatest effect on human health is from particles 10 microns or less in diameter, which can aggravate bronchitis, asthma, and other respiratory diseases. People with asthma, cardiovascular or lung disease, and children and elderly people, are considered to be the most sensitive to the effects of airborne PM_{10} or $PM_{2.5}$ [3].

- **Volatile Organic Compounds**
  VOCs are defined technically as organic compounds having a saturation vapour pressure greater than 10^{-1} Torr at 25°C and standard atmosphere pressure. Certain VOCs warrant special concern because they are capable of being transported very long distances in the atmosphere and play an important role in the formation of ground level ozone and fine particles. VOCs are emitted into the atmosphere from a variety of sources, including, vehicles, petroleum refining, solvent use (industrial and residential), and paint application [3]. Some critical VOCs, which are examined in this report, include, acetaldehyde, acrolein, benzene, 1,3-butadiene, and formaldehyde.

4.2 Results

The current air quality in the Western Vaughan IEA Study Area can be generally characterized with air quality monitoring data from the Ontario Ministry of Environment (MOE) and Environment Canada. The air quality monitoring stations in close proximity to the Study Area include Toronto West (125 Resources Road), Brampton (525 Main Street North and Peel Manor), and Newmarket (Eagle Street and McCaffrey Road) (**Figure 1**). The contaminants summarized from these stations include carbon monoxide (CO), nitrogen oxides (NO_X), and respirable particulate matter ($PM_{2.5}$). As a surrogate, a Toronto National Air Pollution Surveillance (NAPS) station (Ruskin and Perth Street) was used for Toronto VOC data. Data for inhalable particulate matter (PM_{10}) are not available from published reports. The contaminants shown were selected because they are directly associated with transportation emissions and are those that have been measured in the Study Area and will be studied in the local air quality assessment.

Tables 2, **3** and **4** provide the mean, 90th percentile and maximum values of measured ambient air quality concentrations from the monitoring stations listed above. The data are extracted from the MOE's "Air Quality in Ontario – 2006 Report" as well as NAPS data provided by Environment Canada and represent conditions over the year 2006, the most recent data report available from the MOE and Environment Canada. The mean values are more representative of typical conditions, 90th percentile values (value of concentration which is exceeded only 10% of the time) are more representative of credible worst-case conditions, and maximum values are more representative of rare peak events.

The mean and 90th percentile values in **Tables 2** and **3** meet the provincial and federal Ambient Air Quality Criteria (AAQC) (listed in **Table 1**). As expected, the maximum values in **Table 4** for CO and all VOCs meet the AAQC and the maximum values for the other contaminates exceed the AAQCs (excluding the 24-hour criteria for NO_X at Newmarket). This is common to many cities in Southern Ontario.

Table 2. Mean Value of Concentrations of Transportation Related Contaminants for 2006

Contaminant	Averaging Period	Units	MOE Station			NAPS Station
			Brampton (#46089)	Newmarket (#48006)	Toronto West (#35125)	Toronto (#60418)
CO	1-hour	ppm	N/A	N/A	0.35	N/A
NO_x	1-hour	ppb	24.2	11.8	42.4	N/A
$PM_{2.5}$	1-hour	µg/m³	7.2	6.4	8.2	N/A
Acetaldehyde	Annual	µg/m³	0.98	0.66	N/A	1.5
Acrolein	Annual	µg/m³	N/A	N/A	N/A	0.02
1,3-Butadiene	Annual	µg/m³	0.09	0.04	N/A	0.1
Benzene	Annual	µg/m³	0.89	0.73	N/A	1.1
Formaldehyde	Annual	µg/m³	N/A	N/A	N/A	2.7

Table 3. 90th Percentile of Concentrations of Transportation Related Contaminants for 2006

Contaminant	Averaging Period	Units	MOE Station			NAPS Station
			Brampton (#46089)	Newmarket (#48006)	Toronto West (#35125)	Toronto (#60418)
CO	1-hour	ppm	N/A	N/A	0.55	N/A
NO_x	1-hour	ppb	54	28	83	N/A
$PM_{2.5}$	1-hour	µg/m³	16	15	18	N/A
Acetaldehyde	24-hour	µg/m³	1.9	1.2	N/A	2.2
Acrolein	24-hour	µg/m³	N/A	N/A	N/A	0.04
1,3-Butadiene	24-hour	µg/m³	0.17	0.08	N/A	0.16
Benzene	24-hour	µg/m³	1.5	1.14	N/A	1.5
Formaldehyde	24-hour	µg/m³	N/A	N/A	N/A	3.7

Table 4. Maximum Value of Concentrations of Transportation Related Contaminants for 2006

Contaminant	Averaging Period	Units	MOE Station			NAPS Station
			Brampton (#46089)	Newmarket (#48006)	Toronto West (#35125)	Toronto (#60418)
CO	1-hour	ppm	N/A	N/A	2.98	N/A
	8-hour	ppm	N/A	N/A	2.48	N/A
NO_x	1-hour	ppb	360	208	493	N/A
	24-hour	ppb	161	83	191	N/A
$PM_{2.5}$	1-hour	µg/m³	51	53	53	N/A
	24-hour	µg/m³	33	31	35	N/A
Acetaldehyde	24-hour	µg/m³	4	1.8	N/A	2.7
Acrolein	24-hour	µg/m³	N/A	N/A	N/A	0.06
1,3-Butadiene	24-hour	µg/m³	0.42	0.11	N/A	0.18
Benzene	24-hour	µg/m³	3.8	4.2	N/A	1.7
Formaldehyde	24-hour	µg/m³	N/A	N/A	N/A	3.9

Notes: ppm, ppb, and µg/m3 stand for parts per million, parts per billion, and microgram per cubic metre, respectively. N/A stands for "not available".

Transportation is one of the primary sources responding to local air pollution. However, long-range transboundary air quality issues have become more important in Southern Ontario, especially in the summertime. For example, in the case of $PM_{2.5}$, elevated levels in smog events are commonly related to regional photochemical processes. According to the MOE's "Air Quality in Ontario – 2006 Report" and "Transboundary Air Pollution in Ontario – 2005 Report", and other studies undertaken by Environment Canada and RWDI, transboundary air pollution (mainly from United States) is one of the largest contributions to Ontario's smog events in the summer. Lake induced winds along Lake Ontario in summertime can also cause an increase in $PM_{2.5}$ levels under south-westerly wind conditions in the Study Area. Therefore, the data shown in **Tables 2**, **3** and **4** are a combination of local and transboundary effects.

5. Conclusions

The review of historical ambient air quality measurements indicates that levels of CO and the VOCs studied are well below their respective guidelines at the Brampton, West Toronto and Newmarket monitoring sites surrounding the Study Area. Measured levels of NO_X, and $PM_{2.5}$ were found to occasionally exceed the respective air quality criteria. In conclusion, it would appear that existing ambient air quality in the Study Area is typical of the rest of Southwestern Ontario.

6. Recommendations / Further Work

There are no recommendations at this time in relationship to the existing conditions.

7. References

Canadian Council of Ministers of the Environment, 2000
Canada-Wide Standards of Particulate Matter and Ozone. Endorsed by CCME Council of Ministers, June 5-6, 2000, Quebec City.

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