Briefing Note - Summary of the Air Quality Assessment of Tim Hortons Restaurants: Ontario, Canada (May 2008)

Conducted By RWDI AIR Inc Consulting Engineers & Scientists

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Purpose:

RWDI AIR Inc. (RWDI) was retained by the TDL Group Corp. to conduct an air quality study of vehicles using their facilities. The TDL Group is interested in having sound technical information on vehicle emissions at its facilities that have a drive-through component. The TDL Group also requested comparing these vehicles emissions to other common sources of air pollution to assist the public with an easily understood comparison when discussing vehicle emissions at drive-throughs.

In addition, the TDL Group wanted to know how the drive-through emissions will change in the future as aging models of automobiles are gradually phased out and replaced by newer models with lower emissions. Finally, the TDL Group wants information on how the emissions at drive-through facilities affect the local air quality around those facilities.

Methodology

Based on actual traffic surveys taken at peak times in four typical stores, an emission inventory was developed for two scenarios, Scenario 1: a conventional store with both drive-through and in-store operations and Scenario 2: a store with in-store service only (no drive-through.) Typical patterns or modes of operation for vehicles using the drive through and the parking lot were developed from these and other observations

This study examined the main pollutants of concern for motor vehicles, which are as follows:

- Smog pollutants – oxides of nitrogen (NO_X), hydrocarbons (HC), sulphur dioxide (SO_2) and particulate matter (PM);
- Local pollutants – carbon monoxide (CO); and
- Greenhouse gases – carbon dioxide (CO_2).

Emission models produced by the U.S. Environmental Protection Agency and other accepted methodologies were used to estimate emissions. Tedesco Engineering provided detailed traffic survey data that was used to calculate site-specific emissions.

The emission inventory for the drive-through portion of the facility was compared to "everyday" emission sources (i.e. lawn mowers, snow blowers, etc.). Dispersion modelling was conducted for a drive-through facility to predict maximum pollutant concentrations in the areas adjacent to a Tim Hortons store and compare them to provincial standards set out by the Ontario Ministry of the Environment (MOE).

Further technical details of the methodology can be found in the main text of the report. The method and findings were subjected to peer review by Dr. Deniz Karman of Carleton University http://www.carleton.ca/engineeringdesign/research/profiles/personal_bio.php?id=64.

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Findings

The total number of vehicles that use a conventional Tim Hortons facility during the morning peak hour was averaged to be 224; for vehicles using the drive-through, the average time on site ranged from 3 to about 4.5 minutes and for vehicles using the parking lot, the average time on site is about double, ranging from 7 to 8 minutes.

Modes of operation that produce emissions were determined to be:

- Moving into position in the queue lane or moving into a parking space (this mode of operation is referred to as "crawling");
- Idling while waiting for a parking space or warming up a vehicle in a parking space or waiting in the queue lane of the drive-through
- Pulling into and out-of a parking space;
- Starting up the engine in a parking space before exiting (referred to as a "start-up");
- Moving from the service window or from a parking space to the curb while exiting the site ("additional crawling"); and,
- Idling at the curb while waiting to get on the street**.**

Applying the standard vehicle emission data to these modes of operation for the average number of Tim Hortons customers at peak times in stores with drive throughs and without (using two scenarios in which the parking lot was approximately doubled and tripled in size, 2a and 2b respectively) produced the following emissions results during a peak hour of operation:

Figure i: Smog Pollutant Emissions for Drive-Through Restaurants (Scenario 1) and Non-Drive-Through Restaurants (Scenarios 2a and b)

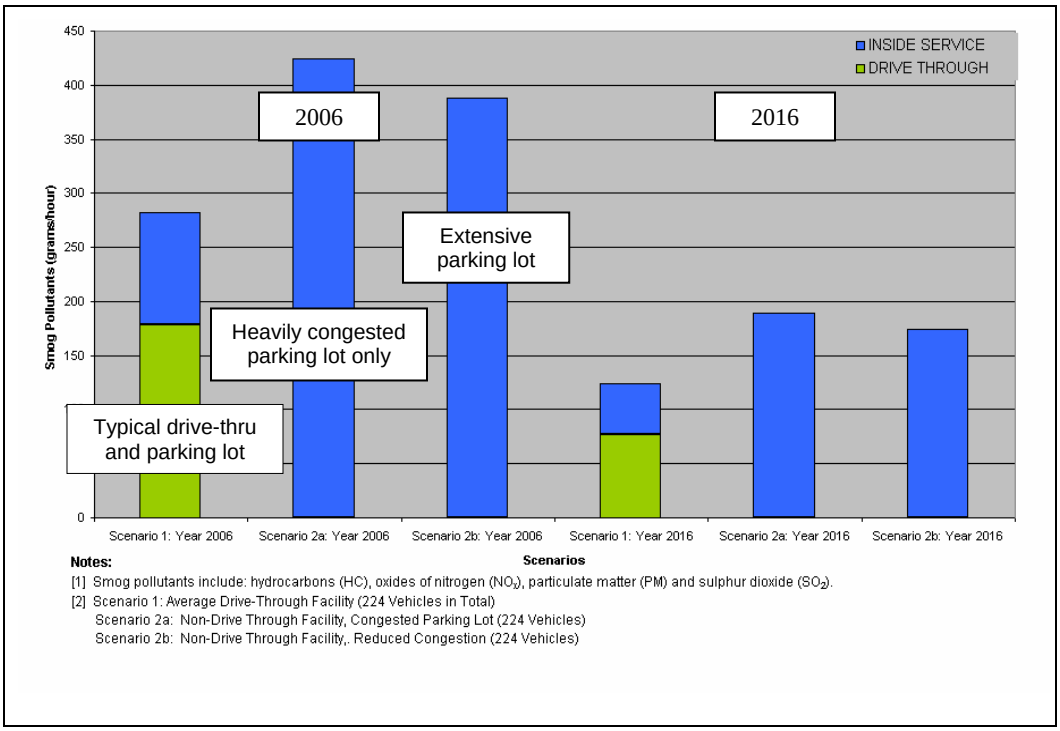
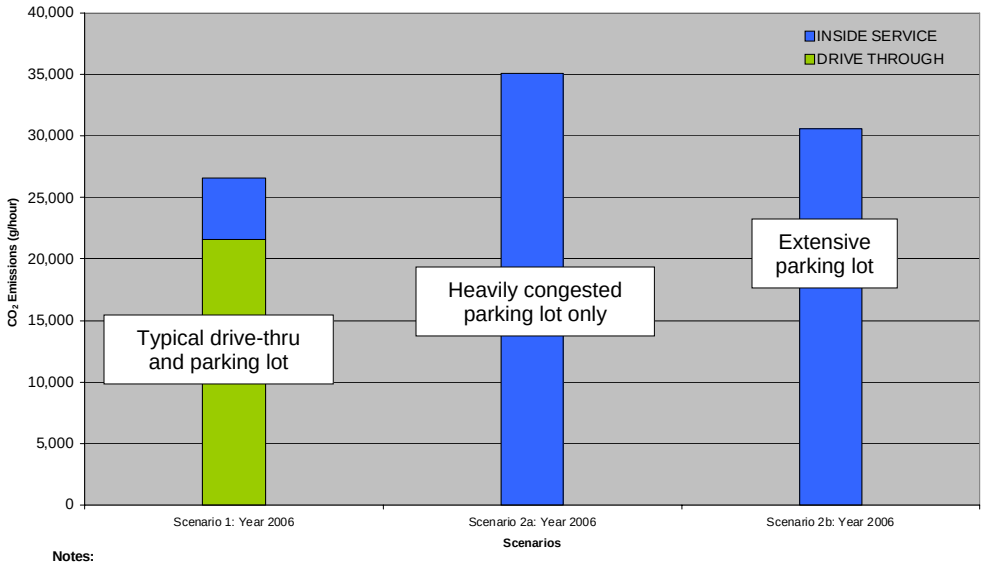


Figure ii: CO_2 Emissions for Drive-Through Restaurants (Scenario 1) and Non-Drive-Through Restaurants (Scenarios 2a and b)



Notes:
[1] Scenario 1: Average Morning Peak Drive-Through Facility (137 Vehicles Use Drive-Through and 87 Vehicles Using Inside Service)
[2] Scenario 1: Average Drive-Through Facility (224 Vehicles in Total)
Scenario 2a: Non-Drive Through Facility, Congested Parking Lot (224 Vehicles)
Scenario 2b: Non-Drive Through Facility,. Reduced Congestion (224 Vehicles)

Conclusions

- **Overall, the findings for the Tim Hortons stores examined in this study indicate no air quality benefit to the public from eliminating drive-throughs.**
- For a Tim Hortons store with no drive-through, the congestion that occurs in the parking lot, together with the start-up emissions and emissions from the extra travel distance to get to and from a space, all contribute to produce somewhat higher emissions per vehicle compared to a store that has a drive-through, this is particularly true in the case of smog pollutants and carbon monoxide (about 40 to 70% higher for those pollutants) but is also true for greenhouse gases (about 10 to 30% higher). These results are considered to be representative for Tim Hortons stores but cannot be generalized to other types of drive-through facilities.
- To put drive-throughs into perspective, combined emissions generated from all vehicles using a drive-through facility during a peak-hour of operation are relatively small in relation to other common emission sources: smog pollutant emissions from all vehicles are comparable to a single chain saw operating for one hour; CO_2 emissions are comparable to a single bus operating for one hour; emissions from all vehicles using a store with a drive-through during the peak hour are less than one fifth of the emissions at an urban intersection; and emissions of smog pollutants and greenhouse gases from a single vehicle using a drive-through are less than 10% and 5% respectively of a typical 30-minute morning commute.

- A comparison of Year 2006 and Year 2016 modelling indicates that predicted trends in fleet-wide emissions will result in reduced impacts from smog pollutants and carbon monoxide in the future.

- Dispersion modeling shows that 1-hour off-site concentrations of CO and NO_X are below the provincial standards in 2006 and even further below in 2016. Therefore, based on a typical site layout, there are no adverse air effects predicted for land uses adjacent to the drive-through facility.

Peer Review

Dr. Deniz Karman, PhD, P.Eng, received a Ph.D. in Chemical Engineering from the University of New Brunswick and is now a professor of environmental engineering at Carleton University in Ottawa. His research interests include: motor vehicle emissions and air quality in microenvironments; air pollution sources, control methods and dispersion modelling; and greenhouse gas emissions from industrial sources.

In addition to pursuing his own research interests, Doctor Karman has acted as a consultant on projects involving motor vehicle emissions monitoring, alternative fuel effects on motor vehicle emissions, dispersion modelling for roadways and street canyons, and receptor modelling source apportionment for volatile organic and particulate matter. http://www.carleton.ca/engineeringdesign/research/profiles/personal_bio.php?id=64

After reviewing the RWDI study Dr. Karman concluded

> **The RWDI study is a detailed quantitative attempt to estimate emissions from different vehicle patterns around *Tim Hortons* facilities with and without drive-through service. It has applied appropriate methodologies for quantifying these emissions in typical cases, has put the results obtained in the context of other emission sources, and estimated ambient concentrations around a typical facility. It provides a sound basis for estimating the effect of the two types of *Tim Hortons* facilities.**

Project Director

Mike Lepage, M.Sc., CCM, Principal / Project Director, joined RWDI in 1981 and became an Associate of the firm in 1988. As a Project Director, he provides overall direction on air quality and meteorological projects, ensuring that a high level of service is provided and, at the same time, RWDI's interests are preserved on all projects. Mike also oversees RWDI regional atmospheric modeling group, which is involved in high-end numerical modeling of regional air pollutants such as ground-level ozone and fine particulate matter. In recent years he has been extensively involved in regional modeling of meteorology and atmospheric chemistry to investigate large scale smog events, using models such MM5, Models-3/CMAQ, SAQM, CALGRID and CALPUFF.

RWDI

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