



Air Quality Assessment – Regional Road 25

Regional Road 25 Widening from 5 Side Road to 10 Side Road, Town of Halton Hills, ON

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Executive Summary

SLR Consulting (Canada) Ltd., was retained by HDR Inc. on behalf of the Regional Municipality of Halton (Halton Region) to conduct an air quality assessment for Regional Road 25 in the Town of Halton Hills, Ontario as part of the North Halton Coordinated Municipal Class Environmental Assessment (MCEA) Study. The purpose of the study is to address the proposed Regional Road 25 (RR 25) roadway improvements from 2 to 3 lanes from 5 Side Road to 10 Side Road in the Town of Halton Hills.

The main objective of the study was to assess the local air quality impacts due to the proposed Regional Road 25 improvements. The study also includes an overview of construction impacts and a screening level assessment of greenhouse gases (GHG). To meet these objectives, the following scenarios were considered:

- **2023 Existing No Build (NB)** – Assess the existing air quality conditions at representative receptors. Predicted contaminant concentrations from the existing traffic levels were combined with 90th percentile measured ambient concentrations to determine cumulative impacts.
- **2031 Future Build (FB)** – Assess the future air quality conditions with the proposed project in place. Predicted contaminant concentrations associated with increased traffic levels for the preferred alternative were combined with 90th percentile measured ambient concentrations to determine cumulative impacts.

The modelling considered vehicle emissions from Regional Road 25 and 5 Side Road. 10 Side Road was not included in the assessment, given there are no receptors in proximity to Regional Road 25 at this intersection.

The cumulative concentrations for the Future Build emissions scenario were below their respective MECP guidelines or CAAQS, with the exception of the annual PM_{2.5}, annual benzene, and 24-hr and annual Benzo(a)Pyrene. Note that background concentrations alone exceeded the guideline for all of these contaminants and averaging periods. The overall contribution from the roadway emissions to the combined concentrations was generally below 10%. The exceptions were the roadway contribution to 1-hour CO and 24-hour TSP which were 15% and 24% of the predicted cumulative concentrations, respectively.

Mitigation measures are not warranted, as the project does not introduce any new exceedances to the guideline, in comparison to background concentrations.



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Acronyms and Abbreviations

AAQC	Ambient Air Quality Criteria
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CH ₄	Methane
CO ₂	Carbon Dioxide
EC	Environment Canada
EPA	U.S. Environmental Protection Agency
FB	Future Build
GHG	Greenhouse Gases
GWP	Global Warming Potential
HC	Health Canada
MCEA	Municipal Class Environmental Assessment
MECP	Ministry of Environment, Conservation and Parks
MOVES	U.S. EPA's Motor Vehicle Emission Simulator
MTO	Ministry of Transportation Ontario
N ₂ O	Nitrous Oxide
NAAQOs	Health Canada/Environment Canada National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
NB	No Build
O ₃	Ground-level Ozone
PM _{2.5}	Particulate Matter
SLR	SLR Consulting (Canada) Ltd.
WRF	Weather Research and Forecasting
RR 25	Regional Road 25



1.0 Introduction

SLR Consulting (Canada) Ltd., was retained by HDR Inc. on behalf of the Regional Municipality of Halton (Halton Region) to conduct an air quality assessment for Regional Road 25 in the Town of Halton Hills, Ontario as part of the North Halton Coordinated Municipal Class Environmental Assessment (MCEA) Study. The purpose of the study is to address the proposed Regional Road 25 (RR 25) roadway improvements from 2 to 3 lanes from 5 Side Road to 10 Side Road. The project study area is shown in Figure 1. This encompasses approximately 3.0 km of improved roadway.

1.1 Study Objectives

The main objective of the study was to assess the local air quality impacts due to the proposed Regional Road 25 improvements. The study also includes an overview of construction impacts and a screening level assessment of greenhouse gases (GHG). To meet these objectives, the following scenarios were considered:

- **2023 Existing No Build (NB)** – Assess the existing air quality conditions at representative receptors. Predicted contaminant concentrations from the existing traffic levels were combined with 90th percentile measured ambient concentrations to determine cumulative impacts.
- **2031 Future Build (FB)** – Assess the future air quality conditions with the proposed project in place. Predicted contaminant concentrations associated with increased traffic levels for the preferred alternative were combined with 90th percentile measured ambient concentrations to determine cumulative impacts.

The modelling considered vehicle emissions from Regional Road 25 and 5 side Road. 10 Side Road was not included in the assessment, given there are no receptors in proximity to Regional Road 25 at this intersection.

The roadway segments considered in this assessment are shown in Figure 1.

1.2 Contaminants of Interest

The contaminants of interest from vehicle emissions are based on the regularly assessed contaminants of interest for transportation assessments in Ontario, as determined by the Ministry of Transportation Ontario (MTO) and Ministry of Environment, Conservation and Parks (MECP). Motor vehicle emissions have largely been determined by scientists and engineers with United States and Canadian government agencies such as the U.S. Environmental Protection Agency (EPA), the MECP, Environment Canada (EC), Health Canada (HC), and the MTO. These contaminants are emitted due to fuel combustion, brake wear, tire wear, the breakdown of dust on the roadway, fuel leaks, evaporation and permeation, and refuelling leaks and spills as illustrated in Figure 2. Note that emissions related to refuelling leaks and spills are not applicable to motor vehicle emissions from roadway travel. Instead, these emissions contribute to the overall background levels of the applicable contaminants. All of the selected contaminants are emitted during fuel combustion, while emissions from brake wear, tire wear, and breakdown of road dust include only the particulates. A summary of these contaminants is provided in Table 1.



Table 1: Contaminant of Interest

Criteria Air Contaminants		Volatile Organic Compounds (VOCs)		Polycyclic Aromatic Hydrocarbons (PAH)	
Name	Symbol	Name	Symbol	Name	Symbol
Nitrogen Dioxide	NO ₂	Acetaldehyde	C ₂ H ₄ O	Benzo(a)Pyrene	C ₂₀ H ₁₂
Carbon Monoxide	CO	Acrolein	C ₃ H ₄ O		
Fine Particulate Matter (<2.5 microns in diameter)	PM _{2.5}	Benzene	C ₆ H ₆		
Coarse Particulate Matter (<10 microns in diameter)	PM ₁₀	1,3-Butadiene	C ₄ H ₆		
Total Suspended Particulate Matter (<44 microns in diameter)	TSP	Formaldehyde	CH ₂ O		

1.3 Applicable Guidelines

In order to understand the existing conditions in the study area, ambient background concentrations have been compared to guidelines established by government agencies and organizations. Relevant agencies and organizations in Ontario and Canada, and their applicable contaminant guidelines are:

- MECP Ambient Air Quality Criteria (AAQC);
- Health Canada/Environment Canada National Ambient Air Quality Objectives (NAAQOs); and
- Canadian Council of Ministers of the Environment (CCME) Canadian Ambient Air Quality Standards (CAAQS).

Within the guidelines, the threshold value for each contaminant and its applicable averaging period were used to assess the maximum predicted impact at sensitive receptors derived from a combined result of ambient concentration and computer simulations. The contaminants of interest are compared against 1-hour, 8-hour, 24-hour, and annual averaging periods. The threshold values and averaging periods used in this assessment are presented in Table 2. It should be noted that the CAAQS for NO₂ and PM_{2.5} are not based on the maximum concentration values; they are assessed based on the annual 98th percentile value, averaged over 3 consecutive years.



Table 2: Applicable Contaminant Guidelines

Contaminant	Averaging Period (hrs)	Threshold Value (µg/m ³)	Source
NO ₂	1	400	AAQC
	24	200	AAQC
	1	79 (42 ppb) ^[1]	CAAQS
	Annual	23 (12 ppb) ^[2]	CAAQS
CO	1	36,200	AAQC
	8	15,700	AAQC
PM _{2.5}	24	27 ^[3]	CAAQS
	Annual	8.8 ^[4]	CAAQS
PM ₁₀	24	50	Interim AAQC
TSP	24	120	AAQC
Acetaldehyde	0.5	500	AAQC
Acetaldehyde	24	500	AAQC
Acrolein	24	0.4	AAQC
	1	4.5	AAQC
Benzene	24	2.3	AAQC
	Annual	0.45	AAQC
1,3-Butadiene	24	10	AAQC
	Annual	2	AAQC
Formaldehyde	24	65	AAQC
Benzo(a)Pyrene	24	0.00005	AAQC
	Annual	0.00001	AAQC
[1] The 1-hour NO₂ CAAQS is based on the 3-year average of the annual 98th percentile of the NO₂ daily maximum 1-hour average concentrations [2] The annual NO₂ CAAQS is based on the average over a single calendar year of all the 1-hour average NO₂ concentrations [3] The 24-hr PM_{2.5} CAAQS is based on the 3-year average of the annual 98th percentile of the 24-hr average concentrations [4] The annual PM_{2.5} CAAQS is based on the average of the three highest annual average values over the study period			

1.4 General Assessment Methodology

The worst-case contaminant concentrations due to motor vehicle emissions from the roadways were predicted at nearby receptors using dispersion modelling software on an hourly basis for a five-year period. Meteorological data for the years 2021-2025 were prepared and provided by the MECF for use in the air quality assessment. Five years were modelled to capture the worst-case meteorological conditions. Two emission scenarios were assessed: 2023 NB and 2031 FB.



Cumulative concentrations were determined by adding modelled and background (i.e., ambient data) concentrations together with 90th percentile background concentrations. Background concentrations for all available contaminants were determined from MECP and NAPS (National Air Pollution Surveillance) stations nearest to the study area with applicable datasets.

Maximum 1-hour, 8-hour, 24-hour, and annual predicted combined concentrations were determined for comparison with the applicable guidelines using emission and dispersion models published by the U.S. Environmental Protection Agency (EPA). The worst-case predicted impacts are presented in this report; however, it is important to note that the worst-case impacts may occur infrequently and at only one receptor location.

2.0 Background Ambient Data

2.1 Overview

Background (ambient) conditions are measured contaminant concentrations that are independent of emissions from the proposed project infrastructure. These concentrations consist of trans-boundary (macro-scale), regional (meso-scale), and local (micro-scale) emission sources and result from both primary and secondary formation. Primary contaminants are emitted directly by the source and secondary contaminants are formed by complex chemical reactions in the atmosphere. Secondary pollution is generally formed over great distances in the presence of sunlight and heat and most noticeably results in the formation of fine particulate matter (PM_{2.5}) and ground-level ozone (O₃), also considered smog.

In Ontario, a significant amount of smog originates from emission sources in the United States, which is the major contributor during smog events that usually occur in the summer season (MECP, 2005). During smog episodes, the U.S. contribution to PM_{2.5} levels can be as much as 90 percent near the southwest Ontario-U.S. border. The effects of U.S. air pollution in Ontario on a high PM_{2.5} day and on an average PM_{2.5} spring/summer day are illustrated in Figure 3.

Air pollution is strongly influenced by weather systems (i.e., meteorology) that commonly move out of central Canada into the mid-west of the U.S. then eastward to the Atlantic coast. This weather system generally produces winds blowing from the southwest, which can travel over major emission sources in the U.S. and result in the transport of pollution into Ontario. This phenomenon is demonstrated in Figure 4 and is based on a computer simulation from the Weather Research and Forecasting (WRF) Model.

As discussed, understanding the composition of background air pollution and its influences are important in determining potential impacts of a project, considering that the majority of the combined concentrations are typically due to existing ambient background levels. In this assessment, background conditions were characterized utilizing existing ambient monitoring data from MECP and NAPS Network stations and added to the modelled predictions to conservatively estimate combined concentrations.

2.2 Selection of Relevant Ambient Monitoring Stations

A review of MECP and NAPS ambient monitoring stations in Ontario was undertaken to identify the monitoring stations that are in relative proximity to the study area and that would be representative of background contaminant concentrations. The nearest MECP stations are the Oakville and Mississauga stations, located approximately 14 km south/southeast of the site. The nearest NAPS station with most recent data available is the Toronto West station.



Therefore, these monitoring stations were reviewed to understand background concentrations in the study area. The locations of the relevant ambient monitoring stations in relation to the study area are shown in Figure 5. Station information is presented in Table 3.

Table 3: Relevant MECP and NAPS Station Information

City/Town	Station ID	Location	Operator	Contaminant
Mississauga	46109	3359 Mississauga Road North	MECP	NO ₂ PM _{2.5}
Oakville	44017	Eighth Line/Glenashton Dr.	MECP	NO ₂ PM _{2.5}
Toronto West	35125	125 Resources Road	MECP	CO
Toronto West	60438	401W - 125 Resources Road	NAPS	Benzo(a)Pyrene Formaldehyde Acetaldehyde Acrolein Benzene 1,3-Butadiene

2.3 Detailed Analysis of Selected Worst-case Monitoring Stations

Ambient monitoring data for the years 2020 to 2024 from the selected stations were reviewed for the desired averaging periods: 1-hour, 8-hour, 24-hour, and annual, where available. Measurements for benzene, 1,3-butadiene, and Benzo(a)Pyrene at the Toronto West monitoring station were available for the years 2019-2024, however, the year 2020 was found to have insufficient data and was therefore excluded from the analysis of background concentrations. The contaminants formaldehyde and acetaldehyde are measured at the Toronto West station from 2018-2019 and 2022-2024; there was found to be insufficient data available for 2020 and 2021. Measurements for Acrolein at the Toronto West monitoring station were available for the years 2014-2018

Note that PM₁₀ and TSP are not measured in Ontario; therefore, background concentrations were estimated by applying a PM_{2.5}/PM₁₀ ratio of 0.54 and a PM_{2.5}/TSP ratio of 0.3 (Lall et al., 2004).

For each contaminant and averaging period, the station with the highest 90th percentile concentration was selected for use in the cumulative analysis. Table 4 shows the selected monitoring station for the various contaminants considered in the assessment. Figure 6A shows a comparison of the 90th percentile concentration from each monitoring station and for each contaminant and averaging period. Figure 6B shows a summary of the measured ambient concentrations at each of the identified worst-case stations, as a percentage of the applicable guideline.



Table 4: Summary of Selected Monitoring Stations

Contaminant	Averaging Period	Monitoring Station	Data Years	Threshold (ug/m3)	Source	90 th Percentile Background Concentration (ug/m3)	Percent of Threshold ^[3]
NO ₂	1-hour	Oakville	2020 - 2024	400	AAQC	31	8%
NO ₂	24-hour	Oakville	2020 - 2024	200	AAQC	26	13%
NO ₂ _CAAQS	1-hour	Oakville	2020 - 2024	79	CAAQS	60	75%
NO ₂ _CAAQS	Annual ^[2]	Oakville	2020 - 2024	23	CAAQS	15	67%
NO _x	1-hour	Toronto West	2020 - 2024	400	AAQC	73	18%
NO _x	24-hour	Toronto West	2020 - 2024	200	AAQC	62	31%
CO	1-hour	Toronto West	2020 - 2024	36200	AAQC	421	1%
CO	8-hour	Toronto West	2020 - 2024	15700	AAQC	396	3%
PM _{2.5}	24-hour	Mississauga	2020 - 2024	27	CAAQS	13	47%
PM _{2.5}	Annual ^[2]	Oakville	2020 - 2024	8.8	CAAQS	10	110%
PM ₁₀ ^[1]	24-hour	Mississauga	2020 - 2024	50	Interim AAQC	24	47%
TSP ^[1]	24-hour	Mississauga	2020 - 2024	120	AAQC	42	35%
Acetaldehyde	0.5-hour	Toronto West	2018 - 2024	500	AAQC	9.77	2%
Acetaldehyde	24-hour	Toronto West	2018 - 2024	500	AAQC	3.26	1%
Acrolein	1-hour	Toronto West	2014 - 2018	4.5	AAQC	0.18	4%
Acrolein	24-hour	Toronto West	2014 - 2018	0.4	AAQC	0.07	18%
Benzene	24-hour	Toronto West	2019 - 2024	2.3	AAQC	0.67	29%
Benzene	Annual ^[2]	Toronto West	2019 - 2024	0.45	AAQC	0.53	118%
1,3-Butadiene	24-hour	Toronto West	2019 - 2024	10	AAQC	0.08	1%
1,3-Butadiene	Annual ^[2]	Toronto West	2019 - 2024	2	AAQC	0.05	3%
Formaldehyde	24-hour	Toronto West	2018 - 2024	65	AAQC	3.01	5%
Benzo(a)Pyrene	24-hour	Toronto West	2019 - 2024	5.00E-05	AAQC	1.09E-04	218%
Benzo(a)Pyrene	Annual ^[2]	Toronto West	2019 - 2024	1.00E-05	AAQC	8.80E-05	880%
Note [1]: PM ₁₀ and TSP are not measured in Ontario; therefore, background concentrations were estimated from PM _{2.5} concentrations.							
Note [2]: For annual averages, the maximum annual average concentration within the five-year period was selected to represent ambient concentrations, rather than the 90 th percentile.							
Note [3]: Red text indicates an exceedance of the threshold.							



Based on a review of the ambient monitoring data, 90th percentile background concentrations were generally below their respective guidelines. The exception is the Benzo(a)Pyrene 24-hour 90th percentile concentration, which is 218% of the guideline. Additionally, the annual PM_{2.5}, benzene and Benzo(a)Pyrene concentrations also exceed the applicable guidelines. Note that for annual averages, the maximum annual average within the five-year period was selected to represent ambient concentrations, rather than the 90th percentile.

3.0 Local Air Quality Assessment

3.1 Location of Sensitive Receptors within the Study Area

Land uses which are defined as sensitive receptors for evaluating potential air quality effects are:

- Health care facilities;
- Senior citizens' residences or long-term care facilities;
- Childcare facilities;
- Educational facilities;
- Places of worship; and
- Residential dwellings.

Twenty-two (22) sensitive receptor locations were selected to be representative of potential impacts within the study area. They include existing residential houses in close proximity to Regional Road 25 as shown in Figure 7A, 7B, and 7C.

3.2 Road Traffic Data

Traffic data was provided by HDR Inc. for Regional Road 25 and 5 side Road for the 2023 NB and 2031 FB configurations. The Future Build volumes include traffic projections along Regional Road 25 and 5 side Road. The AADT volumes used in the assessment are shown in Table 5. Vehicle posted speeds for Regional Road 25 and 5 side Road are also shown in Table 5.

Lastly, a truck percentage was also provided by HDR Inc. for the study area. The detailed breakdown of medium and heavy trucks on all modelled roads can be found in Table 6. Hourly traffic breakdowns were not available for Regional Road 25 and 5 side Road; therefore, the US EPA standard urban weekday and weekend hourly distributions were used for these roadways. The hourly distributions applied in this assessment are shown in Table 7.

Table 5: Traffic Volumes (AADT – Vehicles/Day) Used in the Assessment

Roadway	Section	Posted Speed (km/hr)	2023 NB AADT	2031 FB AADT
RR 25	S. of 5 Side Rd.	70	13,900	14,790
	5 side Rd to 10 Side Rd.	80	13,000	13,900
	N. of 10 Side Rd	80	12,400	13,200
5 Side Rd.	E. of RR 25	60	3,600	3,600
	W. of RR 25	60	2,900	2,900



Table 6: Truck Percentages used in the Assessment

Roadway	Section	Medium Truck (%)	Heavy Truck (%)
RR 25	S. of 5 Side Rd.	4.4	9.9
	5 side Rd to 10 Side Rd.	3.9	8.7
	N. of 10 Side Rd	4.4	9.7
5 Side Rd.	E. of RR 25	5.2	11.7
	W. of RR 25	1.4	3.2

Table 7: Hourly Vehicle Distribution Used in the Assessment

Hour ^[1]	US EPA Weekday	US EPA Weekend
01:00	0.9%	2.2%
02:00	0.6%	1.4%
03:00	0.5%	1.0%
04:00	0.4%	0.8%
05:00	0.6%	0.7%
06:00	1.9%	1.0%
07:00	4.6%	1.9%
08:00	6.9%	2.6%
09:00	6.1%	3.8%
10:00	5.0%	4.8%
11:00	5.1%	5.9%
12:00	5.4%	6.5%
13:00	5.8%	7.1%
14:00	5.9%	7.1%
15:00	6.2%	7.1%
16:00	7.1%	7.2%
17:00	7.7%	7.1%
18:00	7.9%	6.8%
19:00	6.0%	6.0%
20:00	4.4%	5.2%
21:00	3.5%	4.3%
22:00	3.1%	3.9%
23:00	2.5%	3.2%
24:00	1.9%	2.4%

Note [1] – Beginning of hour period.



3.3 Meteorological Data

A 5-year meteorological dataset from 2021 to 2025 was prepared by the MECP, with surface and upper air data from the US National Oceanic and Atmospheric Administration (NOAA)'s UnRestricted Mesoscale Analysis (URMA) (2.5km x 2.5km resolution) and High Resolution Rapid Refresh (3km x 3km resolution) analysis data, respectively, both extracted at the grid cells closest to the center of the proposed road segment. This meteorological dataset provided was ready for use with the CAL3QHCR vehicle emission dispersion model. A wind frequency diagram (wind rose) is shown in Figure 8.

As can be seen in Figure 8, predominant winds are from the southwesterly through northwesterly directions.

3.4 Motor Vehicle Emission Rates

The U.S. EPA's Motor Vehicle Emission Simulator (MOVES) model provides estimates of current and future emission rates from motor vehicles based on a variety of factors such as local meteorology, vehicle fleet composition and speed. MOVES 4.0, released in August 2023, is the U.S. EPA's latest tool for estimating vehicle emissions due to the combustion of fuel, brake and tire wear, fuel evaporation, permeation, and refuelling leaks. The MOVES model is based on "an analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions and accounts for changes in emissions due to proposed standards and regulations".

For this project, MOVES was used to estimate vehicle emissions based on vehicle type, road type, fuel type, and vehicle speed. Emission rates were estimated for the year 2023 and 2031 for various medium/heavy truck percentages (provided in Table 6). Vehicle age is based on the US EPA standard vehicle age distribution.

From the MOVES outputs, the highest monthly value for each contaminant was selected to represent a worst-case emission rate. Example emission rates for each vehicle speed and contaminant modelled are shown in Table 8 and Table 9. These emission rates are for the existing/No-Build (NB) and Future Build (FB) years, for a heavy/medium truck percentage of 4.4/9.9%, respectively. As shown in Table 8 and Table 9, emissions in the future year are generally predicted to decrease. This is due to the key assumptions of the MOVES model which predicts decreases in emissions in the future due to improved technologies and predicts vehicles meeting future federal emission target regulations. The MOVES default values for vehicle fleet population, including electric vehicle fractions was considered in this assessment.

It should be noted that there are two active initiatives aimed at reducing emissions from truck traffic. These include the MTO drive program and the federal initiative of Zero-Emission Trucking Program. The Ontario Drive Program includes performance standards and emissions testing for commercial heavy duty diesel vehicles. The federal Zero-Emission Trucking Program aims to accelerate the deployment of Medium and Heavy-Duty Zero-Emission Vehicles on Canadian roads through four key program activities. Though not quantified through the MOVES emission rates applied in this assessment, these programs are anticipated to support a reduction in future emission from heavy duty vehicles.



Table 8: MOVES Output Emission Factors for Roadway Vehicles (g/VMT); Idle Emission Rates are grams per vehicle hour (NB2023)

Pollutant	2023 (NB)			
	60 km/hr	70 km/hr	80 km/hr	Idle
Carbon Monoxide	2.77E+00	2.37E+00	2.29E+00	6.39E+00
Oxides of Nitrogen	4.76E-01	3.83E-01	3.36E-01	5.84E+00
Benzene	1.56E-03	1.30E-03	1.23E-03	1.84E-02
1,3-Butadiene	3.33E-05	2.70E-05	2.52E-05	9.72E-04
Formaldehyde	1.15E-03	9.40E-04	8.62E-04	2.72E-02
Acetaldehyde	7.49E-04	6.14E-04	5.54E-04	1.61E-02
Acrolein	7.06E-05	5.93E-05	5.44E-05	1.90E-03
Nitrogen Dioxide	8.27E-02	6.50E-02	5.62E-02	9.69E-01
Total PM ₁₀	6.71E-02	4.16E-02	3.15E-02	1.35E-01
Total PM _{2.5}	1.40E-02	1.01E-02	8.43E-03	1.23E-01
Benzo(a)Pyrene	9.72E-07	8.71E-07	8.51E-07	2.15E-05



Table 9: MOVES Output Emission Factors for Roadway Vehicles (g/VMT); Idle Emission Rates are grams per vehicle hour (FB2031)

Pollutant	2031 (FB)			
	60 km/hr	70 km/hr	80 km/hr	Idle
Carbon Monoxide	1.65E+00	1.43E+00	1.38E+00	4.37E+00
Oxides of Nitrogen	2.09E-01	1.63E-01	1.39E-01	3.86E+00
Benzene	1.09E-03	9.35E-04	8.87E-04	1.32E-02
1,3-Butadiene	9.84E-07	8.28E-07	7.69E-07	8.12E-05
Formaldehyde	5.39E-04	4.42E-04	4.02E-04	1.04E-02
Acetaldehyde	3.74E-04	3.03E-04	2.67E-04	7.65E-03
Acrolein	2.90E-05	2.44E-05	2.20E-05	6.49E-04
Nitrogen Dioxide	3.71E-02	2.81E-02	2.35E-02	7.08E-01
Total PM ₁₀	6.42E-02	6.28E-02	3.79E-02	3.94E-02
Total PM _{2.5}	1.31E-02	1.01E-02	6.79E-03	3.58E-02
Benzo(a)Pyrene	9.49E-07	5.31E-07	5.00E-07	6.88E-06



3.5 Re-suspended Particulate Matter Emission Rates

A large portion of highway particulate matter emissions comes from dust on the pavement which is re-suspended by vehicles travelling on the highway. These emissions are estimated using empirically derived values presented by the U.S. EPA in their AP-42 report. The emissions factors for re-suspended PM were estimated by using the following equation from U.S. EPA's Document AP-42 report, Chapter 13.2.1.3 and are summarized in Table 10.

$$E = k(sL)^{0.91} * (W)^{1.02}$$

Where: E = the particulate emission factor

k = the particulate size multiplier

sL = silt loading

W = average vehicle weight (Assumed 3 Tons based on fleet data and U.S. EPA vehicle weight and distribution)

Table 10: Re-suspended Particulate Matter Emission Factors

Roadway AADT	K (PM _{2.5} /PM ₁₀ /TSP)	sL (g/m ²)	W (Tons)	E (g/VMT)		
				PM _{2.5}	PM ₁₀	TSP
<500	0.25/1.0/5.24	0.6	3	0.503	2.02	10.56
500-5,000	0.25/1.0/5.24	0.2	3	0.185	0.74	3.89
5,000-10,000	0.25/1.0/5.24	0.06	3	0.061	0.25	1.30
>10,000	0.25/1.0/5.24	0.03	3	0.032	0.13	0.69

3.6 Air Dispersion Modelling Using CAL3QHCR

The U.S. EPA's CAL3QHCR (Calroads) dispersion model, based on the Gaussian plume equation, was specifically designed to predict air quality impacts from roadways using site specific meteorological data, vehicle emissions, traffic data, and signal data. The model input requirements include roadway geometry, sensitive receptor locations, meteorology, traffic volumes, and motor vehicle emission rates as well as some contaminant physical properties such as settling and deposition velocities. CAL3QHCR uses this information to calculate hourly concentrations which are then used to determine 1-hour, 8-hour, 24-hour, and annual averages for the contaminants of interest at the identified sensitive receptor locations. Table 11 provides the major inputs used in CAL3QHCR. The emission rates used in the model were the outputs from the MOVES and AP-42 models, weighted for the vehicle fleet distributions provided. The outputs of CAL3QHCR are presented in the results section.

Table 11: CAL3QHCR Model Input Parameters

Parameter	Input
Free-Flow and Queue Link Traffic Data	Hourly traffic distributions were applied to the AADT traffic volumes to input traffic volumes in vehicles/hour. Emission rates from the MOVES output were inputted in grams/VMT or grams per vehicle hour. Signal timings for the traffic signal were input in seconds.



Parameter	Input
Meteorological Data	2021-2025 site specific data provided by the MECP
Deposition Velocity	PM _{2.5} : 0.1 cm/s PM ₁₀ : 0.5 cm/s TSP: 0.15 cm/s Benzo(a)Pyrene, NO ₂ , CO and VOCs: 0 cm/s
Settling Velocity	PM _{2.5} : 0.02 cm/s PM ₁₀ : 0.3 cm/s TSP: 1.8 cm/s Benzo(a)Pyrene, CO, NO ₂ , and VOCs: 0 cm/s
Surface Roughness	The land use surrounding the project site is categorized as low-rise residential/commercial/industrial. Therefore, a surface roughness height of 54 cm was applied in the model.
Vehicle Emission Rate	Emission rates calculated in MOVES and AP-42 were input in g/VMT

3.7 Modelling Results

Presented below are the cumulative concentrations for the 2023 NB and 2031 FB scenarios based on 5-years of meteorological data. The cumulative concentration considers the maximum model concentration and the 90th percentile background concentration. Results in this section are presented for the worst-case sensitive receptors for each contaminant and averaging period, which were identified as the maximum modelled concentration for each scenario. Results for all modelled receptors are provided in Appendix A.

The cumulative concentration was used to assess compliance with MECP guidelines or CAAQS. The results for each contaminant and averaging period at the worst-case sensitive receptor for the 2023 NB and 2031 FB scenarios are presented in Table 12, Table 13, and Table 14, respectfully.

The cumulative concentrations for the Future Build emissions scenario were below their respective MECP guidelines or CAAQS, with the exception of the annual PM_{2.5}, annual benzene, and 24-hr and annual Benzo(a)Pyrene. Note that background concentrations alone exceeded the guideline for all of these contaminant averaging periods. The overall contribution from the roadway emissions to the combined concentrations was generally below 10%. The exceptions were the roadway contribution to 1-hour CO and 24-hour TSP which were 15% and 24% of the predicted cumulative concentrations, respectively.

Mitigation measures are not warranted, as the project does not introduce any new exceedances to the guideline, in comparison to background concentrations.

A comparison of the results from each of the modelled scenarios is provided in Table 14. When comparing the two modelled scenarios as a percentage of the applicable guidelines, the results are very similar. This shows that the background concentrations (which are unchanged between the two scenarios) dominate the cumulative concentrations. In addition, while traffic volumes are predicted to increase in future years, emission rates are predicted to decrease in the US EPA MOVES model, resulting in generally similar or lower predicted maximum model concentrations for the Future Build scenario.



Table 12: Worst Case Combined Concentrations for 2023 NB Scenario

Contaminant	Averaging Period	Air Quality Threshold (ug/m ³)	90 th Percentile Background Concentration (ug/m ³)	Maximum Modelled Concentration (ug/m ³)	Cumulative Concentration (ug/m ³)	Cumulative Concentration Percent of Threshold ^[2]	Worst Case Receptor
NO ₂	1-hour	400	31	3.0	34	8%	Rec10
NO ₂	24-hour	200	26	0.5	27	13%	Rec16
NO ₂ _CAAQS	1-hour	79	60	1.8	61	78%	Rec10
NO ₂ _CAAQS	Annual ^[1]	23	15	0.2	16	68%	Rec10
NO _x	1-hour	400	73	16.9	90	23%	Rec10
NO _x	24-hour	200	62	2.8	65	32%	Rec16
CO	1-hour	36200	421	114.0	535	1%	Rec10
CO	8-hour	15700	396	39.3	435	3%	Rec10
PM _{2.5}	24-hour	27	13	0.4	13	49%	Rec16
PM _{2.5}	Annual ^[1]	8.8	10	0.2	10	112%	Rec10
PM ₁₀	24-hour	50	24	2.2	26	51%	Rec16
TSP	24-hour	120	42	12.0	54	45%	Rec16
Acetaldehyde	0.5-hour	500	10	0.04	10	2%	Rec10
Acetaldehyde	24-hour	500	3	0.005	3.3	1%	Rec16
Acrolein	1-hour	4.5	0.18	0.003	0.18	4%	Rec10
Acrolein	24-hour	0.4	0.07	0.0004	0.07	18%	Rec16
Benzene	24-hour	2.3	0.67	0.01	0.68	30%	Rec16
Benzene	Annual ^[1]	0.45	0.53	0.003	0.53	119%	Rec10
1,3-Butadiene	24-hour	10	0.08	2.08E-04	0.08	1%	Rec16
1,3-Butadiene	Annual ^[1]	2	0.05	6.88E-05	0.05	3%	Rec10
Formaldehyde	24-hour	65	3	0.007	3.02	5%	Rec16
Benzo(a)Pyrene	24-hour	5.00E-05	1.09E-04	7.01E-06	1.16E-04	232%	Rec16
Benzo(a)Pyrene	Annual ^[1]	1.00E-05	8.80E-05	2.32E-06	9.03E-05	903%	Rec10

Note [1]: For annual averages, the maximum annual average concentration within the five-year period was selected to represent ambient concentrations, rather than the 90th percentile.
Note [2]: Red text indicates an exceedance of the threshold.



Table 13: Worst Case Combined Concentrations for 2031 FB Scenario

Contaminant	Averaging Period	Air Quality Threshold (ug/m ³)	90 th Percentile Background Concentration (ug/m ³)	Maximum Modelled Concentration (ug/m ³)	Cumulative Concentration (ug/m ³)	Cumulative Concentration Percent of Threshold ^[2]	Worst Case Receptor
NO ₂	1-hour	400	31	1.1	32	8%	Rec3
NO ₂	24-hour	200	26	0.2	26	13%	Rec18
NO ₂ _CAAQS	1-hour	79	60	0.7	60	76%	Rec3
NO ₂ _CAAQS	Annual ^[1]	23	15	0.1	15	67%	Rec3
NO _x	1-hour	400	73	7.5	81	20%	Rec3
NO _x	24-hour	200	62	1.3	63	32%	Rec18
CO	1-hour	36200	421	74.1	496	1%	Rec3
CO	8-hour	15700	396	25.2	421	3%	Rec3
PM _{2.5}	24-hour	27	13	0.5	13	49%	Rec18
PM _{2.5}	Annual ^[1]	8.8	10	0.2	10	112%	Rec3
PM ₁₀	24-hour	50	24	2.5	26	52%	Rec18
TSP	24-hour	120	42	13.5	56	47%	Rec18
Acetaldehyde	0.5-hour	500	10	0.019	10	2%	Rec3
Acetaldehyde	24-hour	500	3	0.003	3.3	1%	Rec18
Acrolein	1-hour	4.5	0.18	0.001	0.18	4%	Rec3
Acrolein	24-hour	0.4	0.07	0.0002	0.07	18%	Rec18
Benzene	24-hour	2.3	0.67	0.008	0.68	30%	Rec18
Benzene	Annual ^[1]	0.45	0.53	0.003	0.53	119%	Rec3
1,3-Butadiene	24-hour	10	0.08	7.43E-06	0.08	1%	Rec18
1,3-Butadiene	Annual ^[1]	2	0.05	2.40E-06	0.05	3%	Rec3
Formaldehyde	24-hour	65	3	0.004	3.02	5%	Rec18
Benzo(a)Pyrene	24-hour	5.00E-05	1.09E-04	4.64E-06	1.14E-04	227%	Rec18
Benzo(a)Pyrene	Annual ^[1]	1.00E-05	8.80E-05	1.50E-06	8.95E-05	895%	Rec3
Note [1]: For annual averages, the maximum annual average concentration within the five year period was selected to represent ambient concentrations, rather than the 90 th percentile.							
Note [2]: Red text indicates an exceedance of the threshold.							



Table 14: Comparison of Results Between Scenarios

Contaminant	Averaging Period	Threshold	90 th Percentile Background Concentration (ug/m ³)	2023 Maximum Modelled Concentration (ug/m ³)	2031 Maximum Modelled Concentration (ug/m ³)	2023 NB Cumulative Concentration Percent of Threshold ^[1]	2031 FB Cumulative Concentration Percent of Threshold ^[1]
NO ₂	1-hour	400	31	3.0	1.1	8%	8%
NO ₂	24-hour	200	26	0.5	0.2	13%	13%
NO ₂ _CAAQS	1-hour	79	60	1.8	0.7	78%	76%
NO ₂ _CAAQS	Annual ^[1]	23	15	0.2	0.1	68%	67%
NO _x	1-hour	400	73	16.9	7.5	23%	20%
NO _x	24-hour	200	62	2.8	1.3	32%	32%
CO	1-hour	36200	421	114.0	74.1	1%	1%
CO	8-hour	15700	396	39.3	25.2	3%	3%
PM _{2.5}	24-hour	27	13	0.4	0.5	49%	49%
PM _{2.5}	Annual ^[1]	8.8	10	0.2	0.2	112%	112%
PM ₁₀	24-hour	50	24	2.2	2.5	51%	52%
TSP	24-hour	120	42	12.0	13.5	45%	47%
Acetaldehyde	0.5-hour	500	10	0.04	0.019	2%	2%
Acetaldehyde	24-hour	500	3	0.005	0.003	1%	1%
Acrolein	1-hour	4.5	0.18	0.003	0.001	4%	4%
Acrolein	24-hour	0.4	0.07	0.0004	0.0002	18%	18%
Benzene	24-hour	2.3	0.67	0.01	0.008	30%	30%
Benzene	Annual ^[1]	0.45	0.53	0.003	0.003	119%	119%
1,3-Butadiene	24-hour	10	0.08	2.08E-04	7.43E-06	1%	1%
1,3-Butadiene	Annual ^[1]	2	0.05	6.88E-05	2.40E-06	3%	3%
Formaldehyde	24-hour	65	3	0.007	0.004	5%	5%
Benzo(a)Pyrene	24-hour	0.00005	1.09E-04	7.01E-06	4.64E-06	232%	227%
Benzo(a)Pyrene	Annual ^[1]	0.00001	8.80E-05	2.32E-06	1.50E-06	903%	895%

Note [1]: Red text indicates an exceedance of the threshold.



4.0 Greenhouse Gas Assessment

In addition to the contaminants of interest assessed in the local air quality assessment, greenhouse gas (GHG) emissions were predicted from the project. Potential impacts were assessed by calculating the relative change in total emissions between the 2023 NB and 2031 FB scenarios as well as comparing the total emissions to the 2030 provincial and Canada-wide GHG targets. Total GHG emissions from the roadway were determined based on the length of the roadway, traffic volumes, and predicted emission rates.

From a GHG perspective, the contaminants of concern from motor vehicle emissions are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). These GHGs can be further classified according to their Global Warming Potential (GWP). The GWP is a multiplier developed for each GHG, which allows comparison of the ability of each GHG to trap heat in the atmosphere, relative to carbon dioxide. Using these multipliers, total GHG emissions can be classified as CO₂ equivalent emissions. Methane has a CO₂ equivalent of 25 and nitrous oxide has a CO₂ equivalent of 298. For this assessment, the MOVES model was used to determine total CO₂ equivalent emission rates for the posted speed and truck percentage on Regional Road 25 and 5 side Road. Table 15 summarizes the length of the roadway, traffic volumes, and emission rates used to determine total GHG emissions on Regional Road 25 and 5 side Road in the 2023 NB and 2031 FB scenarios.

The total predicted annual GHG emissions for the 2023 NB and 2031 FB scenarios are shown in Table 16. Also shown is the percent change in total GHG emissions between the scenarios. The results show that the total GHG emissions decrease by 16%. While there is a 6% increase in road traffic, the decrease in the overall CO₂ equivalent emissions is due to improvements in vehicles emissions from EPA predictions in engine efficiency and federal targets.

Table 17 shows the GHG emissions on Regional Road 25 and 5 side Road represent 0.009% of the Ontario-wide Transportation emissions reduction target and 0.004% of the Canada-wide Transportation emissions reduction target. The contribution of GHG emissions from the project is small in comparison to these provincial and national targets.



Table 15: Summary of the Modelled Roads Traffic Volumes, Roadway Length and Emission Rates

Roadway	Section	2023 Two-Way AADT	2031 Two-Way AADT	Length of Roadway (Miles)	Heavy/Medium Truck Percentage (%)	Posted Speed (km/hr)	2023 CO ₂ Equivalent Emission Rate (g/VMT)	2031 CO ₂ Equivalent Emission Rate (g/VMT)
RR 25	S. of 5 Side Rd.	13,900	14,790	0.16	4.4/9.9	70	451	354
	5 side Rd to 10 Side Rd.	13,000	13,900	1.88	3.9/8.7	80	439	345
	N. of 10 Side Rd	12,400	13,200	0.04	4.4/9.7	80	439	345
5 Side Rd.	E. of RR 25	3,600	3,600	0.17	5.2/11.7	60	501	395
	W. of RR 25	2,900	2,900	0.18	1.4/3.2	60	374	283

Table 16: Changes in predicted GHG Emissions

Roadway	Section	2023 CO ₂ Equivalent Emission Rate (tonnes/year)	2031 CO ₂ Equivalent Emission Rate (tonnes/year)	Changes in Emission (%)
RR 25	S. of 5 Side Rd.	377	315	-16%
	5 side Rd to 10 Side Rd.	3,924	3,292	-16%
	N. of 10 Side Rd	77	64	-16%
5 Side Rd.	E. of RR 25	113	89	-21%
	W. of RR 25	71	54	-24%
Total		4,562	3,813	-16%



Table 17: Predicted Future Build GHG Emissions compare to GHG Targets

Roadway	Total CO ₂ Equivalent (tonnes/year)
Modelled Roadways	3,813
Canada-Wide Transportation 2030 GHG Target ^[1]	96,000,000
Ontario-Wide Transportation 2030 GHG Target ^[2]	42,840,000
Comparison to Canada-wide Transportation Target	0.004%
Comparison to Ontario-wide Transportation Target	0.009%

5.0 Air Quality Impacts During Construction

During construction of the roadway, dust is the primary contaminant of concern. Other contaminants including NO_x and VOC's may be emitted from equipment used during construction activities. Due to the temporary nature of construction activities, there are no air quality criteria specific to construction activities. However, the Environment Canada "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities" document provides several mitigation measures for reducing emissions during construction activities. Mitigation techniques discussed in the document include material wetting or use of non-chloride dust suppressants to reduce dust, use of wind barriers, and limiting exposed areas which may be a source of dust and equipment washing. Furthermore, as the annual PM_{2.5}, 24-hr PM₁₀, and 24-hr TSP levels are predicted to exceed the corresponding guideline due to ambient background levels, additional mitigation measures such as planting vegetation (for example coniferous species and shrubs) should be considered to minimize particulate impacts at nearby sensitive receptors. It is recommended that these best management practices be followed during construction of the roadway to reduce any air quality impacts that may occur.

6.0 Conclusion

Presented in Figure 9 is a summary of the worst-case modelling results for the 2023 No Build and 2031 Future Build scenarios based on 5-years of meteorological data. For each contaminant, cumulative concentrations are presented as a percentage of the applicable guideline. The cumulative concentrations for the Future Build emissions scenario were below their respective MECP guidelines or CAAQS, with the exception of the annual PM_{2.5}, annual benzene, and 24-hr and annual Benzo(a)Pyrene. Note that background concentrations alone exceeded the guideline for all of these contaminants and averaging periods. The overall contribution from the roadway emissions to the combined concentrations was generally below 10%. The exceptions were the roadway contribution to 1-hour CO and 24-hour TSP which were 15% and 24% of the predicted cumulative concentrations, respectively.

¹ The 2030 Emissions reduction plan includes a reduction target of 40% 2005 levels by 2030. Transportation sector 2005 emissions provided at: 2030 ERP: Transportation Fact Sheet:

<https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/erp/factsheet-06-transportation.pdf>

² The Made-in-Ontario Environment plan targets an emissions reduction of 30% below 2005 levels by 2030. Transportation sector 2005 emissions provided at: Transportation Sector Ontario GHG Emissions:

<https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP§or=tran&juris=on&rn=8>



Mitigation measures are not warranted, as the project does not introduce any new exceedances to the guideline, in comparison to background concentrations. However, given the elevated background concentrations of BaP, benzene and PM_{2.5}, consideration should be given to planting vegetation barriers such as coniferous hedges in the vicinity of sensitive receptors located between Sideroad 5 and the Glencairn Golf Club.

7.0 Closure

Should you have any questions on the above report, please contact the undersigned.

Regards,

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8.0 References

- Air & Waste Management Association, 2011. The Role of Vegetation in Mitigating Air Quality Impacts from Traffic Emissions. [online]
<http://www.epa.gov/nrmrl/appcd/nearroadway/pdfs/baldauf.pdf>
- CCME, 2000. Canadian Council of Ministers of the Environment. Canada-Wide Standards of Particulate Matter and Ozone. Endorsed by CCME Council of Ministers, Quebec City. [Online]
http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf
- Environment Canada. 2000. Priority Substances List Assessment Report: Respirable Particulate Matter Less Than or Equal to 10 Microns. Canadian Environmental Protection Act, 1999. Environment Canada, Health Canada. [Online]
<http://www.ec.gc.ca/Substances/ese/eng/psap/final/PM-10.cfm>.
- Health Canada. 1999. National Ambient Air Quality Objectives for Particulate Matter Part 1: Science Assessment Document. Health Canada. A report by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines.
- Lall, R., Kendall, M., Ito, K., Thurston, G., 2004. Estimation of historical annual PM_{2.5} exposures for health effects assessment. *Atmospheric Environment* 38(2004) 5217-5226.
- Ontario Publication 6570e, 2008. Ontario's Ambient Air Quality Criteria. Standards Development Branch, Ontario Ministry of the Environment.
- Ontario Ministry of the Environment, 2005. Transboundary Air Pollution in Ontario. Queens Printer for Ontario.
- Randerson, D., 1984. Atmospheric Science and Power Production . United States Department of Energy.
- Seinfeld, J.H. and Pandis, S.P., 2006. Atmospheric Chemistry and Physics From Air Pollution to Climate Change. New Jersey: John Wiley & Sons.
- United States Environmental Protection Agency, 2008. AERSURFACE User's Guide. USEPA.
- United States Environmental Protection Agency, 1997. Document AP 42, Volume I, Fifth Edition, Chapter 13.2.1. USEPA.
- United States Environmental Protection Agency, 2010. Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition. USEPA.
- United States Environmental Protection Agency, 2009. MOVES 2010 Highway Vehicles: Population and Activity Data. USEPA.
- WHO. 2005. WHO air quality guidelines global update 2005. Report on a Working Group meeting, Boon, Germany, October 18-20, 2005.
- Government of Ontario, 2018. A Made-in-Ontario Environment Plan:
<http://www.ontario.ca/page/climate-change>
- Natural Resources Canada, Transportation Sector Ontario, Table 8: GHG Emissions by Transportation
Mode:
<https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP§or=tran&juris=on&rn=8>

