**MISSISSAUGA ROAD
CLASS ENVIRONMENTAL ASSESSMENT**

**300m NORTH OF FINANCIAL DRIVE TO
300m NORTH OF QUEEN STREET WEST**

AIR QUALITY ASSESSMENT REPORT

Submitted to:

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EXECUTIVE SUMMARY

The Regional Municipality of Peel (Peel Region) retained Wood Environment & Infrastructure Solutions (Wood) (formerly Amec Foster Wheeler), a Division of Wood Canada Limited to undertake an air quality assessment for the proposed improvements and widening of Mississauga Road from 300m North of Financial Drive to 300m North of Queen Street West in the City of Brampton, Ontario.

Mississauga Road is classified as an arterial roadway and is under the jurisdiction of the Region of Peel. It extends from Caledon in the north, through the City of Brampton, and to the City of Mississauga in the south. The Mississauga Road study limits has a speed limit of 60km/h, with auxiliary lanes at many intersections within the Study Area.

This air quality assessment has been based on design information, and traffic predictions up to year 2031. The total expected traffic in the 2031 horizon year is estimated as the sum of the foregoing Regional background traffic growth and the traffic related to the various developments within the study area.

This study contributes to the overall Municipal Class Environmental Assessment.

The purpose of this report is to:

- Provide estimates of the air emissions resulting from vehicular traffic;
- Predict the resulting air quality effects on ambient air, with consideration of existing background air quality; and
- Provide a qualitative discussion of the significance of potential effects and a quantitative comparison of the future air quality effects year 2031 to the current scenario (2015).

Modeling for the site was done using the CALRoads US EPA model, modelling package of Lakes Environmental Consultants Inc., version 6.5.0. CALRoads View is a dynamic and intuitive user friendly interface for the three air dispersion modelling codes: CALINE4, CAL3QHC and CAL3QHCR. The modelling used the meteorological data set for Toronto as recommended by the Ministry of the Environment, Conservation and Parks (MECP). Concentrations of Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon Monoxide (CO) Inhalable particulate (PM_{10}), Respirable particulate ($PM_{2.5}$), and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, Acrolein) were modelled for all two mentioned above scenarios and included predicted concentration levels at the closest sensitive receptors. The emissions rates were developed based on MOVES 2014a US EPA software and traffic data was based on the 2017 study completed for the Class EA by Paradigm Transportation Solutions Limited.

The off-site effects were predicted using the CAL3QHCR dispersion model, using the Tier I approach utilizing peak hour traffic volume and emissions.
CAL3QHCR is considered the most appropriate model to predict pollutant concentrations from motor vehicles at roadway intersections. It can process up to one year of meteorological data and vehicular emissions, traffic volume, and signalization (ETS) data in one run using the basic algorithms from CAL3QHC.

The meteorological data used for the modelling was obtained from the Ministry of the Environment and Climate Change for the year 2000. This consisted of hourly surface data from a met station at Toronto Pearson Airport located approximately 15 kilometres to the east of the study area. The meteorological data incorporated into the model included wind speed, wind direction, stability category, air temperature, rural mixing height, and urban mixing height. For the CAL3HQCR modelling, each run considers one year of meteorological data.

The model was run for the target pollutants (PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2, Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein) stipulated in the scope of work. Note that the model runs for NOx do not take into account any atmospheric reactions or transformations.

The findings of the air quality study were as follow:

- In the case of Mississauga Road, it was noted that passenger vehicles comprise the majority of the traffic, with the average fleet profile consisting of 92% passenger cars and 8% heavy duty diesel vehicles (HDDV) based on the current scenario;
- The potential effect associated with air emissions is an increase in the airborne concentrations of the key pollutants NO_2, $PM_{2.5}$, PM_{10}, CO, SO_2, and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein) in the vicinity of the project;
- The incremental (project) effects for NO_2, $PM_{2.5}$, PM_{10}, CO, SO_2, and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein) predicted to be below the respective ambient air quality criteria;
- Highest effects located proximate to intersections, most significantly Mississauga Rd and Queen St W for current scenario;
- Small increment compared with existing baseline;
- The predicted effects for NO_2 were highest for the current scenario, as the NO_2 emissions reductions achieved as older vehicles are removed from service were significant and off-set the increased traffic volumes for 2031. The emission factors for the other target pollutants ($PM_{2.5}$, PM_{10}, CO, SO_2) also decreased over time and off-set the increase of traffic volume. This resulted in lower impacts on air quality in 2031 scenario of all contaminants except SO_2. SO_2 emissions demonstrate marginal increase in ambient concentrations but still being in compliance with ambient criteria limits;

- The cumulative effects of the roadway $PM_{2.5}$, CO, SO_2, Benzene, and 1-3 Butadiene emissions within the study area and the background concentrations were below the respective ambient air quality criteria for all averaging times under each scenario; and
- The cumulative effect of the NO_2 emissions within the study area and the background concentrations were found to be higher than the respective ambient air quality criteria for the 1-hour, 24-hr, and annual averaging times for the current scenario, and exceeding the annual criterion only for the future scenario.

Cumulated effect for the future scenario is calculated based on the project results plus current background concentrations which is overly conservative approach. As per ECCC website, the background levels of NO_2, SO_2, and VOCs in the ambient air in Canada are lowered between the years 2002 to 2015. NO_2 levels are reduced by 24.5% in that period. It is anticipated that that the same trend will continue between now and 2031.So the proposed project is not expected to have negative impact on the air quality in the study area for the future 2031 scenario

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1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions (Wood) (formerly Amec Foster Wheeler) was retained to complete a study on the air quality for the proposed improvements and widening of Mississauga Road from 300m North of Financial Drive to 300m North of Queen Street West in the City of Brampton, Ontario.

This study contributes to the overall Municipal Class Environmental Assessment.

The purposes of this report are to:

- Provide estimates of the air emissions resulting from vehicular traffic;
- Predict the resulting air quality effects on ambient air, with consideration of existing background air quality; and
- Provide a qualitative discussion of the significance of potential effects and a quantitative comparison of the future air quality effects 2031 to the current scenario.

The assessment addresses the potential for the site to have an effect on the air quality, discusses the likelihood of such air quality effects occurring, and the significance of any effects predicted.

1.1 Key Components of Study

The key components of the study include:

1. Development of a baseline scenario considering the current air quality;
2. Develop an emission scenario for the 2031 level of service along Mississauga Road;
3. Provide a qualitative and quantitative analysis of the effects on air quality; the quantitative analysis will include the use of modeling to predict off-site air concentrations that result from site activities; and
4. Provide a qualitative discussion of the significance of air quality effects.

1.2 Definition of Study Area

The study area comprised of approximately 2 kilometers of Mississauga Road. The northwestern extent of the study area was 300m north of Queen Street West and the southeastern extent was 300m south of Financial Drive.

The study area is presented in Figure 1.1 (Appendix A).

The main roadways within the Study Area include:

- **Mississauga Road (Peel Regional Road 1)** is a north-south Regional Arterial Road. Mississauga Road has speed limit 60 km/h) within the study area, and provides two (2) travel lanes per direction, with auxiliary lanes at many intersections.

- **Queen Street West (Peel Regional Road 6)** is a two (2) to four (4) lane, east-west Regional Arterial Road that runs east from Mississauga Road to Downtown Brampton. It has a posted speed limit of 60 km/h within the Study Area.

- **Embleton Road (Peel Regional Road 6)** is a two (2) lane Regional Arterial Road that runs west from Mississauga Road to the Peel-Halton border and continues as 5th Sideroad within Halton Region. Within the Study Area, Embleton Road has a two (2) lane rural cross- section and a posted speed limit of 50 km/h.

There is one (1) local road that intersects with Mississauga Road within the Study Area:

- **The Lionhead Golf and Country Club driveway** intersects with Mississauga Road south of Embleton Road at a signalized intersection. The west leg of the intersection currently serves as a construction access road to new residential lands.

2.0 IDENTIFICATION OF POTENTIAL AIR QUALITY EFFECTS

There is the potential for vehicular emissions to increase the ambient air concentrations of certain pollutants in the local study area.

The air quality effects of the airborne pollutants may be classified as health effects, environmental effects, or nuisance effects. The health and environmental effects are of significance in the ambient air in general. Nuisance effects are not generally expected to result in health or environmental effects and are considered at locations where people reside or frequent; such locations are deemed ‘sensitive receptors’ for the purposes of air quality studies. In Ontario, the Environmental Protection Act prohibits release of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect, and encompasses potential health, environmental, and nuisance effects.

Nitrogen dioxide, carbon monoxide, sulphur dioxide, fine particulate matter, and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, Acrolein) have standards in Ontario that were set based upon health or environmental effects of exposure to these pollutants.

2.1 Particulate Matter

Particulate Matter, or more practically fugitive dust in the context of outdoor activities, is assessed and regulated in four forms:

- Total suspended particulate (TSP) which usually considers the particle size range of up to 44 micrometres (μm) in aerodynamic diameter, and includes the smaller particle size fractions PM_{10} and $PM_{2.5}$. The larger particles are more likely to settle quickly and proximate to the source; it is the particles that are less than 44 micrometres in diameter that are generally considered as TSP. Ambient TSP standards have become a surrogate for visibility effects, and the assessment of TSP effects is related to potential nuisance effects, and not health effects.

  The coarser particulate matter in road dusts has a standard based upon the nuisance effects that may result from site emissions. The potential exists for road dust generated to lead to reduced air quality, impaired visibility, and deposition in the surrounding area. The proximity of the site to residences increases the likelihood that, if unmitigated, dust may become a nuisance to residents in the community.

- Inhalable particulate (PM_{10}) which has a particle size range up to 10 μm in aerodynamic diameter. PM_{10} includes the smaller particles referred to as $PM_{2.5}$. In addition to the nuisance effects, there are possible health effects that may be attributed to PM_{10}.

- Respirable particulate ($PM_{2.5}$) with a particle size range up to 2.5 μm in aerodynamic diameter. $PM_{2.5}$ is considered to be the most important particle size range from a respiratory public health perspective.

- Settleable particulate, or dustfall, that falls to the ground due to gravity and may be visible on surfaces. The dust fall is comprised of the coarser fraction of TSP that is prone to settling within close proximity to the source rather than being transported any significant distances from the site. According to the U.S. EPA's emission factor document (AP-42 Section 13.2, 1995), for a typical wind speed of 4.4 m/s, particles larger than 100 μm typically settle out within 6 to 9 m of the source.

Fugitive road dust was not quantified and modeled, as the site roads are paved.

2.2 Nitrogen Oxides

Nitrogen oxides (NO_x) are a mixture of compounds of oxygen and nitrogen, including nitric oxide (NO), nitrous oxide (N_20), nitrogen dioxide (NO_2), and others. These compounds are formed during fuel combustion, and are emitted from vehicles, boilers, and diesel generators. Nitrogen oxides may contribute to the formation of smog, or may affect human health at higher concentrations.

NO_2 from vehicle tailpipes were estimated and included in the modeling.

2.3 Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless, tasteless gas, which is produced primarily through the combustion of fossil fuels as a result of incomplete combustion. Over 75% of the CO produced in Ontario is from the transportation sector and 25% is due to the combined effect of power generation, buildings, heating and industrial operations. Exposures at 100 ppm or greater can be dangerous to human health, and larger exposures can lead to significant toxicity of the central nervous system and heart.

The Ontario Regulation 419/05 CO standard is for the ½ hour averaging time; AAQC exist for the 1 hour and 8 hour averaging times. The standards and AAQC for CO are all based upon potential health effects, and are presented in Table 3.1.

2.4 Sulphur Dioxide

Sulphur oxides (SO_x) comprise sulphur dioxide (SO_2), sulphur trioxide (SO_3) and solid sulphate forms. Sulphur dioxide is a non-flammable, non-explosive colourless gas. In connection with fuel burning, where the majority is in the form of SO_2, SO_x is normally expressed in terms of the equivalent mass concentration of SO_2 and sometimes as total sulphur. Sulphur oxide has an odour threshold limit of 0.47 to 3.0 ppm, and has pungent irritating odour above 3 ppm. SO_x compounds are significant contributors to acid rain and also precursors to the formation of secondary fine particulate matter.

SO_2 is irritating to the eyes and respiratory system above 5 ppm (exposure for 10 minutes), in the form of higher airway resistance. The effects of SO_2 on human health with respect to the short-term (acute) respiratory effects have been extensively studied. No clear evidence of long term or chronic effects is apparent.

Air quality standards for SO_2 have been set for the 1-hour and 24-hour averaging times, with equivalent AAQCs, as shown in Table 3.1. In addition, Ontario has an annual AAQC of 55 µg/m^3 for SO_2. The standards and AAQC are based upon potential health effects of SO_2, as well as potential effects on vegetation.

2.5 Volatile Organic Compounds (VOCs)

Some of the VOCs emitted by transportation vehicles are deemed to have significant health impacts and are designated as “air toxics” (MTO Air Quality Guideline).

These are:

- benzene,
- 1, 3-butadiene,
- formaldehyde,
- acetaldehyde, and

- acrolein.

The VOCs released during the fuel combustion were estimated and modelled.

2.6 Greenhouse Gases

Greenhouse Gas (GHG) emissions, such as methane and carbon dioxide, are a potential contributor to long-term, global climate change effects. However, the offsite effects are not modelled because the ambient air quality criteria are intended to provide limits on short-term effects, with the longest averaging time being an annual average.

2.7 Other Pollutants

This study is intended to cover the substances that may be released to the atmosphere in quantities significant enough to affect the air quality. There may be a number of other pollutants released from the site as a result of the activities carried out, such as trace metals in the particulate matter; these other pollutants have not been considered in the modelling assessment due to the minor quantities, and the low potential for off-site effects.

3.0 PROJECT SETTING

3.1 Regulatory Framework and Assessment Criteria

The relevant air quality criteria for Ontario are listed in Table 3.1. This table lists the contaminants, the relevant averaging period for each standard and the standard as a numerical value (where appropriate).

Table 3.1: Air Quality Criteria used for Study

Contaminant	Averaging Time	Ontario Ambient Air Quality Criteria
NO_2	1 hr	400 µg/m³ (0.2 ppm)
	24 hr	200 µg/m³ (0.1 ppm)
	Annual	17 ppb (0.017 ppm) (2020 CAAQS*) 12 ppb (0.012 ppm) (2025 CAAQS*)
SO_2	1 hr	690 µg/m³ (0.25 ppm)
	24 hr	275 µg/m³ (0.10 ppm)
	Annual	55 µg/m³ (0.02 ppm) 5 ppb (0.005 ppm) (2020 CAAQS*) 4 ppb (0.004 ppm) (2025 CAAQS*)
CO	1 hr	36,200 µg/m³ (30 ppm)
	8 hr	15,700 µg/m³ (13 ppm)
PM_{10} (<10µm)	24-hour	50 µg/m³ (Interim)
$PM_{2.5}$ (<2.5 µm)	24-hour	28 µg/m³ (2015 CAAQS*)
	24-hour	27 µg/m³ (2020 CAAQS*)
	Annual	10 µg/m³ (2015 CAAQS*)
	Annual	8.8 µg/m³ (2020 CAAQS*)
Benzene	24-hour	2.3 µg/m³
	Annual	0.45 µg/m³
1-3 Butadiene	24-hour	10 µg/m³
	Annual	2.0 µg/m³

Contaminant	Averaging Time	Ontario Ambient Air Quality Criteria
Formaldehyde	24-hour	65 μg/m^3
Acetaldehyde	24-hour	500 μg/m^3
	½ hour	500 μg/m^3
Acrolein	24-hour	0.4 μg/m^3
	1 hr	4.5 μg/m^3

*CAAQS - Canadian Ambient Air Quality Standards

TSP is the oldest and least used parameter for determining particulate related environmental effects. Ambient TSP standards have become a surrogate for visibility effects; the effects are not health related. The criteria of 50 μg/m^3 as a 24 hour average for PM_{10} is an interim ambient air quality criteria provided as a guide for decision making[1]. For $PM_{2.5}$, the Canadian Ambient Air Quality Standard of 28 μg/m^3; this level has been set for the protection of health and to reduce environmental risk.

3.2 Background Conditions

The background concentrations for pollutants CO, NO_2, $PM_{2.5}$, and select VOCs (benzene and 1-3 Butadiene) considered in this assessment were obtained from the Environment Canada National Air Pollution Surveillance (NAPS) air monitoring station located at 525 Main St. N. (Peel Manor) in Brampton, ON. This station is located approximately 5 kilometers northeast of the study area. A five-year data set was used (2012 to 2016). The background concentration for SO_2 was obtained from air monitoring station located at 3359 Mississauga Rd. N., U of T Campus, Mississauga. A four-year data set was used (2012 to 2015) for SO_2.

The background concentrations for pollutants CO considered in this assessment were obtained from the NAPS air monitoring station located at 125 Resources Road in Etobicoke, ON. This station is located approximately 22 kilometers east of the study area. A five-year data set was used (2012 to 2016).

[1] Ontario's Ambient Air Quality Criteria, Standards Development Branch Ontario Ministry Of The Environment, April 2012

Table 3.2: Background Concentrations

Parameter		Background Concentration, µg/m³ or ppm or ppb	Source of Criteria
CO	1 hr	0.4 ppm	125 Resources Rd. monitoring station
	8 hr	0.38 ppm	125 Resources Rd. monitoring station
SO_2	1 hr	2.15 ppb	3359 Mississauga Rd. N., U of T Campus, Mississauga monitoring station
	24 hr	2.5 ppb	3359 Mississauga Rd. N., U of T Campus, Mississauga monitoring station
	Annual	1.1 ppb	3359 Mississauga Rd. N., U of T Campus, Mississauga monitoring station
NO_2	1 hr	31.6 ppb	525 Main St. N. Brampton monitoring station
	24 hr	28.6 ppb	525 Main St. N. Brampton monitoring station
	Annual	10 ppb	525 Main St. N. Brampton monitoring station
$PM_{2.5}$	24 hr	14.2 µg/m³	525 Main St. N. Brampton monitoring station
	Annual	7 µg/m³	525 Main St. N. Brampton monitoring station
PM_{10}	24 hr	22.2 µg/m³	PM2.5/PM10 = 0.54 (Lall et. all, 2004)
Acetaldehyde	24 hr	1.152** µg/m³	200 College St. Toronto monitoring station
	½ hr	N/A	
Acrolein	24 hr	0.046** µg/m³	200 College St. Toronto monitoring station
	1 hr	N/A	
Benzene	24 hr	0.536* µg/m³	525 Main St. N. Brampton monitoring station
	Annual	N/A	
1,3-Butadiene	24 hr	0.045* µg/m³	525 Main St. N. Brampton monitoring station
	Annual	0.040 µg/m³	525 Main St. N. Brampton monitoring station
Formaldehyde	24 hr	2.248** µg/m³	200 College St. Toronto monitoring station

Note: Annual benzene and 1,3-butadiene values obtained from MECP air quality 2015 report
*Averages based on samples taken in 2014 and 2015

3.3 Regional Climate and Meteorology

Air quality is affected by both the emission sources that release pollutants into the air, and by the climate, or atmospheric conditions, such as wind speed, wind direction, and temperature. The climate in the Greater Toronto Area consists of fairly cold and windy winters and typically hot, humid summers.

For the air quality study, five years of surface meteorological data were obtained for Georgetown, Ontario; this station is located 5 kilometers west of the study area. The 5-year period of record for meteorological data is not considered a climate record, but rather a meteorological data set. The term climate normal is the arithmetic average of a meteorological parameter during a 30-year period.

3.3.1 Wind Speed and Direction

The wind rose depicted in Figure 3.1 for the nearest recent meteorological dataset (TORONTO INTL A; 15 km east of study area) details the distribution of wind directions and wind speeds for 2012 to 2016. A wind rose depicts the predominant wind patterns for a site by graphically illustrating the distribution of wind speed and wind direction. The wind rose is comprised of two parts: the frequency of winds from specified direction around the rose, and the distribution of wind speed indicated by the colours on each bar that represent wind speed ranges. Winds from the west and northwest wind directions were the most common.

The average wind speed for the five-year period was 4.44 m/s (16.0 km/h).

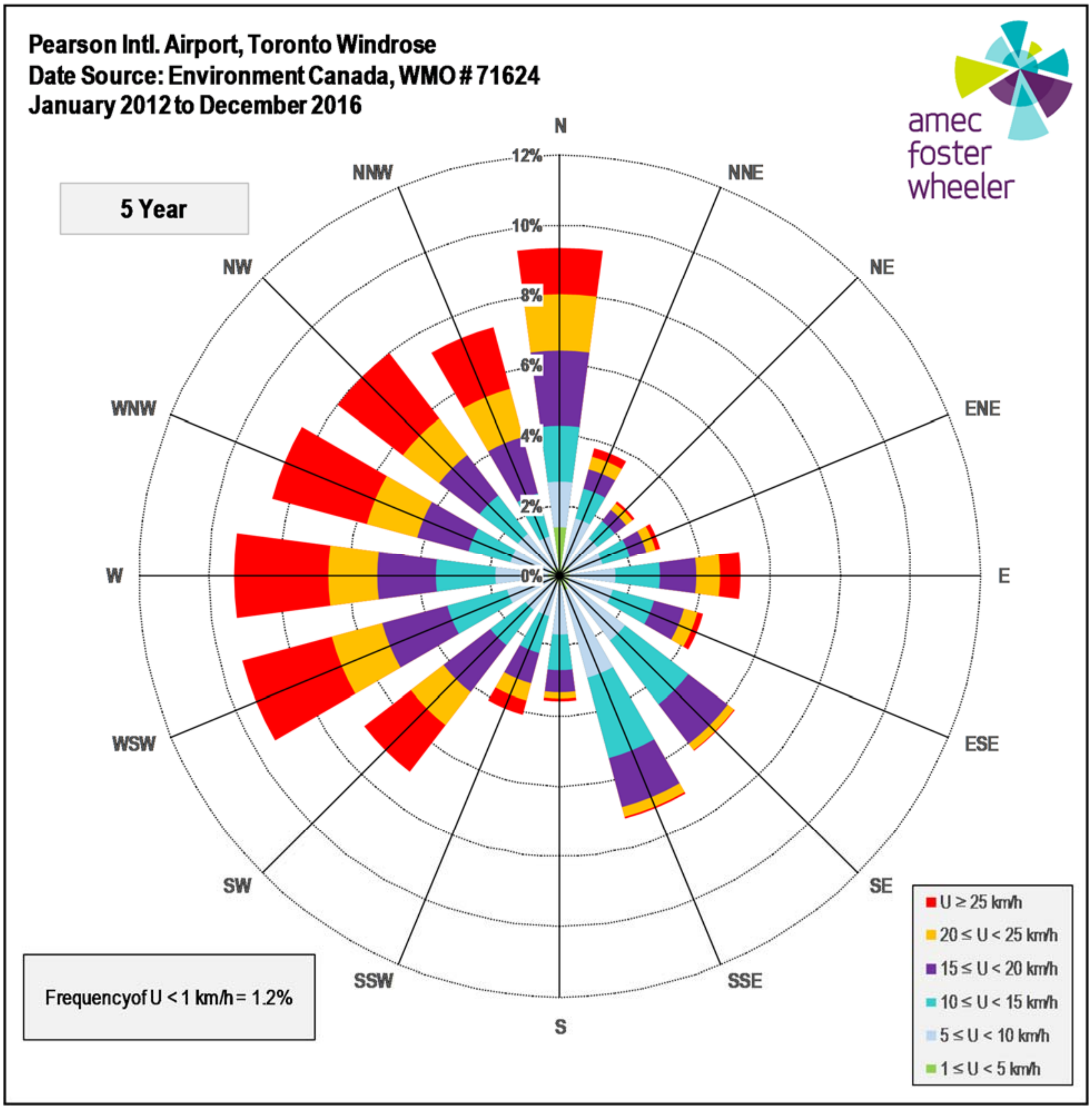

Figure 3.1: Pearson Intl. Airport 5 Year Windrose

3.3.2 Temperature

The temperature in the greater Toronto area fluctuates significantly with the seasons (Figure 3.2). The climate normal annual average temperature reported was 7.1 °C; the January daily average was -6.3 °C and a July average 20.0°C. The daily maximum and minimum temperatures are also demonstrative of the large fluctuations in temperature typical of this climate zone. In July, the daily average temperatures ranged from 13.0 to 26.9 °C. In January, the range was -10.9 to -1.7°C.

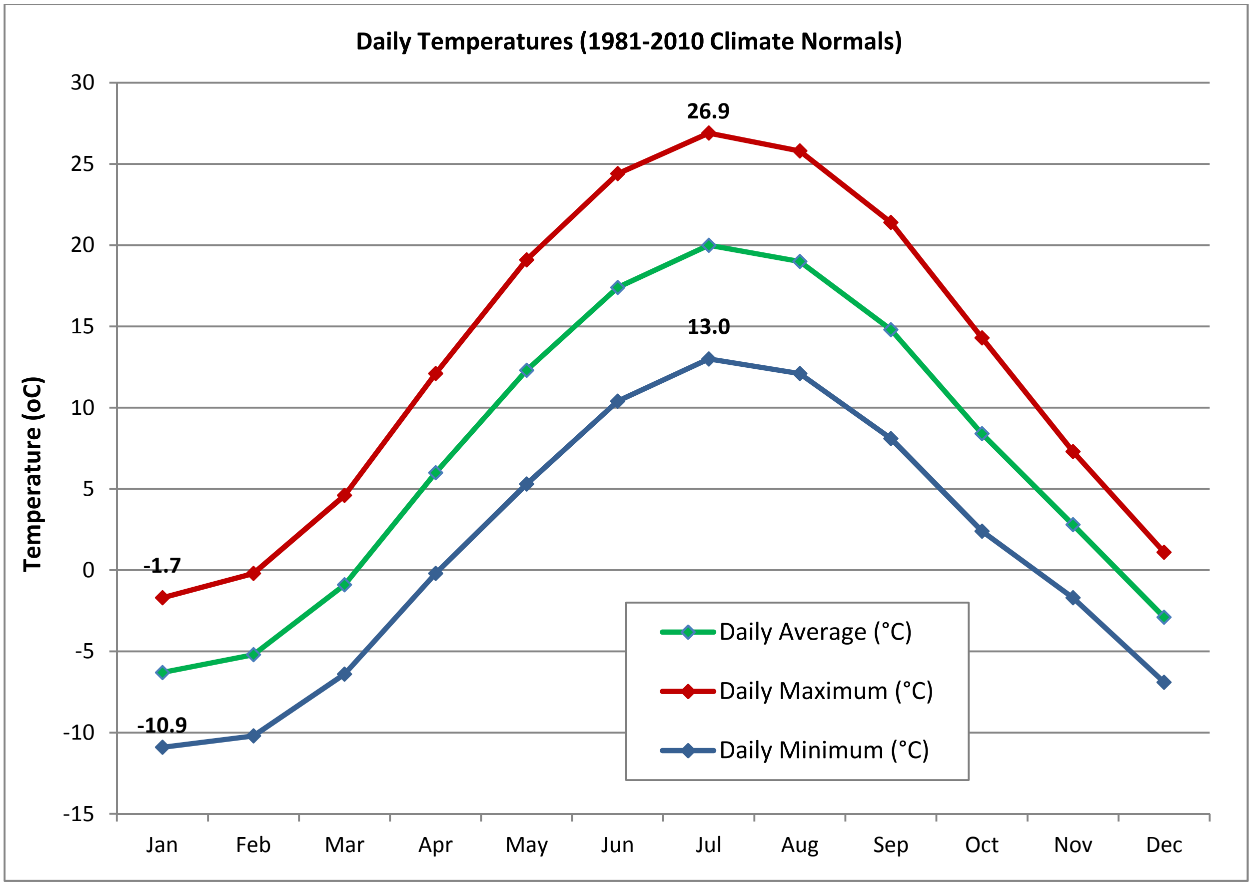

Figure 3.2: Daily Temperature Climate Normals (1981-2010)

3.3.3 Precipitation

Mean annual precipitation for the Project site is estimated at 877 mm (Figure 3.3), with the greatest precipitation contribution occurring as rainfall during the spring and summer.

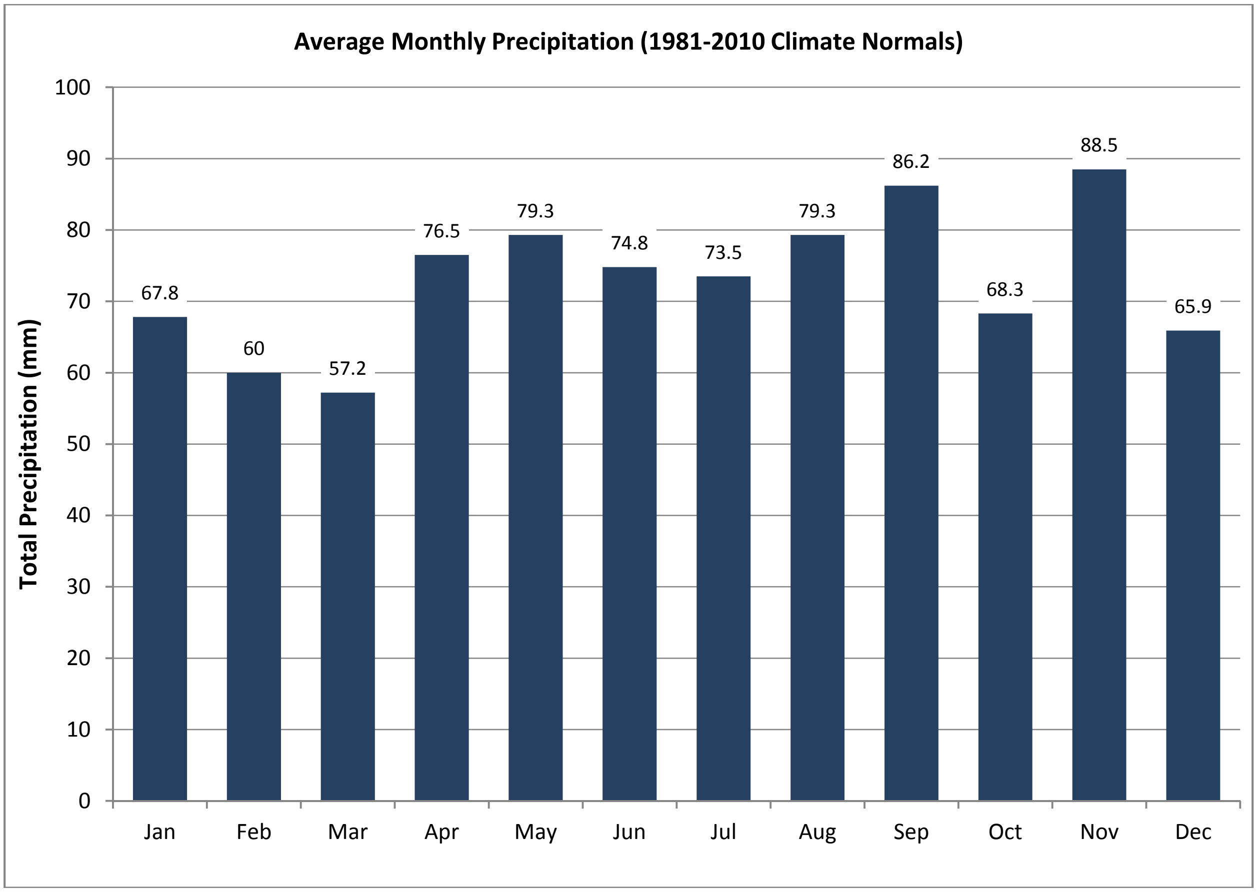

Figure 3.3: Precipitation Climate Normals (1981-2010)

3.4 Surrounding Land Uses

The existing land uses in the study area are a mix of office/business park, agricultural as well as residential type land uses, with some pockets of commercial.

4.0 IDENTIFICATION OF FLEET PROFILES AND EMISSION RATE ESTIMATION

Identification of fleet profiles and emission rate estimation were done based on the following software, traffic study and US EPA guideline:

- MOVES software, estimates g/mile emissions for passenger cars and HDDV.
- MOVES considers the gradual fleet replacement as the higher polluting vehicles are removed from service.
- Fleet profile averaged from Paradigm study, predominantly passenger vehicles.
- Idling emission factors are calculated using MOVES with the vehicle volume of the link as per one (1) vehicle and assign an average speed of 0 mile per hour (recommended practice).

4.1 Description of Scenarios

Two scenarios were considered as part of the air quality assessment:

1. Current Conditions (2015); and
2. Future conditions (2031).

2015 – (Mississauga road): Consists of a four-lane cross-section from Queen Street West to Financial Drive.

2031 - (Mississauga road - six Lanes expansion with Auxiliary Lanes): Consists of a six-lane cross-section from Queen Street West to Financial Drive with existing and additional turn lanes.

The traffic volumes, intersection data, and traffic profile (passenger cars, trucks), detailed in the Mississauga Road Environmental Assessment: Traffic Study Report (by Paradigm, 2017) were used for the dispersion modelling assessment and the discussion of the air quality effects of traffic along Mississauga Road and along the cross-streets in the study area (Queen St W, Embleton Road, and the Lionhead Golf and Country Club driveway).

The traffic profile, or the distribution of vehicles by passenger car and truck, was tabulated by traffic counts in 2015; the distribution was assumed to be applicable to the future years considered in the assessment (2031).

Emission scenarios and emission rates estimate are presented in Appendix B.

4.2 Emission Rate Estimation

The tailpipe emissions, and particulate emissions from brake and tire wear, for passenger vehicles and heavy-duty diesel vehicles were estimated using the Motor Vehicle Emission Simulator (MOVES) 2014a model. This model is the EPA's official model for estimating emissions from highway vehicles, and has replaced the Mobile6.2C model emission factor database used previously.

This model provides estimates of emissions for current and future years, with consideration for gradual fleet replacement as the higher polluting vehicles are removed from service.

Idling emission factors are calculated using MOVES with the vehicle volume of the link as per one (1) vehicle and assign an average speed of 0 mile per hour (recommended practice).

MOVES Input parameters are provided in Table 4.2.

Table 4.2: MOVES (v2014a) Input Parameters

Parameter	Input
Scale Panel	Model Type: Onroad Domain/Scale: Project Calculation type: Emission Rates
Time Spans	Years: 2015 (existing) and 2031 (future build)
Geographic Bounds Panel	Region: Zone & Link - Michigan Washtenaw County
Vehicles/Equipment - Onroad vehicles	Fuels: Gasoline/diesel fuel
	Source Use types: Passenger car/combination long-haul truck
Road type	Rural Unrestricted Access
Pollutants and Processes	PM_{10}/$PM_{2.5}$/NO_2/CO/SO_2/ Benzene/ 1-3 Butadiene/Formaldehyde/Acetaldehyde/Acrolein
Input Database Meteorology	Temperature and relative humidity were obtained from meteorological data from Environment Canada and Climate Change station
Age Distribution	Used MOVES default data based on the years, 2015 (existing), and 2031 (future build) Age fractions of fleet by age and source type

The emissions calculations and a summary of the raw traffic data is provided in Appendix B and Appendix C respectively.

Re-entrainment of dust from paved roads is considered and added to the particulate matter emissions for this project. $PM_{2.5}$ and PM_{10} emission factors are calculated based on US EPA AP-42, Section 13.2.1.

The equation is used to calculate the emission factor:

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

Where:

E = particulate emission factor (g/VKT)
K = particle size multiplier
sL= road surface silt loading factor (g/m2)
W = average vehicle weight (assumed 3 tons)

Sample calculations of emission factors for re-entrainment particulate matter

Contaminant	AADT	K	sL	W	E	E
		g/VMT	g/m2	Tons	g/VKT	g/VMT
PM_{10}	>10,000	0.62	0.03	3	0.078	0.049
$PM_{2.5}$		0.15	0.03	3	0.019	0.012

Notes: k and sL values are from AP-42, Section 13.2.1.3

5.0 DISPERSION MODELLING

The off-site effects were predicted using the CAL3QHCR dispersion model, using the Tier I approach.

CALINE-3 is designed to predict air pollutant concentrations near highways and arterial streets due to emissions from motor vehicles operating under free flow conditions. However, it does not permit the direct estimation of the contribution of emissions from idling vehicles. CAL3QHC enhances CALINE-3 by incorporating methods for estimating queue lengths and the contribution of emissions from idling vehicles, to allow for total air pollution concentrations from both moving and idling vehicles. CAL3QHCR further enhances the model by incorporating local meteorological data rather than the default wind speed and wind directions used by CAL3QHC.

The meteorological data used for the modelling was obtained from the Ministry of the Environment and Climate Change for year 2000. This consisted of hourly surface data from a met station at Toronto Pearson Airport located approximately 15 kilometres to the east of the study area. The meteorological data incorporated into the model included wind speed, wind direction, stability category, air temperature, rural mixing height, and urban mixing height. For the CAL3HQCR modelling, each run considers one year of meteorological data.

891 discrete receptors were selected for the modelling based on site analysis.

The CAL3QHCR modelling input summary table is provided below.

Table 5.1: CAL3QHCR Modelling Input Summary Table

Parameters	Input
Job options	
Run information	Pollutant type: PM/CO Approach: Tier I
Job parameters	Settling velocity: NO_2, CO, and VOCs = 0 cm/s Deposition velocity: NO_2, CO, and VOCs = 0 cm/s Setting: Rural Surface Roughness Length: 50cm
Met Options	
Meteorological data	1996-2000 data from Toronto Pearson International Airport Model can process only one year of met data. The model was run separately for each year (1996, 1997, 1998, 1999, and 2000). Out of all five individual runs the modelling based on year 2000 data predicted the highest POI concentrations at the receptors. This year meteorological data was selected for all subsequent modelling runs as the most conservative.
Link and Group Link Options	
Free flow link Queue link	The traffic volumes (vph), and intersection data are obtained from Traffic Study Report (by Paradigm, 2017). The emission factors (g/v-mi) are obtained from MOVES.
Receptors	Receptors are placed (based on the residential locations) along the Mississauga Road

The model was run for the target pollutants (PM_{10}, $PM_{2.5}$, NOx, CO, SO_2, Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein). Note that the model runs for NOx do not take into account any atmospheric reactions or transformations. The CALRoads Version 6.5.0 model is designed to model the effects of particulate matter or carbon monoxide; NOx SO2, Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein were modeled as “pollutant type - inert gases” with appropriate molecular weight as recommended by Lakes Environmental technical support.

For this study, the highest predicted concentration is reported in Table 6.1 and portrayed in the sample isopleths (Figures 6.1 to 6.2, Appendix A).

6.0 CONSTRUCTION EMISSIONS

Due to a short term duration of the construction phase of the project in comparison with the operational phase, the impacts of the construction activities were not added to the overall project assessment. Dust generated from the construction activities (pavement removal, overburden excavation, material movement, etc.) will be addressed over the construction period. The Best Management Practice (BMP) plan will be developed to manage fugitive dust emissions from the construction phase of the project. Emissions of NO_2, SO_2, and VOCs are also expected to emit from the heavy duty construction equipment at the project area. Environment Canada and Climate Change (ECCC) and Ministry of the Environment, Conservation and Parks (MECP) guidelines will be followed for mitigation techniques of dust and engines emissions.

7.0 ASSESSMENT FINDINGS / RESULTS

Modelling Results are presented in Table 6.1. Combined effect of modelled effects plus background Concentrations is presented in Table 6.2.

Table 6.1: Results of Dispersion Modelling

				Scenario							
				2015 (Current)				2031			
Pollutant	**Source of Criteria**	**Averaging Time**	**Unit**	**Max Concentration**	**AAQC/CAAQS**	**Percentage of Criteria**	**Location of Max**	**Max Concentration**	**AAQC/CAAQS**	**Percentage of Criteria**	**Location of Max**
$PM_{2.5}$	CAAQS	24hr	µg/m³	5.97	28	21.32%	Mississauga Rd + Queen St W	1.09	27	4.04%	Mississauga Rd + Queen St W
		Annual	µg/m³	1.56	10	15.60%	Mississauga Rd + Queen St W	0.35	8.8	3.98%	Mississauga Rd + Queen St W
PM_{10}	AAQC	24hr	µg/m³	6.54	50	13.07%	Mississauga Rd + Queen St W	1.16	50	2.32%	Mississauga Rd + Queen St W
NO_2	AAQC	1 hr	ppm	0.196	0.20	98.00%	Mississauga Rd + Queen St W	0.06	0.20	31.20%	Mississauga Rd + Queen St W
		24 hr	ppm	0.08	0.1	78.40%	-	0.02	0.1	24.96%	-
	CAAQS	Annual	ppm	0.02	0.017	92.24%	-	0.005	0.012	41.60%	-
SO_2	AAQC	1 hr	ppm	0.0008	0.25	0.32%	Mississauga Rd + Queen St W	0.001	0.25	0.48%	Mississauga Rd + Queen St W
		24 hr	ppm	0.0003	0.10	0.32%	-	0.0005	0.10	0.48%	-
	CAAQS	Annual	ppm	0.0003	0.005	6.40%	-	0.0005	0.004	12.00%	-
CO	AAQC	1 hr	ppm	0.60	30	2.00%	Mississauga Rd + Queen St W	0.37	30	1.24%	Mississauga Rd + Queen St W
		8 hr	ppm	0.36	13	2.77%	Mississauga Rd + Queen St W	0.21	13	1.62%	Mississauga Rd + Queen St W
Benzene	AAQC	24hr	µg/m3	0.38	2.30	16.64%	Mississauga Rd + Queen St W	0.13	2.30	5.55%	Mississauga Rd + Queen St W
		Annual	µg/m3	0.075	0.45	16.74%	-	0.03	0.45	5.58%	-
1-3 Butadiene	AAQC	24hr	µg/m3	0.09	10	0.88%	Mississauga Rd + Queen St W	0.0026	10	0.03%	Mississauga Rd + Queen St W
		Annual	µg/m3	0.02	2	0.87%	-	0.0005	2	0.02%	-
Formaldehyde	AAQC	24hr	µg/m3	0.69	65	1.06%	Mississauga Rd + Queen St W	0.29	65	0.45%	Mississauga Rd + Queen St W
Acetaldehyde	AAQC	24hr	µg/m3	0.36	500	0.07%	Mississauga Rd + Queen St W	0.07	500	0.01%	Mississauga Rd + Queen St W
		1/2-hr	µg/m3	1.08	500	0.22%	Mississauga Rd + Queen St W	0.22	500	0.04%	Mississauga Rd + Queen St W
Acrolein	AAQC	24hr	µg/m3	0.05	0.40	11.45%	Mississauga Rd + Queen St W	0.01	0.40	3.00%	Mississauga Rd + Queen St W
		1 hr	µg/m3	0.11	4.50	2.54%	Mississauga Rd + Queen St W	0.03	4.50	0.67%	Mississauga Rd + Queen St W

Note: As can be seen from the above Table 6.1, all compounds are predicted to be below the ambient air quality criteria. The maximum percent of criteria is 98% of the 1 hour criteria for NO_2.
" - " Not available criteria or below modelling threshold results
NOx emissions - expressed as NO_2
CAAQS - Canadian Ambient Air Quality Standards
AAQC - Ontario Ambient Air Quality Criteria

Table 6.2: Combined Effect of Modelled Effects and Background Air Concentrations

				Scenario											
				2015 (Current)						2031					
Pollutant	**Source of Criteria**	**Averaging Time**	**Unit**	**Max Concentration**	**Background Concentration**	**Cumulative = project + Background**	**AAQC/CAAQS**	**Percentage of Criteria**	**Location of Max**	**Max Concentration**	**Background Concentration**	**Cumulative = project + Background**	**AAQC/CAAQS**	**Percentage of Criteria**	**Location of Max**
$PM_{2.5}$	CAAQS	24hr	µg/m³	5.97	14.20	20.17	28	72.04%	Mississauga Rd + Queen St W	1.09	14.20	15.29	27	56.64%	Mississauga Rd + Queen St W
		Annual	µg/m³	1.56	7	8.56	10	85.60%	-	0.35	7	7.35	8.8	83.52%	-
PM_{10}	AAQC	24hr	µg/m³	6.54	26.3	32.84	50	65.67%	Mississauga Rd + Queen St W	1.16	26.3	27.46	50	54.92%	Mississauga Rd + Queen St W
NO_2	AAQC	1 hr	ppm	0.20	31.6 ppb	0.23	0.2	113.80%	Mississauga Rd + Queen St W	0.06	31.6 ppb	0.09	0.2	47.00%	Mississauga Rd + Queen St W
		24 hr	ppm	0.08	28.6 ppb	0.11	0.1	107.00%	-	0.02	28.6 ppb	0.05	0.1	53.56%	-
	CAAQS	Annual	ppm	0.02	10 ppb	0.03	0.017	151.06%	-	0.002	10 ppb	0.01	0.012	104.13%	-
SO_2	AAQC	1 hr	ppm	0.0008	2.15 ppb	0.003	0.25	1.18%	Mississauga Rd + Queen St W	0.0012	2.15 ppb	0.003	0.25	1.34%	Mississauga Rd + Queen St W
		24 hr	ppm	0.001	2.5 ppb	0.003	0.10	3.46%	-	0.001	2.5 ppb	0.004	0.10	3.94%	-
	CAAQS	Annual	ppm	0.00006	1.1 ppb	0.001	0.005	23.28%	-	0.0001	1.1 ppb	0.001	0.004	29.90%	-
CO	AAQC	1 hr	ppm	0.60	0.4	1.00	30	3.33%	Mississauga Rd + Queen St W	0.37	0.4	0.7715	30	2.57%	Mississauga Rd + Queen St W
		8 hr	ppm	0.36	0.38	0.74	13	5.69%	Mississauga Rd + Queen St W	0.21	0.38	0.59	13	4.54%	Mississauga Rd + Queen St W
Benzene	AAQC	24hr	µg/m3	0.38	0.522	0.90	2.30	39.34%	Mississauga Rd + Queen St W	0.13	0.522	0.65	2.30	28.24%	Mississauga Rd + Queen St W
		Annual	µg/m3	0.08	-	-	0.45	-	-	0.03	-	-	0.45	-	-
1-3 Butadiene	AAQC	24hr	µg/m3	0.09	0.0425	0.13	10	1.31%	Mississauga Rd + Queen St W	0.003	0.0425	0.0003	10	0.003%	Mississauga Rd + Queen St W
		Annual	µg/m3	0.02	0.04	0.06	2	2.87%	-	0.0005	0.04	0.0002	2	0.01%	-
Formaldehyde		24hr	µg/m3	0.69	2.248	2.93	65	4.52%	Mississauga Rd + Queen St W	0.29	2.248	2.54	65	3.91%	Mississauga Rd + Queen St W
Acetaldehyde	AAQC	24hr	µg/m3	0.36	1.152	1.51	500	0.30%	Mississauga Rd + Queen St W	0.07	1.152	1.22	500	0.24%	Mississauga Rd + Queen St W
		1/2-hr	µg/m3	1.08	-	-	500	-	-	0.22	-	-	500	-	-
Acrolein	AAQC	24hr	µg/m3	0.05	0.046	0.09	0.4	22.95%	Mississauga Rd + Queen St W	0.01	0.046	0.06	0.4	14.50%	Mississauga Rd + Queen St W
		1 hr	µg/m3	0.11	-	-	4.5	-	-	0.03	-	-	4.5	-	-

Note: " - " Not available or below modelling threshold results
NOx emissions - expressed as NO_2
CAAQS - Canadian Ambient Air Quality Standards
AAQC - Ontario Ambient Air Quality Criteria

The findings of the air quality study were as follow:

- In the case of Mississauga Road, it was noted that passenger vehicles comprise the majority of the traffic, with the average fleet profile consisting of 92% passenger cars and 8% heavy duty diesel vehicles (HDDV) based on the current scenario;
- The potential effect associated with air emissions is an increase in the airborne concentrations of the key pollutants NO_2, $PM_{2.5}$, PM_{10}, CO, SO_2, and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein) in the vicinity of the project;
- The incremental (project) effects for NO_2, $PM_{2.5}$, PM_{10}, CO, SO_2, and VOCs (Benzene, 1-3 Butadiene, Formaldehyde, Acetaldehyde, and Acrolein) predicted to be below the respective ambient air quality criteria;
- Highest effects located proximate to intersections, most significantly Mississauga Rd and Queen St W for current scenario;
- Small increment compared with existing baseline;
- The predicted effects for NO_2 were highest for the current scenario, as the NO_2 emissions reductions achieved as older vehicles are removed from service were significant and off-set the increased traffic volumes for 2031. The emission factors for the other target pollutants ($PM_{2.5}$, PM_{10}, CO, SO_2) also decreased over time and off-set the increase of traffic volume. This resulted in lower impacts on air quality in 2031 scenario of all contaminants except SO_2. SO_2 emissions demonstrate marginal increase in ambient concentrations but still being in compliance with ambient criteria limits;
- The cumulative effects of the roadway $PM_{2.5}$, CO, SO_2, Benzene, and 1-3 Butadiene emissions within the study area and the background concentrations were below the respective ambient air quality criteria for all averaging times under each scenario; and
- The cumulative effect of the NO_2 emissions within the study area and the background concentrations were found to be higher than the respective ambient air quality criteria for the 1-hour, 24-hr, and annual averaging times for the current scenario, and exceeding the annual criterion only for the future scenario.

7.1 Predicted Effect Levels

The isopleths plots (Figures 6.1 to 6.2, Appendix A) for NOx illustrate how localized the areas are where the maximum predicted concentrations lay, and that all concentrations are below the regulatory criteria.

The predicted concentrations presented in Table 6.1 are conservative, as they represent the highest hour or day over the year of meteorological data used for the modelling.

8.0 CONCLUSIONS

Preliminary results from the analysis indicate that all target pollutants are lower than the applicable criteria.

Cumulated effect for the future scenario is calculated based on the project results plus current background concentrations which is overly conservative approach. As per ECCC website, the background levels of NO_2, SO_2, and VOCs in the ambient air in Canada are lowered between the years 2002 to 2015. NO_2 levels are reduced by 24.5% in that period. It is anticipated that that the same trend will continue between now and 2031.So the proposed project is not expected to have negative impact on the air quality in the study area for the future 2031 scenario

9.0 REFERENCES

Paradigm Transportation Solutions Limited 2017 Traffic Study Report Mississauga Road Class Environmental Assessment.

US EPA MOVES 2014a (Nov 2015) User’s Guide, EPA-420-B-15-095.

US EPA CALROAD model (Lakes Environmental version 6.5.0)

Ministry of Transportation (MTO) Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects, June 2012.

Ontario’s Ambient Air Quality Criteria, PIBS # 6570e01, April 2012.

Yours truly,
Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

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Signature: ______________________ Date: December 17, 2018

Reviewed by: Alex Breido Ph.D., P.Eng
Associate Engineer – Air Quality

Signature: ______________________ Date: December 17, 2018

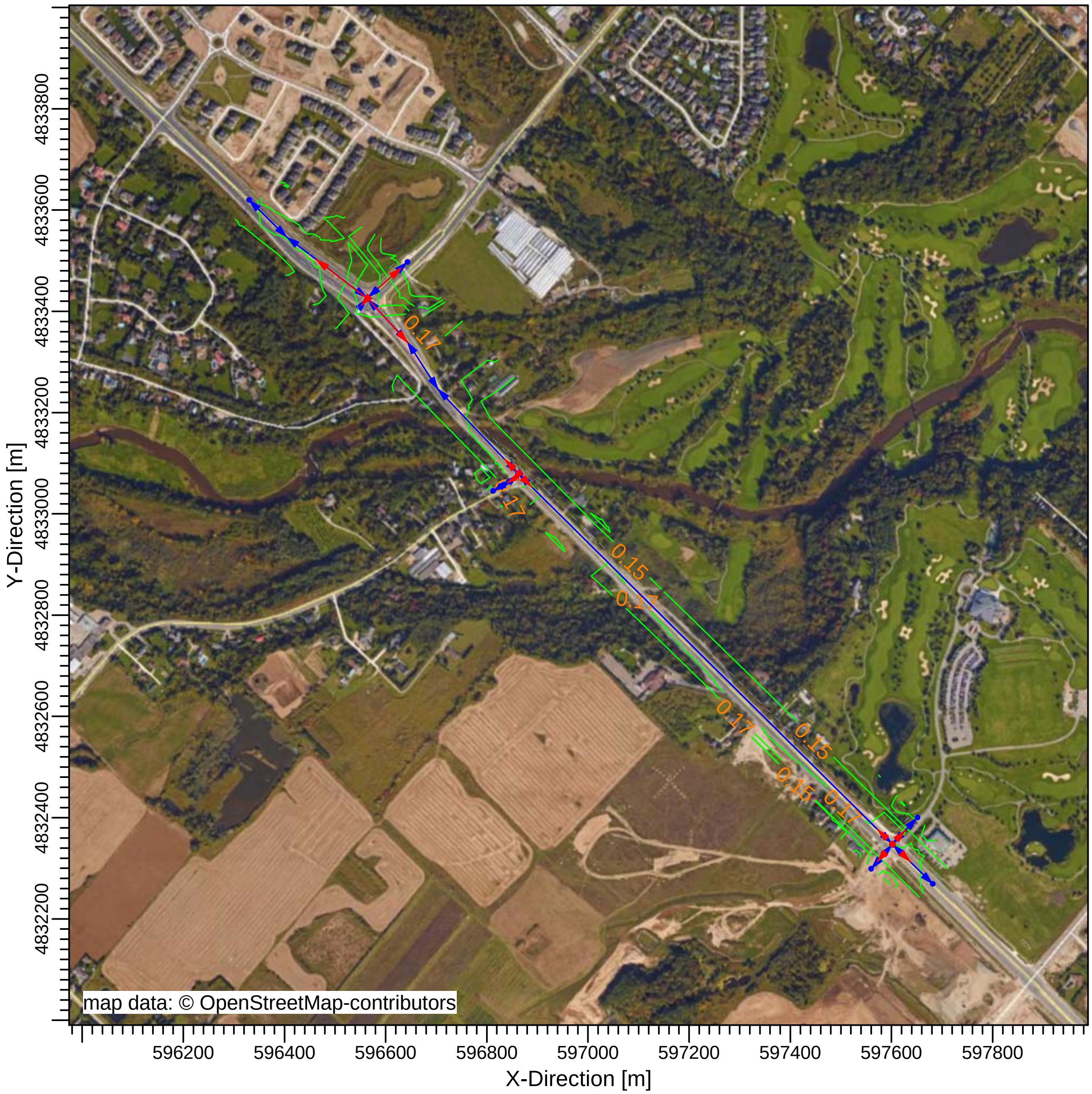
APPENDIX A

FIGURES

Figure 1.1: Study Area

PROJECT TITLE:

C:\CALRoads Modelling Files\Mississauga



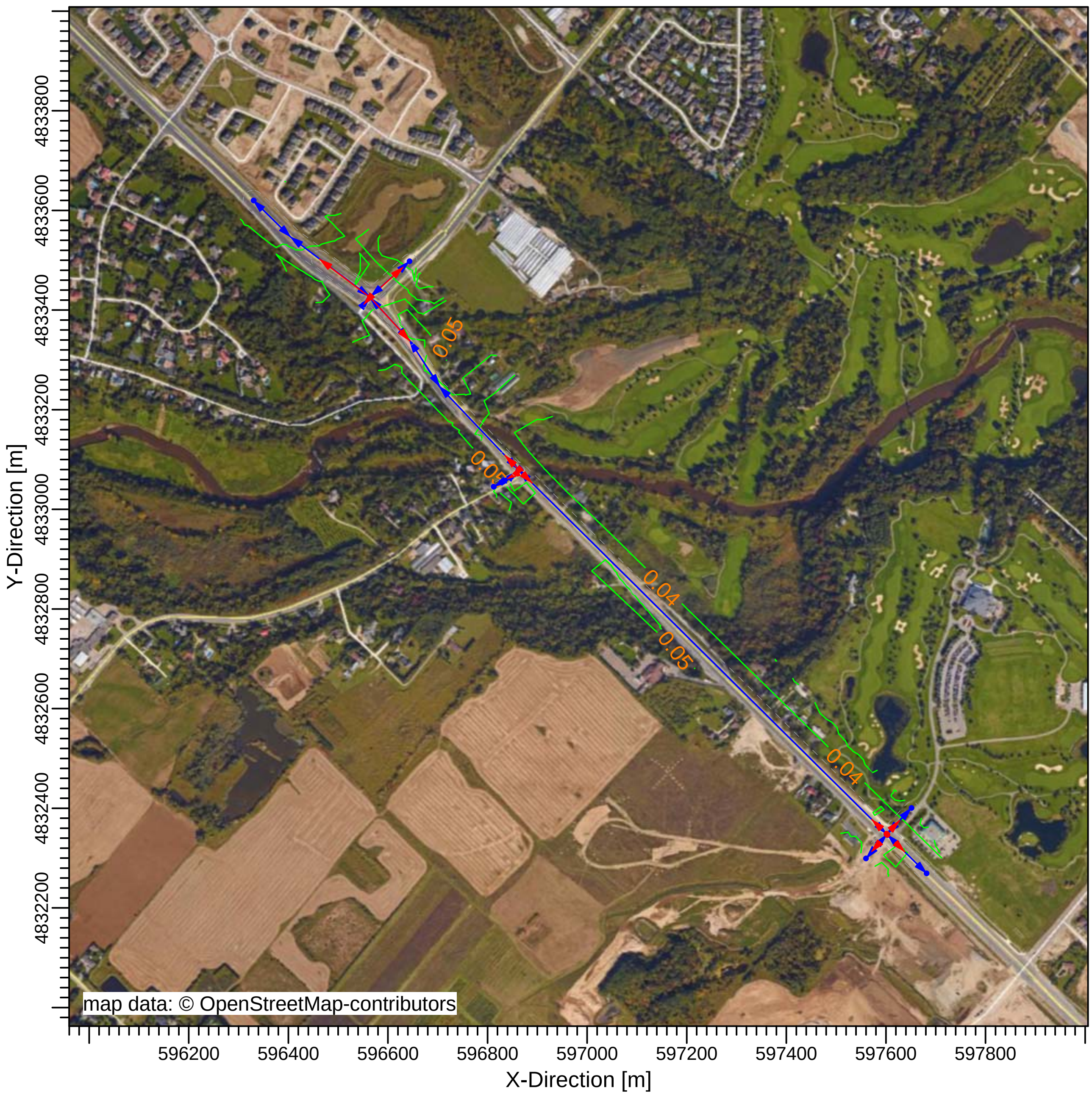
COMMENTS:	MODEL:	POLLUTANT:	COMPANY NAME:	
Existing Road and Traffic Condition (2015) NOx Emissions 1-hr average	**CAL3QHCR**	**NOx**	**Region of Peel**	
	MAX: **0.196**	UNITS: **ppm**	MODELER: **AI**	
	LINKS: **38**	RECEPTORS: **891**		
	SCALE: 1:12,662 0 — 0.4 m		DATE: **06/10/2017**	PROJECT / PLOT NO.: **TP115085**

CALRoads View - Lakes Environmental Software

Figure 6.1 (2015 scenario): NOx modelling (1-hr avg.)

PROJECT TITLE:

C:\CALRoads Modelling Files\Mississauga



COMMENTS:	MODEL:	POLLUTANT:	COMPANY NAME:	
Road and Traffic Condition based on Year 2031 NOx Emissions 1-hr Average	**CAL3QHCR**	**NOx**	**Region of Peel**	
	MAX: **0.06**	UNITS: **ppm**	MODELER: **AI**	
	LINKS: **38**	RECEPTORS: **891**		
	SCALE: 1:12,861 0 — 0.4 m		DATE: **06/10/2017**	PROJECT / PLOT NO.: **TP115085**

CALRoads View - Lakes Environmental Software

Figure 6.2 (2031 Scenario): NOx modelling (1-hr avg.)

APPENDIX B

EMISSION CALCULATIONS

Fleet Profile

2015 Annual Average Daily Traffic (AADT)*					
Intersection	**Direction**	**Total vehicles**	**Cars**	**Trucks**	**% Cars**
Mississauga Rd & Queen St W	Northbound	6413	5927	486	92%
	Southbound	6237	5780	457	93%
Mississauga Rd & Embleton Road	Northbound	7,343	6,872	471	94%
	Southbound	7,446	6,981	465	94%
Mississauga Rd & Lionhead Golf and Country Club Driveway	Northbound	7,509	6,703	806	89%
	Southbound	7,658	7,080	578	92%
	Total	**29,956**	**27,636**	**2,320**	**92%**

* Peak Period - AM, Noon, PM

MOVES 2014a Emission Factors

Emission Factors - 2015

ID	Description	Direction	Speed (km/h)	Speed (mph)	% Cars - AM/PM Peak	$PM_{2.5}$	PM_{10}	NOx	SO_2	CO	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Acrolein
						Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)
M1N	Mississauga Rd South of Lionhead Golf and Country Club	North	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
M1S	Mississauga Rd South of Lionhead Golf and Country Club	South	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
M2N	Mississauga Rd North of Lionhead Golf and Country Club	North	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
M2S	Mississauga Rd North of Lionhead Golf and Country Club	South	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
L1E	Lionhead Golf and Country Club East of Mississauga Rd	East	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
L1W	Lionhead Golf and Country Club East of Mississauga Rd	West	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
L2E	Lionhead Golf and Country Club West of Mississauga Rd	East	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
L2W	Lionhead Golf and Country Club West of Mississauga Rd	West	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
M3N	Mississauga Rd North of Embleton Rd	North	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
M3S	Mississauga Rd North of Embleton Rd	South	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
E1E	Embleton Rd West of Mississauga Rd	East	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
E1W	Embleton Rd West of Mississauga Rd	West	50	31	92%	0.0860	0.1536	1.5096	0.0077	2.8690	0.0027	0.0004	0.0049	0.0026	0.0004
M4N	Mississauga Rd North of Queen St W	North	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
M4S	Mississauga Rd North of Queen St W	South	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
Q1E	Queen St W East of Mississauga Rd	East	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
Q1W	Queen St W East of Mississauga Rd	West	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
R1E	River Rd West of Mississauga Rd	East	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003
R1W	River Rd West of Mississauga Rd	West	60	37	92%	0.0676	0.1183	1.3609	0.0072	2.5242	0.0024	0.0004	0.0045	0.0024	0.0003

MOVES 2014a Emission Factors

Emission Factors - 2015

Idle Emission Rate

% Cars - AM/PM Peak	$PM_{2.5}$			PM_{10}			NOx			SO_2			CO			Benzene			1-3 Butadiene			Formaldehyde			Acetaldehyde			Acrolein		
	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)
92%	0.1004	4.8958	0.4718	0.1135	5.3215	0.5168	0.9884	74.8615	6.7097	0.0596	0.0675	0.0602	12.4431	19.9983	13.0282	0.0323	0.0668	0.0350	0.0044	0.0234	0.0059	0.0133	0.7012	0.0666	0.0139	0.3074	0.0366	0.0006	0.0561	0.0049

MOVES 2014a Emission Factors

Emission Factors - 2031

ID	Description	Direction	Speed (km/h)	Speed (mph)	% Cars - AM/PM Peak	$PM_{2.5}$	PM_{10}	NOx	SO_2	CO	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Acrolein
						Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)	Emission Factor AM/PM (g/veh-mile)
M1N	Mississauga Rd South of Lionhead Golf and Country Club	North	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
M1S	Mississauga Rd South of Lionhead Golf and Country Club	South	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
M2N	Mississauga Rd North of Lionhead Golf and Country Club	North	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
M2S	Mississauga Rd North of Lionhead Golf and Country Club	South	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
L1E	Lionhead Golf and Country Club East of Mississauga Rd	East	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
L1W	Lionhead Golf and Country Club East of Mississauga Rd	West	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
L2E	Lionhead Golf and Country Club West of Mississauga Rd	East	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
L2W	Lionhead Golf and Country Club West of Mississauga Rd	West	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
M3N	Mississauga Rd North of Embleton Rd	North	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
M3S	Mississauga Rd North of Embleton Rd	South	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
E1E	Embleton Rd West of Mississauga Rd	East	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
E1W	Embleton Rd West of Mississauga Rd	West	50	31	92%	0.0161	0.0753	0.2344	0.0054	0.9925	0.0005	0.000008	0.0013	0.0005	0.0001
M4N	Mississauga Rd North of Queen St W	North	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
M4S	Mississauga Rd North of Queen St W	South	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
Q1E	Queen St W East of Mississauga Rd	East	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
Q1W	Queen St W East of Mississauga Rd	West	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
R1E	River Rd West of Mississauga Rd	East	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001
R1W	River Rd West of Mississauga Rd	West	60	37	92%	0.0125	0.0566	0.2114	0.0050	0.8766	0.0005	0.000007	0.0012	0.0004	0.0001

MOVES 2014a Emission Factors

Emission Factors - 2031

Idle Emission Rate

% Cars - AM/PM Peak	$PM_{2.5}$			PM_{10}			NOx			SO_2			CO			Benzene			1-3 Butadiene			Formaldehyde			Acetaldehyde			Acrolein		
	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - AM/PM (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)	Idle Emission Factor - Car (g/hr)	Idle Emission Factor - Truck (g/hr)	Effective Idle Emission Factor - (g/hr)
92%	0.0248	0.4204	0.0555	0.0281	0.4570	0.0613	0.0405	11.4575	0.9247	0.0376	0.0621	0.0395	0.5190	4.4363	0.8224	0.0022	0.0102	0.0028	0.0000	0.0012	0.0001	0.0006	0.1603	0.0130	0.0003	0.0534	0.0044	0.00002	0.0080	0.0006

APPENDIX C

DISPERSION MODELLING INPUT DATA AND ASSUMPTIONS

Raw Traffic Data - Current (2015)

ID	Description	Direction	Link Type	Length (m)	Mixing Zone Width* (m)	AM Peak	PM Peak
						Cars/Trucks	Cars/Trucks
M1N	Mississauga Rd South of Lionhead Golf and Country Club	North	At-Grade	110.71	32.01	839	1789
M1S	Mississauga Rd South of Lionhead Golf and Country Club	South	At-Grade	110.71	32.01	2042	845
M2N	Mississauga Rd North of Lionhead Golf and Country Club	North	At-Grade	1039.15	30.30	809	1794
M2S	Mississauga Rd North of Lionhead Golf and Country Club	South	At-Grade	1039.15	30.30	2043	779
L1E	Lionhead Golf and Country Club East of Mississauga Rd	East	At-Grade	71.48	25.7	16	6
L1W	Lionhead Golf and Country Club East of Mississauga Rd	West	At-Grade	71.48	25.7	3	52
L2E	Lionhead Golf and Country Club West of Mississauga Rd	East	At-Grade	63.24	24.75	4	29
L2W	Lionhead Golf and Country Club West of Mississauga Rd	West	At-Grade	63.24	24.75	22	4
M3N	Mississauga Rd North of Embleton Rd	North	At-Grade	457.54	23.14	1091	2130
M3S	Mississauga Rd North of Embleton Rd	South	At-Grade	457.54	23.14	2147	991
E1E	Embleton Rd West of Mississauga Rd	East	At-Grade	61.07	12.75	382	457
E1W	Embleton Rd West of Mississauga Rd	West	At-Grade	61.07	12.75	204	333
M4N	Mississauga Rd North of Queen St W	North	At-Grade	300.00	39.58	785	1646
M4S	Mississauga Rd North of Queen St W	South	At-Grade	300.00	39.58	1612	737
Q1E	Queen St W East of Mississauga Rd	East	At-Grade	106.03	29.81	460	677
Q1W	Queen St W East of Mississauga Rd	West	At-Grade	106.06	29.81	669	447
R1E	River Rd West of Mississauga Rd	East	At-Grade	19.01	12.82	25	6
R1W	River Rd West of Mississauga Rd	West	At-Grade	19.09	12.82	5	6

* Road Width + 6m

Raw Traffic Data - Current (2015)

Queue Links

					AM Peak								PM Peak							
ID	Segment Details	Link Type	Number of Lanes	Direction	Average Signal Cycle Length (s)	Green Time (s)	Average Red Time Length (s)	Clearance Lost Time (s)	Approach Traffic Volume (vph)	Saturation Flow Rate (v/hr/lane)	Signal Type	Arrival Type	Average Signal Cycle Length (s)	Green Time (s)	Average Red Time Length (s)	Clearance Lost Time (s)	Approach Traffic Volume (vph)	Saturation Flow Rate (v/hr/lane)	Signal Type	Arrival Type
M1NQ	Mississauga Rd South of Lionhead Golf and Country Club	At-Grade	3	North	125.7	109.2	4.2	7.3	839	3716	Actuated	Best Progression	125.7	100.5	12.9	7.3	1789	1904	Actuated	Best Progression
M2SQ	Mississauga Rd North of Lionhead Golf and Country Club	At-Grade	3	South	125.7	109.2	4.2	7.3	2043	3848	Actuated	Best Progression	125.7	100.5	12.9	7.3	779	1704	Actuated	Best Progression
L1WQ	Lionhead Golf and Country Club East of Mississauga Rd	At-Grade	2	West	125.7	1.8	111.5	7.4	3	707	Actuated	Worst Progression	125.7	10.5	102.8	7.4	52	688	Actuated	Worst Progression
L2EQ	Lionhead Golf and Country Club West of Mississauga Rd	At-Grade	1	East	125.7	1.8	111.5	7.4	4	3512	Actuated	Worst Progression	125.7	10.5	102.8	7.4	29	2868	Actuated	Below Average Progression
M2NQ	Mississauga Rd South of Embleton Rd	At-Grade	3	North	130	83.7	35.1	6.2	809	1185	Actuated	Above Avg. Progression	130	83.8	35	6.2	1794	1334	Actuated	Above Avg. Progression
M3SQ	Mississauga Rd North of Embleton Rd	At-Grade	2	South	130	83.7	35.1	6.2	2147	1738	Actuated	Above Avg. Progression	130	83.8	35.0	6.2	991	1683	Actuated	Best Progression
E1EQ	Embleton Rd West of Mississauga Rd	At-Grade	1	East	130	33.7	84.9	6.4	382	1716	Actuated	Worst Progression	130	33.6	85	6.4	457	1757	Actuated	Worst Progression
M3NQ	Mississauga Rd South of Queen St W	At-Grade	3	North	130	58.5	60	6.5	1091	3832	Actuated	Above Avg. Progression	130	83.5	35.0	6.5	2130	1931	Actuated	Best Progression
M4SQ	Mississauga Rd North of Queen St W	At-Grade	3	South	130	54.1	64.4	6.5	1612	1680	Actuated	Worst Progression	130	79.1	39.4	6.5	717	1215	Actuated	Above Avg. Progression
Q1WQ	Queen St W East of Mississauga Rd	At-Grade	2	West	130	57.6	60	7.4	669	3665	Actuated	Average Progression	130	32.6	85	7.4	447	2445	Actuated	Below Average Progression
R1EQ	River Rd West of Mississauga Rd	At-Grade	1	East	130	57.6	60	7.4	25	1674	Actuated	Average Progression	130	32.6	85	7.4	6	1835	Actuated	Below Average Progression

Raw Traffic Data - Future (2031)

ID	Description	Direction	Link Type	Length (m)	Mixing Zone Width* (m)	AM Peak	PM Peak
						Cars/Trucks	Cars/Trucks
M1N	Mississauga Rd South of Lionhead Golf and Country Club	North	At-Grade	110.71	32.01	1337	2868
M1S	Mississauga Rd South of Lionhead Golf and Country Club	South	At-Grade	110.71	32.01	3275	1325
M2N	Mississauga Rd North of Lionhead Golf and Country Club	North	At-Grade	1039.15	30.30	1299	2879
M2S	Mississauga Rd North of Lionhead Golf and Country Club	South	At-Grade	1039.15	30.30	3278	1250
L1E	Lionhead Golf and Country Club East of Mississauga Rd	East	At-Grade	71.48	25.7	16	6
L1W	Lionhead Golf and Country Club East of Mississauga Rd	West	At-Grade	71.48	25.7	3	52
L2E	Lionhead Golf and Country Club West of Mississauga Rd	East	At-Grade	63.24	24.75	7	47
L2W	Lionhead Golf and Country Club West of Mississauga Rd	West	At-Grade	63.24	24.75	35	7
M3N	Mississauga Rd North of Embleton Rd	North	At-Grade	457.54	23.14	1751	3418
M3S	Mississauga Rd North of Embleton Rd	South	At-Grade	457.54	23.14	3445	1591
E1E	Embleton Rd West of Mississauga Rd	East	At-Grade	61.07	12.75	613	734
E1W	Embleton Rd West of Mississauga Rd	West	At-Grade	61.07	12.75	327	535
M4N	Mississauga Rd North of Queen St W	North	At-Grade	300.00	39.58	1851	4153
M4S	Mississauga Rd North of Queen St W	South	At-Grade	300.00	39.58	3945	2339
Q1E	Queen St W East of Mississauga Rd	East	At-Grade	106.03	29.81	588	856
Q1W	Queen St W East of Mississauga Rd	West	At-Grade	106.06	29.81	843	577
R1E	River Rd West of Mississauga Rd	East	At-Grade	19.01	12.82	20	5
R1W	River Rd West of Mississauga Rd	West	At-Grade	19.09	12.82	7	8

* Road Width + 6m

Raw Traffic Data - Future (2031)

Queue Links

					AM Peak								PM Peak							
ID	Segment Details	Link Type	Number of Lanes	Direction	Average Signal Cycle Length (s)	Green Time (s)	Average Red Time Length (s)	Clearance Lost Time (s)	Approach Traffic Volume (vph)	Saturation Flow Rate (v/hr/lane)	Signal Type	Arrival Type	Average Signal Cycle Length (s)	Green Time (s)	Average Red Time Length (s)	Clearance Lost Time (s)	Approach Traffic Volume (vph)	Saturation Flow Rate (v/hr/lane)	Signal Type	Arrival Type
M1NQ	Mississauga Rd South of Lionhead Golf and Country Club	At-Grade	4	North	120	103.5	4.2	7.3	1909	1485	Actuated	Best Progression	120	95.8	11.9	7.3	4313	1661	Actuated	Worst Progression
M2SQ	Mississauga Rd North of Lionhead Golf and Country Club	At-Grade	4	South	120	103.5	4.2	7.3	4468	1528	Actuated	Average Progression	120	95.8	11.9	7.3	2383	1611	Actuated	Best Progression
L1WQ	Lionhead Golf and Country Club East of Mississauga Rd	At-Grade	2	West	120	1.8	105.8	7.4	3	707	Actuated	Worst Progression	120	9.5	98.1	7.4	41	686	Actuated	Worst Progression
L2EQ	Lionhead Golf and Country Club West of Mississauga Rd	At-Grade	1	East	120	1.8	105.8	7.4	6	3512	Actuated	Worst Progression	120	9.5	98.1	7.4	37	2868	Actuated	Below Average Progression
M2NQ	Mississauga Rd South of Embleton Rd	At-Grade	4	North	150	92.7	46.1	6.2	1878	1210	Actuated	Above Avg. Progression	130	82.8	36	6.2	4322	1298	Actuated	Worst Progression
M3SQ	Mississauga Rd North of Embleton Rd	At-Grade	3	South	150	87.1	51.7	6.2	4599	1671	Actuated	Worst Progression	130	70.3	48.5	6.2	2647	1632	Actuated	Below Average Progression
E1EQ	Embleton Rd West of Mississauga Rd	At-Grade	1	East	150	44.7	99.9	0.4	478	1716	Actuated	Worst Progression	130	34.6	84	6.4	573	1757	Actuated	Worst Progression
M3NQ	Mississauga Rd South of Queen St W	At-Grade	4	North	140	57.5	71	6.5	2231	1567	Actuated	Below Average Progression	120	65.0	43.5	6.5	4743	1694	Actuated	Worst Progression
M4SQ	Mississauga Rd North of Queen St W	At-Grade	4	South	140	71.5	57	6.5	3945	1275	Actuated	Worst Progression	120	70.2	38.3	6.5	2339	1264	Actuated	Average Progression
Q1WQ	Queen St W East of Mississauga Rd	At-Grade	2	West	140	54.6	73	7.4	843	2223	Actuated	Worst Progression	120	31.6	76	7.4	577	2445	Actuated	Worst Progression
R1EQ	River Rd West of Mississauga Rd	At-Grade	1	East	140	54.6	73	7.4	20	1681	Actuated	Average Progression	120	31.6	76	7.4	6	1798	Actuated	Average Progression

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January 10, 2019
Our File: TP115085
Your File: EA 01-06-05

Ministry of the Environment, Conservation and Parks
Central Region
5775 Yonge Street, 8th Floor
North York, ON M2M 4J1

Attention: Trevor Bell, Regional Environmental Assessment Coordinator

Dear Mr. Bell:

Re: Mississauga Road from Financial Drive to Queen Street West
Region of Peel
Schedule C Municipal Class Environmental Assessment
Draft Environmental Study Report, July 25, 2018

Wood is pleased to provide the following responses to the comments received from the Ministry of Environment, Conservation and Parks (MECP) on October 2, 2018. The following provides the original comment followed by our response:

Air Quality Comments

1. The Air Quality Assessment (AQA) Report did not discuss potential impacts during construction in relation to air quality. During construction, please apply best management practices to mitigate any air quality impacts caused by construction dust. Please note that the ministry recommends that non-chloride dust suppressants be applied.

   For a comprehensive list of fugitive dust prevention and control measures, please refer to Cheminfo Services Inc. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities. Report prepared for Environment Canada. March 2005.

   Response: *Best Management Practices will be developed to manage fugitive dust emissions from the construction phase of the project. Environment Canada and Climate Change (ECCC) and Ministry of the Environment, Conservation and Parks (MECP) guidelines will be followed for mitigation techniques of dust.*

2. Based on the AQA Report, particulate emissions are underestimated since the study did not account for re-entrainment of dust from paved roads. In addition, background PM_{10} measurements were not included in the cumulative PM_{10} impacts as reported in Tables 6-1 and 6-2 of the AQA Report.

   Typically for these types of assessments, ambient PM10 background concentrations can be estimated from $PM_{2.5}$ measurements by applying a ratio of $PM_{2.5} / PM_{10} = 0.54$ (Lall et. all, 2004). It is recommended to include background PM_{10} concentrations to the combined cumulative concentrations on Tables 6-1 and 6-2 of the final AQA Report and compare with the 24-hour interim criteria of 50 µg/m^3.

Response: *Re-entrainment of dust from paved roads is calculated and added to particulate emissions. Please see the revised tables 6-1 and 6-2. Background concentration PM_{10} is calculated based on the ratio of PM2.5 / PM10 = 0.54 (Lall et. all, 2004) and table 6-2 is revised accordingly. These two PM fractions were remodelled and showing the compliance with applicable limits.*

3. When assessing background conditions, typically a 5-year data set is used and not 1-year as was done in this assessment. For future reference, it is recommended to look at 5-years' worth of monitoring data for the selection of the maximum 90th percentile concentration as representative of background conditions.

   Response: *For future projects we will ensure to follow this recommendation.*

4. For future air quality impact assessments please note that the SO_2 and NO_2 Canadian Ambient Air Quality Standards (CAAQs) released in 2018 are recommended to be used in the assessment. As well, the annual $PM_{2.5}$ CAAQs of 10 µg/m^3 (2015) and 8.8 µg/m^3 (2020) should also be used for comparison purposes, and not only the 24-hour $PM_{2.5}$ CAAQS as used in this study.

   Response: *CAAQs for available contaminants will be used in the assessment for future projects.*

5. Tables 6-1 and 6-2 of the AQA Report compare the 24-hour $PM_{2.5}$ with 30 µg/m^3 instead of the 28 µg/m^3 CAAQs as noted in Table 3.1 "Air Quality Criteria used for Study". This should be revised in the final AQA Report.

   Response: *Tables 6-1, and 6-2 are revised with the CAAQs for $PM_{2.5,}$ please see the final AQA report.*

6. For the future scenario, the 2020 $PM_{2.5}$ 24-hours CAAQs of 27 µg/m^3 should be used for comparison purposes in Table 6-2 "Combined Effect of Modelled Effects and Background Air Concentrations".

   Response: *Table 6-2 is revised accordingly in the final AQA report.*

7. Please confirm if the 8-hour NO_2 and SO_2 concentrations reported on Tables 6-1 and 6-2 should be 8-hour averaging time or 24-hour averaging time. This should be revised in the final AQA Report.

   Response: *These concentrations are for 8-hour averaging time. NOx and SO_2 concentrations for 24-hour averaging time are calculated (using conversion factors) and presented in the revised tables.*

8. Tables 6-1 and 6-2 should include the comparison of the 8-hour CO impacts with the 8-hour ambient air quality criteria (AAQC) of 13 ppm as presented in Table 3-1 "Air Quality Criteria used for Study".

   Response: *Contaminant CO is assessed against 8-hour average criteria. Please see the revised tables 6-1 and 6-2 in the final AQA Report.*

9. Please note that the annual maximum concentrations for benzene and 1-3 butadiene are missing from Tables 6-1 and 6-2.

   Response: *Tables 6-1 and 6-2 are updated in the final AQA report with the Annual maximum concentrations for benzene and 1-3 butadiene.*

10. Since the road widening will bring the road closer to certain residential developments the proponent may consider additional mitigation measures, such as tree planting since it acts as a surface for deposition of

particulate matter and thus it minimizes off-site dust impacts at the nearest sensitive receptors. This should be considered particularly in most impacted areas, such as Mississauga Road and Queen Street West.

In addition, in areas that have critical sensitive receptors, such as daycares, schools, hospitals or long-term facilities, the proponent should consider planting coniferous species since these will act as a barrier all year around and reduce dust impacts at these sensitive receptors.

Response: *A detailed landscaping plan will be completed during the detailed design stage.*

Surface Water Comments

1. It is acknowledged that enhanced level water quality protection was adopted in the stormwater management plan. Based on the report, the increased stormwater will be collected in the proposed infiltration trenches before discharge into the Credit River. The infiltration trenches will be designed to infiltrate the increased runoff volume generated from 27mm storm event. MECP has no concerns to apply Low Impact Development (LID) Best Management Practices (BMPs) to treat the stormwater for this project. However, as the detailed design of the infiltration trenches has not been started, how to effectively use the proposed LID BMPs to achieve the enhanced level of water quality protection is still unknown. Further review by MECP may be required during the detailed design when all details about the preferred stormwater management plan are finalized.

   Response: *The preliminary quality control solution is outlined within the SWM report (Appendix E of the ESR). A rather intensive investigation was completed to determine the suitability of the recommended LID BMPs, including review of soil types and groundwater levels (ref. Section 2.3), geometric constraints based on available right-of-way space, and volumetric sizing completed in PCSWMM (ref. Section 6.0). The volumetric sizing completed in PCSWMM demonstrated that the LID BMPs can be sufficiently sized to capture and infiltrate the runoff volume from the 27 mm storm event. PCSWMM modelling can be made available for review if required.*

   It is understood that the MECP will require soil infiltration rates to be confirmed within the areas of the proposed infiltration trenches, prior to providing an Environmental Compliance Approval (ECA). It should be noted that the infiltration rate testing will be completed at the detailed design stage as part of other geotechnical works. The infiltration rates will be used to ensure that the LID BMPs can be effectively used to achieve the required level of water quality protection. The locations and the configuration of the proposed infiltrations trenches can be adjusted and refined based on the soil infiltration rates determined within the detailed design process. Also, an ECA application will be submitted at the detailed design stage, which would include documentation of how the design of the infiltration trenches has incorporated the determined infiltration rates determined by the geotechnical assessment.

2. For the purpose of LID design, it is recommended that the report include a table to clearly show the calculated runoff volumes by different storm events before and after development conditions for each outlet (outlet 1 to 3). In addition, during detailed design, a performance assessment/monitoring plan should be included to verify that the proposed LID is able to capture required runoff volumes.

   Response: *A table (6.5) has been added to the SWM report, and text has been revised to recommend that a monitoring plan be developed at the detailed design stage, following completion of the design of the preferred SWM solution.*

3. Appendix E indicates that infiltration trenches are the preferred solution. However, the drawings provided in Appendix A, which is attached to Appendix E, only show proposed bio-swales and enhanced swales, but not infiltration trenches. Further clarification is required.

Response: *It is noted that Appendix A, of the stormwater report, contains background information only. This information was used to develop the preferred SWM solution. The proposed infiltration trenches are shown on Figures 4.2 – 5.1, (last 9 pages of the Report)*

4. It is noted that the Credit River and its tributaries may support Redside Dace fish species. There is a concern regarding increased dissolved road salts entering the Credit River and its tributaries through the river crossing/bridge or sewer system as the road widening implies an increase in salt load during snowmelt seasons. The report should review the current practice on road salt management in the project area and evaluate the potential impacts on the watercourses and fish habitats from the increased salt load.

   Response: *The Wood natural sciences team has communicated with MNRF and stated in the Aquatic Existing Conditions Report that Redside Dace are not present within the Credit River. Redside Dace habitat, as described in the Endangered Species Act 2007 Addendum O.Reg 293/11 states that Redside Dace habitat is "the part of the stream or watercourse that has a an average bankfull width of 7.5 metre or less". Wood is currently working with the MNRF regarding Redside Dace on a separate project north of the this project location, which flows adjacent to Mississauga Road, however, this drainage system drains into the Credit River downstream of the project site.*

5. In terms of hydrological and hydraulic models, it is understood that hydraulic models were used to simulate the sewer flow and surcharge conditions before and after development. It is unclear if these models were calibrated before they were used for simulation and design purposes. As the stormwater analysis is purely based on the modeling results, the accuracy of these models would be directly related to the actual effect of the proposed stormwater management plan. In this regard, a general model uncertainty analysis should be provided to review the model's assumptions, limitations, and results. The uncertainty analysis should discuss how the model predictions would be changed or affected if the models did not correctly represent a real situation.

   Response: *After a phone discussion with MECP staff on October 17, 2018 it is understood that the MECP no longer requires an uncertainty analysis to be completed as part of the ESR. Rather, it was agreed that the SWM report would be revised to include a statement regarding the appropriateness of the uncalibrated PCSWMM model results, which make use of industry standard parameters. These revisions have been incorporated into the revised SWM Report. Furthermore, it is noted that a storm sewer design will be completed at the detailed design stage, to confirm pipe size and hydraulic-grade-lines for the storm sewers, as necessary. This design work will make use of industry standard methodologies.*

6. Please be advised that during construction, a Permit to Take Water (PTTW) for dewatering is required for taking/pumping water in excess of 400,000 litres per day. A guideline document and the Permit to Take Water application package can be downloaded directly from the MECP website. If the construction includes the discharge of any collected water from the dewatering activities into a surface watercourse, or a stormwater sewer that directly discharges into a surface watercourse, appropriate treatment and control/mitigation measures shall be provided to ensure that the proposed discharge will not result in any adverse impacts on the receiving waters. In such a case, further detailed review of the construction monitoring and mitigation plan by MECP will be required during the PTTW application process, when all the detailed information, including the dewatering and discharge plan, and the monitoring, contingency, and erosion and sediment control plans developed for the proposed construction, becomes available. In addition, MECP emphasizes that every measure should be considered to prevent any contaminants from entering the watercourses both during and after construction.

   Response: *Should a permit-to-take-water be required, it will be properly obtained at the detailed design stage.*

Should you have any questions or require additional information, please feel free to contact the undersigned.

Yours truly,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Per: Matthew Britton, E.I.T.
Water Resources E.I.T.

Per: Steve Chipps, P.Eng.
Senior Engineer, Water Resources

Per: Akhter Iqbal, P.Eng.
Senior Air Quality Engineer

MB/AI/mb/al