REPORT

Air Quality Report

Municipal Class EA for the Proposed Coleraine Drive Grade Separation, South of Old Ellwood Drive, Town of Caledon

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by CIMA+ to conduct an air quality assessment for the proposed grade separation of Coleraine Drive, south of Old Ellwood Drive, in the Town of Caledon, Ontario (the Project). This assessment was conducted to support a Schedule “C” Municipal Class Environmental Assessment (EA). The primary goal of the air quality assessment is to provide an assessment of the air quality impacts resulting from the proposed grade separation of Coleraine Drive. The air quality impacts will be compared to relevant federal and provincial standards and guidelines. Using the available background air quality data, the assessment was prepared to discuss the existing background air quality in the vicinity of proposed Project and the potential impacts of the proposed Project on local air quality.

2.0 METHODOLOGY

As per the general guidance provided in the Ontario Ministry of Transportation (MTO) Guidance Document *“Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions for Provincial Transportation Projects, June 2012”* (MTO, 2012), the list of parameters focuses on the key pollutants released from mobile sources. As the Project does not involve new roads or widening of existing roads to provide extra capacity, the Project has limited opportunity to impact air emissions. As a result, the air quality assessment follows a primarily qualitative approach, as per the general guidance provided in the Ministry of the Environment, Conservation, and Parks (MECP) Central Region Draft Document “*Traffic Related Air Pollution: Mitigation Strategies and Municipal Class Environmental Assessment Air Quality Impact Assessment Protocol*”, (MECP, 2017).

This air quality assessment includes two main tasks, namely characterizing the existing conditions and assessing the net effects of the Project on air quality. This assessment will be limited to the operational phase of the roadway (i.e. routine traffic) and will not address air quality impacts related to the construction activities to complete the grade separation work. It is assumed that emissions from construction operations will be managed through best management practices for construction operations and monitoring and mitigation requirements will be considered as part of the special provisions that are typically written to the construction tender documents.

3.0 BACKGROUND AIR QUALITY

The background air quality in the area around the proposed Project has been described by considering regional concentrations, based on publicly available monitoring data. The background air quality represents the existing conditions of air quality before the operation of the proposed Project. Sources include roadways, long range transboundary air pollution, small regional sources and large industrial sources.

This section details the selection of compounds considered in the assessment, applicable guidelines for this assessment, selection of the monitoring stations, and comparison of the selected data to the ambient air quality criteria (AAQCs).

3.1 Indicator Compounds

The assessment of background air quality focused on some criteria air contaminants (CACs), compounds that are expected to be released from mobile sources, such as specific VOCs for which relevant air quality criteria exist, and which are generally accepted as indicative of changing air quality. These compounds are emitted from fuel combustion from vehicles travelling on roadways. The indicator compounds for this project include:

- carbon monoxide (CO)
- nitrogen oxides, expressed as nitrogen dioxide (NO_2)
- suspended particulate matter[1] (SPM)
- particulate matter with a diameter of less than 10 microns (PM_{10})
- particulate matter with a diameter of less than 5 microns ($PM_{2.5}$)
- selected volatile organic compounds (VOCs), including benzene, 1-3 butadiene, formaldehyde, acetaldehyde and acrolein.

3.2 Applicable Guidelines

The air quality criteria used for assessing the air quality effects of the Project include the Ontario criteria, and federal standards and objectives where provincial guidelines are not available. The MECP has issued guidelines related to ambient air concentrations, which are summarized in *Ontario's Ambient Air Quality Criteria* (MECP, 2018a). There are two sets of federal objectives and criteria: the Canadian Ambient Air Quality Standards (CAAQSs) (formerly National Ambient Air Quality Standards (NAAQS)), and the National Ambient Air Quality Objectives (NAAQOs).

[1] SPM can also be refered to as total suspended particulate or TSP

The NAAQOs are benchmarks that can be used to facilitate air quality management on a regional scale, and provide goals for outdoor air quality that protect public health, the environment, or aesthetic properties of the environment (CCME, 1999). The federal government has established the following levels of NAAQOs (Health Canada, 1994):

- the maximum desirable level defines the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of control technology
- the maximum acceptable level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort, and well-being

The CAAQSs have been developed under the *Canadian Environmental Protection Act*, and include new standards for NO_2 to be implemented by 2020 and 2025.

A summary of the applicable Ontario and federal standards, objectives and criteria are listed in Table 1, along with the selected project criteria, which were selected to be the most stringent.

Table 1: Ontario and Canadian Regulatory Air Quality Objectives and Criteria

Substance	Averaging Period	Ontario Ambient Air Quality Criteria[a]	Canadian Ambient Air Quality Standards[b]	National Ambient Air Quality Standards and Objectives[c]		Project Criteria
				Desirable	Acceptable	
CO (µg/m³)	1-Hour	36,200	—	15,000	35,000	15,000
	8-Hour	15,700	—	6,000	15,000	6,000
NO_2 (µg/m³)	1-Hour	400	79.1[d] (42 ppb)	—	400	79.1/400
	24-Hour	200	—	—	200	200
	Annual	—	22.6 (12 ppb)	60	100	22.6
SPM (µg/m³)	24-hour	120	—	—	120	120
	Annual	60	—	60	—	60
PM_{10} (µg/m³)	24-Hour	50	—	—	—	50
$PM_{2.5}$ (µg/m³)	24-Hour	30	28/27	—	—	27
	Annual	—	8.8	—	—	8.8
Acrolein (µg/m³)	1-Hour	4.5	—	—	—	4.5
	24-Hour	0.4	—	—	—	0.4

Substance	Averaging Period	Ontario Ambient Air Quality Criteria(a)	Canadian Ambient Air Quality Standards(b)	National Ambient Air Quality Standards and Objectives(c)		Project Criteria
				Desirable	Acceptable	
Acetaldehyde (µg/m³)	24-Hour	500	—	—	—	500
	½ hour	500	—	—	—	500
1,3-Butadiene (µg/m³)	24-Hour	10	—	—	—	10
	Annual	2	—	—	—	2
Benzene (µg/m³)	24-hour	2.3	—	—	—	2.3
	Annual	0.45	—	—	—	0.45
Formaldehyde (µg/m³)	24-hour	65	—	—	—	65

(a) MECP 2018a
(b) CAAQS published in the Canada Gazette Volume 147, No. 21 - May 25, 2013. Final standard phase in date of 2020 used.
(c) CCME 1999
(d) The Canadian ambient air quality standard is effective from 2025, based on the three-year average of the 98th percentile of the daily maximum 1-hour average concentration which is not readily provided by the air quality dispersion models for transportation sources. As a result, the Ontario AAQC is also provided for comparison. .
— = No guideline available.

3.3 Monitoring Data

In Ontario, regional air quality is monitored through a network of air quality monitoring stations operated by the MECP and Environment and Climate Change Canada National Air Pollution Surveillance (NAPS) Network. These stations are operated under strict quality assurance and quality control procedures. Existing air quality was characterized using background air concentrations from monitoring data sources in the Project area as well as representative areas. Data for the most recent five year period with complete and quality assured data by Environment and Climate Change Canada at the time this study was initiated (2011 to 2015) was used for this assessment.

The following stations have identified as being most relevant to the proposed Project:

- Brampton – 525 Main Street, Brampton
- Toronto West – 125 Resources Road, Toronto

The Project is located in an area with a mix of land uses, including residential and commercial. There are no stations directly located in the Project area. The closest stations which are located in areas with similar land uses are the Brampton and Toronto West stations. Both the Brampton and Toronto West stations have a number of industrial sources influencing them, which may lead to a more conservative representation of the background, as there are fewer industrial sources near the Project area.

The Toronto West station was selected because it was the closest station to the Project that monitors CO. Since the station is near the Highway 401 and is in an urban area it is anticipated to be a conservative representation of the background CO conditions in the Project area.

Details of the selected stations are provided in Table 2.

Table 2: Ambient Air Quality Monitoring Parameters

Station Name	NAPS Station ID	Data Available[a]							Distance from Project	Direction from the Project
		CO	NO_2	NO	SPM	PM_{10}	$PM_{2.5}$	VOCs[b]		
Brampton	60428	—	Y	Y	—	—	Y	Y	19 km	South-west
Toronto West[(a)]	60430	Y	Y	Y	—	—	Y	—	24 km	South-east

Note: "—" Station not used for obtaining compound data.

(a) TSP and PM_{10} data was calculated using the following ratios; PM_{10} = 2 x $PM_{2.5}$, TSP= 2 x PM_{10}.

(b) VOCs monitored include 1,3,-butadiene and benzene.

For analyzing monitoring data, the 90th percentile of the available monitoring data is typically considered a conservative estimate of background air quality (MECP, 2017). As a result, the 90th percentile of the measured concentrations have been used to represent background air quality for parameters with shorter averaging periods (i.e., 1-hour, 8-hour, and 24-hour). Annual background concentrations were calculated based on the mean of the available data. A summary of the background air quality concentrations for all compounds is provided below in Table 3 with further discussion in the following sections.

Table 3: Summary of Air Quality Monitoring Data

Indicator Compound	Averaging Period	Background Concentration [µg/m³][(a)]	Project Criteria [µg/m³]	% of Project Criteria
CO	1-Hour	458.10	15,000	3%
	8-Hour	501.04	6,000	8%
NO_2	1-Hour	45.14	79.1/400	57%/11%
	24-Hour	37.55	200	19%
	Annual	19.28	32	60%
SPM	24-Hour	47.86	120	40%
	Annual	21.07	60	35%
PM_{10}	24-Hour	26.59	50	53%
$PM_{2.5}$	24-Hour	14.36	27	53%
	Annual	6.32	8.8	72%

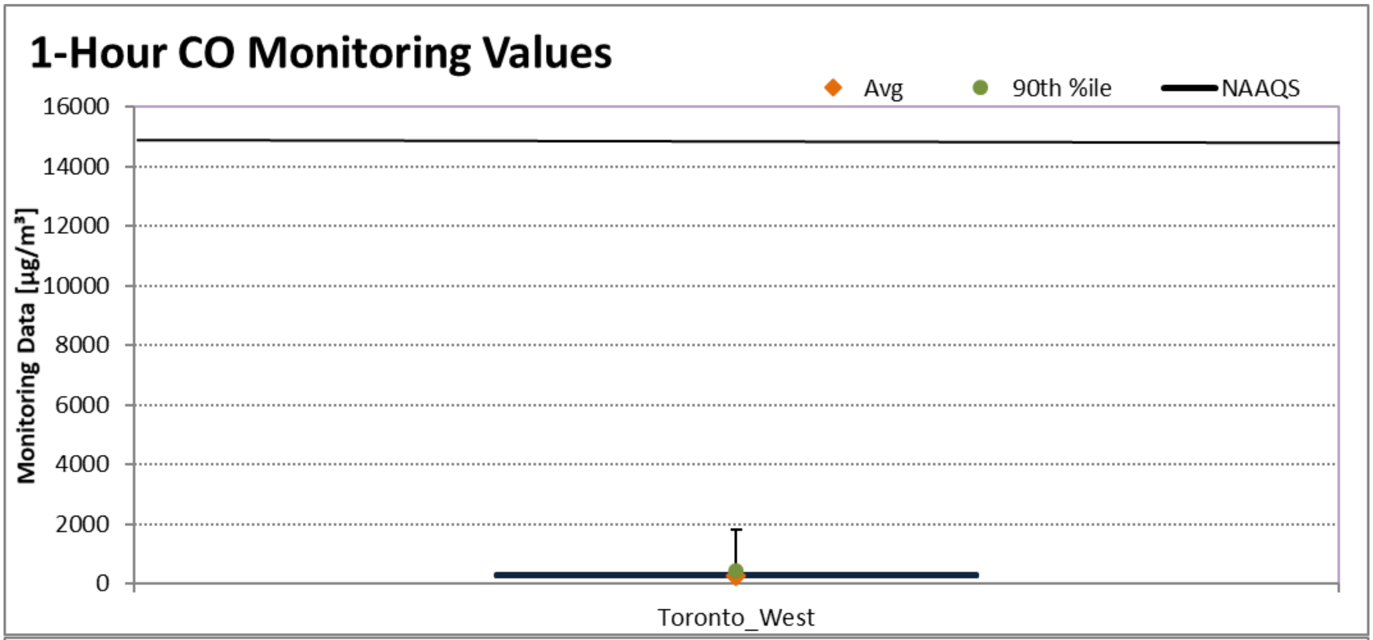
Indicator Compound	Averaging Period	Background Concentration [µg/m³][(a)]	Project Criteria [µg/m³]	% of Project Criteria
1,3,-Butadiene	24-Hour	0.09	10	1%
	Annual	0.04	2	2%
Benzene	24-Hour	0.88	2.3	38%
	Annual	0.54	0.45	119%

(a) All values are based on 90th percentile with the exception of annual averages.

It is understood that emission sources of indicator compounds in the Project area are accounted for in the background air quality, including local traffic, industrial, commercial, and residential sources.

3.3.1 CO Concentrations

Carbon monoxide is a colourless, odourless, tasteless gas, and at high concentrations can cause adverse health effects. It is produced primarily from the incomplete combustion of fossil fuels, as well as natural sources. The monitoring data assessed indicates that no exceedances of the 1-hour or 8-hour National AAQC for CO were recorded (Figure 1).



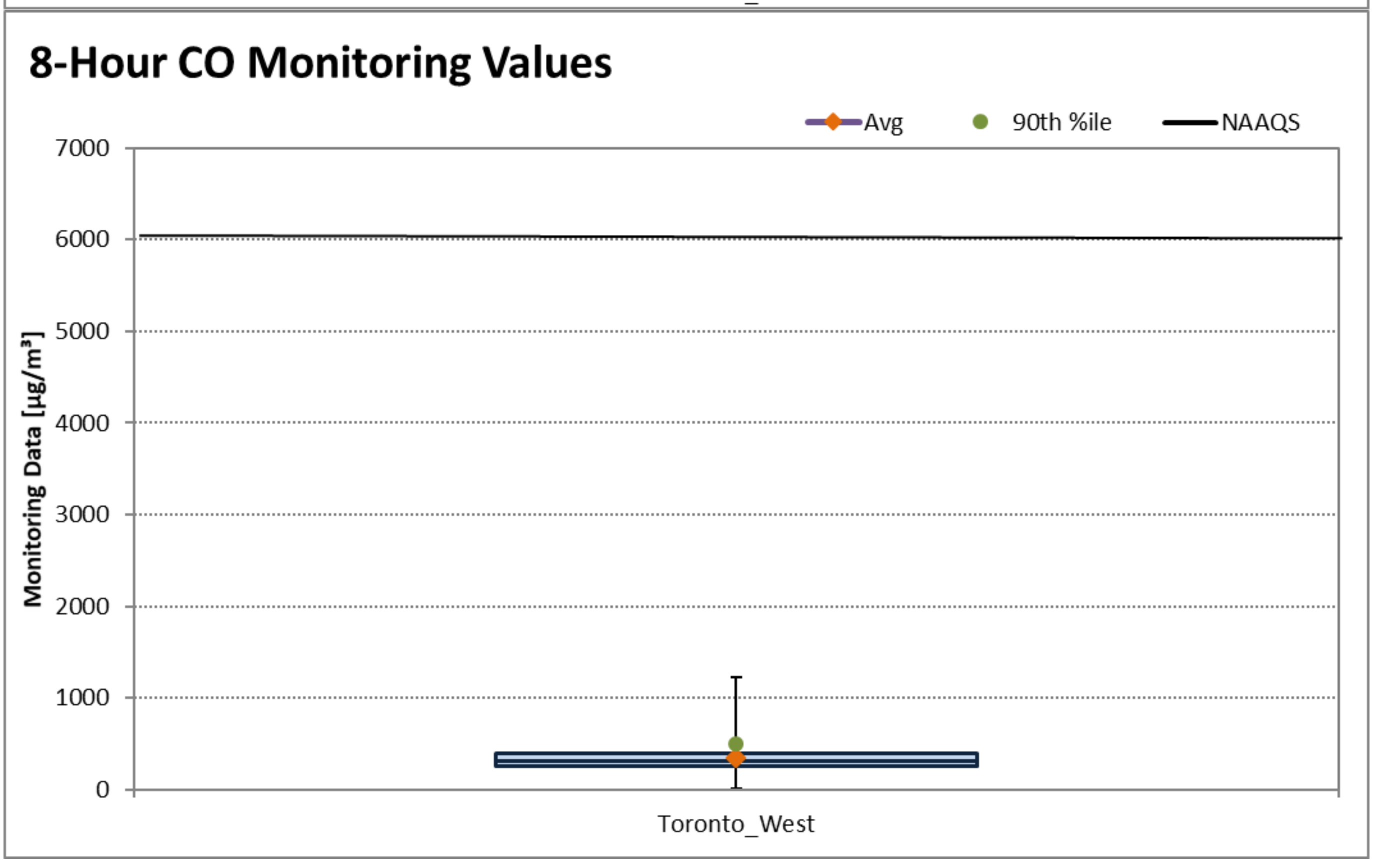
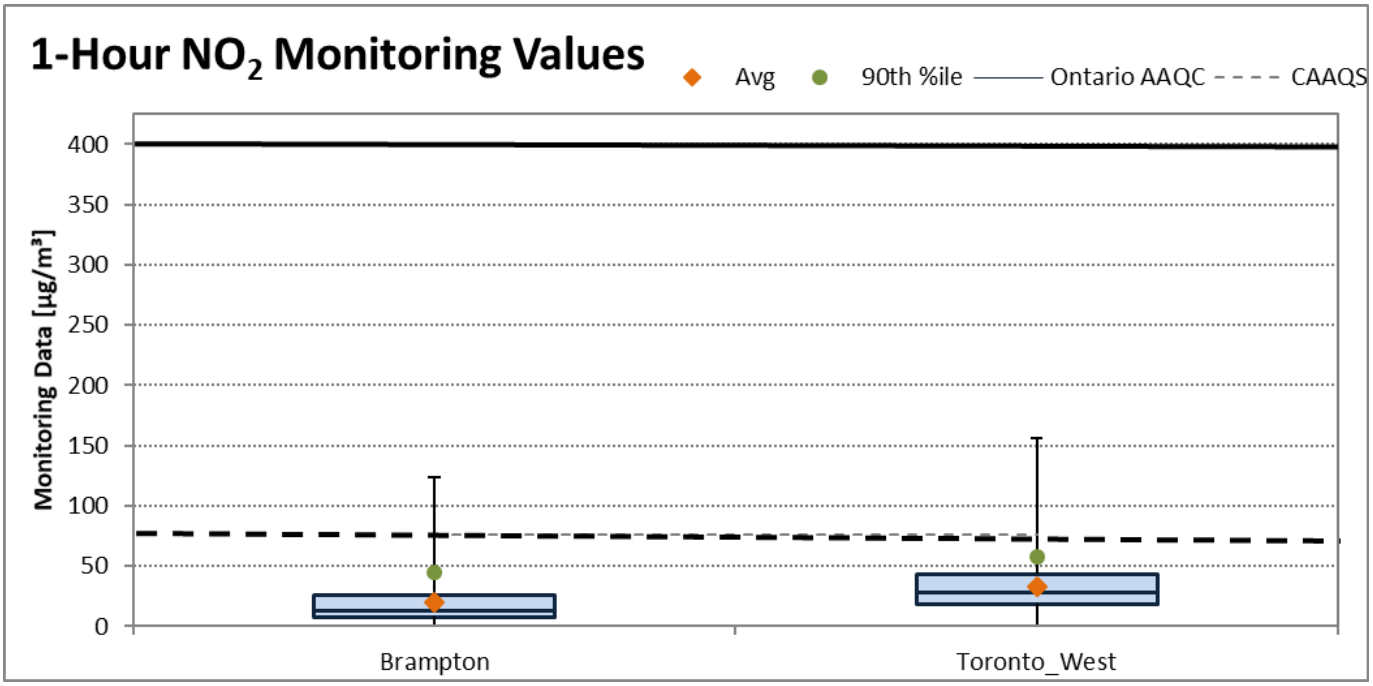


Figure 1: Measured Carbon Monoxide (CO) Concentrations at the Toronto West Station

3.3.2 NO_X and NO_2 Concentrations

NO_X is emitted in two primary forms: nitric oxide (NO) and NO_2. NO reacts with ozone in the atmosphere to create NO_2. The primary source of NO_X in the region is the combustion of fossil fuels. Emissions of NO_X result from the operation of stationary equipment such as incinerators, boilers, and generators, as well as the operation of mobile sources such as vehicles, haul trucks, and other equipment.

The presence of NO_2 in the atmosphere has known health effects (e.g., lung irritation) and environmental effects (e.g., acid precipitation, ground-level ozone formation) (MECP 2015). As a result, regulatory guideline levels are based on NO_2 emissions and concentrations. Emissions of NO_2 in Ontario have shown a steady decline from 2004 (MECP, 2015). The monitoring data assessed shows that no exceedances of the 1-hour or 24-hour AAQC for NO_2 were recorded (Figure 2). The CAAQS has been exceeded over the past few years, but this standard does not come into effect until 2025.



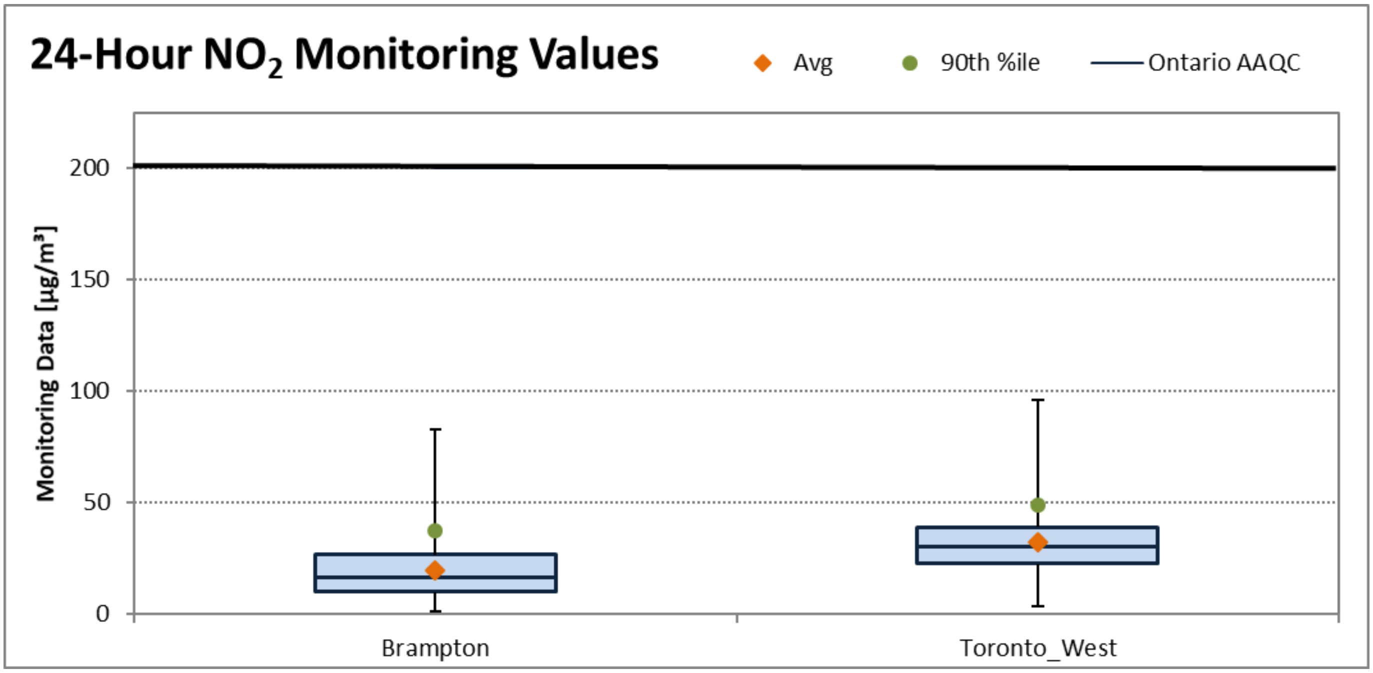


Figure 2: Measured 1-hour and 24-hour Nitrogen Dioxide (NO_2) Concentrations at the Brampton and Toronto West Stations

3.3.3 Particulate Matter (SPM, PM_{10} and $PM_{2.5}$)

Particulate emissions occur due to anthropogenic activities, such as agricultural, industrial and transportation sources, as well as natural sources. Particulate matter is classified based on its aerodynamic particle size, primarily due to the different health effects that can be associated with the particles of different diameters. Fine particulate matter ($PM_{2.5}$) is of primary concern related as they can penetrate deep into the respiratory system and cause health impacts (MECP, 2015). In Ontario, these emissions have been demonstrating a steady decline over time, decreasing by approximately 16% from 2007 to 2016 (MECP, 2018b). As presented in Figure 3 for 24-hour $PM_{2.5}$, measurements meet the Ontario AAQC value of 30 µg/m³ and the CAAQC of 27 µg/m³. No local monitoring data was available for SPM and PM_{10}, however, an estimate of the background SPM and PM_{10} concentrations can be determined from the available $PM_{2.5}$ monitoring data. Fine particulate matter (i.e., $PM_{2.5}$) is a subset of PM_{10}, and PM_{10} is a subset of SPM. Therefore, it is reasonable to assume that the ambient concentrations of SPM will be greater than corresponding PM_{10} levels, and PM_{10} concentrations will be greater than the corresponding levels of $PM_{2.5}$. The mean levels of $PM_{2.5}$ in Canadian locations are found to be about 54% of the PM_{10} concentrations and about 30% of the SPM concentrations (Lall et al., 2004). By applying this ratio, it was possible to estimate the background SPM and PM_{10} concentrations for the Project area.

Larger particles (i.e., SPM) can result in nuisance effects, such as soiling or visibility and, therefore, must be taken into consideration as part of the study. All derived SPM and PM_{10} values are below the relevant AAQC and NAAQOs.

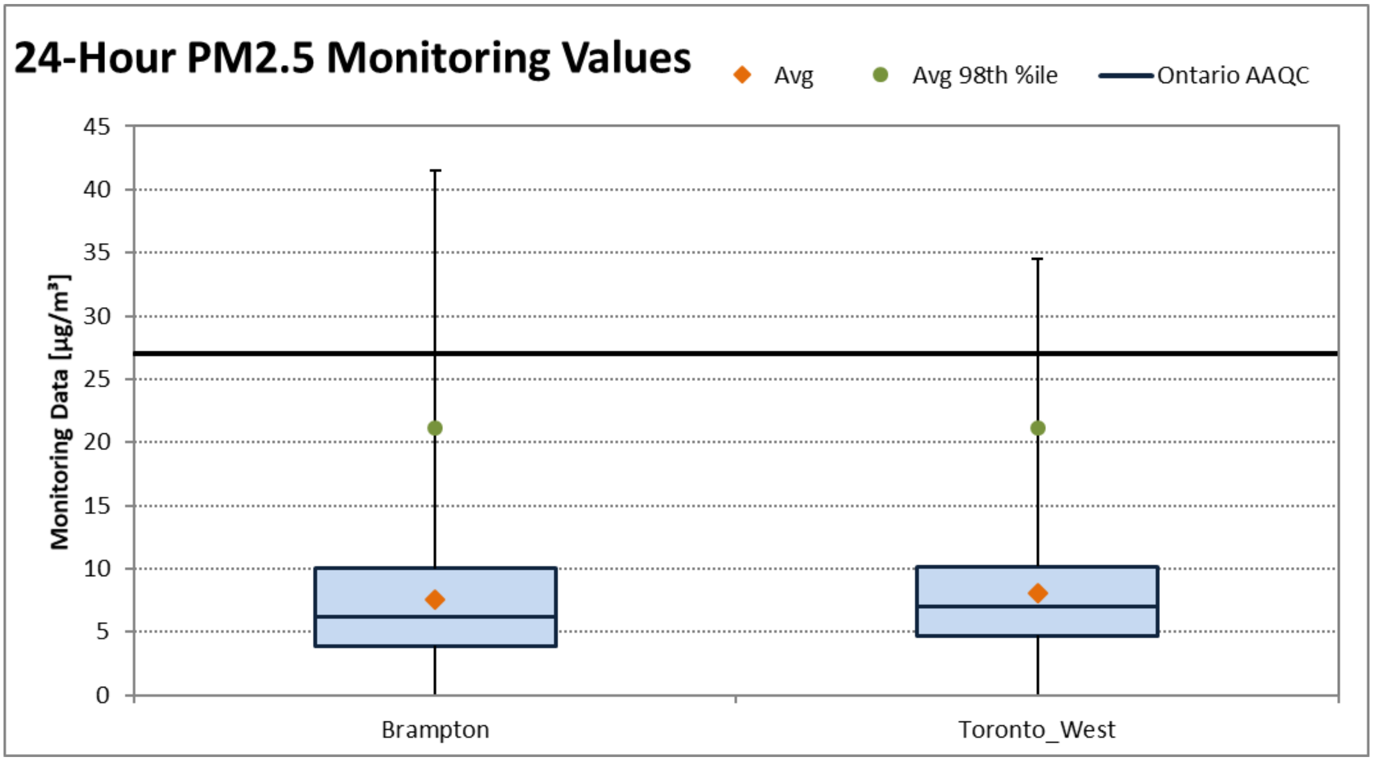


Figure 3: Measured 1-hour and 24-hour $PM_{2.5}$ Concentrations at the Brampton and Toronto West Stations.

3.3.4 VOC Concentrations

Volatile organic compounds are primary precursors to the formation of ground level ozone and aerosols which are the main components of smog, known to have adverse effects on human health and the environment (ECCC 2015a). Ontario's major sources of VOCs includes transportation and general solvent use (MECP 2015). The primary VOCs associated with traffic include benzene, 1,3-butadiene, acrolein, acetaldehyde and formaldehyde However, only benzene and 1,3- butadiene was available for assessment.

Benzene is mainly released from vehicle exhausts due to fuel combustion (ECCC 2015b). Similarly, 1,3-butadiene is typically a product of incomplete combustion, released into the atmosphere from transportation vehicle exhausts or fuel/biomass combustion in non-transportation sources (ECCC, 2015c). 1,3-butadiene may also be released from industrial facilities. The presence of both benzene and 1,3-butadiene in the atmosphere have known health and environmental effects.

The monitoring data for 1,3-butadiene indicates that there were no exceedances for the 24-hour (Figure 4) or annual AAQC for 1,3-butadiene and, additionally, that monitored values were observed to be significantly below the criteria.

From the monitoring data assessed, no exceedances of the 24-hour AAQC for benzene were recorded; however, the annual benzene concentration was exceeded every year, where the average annual benzene concentration was 119% of the AAQC. It should be noted, however, that annual monitored benzene concentrations exceed the AAQC across the Greater Toronto Area at all monitoring stations for which data is publicly available.

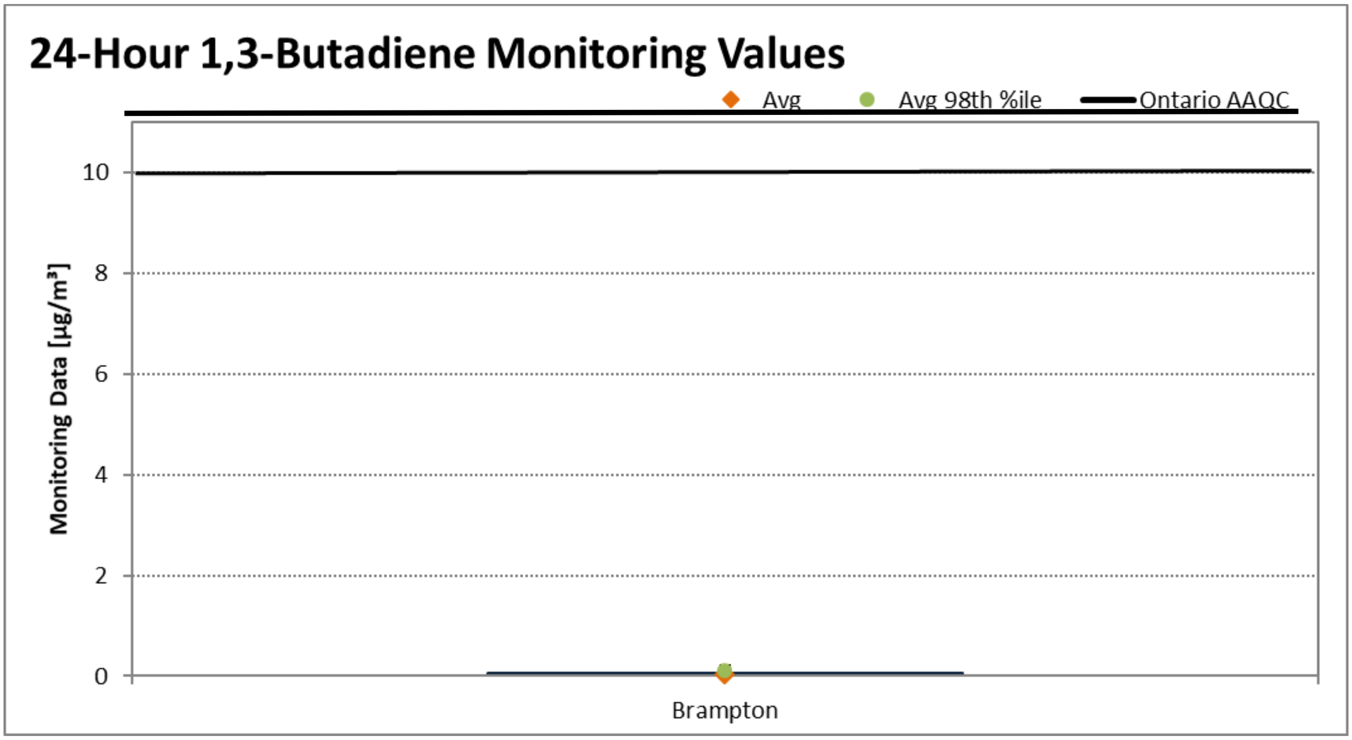


Figure 4: Measured 1,3-Butadiene at the Brampton Station

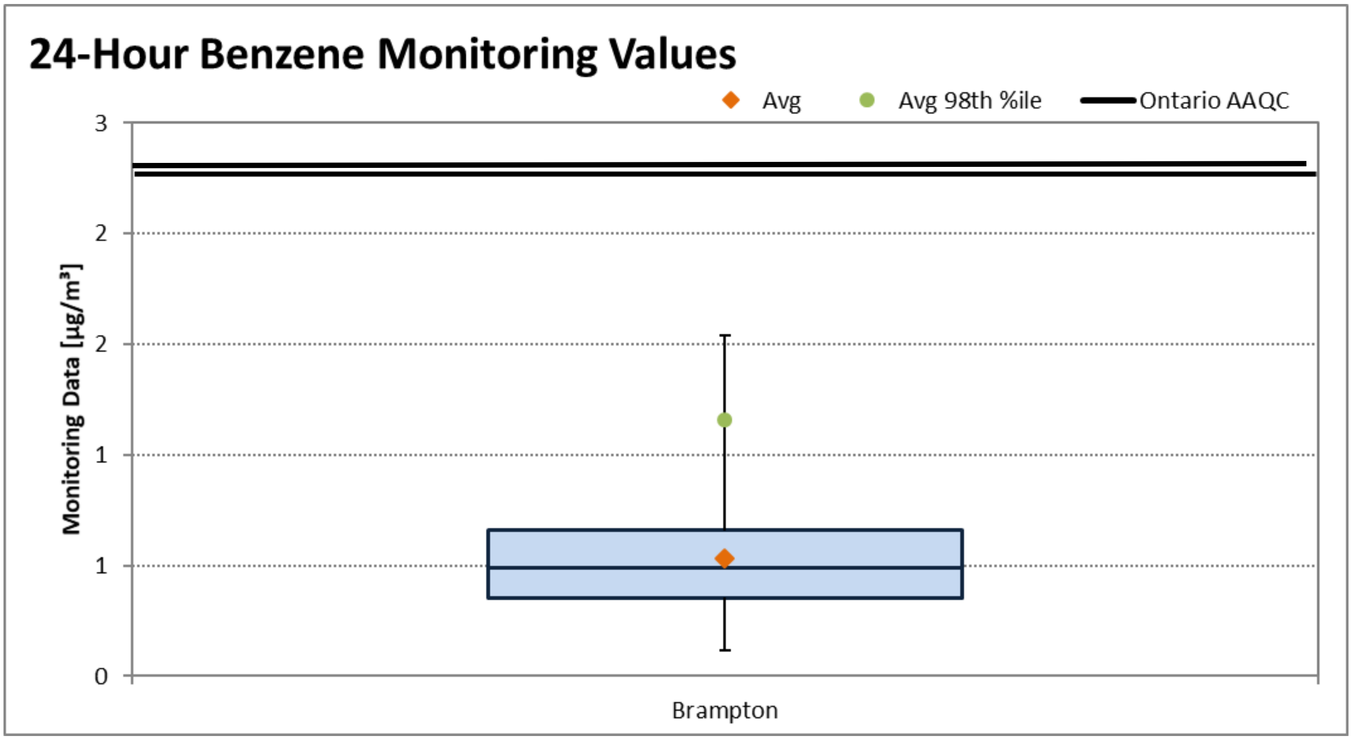


Figure 5: Measured Benzene at the Brampton Station

3.4 Industrial Emission Sources

The assessment of industrial emission sources in the Project's area was limited to a radius of 2 kilometres (the Study Area) covering portions of the Town of Caledon. There are 4 industrial facilities from various sectors that reported to the National Pollutant Release Inventory in 2015 for the indicator compounds (ECCC, 2016). These emissions contribute to the local air quality and the consideration of cumulative effects. These sources are minor contributors of indicator compounds when compared to provincial totals, as summarized in Table 4. None of the 4 facilities reported speciated concentrations of acetaldehyde, acrolein, 1,3- butadiene, benzene or formaldehyde therefore only total VOC releases are presented below.

Table 4: Emission Totals for Industry in the Study Area [Tonnes/year]

Company Name	Facility Name	NOx	CO	VOC	SPM	PM_{10}	$PM_{2.5}$
MARS Canada Inc.	MARS Canada Inc.	—	—	—	—	2.916	2.067
Bolton Steel Tube Co. Ltd.	Bolton Plant	—	—	—	—	0.118	—
Teknaform Inc.	Teknaform Inc 4 Simpson	—	—	49.4	—	—	—
Naizil Inc.	Naizil Inc.	—	—	18.25	—	—	—

Company Name	Facility Name	NOx	CO	VOC	SPM	PM_{10}	$PM_{2.5}$
Total Reported Emissions[1]		—	—	67.65	3.034	3.034	2.067
Ontario Total Emissions		67,304	69,665	43,404	35,054	18,983	9,689
% of Study Area Emissions to Ontario Total		<1%	<1%	<1%	<1%	<1%	<1%

Note:

1. SPM emissions corrected to be equal to reported PM_{10} emissions
   "—" indicates the substance was not reported for the facility

4.0 PROJECT EMISSIONS

The proposed Project involves grade separation along Coleraine Drive, south of Old Ellwood Drive in the town of Caledon, Ontario. The purpose of the grade separation is to improve traffic flows and congestion that are anticipated based on projected traffic volumes associated with expected growth of the Peel Region.

The study area for this Project stretches from Harvest Moon Drive to Holland Drive and is approximately 1.2 km in length (The Study Area). Annual Average Daily Traffic (AADT) was provided for this stretch of road for both 2015 and 2041 years. The percent increase in the daily AADT from 2015 to 2041 was calculated to be 93%. This data is provided in Table 5, below.

Table 5: Existing and Future Traffic Volumes for Study Area

Scenario	Year	AADT	Length of Road [km]	Vehicle Km travelled (VKT)
Existing	2015	13,038	1.2	15,646
Future	2041	25,213	1.2	30,256

Emission rates from roads are typically estimated by multiplying emission factors by corresponding fleet size and kilometers of distance travelled. The US EPA mobile sources emission factor model is one of the MECP and MTO recommended models for calculating emission factors for roads. The current Canadian version, MOBILE 6.2C, uses Canadian climate data and fuel compositions and was therefore used for this assessment. The traffic data in Table 5 was used to run the MOBILE6.2C model and estimate annual emissions from each scenario, based on the posted speed limit of 60 km/h and typical traffic breakdown for an arterial road. Emissions from the re-entrainment of the road dust from vehicles travelling on paved roads were excluded from the assessment as they will be consistent with the change in daily AADT and will not alter the outcome of this assessment. Annual emission rates are summarized in Table 6, below.

Table 6: Project Emission Rates for Current and Future Scenarios [kg/year]

Compound	Current Emissions [kg/year]	Future Emissions [kg/year]	Percentage Increase
NOx	2,725	5,270	93%
CO	40,991	79,270	93%
SPM	59	92	56%
PM_{10}	59	92	56%
$PM_{2.5}$	59	92	56%
Benzene	74	99	34%
1,3 Butadiene	7	10	35%
Formaldehyde	24	34	39%
Acetaldehyde	12	17	37%
Acrolein	1	1	38%
Total VOC	2,072	4,007	93%

As evident from Table 6, future traffic emissions in 2041 are expected to result in as much as a 93% increase in annual emissions from the Study Area. This increase in emissions is directly attributed to expected growth in the Region of Peel and resultant projected traffic volumes. As a result, and given the nature of the Project (grade separation), dispersion modelling was not undertaken as the worst-case emissions would be congestion of the roadway in both the current and future scenarios. However, the proposed Project would act to reduce the frequency of congestion. The reduction of congestion frequency highlights the importance of the proposed Project as the grade separation will be necessary to reduce flow disruption from increased volumes and will also act to minimize the air quality impact of increased traffic through improved traffic flows within the local vicinity of the Project.

5.0 RESULTS

Studies by the US EPA have found that roadways generally influence air quality within a few hundred metres downwind from a heavily travelled road. The actual distance varies by location, time of day, year and prevailing meteorology, topography and traffic patterns (US EPA, 2014). Concentrations will dissipate rapidly from the road source, therefore it is expected that this Project will have a negligible impact on regional air quality. This is further evident when the emissions from Coleraine Drive are compared to emissions from other industrial sources in the area. Table 7, below compares emissions from the Study Area to emissions from neighbouring industrial sources within a 2 km radius of the Project and Ontario total emissions. Emissions from the Project contribute less than 10% to total industrial emissions in a 2 km radius of the Project for all compounds reported to NPRI and furthermore, represent a very small fraction (< 0.1%) of the Ontario total emissions for all compounds. Considering these values, the emissions from Coleraine Drive are not likely to represent a significant contribution to ambient air quality in the area.

Table 7: Comparison of Project Emissions to Background Emissions

Compounds	Current Project Emissions [kg/year]	Future Project Emissions [kg/year]	Industrial emissions within a 2km radius[(1)] [kg/year]	Ontario Total [(1)] [kg/year]
NO_2	2,725	5,270	—	67,304,000
CO	40,991	79,270	—	69,665,000
SPM[2]	59	92	3,034	35,054,000
PM_{10}	59	92	3,034	18,983,000
$PM_{2.5}$	59	92	2,067	9,689,000
Total VOC	2,072	4,007	67,650	43,404,000

Notes:

1. National Pollutant Release Inventory reports for 2015
2. Emissions of SPM reported to NPRI were corrected to be at least as great as PM_{10} emissions

5.1 Sensitive Receptors

As outlined in the MTO guidance, sensitive receptors within 500 m of the study area should be identified and assessed. The area surrounding the Project contains various land use types, including industrial, commercial and natural, however various sensitive receptors have also been identified within 500 m of the Project and are as follows:

- Residences:
  - Residential areas are located on either side of Coleraine Drive at the northern end of the Study area (North of Old Ellwood Drive).

- Schools:
  - St Nicholas Elementary School is approximately 400 m south west of Coleraine Drive within the north end of the Study Area.

All of the above identified receptors are already located close to Coleraine Drive and will be impacted by projected traffic growth, but the proposed Project will act to minimize the air quality impact of increased traffic through improved traffic flows and reduced queuing times at intersections within the local vicinity of the Project. As a result, the impact on the identified sensitive receptors is anticipated to be negligible.

6.0 CONCLUSIONS

Based on the existing monitoring data in the Project area, the levels of NO_2, SO_2, CO and 1,3-butadiene are shown to be below the current standards and guidelines. For these compounds, the emissions from the Project are not expected to cause local air quality to exceed the current standards or guidelines. For the five year period, 2011 - 2015, the annual benzene concentration was greater than the applicable standard in all years, however, the Project will minimize the air quality impact associated with the projected increased traffic through improved traffic flows and reduced queuing times at intersections within the local vicinity of the Project. Emissions from the 1.2 km stretch of Coleraine Drive being considered for this assessment do not represent a significant contribution to local air quality (less than 0.1% of total Ontario emissions), however, given the projected increase in traffic due to the growth of the Region of Peel, emissions are expected almost double by 2041. As a result of the increase in traffic and associated emissions, the proposed grade separation is necessary to help alleviate congestion. The alleviate congestion as a result of the Project will minimize the air quality impact of the increased emissions.

Overall, the Project itself is anticipated to be a relatively minor source when compared to other larger sources within the area, therefore the impact on overall air quality in the region is expected to be negligible.

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