Appendix Q – Air Quality Impact Assessment

Kennedy Road Environmental Assessment between Steeles Avenue and Major Mackenzie Drive

REPORT

Quantitative Air Quality Assessment for Kennedy Road Environmental Assessment Study (Steeles Avenue to Major Mackenzie Drive)

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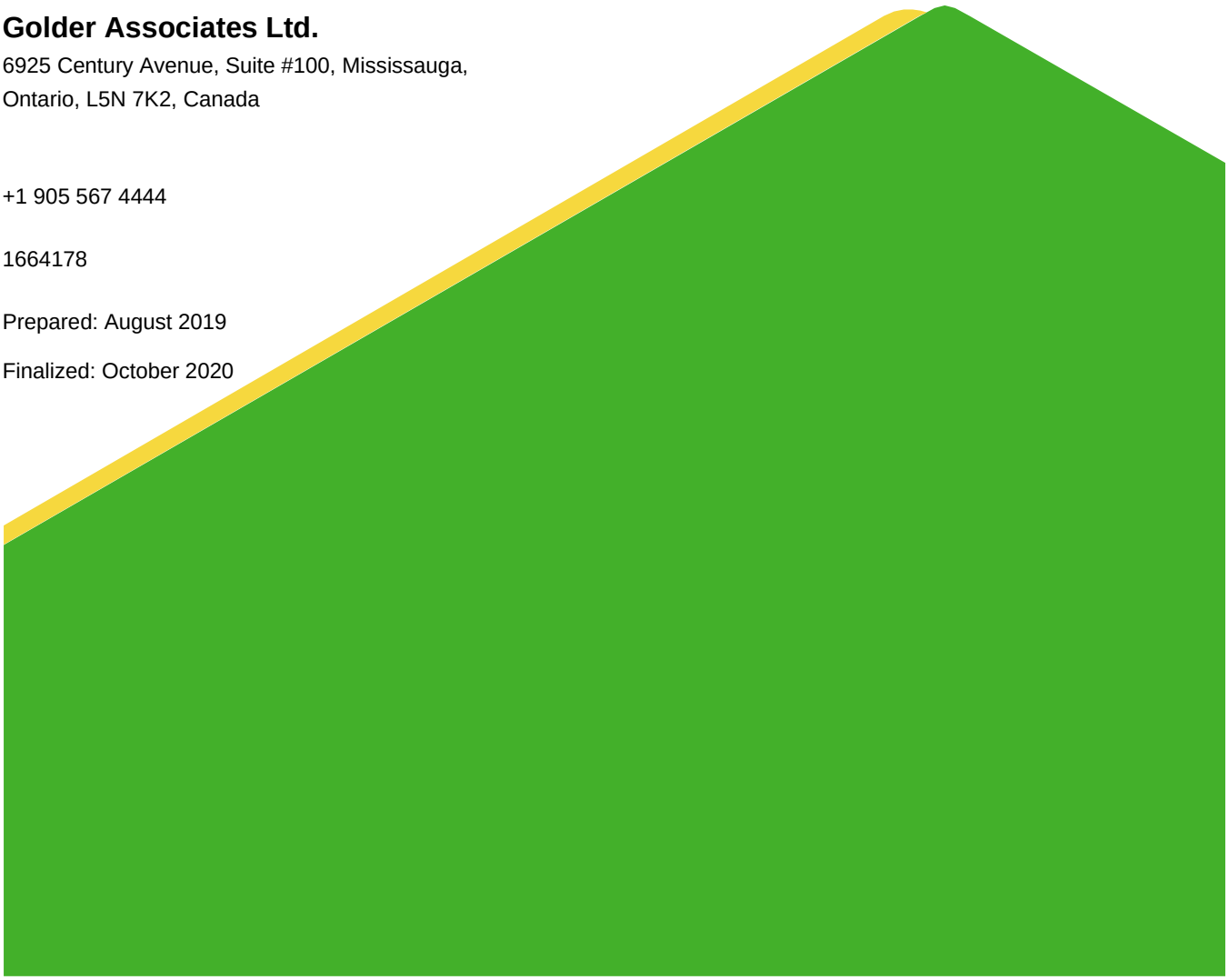

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by HDR Inc. to complete a quantitative air quality assessment to support the Municipality of York in a Municipal Class Environmental Assessment (EA) – Schedule C for the proposed improvements to Kennedy Road in Markham, Ontario (the Project). The air quality assessment was prepared to provide an assessment of the air quality impacts resulting from the proposed Project. The air quality impacts were compared to relevant federal and provincial standards and guidelines. Using the available background air quality data, the assessment also discusses the existing background air quality in the vicinity of the proposed Project and the potential impacts of the proposed Project on local air quality.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. This report should be read in conjunction with *"Important Information and Limitations of This Report"* in Appendix A, following the text of this report. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

This Report was authored under a Subconsultant Agreement between HDR and Golder for the Regional Municipality of York's ("Owner") projects. The Report is provided to HDR and Regional Municipality of York for their use, utilizing their judgment, in fulfilling a portion of HDR's particular scope of work. No other party may rely upon this report, or any portion thereof, without Golder's express written consent and any reliance of the reports by others will be at that user's sole risk and liability, notwithstanding that they may have received this Report through an appropriate user. In addition, Golder shall not be liable for any use of the Report for any purpose other than that for which the same was originally prepared or provided by Golder, or any improper use of this Report, or to any party other than HDR.

2.0 PROJECT DESCRIPTION

The proposed Project involves road improvements along an approximately 8 km corridor of Kennedy Road from Steeles Avenue to Major Mackenzie Drive in the City of Markham. The Project includes widening of the existing four lanes of traffic to six lanes for use by Transit and High Occupancy Vehicles (HOV), in addition to modifications to the streetscape and continuous active transportation facilities.

Transit vehicles anticipated to use the HOV lanes currently use diesel/gasoline fuels. In the future there is potential for transit fleet to use no/low transportation related air pollution (TRAP) fuel sources, i.e. natural gas or electric.

3.0 METHODOLOGY

The assessment was conducted 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, 2017a, “MECP Central Region Draft Guidance”).

As part of pre-consultation with the MECP, it was identified that a partial Air Quality Impact Assessment was recommended for this study, following the “hot spot methodology” identified in the MECP Central Region Draft Guidance. The relevant hot spot area was identified based on the following criteria

- Traffic volumes;
- Critical receptors, identified as parks, schools, childcare facilities, child family programs, long term care facilities, and recreational facilities within 300 m of either side of the roadway;
- Sensitive receptors, identified as residences within 300 m of either side of the roadway; and
- Areas of road curvature or significant change in slope/grade (i.e. grade separation).

To identify the representative “hot spot area” the study corridor was reviewed in the following segments, generally 1km in length:

- Steeles Avenue to Denison Street;
- Denison Street to Highway 407;
- Highway 407 to Highway 7;
- Highway 7 to Carlton Road;
- Carlton Road to 16th Avenue;
- 16th Avenue to Bur Oak Avenue; and
- Bur Oak Avenue to Major Mackenzie Drive.

The stretch of Kennedy Road between Denison Street and Highway 407 was ultimately selected as the hot spot area for future modelling as it has a high future traffic volume, the largest cluster of adjacent critical receptors, and a high volume of sensitive receptors adjacent to both sides of Kennedy Road.

The hot spot location and study area for this proposed Project is shown in Figure 1.

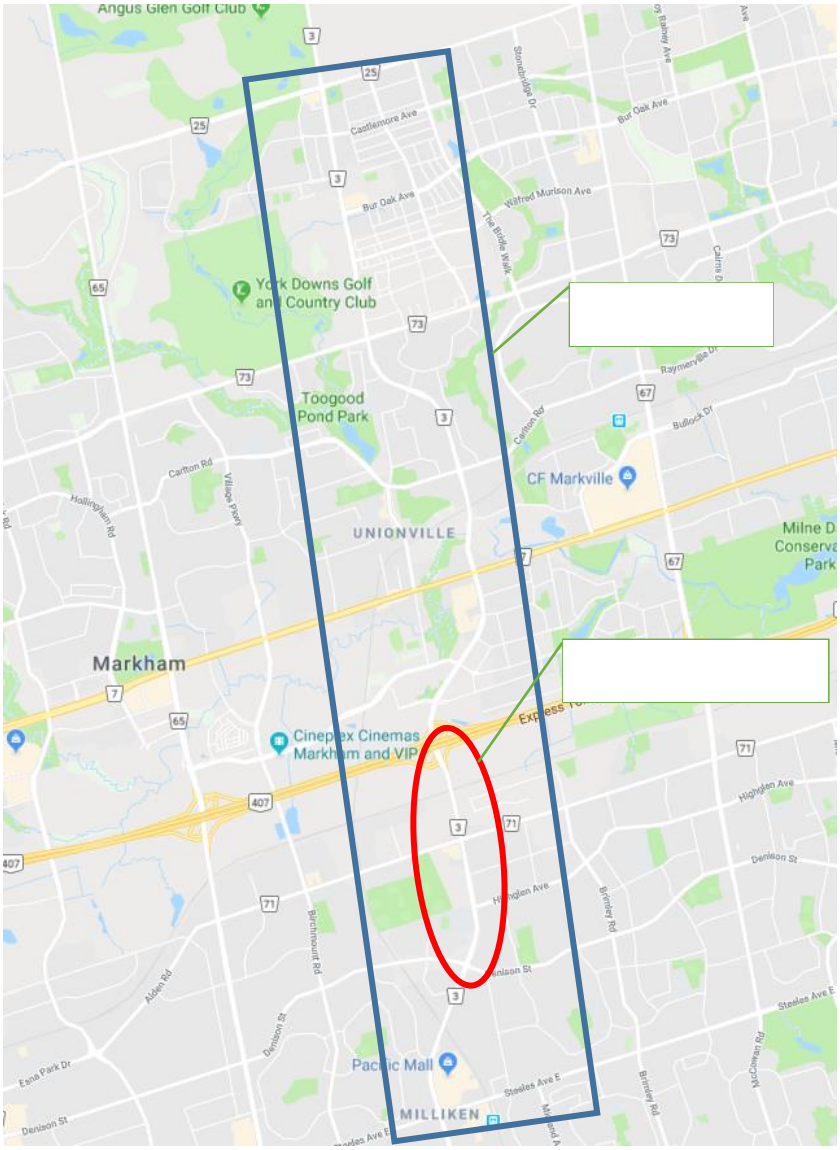


Figure 1: Proposed Project Study Area and Hot Spot Location

This air quality assessment follows the partial AQIA methodology described in the MECP Central Region Draft Guidance and includes two main tasks, characterizing the existing conditions and assessing the net effects of the proposed Project on air quality. The Assessment considers the “maximum worst case” potential emissions for both the current and future scenarios.

4.0 BACKGROUND AIR QUALITY

The background air quality in the area around the proposed Project has been described by considering existing sources of emission and 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).

4.1 Indicator Compounds

The assessment of background air quality focused on 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 2.5 microns ($PM_{2.5}$); and
- selected volatile organic compounds (VOCs): acetaldehyde, acrolein, benzene, 1-3 butadiene, and formaldehyde.

4.2 Applicable Guidelines

The air quality criteria used for assessing the air quality effects of the proposed Project include Ontario criteria, and federal standards and objectives where provincial guidelines are not available. The Ministry of the Environment, Conservation, and Parks (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 (CAAQS) and the National Ambient Air Quality Objectives (NAAQO).

The NAAQO 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 NAAQO (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.

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

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 Criteria[b]	National Ambient Air Quality Standards and Objectives[c]		Project Criteria
				Desirable	Acceptable	
CO (µg/m^3)	1-hour	36,200	—	15,000	35,000	36,200
	8-hour	15,700	—	6,000	15,000	15,700
NO_2 (µg/m^3)	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/m^3)	24-hour	120	—	—	120	120
	Annual	60	—	60	—	60
PM_{10} (µg/m^3)	24-hour	50	—	—	—	50
$PM_{2.5}$ (µg/m^3)	24-hour	30	28/27	—	—	27
	Annual	—	8.8	—	—	8.8
Acrolein (µg/m^3)	1-hour	4.5	—	—	—	4.5
	24-hour	0.4	—	—	—	0.4
Acetaldehyde (µg/m^3)	24-hour	500	—	—	—	500
1,3-Butadiene (µg/m^3)	24-hour	10	—	—	—	10
	Annual	2	—	—	—	2
Benzene (µg/m^3)	24-hour	2.3	—	—	—	2.3
	Annual	0.45	—	—	—	0.45
Formaldehyde (µg/m^3)	24-hour	65	—	—	—	65

Notes:
(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.
— = No guideline available.

Note: 1-hour CAAQS for NO_2 are 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.

4.3 Project Location

The proposed Project is located in a relatively residential area, as a result, there are no industrial facilities within a 1 km radius of the proposed Project that reported to Environment and Climate Change Canada's (ECCC) National Pollutant Reporting Inventory for 2016 (ECCC, 2018). The closest facility that reported emissions in 2016 is located approximately 1 km away from the proposed Project. As a result, the main source of emissions close to the Project is anticipated to be road sources. In particular, Highway 407 bisects the proposed Project Study Area and has an annual average daily traffic of over 100,000 vehicles. Highway 7, Warden Avenue, and McCowan Road are also major arterial roads located within 2 km of the Project. Overall, the Project is located in an area where the dominant source of background emissions is transportation sources.

4.4 Monitoring Data

In Ontario, regional air quality is monitored through a network of air quality monitoring stations operated by the MECP and ECCC 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 local monitoring stations.

The proposed Project is located close to McNicoll Avenue (to the south), Major Mackenzie Drive East (to the north), Birchmount Road (to the west) and McCowan Road (to the east). The areas to the east, south and west of the proposed Project are mainly residential with some open green space. The area directly to the north of the proposed Project is also residential, with a rural area to the north of it.

There are no stations directly located in the proposed Project Study Area. The closest relevant station that monitors the required substances is the Toronto West station. Ambient air measured at this station has several industrial sources and highway traffic sources influencing it, which may lead to a more conservative representation of the background air quality, as there are no industrial sources within a kilometer of the proposed Project Study Area.

The Toronto West station was selected as the most representative station due to its location upwind of the proposed Project, and similarities in nearby highway traffic air pollution sources. Data for the most recent five-year period (2012 to 2016) with complete and quality assured data by ECCC was used for this assessment.

There are no stations in the vicinity of the proposed Project that monitor VOCs for the most recent five-year period (2012 to 2016). The station that is located in an area similar to the proposed Project Study Area (i.e., surrounded by highway traffic as well as arterial and local traffic) and monitors VOCs is the Brampton station. Data from this station is available for the period of 2011 to 2015 but does not include acetaldehyde, acrolein or formaldehyde. These VOCs are not part of NAPS typical suite of VOCs monitored; therefore data is not available for many stations across Ontario. Data for these Indicator Compounds was therefore taken from the station located at 200 College Street in Toronto, however, data was only available for 2014-2016.

Selected station details are provided in Table 2, below.

Table 2: Ambient Air Quality Monitoring Parameters

Station Name	NAPS Station ID	Available Data							Distance from Project	Direction from the Project
		CO	NO_2	NO	SPM[(a)]	PM_{10}[(a)]	$PM_{2.5}$	VOCs		
Toronto West	60430	Y	Y	Y	—	—	Y	—	24 km	Southwest
Brampton	60428	—	Y	Y	—	—	Y	Y[(b)]	41 km	West
200 College	60437	—	—	—	—	—	—	Y[(c)]	21 km	Southwest

Notes:
"—" Station not used for obtaining compound data.
(a) SPM and PM_{10} data were calculated using the following ratios; $PM_{2.5}$ = 0.54 x PM_{10}, $PM_{2.5}$ = 0.3 x SPM (Lall et al., 2004).
(b) Does not include acetaldehyde, acrolein, or formaldehyde
(c) Does not include benzene or 1,3-butadiene

For analyzing monitoring data, the 90th percentile of the available monitoring data is typically considered a conservative estimate of background air quality (CEA Agency and CNSC, 2009). 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 Air Quality Concentration [µg/m³]	Project Criteria [µg/m³]	% of Project Criteria
CO	1-hour	458.10	36,200	1%
	8-hour	501.04	15,700	3%
O_3	1-hour	78.50	N/A	N/A
	8-hour	98.54	N/A	N/A
NO_2	1-hour	58.31	79.1/400	74%/15%
	24-hour	47.02	200	24%
	Annual	30.82	22.6	136%
SPM	24-hour	47.67	120	40%
	Annual	26.72	60	45%
PM_{10}	24-hour	26.70	50	53%

Indicator Compound	Averaging Period	Background Air Quality Concentration [µg/m³]	Project Criteria [µg/m³]	% of Project Criteria
$PM_{2.5}$	24-hour	14.42	27	54%
	Annual	8.08	8.8	92%
Acetaldehyde (µg/m³)	24-hour	1.72	500	<1%
Acrolein (µg/m³)	1-hour	—	4.5	—
	24-hour	0.09	0.4	18%
Benzene (µg/m³)	24-hour	0.88	2.3	38%
	Annual	0.55	0.45	121%
1,3-Butadiene (µg/m³)	24-hour	0.09	10	1%
	Annual	0.05	2	2%
Formaldehyde (µg/m³)	24-hour	3.19	65	5%

Note:
(a) All values are based on 90th percentile with the exception of annual averages.
(b) "—" no data available
(c) N/A - not applicable for this assessment

Emission sources of indicator compounds in the proposed Project Study Area are accounted for in the existing air quality, including local traffic, industrial, commercial, and residential sources.

4.4.1 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 the measured concentrations for the 1-hour or 8-hour CO were below the Ontario AAQC and are presented below (Figure 2).

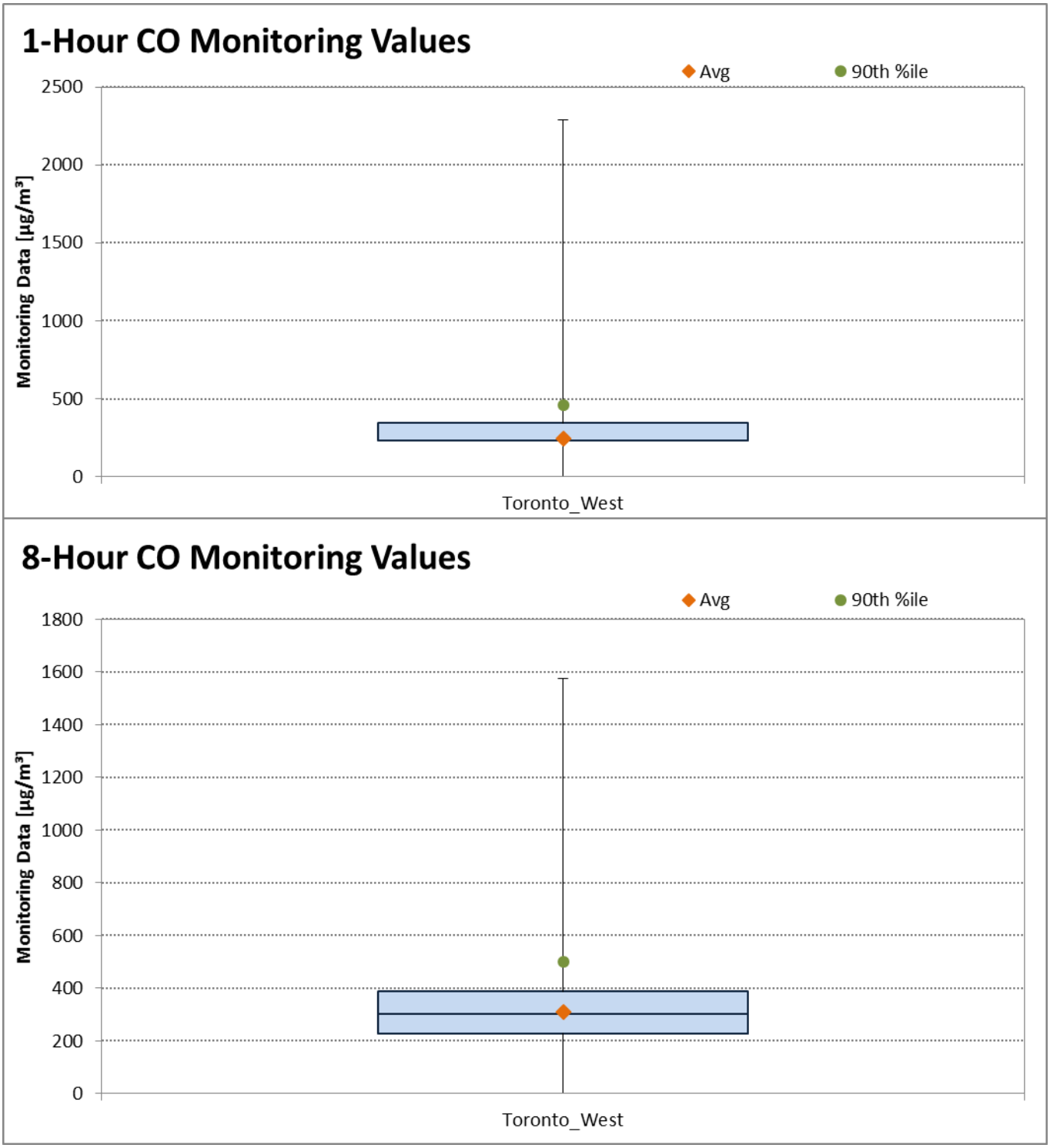
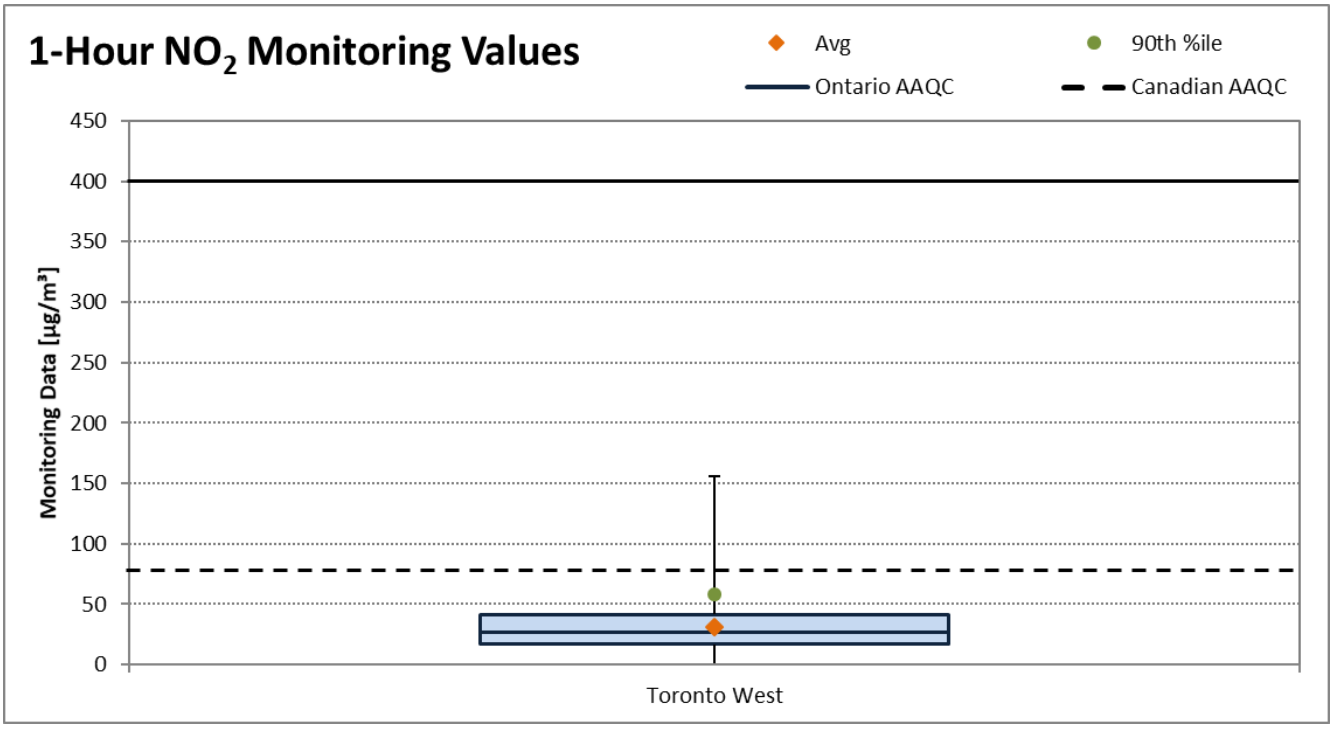


Figure 2: Measured Carbon Monoxide (CO) Concentrations at the Toronto West Station

4.4.2 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 2018b). As a result, regulatory guideline levels are based on NO_2 emissions and concentrations. The annual mean concentrations of NO_2 in Ontario have decreased by 30% from 2007 to 2016 (MECP 2018b) but are currently above the CAAQS which is effective in 2025. The monitoring data assessed shows the 1-hour or 24-hour Ontario AAQC for NO_2 recorded (Figure 3) were below the Ontario AAQC.



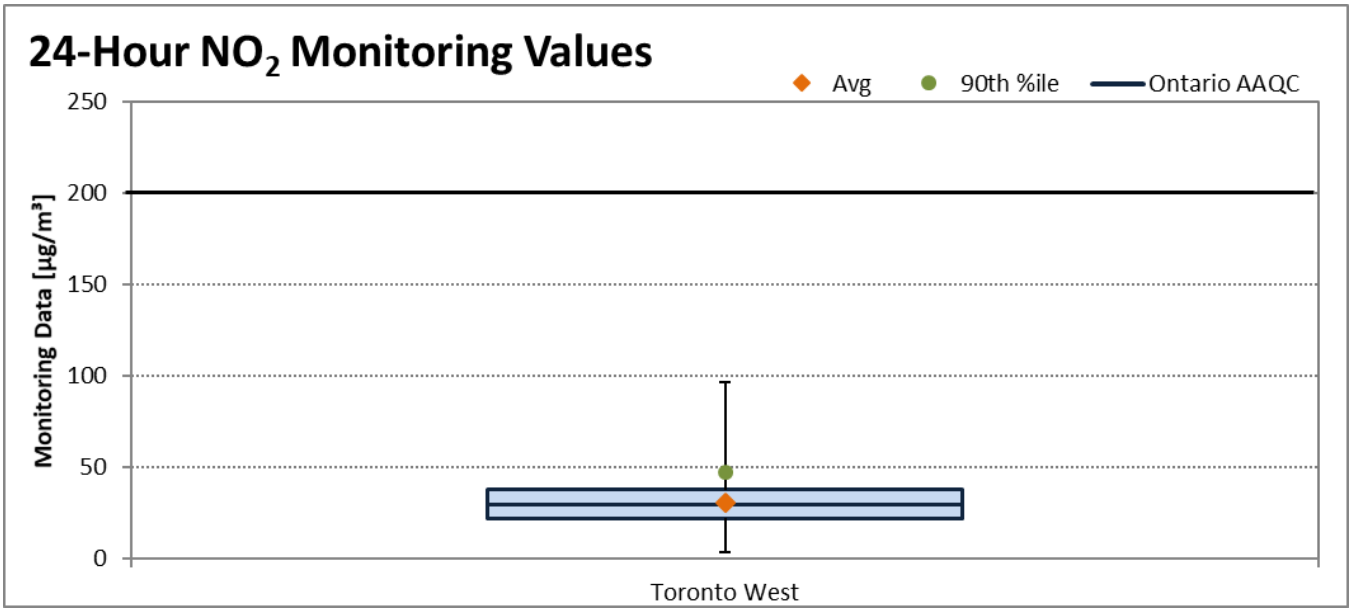


Figure 3: Measured 1-hour and 24-hour Nitrogen Dioxide (NO_2) Concentrations at the Toronto North and Toronto West Stations

4.4.3 O_3 Concentrations

Ground-level ozone is formed when NO_x and VOCs react in the presence of sunlight. Ground-level ozone concentrations are included in this assessment as they may be required to calculate the concentrations of NO_2 as described in the Ozone Limiting Method (OLM).

4.4.4 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 may results in health impacts. In Ontario, these emissions have been demonstrating a steady decline over time, decreasing by approximately 16% from 2007 to 2016 (MECP, 2018b). As presented Figure 4 for 24-hour $PM_{2.5}$, measurements meet the Ontario AAQC value of 27 µg/m³.

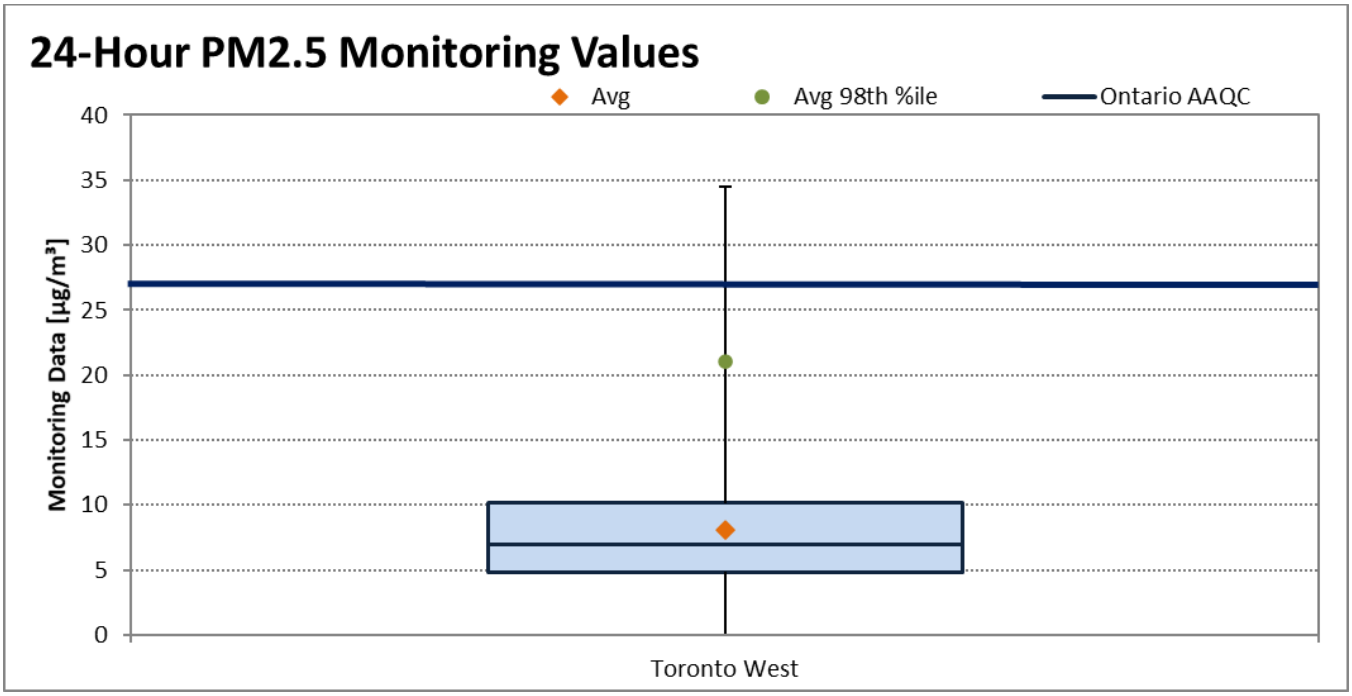


Figure 4: Measured 24-hour PM2.5 Concentrations at the Toronto West Station

No local monitoring data was available for SPM and PM_{10}, however, the background SPM and PM_{10} concentrations can be estimated 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 region.

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. Derived SPM and PM_{10} values are below the relevant AAQC and NAAQOs.

4.4.5 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 (MOECC 2015). The primary VOCs associated with traffic include acetaldehyde, acrolein benzene, 1,3-butadiene, and formaldehyde. Benzene and 1,3- butadiene are routinely measured at the Brampton Station every 6 days and therefore a statistical analysis of these compounds is provided below.

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 the measured values for the 24-hour (Figure 5) and annual AAQC were below the criteria.

From the monitoring data assessed, benzene values were below the 24-hour AAQC (Figure 6); however, the annual benzene concentration was exceeded every year, where the average annual benzene concentration was 120% 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. Additionally, as data is recorded only every 6 days, the annual average serves as an indicator only.

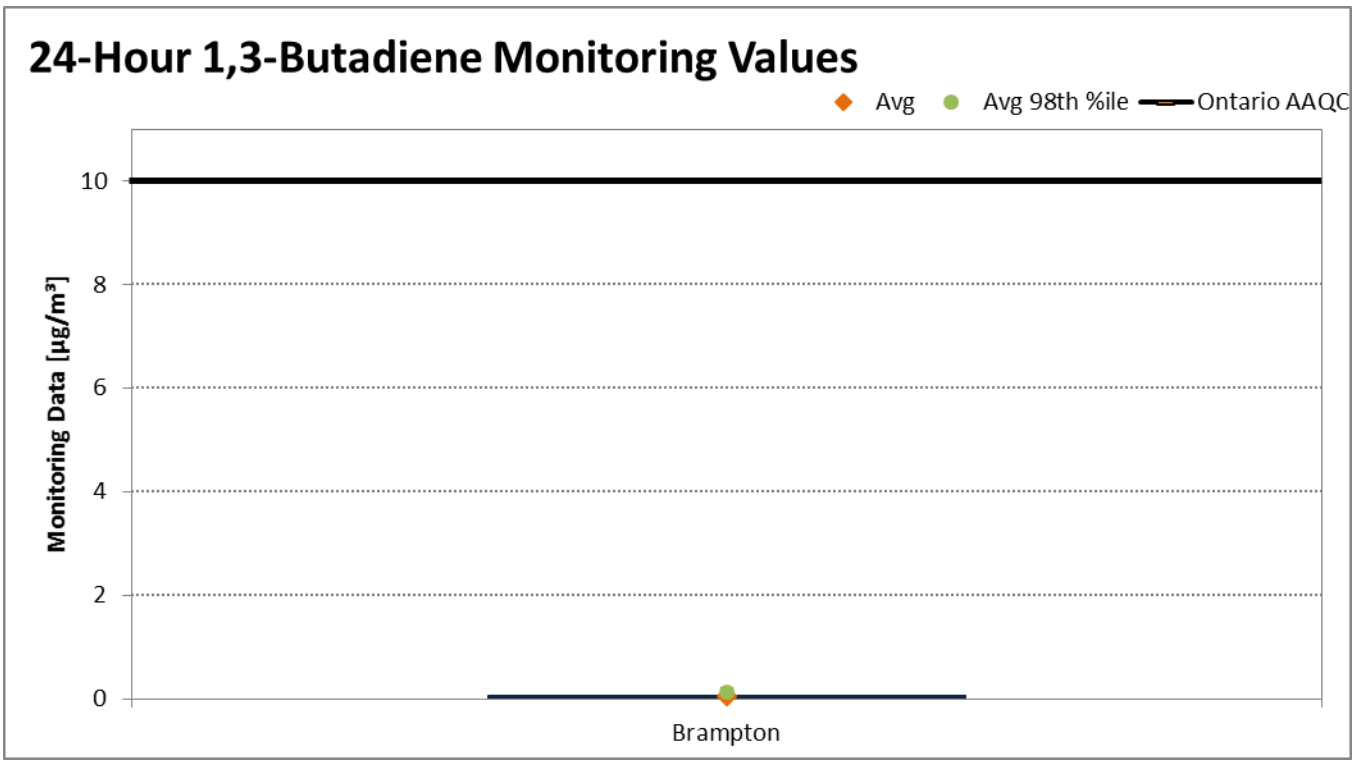


Figure 5: Measured 1,3-Butadiene at the Brampton Station

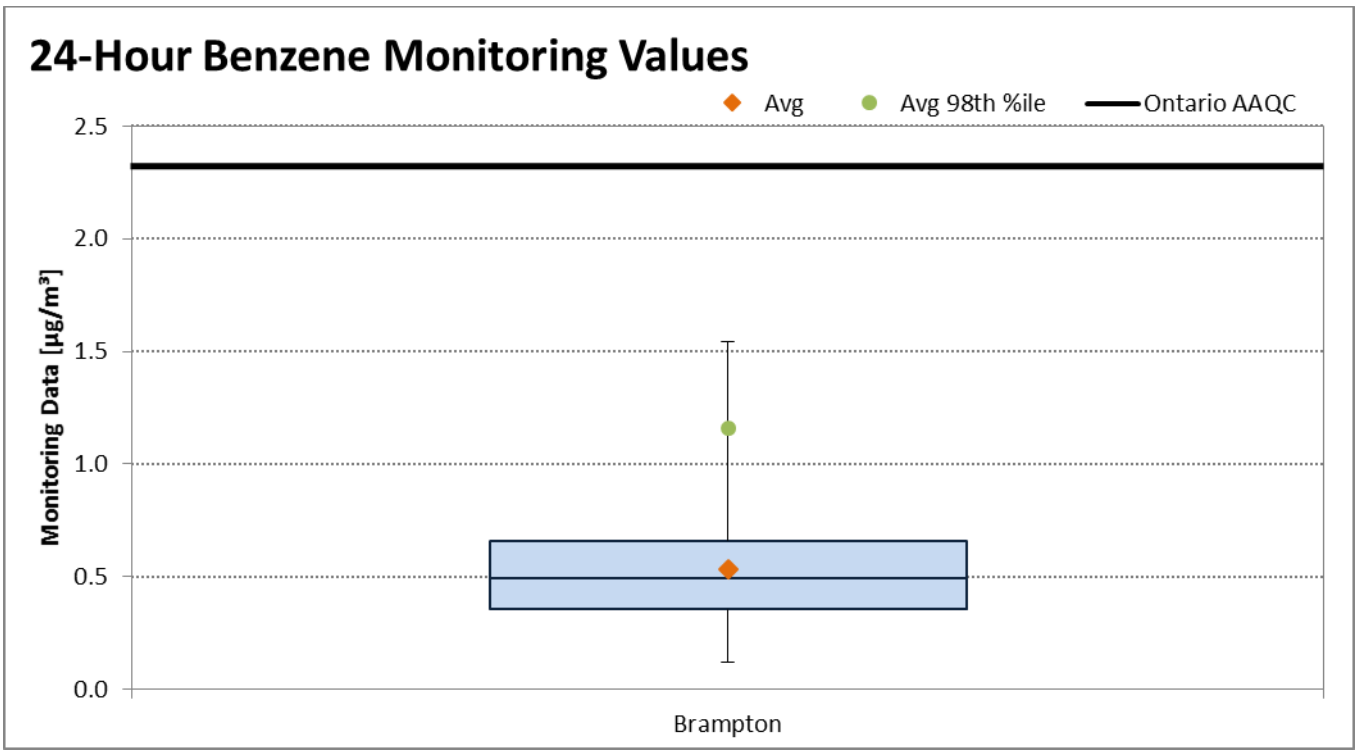


Figure 6: Measured Benzene at the Brampton Station

Limited data is available for acetaldehyde, acrolein, and formaldehyde, as these indicator compounds are only monitored at 2 stations across Ontario and have only been monitored since August 2015, on a sporadic basis. The monitored data for the three indicator compounds were observed to be significantly below the AAQC.

5.0 PROJECT EMISSIONS

The proposed Project involves road improvements along an approximately 8 km corridor of Kennedy Road from Steeles Avenue to Major Mackenzie Drive in the City of Markham. The Project includes widening of the existing four lanes of traffic to six lanes for use by transit and High Occupancy Vehicles, in addition to modifications to the streetscape and continuous active transportation facilities. Emission rates for both the project construction and operation are discussed in the following sections.

5.1 Construction Emissions

Construction activities have the potential to create temporary, localized effects on air quality in the immediate vicinity of the proposed Project. Emissions from construction are primarily comprised of fugitive dust and combustion products from the movement and operation of construction equipment and vehicles.

These emissions, in turn, may create a nuisance or disturbance effect for nearby residents and land users during the construction phase. Mitigation measures to reduce potential nuisance effects of dust and air emissions include the following:

- Regular maintenance of equipment used on site to minimize exhaust;
- Use of effective dust suppression techniques, such as on-site watering, as necessary;
- Reducing speed limits on unpaved areas for mobile equipment;
- Optimization of material transfer operations, including reducing distance for material transfers, if possible.

5.2 Operation Emissions

Worst case impacts from roadway vehicle emissions were assessed for two different scenarios:

1. 2015 Current Conditions – Existing Traffic Volumes on Kennedy Road for the current alignment
2. 2041 Future Build – Projected Traffic Volumes on Kennedy Road when the proposed Project is in the mature state of development

Annual Average Daily Traffic (AADT) data was provided for the Project. The Project AADT for the study area is shown in Table 4 below.

Table 4: Project Traffic Volumes for Study Area

Year	Starting Point	Finishing Point	Project AADT	Percentage of Truck Traffic [%]	Day/Night Split [%]
2015	Denison Avenue	14th Avenue	43,913	7.47%	93%/7%
	14th Avenue	Highway 407	42,943	7.45%	93%/7%
2041	Denison Avenue	14th Avenue	64,133	7.47%	93%/7%
	14th Avenue	Highway 407	64,616	7.45%	93%/7%

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 Ontario Ministry of Transportation (MTO) recommended models for calculating emission factors for roads. The Canadian version, Mobile 6.2C uses Canadian climate data and fuel compositions and was therefore used for this assessment. Model inputs to MOBILE6.2C are summarised below.

Table 5: Inputs to MOBILE6.2C model

MOBILE6.2C Parameter	Input
Year of Evaluation	2015, 2041
Month	January, July
Road Type	Arterial
Diesel Sulphur Content	15 ppm (Ontario Drive Clean)
Gasoline Aromatics (%)	28.4
Gasoline Olefin (%)	10.3
Gasoline Benzene (%)	0.5
E200 - Vapour Percentage of Gasoline at 200 F (%)	47.3
E300 - Vapour Percentage of Gasoline at 300 F (%)	48.3
Vehicle Fleet Characteristics	Default for Arterial roads, adjusted to match truck Percentage

The model was run for the month of July as this month produces the worst-case emissions and is typically the preferred month of assessment by MTO and MECP.

The model was run for both the months of January and July and worst-case emission rates were used. The traffic data from the proposed Project presented in Table 4, above, was used with the emission factor outputs from the MOBILE6.2C model to calculate the annual emissions for the proposed Project.

Emissions from the re-entrainment of the road dust from vehicles travelling on paved roads were calculated using the U.S. EPA AP-42 emission factors from Chapter 13.2.1 – Paved Roads (January 2011). The following predictive emissions equation was used to calculate the fugitive dust emission factor for paved roads:

$$\mathrm{EF} = (\mathrm{k}(\mathrm{sL})^{0.91} \times (\mathrm{W})^{1.02})$$

Where:

EF ..... = particulate emission factor (having units matching the units of k),
k ..... = particle size multiplier for particle size range and units of interest (see Table 6),
sL ..... = road surface silt loading (g/m^2) assumed to be 0.03 (as per U.S. EPA AP-42 Section 13.2.1-2, silt loading for public roadways with an AADT of over 10,000),
W ..... = average weight (tons) of the vehicles traveling the road, assumed to be 3 tons or 2.7 tonnes

Table 6: Particle Size Assumptions for Paved Road Dust

Size Range	K (g/VKT)
SPM	3.23
PM_{10}	0.62
$PM_{2.5}$	0.15

The following is a sample calculation for SPM for the predictive emission factor for vehicles that will travel along the road. It was estimated that the vehicles have an average weight of 3 tons.

$$\mathrm{EF} = (3.23 \times (0.03)^{0.91} \times (2.7)^{1.02})$$

$$\mathrm{EF} = 0.41\ \mathrm{g/VKT}$$

The emission factors of PM_{10} and $PM_{2.5}$ were calculated as presented above.

Emissions from the re-entrainment of road dust were added to the emission rates from MOBILE6.2C.

MOBILE6.2C does not provide emission rates for idling, therefore these were taken from US EPA document "Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks" (USEPA, 2008).

Emission factors associated with the Project, road dust and tailpipe, are presented in Table 7.

Table 7: Project Emission Factors

Indicator Compound	2015 Current Operation Emission Factors		2041 Future Build Emission Factors		Idling Emission Factors
	g/mi	g/VKT	g/mi	g/VKT	g/hour
NOx	0.68	0.43	0.35	0.22	6.43
CO	11.99	7.45	10.61	6.59	72.35
SPM	0.68	0.42	0.68	0.42	1.20
PM_{10}[1]	0.15	0.09	0.15	0.09	1.20
$PM_{2.5}$	0.04	0.03	0.04	0.03	1.10
Acetaldehyde	0.004	0.0024	0.003	0.002	0.025
Acrolein	0.0003	0.0002	0.0002	0.0001	0.0019
Benzene	0.019	0.012	0.014	0.009	0.011
1,3-Butadiene	0.003	0.0016	0.002	0.001	0.0016
Formaldehyde	0.007	0.0044	0.005	0.003	0.048

Note:

[1]Conservatively assumed that tailpipe SPM emissions are the same as tailpipe PM_{10} emissions.

6.0 AIR DISPERSION MODELLING

The estimated environmental effects for the air quality indicators were evaluated based on the results of the MOBILE6.2C model, using the CAL3QHCR dispersion model for paved roads. The CAL3HQCR model is suited to predict concentrations for roadway dispersion and is the preferred model for the credible worst-case analysis method as identified in Ontario Ministry of Transportation's Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects (MTO Guide, MTO 2012). The CAL3QHCR model was selected for air dispersion modelling analysis for the paved road emissions for the Project, given that the majority of air emissions are traffic related.

6.1 Dispersion Modelling Inputs

This section summarizes the dispersion modelling inputs for the CAL3QHCR model. To predict ambient air concentrations from roads with the aid of CAL3QHCR model, site geometry inputs are required to parameterize the sources of emissions as well as their transport. The CAL3QHCR dispersion model also requires input data for vehicle emission rates, receptor locations, and meteorological conditions.

6.1.1 Site Geometry

The CAL3QHCR can process up to 120 links. A link is defined as a straight-line segment and can be specified as either a free flow or a queue link. For this Project, 14 links were used in the dispersion modelling of the hot spot including 10 free flow links and four queue links.

A free flow link is defined as a straight segment of roadway with a constant width, height, traffic volume, travel speed, and vehicle emission factor. The location of the link is specified by its start and end point coordinates, X1, Y1 and X2, Y2.

Link width or mixing zone width (W) is defined as the width of the travelled roadway (lanes of moving traffic only), plus 3 m on each side of the roadway to account for the dispersion of the plume generated by the wake of moving vehicles. For the Project, the road will be widened from 4 lanes to 6 lanes, as a result, this was accounted for in the mixing zone width for the two different scenarios. Link height (H) can be elevated or depressed, but is limited within 10 m for elevated, and -10 m for depressed. For the Project, all the links are assumed to be at grade (i.e., a link height of 0 m has been assumed). 10 free flow links have been defined for the Project to represent the emissions from two-way travel through the Project study area (Table 7).

All the modelling objects have been defined using UTM projection (NAD83, Zone 17). In order for easy tracking in the modelling input and output files, the UTM coordinates have been subtracted by 630,000 m (easting) and 4,850,000 m (northing).

Table 8: Modelled Links – Free Flow

Link ID	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)	Height (m)	Mixing Zone Width 2015 (m)	Mixing Zone Width 2041 (m)
Denison to Windsong NB	6331	4986	6405	5165	0	13	16
Denison to Windsong NB	6262	5883	6327	4896	0	13	16

Link ID	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)	Height (m)	Mixing Zone Width 2015 (m)	Mixing Zone Width 2041 (m)
Windsong to 14th Avenue NB	6405	5165	6266	5886	0	13	16
14th Ave to Hwy 407 NB	6405	5165	6266	5886	0	13	16
14th Ave to Hwy 407 SB	6058	6641	6251	5882	0	13	16
Hwy 407 to Windsong SB	6251	5882	6394	5165	0	13	16
Windsong to Denison SB	6394	5165	6320	4902	0	13	16
Kennedy approach from 14th Ave WB	6006	5797	6260	5878	0	12	12
Kennedy depart from 14th Ave WB	6260	5878	6516	5964	0	12	12
Kennedy approach from 14th Ave EB	6516	5972	6256	5892	0	12	12
Kennedy depart from 14th Ave EB	6256	5892	6004	5811	0	12	12

Four queue links were also used to represent queuing traffic at the Kennedy and 14th Avenue Intersection (Table 9). Data for the four queue links were input based on the timing of the traffic signals.

Table 9: Modelled Links - Queue Links

Link ID	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)	Number of Lanes
NB queue to 14th Ave	6284	5793	6269	5867	4
SB queue to 14th Ave	6250	5903	6239	5957	4
14th Ave Queue WB	6243	5871	6162	5849	4
14th Ave Queue EB	6337	5913	6276	5897	4

6.1.2 Receptors

CAL3QHCR can process up to 60 receptor locations at selected heights. 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. As outlined in the MECP Central Region Draft Guidance, sensitive and critical receptors within 300 m of the study area should be identified and assessed. Sensitive receptors may include residences and critical receptors may include healthcare facilities, long term care facilities, childcare facilities, campgrounds, schools, community centres, daycares, recreational centres and sports facilities or outdoor public recreational areas. This assessment considers current[2] receptors only.

Critical receptors within 300 m of the study area include two school facilities, three child care facilities, one long term care centre, and two recreational sites[2]. A total of 21 sensitive receptors were also included to represent the locations of residential areas. The receptors were modelled at a height of 1.8 m to represent an average breathing height, according to the CAL3QHC guidance document (U.S. EPA, 1995). The CAL3QHCR Critical and sensitive receptor inputs are presented in the following tables and are depicted in Appendix A.

Table 10: CAL3QHCR Critical Receptor Data

I.D.	Description	X (m)	Y (m)	Height (m)
CC1	Childcare facility	6094	4963	1.8
CC2	Childcare facility	6350	6018	1.8
CC3	Childcare facility	6153	6115	1.8
LTerm1	Long term care facility	6113	6007	1.8
REC1	Recreational site	6211	5696	1.8
REC2	Recreational site	6240	5505	1.8
S1	School	6244	5250	1.8
S2	School	6289	5999	1.8

Table 11: CAL3QHCR Sensitive Receptor Data

I.D.	X (m)	Y (m)	Height (m)
Res1	6218	4988	1.8
Res2	6280	5042	1.8
Res3	6402	5017	1.8

[2] Current as of the date of report preparation, August 2019.

I.D.	X (m)	Y (m)	Height (m)
Res4	6436	5075	1.8
Res5	6444	5147	1.8
Res6	6497	5220	1.8
Res7	6484	5281	1.8
Res8	6403	5325	1.8
Res9	6389	5399	1.8
Res10	6377	5471	1.8
Res11	6461	5623	1.8
Res12	6416	5712	1.8
Res13	6325	5719	1.8
Res14	6330	5754	1.8
Res15	6415	5857	1.8
Res16	6141	5874	1.8
Res17	6166	5934	1.8
Res18	6278	5946	1.8
Res19	6248	6073	1.8
Res20	6239	6136	1.8
Res21	6251	6220	1.8

6.1.3 Meteorological Conditions

CAL3QHCR requires five years of consecutive meteorological data which includes hourly wind flow vector, wind speed, ambient temperature, stability class, and urban mixing height. As the emissions are ground based, the maximum downwind concentrations typically occur under low wind speeds and stable conditions. The Toronto Surface Station (ID 61587) was used in the assessment, using a five-year data set from January 1st, 2011 to December 31st, 2015.

Additional parameters including surface roughness length, deposition velocity, and settling velocity. The surface roughness length was set to 108 cm based on recommended values for High Intensity Residential Areas (U.S. EPA, 1995). Following the MTO Guide, the settling velocities for $PM_{2.5}$ and PM_{10} are set to be at 0.02 and 0.3 centimetres per second (cm/s), respectively. The deposition velocities for $PM_{2.5}$ and PM_{10} are set to be at 0.1 and 0.5 cm/s, respectively. The MTO Guide does not have recommended values for SPM. For this analysis, the settling and deposition velocities for SPM are conservatively set to be the same as those of PM_{10}.

6.1.4 Emission Inputs

Emission sources for the Project have been defined using both free flow links and queue links. In addition to the link information, the emission rates for each compound (grams per kilometer [g/km]) and traffic volume (vehicles/hour) were estimated using information from the traffic study and the outputs from MOBILE6.2C results. MOBILE6.2C does not provide emission rates for idling, therefore these were taken from US EPA document "Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks Emission Facts" (USEPA, 2008). The daytime and nighttime traffic proportions were used to vary emissions throughout the day with daytime traffic occurring from 7am to 11pm daily and nighttime traffic occurring between 11pm and 7am.

6.1.5 Conversions of NOx to NO_2

Emissions of NOx were used as inputs to the CAL3QHCR model. Ambient predictions of nitrogen dioxide (NO_2), can be calculated from modelled NOx values using the Ozone Limiting Method (OLM). The OLM consists of comparing the maximum modelled NOx concentration to the background ozone concentration to assess the limiting factor to NO_2 (Cole et al. 1979). The following equations present the methodology:

If background $[O_3]$ >0.90 [NOx], total conversion: $[NO_2]$ = [NOx]

If background $[O_3]$ <0.90 [NOx], NO2 is limited by O_3: $[NO_2] = [O_3] + 0.10$ [NOx]

For the air quality assessment, the NO_2 concentrations were calculated assuming a total conversion of NOx since background ozone values at these averaging periods were above 0.90 [NOx].

6.1.6 Summary of Dispersion Modelling Inputs

A summary of the modelling inputs to CAL3QHCR, as described in the sections above is provided below.

Table 12: Summary of CAL3QHCR Inputs

Parameter	Description
Run Averaging Time (minutes)	60
Roughness Length (cm)	108
Settling Velocity (cm/s)	$PM_{2.5}$: 0.02 PM_{10}: 0.3 SPM: 0.3 All other compounds: 0
Deposition velocity (cm/s)	$PM_{2.5}$: 0.1 PM_{10}: 0.5 SPM: 0.5 All other compounds: 0
Number of Receptors	29 – 8 critical and 21 sensitive
Output Unit	Meters
Meteorological Data	Toronto (2011-2015)
Pollutant Type	"PM" was selected for all compounds except Carbon monoxide, for which "CO" was selected

Parameter	Description
Number of Links	8 (See Tables 8 and 9 for geometry details)
Emission Rates	Emission rates were calculated using MOBILE6.2C and US EPA Emission Factors
Traffic Data	Daytime (92%) and Nighttime (8%) traffic distributions were applied to the AADT traffic volumes in Table 4 in order to input traffic volumes in vehicles per hour.

6.2 Dispersion Modelling Results

CAL3QHCR predicts the maximum 24-hour and annual concentrations for most of the indicator compounds and the maximum 1-hour and 8-hour concentration for CO. In cases where a standard and/or guideline has an averaging period that CAL3QHCR is not designed to predict (e.g. ½-hr), a conversion to the appropriate averaging period was completed using the MECP recommended conversion factors, as documented in the MECP Air Dispersion Modelling Guideline for Ontario (MECP, 2017b). The actual predicted maximum concentrations at ground level are those from the CAL3QHCR model outputs divided by the relevant inflation factors.

The CAL3QHCR output presents the resulting maximum concentrations at each sensitive and critical receptor. The maximum concentration was consistently located at the sensitive receptor Res18, which represents a residence at the north east corner of the Kennedy Road and 14th Avenue intersection. The maximum concentrations predicted at any of the receptors, are presented in Tables 13 and 14 below and compared to the relevant Project Criteria. Maximum concentrations at all receptors are provided in Appendix C.

Table 13: 2015 Current Predicted Concentrations

Indicator Compound	Averaging Period	Project Criteria	Background Concentration		Roadway Predicted Concentration		Cumulative Concentration	
		[µg/m³]	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria
CO	**1-hour**	36,200	458.10	1%	680.64	2%	1138.74	3%
	8-hour	15,700	501.04	3%	423.82	3%	924.86	6%
NO_2	**1-hour**	400	58.31	15%	47.31	12%	105.62	26%
	1-hour	79.1	58.31	74%	47.31	60%	105.62	134%
	24-hour	200	47.02	24%	15.67	8%	62.69	31%
	Annual	22.6	30.82	136%	3.92	17%	34.74	154%
SPM	**24-hour**	120	47.67	40%	14.01	12%	61.68	51%
	Annual	60	26.72	45%	3.63	6%	30.35	51%
PM_{10}	**24-hour**	50	26.70	53%	3.23	6%	29.93	60%
$PM_{2.5}$	**24-hour**	27	14.42	53%	1.43	6%	15.85	59%
	Annual	8.8	8.08	92%	0.32	4%	8.40	95%
Acetaldehyde	**24-hour**	500	1.72	<1%	0.19	<1%	1.91	<1%
Acrolein	**1-hour**	4.5	—	—	0.03	<1%	0.03	<1%
	24-hour	0.4	0.09	23%	0.01	4%	0.10	26%
Benzene	**24-hour**	2.3	0.88	38%	0.94	41%	1.82	79%
	Annual	0.45	0.55	122%	0.25	55%	0.80	177%

Indicator Compound	Averaging Period	Project Criteria	Background Concentration		Roadway Predicted Concentration		Cumulative Concentration	
		[µg/m³]	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria
1,3-Butadiene	**24-hour**	10	0.09	<1%	0.13	1%	0.22	2%
	Annual	2	0.05	3%	0.03	2%	0.08	4%
Formaldehyde	**24-hour**	65	3.19	5%	0.36	<1%	3.55	5%

Table 14: 2041 Future Build Dispersion Modelling Results

Indicator Compound	Averaging Period	Project Criteria	Background Concentration		Roadway Predicted Concentration		Cumulative Concentration	
		[µg/m³]	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria
CO	**1-hour**	36,200	458.10	1%	901.71	2%	1359.81	4%
	8-hour	15,700	501.04	3%	584.19	4%	1085.23	7%
NO_2	**1-hour**	400	58.31	15%	50.35	13%	108.66	27%
	1-hour	79.1	58.31	74%	50.35	64%	108.66	137%
	24-hour	200	47.02	24%	13.01	7%	60.03	30%
	Annual	22.6	30.82	136%	3.37	15%	34.19	151%
SPM	**24-hour**	120	47.67	40%	21.16	18%	68.83	57%
	Annual	60	26.72	45%	5.70	10%	32.42	54%
PM_{10}	**24-hour**	50	26.70	53%	4.76	10%	31.46	63%

Indicator Compound	Averaging Period	Project Criteria	Background Concentration		Roadway Predicted Concentration		Cumulative Concentration	
		[µg/m³]	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria	Concentration [µg/m³]	% of Project Criteria
$PM_{2.5}$	**24-hour**	27	14.42	53%	1.78	7%	16.20	60%
	Annual	8.8	8.08	92%	0.45	5%	8.53	97%
Acetaldehyde	**24-hour**	500	1.72	<1%	0.20	<1%	1.92	<1%
Acrolein	**1-hour**	4.5	—	—	0.03	<1%	0.03	<1%
	24-hour	0.4	0.09	23%	0.02	4%	0.11	26%
Benzene	**24-hour**	2.3	0.88	38%	1.03	45%	1.91	83%
	Annual	0.45	0.55	122%	0.27	60%	0.82	182%
1,3-Butadiene	**24-hour**	10	0.09	<1%	0.14	1%	0.23	2%
	Annual	2	0.05	3%	0.04	2%	0.09	4%
Formaldehyde	**24-hour**	65	3.19	5%	0.40	<1%	3.59	6%

Overall, the results of the air quality assessment show that predicted concentrations of indicator compounds from the road are below the relevant Project criteria. The Project will contribute to a small increase in total emissions for most indicator compounds. A comparison of the results from each scenario is presented in Table 13, below

Table 15: Comparison of Current and Future Predicted Concentrations

Indicator Compound	Averaging Period	2015 Current Predicted Concentrations [µg/m³]	2041 Future Build Predicted Concentrations [µg/m³]	% Change
CO	1-hour	680.64	901.71	32%
	8-hour	423.82	584.19	38%
NO_2	1-hour	47.31	50.35	6%
	24-hour	15.67	13.01	-17%
	Annual	3.92	3.37	-14%
SPM	24-hour	14.01	21.16	51%
	Annual	3.63	5.70	57%
PM_{10}	24-hour	3.23	4.76	48%
$PM_{2.5}$	24-hour	1.43	1.78	24%
	Annual	0.32	0.45	40%
Acetaldehyde (µg/m³)	24-hour	0.19	0.20	10%
Acrolein (µg/m³)	1-hour	0.03	0.03	5%
	24-hour	0.01	0.02	3%
Benzene (µg/m³)	24-hour	0.94	1.03	9%
	Annual	0.25	0.27	10%
1,3-Butadiene (µg/m³)	24-hour	0.13	0.14	10%
	Annual	0.03	0.04	10%
Formaldehyde (µg/m³)	24-hour	0.36	0.40	10%

Background air quality concentrations were added to the predicted concentrations from Kennedy Road for both modelled scenarios. With the addition of the background concentrations, the concentrations of indicator compounds (except for nitrogen dioxide and benzene) are within the Ontario AAQC and CAAQS. The cumulative concentrations of annual averaged nitrogen dioxides and benzene exceed the relevant Project Criteria, however, Kennedy Road contributes less than 11% of annual nitrogen dioxide concentrations and 31% of annual benzene concentrations for 2015 and less than 10% and 33% respectively for the 2041 modelled scenarios. (i.e. baseline concentrations are the more significant contribution to cumulative concentrations). Emissions from the Project itself increase by less than 10% for benzene and decrease for nitrogen dioxide. The maximum predicted 1-hour NO_2 concentration is also greater than the CAAQS, however it is less than the Ontario AAQC. The 1-hour NO_2 CAAQS is based on the three-year average of the 98th percentile of the daily maximum 1-hour average concentration, which CAL3QHCR does not provide. As a result, comparing the maximum worst case 1-hour concentration to this value is very conservative.

It should be noted that results are only presented for the receptor with the highest concentration, which is located closest to Kennedy Road. Predicted concentrations at the next highest receptor are approximately 40% lower. Predicted concentrations for all receptors assessed are presented in Appendix C.

7.0 REGIONAL IMPACTS – GREENHOUSE GASES

In addition to the indicator compounds, emissions of greenhouse gases, specifically carbon dioxide were also assessed for the Project using MOBILE6.2C. Potential impacts were assessed by reviewing the total CO_2 emissions for the two different scenarios and comparing them to identify the relative change. Total GHG emissions from the two different scenarios are provided in Table 16, the results indicate that overall the Project is expected to result in a slight increase in GHG emissions, although emissions from the Project are insignificant compared to Ontario total transportation sector emissions, contributing less than 0.1%.

Table 16: Comparison of CO_2 Emissions to Provincial Totals

Scenario	Annual CO_2 Emissions [MT/year]
2015 – Current	0.0212
2041 – Future Build	0.0312
Ontario Provincial Total for Transportation Sector[1]	56.6

1. Based on 2012 data taken from Ontario's Climate Change Update 2014 (MECP, 2014)

8.0 CONCLUSIONS

A partial air quality impact assessment was completed to assess the impact of widening an 8 km stretch of Kennedy Road from Steeles Avenue to Major Mackenzie Drive in the City of Markham using a hot spot methodology, approved by MECP. The Project includes widening of the existing four lanes of traffic to six lanes for use by Transit and High Occupancy Vehicles, in addition to modifications to the streetscape and continuous active transportation facilities. The air quality assessment focussed on a "hot spot" section of the 8 km corridor between Denison Street and Highway 407. This area was identified as a hot spot as it has a high daily traffic and the highest number of critical and sensitive receptors in close proximity.

Two different scenarios were included in the assessment, 2015 base case emissions based on current road alignment and traffic volumes; and 2041 emissions based on projected future traffic growth and future road alignment. Emission rates were calculated using the MOBILE 6.2C model, AP-42 and dispersion modelling was completed using CAL3QHCR.

The results of the air quality impact assessment indicate that the proposed Project will result in a small increase in predicted concentrations of indicator compounds, with the exception of nitrogen dioxide, which shows a decrease. However, when results are compared to the Project Criteria, predicted concentrations of relevant compounds from the Project alone are below the relevant criteria.

A cumulative assessment was completed using background air quality data taken from local monitoring stations. The background air quality was added to the predicted concentrations from the road and used to provide an estimate of cumulative air quality. The results of this assessment indicate that cumulative concentrations are below the relevant ambient air quality criteria for indicator compounds with the exception of nitrogen dioxide and benzene. For both of these indicator compounds, the background air quality concentration is already close to or above the relevant ambient air quality criteria and the road itself contributes less than 35% of the total annual concentration at the receptor with the maximum concentration. The maximum predicted 1-hour NO_2 concentration is also greater than the CAAQS, however it is less than the Ontario AAQC. The 1-hour NO_2 CAAQS is based on the three-year average of the 98th percentile of the daily maximum 1-hour average concentration, which CAL3QHCR does not provide. As a result, comparing the maximum worst case 1-hour concentration to this value is very conservative.

The proposed Project aims to minimize the air quality impact associated with the projected increased traffic for the Study Area through improved traffic flows within the local vicinity of the proposed Project and reducing queuing times at other roads surrounding the proposed Project. Emissions from the proposed Project within the Study Area do not represent a significant contribution to local air quality. As a result, the proposed Project is necessary to help alleviate congestion and the proposed Project will minimize the air quality impact. The Project will introduce HOV lanes which will encourage the use of carpooling and Transit vehicles. Additionally, this assessment is considered to be conservative as transit vehicles currently use a diesel/gasoline fuel, which was included in the emission estimates, however, in the future, there is potential for these vehicles to be electric.

Overall, the proposed Project itself is therefore anticipated to be a relatively minor source of emissions, and the impact on overall air quality in the region is expected to be negligible.

9.0 REFERENCES

Cole, H.S. and J.E. Summerhays, 1979. A Review of Techniques Available for Estimation of Short-Term NO2 Concentrations. Journal of the Air Pollution Control Association, 29(8): 812– 817.

Canadian Council of Ministers of the Environment (CCME) (1999). Canadian National Ambient Air Quality Objectives: Process and Status. Available at ceqg-rcqe.ccme.ca/download/en/133/. Retrieved April 2018.

Environment and Climate Change Canada (2015a). Volatile Organic Compounds in Consumer and Commercial Products. Retrieved April 2018.http://www.ec.gc.ca/cov-voc/

Environment and Climate Change Canada (2015b). Benzene. Retrieved April 2018.https://www.ec.gc.ca/toxiques-toxics/Default.asp?lang=En&n=B6BEFB22-1

Environment and Climate Change Canada (2015c). 1,3-Butadiene. Retrieved April 2018.https://www.ec.gc.ca/toxiques-toxics/Default.asp?lang=En&n=2A75F329-1

Environment and Climate Change Canada (2018). NPRI Online Data Search. Available at http://open.canada.ca/data/en/dataset/1fb7d8d4-7713-4ec6-b957-4a882a84fed3. Retrieved April 2018.

Health Canada. 1994. Canadian National Ambient Air Quality Objectives: Process and Status

Lall, R., Kendall, M., Ito, K., Thurston, G. (2004). Estimation of historical annual $PM_{2.5}$ exposures for health effects assessment. Atmospheric Environment 38(2004) 5217-5226.

MECP (2018a). Ontario's Ambient Air Quality Criteria, PIBS #6570e01. Standards Development Branch, Ontario Ministry of Conservation and Parks.

MECP (2018b). Air Quality in Ontario 2016 Report, ISSN# 1710-8136.

MECP (2017a). Traffic Related Air Pollution: Mitigation Strategies and Municipal Class Road Environmental Assessment Air Quality Impact Assessment Protocol

MECP (2017b) Air Dispersion Modelling Guideline for Ontario

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

Regional Municipality of York (2016) 2015 Transportation Factbook. Available at http://www.york.ca/wps/wcm/connect/yorkpublic/520a6d51-bfcd-460d-befa-bad562f89aca/2015+Transportation+Fact+Book+Accessible.pdf?MOD=AJPERES. Retrieved April 2018.

U.S. EPA. (1995). User's Guide to CAL3HQC Version 2.0: A Modelling Methodology for Predicting Pollutant Concentrations near Roadway Intersections (CAL3HQC Model User's Guide). EPA-454/R-92-006 (Revised). Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division, Research Triangle Park, North Carolina. https://www3.epa.gov/ttn/scram/userg/regmod/cal3qhcug.pdf

U.S. EPA. (1995). Addendum to the User's Guide to CAL3HQC Version 2.0 (CAL3HQC Model User's Guide). Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division, Research Triangle Park, North Carolina.

US EPA (2008). Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks Emission Facts.

US EPA (2014). Health: Frequently Asked Questions. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100NFFD.PDF?Dockey=P100NFFD.PDF. Retrieved April 2018.

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APPENDIX A

Limitations

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Receptors


N
REC2
Res10
Res9
Res8
Res7
Res6
S1
Res5
Res4
Res3
Res2
Res1
CC1
Kennedy Road
Denison Avenue
Regional Road 71
Highglen Ave
Kimbark Cresc
Winesong Ct
Northolt Crescent
Malloy Ave
Fresno Ct
Old Kennedy Rd
Ashmore Crescent
Millcreek Dr


N
Res21
Res20
CC3
Res19
CC2
LTERM1
S2
Res18
Res17
Res16
Res15
Res12
Res14
Res13
REC1
Res11
REC2
Res10
Res9
14th Avenue
Kennedy Road
Beckenridge Dr
Devenwood Dr
Chiavatti Dr
Lee Ave
Ale Cir
Kewin Rd
Noble St
McDowell Gate


N
Highway 407
Express Toll Route (Toll road)
407
Kennedy Road
Res21
Res20
CC3
Res19
CC2
LTERM1
S2
Res18
Beckenridge Dr
Deverill Cr

APPENDIX C

Predicted Concentrations – All Receptors

Table C1: 2015 - Maximum Predicted Concentrations from the Roadway Only [µg/m³]

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	129.09	57.27	7.57	7.57	1.64	0.23	1.59	0.23	0.35	0.11	0.02	0.01	0.005	0.001	0.06	0.01	0.01	0.00	0.02
CC2	Child care facility	213.29	114.55	12.33	12.33	3.59	0.88	3.43	0.86	0.76	0.22	0.06	0.02	0.007	0.002	0.12	0.03	0.01	0.00	0.04
CC3	Child care facility	362.77	206.18	22.69	22.69	7.53	1.87	6.71	1.86	1.57	0.56	0.13	0.05	0.014	0.004	0.25	0.08	0.03	0.01	0.09
LTerm1	Long term care facility	541.35	332.19	34.00	34.00	12.04	2.80	10.57	2.63	2.49	1.04	0.20	0.09	0.019	0.007	0.50	0.10	0.07	0.01	0.19
REC1	Recreational site	272.39	171.82	16.07	16.07	6.10	1.38	5.44	1.31	1.27	0.48	0.10	0.04	0.014	0.003	0.23	0.05	0.03	0.01	0.09
REC2	Recreational site	347.88	229.09	21.63	21.63	7.22	1.76	6.36	1.72	1.50	0.57	0.13	0.05	0.014	0.004	0.26	0.07	0.03	0.01	0.09
S1	School	647.30	423.82	37.73	37.73	13.75	3.69	13.21	3.61	2.96	0.87	0.24	0.08	0.018	0.007	0.43	0.12	0.05	0.02	0.15
S2	School	378.23	229.09	22.52	22.52	7.52	2.01	7.21	1.97	1.60	0.47	0.13	0.04	0.012	0.004	0.24	0.07	0.03	0.01	0.08
Res1	Residential	150.17	80.18	8.76	8.76	2.36	0.40	2.29	0.39	0.50	0.15	0.03	0.01	0.005	0.001	0.08	0.01	0.01	0.00	0.03
Res2	Residential	176.86	114.55	10.21	10.21	3.67	0.83	3.51	0.82	0.78	0.22	0.05	0.02	0.006	0.002	0.12	0.03	0.01	0.00	0.04
Res3	Residential	474.57	171.82	27.16	27.16	5.10	1.45	4.97	1.43	1.10	0.31	0.09	0.03	0.014	0.003	0.16	0.05	0.02	0.01	0.06
Res4	Residential	433.22	148.91	24.78	24.78	4.56	1.23	4.44	1.21	0.98	0.28	0.08	0.03	0.014	0.002	0.15	0.04	0.02	0.00	0.05
Res5	Residential	379.26	171.82	21.72	21.72	5.11	1.48	4.98	1.45	1.10	0.32	0.09	0.03	0.012	0.003	0.17	0.05	0.02	0.01	0.06
Res6	Residential	221.42	91.64	12.89	12.89	2.75	0.81	2.70	0.79	0.59	0.17	0.05	0.02	0.008	0.002	0.10	0.03	0.01	0.00	0.04
Res7	Residential	224.85	91.64	13.14	13.14	2.80	0.86	2.75	0.84	0.60	0.18	0.05	0.02	0.008	0.002	0.10	0.03	0.01	0.00	0.04
Res8	Residential	425.31	217.64	24.43	24.43	7.61	2.23	7.36	2.18	1.64	0.46	0.14	0.04	0.014	0.004	0.23	0.07	0.03	0.01	0.08
Res9	Residential	426.11	217.64	24.57	24.57	7.63	2.25	7.37	2.21	1.64	0.46	0.14	0.04	0.014	0.004	0.24	0.07	0.03	0.01	0.08
Res10	Residential	418.09	217.64	24.26	24.26	7.34	2.19	7.08	2.14	1.58	0.45	0.14	0.04	0.014	0.004	0.23	0.07	0.03	0.01	0.08
Res11	Residential	206.64	91.64	12.48	12.48	2.67	0.80	2.51	0.78	0.56	0.20	0.05	0.02	0.008	0.002	0.11	0.03	0.01	0.00	0.04
Res12	Residential	229.89	114.55	13.82	13.82	3.45	1.06	3.20	1.02	0.72	0.27	0.08	0.03	0.010	0.002	0.15	0.04	0.02	0.01	0.05
Res13	Residential	555.21	252.00	34.97	34.97	8.14	2.73	7.78	2.61	1.74	0.64	0.19	0.06	0.016	0.005	0.31	0.10	0.04	0.01	0.11
Res14	Residential	476.97	240.55	31.25	31.25	7.72	2.43	6.58	2.23	1.59	0.67	0.19	0.06	0.016	0.004	0.30	0.09	0.04	0.01	0.11
Res15	Residential	246.85	137.46	15.29	15.29	4.51	1.41	4.40	1.33	0.94	0.35	0.11	0.04	0.016	0.003	0.23	0.06	0.03	0.01	0.09
Res16	Residential	421.99	320.73	25.26	25.26	10.82	2.63	14.01	3.63	2.29	0.77	0.18	0.19	0.032	0.015	0.94	0.25	0.13	0.03	0.36
Res17	Residential	369.99	252.00	24.56	24.56	9.92	1.99	7.91	2.15	2.02	0.94	0.15	0.09	0.019	0.007	0.45	0.12	0.06	0.02	0.17
Res18	Residential	680.64	423.82	47.31	47.31	15.67	3.92	13.06	3.45	3.23	1.43	0.32	0.12	0.027	0.008	0.62	0.14	0.08	0.02	0.23
Res19	Residential	495.30	274.91	29.88	29.88	9.62	2.49	9.29	2.41	2.03	0.69	0.17	0.07	0.016	0.006	0.40	0.09	0.05	0.01	0.14
Res20	Residential	416.83	229.09	24.75	24.75	7.95	2.08	7.80	2.02	1.68	0.55	0.14	0.06	0.014	0.005	0.32	0.07	0.04	0.01	0.12
Res21	Residential	292.78	160.37	17.39	17.39	5.44	1.30	5.29	1.27	1.14	0.38	0.08	0.04	0.010	0.003	0.22	0.04	0.03	0.01	0.08
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C2: 2015 - Maximum Predicted Concentrations from the Roadway Only as a Percentage of Project Criteria

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	0%	0%	2%	10%	1%	1%	1%	0%	1%	0%	0%	0.00%	0.11%	0.23%	3%	2%	0.1%	0.1%	0.0%
CC2	Child care facility	1%	1%	3%	16%	2%	4%	3%	1%	2%	1%	1%	0.00%	0.16%	0.45%	5%	7%	0.1%	0.2%	0.1%
CC3	Child care facility	1%	1%	6%	29%	4%	8%	6%	3%	3%	2%	1%	0.01%	0.30%	0.90%	11%	17%	0.3%	0.5%	0.1%
LTerm1	Long term care facility	1%	2%	8%	43%	6%	12%	9%	4%	5%	4%	2%	0.02%	0.42%	1.75%	22%	23%	0.7%	0.7%	0.3%
REC1	Recreational site	1%	1%	4%	20%	3%	6%	5%	2%	3%	2%	1%	0.01%	0.32%	0.83%	10%	12%	0.3%	0.3%	0.1%
REC2	Recreational site	1%	1%	5%	27%	4%	8%	5%	3%	3%	2%	1%	0.01%	0.30%	0.93%	11%	16%	0.3%	0.5%	0.1%
S1	School	2%	3%	9%	48%	7%	16%	11%	6%	6%	3%	3%	0.02%	0.40%	1.63%	19%	27%	0.5%	0.8%	0.2%
S2	School	1%	1%	6%	28%	4%	9%	6%	3%	3%	2%	1%	0.01%	0.26%	0.93%	11%	16%	0.3%	0.4%	0.1%
Res1	Residential	0%	1%	2%	11%	1%	2%	2%	1%	1%	1%	0%	0.00%	0.11%	0.30%	4%	3%	0.1%	0.1%	0.0%
Res2	Residential	0%	1%	3%	13%	2%	4%	3%	1%	2%	1%	1%	0.00%	0.13%	0.45%	5%	6%	0.1%	0.2%	0.1%
Res3	Residential	1%	1%	7%	34%	3%	6%	4%	2%	2%	1%	1%	0.01%	0.32%	0.63%	7%	10%	0.2%	0.3%	0.1%
Res4	Residential	1%	1%	6%	31%	2%	5%	4%	2%	2%	1%	1%	0.01%	0.30%	0.58%	6%	9%	0.2%	0.2%	0.1%
Res5	Residential	1%	1%	5%	27%	3%	7%	4%	2%	2%	1%	1%	0.01%	0.28%	0.65%	7%	10%	0.2%	0.3%	0.1%
Res6	Residential	1%	1%	3%	16%	1%	4%	2%	1%	1%	1%	1%	0.00%	0.18%	0.38%	4%	6%	0.1%	0.2%	0.1%
Res7	Residential	1%	1%	3%	17%	1%	4%	2%	1%	1%	1%	1%	0.00%	0.19%	0.40%	4%	6%	0.1%	0.2%	0.1%
Res8	Residential	1%	1%	6%	31%	4%	10%	6%	4%	3%	2%	2%	0.01%	0.31%	0.90%	10%	16%	0.3%	0.4%	0.1%
Res9	Residential	1%	1%	6%	31%	4%	10%	6%	4%	3%	2%	2%	0.01%	0.31%	0.90%	10%	16%	0.3%	0.5%	0.1%
Res10	Residential	1%	1%	6%	31%	4%	10%	6%	4%	3%	2%	2%	0.01%	0.30%	0.88%	10%	16%	0.3%	0.4%	0.1%
Res11	Residential	1%	1%	3%	16%	1%	4%	2%	1%	1%	1%	1%	0.00%	0.18%	0.40%	5%	7%	0.1%	0.2%	0.1%
Res12	Residential	1%	1%	3%	17%	2%	5%	3%	2%	1%	1%	1%	0.01%	0.23%	0.53%	6%	9%	0.2%	0.3%	0.1%
Res13	Residential	2%	2%	9%	44%	4%	12%	6%	4%	3%	2%	2%	0.01%	0.36%	1.13%	14%	22%	0.4%	0.6%	0.2%
Res14	Residential	1%	2%	8%	40%	4%	11%	5%	4%	3%	2%	2%	0.01%	0.35%	1.05%	13%	20%	0.4%	0.6%	0.2%
Res15	Residential	1%	1%	4%	19%	2%	6%	4%	2%	2%	1%	1%	0.01%	0.35%	0.85%	10%	13%	0.3%	0.4%	0.1%
Res16	Residential	1%	2%	6%	32%	5%	12%	12%	6%	5%	3%	2%	0.04%	0.72%	3.63%	41%	55%	1.3%	1.6%	0.6%
Res17	Residential	1%	2%	6%	31%	5%	9%	7%	4%	4%	3%	2%	0.02%	0.41%	1.63%	19%	26%	0.6%	0.8%	0.3%
Res18	Residential	2%	3%	12%	60%	8%	17%	11%	6%	6%	5%	4%	0.02%	0.59%	2.10%	27%	32%	0.8%	0.9%	0.4%
Res19	Residential	1%	2%	7%	38%	5%	11%	8%	4%	4%	3%	2%	0.01%	0.35%	1.48%	17%	19%	0.5%	0.5%	0.2%
Res20	Residential	1%	1%	6%	31%	4%	9%	6%	3%	3%	2%	2%	0.01%	0.30%	1.20%	14%	16%	0.4%	0.4%	0.2%
Res21	Residential	1%	1%	4%	22%	3%	6%	4%	2%	2%	1%	1%	0.01%	0.23%	0.83%	10%	10%	0.3%	0.3%	0.1%
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C3: 2015 Maximum Predicted Cumulative Concentrations[µg/m³]

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	587.19	558.31	65.88	65.88	48.66	31.05	49.26	26.95	27.05	14.53	8.10	1.73	0.005	0.091	0.94	0.56	0.10	0.05	3.21
CC2	Child care facility	671.39	615.59	70.64	70.64	50.61	31.70	51.10	27.58	27.46	14.64	8.14	1.74	0.007	0.092	1.00	0.58	0.10	0.05	3.23
CC3	Child care facility	820.87	707.22	81.00	81.00	54.55	32.69	54.38	28.58	28.27	14.98	8.21	1.77	0.014	0.094	1.13	0.63	0.12	0.06	3.28
LTerm1	Long term care facility	999.45	833.23	92.31	92.31	59.06	33.62	58.24	29.35	29.19	15.46	8.28	1.81	0.019	0.097	1.38	0.65	0.16	0.06	3.38
REC1	Recreational site	730.49	672.86	74.38	74.38	53.12	32.20	53.11	28.03	27.97	14.90	8.18	1.76	0.014	0.093	1.11	0.60	0.12	0.06	3.28
REC2	Recreational site	805.98	730.13	79.94	79.94	54.24	32.58	54.03	28.44	28.20	14.99	8.21	1.77	0.014	0.094	1.14	0.62	0.12	0.06	3.28
S1	School	1,105.40	924.86	96.04	96.04	60.77	34.51	60.88	30.33	29.66	15.29	8.32	1.80	0.018	0.097	1.31	0.67	0.14	0.07	3.34
S2	School	836.33	730.13	80.83	80.83	54.54	32.83	54.88	28.69	28.30	14.89	8.21	1.76	0.012	0.094	1.12	0.62	0.12	0.06	3.27
Res1	Residential	608.27	581.22	67.07	67.07	49.38	31.22	49.96	27.11	27.20	14.57	8.11	1.73	0.005	0.091	0.96	0.56	0.10	0.05	3.22
Res2	Residential	634.96	615.59	68.52	68.52	50.69	31.65	51.18	27.54	27.48	14.64	8.13	1.74	0.006	0.092	1.00	0.58	0.10	0.05	3.23
Res3	Residential	932.67	672.86	85.47	85.47	52.12	32.27	52.64	28.15	27.80	14.73	8.17	1.75	0.014	0.093	1.04	0.60	0.11	0.06	3.25
Res4	Residential	891.32	649.95	83.09	83.09	51.58	32.05	52.11	27.93	27.68	14.70	8.16	1.75	0.014	0.092	1.03	0.59	0.11	0.05	3.24
Res5	Residential	837.36	672.86	80.03	80.03	52.13	32.30	52.65	28.17	27.80	14.74	8.17	1.75	0.012	0.093	1.05	0.60	0.11	0.06	3.25
Res6	Residential	679.52	592.68	71.20	71.20	49.77	31.63	50.37	27.51	27.29	14.59	8.13	1.74	0.008	0.092	0.98	0.58	0.10	0.05	3.23
Res7	Residential	682.95	592.68	71.45	71.45	49.82	31.68	50.42	27.56	27.30	14.60	8.13	1.74	0.008	0.092	0.98	0.58	0.10	0.05	3.23
Res8	Residential	883.41	718.68	82.74	82.74	54.63	33.05	55.03	28.90	28.34	14.88	8.22	1.76	0.014	0.094	1.11	0.62	0.12	0.06	3.27
Res9	Residential	884.21	718.68	82.88	82.88	54.65	33.07	55.04	28.93	28.34	14.88	8.22	1.76	0.014	0.094	1.12	0.62	0.12	0.06	3.27
Res10	Residential	876.19	718.68	82.57	82.57	54.36	33.01	54.75	28.86	28.28	14.87	8.22	1.76	0.014	0.094	1.11	0.62	0.12	0.06	3.27
Res11	Residential	664.74	592.68	70.79	70.79	49.69	31.62	50.18	27.50	27.26	14.62	8.13	1.74	0.008	0.092	0.99	0.58	0.10	0.05	3.23
Res12	Residential	687.99	615.59	72.13	72.13	50.47	31.88	50.87	27.74	27.42	14.69	8.16	1.75	0.010	0.092	1.03	0.59	0.11	0.06	3.24
Res13	Residential	1,013.31	753.04	93.28	93.28	55.16	33.55	55.45	29.33	28.44	15.06	8.27	1.78	0.016	0.095	1.19	0.65	0.13	0.06	3.30
Res14	Residential	935.07	741.59	89.56	89.56	54.74	33.25	54.25	28.95	28.29	15.09	8.27	1.78	0.016	0.094	1.18	0.64	0.13	0.06	3.30
Res15	Residential	704.95	638.50	73.60	73.60	51.53	32.23	52.07	28.05	27.64	14.77	8.19	1.76	0.016	0.093	1.11	0.61	0.12	0.06	3.28
Res16	Residential	880.09	821.77	83.57	83.57	57.84	33.45	61.68	30.35	28.99	15.19	8.26	1.91	0.032	0.105	1.82	0.80	0.22	0.08	3.55
Res17	Residential	828.09	753.04	82.87	82.87	56.94	32.81	55.58	28.87	28.72	15.36	8.23	1.81	0.019	0.097	1.33	0.67	0.15	0.07	3.36
Res18	Residential	1,138.74	924.86	105.62	105.62	62.69	34.74	60.73	30.17	29.93	15.85	8.40	1.84	0.027	0.098	1.50	0.69	0.17	0.07	3.42
Res19	Residential	953.40	775.95	88.19	88.19	56.64	33.31	56.96	29.13	28.73	15.11	8.25	1.79	0.016	0.096	1.28	0.64	0.14	0.06	3.33
Res20	Residential	874.93	730.13	83.06	83.06	54.97	32.90	55.47	28.74	28.38	14.97	8.22	1.78	0.014	0.095	1.20	0.62	0.13	0.06	3.31
Res21	Residential	750.88	661.41	75.70	75.70	52.46	32.12	52.96	27.99	27.84	14.80	8.16	1.76	0.010	0.093	1.10	0.59	0.12	0.06	3.27
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C4: 2015 - Maximum Predicted Cumulative Concentrations as a percentage of Project Criteria

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	2%	4%	16%	83%	24%	137%	41%	45%	54%	54%	92%	0.35%	0.11%	23%	41%	124%	1%	3%	5%
CC2	Child care facility	2%	4%	18%	89%	25%	140%	43%	46%	55%	54%	92%	0.35%	0.16%	23%	43%	129%	1%	3%	5%
CC3	Child care facility	2%	5%	20%	102%	27%	145%	45%	48%	57%	55%	93%	0.35%	0.30%	23%	49%	140%	1%	3%	5%
LTerm1	Long term care facility	3%	5%	23%	117%	30%	149%	49%	49%	58%	57%	94%	0.36%	0.42%	24%	60%	145%	2%	3%	5%
REC1	Recreational site	2%	4%	19%	94%	27%	142%	44%	47%	56%	55%	93%	0.35%	0.32%	23%	48%	134%	1%	3%	5%
REC2	Recreational site	2%	5%	20%	101%	27%	144%	45%	47%	56%	56%	93%	0.35%	0.30%	23%	50%	139%	1%	3%	5%
S1	School	3%	6%	24%	121%	30%	153%	51%	51%	59%	57%	94%	0.36%	0.40%	24%	57%	149%	1%	3%	5%
S2	School	2%	5%	20%	102%	27%	145%	46%	48%	57%	55%	93%	0.35%	0.26%	23%	49%	138%	1%	3%	5%
Res1	Residential	2%	4%	17%	85%	25%	138%	42%	45%	54%	54%	92%	0.35%	0.11%	23%	42%	125%	1%	3%	5%
Res2	Residential	2%	4%	17%	87%	25%	140%	43%	46%	55%	54%	92%	0.35%	0.13%	23%	43%	128%	1%	3%	5%
Res3	Residential	3%	4%	21%	108%	26%	143%	44%	47%	56%	55%	93%	0.35%	0.32%	23%	45%	132%	1%	3%	5%
Res4	Residential	2%	4%	21%	105%	26%	142%	43%	47%	55%	54%	93%	0.35%	0.30%	23%	45%	131%	1%	3%	5%
Res5	Residential	2%	4%	20%	101%	26%	143%	44%	47%	56%	55%	93%	0.35%	0.28%	23%	46%	133%	1%	3%	5%
Res6	Residential	2%	4%	18%	90%	25%	140%	42%	46%	55%	54%	92%	0.35%	0.18%	23%	43%	128%	1%	3%	5%
Res7	Residential	2%	4%	18%	90%	25%	140%	42%	46%	55%	54%	92%	0.35%	0.19%	23%	43%	129%	1%	3%	5%
Res8	Residential	2%	5%	21%	105%	27%	146%	46%	48%	57%	55%	93%	0.35%	0.31%	23%	48%	138%	1%	3%	5%
Res9	Residential	2%	5%	21%	105%	27%	146%	46%	48%	57%	55%	93%	0.35%	0.31%	23%	48%	138%	1%	3%	5%
Res10	Residential	2%	5%	21%	104%	27%	146%	46%	48%	57%	55%	93%	0.35%	0.30%	23%	48%	138%	1%	3%	5%
Res11	Residential	2%	4%	18%	89%	25%	140%	42%	46%	55%	54%	92%	0.35%	0.18%	23%	43%	129%	1%	3%	5%
Res12	Residential	2%	4%	18%	91%	25%	141%	42%	46%	55%	54%	93%	0.35%	0.23%	23%	45%	131%	1%	3%	5%
Res13	Residential	3%	5%	23%	118%	28%	148%	46%	49%	57%	56%	94%	0.36%	0.36%	24%	52%	144%	1%	3%	5%
Res14	Residential	3%	5%	22%	113%	27%	147%	45%	48%	57%	56%	94%	0.36%	0.35%	24%	51%	142%	1%	3%	5%
Res15	Residential	2%	4%	18%	93%	26%	143%	43%	47%	55%	55%	93%	0.35%	0.35%	23%	48%	135%	1%	3%	5%
Res16	Residential	2%	5%	21%	106%	29%	148%	51%	51%	58%	56%	94%	0.38%	0.72%	26%	79%	177%	2%	4%	5%
Res17	Residential	2%	5%	21%	105%	28%	145%	46%	48%	57%	57%	94%	0.36%	0.41%	24%	58%	149%	1%	3%	5%
Res18	Residential	3%	6%	26%	134%	31%	154%	51%	50%	60%	59%	95%	0.37%	0.59%	25%	65%	154%	2%	3%	5%
Res19	Residential	3%	5%	22%	111%	28%	147%	47%	49%	57%	56%	94%	0.36%	0.35%	24%	56%	141%	1%	3%	5%
Res20	Residential	2%	5%	21%	105%	27%	146%	46%	48%	57%	55%	93%	0.36%	0.30%	24%	52%	138%	1%	3%	5%
Res21	Residential	2%	4%	19%	96%	26%	142%	44%	47%	56%	55%	93%	0.35%	0.23%	23%	48%	132%	1%	3%	5%
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C5: 2041 - Maximum Predicted Concentrations from the Roadway Only [µg/m³]

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	161.40	68.73	6.12	6.12	1.24	0.18	2.21	0.32	0.51	0.15	0.02	0.01	0.005	0.001	0.06	0.01	0.01	0.00	0.02
CC2	Child care facility	268.61	148.91	9.45	9.45	2.81	0.70	5.12	1.28	1.15	0.33	0.08	0.02	0.006	0.001	0.12	0.03	0.02	0.00	0.04
CC3	Child care facility	481.21	263.46	21.35	21.35	6.37	1.51	9.35	2.45	2.34	0.82	0.19	0.05	0.013	0.003	0.27	0.09	0.04	0.01	0.10
LTerm1	Long term care facility	716.15	412.37	33.45	33.45	10.00	2.29	12.62	3.65	3.49	1.33	0.29	0.10	0.019	0.007	0.54	0.11	0.07	0.01	0.20
REC1	Recreational site	329.66	206.18	14.69	14.69	4.72	1.06	6.45	1.66	1.69	0.61	0.13	0.05	0.015	0.003	0.24	0.05	0.03	0.01	0.09
REC2	Recreational site	455.21	274.91	20.54	20.54	5.87	1.43	8.56	2.23	2.17	0.75	0.18	0.05	0.013	0.004	0.28	0.08	0.04	0.01	0.10
S1	School	901.71	584.19	32.43	32.43	11.47	3.11	21.16	5.70	4.76	1.37	0.37	0.09	0.015	0.005	0.48	0.14	0.06	0.02	0.17
S2	School	501.60	309.28	19.39	19.39	5.99	1.62	10.84	2.89	2.45	0.72	0.20	0.05	0.010	0.003	0.26	0.08	0.03	0.01	0.09
Res1	Residential	198.51	103.09	7.19	7.19	1.81	0.32	3.29	0.58	0.75	0.21	0.04	0.02	0.005	0.001	0.09	0.01	0.01	0.00	0.03
Res2	Residential	224.51	160.37	7.73	7.73	2.88	0.67	5.42	1.24	1.20	0.34	0.08	0.02	0.005	0.001	0.12	0.03	0.02	0.00	0.04
Res3	Residential	619.47	229.09	21.02	21.02	4.09	1.18	7.63	2.22	1.71	0.49	0.14	0.03	0.012	0.002	0.18	0.05	0.02	0.01	0.06
Res4	Residential	579.95	194.73	19.96	19.96	3.64	1.00	6.74	1.87	1.52	0.43	0.12	0.03	0.012	0.002	0.16	0.04	0.02	0.01	0.06
Res5	Residential	502.06	240.55	17.28	17.28	4.07	1.19	7.52	2.25	1.69	0.48	0.14	0.03	0.011	0.002	0.18	0.05	0.02	0.01	0.06
Res6	Residential	278.69	126.00	9.98	9.98	2.17	0.65	3.86	1.19	0.88	0.26	0.08	0.02	0.007	0.001	0.11	0.03	0.01	0.00	0.04
Res7	Residential	276.06	126.00	10.20	10.20	2.21	0.69	4.14	1.27	0.93	0.26	0.08	0.02	0.008	0.001	0.11	0.03	0.01	0.00	0.04
Res8	Residential	565.97	297.82	19.66	19.66	6.09	1.81	11.48	3.41	2.55	0.72	0.22	0.05	0.012	0.003	0.25	0.08	0.03	0.01	0.09
Res9	Residential	567.35	309.28	19.94	19.94	6.10	1.83	11.48	3.42	2.55	0.72	0.22	0.05	0.012	0.003	0.25	0.08	0.03	0.01	0.09
Res10	Residential	556.47	297.82	19.95	19.95	5.86	1.77	11.01	3.30	2.45	0.69	0.21	0.04	0.012	0.003	0.24	0.08	0.03	0.01	0.08
Res11	Residential	267.58	114.55	10.86	10.86	2.15	0.63	3.38	1.06	0.80	0.27	0.08	0.02	0.008	0.002	0.11	0.03	0.02	0.00	0.04
Res12	Residential	296.90	148.91	12.85	12.85	2.81	0.84	4.19	1.34	1.01	0.36	0.11	0.03	0.010	0.002	0.16	0.04	0.02	0.01	0.06
Res13	Residential	719.93	343.64	32.25	32.25	6.91	2.25	12.04	3.75	2.71	0.90	0.28	0.06	0.015	0.004	0.34	0.11	0.05	0.01	0.13
Res14	Residential	638.02	332.19	31.78	31.78	6.89	2.02	9.59	3.00	2.29	0.94	0.26	0.06	0.015	0.004	0.34	0.10	0.05	0.01	0.13
Res15	Residential	297.82	160.37	13.10	13.10	3.62	1.08	4.81	1.56	1.29	0.48	0.14	0.05	0.016	0.003	0.25	0.06	0.03	0.01	0.10
Res16	Residential	459.90	355.09	19.32	19.32	7.37	1.77	9.10	2.30	2.82	0.93	0.22	0.20	0.034	0.015	1.03	0.27	0.14	0.04	0.40
Res17	Residential	477.66	297.82	25.01	25.01	8.00	1.56	8.72	2.08	2.60	1.10	0.20	0.09	0.019	0.006	0.49	0.13	0.07	0.02	0.19
Res18	Residential	879.37	492.55	50.35	50.35	13.01	3.37	15.05	4.46	4.37	1.78	0.45	0.13	0.027	0.008	0.67	0.15	0.09	0.02	0.25
Res19	Residential	663.68	355.09	26.84	26.84	7.70	2.05	12.27	3.59	3.00	0.96	0.25	0.08	0.015	0.005	0.44	0.09	0.06	0.01	0.16
Res20	Residential	561.28	309.28	21.74	21.74	6.33	1.70	10.59	3.04	2.53	0.77	0.21	0.07	0.012	0.004	0.35	0.08	0.05	0.01	0.13
Res21	Residential	377.55	206.18	14.60	14.60	4.28	1.05	7.05	1.88	1.69	0.52	0.13	0.05	0.010	0.003	0.24	0.05	0.03	0.01	0.09
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C6: 2041 - Maximum Predicted Concentrations from the Roadway Only as a Percentage of Project Criteria

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	0%	0%	2%	8%	1%	1%	2%	1%	1%	1%	0%	0.00%	0.10%	0.20%	3%	2%	0.1%	0.1%	0.0%
CC2	Child care facility	1%	1%	2%	12%	1%	3%	4%	2%	2%	1%	1%	0.00%	0.14%	0.35%	5%	7%	0.2%	0.2%	0.1%
CC3	Child care facility	1%	2%	5%	27%	3%	7%	8%	4%	5%	3%	2%	0.01%	0.28%	0.83%	12%	19%	0.4%	0.6%	0.2%
LTerm1	Long term care facility	2%	3%	8%	42%	5%	10%	11%	6%	7%	5%	3%	0.02%	0.42%	1.63%	24%	25%	0.7%	0.7%	0.3%
REC1	Recreational site	1%	1%	4%	19%	2%	5%	5%	3%	3%	2%	2%	0.01%	0.32%	0.70%	10%	12%	0.3%	0.3%	0.1%
REC2	Recreational site	1%	2%	5%	26%	3%	6%	7%	4%	4%	3%	2%	0.01%	0.28%	0.90%	12%	18%	0.4%	0.5%	0.2%
S1	School	2%	4%	8%	41%	6%	14%	18%	10%	10%	5%	4%	0.02%	0.34%	1.35%	21%	31%	0.6%	0.9%	0.3%
S2	School	1%	2%	5%	25%	3%	7%	9%	5%	5%	3%	2%	0.01%	0.23%	0.75%	11%	17%	0.3%	0.5%	0.1%
Res1	Residential	1%	1%	2%	9%	1%	1%	3%	1%	1%	1%	0%	0.00%	0.11%	0.25%	4%	3%	0.1%	0.1%	0.0%
Res2	Residential	1%	1%	2%	10%	1%	3%	5%	2%	2%	1%	1%	0.00%	0.12%	0.35%	5%	6%	0.2%	0.2%	0.1%
Res3	Residential	2%	1%	5%	27%	2%	5%	6%	4%	3%	2%	2%	0.01%	0.26%	0.50%	8%	11%	0.2%	0.3%	0.1%
Res4	Residential	2%	1%	5%	25%	2%	4%	6%	3%	3%	2%	1%	0.01%	0.26%	0.45%	7%	9%	0.2%	0.3%	0.1%
Res5	Residential	1%	2%	4%	22%	2%	5%	6%	4%	3%	2%	2%	0.01%	0.24%	0.53%	8%	11%	0.2%	0.3%	0.1%
Res6	Residential	1%	1%	2%	13%	1%	3%	3%	2%	2%	1%	1%	0.00%	0.16%	0.33%	5%	6%	0.1%	0.2%	0.1%
Res7	Residential	1%	1%	3%	13%	1%	3%	3%	2%	2%	1%	1%	0.00%	0.17%	0.33%	5%	7%	0.1%	0.2%	0.1%
Res8	Residential	2%	2%	5%	25%	3%	8%	10%	6%	5%	3%	2%	0.01%	0.27%	0.70%	11%	17%	0.3%	0.5%	0.1%
Res9	Residential	2%	2%	5%	25%	3%	8%	10%	6%	5%	3%	2%	0.01%	0.27%	0.70%	11%	17%	0.3%	0.5%	0.1%
Res10	Residential	2%	2%	5%	25%	3%	8%	9%	5%	5%	3%	2%	0.01%	0.26%	0.68%	11%	17%	0.3%	0.5%	0.1%
Res11	Residential	1%	1%	3%	14%	1%	3%	3%	2%	2%	1%	1%	0.00%	0.18%	0.38%	5%	7%	0.2%	0.2%	0.1%
Res12	Residential	1%	1%	3%	16%	1%	4%	3%	2%	2%	1%	1%	0.01%	0.23%	0.50%	7%	10%	0.2%	0.3%	0.1%
Res13	Residential	2%	2%	8%	41%	3%	10%	10%	6%	5%	3%	3%	0.01%	0.33%	1.00%	15%	23%	0.5%	0.7%	0.2%
Res14	Residential	2%	2%	8%	40%	3%	9%	8%	5%	5%	3%	3%	0.01%	0.34%	0.95%	15%	22%	0.5%	0.6%	0.2%
Res15	Residential	1%	1%	3%	17%	2%	5%	4%	3%	3%	2%	2%	0.01%	0.36%	0.85%	11%	13%	0.3%	0.4%	0.2%
Res16	Residential	1%	2%	5%	24%	4%	8%	8%	4%	6%	3%	2%	0.04%	0.75%	3.75%	45%	60%	1.4%	1.8%	0.6%
Res17	Residential	1%	2%	6%	32%	4%	7%	7%	3%	5%	4%	2%	0.02%	0.41%	1.60%	21%	29%	0.7%	0.9%	0.3%
Res18	Residential	2%	3%	13%	64%	7%	15%	13%	7%	9%	7%	5%	0.03%	0.60%	1.93%	29%	34%	0.9%	1.0%	0.4%
Res19	Residential	2%	2%	7%	34%	4%	9%	10%	6%	6%	4%	3%	0.02%	0.32%	1.35%	19%	21%	0.6%	0.6%	0.2%
Res20	Residential	2%	2%	5%	27%	3%	8%	9%	5%	5%	3%	2%	0.01%	0.28%	1.10%	15%	17%	0.5%	0.5%	0.2%
Res21	Residential	1%	1%	4%	18%	2%	5%	6%	3%	3%	2%	1%	0.01%	0.21%	0.75%	10%	11%	0.3%	0.3%	0.1%
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C7: 2041 Maximum Predicted Cumulative Concentrations[µg/m³]

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	619.50	569.77	64.43	64.43	48.26	31.00	49.88	27.04	27.21	14.57	8.10	1.73	0.005	0.091	0.94	0.56	0.10	0.05	3.21
CC2	Child care facility	726.71	649.95	67.76	67.76	49.83	31.52	52.79	28.00	27.85	14.75	8.16	1.74	0.006	0.091	1.00	0.58	0.11	0.05	3.23
CC3	Child care facility	939.31	764.50	79.66	79.66	53.39	32.33	57.02	29.17	29.04	15.24	8.27	1.77	0.013	0.093	1.15	0.64	0.13	0.06	3.29
LTerm1	Long term care facility	1,174.25	913.41	91.76	91.76	57.02	33.11	60.29	30.37	30.19	15.75	8.37	1.82	0.019	0.097	1.42	0.66	0.16	0.06	3.39
REC1	Recreational site	787.76	707.22	73.00	73.00	51.74	31.88	54.12	28.38	28.39	15.03	8.21	1.77	0.015	0.093	1.12	0.60	0.12	0.06	3.28
REC2	Recreational site	913.31	775.95	78.85	78.85	52.89	32.25	56.23	28.95	28.87	15.17	8.26	1.77	0.013	0.094	1.16	0.63	0.13	0.06	3.29
S1	School	1,359.81	1,085.23	90.74	90.74	58.49	33.93	68.83	32.42	31.46	15.79	8.45	1.81	0.015	0.095	1.36	0.69	0.15	0.07	3.36
S2	School	959.70	810.32	77.70	77.70	53.01	32.44	58.51	29.61	29.15	15.14	8.28	1.77	0.010	0.093	1.14	0.63	0.12	0.06	3.28
Res1	Residential	656.61	604.13	65.50	65.50	48.83	31.14	50.96	27.30	27.45	14.63	8.12	1.74	0.005	0.091	0.97	0.56	0.10	0.05	3.22
Res2	Residential	682.61	661.41	66.04	66.04	49.90	31.49	53.09	27.96	27.90	14.76	8.16	1.74	0.005	0.091	1.00	0.58	0.11	0.05	3.23
Res3	Residential	1,077.57	730.13	79.33	79.33	51.11	32.00	55.30	28.94	28.41	14.91	8.22	1.75	0.012	0.092	1.06	0.60	0.11	0.06	3.25
Res4	Residential	1,038.05	695.77	78.27	78.27	50.66	31.82	54.41	28.59	28.22	14.85	8.20	1.75	0.012	0.092	1.04	0.59	0.11	0.06	3.25
Res5	Residential	960.16	741.59	75.59	75.59	51.09	32.01	55.19	28.97	28.39	14.90	8.22	1.75	0.011	0.092	1.06	0.60	0.11	0.06	3.25
Res6	Residential	736.79	627.04	68.29	68.29	49.19	31.47	51.53	27.91	27.58	14.68	8.16	1.74	0.007	0.091	0.99	0.58	0.10	0.05	3.23
Res7	Residential	734.16	627.04	68.51	68.51	49.23	31.51	51.81	27.99	27.63	14.68	8.16	1.74	0.008	0.091	0.99	0.58	0.10	0.05	3.23
Res8	Residential	1,024.07	798.86	77.97	77.97	53.11	32.63	59.15	30.13	29.25	15.14	8.30	1.77	0.012	0.093	1.13	0.63	0.12	0.06	3.28
Res9	Residential	1,025.45	810.32	78.25	78.25	53.12	32.65	59.15	30.14	29.25	15.14	8.30	1.77	0.012	0.093	1.13	0.63	0.12	0.06	3.28
Res10	Residential	1,014.57	798.86	78.26	78.26	52.88	32.59	58.68	30.02	29.15	15.11	8.29	1.76	0.012	0.093	1.12	0.63	0.12	0.06	3.27
Res11	Residential	725.68	615.59	69.17	69.17	49.17	31.45	51.05	27.78	27.50	14.69	8.16	1.74	0.008	0.092	0.99	0.58	0.11	0.05	3.23
Res12	Residential	755.00	649.95	71.16	71.16	49.83	31.66	51.86	28.06	27.71	14.78	8.19	1.75	0.010	0.092	1.04	0.59	0.11	0.06	3.25
Res13	Residential	1,178.03	844.68	90.56	90.56	53.93	33.07	59.71	30.47	29.41	15.32	8.36	1.78	0.015	0.094	1.22	0.66	0.14	0.06	3.32
Res14	Residential	1,096.12	833.23	90.09	90.09	53.91	32.84	57.26	29.72	28.99	15.36	8.34	1.78	0.015	0.094	1.22	0.65	0.14	0.06	3.32
Res15	Residential	755.92	661.41	71.41	71.41	50.64	31.90	52.48	28.28	27.99	14.90	8.22	1.77	0.016	0.093	1.13	0.61	0.12	0.06	3.29
Res16	Residential	918.00	856.13	77.63	77.63	54.39	32.59	56.77	29.02	29.52	15.35	8.30	1.92	0.034	0.105	1.91	0.82	0.23	0.09	3.59
Res17	Residential	935.76	798.86	83.32	83.32	55.02	32.38	56.39	28.80	29.30	15.52	8.28	1.81	0.019	0.096	1.37	0.68	0.16	0.07	3.38
Res18	Residential	1,337.47	993.59	108.66	108.66	60.03	34.19	62.72	31.18	31.07	16.20	8.53	1.85	0.027	0.098	1.55	0.70	0.18	0.07	3.44
Res19	Residential	1,121.78	856.13	85.15	85.15	54.72	32.87	59.94	30.31	29.70	15.38	8.33	1.80	0.015	0.095	1.32	0.64	0.15	0.06	3.35
Res20	Residential	1,019.38	810.32	80.05	80.05	53.35	32.52	58.26	29.76	29.23	15.19	8.29	1.79	0.012	0.094	1.23	0.63	0.14	0.06	3.32
Res21	Residential	835.65	707.22	72.91	72.91	51.30	31.87	54.72	28.60	28.39	14.94	8.21	1.77	0.010	0.093	1.12	0.60	0.12	0.06	3.28
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

Table C8: 2041 - Maximum Predicted Cumulative Concentrations as a percentage of Project Criteria

Receptor ID	Receptor Description	CO		NO_2				SPM		PM_{10}	$PM_{2.5}$		Acetaldehyde	Acrolein		Benzene		1,3-Butadiene		Formaldehyde
		1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	24-hour	24-hour	Annual	24-hour	1-hour	24-hour	24-hour	Annual	24-hour	Annual	24-hour
CC1	Child care facility	2%	4%	16%	81%	24%	137%	42%	45%	54%	54%	92%	0.35%	0.10%	23%	41%	124%	1%	3%	5%
CC2	Child care facility	2%	4%	17%	86%	25%	139%	44%	47%	56%	55%	93%	0.35%	0.14%	23%	44%	129%	1%	3%	5%
CC3	Child care facility	3%	5%	20%	101%	27%	143%	48%	49%	58%	56%	94%	0.35%	0.28%	23%	50%	141%	1%	3%	5%
LTerm1	Long term care facility	3%	6%	23%	116%	29%	147%	50%	51%	60%	58%	95%	0.36%	0.42%	24%	62%	147%	2%	3%	5%
REC1	Recreational site	2%	5%	18%	92%	26%	141%	45%	47%	57%	56%	93%	0.35%	0.32%	23%	49%	134%	1%	3%	5%
REC2	Recreational site	3%	5%	20%	100%	26%	143%	47%	48%	58%	56%	94%	0.35%	0.28%	23%	50%	140%	1%	3%	5%
S1	School	4%	7%	23%	115%	29%	150%	57%	54%	63%	58%	96%	0.36%	0.34%	24%	59%	153%	1%	3%	5%
S2	School	3%	5%	19%	98%	27%	144%	49%	49%	58%	56%	94%	0.35%	0.23%	23%	50%	139%	1%	3%	5%
Res1	Residential	2%	4%	16%	83%	24%	138%	42%	45%	55%	54%	92%	0.35%	0.11%	23%	42%	125%	1%	3%	5%
Res2	Residential	2%	4%	17%	83%	25%	139%	44%	47%	56%	55%	93%	0.35%	0.12%	23%	44%	129%	1%	3%	5%
Res3	Residential	3%	5%	20%	100%	26%	142%	46%	48%	57%	55%	93%	0.35%	0.26%	23%	46%	133%	1%	3%	5%
Res4	Residential	3%	4%	20%	99%	25%	141%	45%	48%	56%	55%	93%	0.35%	0.26%	23%	45%	132%	1%	3%	5%
Res5	Residential	3%	5%	19%	96%	26%	142%	46%	48%	57%	55%	93%	0.35%	0.24%	23%	46%	134%	1%	3%	5%
Res6	Residential	2%	4%	17%	86%	25%	139%	43%	47%	55%	54%	93%	0.35%	0.16%	23%	43%	129%	1%	3%	5%
Res7	Residential	2%	4%	17%	87%	25%	139%	43%	47%	55%	54%	93%	0.35%	0.17%	23%	43%	129%	1%	3%	5%
Res8	Residential	3%	5%	19%	99%	27%	144%	49%	50%	59%	56%	94%	0.35%	0.27%	23%	49%	139%	1%	3%	5%
Res9	Residential	3%	5%	20%	99%	27%	144%	49%	50%	59%	56%	94%	0.35%	0.27%	23%	49%	140%	1%	3%	5%
Res10	Residential	3%	5%	20%	99%	26%	144%	49%	50%	58%	56%	94%	0.35%	0.26%	23%	49%	139%	1%	3%	5%
Res11	Residential	2%	4%	17%	87%	25%	139%	43%	46%	55%	54%	93%	0.35%	0.18%	23%	43%	129%	1%	3%	5%
Res12	Residential	2%	4%	18%	90%	25%	140%	43%	47%	55%	55%	93%	0.35%	0.23%	23%	45%	132%	1%	3%	5%
Res13	Residential	3%	5%	23%	114%	27%	146%	50%	51%	59%	57%	95%	0.36%	0.33%	24%	53%	146%	1%	3%	5%
Res14	Residential	3%	5%	23%	114%	27%	145%	48%	50%	58%	57%	95%	0.36%	0.34%	23%	53%	144%	1%	3%	5%
Res15	Residential	2%	4%	18%	90%	25%	141%	44%	47%	56%	55%	93%	0.35%	0.36%	23%	49%	135%	1%	3%	5%
Res16	Residential	3%	5%	19%	98%	27%	144%	47%	48%	59%	57%	94%	0.38%	0.75%	26%	83%	182%	2%	4%	6%
Res17	Residential	3%	5%	21%	105%	28%	143%	47%	48%	59%	57%	94%	0.36%	0.41%	24%	60%	151%	2%	3%	5%
Res18	Residential	4%	6%	27%	137%	30%	151%	52%	52%	62%	60%	97%	0.37%	0.60%	24%	67%	157%	2%	4%	5%
Res19	Residential	3%	5%	21%	108%	27%	145%	50%	51%	59%	57%	95%	0.36%	0.32%	24%	57%	143%	1%	3%	5%
Res20	Residential	3%	5%	20%	101%	27%	144%	49%	50%	58%	56%	94%	0.36%	0.28%	24%	54%	139%	1%	3%	5%
Res21	Residential	2%	5%	18%	92%	26%	141%	46%	48%	57%	55%	93%	0.35%	0.21%	23%	49%	133%	1%	3%	5%
Project Criteria		**36,200**	**15,700**	**400**	**79.1**	**200**	**22.6**	**120**	**60**	**50**	**27**	**8.8**	**500**	**4.5**	**0.4**	**2.3**	**0.45**	**10**	**2**	**65**

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