APPENDIX

I

AIR QUALITY ASSESSMENT REPORT

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Date: February 25, 2022

To: WSP Canada Inc.
610 Chartwell Road, Suite 300
Oakville, ON L6J 4A5

Re: **Local Air Quality Assessment**
Steeles Avenue EA
(Tremaine Road to Industrial Drive)
Milton, Regional Municipality of Halton, ON
SLR Project #241.20181.000

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TABLE OF CONTENTS

1.0 INTRODUCTION

SLR Consulting (SLR) was retained by WSP Canada Inc. to conduct an air quality assessment in support of the Municipal Class Environmental Assessment (MCEA) for the improvements to Steeles Avenue from Tremaine Road to Industrial Drive located in The Regional Municipality of Halton. The study area is approximately 1.5 km in length. This report includes a qualitative air quality assessment of the existing conditions and the preferred alternative of the Steeles Avenue roadway in Milton, Ontario.

1.1 Proposed Roadway

The proposed project will realign Steeles Avenue south of the existing Steels Avenue, with a new roundabout east of Peru Road. The proposed roadway is shown in **Figure 1**. The roadway will be a two-lane road with an Annual Average Daily Traffic (AADT) volume of approximately 15,000 vehicles per day and a posted speed limit of 60 km/hr. Traffic on the new roadway is expected to be broken down as follows: 89% light duty-vehicles, 4% medium-duty vehicles and 7% heavy-duty vehicles.

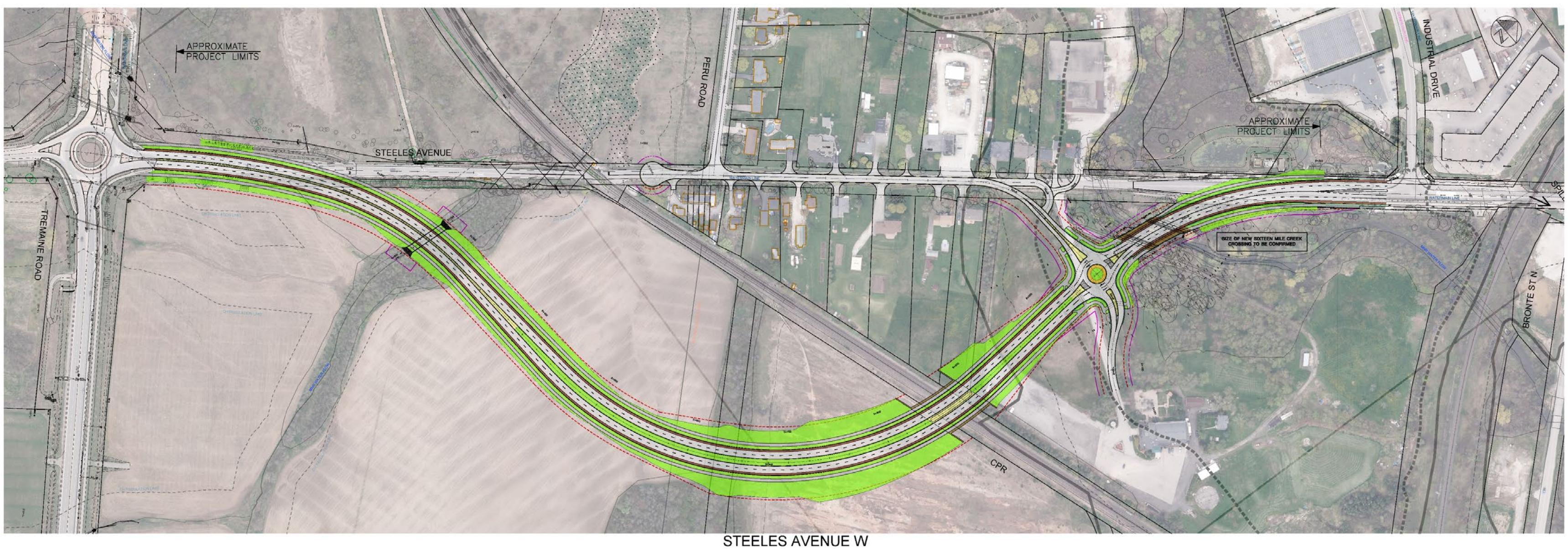


Figure 1: Proposed Roadway
Credit: WSP Canada Inc.

1.2 Study Objectives

The main objective of the study was to assess the local air quality impacts due to the proposed realignment of Steeles Avenue. The study also included an assessment of total greenhouse (GHG) emissions due to the project, and an overview of construction impacts. To meet these objectives, the following scenarios were considered:

- 2020 Existing – Assess the existing air quality conditions at representative receptors. Predicted contaminant concentrations from the existing roadway were combined with hourly measured ambient concentrations to determine the combined impact.
- 2031 Future Build – Assess the future air quality conditions with the proposed new roadway in place. Predicted contaminant concentrations from the proposed roadway improvements were combined with hourly measured ambient concentrations to determine the combined impact.

The assessment considered Steeles Avenue as well as nearby intersecting roads. The roadway segments considered in this assessment are shown in Table 1 and labelled in Figure 2.

Table 1: Modelled Road Segments

Name	2020 Two-Way AADT	2031 Two-Way AADT	Model Length (m)	Posted Speed (km/h)
Steeles Ave from Tremaine Rd to Peru Rd	10,487	13,534	600 m in 2020 1,139 m in 2031	60
Steeles Ave from Peru Rd to Industrial Dr	10,680	16,760	675 m in 2020 300 m in 2031	60
Tremaine Rd N of Steeles Ave	8,156	34,652	283 m	70
Tremaine Rd S of Steeles Ave	11,521	37,229	539 m	70
Peru Rd N of Steeles Ave	245	2,451 (North of Future Old Steele) 1,013 (On Future Old Steele)	588 m	50
Peru Rd S Steeles Ave	-	1,013	100 m	50
Industrial Dr N of Steeles Ave	4,654	4,654	418 m	50

Figure 2: Modelled Road Segments in Study Area

1.3 Contaminants of Interest

The contaminants of interest from vehicle emissions are based on the regularly assessed contaminants of interest for transportation assessments in Ontario, as determined by the Ministry of Transportation Ontario (MTO) and Ministry of Environment, Conservation and Parks (MECP). Motor vehicle emissions have largely been determined by scientists and engineers with United States and Canadian government agencies such as the U.S. Environmental Protection Agency (EPA), the MECP, Environment Canada (EC), Health Canada (HC), and the MTO. These contaminants are emitted due to fuel combustion, brake wear, tire wear, the breakdown of dust on the roadway, fuel leaks, evaporation and permeation, and refuelling leaks and spills as illustrated in **Figure 3**. Note that emissions related to refuelling leaks and spills are not applicable to motor vehicle emissions from roadway travel. Instead, these emissions contribute to the overall background levels of the applicable contaminants. All of the selected contaminants are emitted during fuel combustion, while emissions from brake wear, tire wear, and breakdown of road dust include only the particulates. A summary of these contaminants is provided in **Table 2**.

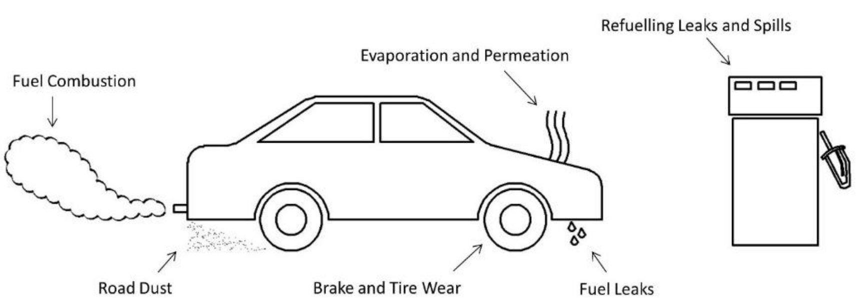


Figure 3: Motor Vehicle Emission Sources

Table 2: Contaminants of Interest Associated with Vehicle Emissions

Criteria Air Contaminants		Volatile Organic Compounds (VOCs)	
Name	Symbol	Name	Symbol
Nitrogen Dioxide	NO_2	Acetaldehyde	C_2H_4O
Carbon Monoxide	CO	Acrolein	C_3H_4O
Fine Particulate Matter (<2.5 microns in diameter)	$PM_{2.5}$	Benzene	C_6H_6
Coarse Particulate Matter (<10 microns in diameter)	PM_{10}	1,3-Butadiene	C_4H_6
Total Suspended Particulate Matter (<44 microns in diameter)	TSP	Formaldehyde	CH_2O

1.4 Applicable Guidelines

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

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

Within the guidelines, the threshold value for each contaminant and its applicable averaging period were used to assess the maximum predicted impact at sensitive receptors derived from computer simulations. The contaminants of interest are compared against 1-hour, 8-hour, 24-hour, and annual averaging periods. The threshold values and averaging periods used in this assessment are presented in **Table 3**. It should be noted that the CAAQS for PM2.5 is not based on the maximum 24-hour concentration value; PM2.5 is assessed based on the annual 98th percentile value, averaged over 3 consecutive years.

Table 3: Applicable Guidelines

Contaminant	Averaging Period (hrs)	Threshold Value ($\mu g/m^3$)	Source
NO_2	1	400	AAQC
	24	200	AAQC
	1	79 (42 ppb)[1]	CAAQS (standard is to be phased-in in 2025)
	Annual	23 (12 ppb)[2]	CAAQS (standard is to be phased-in in 2025)
CO	1	36,200	AAQC
	8	15,700	AAQC
$PM_{2.5}$	24	27[3]	CAAQS
	Annual	8.8[4]	CAAQS
PM_{10}	24	50	Interim AAQC
TSP	24	120	AAQC
Acetaldehyde	24	500	AAQC
Acrolein	24	0.4	AAQC
	1	4.5	AAQC
Benzene	Annual	0.45	AAQC
	24	2.3	AAQC
1,3-Butadiene	24	10	AAQC
	Annual	2	AAQC
Formaldehyde	24	65	AAQC

[1] The 1-hour NO_2 CAAQs is based on the 3-year average of the annual 98th percentile of the NO_2 daily-maximum 1-hour average concentrations
[2] The average over a single calendar year of all the 1-hour average NO_2 concentrations
[3]The 24-hr $PM_{2.5}$ CAAQS is based on the annual 98th percentile concentration, averaged over three consecutive years
[4] The annual $PM_{2.5}$ CAAQS is based on the average of the three highest annual average values over the study period

1.5 General Assessment Methodology

The worst-case contaminant concentrations due to motor vehicle emissions from the roadways were predicted at nearby receptors using dispersion modelling software on an hourly basis for a five-year period. 2013-2017 historical meteorological data from Toronto Pearson Airport was used. Five years were modelled in order to capture the worst-case meteorological conditions. Two emission scenarios were assessed: 2020 Existing and 2031 Future Build.

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

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

2.0 BACKGROUND AMBIENT DATA

2.1 Overview

Background (ambient) conditions are measured contaminant concentrations that are independent of emissions from the proposed project infrastructure. These concentrations consist of trans-boundary (macro-scale), regional (meso-scale), and local (micro-scale) emission sources and result from both primary and secondary formation. Primary contaminants are emitted directly by the source and secondary contaminants are formed by complex chemical reactions in the atmosphere. Secondary pollution is generally formed over great distances in the presence of sunlight and heat and most noticeably results in the formation of fine particulate matter ($PM_{2.5}$) and ground-level ozone (O_3), also considered smog.

In Ontario, a significant amount of smog originates from emission sources in the United States which is the major contributor during smog events which usually occur in the summer season (MECP, 2005). During smog episodes, the U.S. contribution to $PM_{2.5}$ can be as much as 90 percent near the southwest Ontario-U.S. border. The effects of U.S. air pollution in Ontario on a high $PM_{2.5}$ day and on an average $PM_{2.5}$ spring/summer day are illustrated in **Figure 4**.

High $PM_{2.5}$ Days	Average $PM_{2.5}$ of Spring/Summer Season

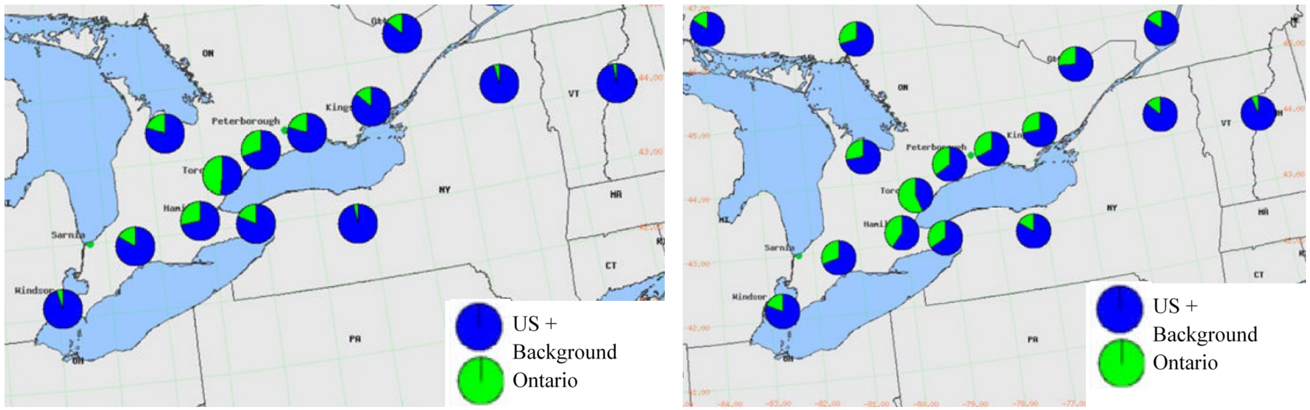


Figure 4: Effect of Trans-Boundary Air Pollution (MECP, 2005)

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

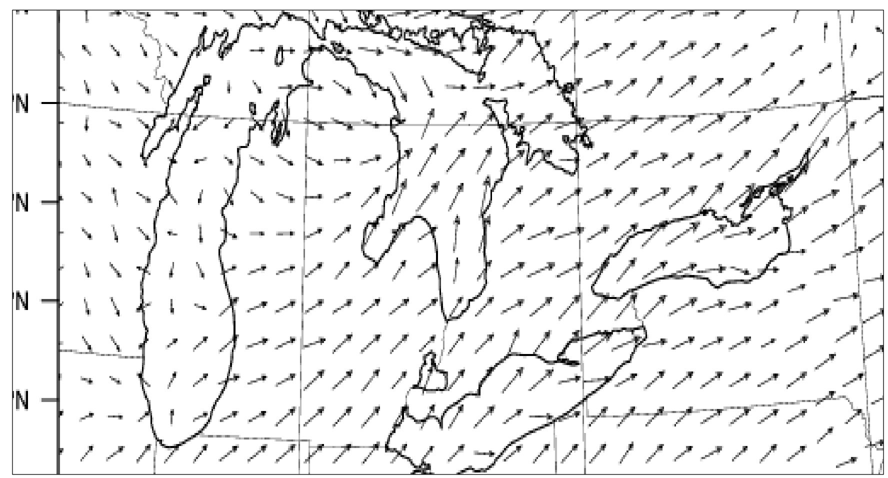


Figure 5: Typical Wind Direction during an Ontario Smog Episode

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

2.2 Selection of Relevant Ambient Monitoring Stations

A review of MECP and NAPS ambient monitoring stations in Ontario was undertaken to identify the monitoring stations that are in relative proximity to the study area and that would be representative of background contaminant concentrations in the study area. Five MECP (Brampton, Burlington, Mississauga, Oakville, and Toronto West) and three NAPS (Brampton, Etobicoke West, and Windsor) stations were selected for the analysis. Note that CO is only monitored at the Toronto West Station, therefore this station was used only to assess background CO concentrations. Also note that Windsor is the only station in Ontario at which background Acrolein, Formaldehyde, and Acetaldehyde are measured in recent years. Only these contaminants were considered from the Windsor station; the remaining contaminants from the Windsor station were not considered given the stations' distance from the study area. The locations of the relevant ambient monitoring stations in relation to the study area are shown in **Figure 6**. Station information is presented in **Table 4**.

Table 4: Relevant MECP and NAPS Station Information

City/Town	Station ID	Location	Operator	Contaminants
Brampton	46090	109 Mclaughlin Rd. S.	MECP	NO_2 | $PM_{2.5}$
Burlington	44008	North Shore Blvd. E./Lakeshore Rd.	MECP	NO_2 | $PM_{2.5}$
Mississauga	46108	3359 Mississauga Rd. N.	MECP	NO_2 | $PM_{2.5}$
Oakville	44017	Eighth Line/Glenashton Dr.	MECP	NO_2 | $PM_{2.5}$
Toronto West	35125	125 Resources Rd	MECP	CO
Brampton	60428	525 Main St	NAPS	1,3-Butadiene | Benzene
Etobicoke West	60413	Elmcrest Road	NAPS	1,3-Butadiene | Benzene
Windsor	60211	College St/Prince St	NAPS	Formaldehyde | Acetaldehyde | Acrolein

Since there are several monitoring stations which could be used to represent the study area, a comparison was performed for the available data on a contaminant basis, to determine the worst-case representative background concentration. Selecting the worst-case ambient data will result in a conservative combined assessment.

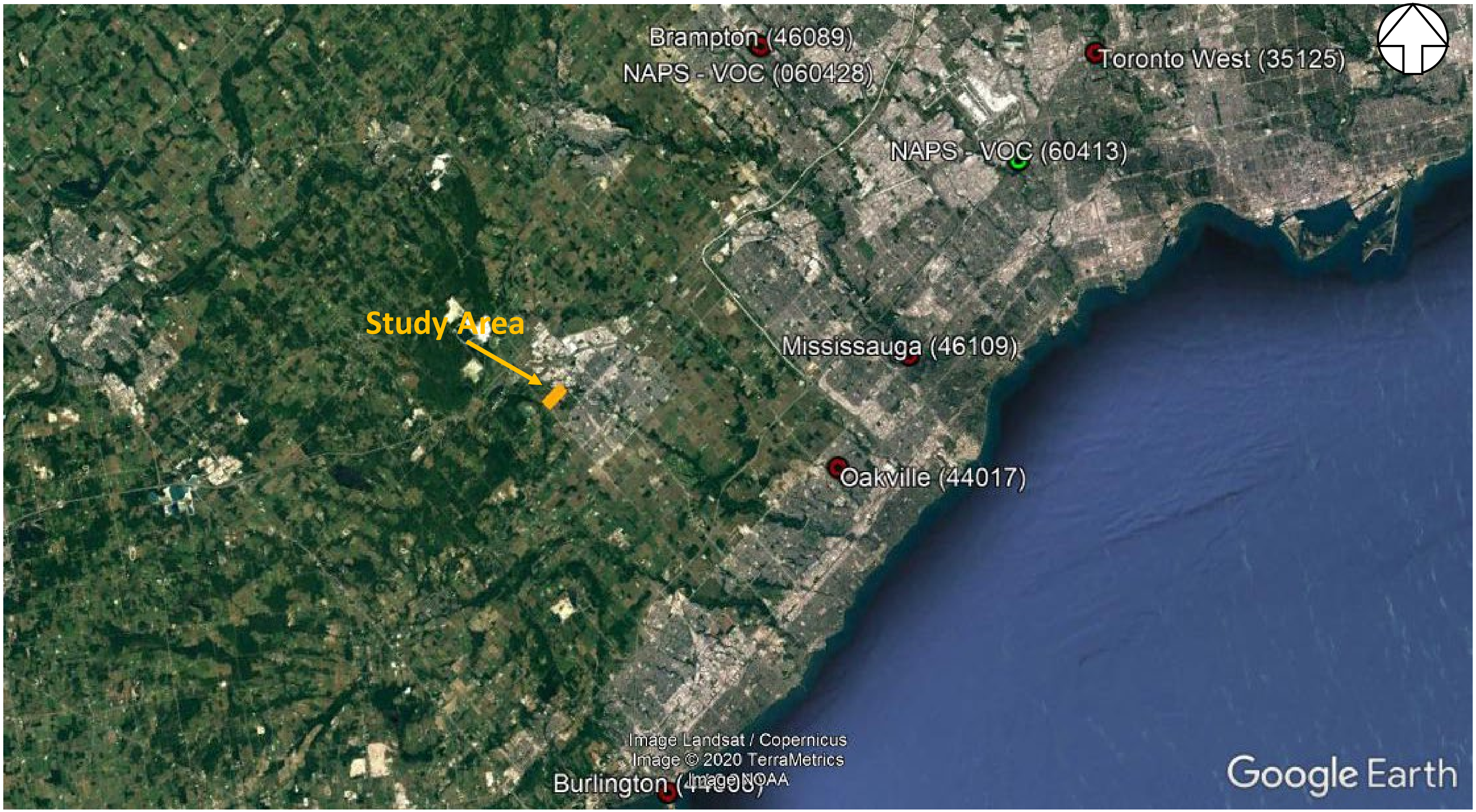


Figure 6: Location of Ambient Monitoring Stations, Relevant to the Study Area

2.3 Selection of Worst-Case Monitoring Stations

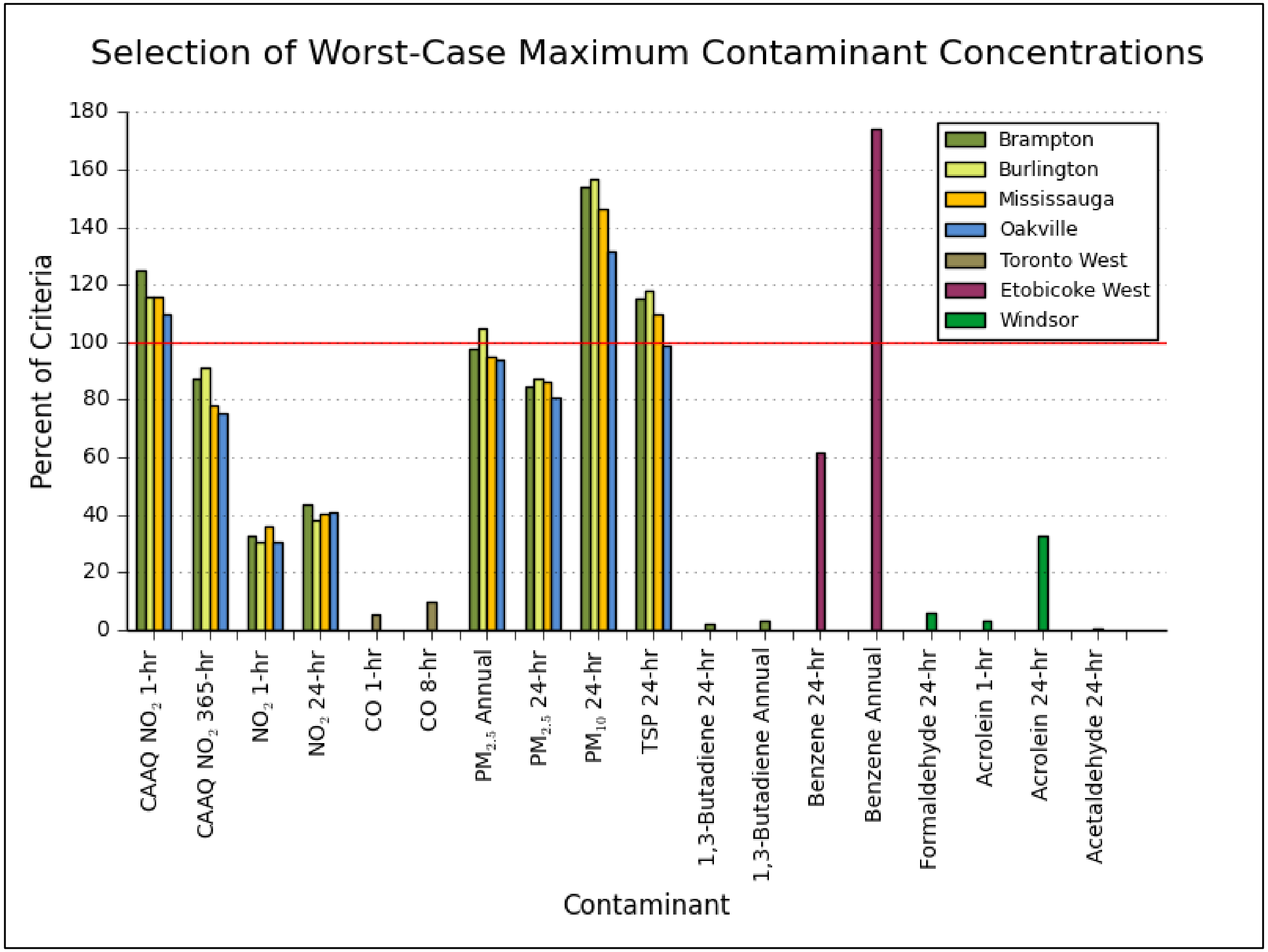
Year 2013 to 2017 hourly ambient monitoring data from the selected stations were statistically summarized for the desired averaging periods: 1-hour, 8-hour, 24-hour, and annual. Note that at the Etobicoke West and Brampton NAPS stations, minimal data was available in 2016, therefore, 2011-2015 data was used for these stations. Formaldehyde, acetaldehyde and acrolein are only recently measured at the Windsor station, and were not measured after 2013. Therefore 2009-2013 data was used for these VOCs. For consistency with the combined effects analysis (using 2013-2017 meteorological data to predict roadway concentrations), the actual date of measured VOC data within dataset was used when possible.

The station with the highest maximum value over the five-year period for each contaminant and averaging period was selected to represent background concentrations in the study area. The maximum concentration represents an absolute worst-case background scenario. Note that PM_{10} and TSP are not measured in Ontario; therefore, background concentrations were estimated by applying a $PM_{2.5}/PM_{10}$ ratio of 0.54 and a $PM_{2.5}$/TSP ratio of 0.3 (Lall et al., 2004). Ambient VOC data is not monitored hourly, but is typically measured every six days. To combine this dataset with the hourly modelled concentrations, each measured six-day value was applied to all hours between measurement dates, when there were 6 days between measurements. When there was greater than 6 days between measurements, the 90th percentile measured value for the year in question was applied for those days in order to determine combined concentrations. This method is conservative as it applies a concentration that is higher than 90% of the measured concentrations whenever data was not available.

Following the above methodology, the worst-case concentrations for each contaminant and averaging period were summarized for each of the selected monitoring stations. The station with the highest concentration, for each contaminant and averaging period, was selected for the analysis. **Table 5** and **Figure 7** show a comparison of the contaminant concentrations from each station and the selection of the worst-case station.

Table 5: Comparison and Selection of Background Concentrations

Contaminant	Worst-Case Station	Contaminant	Worst-Case Station
CAAQ NO_2 (1-Hr)	Brampton	TSP	Burlington
CAAQ NO_2 (ann)	Burlington	1,3-Butadiene (24-hr)	Brampton
NO_2 (1-Hr)	Mississauga	1,3-Butadiene (ann)	Brampton
NO_2 (24-Hr)	Brampton	Benzene (24-hr)	Etobicoke West
CO (1-Hr)	Burlington	Benzene (ann)	Etobicoke West
CO (8-hr)	Burlington	Formaldehyde	Windsor
$PM_{2.5}$ (24-hr)	Burlington	Acrolein	Windsor
$PM_{2.5}$ (ann)	Burlington	Acetaldehyde	Windsor
PM_{10}	Burlington		



Note: PM_{10} and TSP are not measured in Ontario; therefore, background concentrations were estimated from $PM_{2.5}$ concentrations

Figure 7: Summary of Ambient Concentrations

2.4 Summary of Worst-Case Monitoring Stations

A detailed statistical analysis of the selected worst-case background monitoring station for each of the contaminants was performed and is summarized in Figure 8. Presented is the average, 90th percentile, and maximum concentrations as a percentage of the guideline for each contaminant from the worst-case monitoring station determined above. Maximum ambient concentrations represent a single worst-case value. The 90th percentile concentration represents a reasonably worst-case background concentrations, and the average concentration represents a typical background value. The 98th percentile concentration is shown for $PM_{2.5}$, as the guideline for $PM_{2.5}$ is based on 98th percentile concentrations.

Based on a review of ambient monitoring data from 2013-2017, all background concentrations were below their respective guidelines with the exception of 24-hour PM_{10}, 24-hour TSP, and annual $PM_{2.5}$ and benzene. It should be noted that PM_{10} and TSP were calculated based on their relationship to $PM_{2.5}$. In addition, the 1-hour NO_2 CAAQS standard is not met.

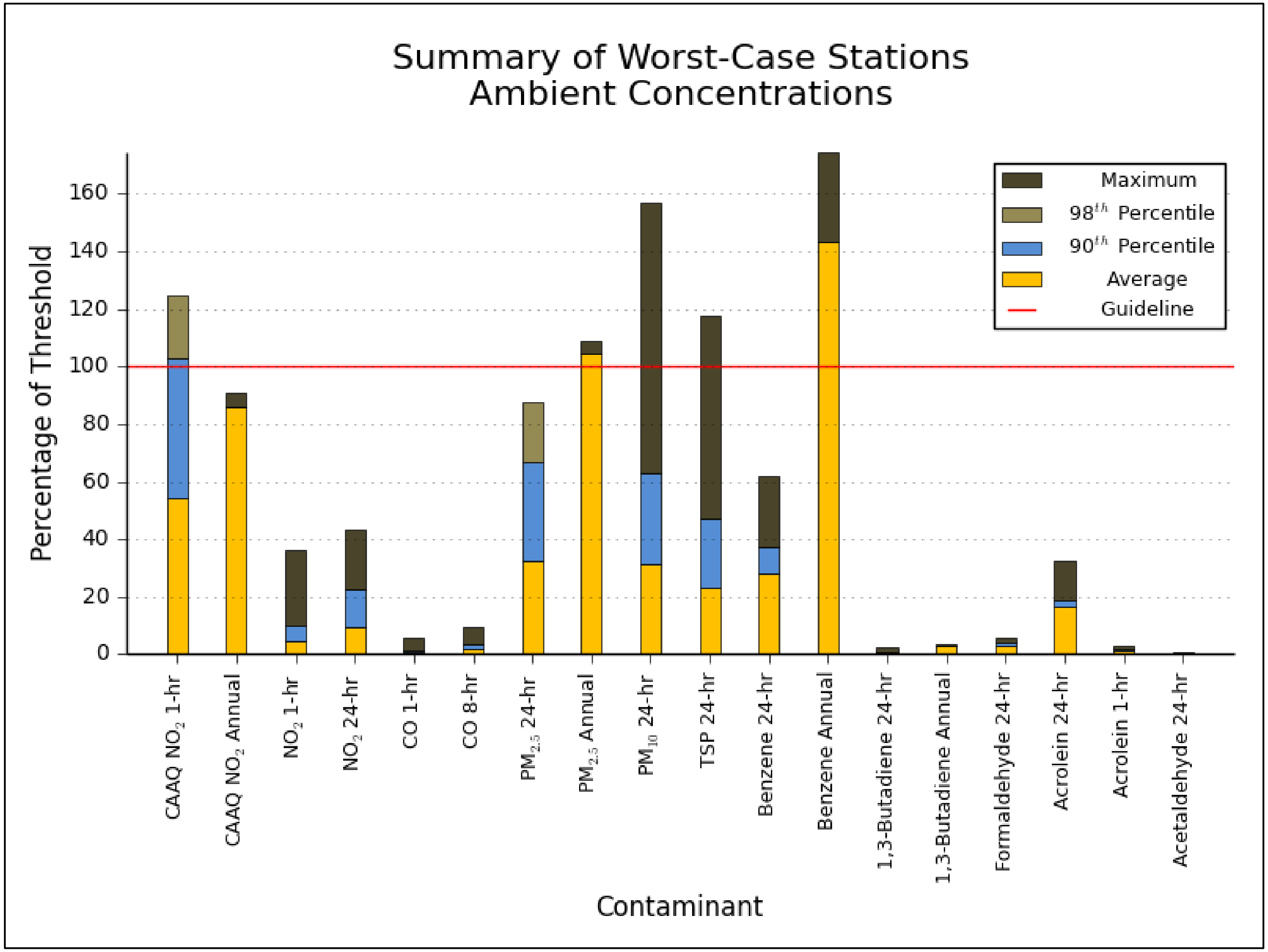


Figure 8: Summary of Background Conditions Applied in the Assessment

3.0 LOCAL AIR QUALITY ASSESSMENT

3.1 Location of Sensitive Receptors within the Study Area

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

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

Worst-case impacts generally occur at the sensitive receptors closest to roadway/highway sources. This is due to the fact that contaminant concentrations disperse significantly with downwind distance from the roadway resulting in reduced contaminant concentrations. At approximately 500 m from the roadway, contaminant concentrations from motor vehicles generally become indistinguishable from background levels. The maximum predicted contaminant concentrations at the closest sensitive receptors will usually occur during weather events which produce calm to light winds (< 3 m/s). During weather events with higher wind speeds, the contaminant concentrations disperse much more quickly.

Sensitive receptors within the study area were identified using aerial imagery. Sensitive receptor locations are shown in **Figure 9**. They all represent residences along Peru Road North and Steeles Avenue.

Buildings along Industrial Drive and beyond are all commercial or industrial in nature.

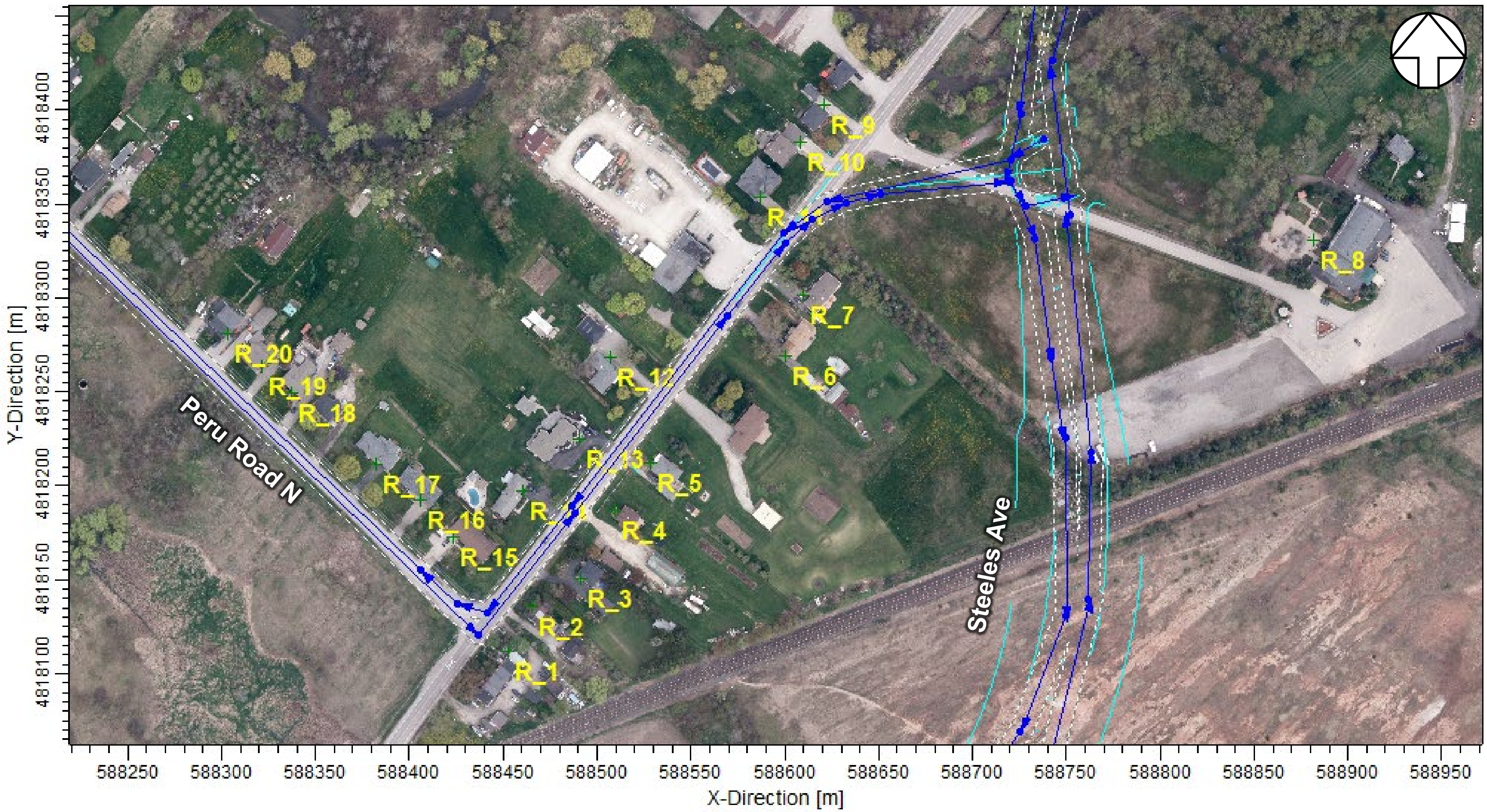


Figure 9: Identified Sensitive Receptors

3.2 Road Traffic Data

Traffic data was provided in the form of Annual Average Daily Traffic (AADT) volumes by WSP for the intersections within the study area for both the Existing 2020 and 2031 configurations. The AADT volumes used in the assessment are shown in **Table 6** with an assumed 50% split between travelling directions with the exception of Steeles Avenue, which included AADT for each direction. Hourly traffic volumes were not available, therefore the US EPA standard off-network and rural weekday hourly distribution was used both scenarios. The hourly distributions are shown in **Table 7.**

Table 6: **Traffic Volumes (AADT – vehicles/day) Used in the Assessment**

Roadway	2020 Two-Way AADT	2031 Two-Way AADT	Posted Speed (km/h)
Steeles Ave from Tremaine Rd to Peru Rd	10,487	13,534	60
Steeles Ave from Peru Rd to Industrial Dr	10,680	16,760	
Tremaine Rd N of Steeles Ave	8,156	34,652	70
Tremaine Rd S of Steeles Ave	11,521	37,229	
Peru Rd N of Steeles Ave	245	2,451 (North of Future Old Steele) 1,013 (On Future Old Steele)	50
Peru Rd S of Steeles Ave	-	1,013	
Industrial Dr N of Steeles Ave	4,654	4,654	

Table 7: **US EPA Rural, Weekday, Hourly Vehicle Distribution**

Hour	MON	TUE	WED	THU	FRI	SAT	SUN
1	1.0%	1.0%	1.0%	1.0%	1.0%	1.8%	1.8%
2	0.7%	0.7%	0.7%	0.7%	0.7%	1.1%	1.1%
3	0.6%	0.6%	0.6%	0.6%	0.6%	0.9%	0.9%
4	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%
5	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%
6	2.0%	2.0%	2.0%	2.0%	2.0%	1.0%	1.0%
7	4.1%	4.1%	4.1%	4.1%	4.1%	1.9%	1.9%
8	5.8%	5.8%	5.8%	5.8%	5.8%	2.7%	2.7%
9	5.4%	5.4%	5.4%	5.4%	5.4%	3.9%	3.9%
10	5.3%	5.3%	5.3%	5.3%	5.3%	5.2%	5.2%
11	5.5%	5.5%	5.5%	5.5%	5.5%	6.3%	6.3%
12	5.8%	5.8%	5.8%	5.8%	5.8%	7.0%	7.0%
13	5.9%	5.9%	5.9%	5.9%	5.9%	7.2%	7.2%
14	6.0%	6.0%	6.0%	6.0%	6.0%	7.2%	7.2%
15	6.6%	6.6%	6.6%	6.6%	6.6%	7.3%	7.3%
16	7.2%	7.2%	7.2%	7.2%	7.2%	7.4%	7.4%
17	7.8%	7.8%	7.8%	7.8%	7.8%	7.3%	7.3%
18	7.6%	7.6%	7.6%	7.6%	7.6%	7.0%	7.0%
19	5.9%	5.9%	5.9%	5.9%	5.9%	6.1%	6.1%
20	4.3%	4.3%	4.3%	4.3%	4.3%	5.1%	5.1%
21	3.6%	3.6%	3.6%	3.6%	3.6%	4.1%	4.1%
22	3.1%	3.1%	3.1%	3.1%	3.1%	3.3%	3.3%
23	2.4%	2.4%	2.4%	2.4%	2.4%	2.6%	2.6%
24	1.8%	1.8%	1.8%	1.8%	1.8%	2.0%	2.0%

3.3 Mereological Data

2013-2017 hourly meteorological data was obtained from the Pearson International Airport in Toronto and upper air data was obtained from Buffalo, New York as recommended by the MECP for the study area. The combined data was processed to reflect conditions at the study area using the U.S. EPA's PCRAMMET software program which prepares meteorological data for use with the CAL3QHCR vehicle emission dispersion model. A wind frequency diagram (wind rose) is shown in **Figure 10.**

As can be seen in this figure, predominant winds are from the south-westerly through northerly directions.

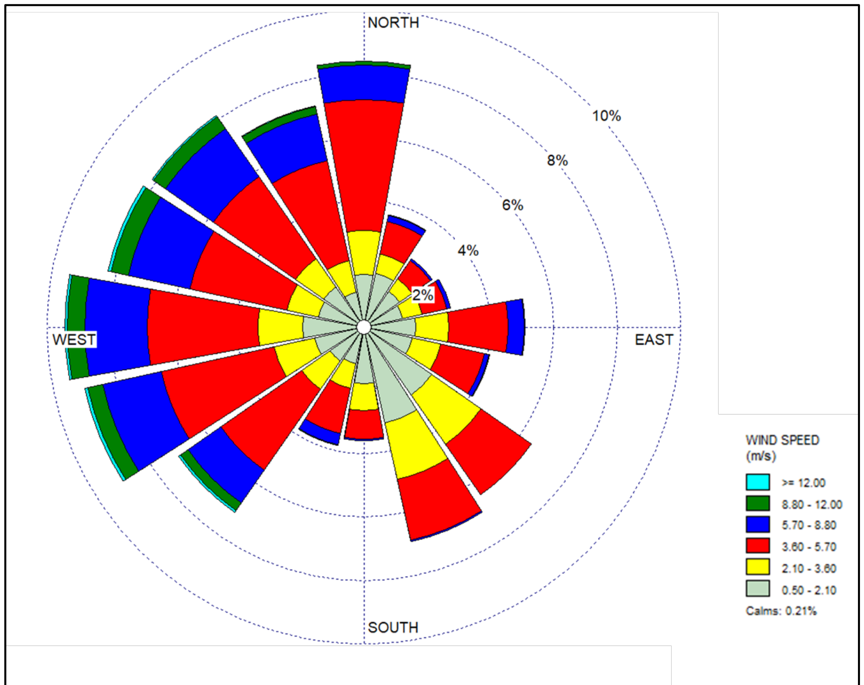


Figure 10: Wind Frequency Diagram for Toronto Pearson International Airport (2013-2017)

3.4 Motor Vehicle Emission Rates

The U.S. EPA's Motor Vehicle Emission Simulator (MOVES) model provides estimates of current and future emission rates from motor vehicles based on a variety of factors such as local meteorology, vehicle fleet composition and speed. MOVES 2014b, released in December 2018, is the U.S. EPA's latest tool for estimating vehicle emissions due to the combustion of fuel, brake and tire wear, fuel evaporation, permeation, and refuelling leaks. The model is based on "an analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions and accounts for changes in emissions due to proposed standards and regulations". For this project, MOVES was used to estimate vehicle emissions based on vehicle type, road type, model year, and vehicle speed. Emission rates were estimated based on the heavy-duty vehicle percentages provided by WSP. Vehicle age was based on the U.S. EPA's default distribution. **Table 8** specifies the major inputs into MOVES.

From the MOVES outputs, the highest monthly value for each contaminant was selected to represent a worst-case emission rate. The emission rates for each vehicle speed and contaminant modelled are shown in **Table 9** for the Existing and Future Build years, for a heavy/medium duty vehicle percentage of 4/7. As shown in **Table 9**, emissions in the future year are generally predicted to decrease.

Table 8: MOVES Input Parameters

Parameter	Input
Scale	Custom County Domain
Meteorology	Temperature and Relative Humidity were obtained from meteorological data from the Environment Canada Toronto INTL A station for the years 2013 to 2017.
Years	2020 (Existing) and 2031 (Future Build)
Geographical Bounds	Custom County Domain
Fuels	Compressed Natural Gas / Diesel Fuels / Gasoline Fuels
Source Use Types	Combination Long-haul Truck / Combination Short-haul Truck / Intercity Bus / Light Commercial Truck / Motor Home / Motorcycle / Passenger Car / Passenger Truck / Refuse Truck / School Bus / Single Unit Long-haul Truck / Single Unit Short-haul Truck / Transit Bus
Road Type	Rural Arterial
Contaminants and Processes	NO_2 / CO / $PM_{2.5}$ / PM_{10} / Acetaldehyde / Acrolein / Benzene / 1,3-Butadiene / Formaldehyde/Equivalent CO_2 TSP can't be directly modelled by MOVES. However, the U.S. EPA has determined, based on emissions test results, that >97% of tailpipe particulate matter is PM_{10} or less. Therefore, the PM10 exhaust emission rate was used for TSP.
Vehicle Age Distribution	MOVES defaults based on years selected for the roadway.

Table 9: MOVES Output Emission Factors for Roadway Vehicles (g/VMT)

Year	Speed	CO	NO_x	Benzene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	$PM_{2.5}$	PM_{10}	TSP[1]
2020	50 km/hr	2.70	0.33	0.0020	0.000114	0.0020	0.0009	0.00012	0.020	0.078	0.078
	60 km/hr	2.51	0.31	0.0019	0.000103	0.0019	0.0008	0.00011	0.017	0.063	0.063
	70 km/hr	2.22	0.30	0.0016	0.000088	0.0016	0.0007	0.00009	0.013	0.041	0.041
2031	50 km/hr	1.29	0.14	0.0011	0.0000	0.0011	0.0004	0.0001	0.01	0.07	0.07
	60 km/hr	1.22	0.13	0.0010	0.0000	0.0010	0.0004	0.0001	0.01	0.06	0.06
	70 km/hr	1.12	0.13	0.0009	0.0000	0.0009	0.0003	0.0000	0.01	0.04	0.04

[1] – Note that TSP cannot be directly modelled by MOVES. However, the U.S. EPA has determined, based on emissions test results, that >97% of tailpipe particulate matter is PM10 or less. Therefore, the PM¬10 exhaust emission rate was used for TSP.

3.5 Re-suspended Particulate Matter Emission Rates

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

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

Where: E = the particulate emission factor

k = the particulate size multiplier

sL = silt loading

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

Table 10: Re-suspended Particulate Matter Emission Factors

Roadway AADT	K (PM2.5/PM10 /TSP)	sL (g/m2)	W (Tons)	E (g/VMT)		
				PM2.5	PM10	TSP
<500	0.25/1.0/5.24	0.6	3	0.503	2.015	10.561
500-5,000	0.25/1.0/5.24	0.2	3	0.185	0.741	3.886
5,000-10,000	0.25/1.0/5.24	0.06	3	0.061	0.247	1.299
>10,000	0.25/1.0/5.24	0.03	3	0.033	0.132	0.6914

3.6 Air Dispersion Modelling Using CAL3QHCR

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

Table 11: CAL3QHCR Model Input Parameters

Parameter	Input
Free-Flow and Queue Link Traffic Data	Hourly traffic distributions were applied to the AADT traffic volumes in order to input traffic volumes in vehicles/hour. Emission rates from the MOVES output were input in grams/VMT or grams per vehicle hour. Signal timings for the traffic signal were input in seconds.
Meteorological Data	2013-2017 data from Pearson International Airport
Deposition Velocity	$PM_{2.5}$: 0.1 cm/s PM_{10}: 0.5 cm/s TSP: 0.15 cm/s NO_2, CO and VOCs: 0 cm/s
Settling Velocity	$PM_{2.5}$: 0.02 cm/s PM_{10}: 0.3 cm/s TSP: 1.8 cm/s CO, NO_2, and VOCs: 0 cm/s
Surface Roughness	The land type surrounding the project site is categorized as 'rural'. The average surface roughness height for low intensity residential for all seasons of 52 cm was applied in the model.
Vehicle Emission Rate	Emission rates calculated in MOVES and AP-42 were input in g/VMT

3.7 Modelling Results

Presented below are the modelling results for the 2020 Existing and 2031 Future Build scenarios based on 5-years of meteorological data. For each contaminant, combined concentrations are presented along with the relevant contribution due to the background and roadway. Results in this section are presented for the worst-case sensitive receptors for each contaminant and averaging period (see **Table 12**), which were identified as the maximum combined concentration for the 2031 Future Build scenario. Results for all modelled receptors are provided in Appendix A. It should be noted that the maximum combined concentration at any sensitive receptor often occurs infrequently and may only occur for one hour or day over the 5-year period.

Coincidental hourly modelled roadway and background concentrations were added to derive the combined concentration for each hour over the 5-year period. Hourly combined concentrations were then used to determine contaminant concentrations based on the applicable averaging period. Statistical analysis in the form of maximum, 90th percentile, and average combined concentrations were calculated for the worst-case sensitive receptor for each contaminant and are presented below. The maximum combined concentration (or 3-year average annual 98th percentile concentration in the case of $PM_{2.5}$) was used to assess compliance with MECP guidelines or CAAQS. If excesses of the guideline were predicted, frequency analysis was undertaken in order to estimate the number of occurrences above the guideline. Provided below are the modelling results for the contaminants of interest.

Table 12: Worst-Case Sensitive Receptors for 2031 Future Build Scenario

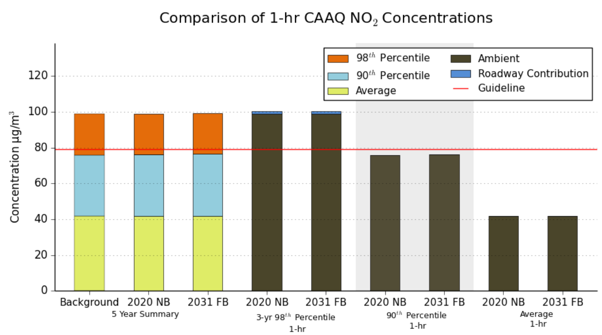
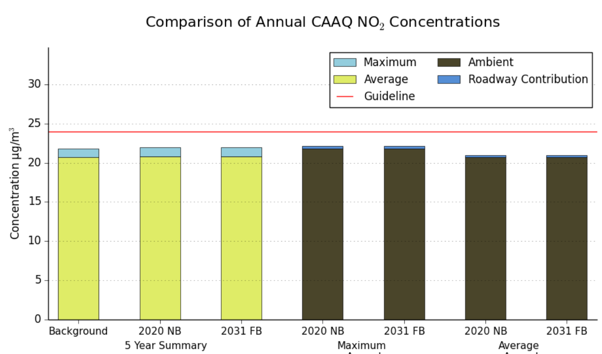
Contaminant	Averaging Period	Sensitive Receptor
CAAQ NO_2	1-hour	20
	Annual	12
NO_2	1-hour	12
	24-hour	18
CO	1-hour	19
	8-hour	13
$PM_{2.5}$	24-hour	7
	Annual	11
PM_{10}	24-hour	13
TSP	24-hour	13
1,3-Butadiene	24-hour	1
	Annual	1
Formaldehyde	24-hour	20
Benzene	24-hour	13
	Annual	12
Acrolein	1-hour	20
	24-hour	2
Acetaldehyde	24-hour	19

Nitrogen Dioxide CAAQS

Table 13 presents the predicted combined concentrations for the worst-case sensitive receptor for 1-hour and annual NO_2 based on 5 years of meteorological data. The results conclude that:

- The annual 98th percentile of daily maximum 1-hour NO_2 concentration, averaged over three consecutive years exceeds the CAAQS with an 2% contribution from the highway.
- The annual average concentration is below the guideline with a 1% contribution from the highway.

Table 13: Summary of Predicted NO_2 Concentrations

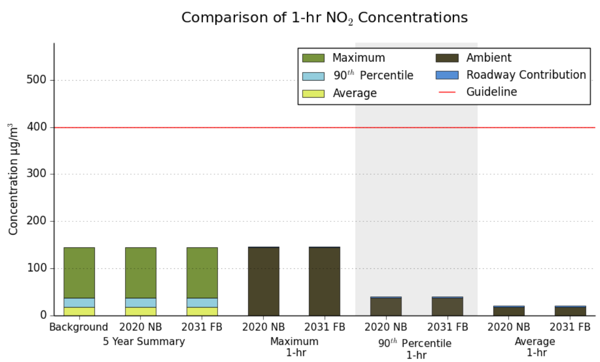
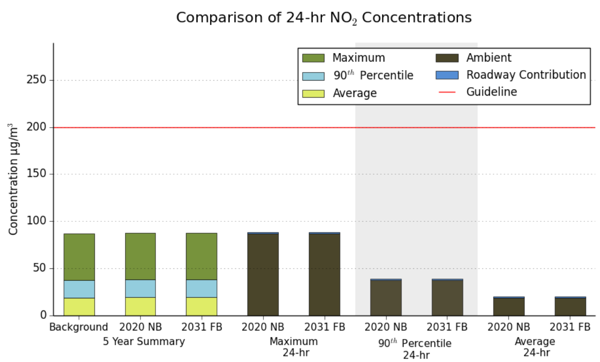
<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="10">
</td><td colspan="2">% of CAAQ Guideline:</td></tr>
<tr><td>98th Percentile</td><td>125%</td></tr>
<tr><td>90th Percentile</td><td>97%</td></tr>
<tr><td>Average</td><td>53%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>98th Percentile</td><td>2%</td></tr>
<tr><td>90th Percentile</td><td>1%</td></tr>
<tr><td>Average</td><td>1%</td></tr>
<tr><td colspan="2">Maximum combined concentrations exceed the 1-hour CAAQ Guideline. Note that the maximum background concentrations alone exceed the CAAQ's 1-hr objective of 79 µg/m3. Also note that this objective is based on the 3-year average of the annual 98th percentile of the NO2 daily-maximum 1-hour average concentrations.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="8">
</td><td colspan="2">% of CAAQ Guideline:</td></tr>
<tr><td>Maximum</td><td>92%</td></tr>
<tr><td>Average</td><td>87%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td>1%</td></tr>
<tr><td>Average</td><td>1%</td></tr>
<tr><td colspan="2">Maximum combined concentrations are below the annual CAAQ Guideline.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Nitrogen Dioxide

Table 14 presents the predicted combined concentrations for the worst-case sensitive receptor for 1-hour and 24-hour NO_2 based on 5 years of meteorological data. The results conclude that:

- Both the maximum 1-hour and 24-hour NO_2 combined concentrations were below their respective MECP guidelines.

Table 14: Summary of Predicted NO_2 Concentrations

<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="8">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>36%</td></tr>
<tr><td>90th Percentile</td><td>9%</td></tr>
<tr><td>Average</td><td>4%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td>1%</td></tr>
<tr><td>Average</td><td>1%</td></tr>
<tr><td rowspan="8">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>44%</td></tr>
<tr><td>90th Percentile</td><td>19%</td></tr>
<tr><td>Average</td><td>9%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td>1%</td></tr>
<tr><td>90th Percentile</td><td>1%</td></tr>
<tr><td>Average</td><td>1%</td></tr>
</table>

Conclusions:

- All combined concentrations were below their respective MECP guidelines.
- The contribution from the roadway to the combined concentrations was less 1% or less.

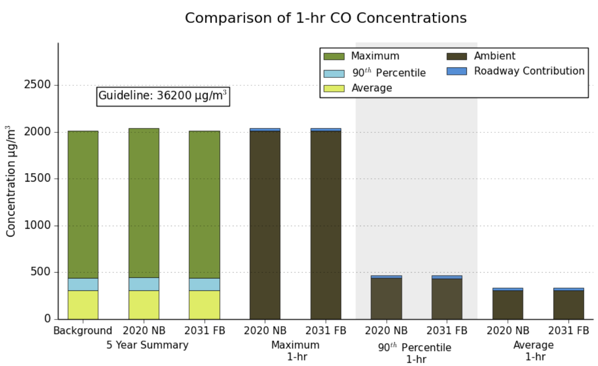
Carbon Monoxide

Table 15 presents the predicted combined concentrations for the worst-case sensitive receptor for 1-hour and 8-hour CO based on 5 years of meteorological data. The results conclude that:

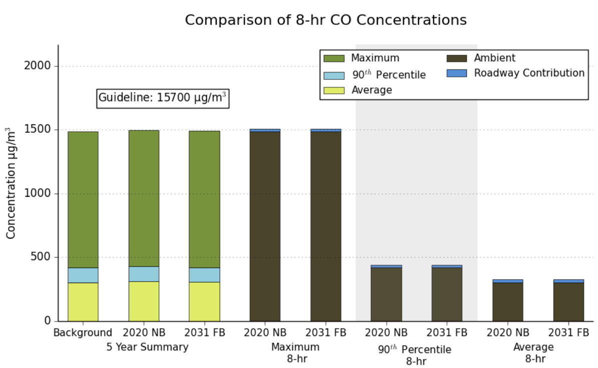
- Both the maximum 1-hour and 8-hour CO combined concentrations were well below their respective MECP guidelines.

Table 15: Summary of Predicted CO Concentrations

Statistical Analysis | **2031 FB**



% of MECP Guideline:	
Maximum	6%
90^{th} Percentile	1%
Average	1%
Roadway Contribution:	
Maximum	<1%
90^{th} Percentile	<1%
Average	<1%



% of MECP Guideline:	
Maximum	9%
90th Percentile	3%
Average	2%
Roadway Contribution:	
Maximum	1%
90th Percentile	1%
Average	1%

Conclusions:

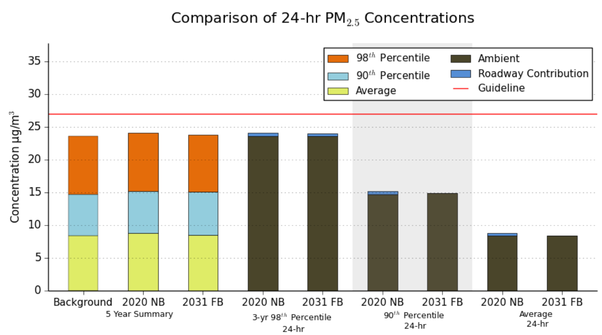
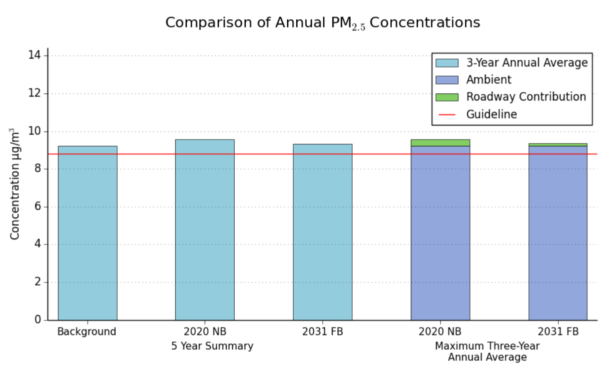
- All combined concentrations were below their respective MECP guidelines.
- The contribution from the roadway to the combined concentrations was less 1% or less.

Fine Particulate Matter ($PM_{2.5}$)

Table 16 presents the predicted combined concentrations for the worst-case sensitive receptor for 24-hour and annual $PM_{2.5}$ based on 5 years of meteorological data. The results conclude that:

- The average annual 98th percentile 24-hour $PM_{2.5}$ combined concentrations, averaged over three consecutive years was below the CAAQS.
- The three-year annual average concentration exceeded the guideline with a 2% contribution from the roadway.

Table 16: Summary of Predicted $PM_{2.5}$ Concentrations

<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of CAAQS Guideline:</td></tr>
<tr><td>98th Percentile</td><td>88%</td></tr>
<tr><td>90th Percentile</td><td>56%</td></tr>
<tr><td>Average</td><td>32%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>98th Percentile</td><td>2%</td></tr>
<tr><td>90th Percentile</td><td>2%</td></tr>
<tr><td>Average</td><td>3%</td></tr>
<tr><td colspan="2">The PM2.5 results were below the 3-year CAAQS. The highest 3 year rolling average of the yearly 98th percentile combined concentrations was calculated to be 23.75 µg/m3 or 88% of the CAAQS.</td></tr>
<tr><td rowspan="5">
</td><td colspan="2">% of CAAQS Guideline:</td></tr>
<tr><td>Maximum 3-Year Annual Average</td><td>111%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum 3-Year Annual Average</td><td>1%</td></tr>
<tr><td colspan="2">The PM2.5 results were above the 3-year CAAQS. The maximum 3-year annual average concentration was 111% of the guideline. It should be noted that ambient concentrations alone were 110% of the guideline.</td></tr>
</table>

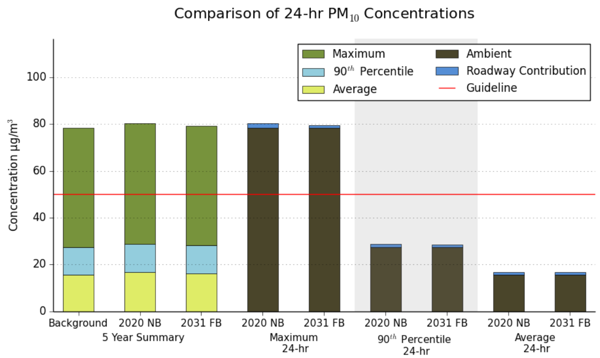
Coarse Particulate Matter (**PM_{10}**)

Table 17 presents the predicted combined concentration for the worst-case sensitive receptor for 24-hour PM_{10} based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hr PM_{10} combined concentration exceeded the MECP guideline.

Table 17: Summary of Predicted **PM_{10}** Concentrations

Statistical Analysis



2031 FB	
% of MECP Guideline:	
Maximum	159%
90th Percentile	56%
Average	32%
Roadway Contribution:	
Maximum	1%
90th Percentile	2%
Average	4%

Conclusions:

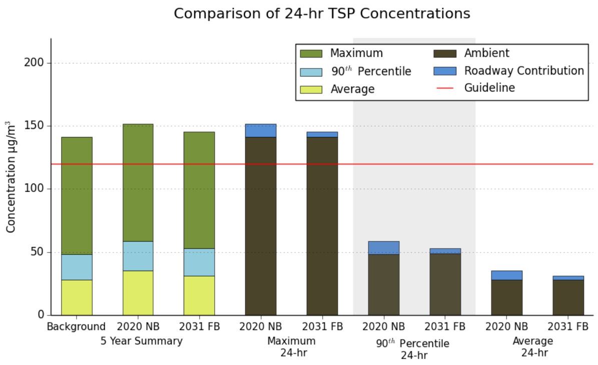
- The combined concentrations of PM_{10} surrounding the study area exceed the standard of 50 µg/m3. It should be noted, however, that background concentrations alone exceeded the standard and that the roadway contribution is 1% of the maximum value.
- Frequency analysis was conducted to determine the frequency of exceedances over the 5-year period.
- A total of 14 days exceeded the guideline in the five-year period, which equates to less than 1% of the time.
- Frequency analysis showed that three less exceedances are expected due to the project over the five-year period, when comparing the 2020 Existing scenario and the 2031 Future Build scenario.

Total Suspended Particulate Matter (TSP)

Table 18 presents the predicted combined concentration for the worst-case sensitive receptor for 24-hour TSP based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hr TSP combined concentration exceeded the MECP guideline.

Table 18: Summary of Predicted TSP Concentrations

<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>121%</td></tr>
<tr><td>90th Percentile</td><td>44%</td></tr>
<tr><td>Average</td><td>26%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td>3%</td></tr>
<tr><td>90th Percentile</td><td>8%</td></tr>
<tr><td>Average</td><td>10%</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Conclusions:

- The TSP results show that the combined concentrations exceed the guideline. It should be noted, however, that background concentrations alone exceeded the standard and that the roadway contribution is 3% of the maximum value.
- Frequency analysis was conducted to determine the frequency of exceedances over the 5-year period.
- 3 days exceeded the guideline in the five-year period in, which equates to less than 1%.
- Frequency analysis showed that no additional exceedances are expected due to the roadway over the five-year period, when comparing the 2020 Existing scenario and the 2031 Future Build scenario.

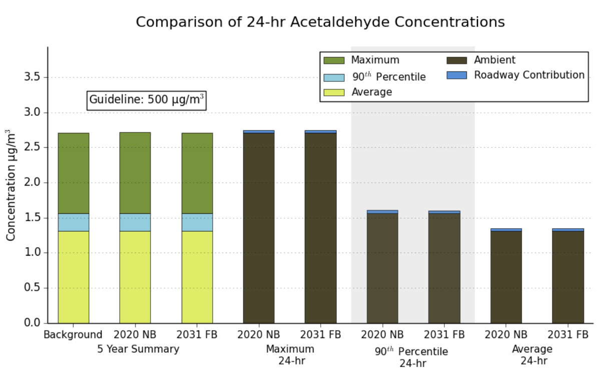
Ambient VOC concentrations are typically measured every 6 days in Ontario. In order to combine the ambient data to the modelled results, the measured concentrations were applied to the following 6 days when measurements were 6 days apart. When measurements were further than 6 days apart, the 90th percentile annual value was used to represent the missing data. This background data was added to the predicted hourly roadway concentrations at each receptor to obtain results for the VOCs.

Acetaldehyde

Table 19 presents the predicted combined concentration for the worst-case sensitive receptor for 24-hour acetaldehyde based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hour acetaldehyde combined concentration was well below the respective MECP guideline.

Table 19: Summary of Predicted Acetaldehyde Concentrations

<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2"></td></tr>
</table>

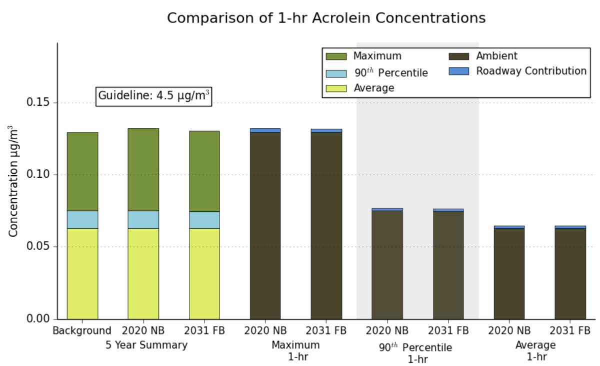
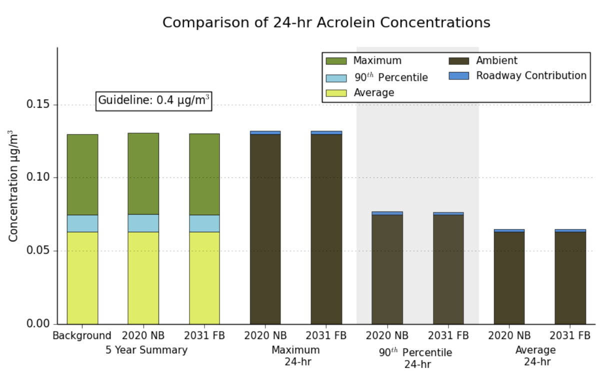
Conclusions:
- All combined concentrations were below their respective MECP guidelines.
- The contribution from the roadway to the combined concentrations was less than 1%.

Acrolein

Table 20 presents the predicted combined concentrations for the worst-case sensitive receptor for 1-hour and 24-hour acrolein based on 5 years of meteorological data. The results conclude that:

- The maximum 1-hour and 24-hour acrolein combined concentrations were below the respective MECP guidelines.

Table 20: Summary of Predicted Acrolein Concentrations

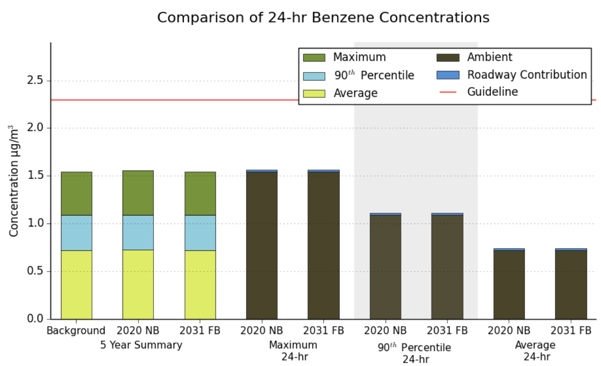
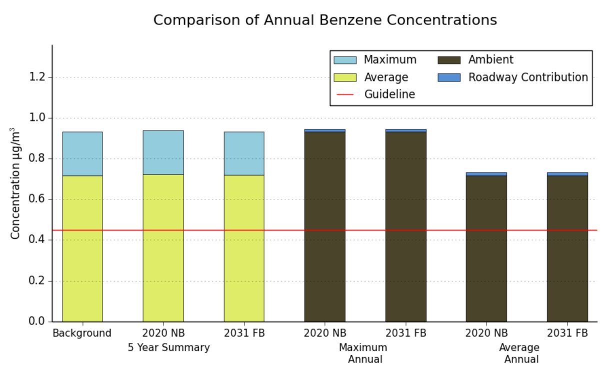
<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>3%</td></tr>
<tr><td>90th Percentile</td><td>2%</td></tr>
<tr><td>Average</td><td>1%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2">Conclusions:
The combined concentrations were below the respective MECP guideline. The contribution from the roadway was less than 1%.</td></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>33%</td></tr>
<tr><td>90th Percentile</td><td>19%</td></tr>
<tr><td>Average</td><td>16%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2">Conclusions:
The combined concentrations were below the respective MECP guideline. The contribution from the roadway was less than 1%.</td></tr>
</table>

Benzene

Table 21 presents the predicted combined concentrations for the worst-case sensitive receptor for 24-hour and annual benzene based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hour benzene combined concentration was below the respective MECP guideline.
- The annual benzene concentration exceeded the guideline due to ambient concentrations. The roadway contribution to the maximum annual average was less than 1%.

Table 21: Summary of Predicted Benzene Concentrations

<table>
<tr><th>Statistical Analysis</th><th colspan="2">2031 FB</th></tr>
<tr><td rowspan="9">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>67%</td></tr>
<tr><td>90th Percentile</td><td>47%</td></tr>
<tr><td>Average</td><td>31%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>90th Percentile</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2">.</td></tr>
<tr><td rowspan="7">
</td><td colspan="2">% of MECP Guideline:</td></tr>
<tr><td>Maximum</td><td>208%</td></tr>
<tr><td>Average</td><td>160%</td></tr>
<tr><td colspan="2">Roadway Contribution:</td></tr>
<tr><td>Maximum</td><td><1%</td></tr>
<tr><td>Average</td><td><1%</td></tr>
<tr><td colspan="2">Conclusions:
The combined concentration exceeded the MECP guideline. It should be noted that ambient concentrations were 208% of the guideline and the roadway contribution to the maximum was 1%.</td></tr>
</table>

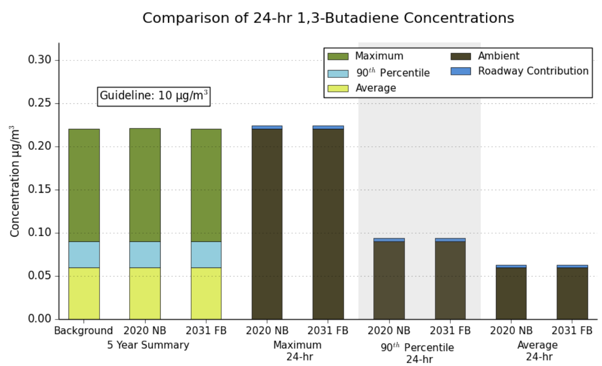
1,3-Butadiene

Table 22 presents the predicted combined concentrations for the worst-case sensitive receptor for 24-hour and annual 1,3-butadiene based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hour and annual 1,3-Butadiene combined concentrations were well below the respective MECP guidelines.

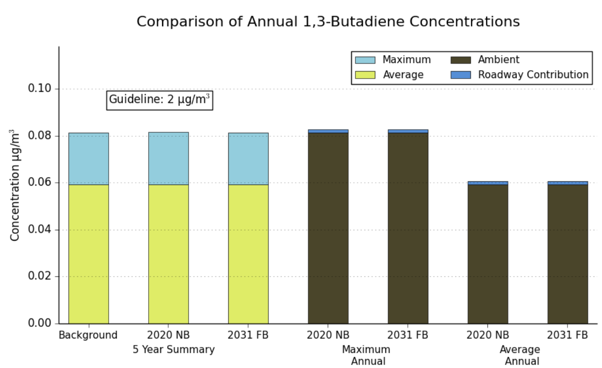
Table 22: Summary of Predicted 1,3-Butadiene Concentrations

Statistical Analysis | **2031 FB**



% of MECP Guideline:	
Maximum	2%
90th Percentile	1%
Average	<1%
Roadway Contribution:	
Maximum	<1%
90th Percentile	<1%
Average	<1%

Conclusions:
The combined concentrations were below the respective MECP guideline. The contribution from the roadway was less than 1%.



% of MECP Guideline:	
Maximum	4%
Average	3%
Roadway Contribution:	
Maximum	<1%
Average	<1%

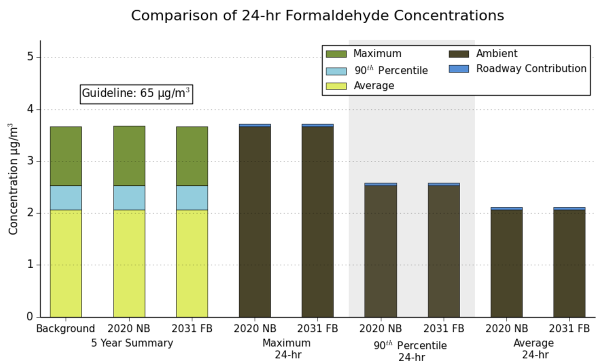
Conclusions:
The combined concentrations were below the respective MECP guideline. The contribution from the roadway was less than 1%.

Formaldehyde

Table 23 presents the predicted combined concentration for the worst-case sensitive receptor for 24-hour formaldehyde based on 5 years of meteorological data. The results conclude that:

- The maximum 24-hour formaldehyde combined concentration was below the respective MECP guideline.

Table 23: Summary of Predicted Formaldehyde Concentrations



Statistical Analysis	2031 FB	
	% of MECP Guideline:	
	Maximum	6%
	90th Percentile	5%
	Average	3%
	Roadway Contribution:	
	Maximum	<1%
	90th Percentile	<1%
	Average	<1%

Conclusions:

- All combined concentrations were below their respective MECP guideline.
- The contribution from the roadway to the combined concentration was less than 1%.

4.0 Greenhouse Gas Assessment

In addition to the contaminants of interest assessed in the local air quality assessment, greenhouse gas (GHG) emissions were predicted by calculating the relative change in total emissions between the 2020 Existing and 2031 Future Build scenarios. Total GHG emissions from the roadway were determined based on the length of the roadway, traffic volumes, and predicted emission rates.

From a GHG perspective, the contaminants of concern from motor vehicle emissions are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These GHGs can be further classified according to their Global Warming Potential. The Global Warming Potential is a multiplier developed for each GHG, which allows comparison of the ability of each GHG to trap heat in the atmosphere, relative to carbon dioxide. Using these multipliers, total GHG emissions can be classified as CO_2 equivalent emissions. For this assessment, the MOVES model was used to determine total CO_2 equivalent emission rates for the posted speed and heavy-duty vehicle percentage in the study area.

The total predicted annual GHG emissions for Steeles Avenue for the 2020 Existing and 2031 Future Build scenarios are shown in **Table 24**. Also shown is the percent change in total GHG emissions between the scenarios. The results show that due to the increases in traffic volumes, total GHG emissions on Steeles Avenue will increase by 37%.

Table 24: Changes in predicted GHG Emissions

Roadway	2020 Total CO_2 Equivalent (tonnes/year)	2031 Total CO_2 Equivalent (tonnes/year)	Change in Emissions (%)
Steeles Ave	1,309	1,797	37%

5.0 Air Quality Impacts During Construction

During construction of the roadway, dust is the primary contaminant of concern. Other contaminants including NO_x and VOC's may be emitted from equipment used during construction activities. Due to the temporary nature of construction activities, there are no air quality criteria specific to construction activities. However, the Environment Canada "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities" document provides several mitigation measures for reducing emissions during construction activities. Mitigation techniques discussed in the document include material wetting or use of chemical suppressants to reduce dust, use of wind barriers, and limiting exposed areas which may be a source of dust and equipment washing. It is recommended that these best management practices be followed during construction of the roadway to reduce any air quality impacts that may occur.

6.0 CONCLUSIONS

The potential impact of the proposed project infrastructure on local air quality has been assessed and the results are summarized in **Table 25**. An assessment of GHG emissions was also conducted. The following conclusions and recommendations are a result of this assessment.

- The maximum combined concentrations for the future build scenario were all below their respective MECP guidelines or CAAQS, with the exception of the 1-hr NO_2 CAAQ, annual $PM_{2.5}$, 24-hr PM_{10}, 24-hr TSP and annual benzene. Note that for each of these contaminants, background concentrations alone exceeded the guidelines.

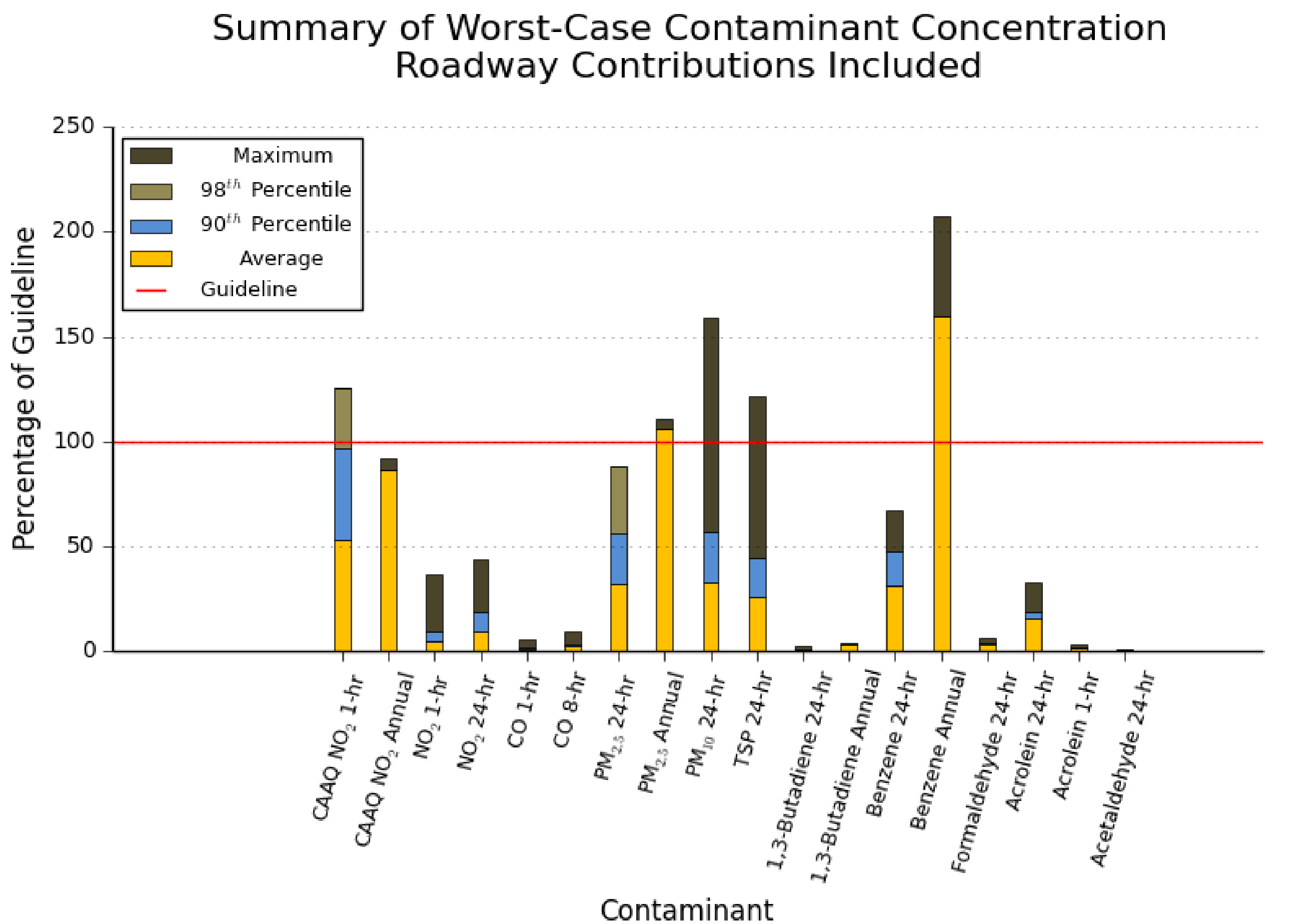
- Frequency Analysis determined that there were no additional days on which exceedances of PM_{10} or TSP occurred in 2031 Future Build scenarios in comparison to the 2020 Existing scenario. For both PM_{10} and TSP, exceedances of the guideline occurred less than 1% of the time.

- Mitigation measures are not warranted, due to the small number of days which are expected to exceed the guideline.

- Total GHG emissions from Steeles Avenue are expected to increase by 37% from the 2020 Existing scenario to the 2031 Future Build Scenario.

Table 25: Summary of 2031 Future Build Results

5 Year Statistical Summary



Note: The $PM_{2.5}$ results are in compliance with the CAAQS. The highest 3 year rolling average of the yearly 98th percentile combined concentrations was calculated to be 23.75 µg/m³ or 88% of the CAAQS.

% of Guideline	
2031 Future Build	
NO_2 CAAQS (1-hr)	125%
NO_2 CAAQS (annual)	92%
NO_2 (1-hr)	36%
NO_2 (24-hr)	44%
CO (1-hr)	6%
CO (8-hr)	9%
$PM_{2.5}$ (24-hr See Note)	88%
$PM_{2.5}$ (Annual)	111%
PM_{10}	159%
TSP	121%
Acetaldehyde	<1%
Acrolein (1-hr)	3%
Acrolein (24-hr)	33%
Benzene (24-hr)	67%
Benzene (Annual)	208%
1,3-Butadiene (24-hr)	2%
1,3-Butadiene (Annual)	4%
Formaldehyde	6%

7.0 References

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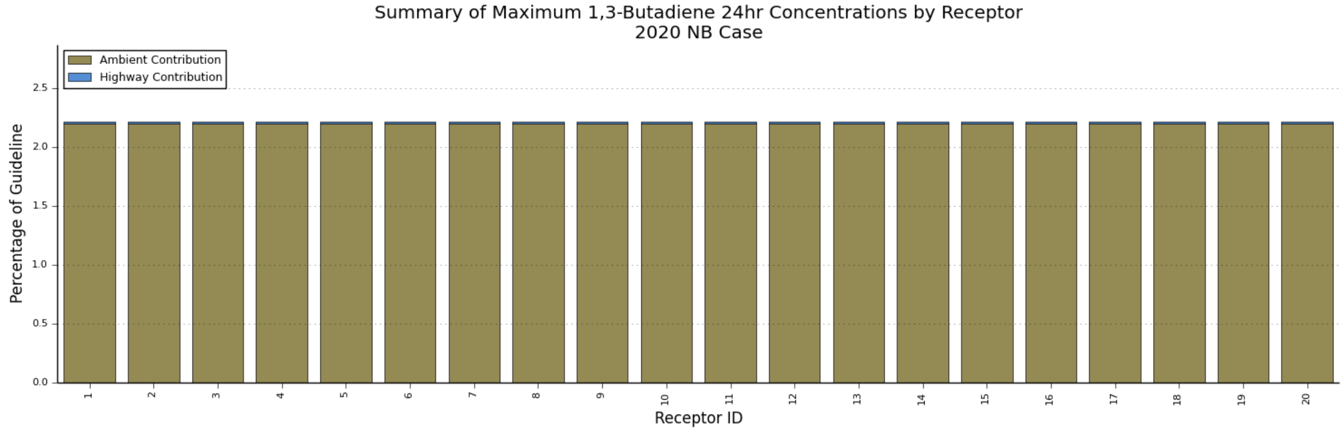
Appendix A


Summary of Maximum 1,3-Butadiene 24hr Concentrations by Receptor
2020 NB Case
Ambient Contribution
Highway Contribution
Percentage of Guideline
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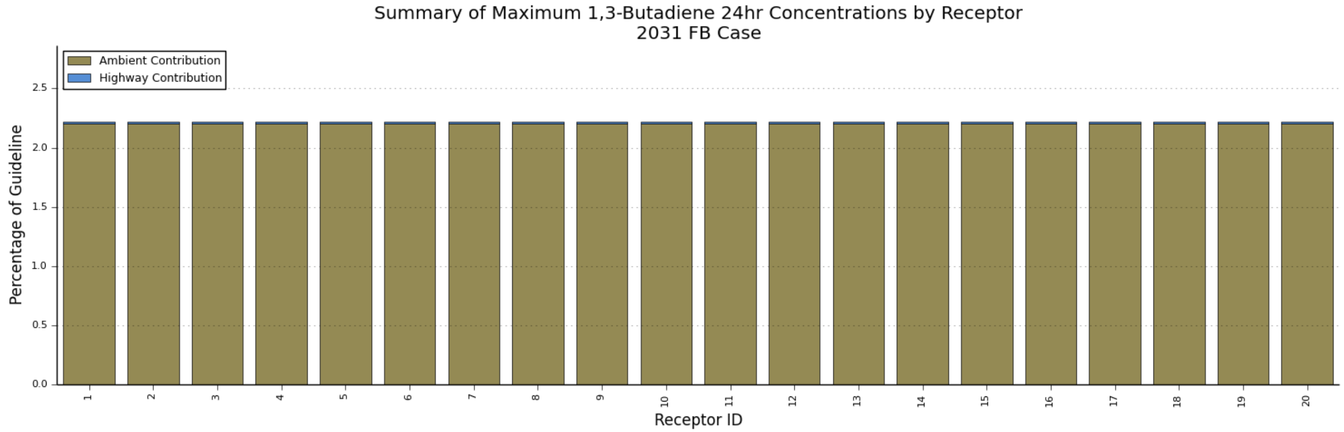
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2031 FB Case
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Highway Contribution
Percentage of Guideline
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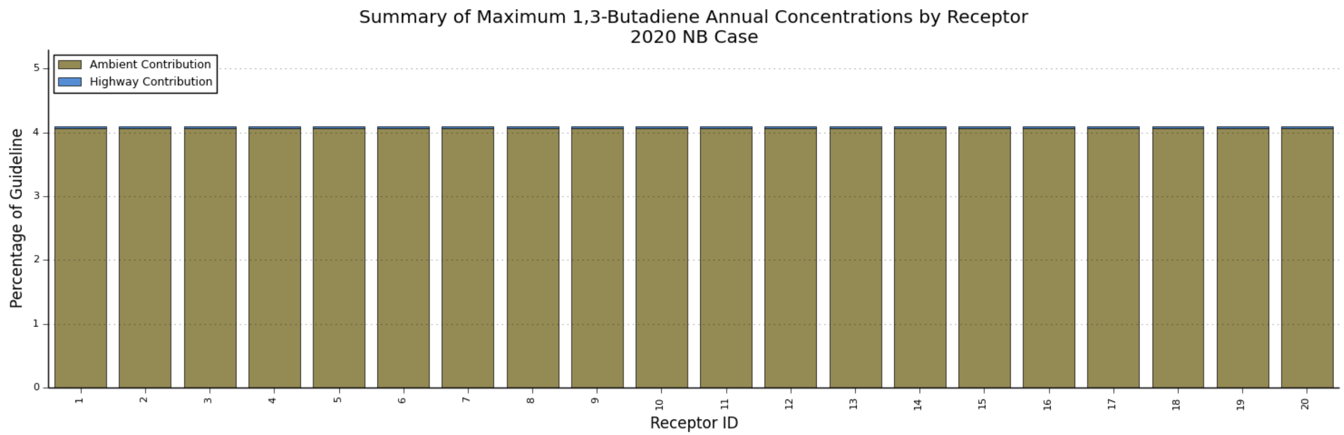
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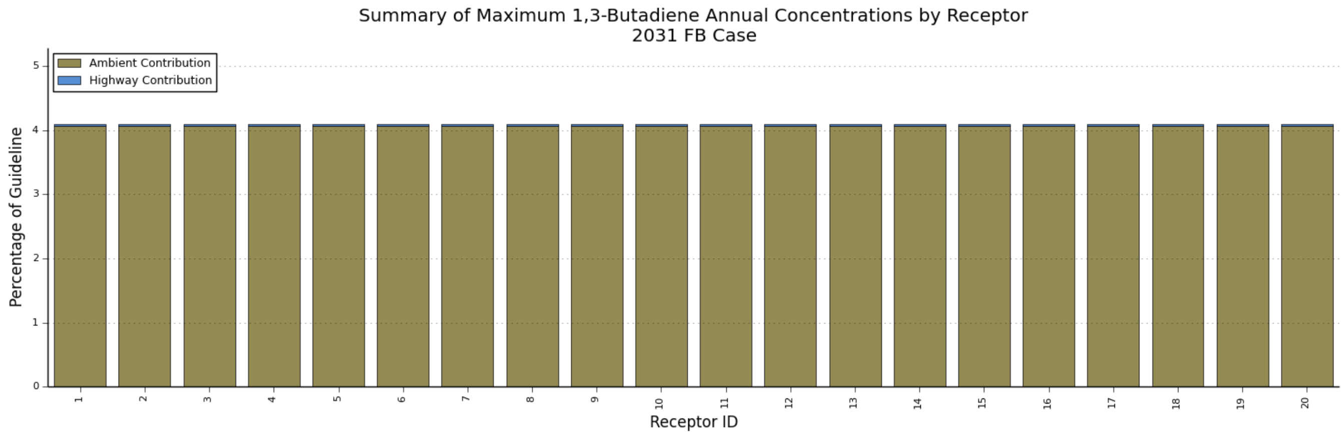
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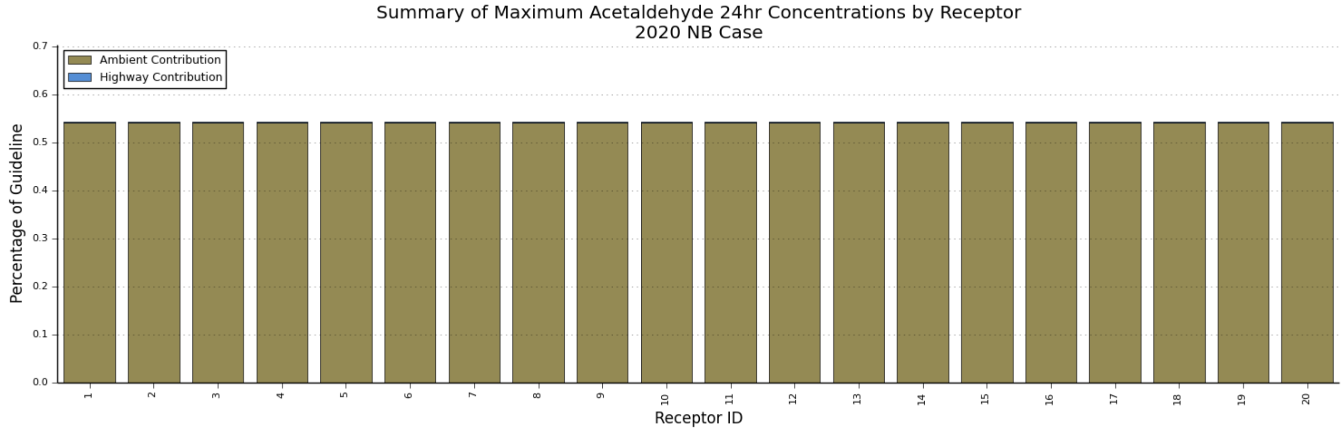
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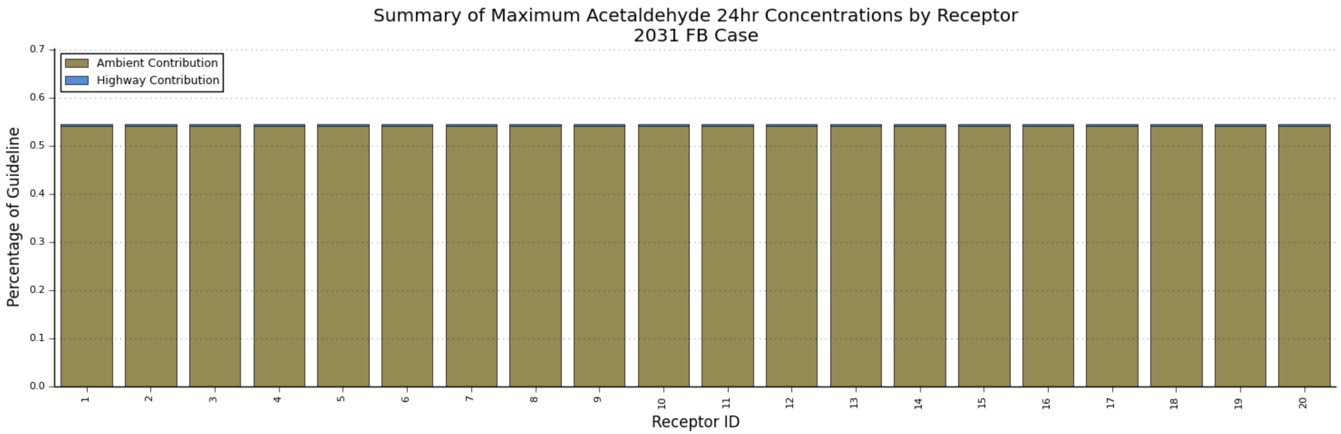
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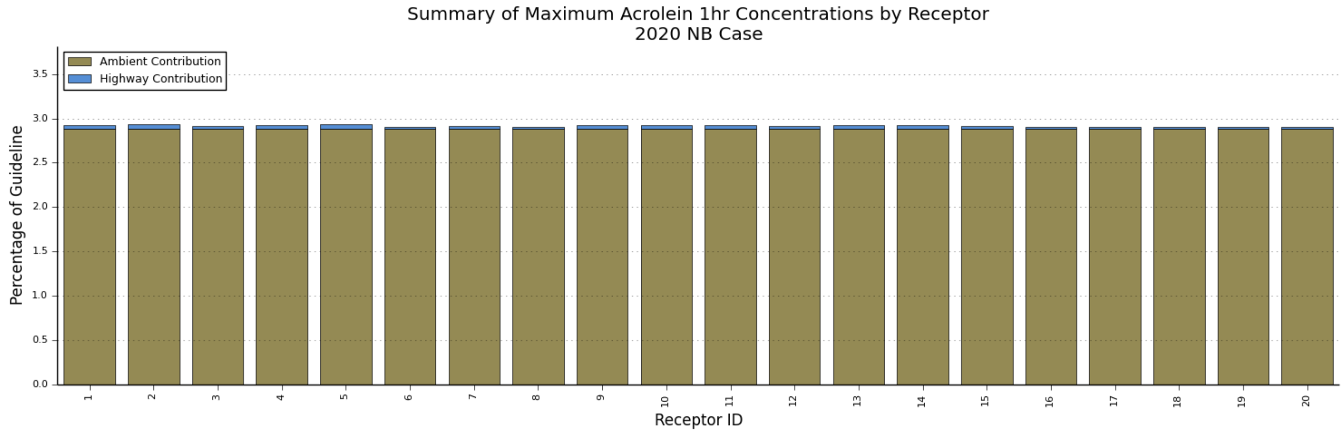
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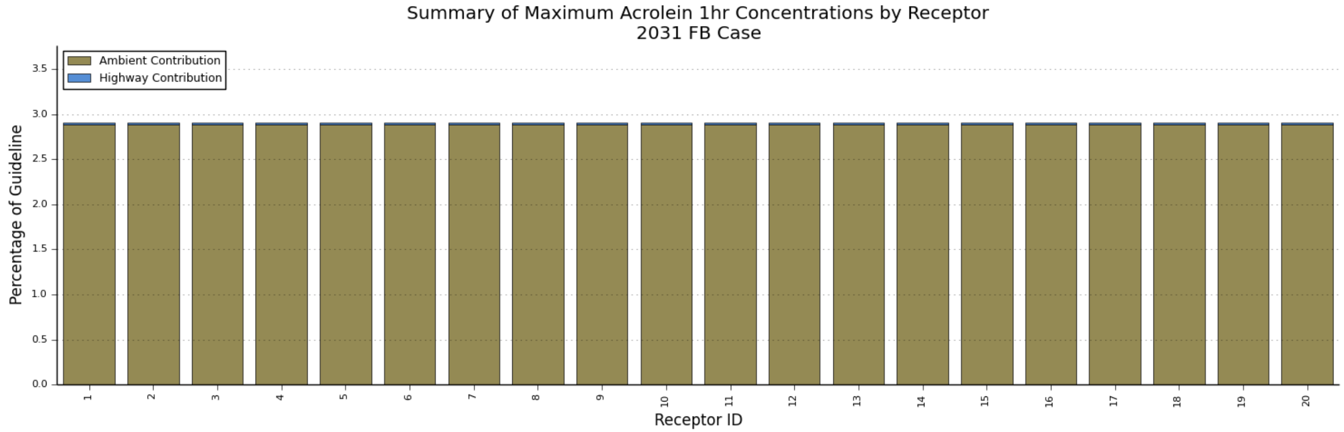
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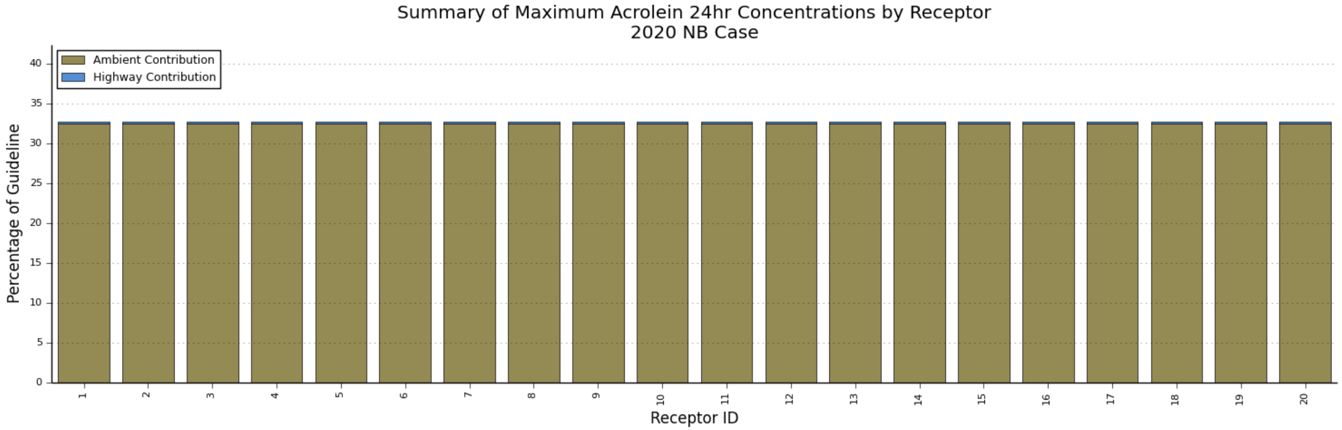
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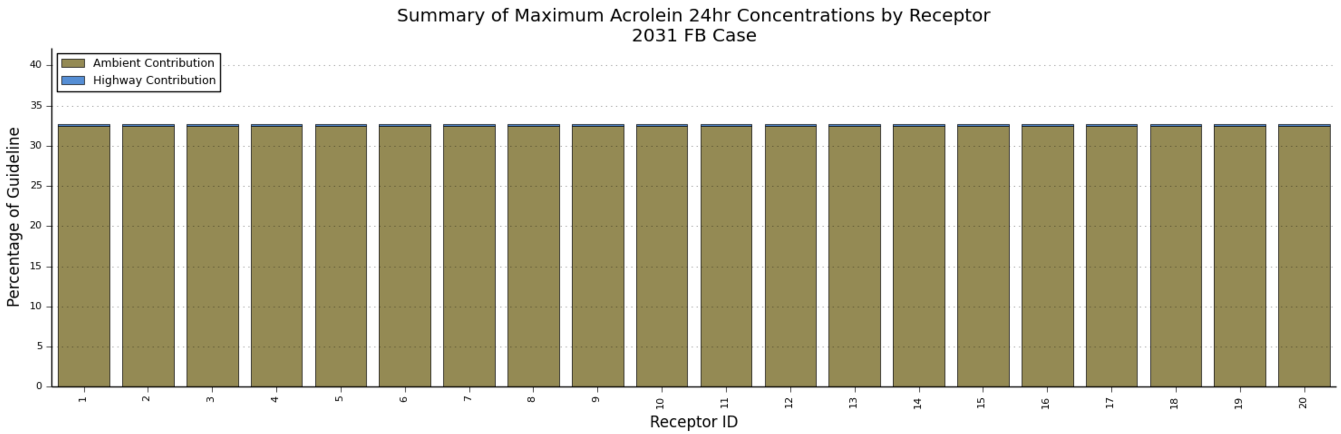
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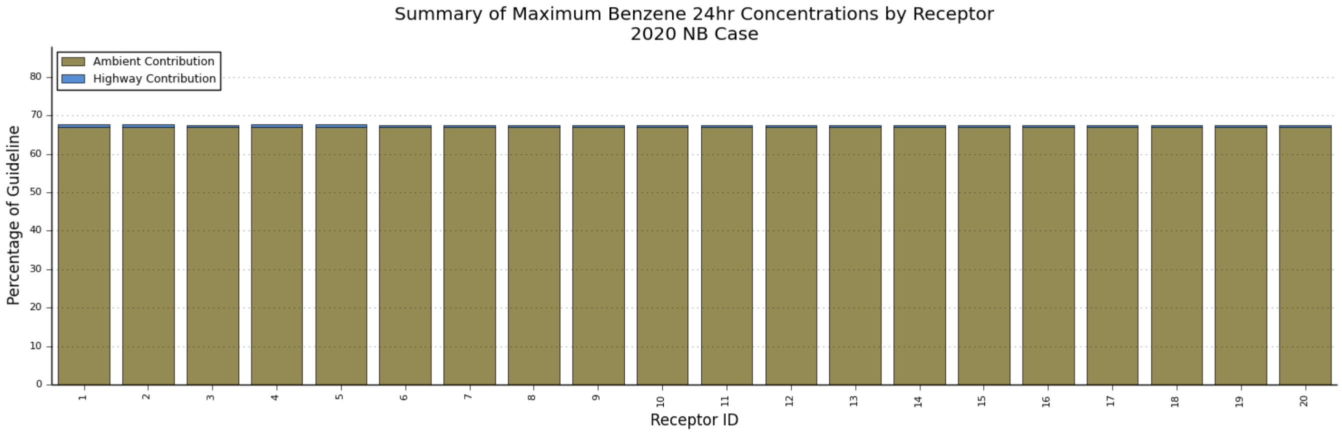
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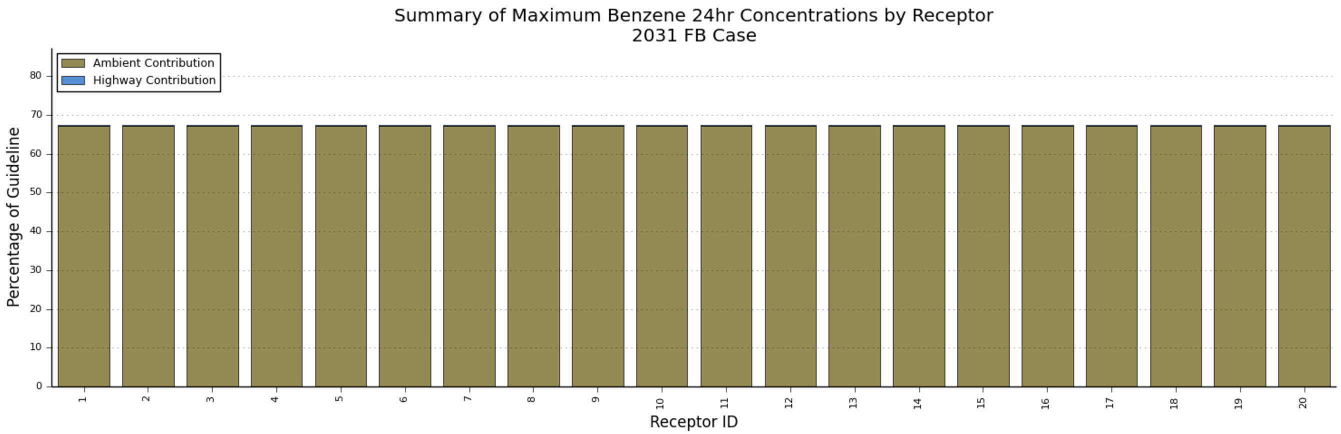
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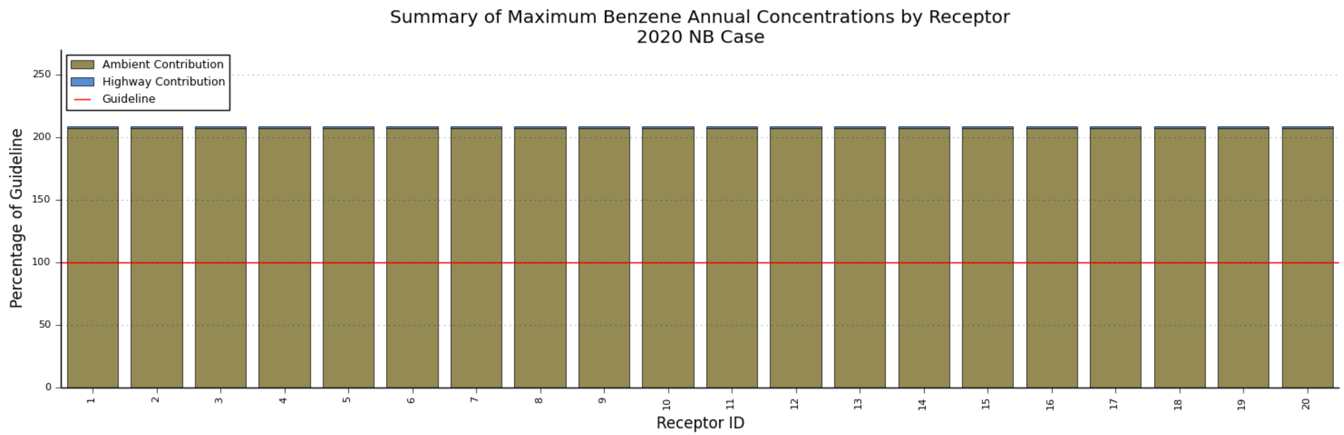
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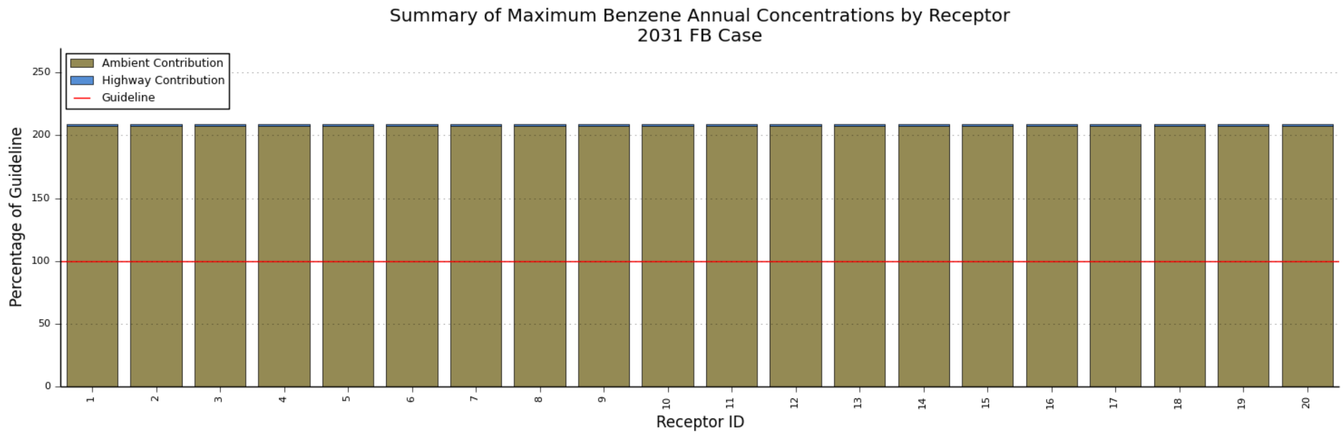
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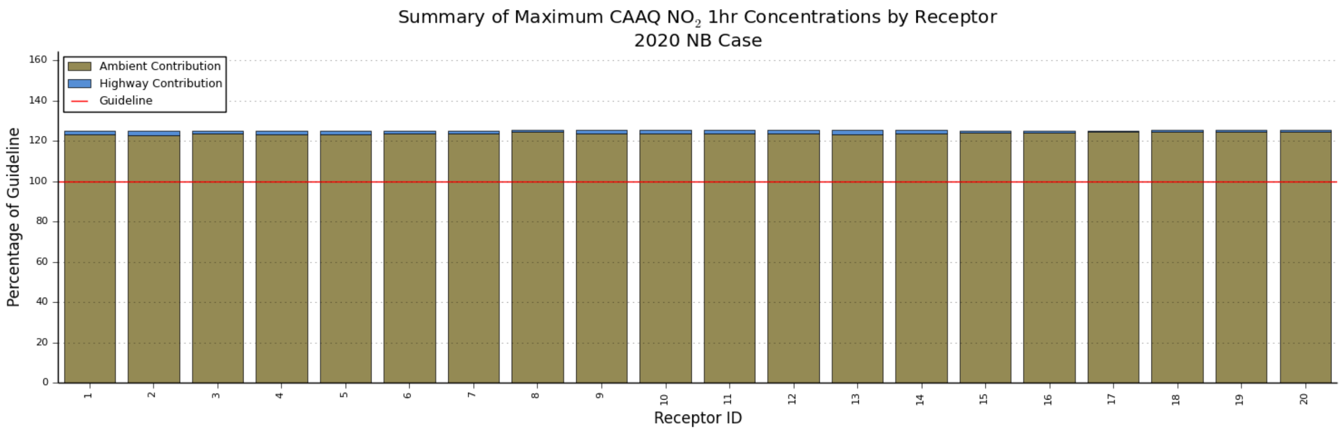
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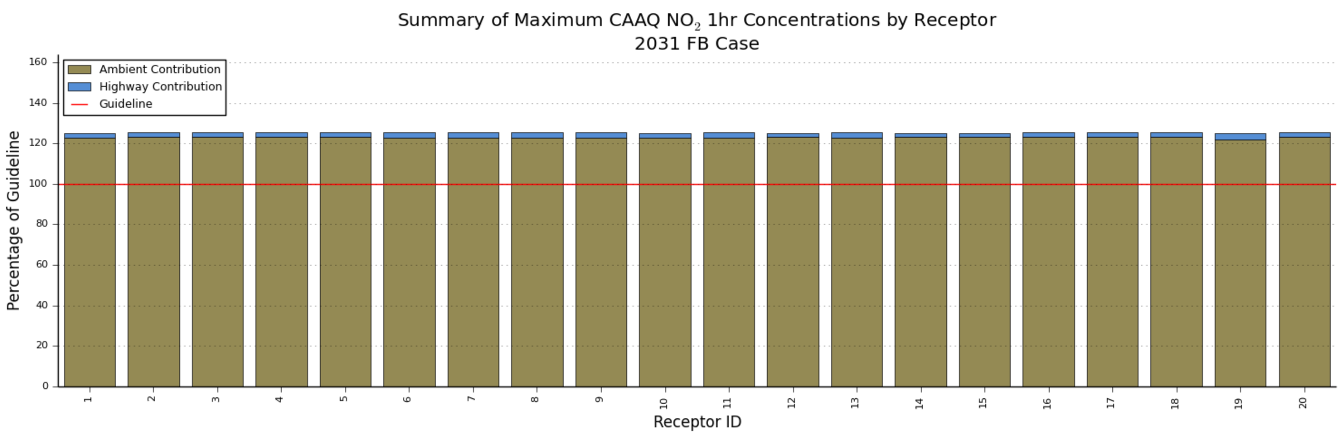
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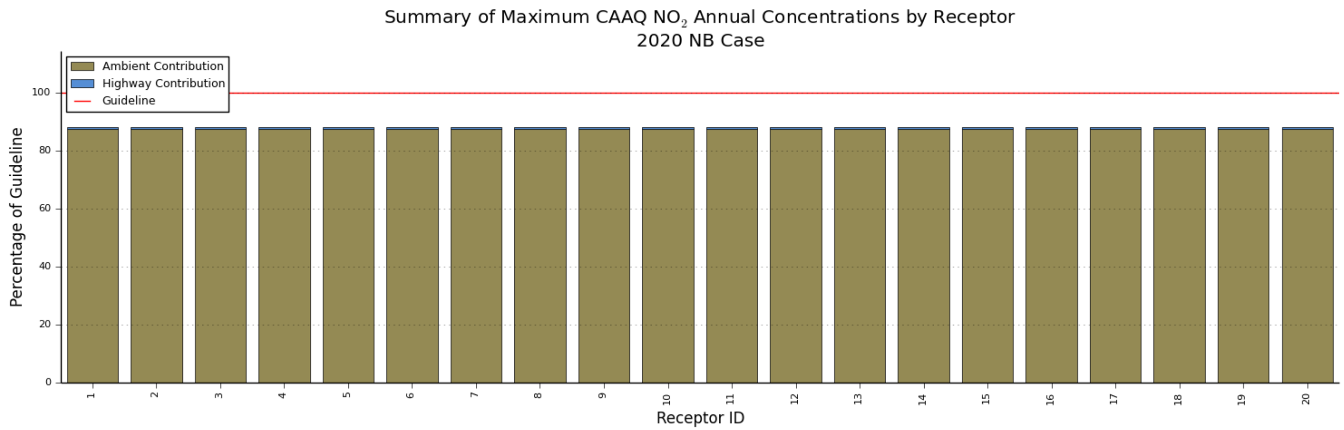
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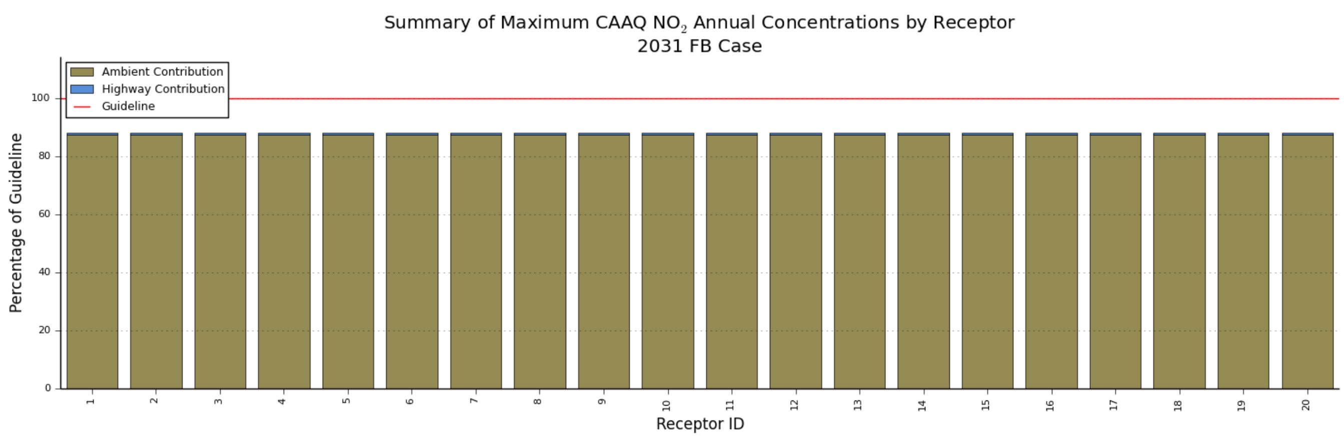
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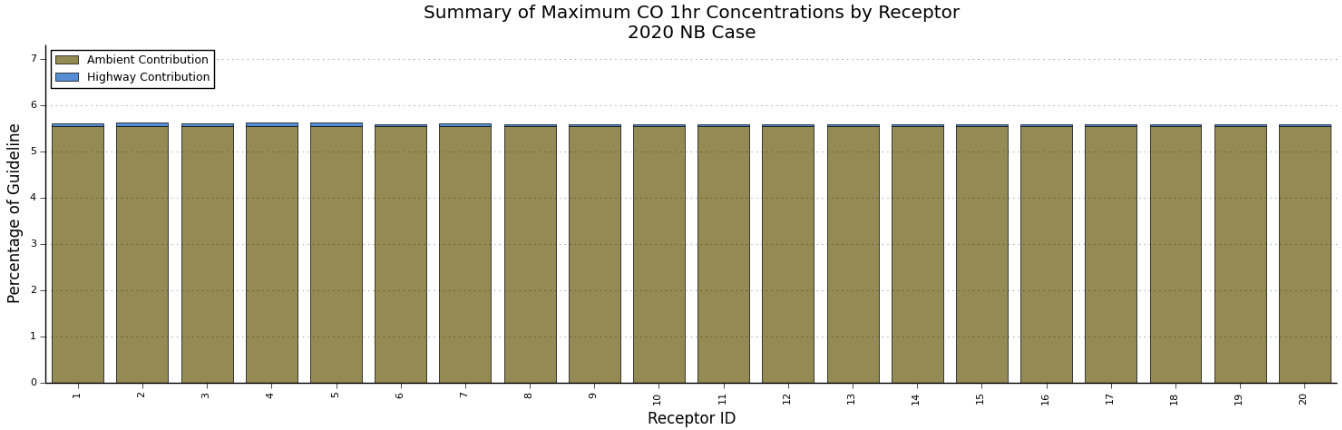
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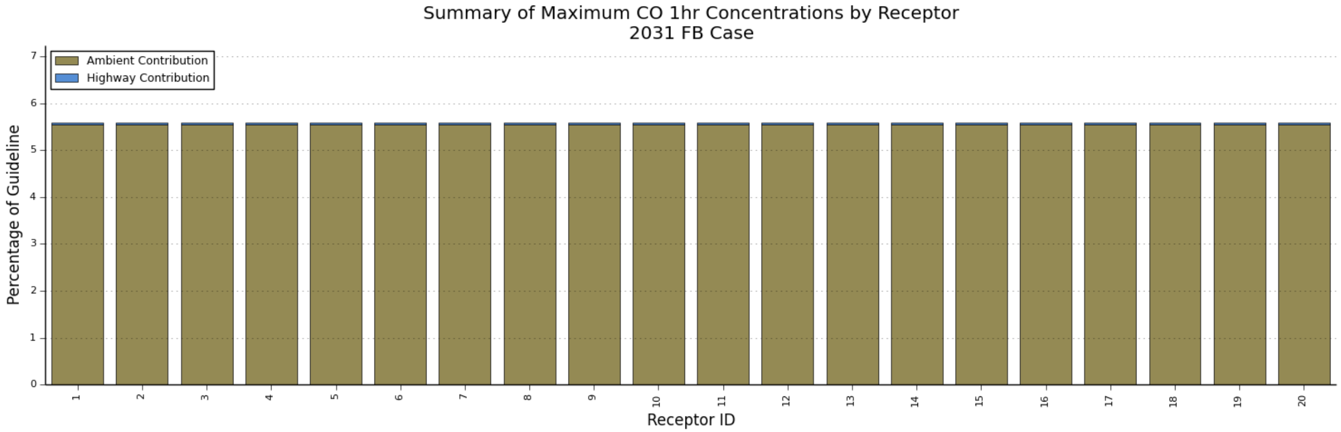
Percentage of Guideline
Receptor ID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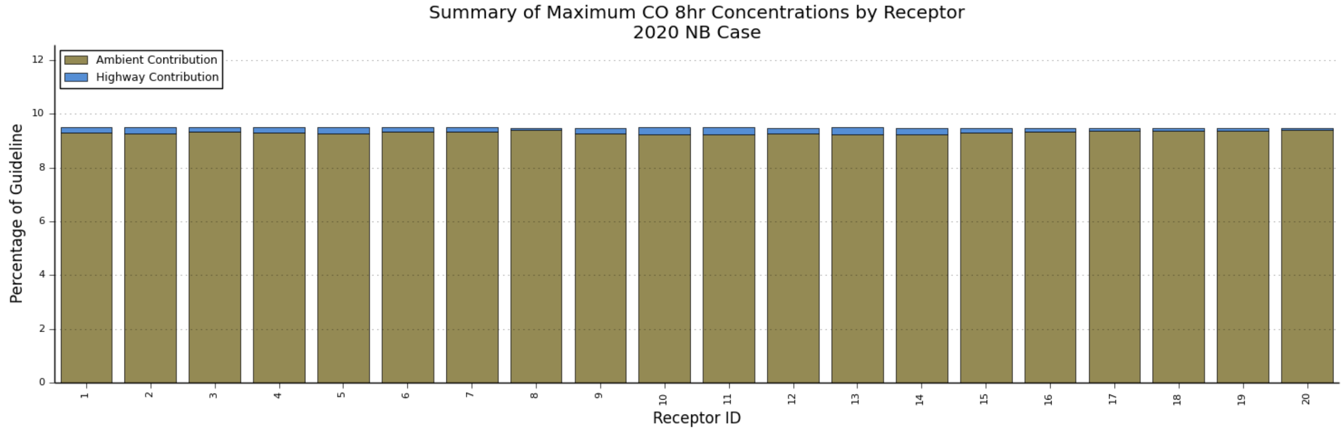
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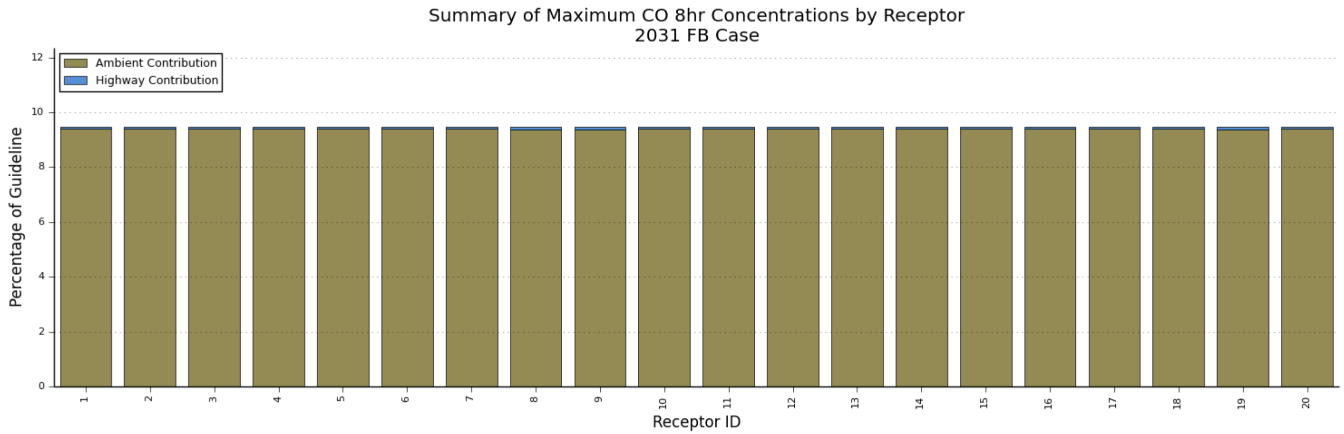
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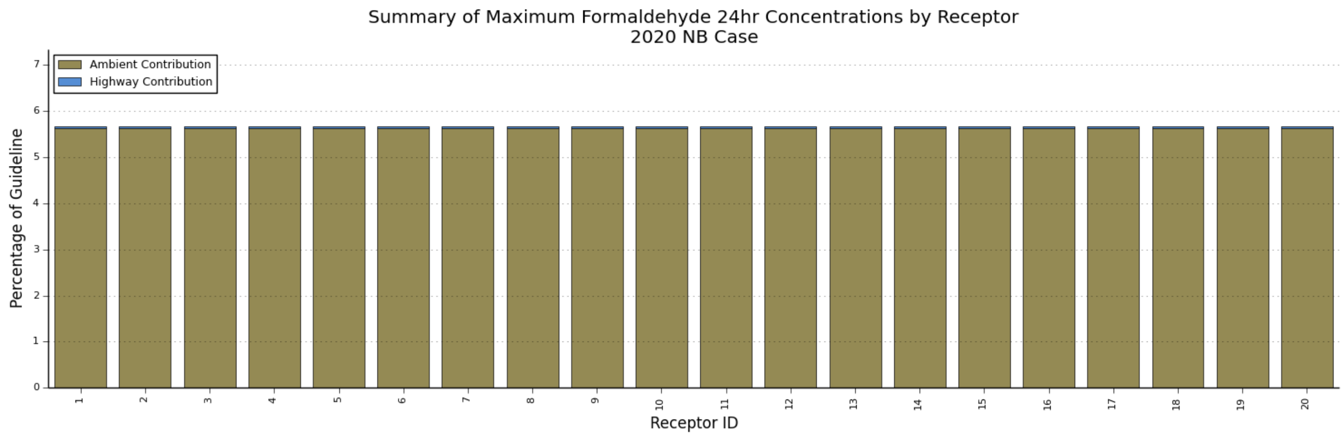
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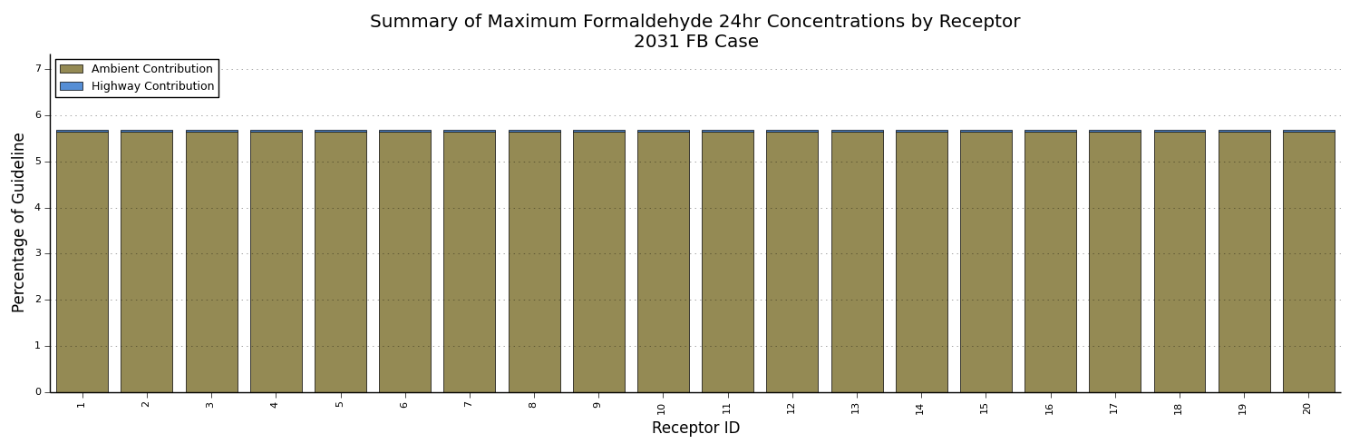
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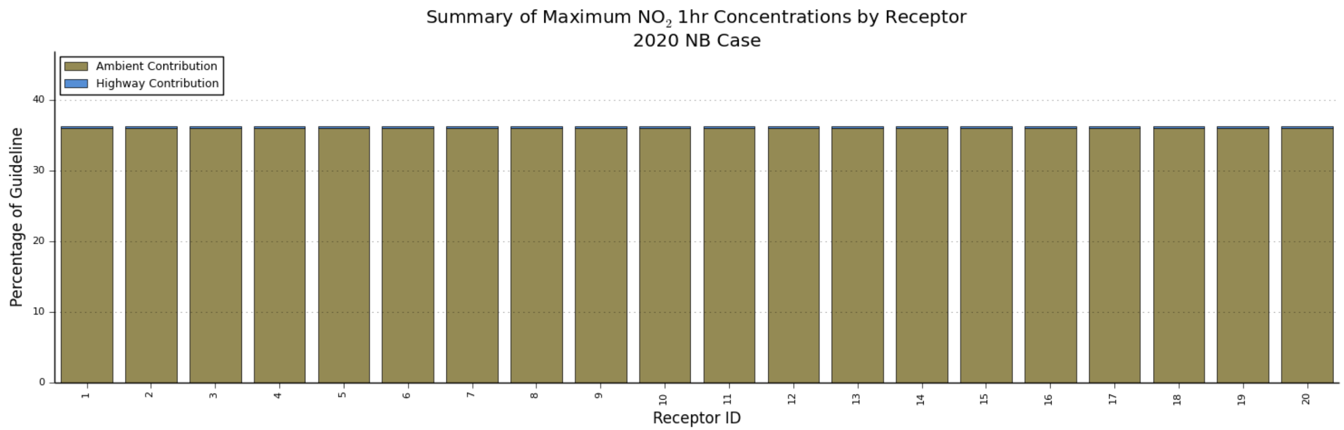
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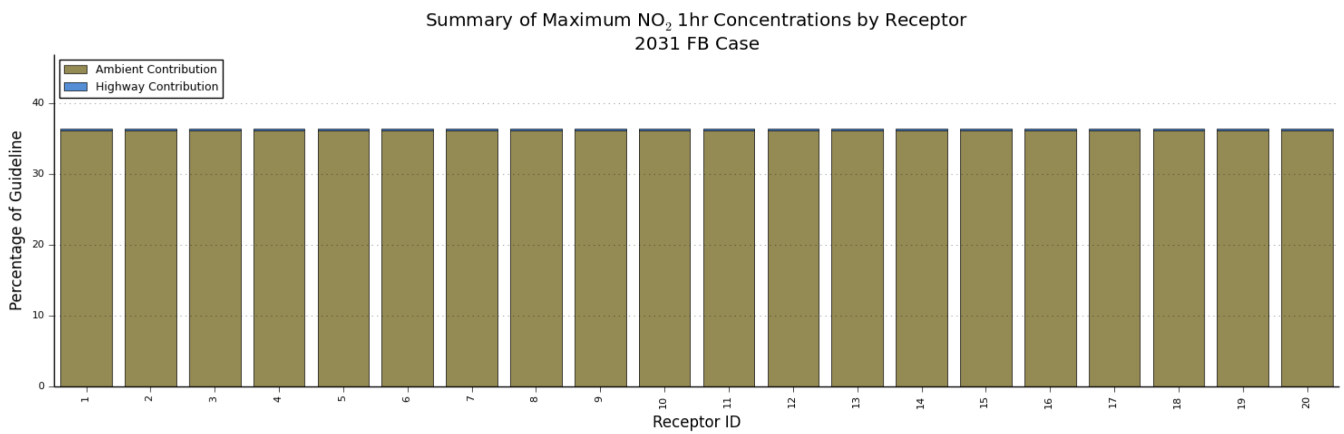
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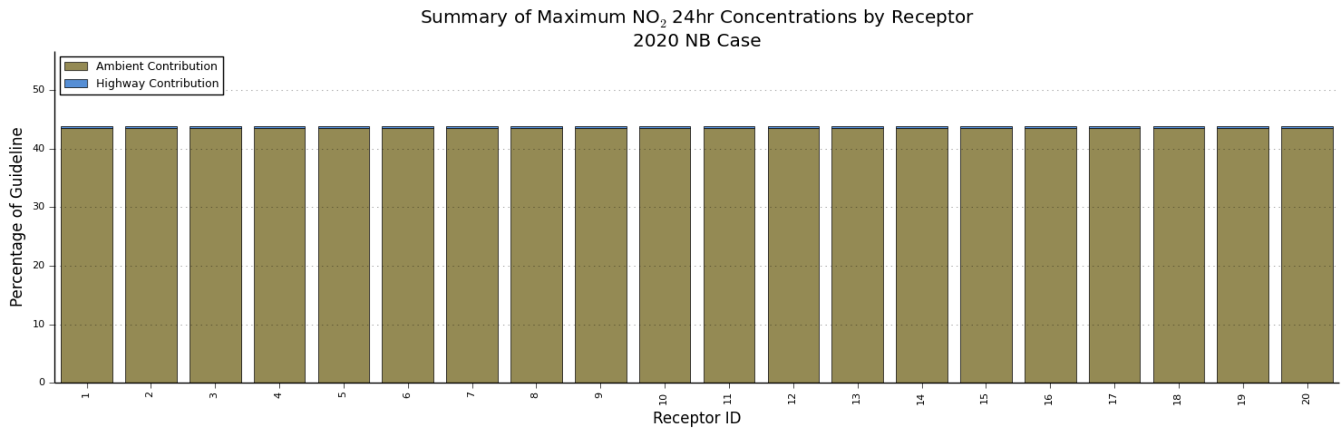
Summary of Maximum NO_2 24hr Concentrations by Receptor
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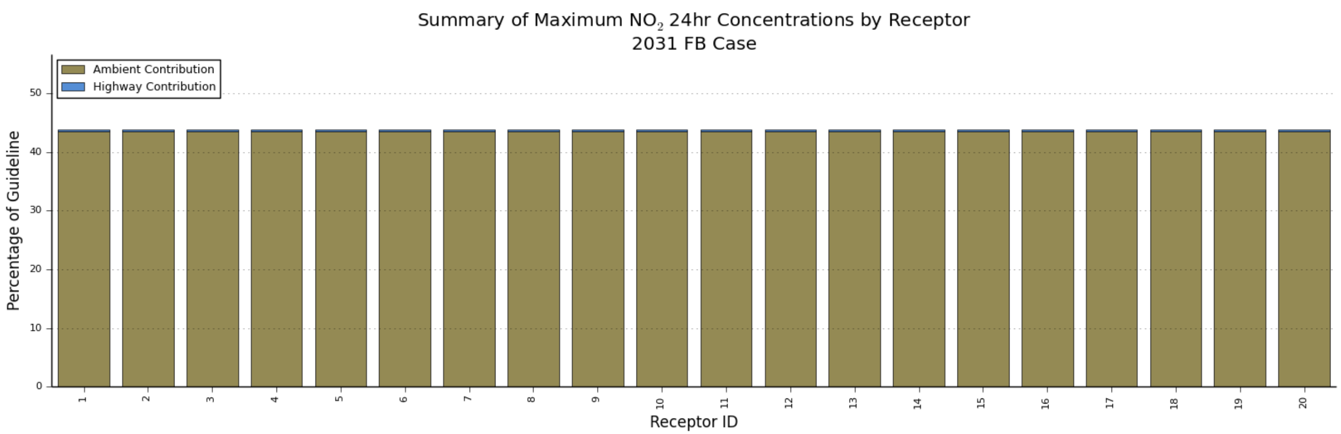
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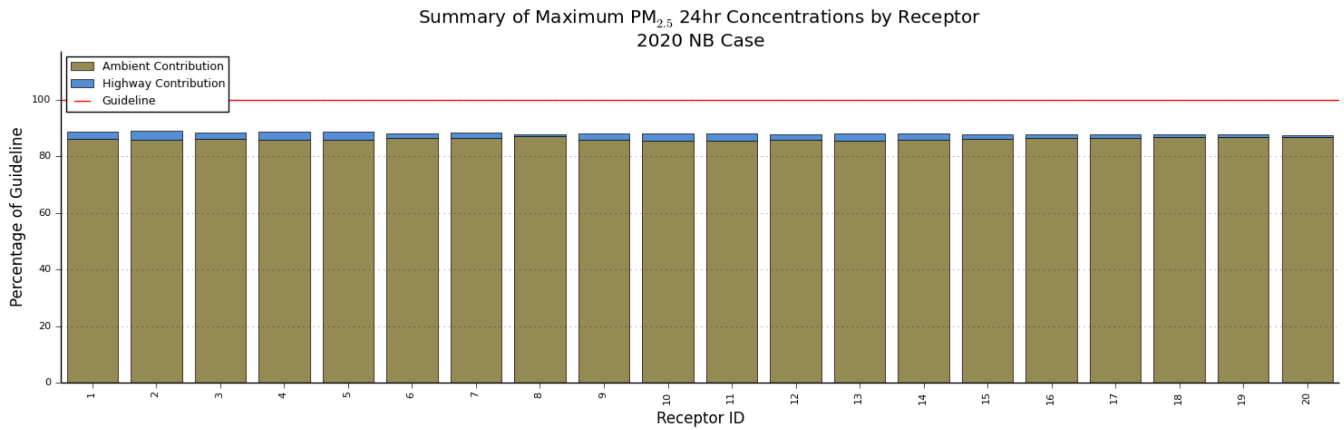
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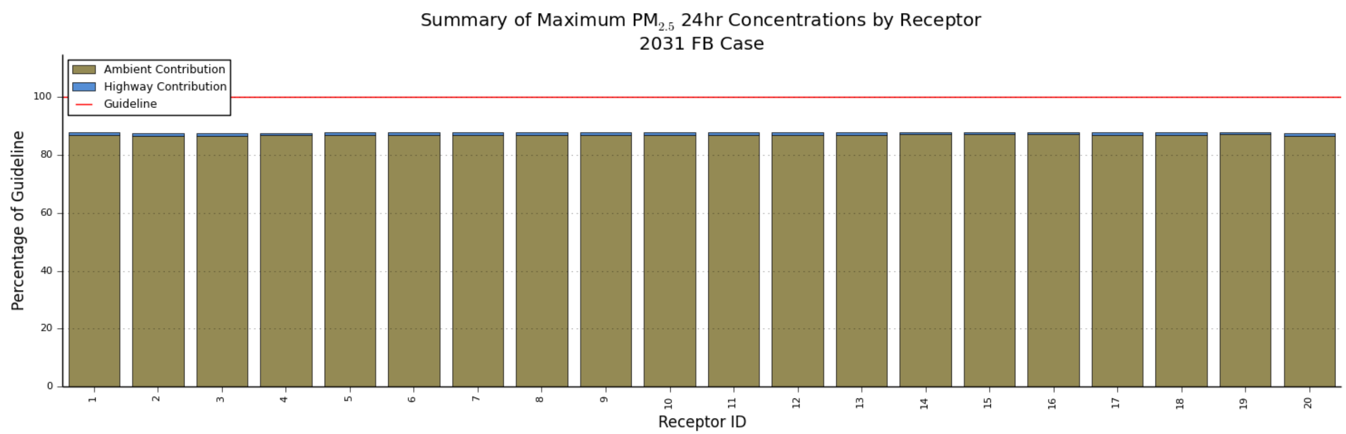
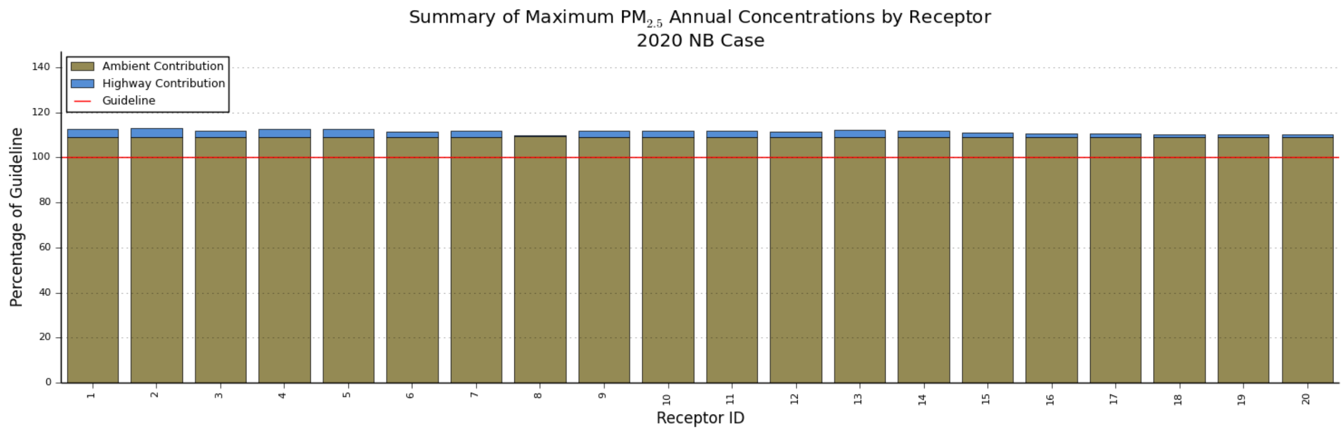
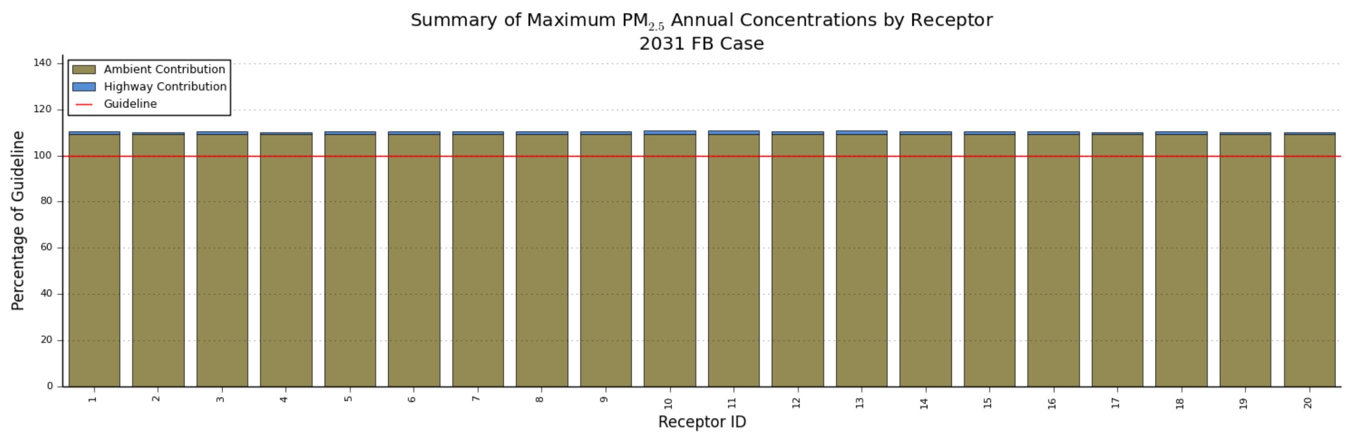
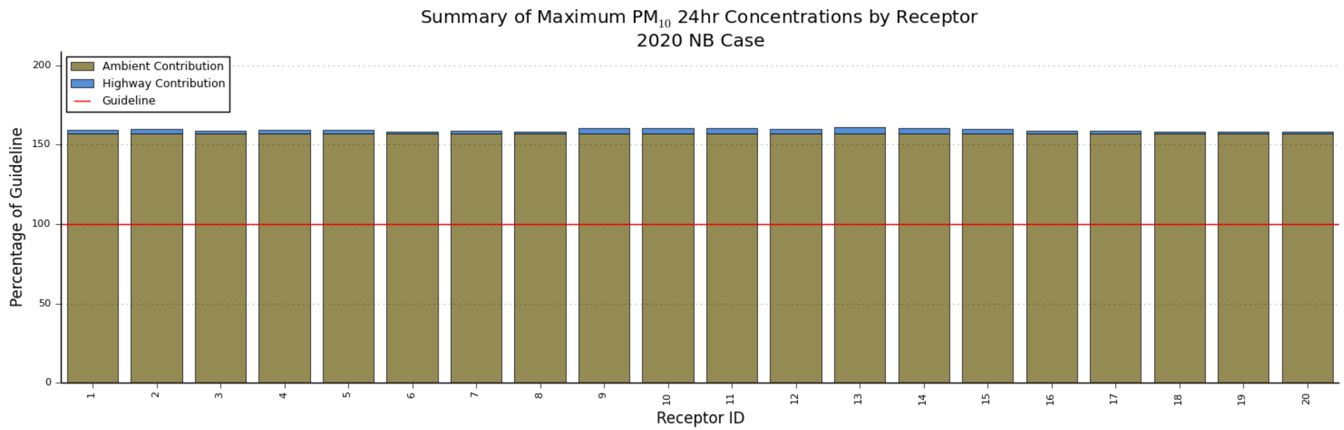
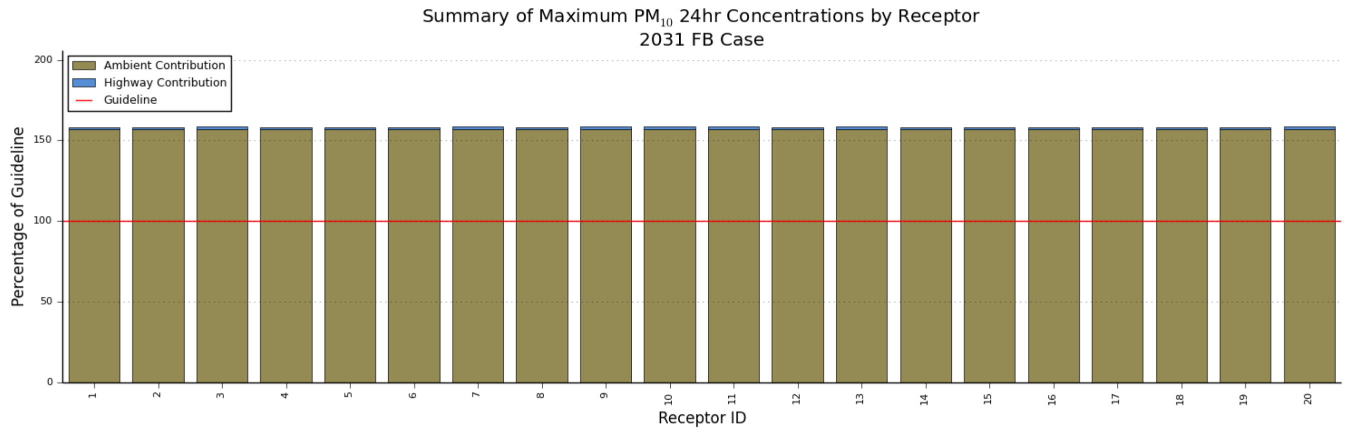
Receptor ID

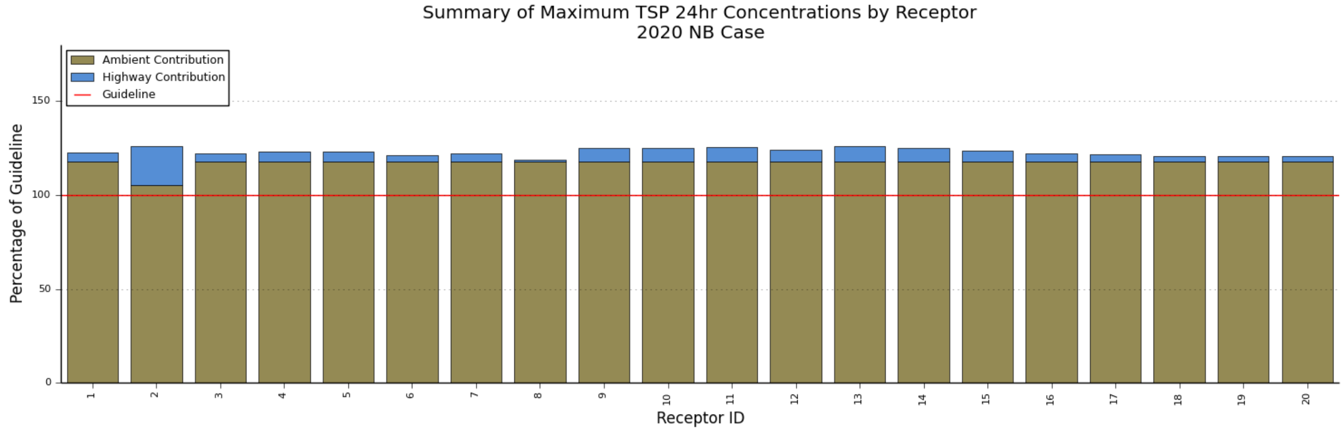

Summary of Maximum $PM_{2.5}$ 24hr Concentrations by Receptor
2031 FB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Receptor ID

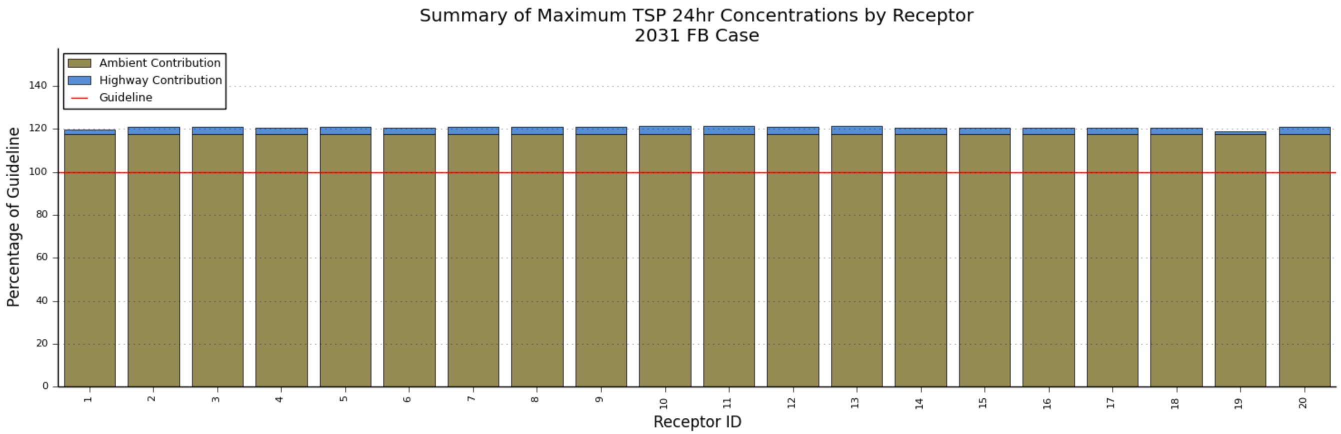

Summary of Maximum PM2.5 Annual Concentrations by Receptor
2020 NB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
Receptor ID


Summary of Maximum PM2.5 Annual Concentrations by Receptor
2031 FB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
Receptor ID


Summary of Maximum PM_{10} 24hr Concentrations by Receptor
2020 NB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
Receptor ID


Summary of Maximum PM_{10} 24hr Concentrations by Receptor
2031 FB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
Receptor ID


Summary of Maximum TSP 24hr Concentrations by Receptor
2020 NB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
0
50
100
150
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Receptor ID


Summary of Maximum TSP 24hr Concentrations by Receptor
2031 FB Case
Ambient Contribution
Highway Contribution
Guideline
Percentage of Guideline
0
20
40
60
80
100
120
140
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Receptor ID