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Appendix E:

Air Quality Report

REPORT

REGION OF PEEL AIRPORT ROAD EA

CALEDON, ONTARIO

AIR QUALITY ASSESSMENT
RWDI # 1702763
January 8, 2019

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) was retained by IBI Group (IBI) to conduct an air quality impact assessment of proposed improvements to Airport Road between King Street (Regional Road 9) and Huntsmill Drive in Caledon, Ontario. The air quality assessment has been completed in support of a Schedule C Municipal Class Environmental Assessment.

The Airport Road study corridor is approximately 7.5 km in length and extends from King Street (Regional Road 9) northerly to 500 m northwest of Huntsmill Drive. Planned build-outs proposed through development applications include adding two access roads on the southwest side of Airport Road between Leamster Trail and Walker Road, adding one access road on the southwest side of Airport Road between Boston Mills Road and King Street, and extending Caledon East Public School access and Cranston Drive northeast of Airport Road. These changes are planned to occur between 2018 and 2022. The Project potentially includes an extension of Old Church Road to Ivan Avenue, and roundabouts at Boston Mills Road and Castlederg Side Road, Olde Base Line Road, Cranston Drive, Walker Road, and Huntsmill Drive. The project also includes alternative design concepts for sidewalks, bike lanes and on-street parking.

Two scenarios were modelled to quantify the effects of a project on the surrounding air quality: one scenario with the proposed improvements in place (the Future Build scenario); and one do-nothing scenario (the No-Build scenario). A common time horizon was used with respect to traffic volumes and vehicle exhaust emission factors, to isolate the effect of the project from other effects that occur over time, such as traffic growth and declining tailpipe emissions. Traffic volumes were based on the year 2041, and vehicle exhaust emission factors were based on the year 2021. This combination represents the upper bound in terms of vehicle emissions, making it a suitable scenario for comparing the results to ambient air quality criteria.

The No-Build scenario represented Airport Road with planned build-outs to 2022, arising from development applications, and the Future-Build scenario included the planned build-outs, plus a proposed extension of Old Church Road to Ivan Avenue, and roundabouts at Boston Mills Road and Castlederg Side Road, Olde Base Line Road, Cranston Drive, Walker Road, and Huntsmill Drive. The Future Build scenario also included worst-case design concepts for sidewalks, bike lanes and on-street parking, i.e., those that would result in the largest shift in the position of the traffic lanes relative to the No-Build scenario. The alternative design concepts resulting in the largest shift in traffic lanes are:

- 2-Lane Urban 2-Lane Urban Cross-Section with Multi-Use Trails – North of King Street to South of Hilltop Drive;
- 2-Lane Urban Cross-Section with Improved Sidewalks, Bike Lanes and Streetscaping between Parking Lay-bys on one side of road – Caledon Trailway to Walker Road; and,
- 2-Lane Urban Cross-Section with Buffered Bike Lanes and New Sidewalks - Walker Road to Huntsmill Drive.

For both the Future No-Build and Future Build scenario, vehicle emissions were represented using projected 2041 traffic volumes and 2021 vehicle emission factors, providing an upper bound estimate of emissions.

The emission modelling was based on the US EPA's roadway emissions model, MOVES, and the dispersion modelling was based on the US EPA's roadway dispersion model, CAL3QHCR. The background concentrations were estimated using air quality monitoring data collected by the Ontario Ministry of Environment, and Conservation and Parks (MECP) and Environment Canada (EC).

Receptors were modelled, to represent a worst-case selection of residences in the study area.

Air contaminants assessed as part of the study included $PM_{2.5}$, PM_{10}, CO, NO_2, acetaldehyde, acrolein, benzene, 1,3-butadiene and formaldehyde.

The proposed project is expected to increase local air contaminant levels slightly at the most-impacted receptor location. The maximum predicted cumulative concentrations for all contaminants and for all averaging periods are less than the currently applicable standards and criteria. The pollutant closest to its limit was benzene at 94% and 96% of the threshold for annual average concentration, in the Future No-Build and Future-Build scenarios respectively, at the most impacted receptor location. For NO_2, the 1-hour cumulative maximum predicted concentration is less than the current Ontario Ambient Air Quality Criterion (AAQC) but higher than the proposed future 2020 CAAQS in both the Build and No Build scenarios. Overall, the project will have similar air quality impacts to the do-nothing alternative, and therefore, has little implications for air quality. No mitigation measures are recommended, beyond those which are already in place through phased-in federal regulations for on-road vehicle and engine emissions, which will significantly reduce NO_2 and other tailpipe emissions beyond the 2021 horizon year used for emission factors in the present study.

Construction phase impacts were not included in the dispersion modelling analysis but were addressed qualitatively in the assessment. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an emissions management plan.

Overall, the proposed Future Build project will have similar air quality impacts as the Future No-Build scenario.

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1 INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by IBI to conduct an air quality assessment of Airport Road between King Street (Regional Road 9) and Huntsmill Drive in Caledon, Ontario. The main objective of the assessment was to quantify how the project will affect air quality in the future. The air quality assessment has been completed in support of a Schedule C Municipal Class Environmental Assessment.

The scope of the study is itemized below:

- Use vehicle emissions modelling techniques to predict tailpipe and road dust emissions associated with the traffic for the selected scenario / scenarios.
- Use a computer simulation of atmospheric dispersion to predict maximum contaminant concentrations at representative sensitive receptors due to emissions from the project related traffic movement.
- Use representative historical monitoring data to establish background concentrations for each contaminant of interest, due to various other sources in the surrounding area other than those associated with the proposed project.
- Combine the dispersion model results with the background concentrations and compare to applicable air quality thresholds.

2 PROJECT DESCRIPTION

Airport Road is a arterial road that runs north-south through the Town of Caledon from Highway 427 at Toronto Pearson International Airport to Mulmur Nottawasaga Townline. Within the study area, it is a 2-lane roadway with minor street intersections that may include a left or right turn lane.

The Airport Road study corridor is approximately 7.5 km in length and extends from King Street northerly to Huntsmill Drive. Planned changes to the existing road configuration proposed through development applications include adding two access roads on the southwest side of Airport Road between Leamster Trail and Walker Road, adding one access road on the southwest side of Airport Road between Boston Mills Road and King Street, and extending Caledon East Public School Access and Cranston Drive northeast of Airport Road. These changes are planned to be implemented between 2018 and 2022 and are considered in the No-Build scenario. The Project potentially includes an extension of Old Church Road to Ivan Avenue, and roundabouts at Boston Mills Road and Castlederg Side Road, Olde Base Line Road, Cranston Drive, Walker Road, and Huntsmill Drive.

3 INPUT DATA AND MODELS

3.1 Traffic Data

Projected traffic volumes, posted speeds and vehicle distribution percentages were provided by IBI (H. McWilliam, pers. comm., April 16, 2018). Traffic volumes were provided for a number of horizon years, with the farthest out being 2041. The 2041 peak hour data were used to model future conditions, thus representing the worst case. Table 3.1 provides a summary of the modelled traffic volume and speed data.

In order to easily assign the vehicle distribution percentages to appropriate vehicle classes, the Federal Highway Administration (FHWA) vehicle classification system was used. Vehicle distribution percentages were supplied by IBI for light vehicles, buses, single unit trucks and articulated trucks at all existing intersections within the study area. The vehicle distribution percentages were assigned to vehicle classes for automobiles and sport utility vehicles (FHWA 1-3), buses (FHWA 4), single-unit trucks (FHWA 5-7), and multi-unit trucks (FHWA 8-13), respectively.

The distribution of vehicle types for northbound traffic on Airport Road is relatively homogeneous throughout the study area, during the mid-day and PM peak periods. The same is true for the distribution of vehicle types for southbound traffic, during the mid-day and AM peak periods. For each of these periods, therefore, an average vehicle distribution was adopted for the entire length of Airport Road within the study area. For northbound traffic during the AM peak and southbound traffic during the PM peak, the distribution of vehicle types north of Old Church Road differed from that to the south. In those cases, therefore, separate average vehicle distributions were adopted for these two sections of Airport Road.

Table 3.1: 2041 Future Traffic Volumes and Speeds for the Study Area

Road	Portion of Road	Direction	Peak Hour Volume	AADT	Posted Speed Limit (km/hour)
Airport Road	Old School Road to King Street	Northbound	750	7,500	80
		Southbound	956	9,560	
	King Street to King Street Access	Northbound	901	9,010	80
		Southbound	930	9,300	
	King Street Access to Castlederg Side Road	Northbound	958	9,580	60
		Southbound	1,125	11,250	
	Castlederg Side Road to Olde Base Line Road	Northbound	992	9,920	60
		Southbound	995	9,950	
	Olde Base Line Road to Cranston Drive	Northbound	1,355	13,550	60
		Southbound	1,088	10,880	

Road	Portion of Road	Direction	Peak Hour Volume	AADT	Posted Speed Limit (km/hour)
	Cranston Drive to Caledon Post Secondary Driveway	Northbound	1,097	10,970	50
		Southbound	1,070	10,700	
	Caledon Post Secondary Driveway to Foodland Plaza	Northbound	1,227	12,270	50
		Southbound	1,001	10,010	
	Foodland Plaza to Hilltop Drive	Northbound	1,282	12,820	50
		Southbound	1,045	10,450	
	Hilltop Drive to Marion Street	Northbound	1,212	12,120	50
		Southbound	1,107	11,070	
	Marion Street to Larry Street	Northbound	1,226	12,260	50
		Southbound	1,048	10,480	
	Larry Street to Mountcrest Road	Northbound	1,239	12,390	50
		Southbound	1,087	10,870	
	Mountcrest Road to Caledon Trailway	Northbound	1,227	12,270	50
		Southbound	1,074	10,740	
	Caledon Trailway to Emma Street	Northbound	1,213	12,130	50
		Southbound	1,079	10,790	
	Emma Street to Parsons Avenue	Northbound	1,171	11,710	50
		Southbound	1,067	10,670	
	Parsons Avenue to Old Church Road	Northbound	1,252	12,520	50
		Southbound	1,006	10,060	
	Old Church Road to Walker Road	Northbound	944	9,440	50
		Southbound	724	7,240	
	Walker Road to Airport Road Access (S)	Northbound	873	8,730	50
		Southbound	725	7,250	
	Airport Road Access (S) to Airport Road Access (N)	Northbound	862	8,620	50
		Southbound	756	7,560	
	Airport Road Access (N) to Leamster Trail	Northbound	861	8,610	50
		Southbound	742	7,420	
	Leamster Trail to Huntsmill Drive	Northbound	846	8,460	50
		Southbound	741	7,410	

Road	Portion of Road	Direction	Peak Hour Volume	AADT	Posted Speed Limit (km/hour)
	Huntsmill Drive to Patterson	Northbound	844	8,440	80
		Southbound	711	7,110	
King Street	Torbram Road to Airport Road	Eastbound	626	6,260	70
		Westbound	740	7,400	
	Innis Lake Road to Airport Road	Eastbound	686	6,860	70
		Westbound	844	8,440	
Olde Base Line Road	Mountainview Road to Airport Road	Eastbound	442	4,420	50
		Westbound	356	3,560	
Old Church Road	Greer Street to Airport Road	Eastbound	576	5,760	50
		Westbound	455	4,550	

Note: Future traffic volumes are projected to be the same for No-Build and Build scenarios

AADT: Annual average daily traffic

3.2 Land Use

Figure 1 shows the Project area and its surrounding land use. The Project area is surrounded by mostly agricultural land use on the south and residential and commercial land use on the north part.

3.3 Emissions Model

The standard approach for estimating vehicular emissions is to use computer simulation techniques that are based on extensive previous testing of a wide range of vehicles. Motor Vehicle Emission Simulator (MOVES) is such a model that has been developed for this purpose by the U.S. Environmental Protection Agency (EPA). MOVES was used to generate vehicle emission factors for a worst-case emission horizon year of 2021, which corresponds to the earliest design year for the Project. Since motor vehicle emissions are on a declining trend, with older vehicles gradually being replaced by newer, lower-emission vehicles, emission factors for later years are lower than those for 2021. Therefore, the use of 2021 emission factors provides an upper bound estimate of emissions associated with the Project.

MOVES allows the user to generate emission factors by time of day, which accounts for diurnal fluctuations in temperature and relative humidity. In the present analysis, four sets of emission factors were generated – morning (AM, 6:00am to 9:00am), mid-day (MD, 9:00am-4:00pm), evening (PM, 4:00pm-7:00pm), and overnight (ON, 7:00pm-6:00am).

Exhaust emissions vary widely by type of vehicle, and MOVES provides emission factors for several different categories. These individual emission factors were aggregated to produce a composite emission factor for each pollutant, representing the average vehicle. This required information on the mix of different vehicle types on each roadway, which was provided by IBI.

For particulate matter, it is necessary to account for the re-suspension of dust as vehicles travel over a roadway surface, in addition to tailpipe emissions. The road dust emissions were calculated based on the revised version of U.S. EPA's AP-42, Chapter 13.2.1 (EPA, 2011). The tailpipe emission factor for particulate matter, from MOVES, was added to the road dust emission factor to account for both emission sources.

3.4 Dispersion Model

Air contaminants emitted from vehicles on a roadway will drift downwind and disperse as they travel. The degree to which the contaminants disperse depends on the weather-related factors, such as wind speed and amount of turbulence. The typical approach to determine potential future downwind concentrations from a proposed project is to use a computer simulation that predicts the dispersal of air pollutants as they drift away from the roads. These simulations are referred to as dispersion models.

Dispersion modelling is a common approach for assessing local air quality near an emission source such as vehicular traffic. The U.S. EPA developed a model known as CAL3QHCR that is intended specifically to predict air contaminant levels downwind of roadways. The model takes emission factors and combines them with historical hourly meteorological data, information on traffic volumes, and the configuration of the roadway. It uses this information to predict roadway contributions to air quality levels at selected locations (sensitive receptors) adjacent to the study area under a variety of weather conditions.

The CAL3QHCR dispersion model predicts air pollutant concentrations near a roadway by first allocating the vehicle emissions to linear segments of the roadway, known as roadway links. A new link must be defined whenever the road width, traffic volume, speed, alignment, or type of traffic movement (free flow or queue) changes.

A free flow link is defined as a straight segment of roadway having a constant width, height, traffic volume, travel speed, and vehicle emission factor. A queue link is defined as a straight segment of roadway with constant width and emission source strength, on which vehicle idling takes place for specified periods (e.g., at signalized intersections). The model calculates the contribution from all of the relevant links to each individual receptor so that the cumulative impact can be determined (US EPA, 1995).

In the case of the Project, there are signalized intersections that would warrant the use of queue links in the modelling of King Street, Olde Base Line Road, Caledon East Public School Access, Caledon Trailway Path and Old Church Road. A reduced travel speed based on the free flow speed limit and the signalized delays were estimated for vehicles approaching these intersections, where signal delays were available. All links approaching a signalized intersection were modelled as queuing links using emission factors associated with the reduced average speed. Roundabouts were modelled as multiple free flow links with reduced average speed.

3.5 Meteorological Data

A meteorological dataset was needed in order to run the CAL3QHCR model. This dataset was created with the PCrammet program using upper air data and surface data. The dataset used in the analysis was prepared based on guidance from the Ontario Ministry of the Environment, Conservation and Parks (MECP) for regulatory dispersion modelling in Ontario (MECP, 2009). Upper air data were obtained from the Buffalo station. Surface data were obtained for Toronto Pearson Airport. A meteorological dataset was prepared for a 5-year period from 2011 to 2015. Year 2012 was selected from the 5-year period since it displays the lowest mean wind speed and more stable atmospheric conditions that will lead to more conservative dispersion results.

4 ASSESSMENT METHODOLOGY

4.1 Modelled Scenarios

Two scenarios were modelled in order to quantify the effects of a project on the surrounding air quality: one scenario with the proposed improvements in place; and one do-nothing scenario. A common time horizon was used with respect to traffic volumes and vehicle exhaust emission factors, to isolate the effect of the project from other effects that occur over time, such as traffic growth and declining tailpipe emissions. As already explained in Sections 3. 1, traffic volumes were based on the year 2041, and as explained in Section 3.3, vehicle exhaust emission factors were based on the year 2021. These combinations represent the upper bound in terms of vehicle emissions, making it a suitable scenario for comparing the results to ambient air quality criteria.

The No-Build scenario represented Airport Road with planned build-outs to the year 2022, arising from development applications. The Future-Build scenario represented it with the planned build-outs plus a worst-case combination of alternative design concepts for the project with respect to roundabouts, bike lanes, sidewalks, and on-street parking. The worst-case combination of alternatives is the one that results in the biggest change in separation distance between sensitive land uses (primarily residences) and the traffic lanes. The alternative design concepts resulting in the largest change in separation distance are:

- 2-Lane Urban 2-Lane Urban Cross-Section with Multi-Use Trails – North of King Street to South of Hilltop Drive;
- 2-Lane Urban Cross-Section with Improved Sidewalks, Bike Lanes and Streetscaping between Parking Lay-bys on one side of road – Caledon Trailway to Walker Road; and,
- 2-Lane Urban Cross-Section with Buffered Bike Lanes and New Sidewalks - Walker Road to Huntsmill Drive.

4.2 Modelled Roadways

The model included all of Airport Road within the study area, as well as sections of King Street, Olde Base Line Road, and Old Church Road. In the Future Build scenario, proposed roundabouts and right or left turn lanes were modelled only at intersections where sensitive uses are located in close proximity to the roundabout. There are no sensitive receptors near the roundabouts proposed on Airport Road at Castlederg Side Road/Boston Mills Road and at Huntsmill Drive; therefore, those roundabouts were not modelled. The modelled roadway segments are shown in Figure 1.

4.3 Selection of Sensitive Receptors

Receptors were placed throughout the study area to represent operable windows and outdoor amenity areas of a worst-case selection of residences that are in close proximity to the major roadways. Figure 1 and 2 show the receptor locations selected for modelling.

4.4 Modelled Air Contaminants

Vehicular traffic produces a variety of air contaminants as a result of fuel combustion inside the engine, evaporation of fuel from the tank, brake and tire wear, and re-suspension (also known as re-entrainment) of loose particles on the road surface (silt) as the vehicle travels over the road surface. The following key contaminants have commonly been assessed in air quality studies for Ontario roadway EAs: respirable particulate matter, inhalable particulate matter, carbon monoxide, nitrogen dioxide, acetaldehyde, acrolein, benzene, 1,3-butadiene and formaldehyde. Inhalable particulate matter was used as a surrogate for total suspended particulate (TSP) as there are no emission factors generated by MOVES for TSP. For the present study, nine worst-case air contaminants were chosen, consisting of those having the highest ratios of emission rate to air quality threshold. Table 4.1 lists the selected contaminants of interest.

Table 4.1: Contaminants of Interest

Contaminant	Symbol or Chemical Formula
Respirable Particulate Matter	$PM_{2.5}$
Inhalable Particulate Matter	PM_{10}
Carbon Monoxide	CO
Nitrogen Dioxide	NO_2
Acetaldehyde	C_2H_4O
Acrolein	C_3H_4O
Benzene	C_6H_6
1,3-Butadiene	C_4H_6
Formaldehyde	CH_2O

4.5 Conversion of NO_x to NO_2, Ozone Limited Method

Any chemical reactions among pollutants are not considered in the assessment of local air quality impacts, except for the conversion of nitric oxide (NO) to nitrogen dioxide (NO_2), through reaction with ambient ground-level ozone (O_3). Vehicle exhausts initially consist mainly of NO. However, NO can convert to NO_2 once in the outside air. The Ozone Limiting Method (OLM) was used to estimate this conversion for the credible worst-case NO concentration.

The OLM assumes that the conversion of NO to NO_2 is limited only by the amount of ozone (O_3) present in the outside air. If the concentration of available O_3 (parts per million or ppm) is less than that of the NO contributed by the modelled roadway emissions, then the portion of NO that is converted to NO_2 equals the available O_3. On the other hand, if the concentration of available O_3 exceeds that of the NO contributed by the modelled roadway, then all of the NO is converted to NO_2. For the credible worst-case analysis, a fixed concentration of ozone was used in the OLM, corresponding to the 90th percentile of measured values from historical monitoring data recorded at a nearby monitoring station operated by the MECP.

Emissions modelling (US EPA's MOVES model) was used to determine the portion of emitted total NO_X that is already in the form of NO_2 before exiting the tailpipe. The average weighted NO_X/NO_2 ratio derived from MOVES for year 2021 was 13%.

4.6 Air Quality Thresholds

The Province of Ontario has benchmarks, Ontario Ambient Air Quality Criterion (AAQC), that are used to judge the acceptability of airborne concentrations of PM_{10}, CO, NO_2, Acetaldehyde, Acrolein, Benzene, 1,3-Butadiene and Formaldehyde. The Province does not have a benchmark for $PM_{2.5}$. Instead, the Federal Government has established Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ (Environment Canada, 2017). The Federal Government also has recently established standards for 1-hour and annual concentrations of NO_2 that will come into effect in the year 2020. The benchmarks and standards are collectively referred to as air quality thresholds in this report. The thresholds are summarized in Table 4.2 (in micrograms per cubic metre, µg/m³).

Table 4.2: Summary of Relevant Air Quality Thresholds (µg/m³)

Pollutant	Criterion (µg/m³)	Averaging Period	Source of Threshold Value
$PM_{2.5}$	27	24-hour	CAAQS
	8.8	Annual	CAAQS
PM_{10}	50	24-hour	AAQC
CO	36,200	1-hour	AAQC
	15,700	8-hour	AAQC
NO_2	400	1-hour	AAQC
	113	1-hour	CAAQS[1]
	200	24-hour	AAQC
	32	Annual	CAAQS[1]
Acetaldehyde	500	0.5-hour	AAQC
	500	24-hour	AAQC
Acrolein	4.5	1-hour	AAQC
	0.4	24-hour	AAQC

Pollutant	Criterion (µg/m³)	Averaging Period	Source of Threshold Value
Benzene	2.3	24-hour	AAQC
	0.45	Annual	AAQC
1,3-Butadiene	10	24-hour	AAQC
	2	Annual	AAQC
Formaldehyde	65	24-hour	AAQC

Note: [1]: those proposed criteria that will come into effect in year 2020

4.7 Background Air Quality Data

CAL3QHCR predicted the contribution of the modelled roadway (Airport Road) to concentrations of contaminants at nearby sensitive receptors. The predicted maximum concentrations were combined with estimated background concentrations that are due to other emission sources in the surrounding area (primarily other roadways), thus providing a prediction of maximum cumulative concentrations.

The background concentrations were estimated using air quality monitoring data collected by the MECP and Environment Canada (EC). Data from the nearest representative monitoring stations were used. For $PM_{2.5}$ and NO_2, the data came from an MECP monitoring station located at Eagle Street and McCaffrey Road in Newmarket (MECP, 2016). Data for benzene and 1,3-butadiene were obtained from Newmarket at the same location but operated by Environment and Climate Change Canada (ECCC). For CO, the data came from an MECP monitoring station located at 125 Resources Road in Toronto West (MECP, 2016). For Acrolein, the data came from an EC monitoring station located near the intersection of Ruskin Avenue and Perth Avenue in Toronto. The latter monitoring station is located in a more built up environment than the Airport Road study area, and therefore, provides a worst-case representation of background acrolein concentrations. For acetaldehyde and formaldehyde, the data came from an ECCC monitoring station located at 8th Line & 10th Sideroad in Egbert.

For the purpose of predicting maximum 1-hour and 24-hour cumulative concentrations, the maximum modelled concentration at each receptor location was combined with the 90th percentile background concentration from the monitoring data, as per common practice in Ontario EAs. For $PM_{2.5}$, CO and NO_2, annual reports published by the MECP present 90th percentile values for 1-hour concentration. A 5-year average of these 90th percentile values was used. For PM_{10}, the background concentration was scaled from background concentrations of $PM_{2.5}$ based on the typical average ratio between PM_{10} and $PM_{2.5}$. For acetaldehyde, acrolein, benzene, 1,3-butadiene and formaldehyde, 90th percentile values for 24-hour concentrations were derived from a 5-year average of these values. In the case of acrolein and acetaldehyde, 1-hour and 30-minute background values were also calculated. This was done by scaling the 24-hour background values for these substances, using an averaging time scale factor described in the guidance from the MECP for regulatory dispersion modelling in Ontario, respectively (MECP, 2009).

Table 4.3 shows the background concentrations.

Table 4.3: Ambient Air Measurements used for Background

Pollutant	Averaging Period	Adopted Background Value (µg/m³)	Description	Data Period	Criterion (µg/m³)
PM_{10}	24-hour	26.3	90th Percentile	2012-2016	50
$PM_{2.5}$	24-hour	14.2	90th Percentile	2012-2016	27
	Annual	6.7	Annual Average	2012-2016	8.8
CO	1-hour	0.36	90th Percentile	2011-2015	36,200
	8-hour	0.36	90th Percentile	2011-2015	15,700
NO_2	1-hour	29.3	90th Percentile	2012-2016	400
	1-hour	29.3	90th Percentile	2012-2016	113[1]
	24-hour	29.3	90th Percentile	2012-2016	200
	Annual	13.5	Annual Average	2012-2016	32[1]
Acetaldehyde	0.5-hour	4.58	90th Percentile	2006-2010	500
	24-hour	1.55	90th Percentile	2006-2010	500
Acrolein	1-hour	0.75	90th Percentile	2002-2006	4.5
	24-hour	0.30	90th Percentile	2002-2006	0.4
Benzene	24-hour	0.63	90th Percentile	2012-2016	0.45
	Annual	0.39	Annual Average	2012-2016	2.3
1,3-Butadiene	24-hour	0.04	90th Percentile	2012-2016	10
	Annual	0.02	Annual Average	2012-2016	2
Formaldehyde	24-hour	4.21	90th Percentile	2006-2010	65
Ozone	1-hour	92.1	90th Percentile	2012-2016	NA

Note: [1] CAAQS proposed criteria that will come into effect in year 2020

5 RESULTS

5.1 Assessment of Maximum Cumulative Concentrations

Table 5.1 and Table 5.2 presents a summary of the predicted maximum cumulative concentrations (maximum modelled project contribution plus the 90th percentile 1-hour and 24-hour background concentration) at the most impacted discrete sensitive receptors for the Future No-Build and Future-Build scenarios, respectively. The resultant concentrations are compared to applicable thresholds. Predicted maximum concentrations for each contaminant at each sensitive receptor location are provided in Appendix B and Appendix C for the Future No-Build and Future-Build scenarios, respectively.

The resultant concentrations for the Future-Build scenario were only slightly higher than the concentrations for the No-Build scenario.

The cumulative maximum predicted concentrations for all contaminants, for all averaging periods, are less than their current respective thresholds for both the Future No-Build and Future-Build scenarios. Predicted concentrations of PM_{10} with background were 69% and 71% of the CAAQS for the Future No-Build and Future Build scenarios, respectively. $PM_{2.5}$ concentrations with background for the Future No-Build and Future Build scenarios were predicted to be 64% and 65% of the AAQC for the 24-hour averaging period, respectively, and 85% and 86% of the AAQC for the annual averaging period, respectively. Predicted concentrations of CO were no greater than 3% of the AAQC for all averaging periods and modelled scenarios. For NO_2, the 1-hour cumulative maximum predicted concentration is less than the AAQC but higher than the future CAAQS for both the Future and No Build scenarios. Predicted concentrations for all modelled averaging periods of selected VOCs (benzene, 1-3 butadiene, formaldehyde, acetaldehyde and acrolein) were below the AAQC for the Future No-Build and Future Build scenarios. The VOCs with predicted concentrations nearest the AAQC were annual average benzene (94% and 96% of the AAQC for the Future No-Build and Future Build scenarios, respectively) and 24-hour average acrolein (78% and 80% of the AAQC for the Future No-Build and Future Build scenarios, respectively).

Overall, the proposed project will result with similar air quality impacts as in the Future No-Build scenario.

Table 5.1: Maximum Predicted Concentrations (μg/m³) for the 2041 Future No-Build Scenario

Pollutant	Averaging Period	Most Impacted Receptor	Predicted Conc.	Background Conc.	Combined Conc.	Threshold	Source of Threshold Value	% of Threshold
PM_{10}	24-h	S27	8.13	26.3	34.4	50	AAQC	69%
$PM_{2.5}$	24-h	S27	2.97	14.2	17.2	27	AAQC	64%
	Annual	S27	0.82	6.7	7.5	8.8	AAQC	85%
CO	1-h	S27	1,048	0.36	1048	36,200	AAQC	3%
	8-h	S27	325	0.36	325	15,700	AAQC	2%
NO_2	1-h	S48	111	29.3	140	400	AAQC	35%
	1-h	S48	111	29.3	140	113	CAAQS	**124**%
	24-h	S27	33.8	29.3	63.1	200	AAQC	32%
	Annual	S45	9.2	13.5	22.7	32	CAAQS	71%
Acetaldehyde	0.5-h	S48	0.53	4.58	5.11	500	AAQC	1%
	24-h	S27	0.09	1.55	1.64	500	AAQC	0.3%
Acrolein	1-h	S48	0.07	0.75	0.82	4.5	AAQC	18%
	24-h	S27	0.01	0.30	0.31	0.4	AAQC	78%
Benzene	24-h	S27	0.13	0.63	0.76	2.3	AAQC	33%
	Annual	S27	0.03	0.39	0.42	0.45	AAQC	94%
1,3-Butadiene	24-h	S27	0.01	0.04	0.05	10	AAQC	0.5%
	Annual	S27	0.00	0.02	0.02	2	AAQC	1%
Formaldehyde	24-hour	S27	0.18	4.21	4.39	65	AAQC	7%

Table 5.2: Maximum Predicted Concentrations (µg/m³) for the 2041 Future Build Scenario

Pollutant	Averaging Period	Most Impacted Receptor	Predicted Conc.	Background Conc.	Combined Conc.	Threshold	Source of Threshold Value	% of Threshold
PM_{10}	24-h	S27	9.23	26.3	35.5	50	AAQC	71%
$PM_{2.5}$	24-h	S27	3.37	14.2	17.6	27	AAQC	65%
	Annual	S27	0.94	6.7	7.6	8.8	AAQC	86%
CO	1-h	S27	1,178	0.36	1178	36,200	AAQC	3%
	8-h	S27	365	0.36	365	15,700	AAQC	2%
NO_2	1-h	S27	112	29.3	141	400	AAQC	34%
	1-h	S27	112	29.3	141	113	CAAQS	**125%**
	24-h	S27	38.3	29.3	67.6	200	AAQC	34%
	Annual	S27	10.5	13.5	24.0	32	CAAQS	75%
Acetaldehyde	0.5-h	S27	0.58	4.58	5.16	500	AAQC	1%
	24-h	S27	0.10	1.55	1.65	500	AAQC	0.3%
Acrolein	1-h	S27	0.08	0.75	0.83	4.5	AAQC	18%
	24-h	S27	0.02	0.30	0.32	0.4	AAQC	80%
Benzene	24-h	S27	0.15	0.63	0.78	2.3	AAQC	34%
	Annual	S27	0.04	0.39	0.43	0.45	AAQC	96%
1,3-Butadiene	24-h	S27	0.01	0.04	0.05	10	AAQC	0.5%
	Annual	S27	0.00	0.02	0.02	2	AAQC	1%
Formaldehyde	24-hour	S27	0.21	4.21	4.42	65	AAQC	7%

5.2 Emissions During the Construction Phase

Construction phase impacts are not included in the dispersion modelling analysis but are addressed qualitatively here. Construction activities involve heavy equipment that generates air pollutants and dust; however, these impacts are temporary in nature. The emissions are highly variable, difficult to predict, and depend on the specific activities that are taking place and the effectiveness of the mitigation measures. The best manner to deal with these emissions is through diligent implementation of operating procedures such as application of dust suppressants, reduced travel speeds for heavy vehicles, efficient staging of activities and minimization of haul distances, covering up stockpiles, etc. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an emissions management plan. Such a plan would set out established best management practices for dust and other emissions. Some of the best practices include the following:

- Use of reformulated fuels, emulsified fuels, exhaust catalyst and filtration technologies, cleaner engine repowers, and new alternative-fueled trucks to reduce emissions from construction equipment.
- Regular cleaning of construction sites and access roads to remove construction-caused debris and dust.
- Dust suppression on unpaved haul roads and other traffic areas susceptible to dust, subject to the area being free of sensitive plant, water or other ecosystems that may be affected by dust suppression chemicals.
- Covered loads when hauling fine-grained materials.
- Prompt cleaning of paved streets/roads where tracking of soil, mud or dust has occurred.
- Tire washes and other methods to prevent trucks and other vehicles from tracking soil, mud or dust onto paved streets or roads.
- Covered stockpiles of soil, sand and aggregate as necessary.
- Compliance with posted speed limits and, as appropriate, further reductions in speeds when travelling sites on unpaved surfaces.

6 CONCLUSIONS

The proposed project is expected to increase local air contaminant levels slightly at the most-impacted sensitive receptor, but the maximum predicted cumulative concentrations for all contaminants and for all averaging periods are less than their current respective thresholds. For NO_2, the 1-hour cumulative maximum predicted concentration is less than the AAQC but higher than the future CAAQS for both the Future and No Build scenarios. Overall, the project will have similar air quality impacts to the do-nothing alternative, and therefore, has little implications for air quality. No mitigation measures are recommended, beyond those which are already in place through phased-in federal regulations for on-road vehicle and engine emissions, which will significantly reduce NO_2 and other tailpipe emissions beyond the 2021 horizon year used for emission factors in the present study.

Construction phase impacts were not included in the dispersion modelling analysis but were addressed qualitatively in Section 5 of the report. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an emissions management plan.

7 REFERENCES

1. CAAQS, Environment Canada, 2017, http://airquality-qualitedelair.ccme.ca/en/
2. McWilliam, Hailey. IBI Group. Personal Communication. Email: April 16, 2018.
3. MECP, 2009. Air Dispersion Modelling Guideline for Ontario, version 2.0, PIBs # 5165e02, March 2009.
4. MECP, 2016. Air Quality in Ontario Summary Reports: 2011-2016. 2011-2016.
5. United States Environmental Protection Agency (EPA), 2011. AP-42: Section 13.2.1 Paved Roads. January 2011.
6. United States Environmental Protection Agency. User's Guide to CAL3QHCR Version 2: A Modelling Methodology for Prediction Pollutant Concentrations near Roadway Intersections (454/R-92-006). September 1995.

FIGURES

Key Map

Future No-Build Scenario

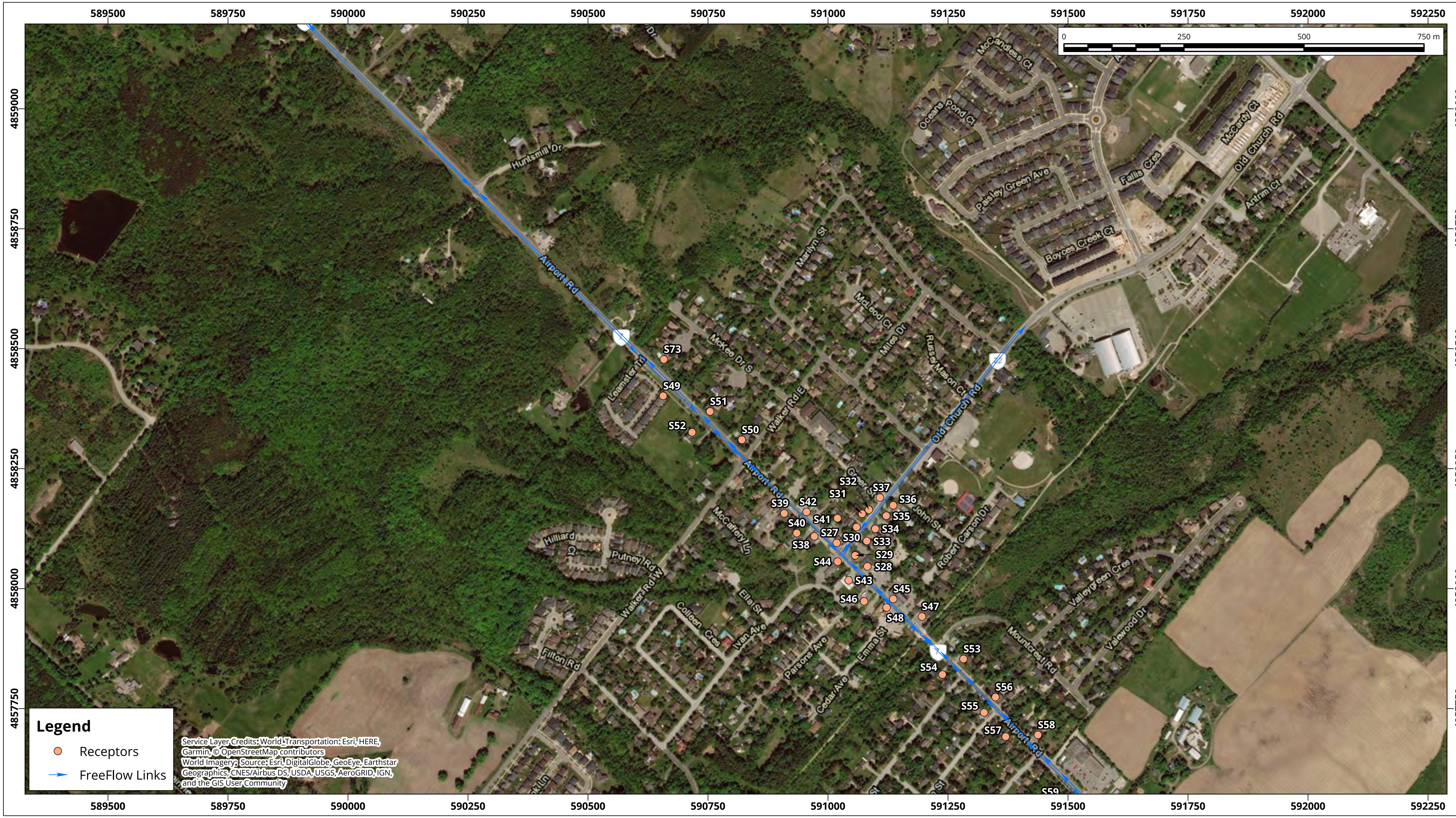
Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by:	DJH	Figure:	1
Approx. Scale:	1:30,000		
Date Revised:	Sep 12, 2018		



Links and Receptors
Future No-Build Scenario

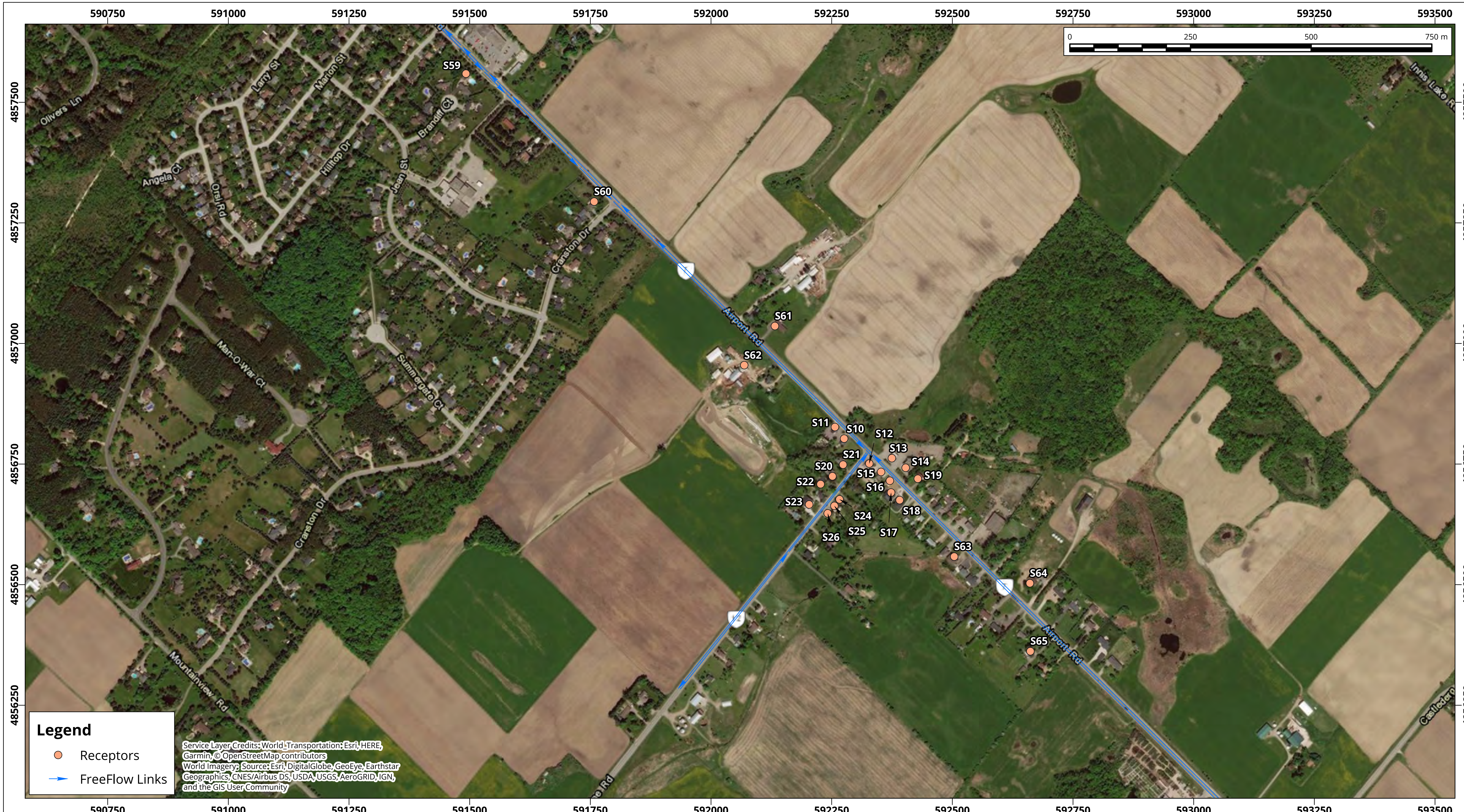
Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 1a
Approx. Scale:	1:7,500
Date Revised:	Sep 12, 2018



Links and Receptors

Future No-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 1b
Approx. Scale:	1:7,500
Date Revised:	Sep 12, 2018

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Links and Receptors
Future No-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

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Approx. Scale:	1:7,500
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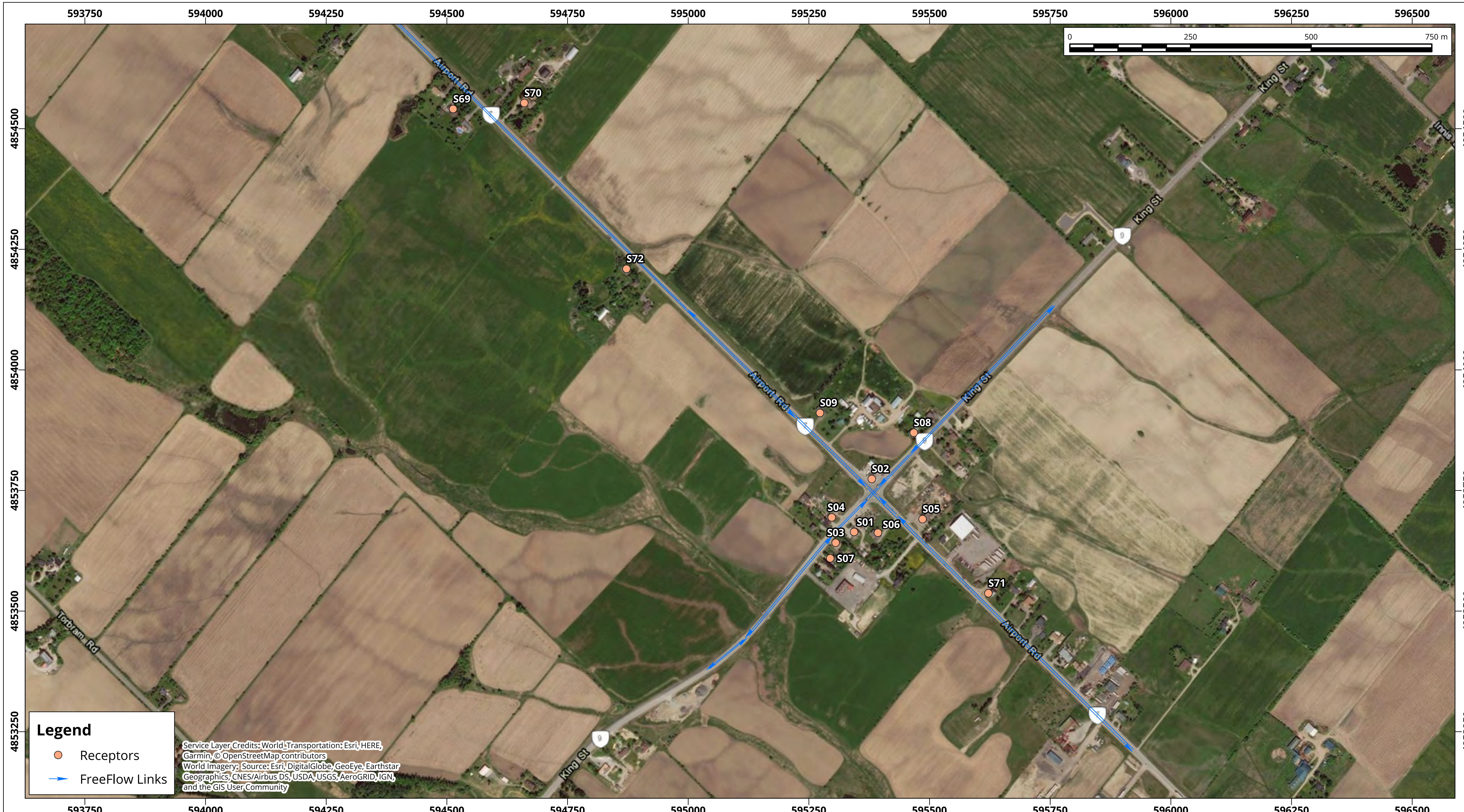


Links and Receptors
Future No-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 1d
Approx. Scale:	1:7,500
Date Revised:	Sep 12, 2018

Key Map

Future-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 2
Approx. Scale: 1:30,000	
Date Revised: Oct 1, 2018	

Links and Receptors
Future-Build Scenario

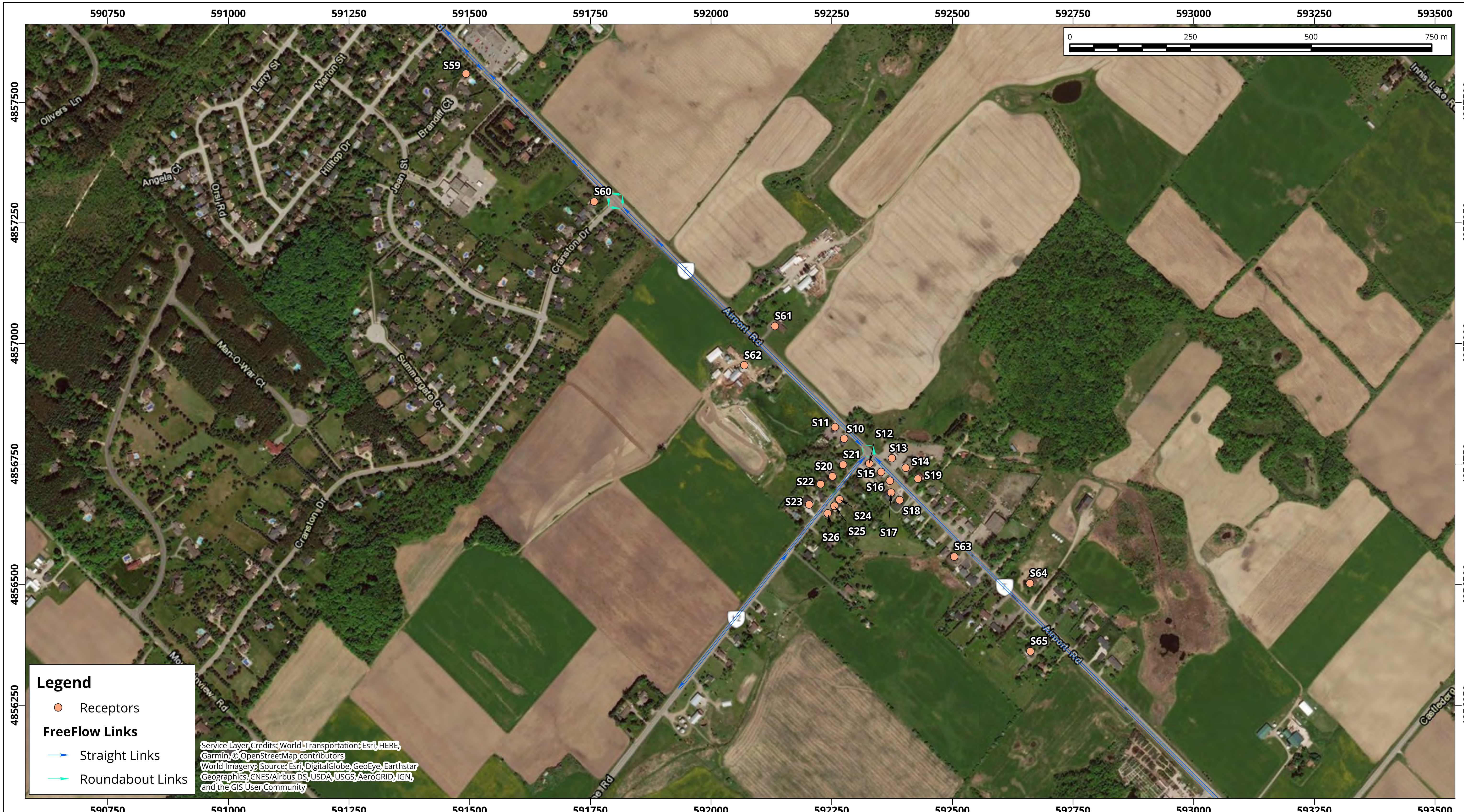
Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 2a
Approx. Scale:	1:7,500
Date Revised:	Sep 24, 2018



Links and Receptors
Future-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 2b
Approx. Scale:	1:7,500
Date Revised:	Sep 24, 2018

Map Document: C:\Users\djh\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC\GIS Temp\1702763\1702763_Peel_Airport_Rd.aprx

Links and Receptors
Future-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

Project #: 1702763

True North

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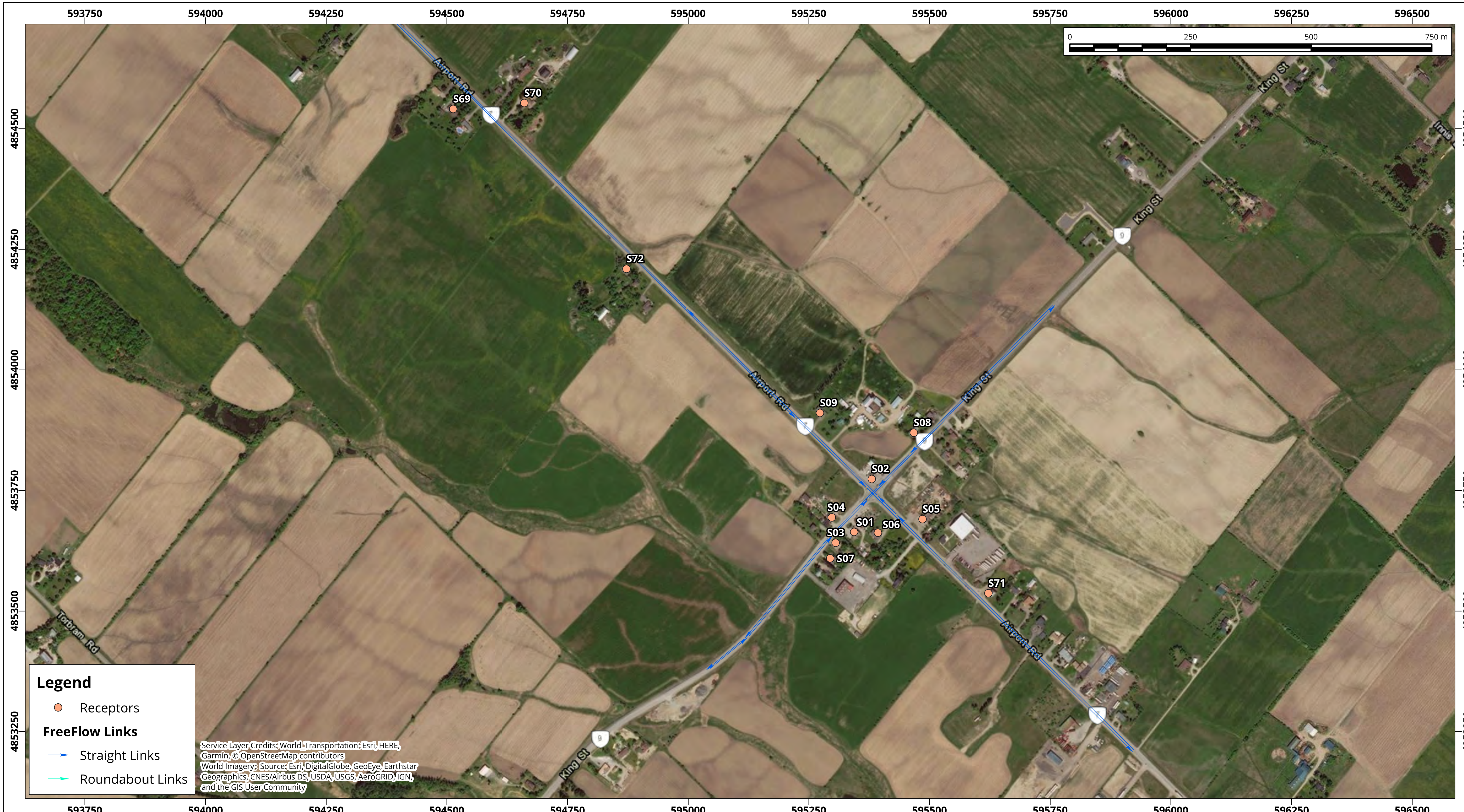

Links and Receptors

Future-Build Scenario

Map Projection: NAD 1983 UTM Zone 17N

Airport Road between King Street and Huntsmill Drive - Caledon, ON

True North

Project #: 1702763

Drawn by: DJH	Figure: 2d
Approx. Scale:	1:7,500
Date Revised:	Sep 24, 2018

APPENDIX A

Table A1: MOVES Key Model Input Parameters

Parameter	Input
Pollutants	NO_X, $PM_{2.5}$, CO, Acetaldehyde, Acrolein, Benzene, 1,3-Butadiene, and Formaldehyde
Operating Year	2021
Evaluation Month	January, July
Ambient Temperature	January - Minimum Daily Temperature = 15.1 °F (-9.4°C) January - Maximum Daily Temperature = 29.3 °F (-1.5°C) July - Minimum Daily Temperature = 60.4°F (15.8°C) July - Maximum Daily Temperature = 80.8 °F (21.7°C) (Canadian Climate Normal, Toronto Pearson Airport, ON – Climate ID: 6158733
Altitude	Low
Relative Humidity at 6:00 LST	January – 80.8% (From Toronto Lester B. Pearson Int'l A) July – 81.9% (From Toronto Lester B. Pearson Int'l A)
Relative Humidity at 15:00 LST	January – 72.0% (From Toronto Lester B. Pearson Int'l A) July – 53.3% (From Toronto Lester B. Pearson Int'l A)
Fuel Volatility	Reid Vapor Pressure (RVP) = 9 psi
Fuel Program	Conventional Gasoline East
Vehicle Speed	0 km/hr to posted speed of 80 km/hr

Table A2a: Summary of MOVES 2021 Morning (AM) Emission Factors on a Rural Arterial Roadway (g/mile)

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
10	FHWA1-3(Cars)	5.83E-04	2.12E-03	1.91E-04	8.08E-03	5.84E+00	3.45E-03	4.51E-01	1.82E-01	4.22E-02
10	FHWA4(Buses)	5.83E-03	7.76E-02	1.38E-02	1.87E-02	5.89E+00	1.84E-01	1.30E+01	1.57E+00	9.07E-01
10	FHWA5-7(SingleUnitTrucks)	5.55E-03	5.87E-02	9.88E-03	4.12E-02	1.30E+01	1.32E-01	1.03E+01	1.51E+00	7.16E-01
10	FHWA8-13(CombinationTrucks)	5.39E-03	7.52E-02	1.35E-02	1.62E-02	7.60E+00	1.76E-01	2.17E+01	3.22E+00	1.45E+00
20	FHWA1-3(Cars)	3.52E-04	1.32E-03	1.18E-04	5.25E-03	4.35E+00	2.17E-03	3.97E-01	1.18E-01	3.07E-02
20	FHWA4(Buses)	2.82E-03	3.76E-02	6.70E-03	9.00E-03	2.74E+00	8.91E-02	6.12E+00	7.73E-01	4.41E-01
20	FHWA5-7(SingleUnitTrucks)	3.17E-03	3.25E-02	5.44E-03	2.46E-02	9.08E+00	7.30E-02	6.36E+00	8.51E-01	4.06E-01
20	FHWA8-13(CombinationTrucks)	2.85E-03	3.97E-02	7.15E-03	8.57E-03	4.60E+00	9.27E-02	1.43E+01	1.71E+00	8.91E-01
30	FHWA1-3(Cars)	2.75E-04	1.05E-03	9.39E-05	4.29E-03	3.85E+00	1.74E-03	3.79E-01	9.88E-02	2.71E-02
30	FHWA4(Buses)	1.89E-03	2.51E-02	4.46E-03	6.06E-03	1.97E+00	5.96E-02	4.27E+00	5.39E-01	3.05E-01
30	FHWA5-7(SingleUnitTrucks)	2.36E-03	2.37E-02	3.96E-03	1.83E-02	8.15E+00	5.31E-02	5.03E+00	5.93E-01	2.96E-01
30	FHWA8-13(CombinationTrucks)	1.97E-03	2.72E-02	4.91E-03	5.88E-03	3.56E+00	6.34E-02	1.23E+01	1.20E+00	7.32E-01
40	FHWA1-3(Cars)	2.27E-04	8.78E-04	7.79E-05	3.62E-03	3.05E+00	1.45E-03	3.59E-01	8.19E-02	2.10E-02
40	FHWA4(Buses)	1.60E-03	2.13E-02	3.76E-03	5.24E-03	1.95E+00	5.08E-02	4.10E+00	4.66E-01	2.68E-01
40	FHWA5-7(SingleUnitTrucks)	1.84E-03	1.84E-02	3.08E-03	1.38E-02	7.17E+00	4.12E-02	4.18E+00	4.30E-01	2.30E-01
40	FHWA8-13(CombinationTrucks)	1.58E-03	2.18E-02	3.93E-03	4.71E-03	3.08E+00	5.07E-02	1.10E+01	1.02E+00	6.48E-01
50	FHWA1-3(Cars)	1.93E-04	7.64E-04	6.82E-05	3.18E-03	2.85E+00	1.27E-03	3.30E-01	6.25E-02	1.73E-02
50	FHWA4(Buses)	1.42E-03	1.88E-02	3.32E-03	4.69E-03	1.91E+00	4.51E-02	3.95E+00	4.16E-01	2.43E-01
50	FHWA5-7(SingleUnitTrucks)	1.59E-03	1.57E-02	2.61E-03	1.20E-02	7.03E+00	3.49E-02	3.93E+00	3.69E-01	2.05E-01
50	FHWA8-13(CombinationTrucks)	1.34E-03	1.85E-02	3.34E-03	4.00E-03	2.77E+00	4.29E-02	1.07E+01	8.71E-01	5.92E-01
60	FHWA1-3(Cars)	1.74E-04	6.96E-04	6.22E-05	2.92E-03	2.61E+00	1.16E-03	3.42E-01	4.83E-02	1.52E-02
60	FHWA4(Buses)	1.25E-03	1.65E-02	2.91E-03	4.10E-03	1.75E+00	3.97E-02	3.62E+00	3.49E-01	2.09E-01
60	FHWA5-7(SingleUnitTrucks)	1.32E-03	1.36E-02	2.29E-03	9.06E-03	5.57E+00	3.05E-02	3.33E+00	2.93E-01	1.71E-01
60	FHWA8-	1.22E-03	1.68E-02	3.03E-03	3.63E-03	2.40E+00	3.89E-02	9.23E+00	6.57E-01	4.48E-01

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
	13(CombinationTrucks)									
70	FHWA1-3(Cars)	1.60E-04	6.47E-04	5.79E-05	2.72E-03	2.44E+00	1.08E-03	3.50E-01	3.84E-02	1.37E-02
70	FHWA4(Buses)	1.12E-03	1.48E-02	2.61E-03	3.67E-03	1.64E+00	3.57E-02	3.40E+00	3.02E-01	1.86E-01
70	FHWA5-7(SingleUnitTrucks)	1.15E-03	1.20E-02	2.04E-03	7.41E-03	5.04E+00	2.71E-02	3.09E+00	2.41E-01	1.52E-01
70	FHWA8-13(CombinationTrucks)	1.13E-03	1.54E-02	2.79E-03	3.34E-03	2.23E+00	3.57E-02	8.97E+00	5.61E-01	4.04E-01
80	FHWA1-3(Cars)	1.50E-04	6.13E-04	5.48E-05	2.59E-03	2.33E+00	1.03E-03	3.58E-01	3.06E-02	1.26E-02
80	FHWA4(Buses)	1.14E-03	1.51E-02	2.69E-03	3.67E-03	1.77E+00	3.63E-02	3.59E+00	2.69E-01	1.82E-01
80	FHWA5-7(SingleUnitTrucks)	1.01E-03	1.08E-02	1.84E-03	6.05E-03	4.57E+00	2.43E-02	2.86E+00	2.06E-01	1.37E-01
80	FHWA8-13(CombinationTrucks)	1.07E-03	1.44E-02	2.62E-03	3.13E-03	2.08E+00	3.33E-02	8.68E+00	4.58E-01	3.47E-01

Note: [1] PM_{10} and $PM_{2.5}$ shown in this table does not include road dust contribution.

Table A2b: Summary of MOVES 2021 Midday (MD) Emission Factors on a Rural Arterial Roadway (g/mile)

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
10	FHWA1-3(Cars)	6.15E-04	2.23E-03	2.01E-04	8.46E-03	7.80E+00	3.62E-03	4.81E-01	1.78E-01	3.83E-02
10	FHWA4(Buses)	5.83E-03	7.76E-02	1.38E-02	1.87E-02	5.89E+00	1.84E-01	1.30E+01	1.57E+00	9.06E-01
10	FHWA5-7(SingleUnitTrucks)	5.55E-03	5.87E-02	9.88E-03	4.12E-02	1.30E+01	1.32E-01	1.03E+01	1.50E+00	7.10E-01
10	FHWA8-13(CombinationTrucks)	5.39E-03	7.52E-02	1.35E-02	1.62E-02	7.60E+00	1.76E-01	2.17E+01	3.22E+00	1.45E+00
20	FHWA1-3(Cars)	3.72E-04	1.39E-03	1.25E-04	5.51E-03	5.89E+00	2.28E-03	3.97E-01	1.14E-01	2.72E-02
20	FHWA4(Buses)	2.82E-03	3.76E-02	6.70E-03	9.00E-03	2.74E+00	8.91E-02	6.12E+00	7.72E-01	4.40E-01
20	FHWA5-7(SingleUnitTrucks)	3.17E-03	3.25E-02	5.44E-03	2.46E-02	9.08E+00	7.30E-02	6.36E+00	8.47E-01	4.02E-01
20	FHWA8-13(CombinationTrucks)	2.85E-03	3.97E-02	7.15E-03	8.57E-03	4.60E+00	9.27E-02	1.43E+01	1.71E+00	8.91E-01
30	FHWA1-3(Cars)	2.91E-04	1.11E-03	9.92E-05	4.53E-03	5.24E+00	1.83E-03	3.79E-01	9.50E-02	2.37E-02
30	FHWA4(Buses)	1.89E-03	2.51E-02	4.46E-03	6.06E-03	1.97E+00	5.96E-02	4.27E+00	5.38E-01	3.04E-01
30	FHWA5-7(SingleUnitTrucks)	2.36E-03	2.37E-02	3.96E-03	1.83E-02	8.15E+00	5.31E-02	5.03E+00	5.89E-01	2.93E-01
30	FHWA8-13(CombinationTrucks)	1.97E-03	2.72E-02	4.91E-03	5.88E-03	3.56E+00	6.34E-02	1.23E+01	1.20E+00	7.32E-01
40	FHWA1-3(Cars)	2.41E-04	9.30E-04	8.25E-05	3.82E-03	4.15E+00	1.53E-03	3.59E-01	7.93E-02	1.87E-02
40	FHWA4(Buses)	1.60E-03	2.13E-02	3.76E-03	5.24E-03	1.95E+00	5.08E-02	4.10E+00	4.66E-01	2.68E-01
40	FHWA5-7(SingleUnitTrucks)	1.84E-03	1.84E-02	3.08E-03	1.38E-02	7.17E+00	4.12E-02	4.18E+00	4.27E-01	2.28E-01
40	FHWA8-13(CombinationTrucks)	1.58E-03	2.18E-02	3.93E-03	4.71E-03	3.08E+00	5.07E-02	1.10E+01	1.02E+00	6.48E-01
50	FHWA1-3(Cars)	2.05E-04	8.11E-04	7.24E-05	3.37E-03	3.89E+00	1.35E-03	3.30E-01	6.02E-02	1.52E-02
50	FHWA4(Buses)	1.42E-03	1.88E-02	3.32E-03	4.69E-03	1.91E+00	4.51E-02	3.95E+00	4.16E-01	2.43E-01
50	FHWA5-7(SingleUnitTrucks)	1.59E-03	1.57E-02	2.61E-03	1.20E-02	7.03E+00	3.49E-02	3.93E+00	3.66E-01	2.02E-01
50	FHWA8-13(CombinationTrucks)	1.34E-03	1.85E-02	3.34E-03	4.00E-03	2.77E+00	4.29E-02	1.07E+01	8.71E-01	5.92E-01
60	FHWA1-3(Cars)	1.85E-04	7.40E-04	6.61E-05	3.09E-03	3.55E+00	1.23E-03	3.42E-01	4.61E-02	1.32E-02
60	FHWA4(Buses)	1.25E-03	1.65E-02	2.91E-03	4.10E-03	1.75E+00	3.97E-02	3.62E+00	3.49E-01	2.09E-01
60	FHWA5-7(SingleUnitTrucks)	1.32E-03	1.36E-02	2.29E-03	9.06E-03	5.57E+00	3.05E-02	3.33E+00	2.91E-01	1.69E-01
60	FHWA8-	1.22E-03	1.68E-02	3.03E-03	3.63E-03	2.40E+00	3.89E-02	9.23E+00	6.56E-01	4.48E-01

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
	13(CombinationTrucks)									
70	FHWA1-3(Cars)	1.71E-04	6.89E-04	6.16E-05	2.89E-03	3.30E+00	1.15E-03	3.50E-01	3.62E-02	1.18E-02
70	FHWA4(Buses)	1.12E-03	1.48E-02	2.61E-03	3.67E-03	1.64E+00	3.57E-02	3.40E+00	3.02E-01	1.86E-01
70	FHWA5-7(SingleUnitTrucks)	1.15E-03	1.20E-02	2.04E-03	7.41E-03	5.04E+00	2.71E-02	3.09E+00	2.38E-01	1.49E-01
70	FHWA8-13(CombinationTrucks)	1.13E-03	1.54E-02	2.79E-03	3.34E-03	2.23E+00	3.57E-02	8.97E+00	5.61E-01	4.04E-01
80	FHWA1-3(Cars)	1.61E-04	6.53E-04	5.85E-05	2.75E-03	3.15E+00	1.09E-03	3.58E-01	2.85E-02	1.07E-02
80	FHWA4(Buses)	1.14E-03	1.51E-02	2.69E-03	3.67E-03	1.77E+00	3.63E-02	3.59E+00	2.69E-01	1.82E-01
80	FHWA5-7(SingleUnitTrucks)	1.01E-03	1.08E-02	1.84E-03	6.05E-03	4.57E+00	2.43E-02	2.86E+00	2.03E-01	1.34E-01
80	FHWA8-13(CombinationTrucks)	1.07E-03	1.44E-02	2.62E-03	3.13E-03	2.08E+00	3.33E-02	8.68E+00	4.58E-01	3.47E-01

Note: [1] PM_{10} and $PM_{2.5}$ shown in this table does not include road dust contribution.

Table A2c: Summary of MOVES 2021 Evening (PM) Emission Factors on a Rural Arterial Roadway (g/mile)

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
10	FHWA1-3(Cars)	6.16E-04	2.24E-03	2.01E-04	8.48E-03	7.90E+00	3.63E-03	4.86E-01	1.78E-01	3.81E-02
10	FHWA4(Buses)	5.83E-03	7.76E-02	1.38E-02	1.87E-02	5.89E+00	1.84E-01	1.30E+01	1.57E+00	9.06E-01
10	FHWA5-7(SingleUnitTrucks)	5.55E-03	5.87E-02	9.88E-03	4.12E-02	1.30E+01	1.32E-01	1.03E+01	1.50E+00	7.09E-01
10	FHWA8-13(CombinationTrucks)	5.39E-03	7.52E-02	1.35E-02	1.62E-02	7.60E+00	1.76E-01	2.17E+01	3.22E+00	1.45E+00
20	FHWA1-3(Cars)	3.73E-04	1.40E-03	1.25E-04	5.53E-03	5.97E+00	2.29E-03	3.97E-01	1.14E-01	2.70E-02
20	FHWA4(Buses)	2.82E-03	3.76E-02	6.70E-03	9.00E-03	2.74E+00	8.91E-02	6.12E+00	7.72E-01	4.40E-01
20	FHWA5-7(SingleUnitTrucks)	3.17E-03	3.25E-02	5.44E-03	2.46E-02	9.08E+00	7.30E-02	6.36E+00	8.47E-01	4.02E-01
20	FHWA8-13(CombinationTrucks)	2.85E-03	3.97E-02	7.15E-03	8.57E-03	4.60E+00	9.27E-02	1.43E+01	1.71E+00	8.91E-01
30	FHWA1-3(Cars)	2.91E-04	1.12E-03	9.95E-05	4.54E-03	5.31E+00	1.84E-03	3.79E-01	9.48E-02	2.36E-02
30	FHWA4(Buses)	1.89E-03	2.51E-02	4.46E-03	6.06E-03	1.97E+00	5.96E-02	4.27E+00	5.38E-01	3.04E-01
30	FHWA5-7(SingleUnitTrucks)	2.36E-03	2.37E-02	3.96E-03	1.83E-02	8.15E+00	5.31E-02	5.03E+00	5.89E-01	2.93E-01
30	FHWA8-13(CombinationTrucks)	1.97E-03	2.72E-02	4.91E-03	5.88E-03	3.56E+00	6.34E-02	1.23E+01	1.20E+00	7.32E-01
40	FHWA1-3(Cars)	2.42E-04	9.32E-04	8.27E-05	3.83E-03	4.20E+00	1.53E-03	3.59E-01	7.92E-02	1.86E-02
40	FHWA4(Buses)	1.60E-03	2.13E-02	3.76E-03	5.24E-03	1.95E+00	5.08E-02	4.10E+00	4.66E-01	2.68E-01
40	FHWA5-7(SingleUnitTrucks)	1.84E-03	1.84E-02	3.08E-03	1.38E-02	7.17E+00	4.12E-02	4.18E+00	4.27E-01	2.28E-01
40	FHWA8-13(CombinationTrucks)	1.58E-03	2.18E-02	3.93E-03	4.71E-03	3.08E+00	5.07E-02	1.10E+01	1.02E+00	6.48E-01
50	FHWA1-3(Cars)	2.06E-04	8.13E-04	7.26E-05	3.38E-03	3.94E+00	1.35E-03	3.30E-01	6.01E-02	1.52E-02
50	FHWA4(Buses)	1.42E-03	1.88E-02	3.32E-03	4.69E-03	1.91E+00	4.51E-02	3.95E+00	4.16E-01	2.43E-01
50	FHWA5-7(SingleUnitTrucks)	1.59E-03	1.57E-02	2.61E-03	1.20E-02	7.03E+00	3.49E-02	3.93E+00	3.66E-01	2.02E-01
50	FHWA8-13(CombinationTrucks)	1.34E-03	1.85E-02	3.34E-03	4.00E-03	2.77E+00	4.29E-02	1.07E+01	8.71E-01	5.92E-01
60	FHWA1-3(Cars)	1.86E-04	7.42E-04	6.63E-05	3.10E-03	3.59E+00	1.23E-03	3.42E-01	4.60E-02	1.32E-02
60	FHWA4(Buses)	1.25E-03	1.65E-02	2.91E-03	4.10E-03	1.75E+00	3.97E-02	3.62E+00	3.49E-01	2.09E-01
60	FHWA5-7(SingleUnitTrucks)	1.32E-03	1.36E-02	2.29E-03	9.06E-03	5.57E+00	3.05E-02	3.33E+00	2.91E-01	1.69E-01
60	FHWA8-	1.22E-03	1.68E-02	3.03E-03	3.63E-03	2.40E+00	3.89E-02	9.23E+00	6.56E-01	4.48E-01

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
	13(CombinationTrucks)									
70	FHWA1-3(Cars)	1.72E-04	6.91E-04	6.18E-05	2.90E-03	3.34E+00	1.15E-03	3.50E-01	3.61E-02	1.18E-02
70	FHWA4(Buses)	1.12E-03	1.48E-02	2.61E-03	3.67E-03	1.64E+00	3.57E-02	3.40E+00	3.02E-01	1.86E-01
70	FHWA5-7(SingleUnitTrucks)	1.15E-03	1.20E-02	2.04E-03	7.41E-03	5.04E+00	2.71E-02	3.09E+00	2.38E-01	1.49E-01
70	FHWA8-13(CombinationTrucks)	1.13E-03	1.54E-02	2.79E-03	3.34E-03	2.23E+00	3.57E-02	8.97E+00	5.61E-01	4.04E-01
80	FHWA1-3(Cars)	1.61E-04	6.55E-04	5.87E-05	2.76E-03	3.19E+00	1.10E-03	3.58E-01	2.84E-02	1.06E-02
80	FHWA4(Buses)	1.14E-03	1.51E-02	2.69E-03	3.67E-03	1.77E+00	3.63E-02	3.59E+00	2.69E-01	1.82E-01
80	FHWA5-7(SingleUnitTrucks)	1.01E-03	1.08E-02	1.84E-03	6.05E-03	4.57E+00	2.43E-02	2.86E+00	2.03E-01	1.34E-01
80	FHWA8-13(CombinationTrucks)	1.07E-03	1.44E-02	2.62E-03	3.13E-03	2.08E+00	3.33E-02	8.68E+00	4.58E-01	3.47E-01

Note: [1] PM_{10} and $PM_{2.5}$ shown in this table does not include road dust contribution.

Table A2d: Summary of MOVES 2021 Overnight (ON) Emission Factors on a Rural Arterial Roadway (g/mile)

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
10	FHWA1-3(Cars)	5.83E-04	2.12E-03	1.91E-04	8.08E-03	5.84E+00	3.45E-03	4.51E-01	1.81E-01	4.11E-02
10	FHWA4(Buses)	5.83E-03	7.76E-02	1.38E-02	1.87E-02	5.89E+00	1.84E-01	1.30E+01	1.57E+00	9.07E-01
10	FHWA5-7(SingleUnitTrucks)	5.55E-03	5.87E-02	9.88E-03	4.12E-02	1.30E+01	1.32E-01	1.03E+01	1.51E+00	7.14E-01
10	FHWA8-13(CombinationTrucks)	5.39E-03	7.52E-02	1.35E-02	1.62E-02	7.60E+00	1.76E-01	2.17E+01	3.22E+00	1.45E+00
20	FHWA1-3(Cars)	3.52E-04	1.32E-03	1.18E-04	5.25E-03	4.35E+00	2.17E-03	3.97E-01	1.17E-01	2.98E-02
20	FHWA4(Buses)	2.82E-03	3.76E-02	6.70E-03	9.00E-03	2.74E+00	8.91E-02	6.12E+00	7.73E-01	4.41E-01
20	FHWA5-7(SingleUnitTrucks)	3.17E-03	3.25E-02	5.44E-03	2.46E-02	9.08E+00	7.30E-02	6.36E+00	8.50E-01	4.05E-01
20	FHWA8-13(CombinationTrucks)	2.85E-03	3.97E-02	7.15E-03	8.57E-03	4.60E+00	9.27E-02	1.43E+01	1.71E+00	8.91E-01
30	FHWA1-3(Cars)	2.75E-04	1.05E-03	9.39E-05	4.29E-03	3.85E+00	1.74E-03	3.79E-01	9.78E-02	2.62E-02
30	FHWA4(Buses)	1.89E-03	2.51E-02	4.46E-03	6.06E-03	1.97E+00	5.96E-02	4.27E+00	5.39E-01	3.05E-01
30	FHWA5-7(SingleUnitTrucks)	2.36E-03	2.37E-02	3.96E-03	1.83E-02	8.15E+00	5.31E-02	5.03E+00	5.92E-01	2.95E-01
30	FHWA8-13(CombinationTrucks)	1.97E-03	2.72E-02	4.91E-03	5.88E-03	3.56E+00	6.34E-02	1.23E+01	1.20E+00	7.32E-01
40	FHWA1-3(Cars)	2.27E-04	8.78E-04	7.79E-05	3.62E-03	3.05E+00	1.45E-03	3.59E-01	8.12E-02	2.04E-02
40	FHWA4(Buses)	1.60E-03	2.13E-02	3.76E-03	5.24E-03	1.95E+00	5.08E-02	4.10E+00	4.66E-01	2.68E-01
40	FHWA5-7(SingleUnitTrucks)	1.84E-03	1.84E-02	3.08E-03	1.38E-02	7.17E+00	4.12E-02	4.18E+00	4.29E-01	2.30E-01
40	FHWA8-13(CombinationTrucks)	1.58E-03	2.18E-02	3.93E-03	4.71E-03	3.08E+00	5.07E-02	1.10E+01	1.02E+00	6.48E-01
50	FHWA1-3(Cars)	1.93E-04	7.64E-04	6.82E-05	3.18E-03	2.85E+00	1.27E-03	3.30E-01	6.19E-02	1.67E-02
50	FHWA4(Buses)	1.42E-03	1.88E-02	3.32E-03	4.69E-03	1.91E+00	4.51E-02	3.95E+00	4.16E-01	2.43E-01
50	FHWA5-7(SingleUnitTrucks)	1.59E-03	1.57E-02	2.61E-03	1.20E-02	7.03E+00	3.49E-02	3.93E+00	3.68E-01	2.04E-01
50	FHWA8-13(CombinationTrucks)	1.34E-03	1.85E-02	3.34E-03	4.00E-03	2.77E+00	4.29E-02	1.07E+01	8.71E-01	5.92E-01
60	FHWA1-3(Cars)	1.74E-04	6.96E-04	6.22E-05	2.92E-03	2.61E+00	1.16E-03	3.42E-01	4.77E-02	1.47E-02
60	FHWA4(Buses)	1.25E-03	1.65E-02	2.91E-03	4.10E-03	1.75E+00	3.97E-02	3.62E+00	3.49E-01	2.09E-01
60	FHWA5-7(SingleUnitTrucks)	1.32E-03	1.36E-02	2.29E-03	9.06E-03	5.57E+00	3.05E-02	3.33E+00	2.93E-01	1.70E-01
60	FHWA8-	1.22E-03	1.68E-02	3.03E-03	3.63E-03	2.40E+00	3.89E-02	9.23E+00	6.57E-01	4.48E-01

Speed (km/h)	Vehicle Class	BUT	ACT	ACR	BEN	CO	FORM	NOx	PM_{10}	$PM_{2.5}$
	13(CombinationTrucks)									
70	FHWA1-3(Cars)	1.60E-04	6.47E-04	5.79E-05	2.72E-03	2.44E+00	1.08E-03	3.50E-01	3.78E-02	1.32E-02
70	FHWA4(Buses)	1.12E-03	1.48E-02	2.61E-03	3.67E-03	1.64E+00	3.57E-02	3.40E+00	3.02E-01	1.86E-01
70	FHWA5-7(SingleUnitTrucks)	1.15E-03	1.20E-02	2.04E-03	7.41E-03	5.04E+00	2.71E-02	3.09E+00	2.40E-01	1.51E-01
70	FHWA8-13(CombinationTrucks)	1.13E-03	1.54E-02	2.79E-03	3.34E-03	2.23E+00	3.57E-02	8.97E+00	5.61E-01	4.04E-01
80	FHWA1-3(Cars)	1.50E-04	6.13E-04	5.48E-05	2.59E-03	2.33E+00	1.03E-03	3.58E-01	3.00E-02	1.21E-02
80	FHWA4(Buses)	1.14E-03	1.51E-02	2.69E-03	3.67E-03	1.77E+00	3.63E-02	3.59E+00	2.69E-01	1.82E-01
80	FHWA5-7(SingleUnitTrucks)	1.01E-03	1.08E-02	1.84E-03	6.05E-03	4.57E+00	2.43E-02	2.86E+00	2.05E-01	1.36E-01
80	FHWA8-13(CombinationTrucks)	1.07E-03	1.44E-02	2.62E-03	3.13E-03	2.08E+00	3.33E-02	8.68E+00	4.58E-01	3.47E-01

Note: [1] PM_{10} and $PM_{2.5}$ shown in this table does not include road dust contribution.

Table A3: Summary of AP-42 Re-entrained Road Dust Emission Factors

Road	Portion of Road	Direction	AM				Midday & Overnight				PM			
			Auto	Medium	Bus	Heavy	Auto	Medium	Bus	Heavy	Auto	Medium	Bus	Heavy
Airport Road	Old School Road to Old Church Road	Northbound	84.3%	4.0%	3.8%	8.0%	89.3%	4.2%	0.7%	5.7%	96.6%	1.8%	0.1%	1.4%
		Southbound	93.3%	2.2%	1.1%	3.3%	84.3%	7.2%	0.9%	7.7%	90.0%	4.5%	0.9%	4.6%
	Old Church Road to Patterson Side Road	Northbound	67.3%	10.4%	6.4%	15.9%	89.3%	4.2%	0.7%	5.7%	96.6%	1.8%	0.1%	1.4%
		Southbound	93.3%	2.2%	1.1%	3.3%	84.3%	7.2%	0.9%	7.7%	81.8%	8.9%	1.4%	8.0%
King Street	Torbram Road to Innis Lake Road	Eastbound	93.9%	0.0%	0.0%	6.1%	80.3%	0.0%	0.0%	19.7%	98.6%	0.0%	0.0%	1.4%
		Westbound	95.8%	0.0%	0.0%	4.2%	85.9%	0.0%	0.0%	14.1%	99.0%	0.0%	0.0%	1.0%
Olde Base Line Road	Mountainview Road to Airport Road	Eastbound	93.3%	2.2%	4.5%	0.0%	96.7%	0.8%	2.5%	0.0%	97.9%	1.0%	1.0%	0.0%
		Westbound	93.3%	2.2%	4.5%	0.0%	96.7%	0.8%	2.5%	0.0%	97.9%	1.0%	1.0%	0.0%
Old Church Road	Greer Street to Airport Road	Eastbound	93.0%	1.0%	4.4%	1.7%	95.9%	2.9%	0.6%	0.6%	98.2%	1.1%	0.0%	0.7%
		Westbound	93.0%	1.0%	4.4%	1.7%	95.9%	2.9%	0.6%	0.6%	98.2%	1.1%	0.0%	0.7%

Sample Calculations

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

where:

E = particulate emission factor (g/VMT);

k = particle size multiplier for particle size range and units of interest (g/VMT)

Particle Size	k (g/VMT)
$PM_{2.5}$	0.25

sL = road surface silt loading (g/m^2)

AADT Category	sL (g/VMT)
<500	0.6
500-5000	0.2
5000-10000	0.06
>10000	0.03
	0.015 (limited access)

Notes: ubiquitous baseline silt loadings were used (AP-42 CH.13.2.1).

W = average weight (tons) of the vehicle traveling the road.

	sL (g/m^2)	Heavy Weight (tons)	Medium Weight (tons)	Bus Weight (tons)	Auto Weight (tons)	Average Weight (tons)	$PM_{2.5}$
Old Church Road Eastbound	0.03	23.3	15.3	10.6	1.8	2.7	0.028

Table A4: CAL3QHCR Key Input Parameters

Parameter	Input
Meteorological Data	Year 2012 hourly surface data are from the Toronto Pearson Airport, Ontario and upper air data are from Buffalo station
Traffic Volumes	Provided by IBI
Hourly Traffic Volume Distribution	Provided by IBI
Deposition Velocity	$PM_{2.5}$ = 0.1 cm/s
Settling Velocity	$PM_{2.5}$ = 0.02 cm/s
Surface Roughness	From MTO Guidance Document, Page 47: Low Intensity Residential: 0.50 m for January
Dispersion Coefficient (Urban or Rural)	Rural

Table A5: Daily Traffic Profile

Hour of Day	ITE Hourly Distribution[1]	Airport Road Northbound[2]	Airport Road Southbound[2]	Eastbound and Westbound[2]
1:00	0.75%	0.75%	0.75%	0.75%
2:00	0.50%	0.50%	0.50%	0.50%
3:00	0.45%	0.45%	0.45%	0.45%
4:00	0.47%	0.47%	0.47%	0.47%
5:00	1.10%	1.10%	1.10%	1.10%
6:00	5.00%	1.70%	5.00%	5.00%
7:00	7.50%	2.56%	10.30%	6.70%
8:00	7.20%	5.02%	9.50%	9.66%
9:00	5.45%	4.89%	7.16%	7.42%
10:00	5.13%	4.09%	6.54%	5.48%
11:00	5.18%	3.29%	5.92%	3.53%
12:00	4.80%	3.81%	4.73%	3.72%
13:00	4.90%	5.33%	4.34%	3.64%
14:00	5.60%	5.21%	5.37%	4.35%
15:00	6.90%	7.36%	5.35%	5.34%
16:00	8.13%	10.96%	5.65%	9.14%
17:00	7.50%	13.07%	5.26%	9.47%
18:00	5.60%	11.71%	4.57%	6.54%
19:00	4.20%	4.20%	3.50%	3.20%
20:00	3.10%	3.10%	3.10%	3.10%
21:00	3.10%	3.10%	3.10%	3.10%
22:00	3.10%	3.10%	3.10%	3.10%
23:00	2.75%	2.75%	2.75%	2.75%
24:00	1.50%	1.50%	1.50%	1.50%

Note: **ITE**: Institute of Traffic Engineers

[1] Kraft, W.H.; Homburger, W.S.; and Pline, J.L. (Ed.) Traffic Engineering Handbook (6th ed.). Institute of Traffic Engineers. 2010. Page 97

[2] Hourly distribution during AM, Midday and PM were estimated based on traffic provided by IBI. Overnight hours were adopted from ITE.

APPENDIX B

Appendix B
Details of Maximum Predicted Concentrations for Future No-Build Scenario
Model Results without Ambient Background Added

	PM_{10}	$PM_{2.5}$		CO		NO_2			Acetaldehyde		Acrolein		Benzene		1,3-Butadiene		Formaldehyde
Receptor ID	**24H**	**24H**	**Ann**	**1H**	**8H**	**1H**	**24H**	**Ann**	**0.5H**	**24H**	**1H**	**24H**	**24H**	**Ann**	**24H**	**Ann**	**24H**
R1	3.85	1.47	0.36	209	86	101.8	18.4	4.5	0.24	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R2	5.01	1.85	0.66	535	152	103.2	23.0	8.2	0.27	0.05	0.03	0.01	0.07	0.02	0.01	0.00	0.10
R3	4.29	1.64	0.42	315	94	110.0	21.0	5.4	0.38	0.04	0.05	0.01	0.05	0.01	0.00	0.00	0.09
R4	3.35	1.28	0.34	289	64	68.7	16.0	4.2	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.07
R5	3.03	1.11	0.33	461	114	81.7	14.1	4.1	0.23	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.06
R6	3.35	1.26	0.28	181	77	66.1	16.0	3.5	0.18	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.07
R7	3.12	1.20	0.29	191	71	97.5	15.2	3.8	0.22	0.03	0.03	0.00	0.04	0.01	0.00	0.00	0.06
R8	2.70	1.03	0.33	189	59	86.3	13.4	4.2	0.20	0.03	0.03	0.00	0.03	0.01	0.00	0.00	0.05
R9	2.66	0.97	0.29	374	97	67.7	11.9	3.6	0.19	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R10	5.97	2.10	0.52	657	152	103.3	23.7	5.8	0.35	0.06	0.05	0.01	0.09	0.02	0.01	0.00	0.13
R11	6.78	2.38	0.61	741	172	105.9	27.0	6.9	0.40	0.07	0.05	0.01	0.10	0.02	0.01	0.00	0.15
R12	5.70	2.03	0.54	601	150	103.2	22.4	5.7	0.36	0.06	0.05	0.01	0.08	0.02	0.01	0.00	0.12
R13	4.84	1.73	0.46	608	155	101.9	19.7	5.1	0.31	0.05	0.04	0.01	0.07	0.02	0.01	0.00	0.10
R14	4.11	1.48	0.39	530	134	91.2	17.0	4.3	0.27	0.04	0.03	0.01	0.06	0.02	0.01	0.00	0.09
R15	5.93	2.15	0.57	720	162	105.8	24.6	6.3	0.40	0.06	0.05	0.01	0.09	0.02	0.01	0.00	0.13
R16	5.83	2.11	0.56	723	162	105.9	24.3	6.3	0.40	0.06	0.05	0.01	0.09	0.02	0.01	0.00	0.13
R17	3.83	1.36	0.33	458	99	87.0	15.5	3.7	0.26	0.04	0.04	0.01	0.05	0.01	0.00	0.00	0.08
R18	3.91	1.39	0.34	473	101	89.7	15.9	3.8	0.26	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.08
R19	3.91	1.42	0.37	516	131	88.8	16.3	4.1	0.26	0.04	0.03	0.01	0.06	0.02	0.01	0.00	0.09
R20	2.82	0.98	0.23	283	66	48.4	10.6	2.3	0.15	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R21	3.41	1.19	0.29	371	86	62.6	13.1	2.9	0.18	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R22	2.43	0.85	0.19	230	54	40.5	9.3	1.9	0.13	0.02	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R23	2.28	0.78	0.18	190	52	35.3	8.2	1.7	0.11	0.02	0.01	0.00	0.03	0.01	0.00	0.00	0.05
R24	3.41	1.13	0.27	180	94	43.6	11.2	2.4	0.14	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.07
R25	3.30	1.09	0.26	178	93	40.6	10.8	2.3	0.13	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R26	3.28	1.08	0.25	180	95	37.7	10.4	2.3	0.13	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R27	8.13	2.97	0.82	1048	325	109.1	33.8	9.1	0.51	0.09	0.07	0.01	0.13	0.03	0.01	0.00	0.18
R28	6.13	2.25	0.61	621	198	102.6	25.7	6.8	0.34	0.07	0.05	0.01	0.10	0.03	0.01	0.00	0.14
R29	6.71	2.43	0.65	663	216	103.6	27.6	7.2	0.37	0.07	0.05	0.01	0.11	0.03	0.01	0.00	0.15
R30	3.73	1.27	0.38	390	134	68.9	13.9	4.2	0.23	0.04	0.03	0.01	0.07	0.02	0.01	0.00	0.08
R31	2.84	0.97	0.28	298	102	55.8	10.9	3.1	0.18	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R32	2.84	0.97	0.29	278	98	56.1	10.7	3.1	0.18	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R33	3.78	1.38	0.36	328	107	66.6	15.7	4.0	0.21	0.04	0.03	0.01	0.06	0.02	0.01	0.00	0.09
R34	3.17	1.14	0.30	240	81	52.8	13.0	3.3	0.17	0.03	0.02	0.01	0.05	0.01	0.00	0.00	0.07
R35	2.76	0.99	0.26	201	73	45.0	11.2	2.8	0.14	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R36	2.65	0.94	0.25	196	73	42.1	10.6	2.7	0.13	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R37	2.70	0.90	0.27	299	88	53.1	9.9	3.0	0.17	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.05
R38	6.00	2.17	0.54	874	195	108.0	24.4	6.1	0.46	0.07	0.06	0.01	0.10	0.02	0.01	0.00	0.14
R39	4.36	1.59	0.36	631	136	102.7	18.0	4.1	0.33	0.05	0.04	0.01	0.07	0.01	0.01	0.00	0.10
R40	3.66	1.34	0.29	511	107	93.7	15.1	3.2	0.28	0.04	0.04	0.01	0.06	0.01	0.00	0.00	0.09
R41	3.52	1.27	0.32	421	135	70.8	14.2	3.6	0.22	0.04	0.03	0.01	0.06	0.01	0.01	0.00	0.08
R42	6.69	2.49	0.65	828	253	106.2	28.5	7.3	0.43	0.07	0.06	0.01	0.11	0.03	0.01	0.00	0.16
R43	5.19	1.87	0.38	576	134	102.1	20.9	4.3	0.32	0.06	0.04	0.01	0.08	0.02	0.01	0.00	0.12
R44	6.26	2.23	0.51	781	179	106.6	25.1	5.7	0.42	0.06	0.05	0.01	0.10	0.02	0.01	0.00	0.14
R45	8.08	2.94	0.82	897	284	107.5	33.6	9.2	0.48	0.08	0.06	0.01	0.12	0.03	0.01	0.00	0.18
R46	4.33	1.57	0.32	482	108	89.5	17.7	3.6	0.26	0.05	0.03	0.01	0.06	0.01	0.01	0.00	0.10
R47	4.92	1.82	0.48	526	162	93.0	20.9	5.3	0.27	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R48	7.31	2.62	0.66	940	213	110.9	29.6	7.5	0.53	0.07	0.07	0.01	0.11	0.03	0.01	0.00	0.16
R49	3.44	1.27	0.29	538	115	98.3	14.6	3.3	0.30	0.04	0.04	0.01	0.06	0.01	0.00	0.00	0.08
R50	4.24	1.61	0.39	548	165	92.4	18.7	4.5	0.29	0.05	0.04	0.01	0.07	0.02	0.01	0.00	0.10
R51	4.79	1.81	0.46	585	177	101.7	21.1	5.2	0.32	0.05	0.04	0.01	0.07	0.02	0.01	0.00	0.11
R52	2.94	1.09	0.23	465	96	82.5	12.5	2.7	0.25	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.07
R53	4.98	1.84	0.49	524	162	92.4	21.2	5.5	0.28	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R54	4.31	1.57	0.35	549	119	101.2	17.8	3.9	0.29	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R55	4.79	1.73	0.40	631	138	103.5	19.8	4.5	0.34	0.05	0.04	0.01	0.07	0.02	0.01	0.00	0.10
R56	6.22	2.28	0.63	739	205	104.2	26.3	7.1	0.39	0.06	0.05	0.01	0.09	0.02	0.01	0.00	0.13
R57	4.58	1.66	0.37	577	125	102.4	19.0	4.2	0.31	0.05	0.04	0.01	0.07	0.01	0.01	0.00	0.10
R58	4.96	1.83	0.49	577	164	96.8	21.2	5.5	0.30	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R59	4.16	1.51	0.33	493	106	95.1	17.3	3.8	0.28	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R60	4.10	1.49	0.33	485	103	94.6	17.1	3.8	0.28	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R61	3.26	1.20	0.32	376	101	64.1	14.0	3.6	0.19	0.03	0.02	0.01	0.05	0.01	0.00	0.00	0.07
R62	3.22	1.16	0.24	330	70	62.4	13.2	2.7	0.18	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R63	3.62	1.29	0.30	436	92	84.0	14.8	3.4	0.24	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R64	3.11	1.14	0.29	426	107	72.3	13.3	3.3	0.22	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R65	2.55	0.92	0.19	278	58	58.2	10.6	2.2	0.17	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R66	2.60	0.94	0.19	256	58	57.5	11.2	2.3	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R67	3.18	1.17	0.31	428	109	74.1	14.0	3.6	0.22	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R68	2.33	0.87	0.23	330	83	57.4	10.4	2.7	0.17	0.02	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R69	2.81	1.01	0.21	229	62	57.6	12.0	2.5	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R70	2.03	0.74	0.20	298	75	52.4	9.0	2.4	0.15	0.02	0.02	0.00	0.03	0.01	0.00	0.00	0.04
R71	3.15	1.14	0.34	504	127	92.9	14.5	4.3	0.25	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.06
R72	3.56	1.27	0.29	286	77	73.7	15.1	3.4	0.21	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R73	3.77	1.44	0.35	478	142	82.7	16.8	4.1	0.26	0.04	0.03	0.01	0.06	0.01	0.00	0.00	0.09
MAX	**8.13**	**2.97**	**0.82**	**1048**	**325**	**111**	**33.8**	**9.2**	**0.53**	**0.09**	**0.07**	**0.01**	**0.13**	**0.03**	**0.01**	**0.00**	**0.18**

APPENDIX C

Appendix C
Details of Maximum Predicted Concentrations for Future-Build Scenario
Model Results without Ambient Background Added

	PM_{10}	$PM_{2.5}$		CO		NO_2			Acetaldehyde		Acrolein		Benzene		1,3-Butadiene		Formaldehyde
Receptor ID	24H	24H	Ann	1H	8H	1H	24H	Ann	0.5H	24H	1H	24H	24H	Ann	24H	Ann	24H
R1	3.85	1.47	0.36	209	86	101.8	18.4	4.5	0.24	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R2	5.01	1.85	0.66	535	152	103.2	23.0	8.2	0.28	0.05	0.03	0.01	0.07	0.02	0.01	0.00	0.10
R3	4.30	1.65	0.42	315	94	110.0	21.0	5.4	0.38	0.04	0.05	0.01	0.05	0.01	0.01	0.00	0.09
R4	3.35	1.28	0.34	289	64	68.7	16.0	4.2	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.07
R5	3.05	1.12	0.33	461	114	83.3	14.1	4.1	0.23	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.06
R6	3.35	1.26	0.28	182	77	66.2	16.0	3.5	0.18	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.07
R7	3.12	1.20	0.29	191	71	97.5	15.2	3.8	0.22	0.03	0.03	0.00	0.04	0.01	0.00	0.00	0.06
R8	2.70	1.03	0.33	190	59	86.3	13.4	4.2	0.20	0.03	0.03	0.00	0.03	0.01	0.00	0.00	0.05
R9	2.66	0.97	0.29	375	97	69.6	11.9	3.6	0.20	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R10	6.02	2.13	0.54	679	159	108.6	24.2	6.0	0.49	0.06	0.06	0.01	0.09	0.02	0.01	0.00	0.13
R11	6.80	2.40	0.62	722	171	109.8	27.3	7.0	0.52	0.07	0.06	0.01	0.10	0.02	0.01	0.00	0.15
R12	6.13	2.18	0.59	626	159	107.4	24.8	6.4	0.46	0.06	0.05	0.01	0.08	0.02	0.01	0.00	0.13
R13	5.24	1.93	0.49	667	171	103.3	22.1	5.5	0.34	0.06	0.04	0.01	0.08	0.02	0.01	0.00	0.12
R14	4.49	1.66	0.41	562	143	97.2	19.1	4.6	0.29	0.05	0.04	0.01	0.06	0.02	0.01	0.00	0.10
R15	6.77	2.49	0.65	761	172	111.8	28.6	7.2	0.56	0.07	0.07	0.01	0.10	0.03	0.01	0.00	0.16
R16	6.54	2.38	0.63	764	173	111.9	27.5	7.1	0.57	0.07	0.07	0.01	0.10	0.02	0.01	0.00	0.15
R17	4.16	1.49	0.36	469	100	102.3	17.1	4.1	0.33	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R18	4.27	1.53	0.37	486	104	102.8	17.6	4.2	0.34	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R19	4.24	1.57	0.39	543	136	94.8	18.2	4.5	0.28	0.05	0.04	0.01	0.06	0.02	0.01	0.00	0.10
R20	2.97	1.04	0.24	286	67	51.7	11.4	2.4	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R21	3.62	1.28	0.30	376	87	72.8	14.2	3.1	0.23	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R22	2.55	0.90	0.20	231	54	42.5	9.9	2.0	0.13	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R23	2.38	0.83	0.18	191	52	34.8	8.7	1.8	0.11	0.02	0.01	0.00	0.04	0.01	0.00	0.00	0.05
R24	3.50	1.18	0.27	178	93	43.9	11.9	2.5	0.14	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.07
R25	3.38	1.14	0.26	176	92	41.0	11.3	2.4	0.13	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.07
R26	3.33	1.11	0.26	178	94	38.2	10.9	2.3	0.13	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R27	9.23	3.37	0.94	1178	365	112.3	38.3	10.5	0.58	0.10	0.08	0.02	0.15	0.04	0.01	0.00	0.21
R28	6.48	2.38	0.65	649	208	103.5	27.1	7.2	0.36	0.07	0.05	0.01	0.10	0.03	0.01	0.00	0.15
R29	7.13	2.59	0.69	710	230	104.7	29.3	7.7	0.40	0.08	0.05	0.01	0.11	0.03	0.01	0.00	0.16
R30	3.78	1.28	0.39	392	135	70.2	14.2	4.2	0.23	0.04	0.03	0.01	0.07	0.02	0.01	0.00	0.08
R31	2.87	0.99	0.28	299	103	56.5	11.1	3.1	0.18	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R32	2.87	0.98	0.29	279	99	56.5	10.8	3.2	0.18	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R33	3.86	1.41	0.37	331	109	70.2	16.1	4.1	0.22	0.04	0.03	0.01	0.06	0.02	0.01	0.00	0.09
R34	3.23	1.17	0.31	242	82	55.7	13.3	3.4	0.17	0.03	0.02	0.01	0.06	0.01	0.00	0.00	0.07
R35	2.80	1.01	0.26	202	74	47.1	11.4	2.9	0.15	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R36	2.69	0.95	0.25	198	74	44.5	10.8	2.7	0.14	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.06
R37	2.70	0.91	0.27	297	89	53.2	10.0	3.0	0.17	0.03	0.02	0.00	0.05	0.01	0.00	0.00	0.05
R38	5.61	2.03	0.50	814	181	106.7	22.8	5.6	0.44	0.06	0.06	0.01	0.09	0.02	0.01	0.00	0.13
R39	4.20	1.53	0.35	606	131	102.2	17.3	3.9	0.33	0.05	0.04	0.01	0.07	0.01	0.01	0.00	0.10
R40	3.57	1.30	0.28	500	105	92.1	14.7	3.1	0.27	0.04	0.04	0.01	0.05	0.01	0.00	0.00	0.08
R41	3.60	1.29	0.33	428	137	72.6	14.7	3.7	0.22	0.04	0.03	0.01	0.06	0.01	0.01	0.00	0.08
R42	7.45	2.77	0.73	910	279	108.4	31.7	8.3	0.48	0.08	0.06	0.01	0.12	0.03	0.01	0.00	0.17
R43	5.01	1.80	0.36	567	130	101.9	20.2	4.1	0.31	0.05	0.04	0.01	0.07	0.01	0.01	0.00	0.11
R44	5.85	2.09	0.47	739	170	105.6	23.5	5.3	0.40	0.06	0.05	0.01	0.10	0.02	0.01	0.00	0.13
R45	8.79	3.19	0.90	1007	309	109.7	36.4	10.1	0.53	0.09	0.06	0.01	0.13	0.04	0.01	0.00	0.19
R46	4.22	1.53	0.31	482	107	90.2	17.3	3.5	0.26	0.04	0.03	0.01	0.06	0.01	0.01	0.00	0.09
R47	5.03	1.86	0.49	529	164	94.2	21.4	5.5	0.28	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R48	6.89	2.47	0.61	893	203	109.6	28.0	6.9	0.50	0.07	0.06	0.01	0.11	0.02	0.01	0.00	0.15
R49	3.37	1.25	0.28	524	112	97.7	14.3	3.2	0.31	0.04	0.04	0.01	0.06	0.01	0.00	0.00	0.07
R50	5.02	1.87	0.45	683	205	104.8	21.6	5.2	0.39	0.05	0.05	0.01	0.08	0.02	0.01	0.00	0.11
R51	5.07	1.92	0.49	644	195	103.7	22.3	5.6	0.36	0.06	0.05	0.01	0.08	0.02	0.01	0.00	0.12
R52	2.89	1.07	0.23	457	94	83.7	12.3	2.6	0.26	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.06
R53	5.01	1.86	0.49	527	162	93.7	21.4	5.6	0.29	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R54	4.34	1.58	0.35	552	119	101.7	18.0	3.9	0.30	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R55	4.79	1.74	0.40	635	139	103.7	19.8	4.5	0.35	0.05	0.04	0.01	0.07	0.02	0.01	0.00	0.10
R56	6.24	2.29	0.63	737	206	104.2	26.4	7.1	0.39	0.06	0.05	0.01	0.09	0.02	0.01	0.00	0.14
R57	4.58	1.66	0.37	581	126	102.7	19.0	4.2	0.32	0.05	0.04	0.01	0.07	0.01	0.01	0.00	0.10
R58	4.99	1.85	0.49	576	165	96.7	21.3	5.6	0.30	0.05	0.04	0.01	0.08	0.02	0.01	0.00	0.11
R59	4.17	1.52	0.33	496	106	97.4	17.4	3.8	0.29	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R60	4.25	1.54	0.35	486	103	97.9	17.7	4.0	0.29	0.04	0.04	0.01	0.06	0.01	0.01	0.00	0.09
R61	3.39	1.26	0.32	382	102	70.3	14.8	3.7	0.22	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R62	3.26	1.17	0.24	332	71	71.0	13.4	2.7	0.22	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R63	3.91	1.41	0.33	446	94	100.4	16.2	3.7	0.31	0.04	0.04	0.01	0.05	0.01	0.01	0.00	0.09
R64	3.31	1.24	0.32	423	107	83.0	14.5	3.6	0.26	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R65	2.72	0.99	0.21	281	58	61.7	11.5	2.4	0.18	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R66	2.60	0.94	0.19	256	58	57.5	11.2	2.3	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R67	3.18	1.17	0.31	430	110	83.5	14.0	3.6	0.25	0.03	0.03	0.01	0.05	0.01	0.00	0.00	0.07
R68	2.32	0.86	0.23	331	84	63.8	10.4	2.7	0.19	0.02	0.02	0.00	0.04	0.01	0.00	0.00	0.05
R69	2.81	1.01	0.21	229	62	57.9	12.0	2.5	0.16	0.03	0.02	0.00	0.04	0.01	0.00	0.00	0.06
R70	2.03	0.74	0.20	299	76	55.9	9.0	2.4	0.16	0.02	0.02	0.00	0.03	0.01	0.00	0.00	0.04
R71	3.17	1.15	0.34	504	127	94.3	14.5	4.3	0.26	0.03	0.03	0.00	0.05	0.01	0.00	0.00	0.06
R72	3.56	1.27	0.29	286	77	73.9	15.1	3.4	0.21	0.04	0.03	0.01	0.05	0.01	0.00	0.00	0.08
R73	3.90	1.49	0.37	502	149	89.2	17.4	4.2	0.28	0.04	0.03	0.01	0.06	0.01	0.01	0.00	0.09
MAX	**9.23**	**3.37**	**0.94**	**1178**	**365**	**112**	**38.3**	**10.5**	**0.58**	**0.10**	**0.08**	**0.02**	**0.15**	**0.04**	**0.01**	**0.00**	**0.21**