# *Appendix A3*
# *Air Quality Technical Report*

# Addendum to Oshawa to Bowmanville Rail Service Extension Environmental Project Report: Air Quality Technical Report

Final

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## Limitations and Sign-off

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# Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Metrolinx, an agency of the Province of Ontario, to complete an Air Quality Impact Assessment Report for the Oshawa to Bowmanville Rail Service Extension Project (the Project) located in the City of Oshawa and the Municipality of Clarington, within the Regional Municipality of Durham, Ontario. This Assessment is to support the Addendum to the Rail Service Extension Report (EPR Addendum). This Report has been prepared in accordance with Ontario Regulation 231/08 - Transit Projects and Metrolinx Undertakings.

The Project includes the extension of GO rail service from the Durham College (DC) Oshawa GO Station[1] (formerly Oshawa GO Station) through to Bowmanville. The following Project components are proposed to be located on or adjacent to the rail corridor between the DC Oshawa GO and Bowmanville Avenue in the Municipality of Clarington (i.e., GO Subdivision Mile 11.67 in the west to CP Belleville Subdivision Mile 164.8 in the east):

- Tracking and supporting track infrastructure:
  - Proposed new track within the existing GO Lakeshore East Rail Corridor at the western limit of the Project, crossing Highway 401 via the existing General Motors (GM) Spur bridge. A new bridge will be constructed adjacent to the existing GM Spur bridge for the proposed realigned CP Rail track. The new GO track will extend north to the existing CP Rail corridor, ending at Bowmanville Avenue.
  - Retaining walls and grading to support track infrastructure
- Proposed GO Station locations in proximity to:
  - Fox Street (B1 Thornton's Corners East)
  - Front Street (B2 Ritson)
  - Courtice Road (B3 Courtice)
  - Bowmanville Avenue (B4 Bowmanville)
- New bridges at the following locations:

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[1] In October 2022, Metrolinx announced that the Oshawa GO Station has been renamed Durham College Oshawa GO. Therefore, throughout the EPR Addendum and this Project, the Oshawa GO Station is referred to as Durham College Oshawa GO, or DC Oshawa GO.

  - Highway 401
  - GM Spur
  - Oshawa Creek
  - Wilson Road
  - Farewell Creek
  - Harmony Creek
  - Green Road
- New multi-use crossing (bridge or tunnel, to be determined)
  - Front Street (Michael Starr Trail)
- Bridge replacements at the following locations:
  - Simcoe Street
  - Ritson Road
  - Farewell Street[2]
- Bridge removal at Albert Street
- Bridge expansions at the following locations:
  - DC Oshawa GO pedestrian bridge
  - Stevenson Road
  - Park Road
  - Harmony Road
  - Courtice Road
- Widening of at-grade crossings to accommodate GO track(s) at the following locations:
  - Bloor Street

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[2] Multi-use rail crossing for pedestrians and cyclists.

- Prestonvale Road
- Private crossing for Dom’s Auto
- Trulls Road
- Baseline Road (two crossings)
- Rundle Road
- Holt Road
- Private farm crossing west of Maple Grove Road
- Maple Grove Road

Further details of the Project and Project components are included in Section 1.4 and figures in Appendix A.

The purpose of this Report is to assess the potential impacts on air quality associated with the construction and operation of the Project, and to identify mitigation measures and monitoring activities for any negative impacts to air quality as a result of the construction and operation activities.

The air contaminants of interest (COI) included in this assessment are outlined in Section 2.1 and these have been selected in accordance with the Draft Metrolinx Environmental Guide: Recommended Approach for Assessing and Mitigating Air Quality Impacts and Greenhouse Gas Emissions of Metrolinx Public Transit Projects (Metrolinx Guide) (Metrolinx, 2019a) and MTO Environmental Guide for Assessing and Mitigating the Air Quality Impacts of Greenhouse Gas Emissions of Provincial Transportation Projects (MTO Guide) (MTO 2020). Section 1.5 provides an overview of the methodology undertaken for the assessment, which includes conducting air dispersion modelling using site specific information for each of the four Project components at representative worst-case locations for the construction phase and the entire GO line during the operation phase. An assessment of direct and indirect greenhouse gas (GHG) emissions from the Project is also included for both the construction phase and the operation phase.

**Air Quality Assessment – Construction**

For the construction phase, a representative worst-case location for each of the four Project components was selected for the detailed quantitative assessment (including air dispersion modelling) based on a review of the available Project design, construction activity and duration, the expected construction equipment to be used, the expected Project footprint and the receptor types and their proximities to the construction area. Rationales for their selection are provided in Table 1.2. For all modelling assessment locations, maximum construction activity levels that result in maximum emissions were assessed. Ground level concentrations (GLCs) were predicted at sensitive (residential) and critical (schools, hospitals, retirement homes, childcare centres, and similar institutional buildings) receptors identified in the vicinity of the representative locations.

Additionally, GLCs were predicted over a receptor grid extending 500-m around each location to:

- develop concentration contour plots
- identify concentration impact zones[3]
- support recommendations for mitigation where required

The results of the detailed assessment for each worst-case Project component location were applied to the other Project component locations to develop site-specific recommendations.

<u>Project Alone Predictions</u>

The dispersion modelling of air contaminants generated during construction predicted that applicable provincial and national ambient air quality criteria and standards are met for 10 of the 12 COIs. For the two that exceeded the standard, $NO_2$ and $PM_{10}$, the maximum predicted concentrations at both sensitive and critical receptors are below their applicable criteria 99.9% of the time. These predictions assume a maximum construction emissions scenario in which no additional mitigation measures other than standard methods are applied. When a construction phase exceedance is predicted to occur, the area of exceedance around the Project component is predicted to extend no greater than:

- 60 m for widening of at-grade crossings
- 100 m for GO station construction
- 10 m for tracking and grading construction
- 25 m for bridge construction

<u>Cumulative Predictions</u>

Maximum predicted cumulative concentrations (i.e., Project plus background concentrations) of COIs at sensitive and critical receptors are predicted to remain below the applicable provincial and national ambient air quality criteria and standards for 7 of the 12 COIs. For those five that exceeded a standard, $NO_2$, TSP, $PM_{10}$, benzene and benzo(a)pyrene, it is noted that: i) the 1-hour and annual average background $NO_2$ concentrations used are by themselves 67% and 118% of the 1-hour and annual

[3] A concentration impact zone is the maximum distance from the Project footprint or construction activity to where an air quality objective is predicted to be exceeded.

CAAQS, respectively; ii) the background annual benzene and 24-hour and annual benzo(a)pyrene concentrations are 119%, 278% and 858% of their respective criteria with the Project having only a minor contribution to the cumulative levels.

Construction Mitigation and Monitoring Recommendations

Based on the results of the air quality assessment, Stantec has recommended additional mitigation measures beyond those included in the modelling assessment. With the implementation of the additional mitigation measures recommended in Section 8.0 of this report, no significant adverse effects from the Project construction phase are expected. Additionally, scheduling construction activities to minimize activities that generate emissions from occurring concurrently will aid in reducing the potential for adverse effects.

Monitoring activities recommended in Section 8.0 of this report for Project construction will be implemented to verify that mitigation measures are effectively being implemented. The contractor will monitor the air quality and the weather in the vicinity of the construction activities and review the measurements on an on-going basis. When the ambient measurements indicate that concentrations are increasing and approaching an air quality action threshold, criteria or standard, remedial actions to reduce construction related emissions will be implemented by the contractor. For example, the contractor may need to apply additional dust suppressant (e.g., increasing watering amounts or frequency of application), and/or reduce the number of vehicles/equipment operating at the site.

At the time of this study, the construction project is still in the preliminary planning stages and details regarding construction activities, schedule, and operations are limited. Assumptions used in the air dispersion modelling were based on information available at the time of the study and best estimates. If the actual construction operations differ significantly from the maximum emissions scenario parameters and assumptions used in this study, the air quality impacts of the Project should be re-assessed to guide the contractor's planning of mitigation measures.

**Air Quality Assessment – Operation**

The air quality assessment for the operation phase considered Project related incremental changes in air quality due to the addition of GO trains, GO bus service and parking at the proposed GO stations. Three scenarios were assessed for Project operations:

- Baseline (2021) (i.e., existing conditions)
- Future (2031) No Build (i.e., future conditions without the Project)
- Future (2031) Build (i.e., future conditions with the Project)

Project Alone Predictions

Project Alone concentrations at special/critical receptors for the COIs are predicted to be higher in the Future Build scenario compared to the Existing and Future No Build scenarios, but below their respective AQ objectives except for nitrogen dioxide ($NO_2$) concentrations for the Future Build scenario. There is a predicted exceedance of the 1-hour average 98$^{th}$ percentile and annual CAAQS by 145% and 6% respectively. No Project Alone exceedances were predicted to occur at special receptors for the Existing and Future No Build scenarios.

Cumulative Predictions

With the addition of background concentrations, the maximum cumulative concentrations of COIs remain below their AQ objectives at sensitive and critical receptor locations for the Existing, Future No Build and Future Build scenarios other than:

- $NO_2$ for the Future Build Scenario (exceeds the 1-hour and annual 2025 CAAQS by 212% and 125%, respectively)
- Benzene for the Existing/Future No Build (exceeds the annual AAQC by 20%) and Future Build scenarios (exceeds the annual AAQC by 32%)
- Benzo(a)pyrene for the Existing/Future No Build (exceeds the 24-hour and annual AAQC by 208% and 781%) and Future Build scenarios (exceeds the 24-hour and annual AAQC by 252% and 844%)

Similar to the findings for construction, the background levels during operation of benzene and benzo(a)pyrene are above their respective air quality objectives, with the Project only contributing a small amount (less than 21%) to the cumulative levels.

**Greenhouse Gases Assessment – Construction and Operation**

Direct and indirect (third-party) GHG emissions are estimated for the Project activities during construction and operation of the Project.

Direct GHG emissions are expected during construction and operation as a result of equipment and vehicles burning hydrocarbon fuel(s). Direct construction phase emissions are estimated to be 4.1 kilotonnes of carbon dioxide equivalent (kt $CO_2$e) per year. Direct operation phase emissions are estimated to be 14.7 kt $CO_2$e/year.

Following implementation of mitigation measures, direct Project contributions to GHG emissions from annual construction and operation are estimated to be:

- 0.001% (construction) and 0.002% (operation) of Canada’s total GHG emissions
- 0.003% (construction) and 0.009% (operation) of Ontario’s total GHG emissions

- 0.002% (construction) and 0.008% (operation) of the Canadian Transportation sector emission total
- 0.008% (construction) and 0.03% (operation) of the Ontario Transportation sector emission total

Indirect (third-party) GHG emissions from electricity may be released during operation as a result of additional electrical power required to operate the stations and for wayside power. Predicted annual indirect (third-party) electricity operation emissions are estimated to be 0.4 kt $CO_2e$/year.

The GHGs released by the Project are expected to comprise 0.004% and 0.01% of the Government of Canada's and Province of Ontario's 2030 emission target, respectively.

The implementation of the Project is predicted to reduce the use of private vehicles in and near the Project footprint. Over a 60-year lifecycle, Metrolinx estimates that the Project can result in a reduction of 1.7 billion vehicle kilometers travelled and is equivalent to a reduction of up to 353 kt $CO_2e$. The reduction is estimated using a Canada specific average fuel consumption emission factor per kilometer travelled for light duty vehicles (IEA, 2019). On an annual basis, the Project can reduce up to 31 million vehicle kilometers traveled which is equivalent to 6.4 kt $CO_2e$. It is expected that over time, more electric vehicles will be deployed in the area and the electricity GHG intensity will decline, leading to less GHG savings from the project annually over time.

The preliminary GHG emissions are estimated assuming that diesel locomotives will be used for the 60-year lifecycle of the Project. This may change over time toward the use of some electrically driven locomotives. This assumption for GHG emissions from the Project is therefore conservative. Nevertheless, there is expected to be a small net increase in GHG emissions as a result of the operation of the Project. The operation of the Project is therefore not expected to help the Government of Canada or the Government of Ontario to meet its future 2030 GHG emissions targets.

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## Abbreviations

| | |
|---|---|
| AAQC | ambient air quality criteria |
| AERMOD | Air dispersion model developed by the American Meteorological Society and United States Environmental Protection Agency |
| AQ | air quality |
| CAAQS | Canadian Ambient Air Quality Standards |
| CAC | criteria air contaminants |
| CARB | California Environmental Protection Agency Air Resources Board |
| CAS | Chemical Abstracts Service |
| CCME | Canadian Council of Ministers of the Environment |
| COI | contaminant of interest |
| EA | Environmental Assessment |
| EPR | Environmental Project Report |
| FHWA | Federal Highway Administration |
| GHG | Greenhouse Gas |
| GLCs | Ground level concentrations |
| GTHA | Greater Toronto and Hamilton Area |
| HEP | Head End Power |
| IPCC | Intergovernmental Panel on Climate Change |
| ISR | In-stack ratio |
| MECP | Ontario Ministry of the Environment, Conservation and Parks |
| MOVES | U.S. EPA Motor Vehicle Emission Simulator |
| MTO | Ministry of Transportation – Ontario |
| N/A | not applicable |

| | |
|---|---|
| NAPS | National Air Pollution Surveillance |
| O. Reg. | Ontario Regulation |
| OLM | Ozone Limiting Method |
| PBL | Planetary Boundary Layer |
| Stantec | Stantec Consulting Ltd. |
| TPAP | Transit Project Assessment Process |
| U.S. EPA | United States Environmental Protection Agency |
| UTM | Universal Transverse Mercator |
| WRAP | Western Regional Air Partnership |
| WGS84 | World Geodetic System, established in 1984 |

**Units of Measurement**

| | | |
|---|---|---|
| µg | microgram | 1 x $10^{-6}$ grams |
| °C | degrees Celsius | |
| g | gram | |
| h | hour | |
| L | litre | |
| $m^3$ | cubic metre | 1 $m^3$ = 1 x $10^3$ L |
| min | minute | |
| s | second | |
| yr | year | |
| kph | kilometres per hour | |
| ppb | Part per billion | |
| ppm | Part per million | |

### Elements and Compounds

| | |
|---|---|
| B(a)P | benzo(a)pyrene |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| HC | hydrocarbon |
| $NO_x$ | nitrogen oxides |
| $NO_2$ | nitrogen dioxide |
| $PM_{2.5}$ | particulate matter with particles of diameter ≤2.5 μm |
| $PM_{10}$ | particulate matter with particles of diameter ≤10 μm |
| PAHs | polycyclic aromatic hydrocarbons |
| $SO_2$ | sulphur dioxide |
| THC | total hydrocarbon |
| TSP | total suspended particulate |
| VOC | volatile organic compounds |

# 1.0 Introduction

## 1.1 Project Overview

Stantec Consulting Ltd. (Stantec) was retained by Metrolinx, an agency of the Province of Ontario, to complete an Air Quality Impact Assessment Report) for the Oshawa to Bowmanville Rail Service Extension Project (the Project), formerly referred to as the Oshawa to Bowmanville Rail Service Extension Project in the 2011 Environmental Project Report (EPR). The Project is located in the City of Oshawa and Municipality of Clarington, within the Regional Municipality of Durham, Ontario.

## 1.2 Purpose of the Addendum to the Environmental Project Report

All-day rail service currently operates on the Lakeshore East Rail Corridor between Union Station in downtown Toronto and the Durham Collect (DC) Oshawa GO Station[4] (formerly Oshawa GO Station). The Lakeshore East Rail Corridor extension from Oshawa to Bowmanville was originally identified as one of 52 rapid transit improvements and expansion projects in the *MoveOntario* 2020 plan (Government of Ontario 2007), Ontario's multi-year $17.5 billion rapid transit action plan for the Greater Toronto and Hamilton Area (GTHA). More recently, the expansion initiative was supported through the Initial Business Case Update (Metrolinx 2020) and a preferred alignment option was selected.

The Oshawa to Bowmanville Rail Service Expansion and Rail Maintenance Facility Environmental Project Report (EPR) was completed in 2011, in accordance with the Transit Project Assessment Process (TPAP) outlined in Ontario Regulation (O. Reg.) 231/08 – Transit Projects and Metrolinx Undertakings, to assess Metrolinx's plan to expand GO Transit rail services from Oshawa to Bowmanville utilizing the Canadian Pacific (CP) Rail corridor.

[4] In October 2022, Metrolinx announced that the Oshawa GO Station has been renamed Durham College Oshawa GO. Therefore, throughout the EPR Addendum and this Project, the Oshawa GO Station is referred to as Durham College Oshawa GO, or DC Oshawa GO.

Since the completion of the 2011 EPR, Metrolinx has advanced the design of the rail extension project, including updates to the alignment and infrastructure needs of the project. As outlined in Section 15 (1) of O. Reg. 231/08, if a proponent wishes to make a change to a transit project that is inconsistent with a completed EPR, an addendum to the EPR must be prepared. In addition, as per Section 16 of O. Reg. 231/08, should a project not commence within 10 years of the Statement of Completion, a review of the project documentation is required. The Statement of Completion for the 2011 EPR is dated April 13, 2011, and more than 10 years has lapsed since the filing of this document.

An EPR Addendum Report is being undertaken to document the changes to the transit project based on refinements to the design approach identified in the EPR, and to consider relevant updates to environmental conditions since the completion of the EPR in 2011.

## 1.3 Purpose of the Air Quality Impact Assessment Report

Metrolinx is conducting preliminary planning studies and developing a conceptual design for the Project. Potential environmental effects of the Project are being assessed to meet the requirements of the O. Reg. 231/08 and the Ontario *Environmental Assessment Act*. This Air Quality Impact Assessment Report (Report) considers the potential effects to air quality resulting from activities during both construction and operation, based on the proposed tracking and grading, new GO stations, new bridges/bridge replacement/bridge expansions and upgrades to at-grade crossings. This Report will be used to support the EPR Addendum.

The purpose of this Report is to:

- Assess the potential impacts on air quality associated with the construction of the Project
- Assess the potential impacts on air quality associated with the operation of the Project
- Identify mitigation measures and monitoring activities for any negative impacts to air quality as a result of the construction and operation activities

An assessment of direct and indirect greenhouse gas (GHG) emissions from the Project is also included for both the construction and operation phases. Project GHG emissions are compared with provincial, federal and sector GHG emissions totals and the federal GHG emissions reduction target.

This Report has been prepared in accordance with Ontario Regulation 231/08 – Transit Projects and Metrolinx Undertakings and contains the information outlined in Section 1.4 below.

## 1.4 Project Description

The current Project includes the extension of GO rail service from the DC Oshawa GO through to Bowmanville, with development of four new proposed GO stations. The following Project components (Figures A.1.1 to A.1.8 in Appendix A) are proposed to be located on or adjacent to the rail corridor between the DC Oshawa GO and Bowmanville Avenue in the Municipality of Clarington (i.e., GO Subdivision Mile 11.67 in the west to CP Belleville Submission Mile 164.8 in the east):

- Tracking and supporting track infrastructure:
  - Proposed new track within the existing GO Lakeshore East Rail Corridor at the western limit of the Project, crossing Highway 401 via the existing General Motors (GM) Spur bridge. A new bridge will be constructed adjacent to the existing GM Spur bridge for the proposed realigned CP Rail track. The new GO track will extend north to the existing CP Rail corridor, ending at Bowmanville Avenue.
  - Retaining walls and grading to support track infrastructure
- Proposed GO station locations in proximity to:
  - Fox Street (B1 Thornton's Corners East)
  - Front Street (B2 Ritson)
  - Courtice Road (B3 Courtice)
  - Bowmanville Avenue (B4 Bowmanville)
- New bridges at the following locations:
  - Highway 401
  - GM Spur
  - Oshawa Creek
  - Wilson Road
  - Farewell Creek

- Harmony Creek
- Green Road

- New multi-use crossing (bridge or tunnel, to be determined):
  - Front Street (Michael Starr Trail)
- Bridge replacements at the following locations:
  - Simcoe Street
  - Ritson Road
  - Farewell Street[5]
- Bridge removal at Albert Street
- Bridge expansions at the following locations:
  - DC Oshawa GO (pedestrian bridge)
  - Stevenson Road
  - Park Road
  - Harmony Road
  - Courtice Road
- Widening of at-grade crossings to accommodate GO track(s) at the following locations:
  - Bloor Street
  - Prestonvale Road
  - Private crossing for Dom’s Auto
  - Trulls Road
  - Baseline Road (two crossings)

[5] Multi-use bridge only. Multi-use bridges can be used by pedestrians and cyclists crossing the rail corridor.

- Rundle Road
- Holt Road
- Private farm crossing west of Maple Grove Road
- Maple Grove Road

## 1.5 Assessment Methodology

The scope of this study is based on the preliminary Project design information and construction schedule available at the time of the assessment (September 2021). Where applicable, guidance from the Draft, Environmental Guide: Recommended Approach for Assessing and Mitigating Air Quality Impacts and Greenhouse Gas Emissions of Metrolinx Public Transit Projects (Draft Metrolinx Guide) (Metrolinx 2019a) and the MTO Environmental Guide for Assessing and Mitigating the Air Quality Impacts of Greenhouse Gas Emissions of Provincial Transportation Projects (MTO Guide), (MTO 2020) was followed. The methodology used in this Report is described in detail below.

**Study Area, Contaminants of Interest and Regulatory Framework**

- Establishing a study area for the Project.
- Selection of one assessment location for each of the four main Project components listed in Section 1.4 for quantitative construction and operation air quality dispersion modelling (modelling assessment locations) and establishing a study area for each location.
- Identifying the air Contaminants of Interest (COI) and greenhouse gases (GHGs).
- Reviewing applicable air quality regulatory requirements/objectives.
- Identifying air emissions associated with construction of the Project, the operation of the Project (i.e., the Future Build scenario), as well as without the Project (i.e., the Future No-build scenario).
- Identifying GHG emissions associated with direct and indirect sources during construction and operation of the Project.

**Existing Conditions**

- Reviewing ambient monitoring data available from the National Air Pollution Surveillance Network (NAPS) or the Ministry of the Environment, Conservation and Parks (MECP) to establish baseline air quality levels.

- Identifying sensitive (residential) and critical (schools, hospitals, retirement homes, childcare centres, and similar institutional building) receptors (MTO 2020) in the Project study area and the study area for each location.
- Reviewing baseline GHG emissions at the provincial and national level, as well as for the provincial and national transportation sector.

### Emission Inventory and Air Dispersion Modelling

- Conducting air dispersion modelling using site specific parameters for each of the four Project components at representative worst-case locations for the construction phase and the entire GO line during the operation phase, which entailed:
  - Developing maximum construction emissions scenarios for each of the four Project component locations and an operations emission scenario for the entire GO line based on available construction equipment and scheduling data, identification of laydown and staging areas, operation details, and road and rail line detours (if applicable).
  - Quantifying construction emissions, using standard methods and references, including the U.S. EPA AP-42: Compilation of Air Emissions Factors (U.S. EPA 2006 and 2011), Western Regional Air Partnership Fugitive Dust Handbook (WRAP 2006), U.S. EPA Exhaust Emission Standards (U.S. EPA 2016 and U.S. EPA 2020a), train and auxiliary engine load factors provided by Metrolinx (Metrolinx 2021a), and U.S. EPA's Motor Vehicle Emission Simulator (MOVES) 3 model (U.S. EPA 2020b).
  - Dispersion modelling of each Project component location using the U.S. EPA AERMOD model to predict changes in air quality during construction and operation. Impacts at identified special receptors and gridded receptors at specified spacings at each modelling location were assessed.
- Conducting a quantitative GHG assessment for the construction and operation of the Project components, including direct and indirect GHG emissions.

### Effects Assessment

- Comparing the predicted Project Alone concentrations for construction and operation at the special or gridded receptors to applicable air quality criteria, standards, or Metrolinx thresholds.
- Comparing the predicted cumulative concentrations (Project plus background levels) for construction and operation to applicable air quality criteria, standards, or Metrolinx thresholds.
- Comparing Project construction and operation emissions on an annual basis to provincial, federal and transportation sector GHG emissions totals.

- Assessing the net contribution of the Project towards Canada's GHG emissions reduction target.
- Providing recommendations for mitigation measures to be implemented to manage and mitigate emissions associated with Project construction and operation at all locations and to provide recommendations for ambient air monitoring (e.g., air contaminants to monitor, monitoring locations), if required.

## 1.6 Study Area and Selection of Air Dispersion Modelling Locations

A study area has been identified based on the Project footprint and geographic limits within which the potential impact on air quality is assessed. Study areas were also identified for the footprints of the selected modelling assessment locations for each of the Project components (refer to Appendix A Figures A.1.1 to Figure A.1.8).

The Project footprint includes the total area potentially affected by the proposed construction activities and operations of the Project, which includes the four Project components as follows:

- tracking, supporting track infrastructure, grading
- new GO stations
- new bridges, bridge replacement/expansion and bridge removal
- at-grade crossing widening

The extent of the proposed physical works from construction and operation includes, but is not limited to, roadway detours, temporary laydown areas, retaining walls, new bridges, new stations, new railway track grading, at-grade crossing upgrades and utility realignments.

The study area for the Project location encompasses the Project Footprint and the land within 500 m of the boundaries of the Project Footprint. The study area for the modelling assessment of each Project component described above encompasses the land within 500 m of the footprint of the assessed Project component.

The assessed Project component locations, potential road detours, construction activities and estimated construction durations, sensitive and critical receptors in the vicinity of the Project component locations, are provided in Table 1.1 below. A detailed list of receptors and their locations is presented in Appendix D.

One representative modelling assessment location for each of the four Project components was selected for the detailed quantitative assessment (including air dispersion modelling) based on a review of the available Project design, construction activity and duration, the expected construction equipment to be used, the expected Project footprint and the receptor types and their proximities to the construction area.

For all modelling assessment locations, maximum activity levels during construction and operation that correspond to maximum emissions scenarios were assessed in this study (described in Section 4.0).

### Table 1.1: Summary of Project Components and Construction Information

### Tracking, Supporting Track Infrastructure, Grading

| Location | Road Detours | Land Uses/Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| 18.6 km of track extending from the DC Oshawa GO to Bowmanville Avenue in the Municipality of Clarington (GO Sub Mile 11.67 in the west to Canadian Pacific [CP] Mile 164.8 in the east) | Road detours not anticipated | • Residential, commercial, institutional, and agricultural land uses are located along the track.<br>• The closest sensitive receptors are located to the west of Farewell Street, and approximately 20 m to the south of the track.<br>• The closest critical receptor is a place of worship located to the east of Farewell Street, approximately 30 m to the north of the track. | • Grading<br>• Track | • Estimated 18 months<br>• Estimated 18 months |

## GO Stations

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| B1 Thornton's Corners East | Road detours not anticipated | • Residential - 230 m to the north<br>• Commercial / industrial 35 m to the east, 50 m to the west and 150 m to the south | • Land Clearing<br>• Parking Construction<br>• Building / Platform Construction | • Estimated 1 month<br>• Estimated 9 months<br>• Estimated 24 months |
| B2 Ritson | Road detours not anticipated | • Institutional (Place of worship / community service) - 65 m to the west<br>• Residential - 10 m to 20 m to the north, east, west<br>• Industrial - 65 m to the south | | |
| B3 Courtice | Road detours not anticipated | • Residential farmhouse - 30 m to the north<br>• Agricultural land immediately to the north, east, west, and southeast<br>• Industrial - 50 m to the south | | |
| B4 Bowmanville | Road detours not anticipated | • Institutional (Senior's residence) - 20 m to the southwest<br>• Residential houses and condominiums - 40 m to the east and south, and 30 m to the southwest<br>• Commercial - 50 m to the northwest | | |

## Bridges - New Bridges

<table>
<tr><th>Location</th><th>Road Detours</th><th>Land Uses / Receptors Adjacent to Project Component Footprint</th><th>Construction Activity</th><th>Estimated Duration of Construction Activities</th></tr>
<tr><td>Highway 401</td><td>Road detours not anticipated</td><td>• Commercial / Industrial - 30 m to the southeast, 50 m to the southwest, and 140 m to the northeast<br>• Hotels - 150 m and 230 m to the southeast</td><td rowspan="4">• Utility Relocation and Road Closure<br>• Abutment Construction<br>• Span Construction<br>• Road reinstatement<br>• Site clean up</td><td rowspan="4">• Estimated 6 months<br>• Estimated 1 month<br>• Estimated 2 months<br>• Estimated 2 months<br>• Estimated 1 month</td></tr>
<tr><td>GM Spur</td><td>Road detours not anticipated</td><td>• Commercial / Industrial - 50 m to the west, 200 m to the east and south</td></tr>
<tr><td>Oshawa Creek</td><td>Road detours not anticipated</td><td>• Residential houses - over 100 m to the northeast, southeast, southwest and northwest<br>• Institutional (school) - sports field 45 m to the northwest, and school building 200 m to the northwest</td></tr>
<tr><td>Wilson Road</td><td>Road detours not anticipated</td><td>• Institutional (school) - school building 50 m to the southwest<br>• Residential houses - 6 m to the west and over 20 m to the east</td></tr>
<tr><td>Farewell Creek</td><td>Road detours not anticipated</td><td>• Residential houses - 120 m to the northeast and 250 m to the northwest<br>• Golf course - 50 m to the south</td><td rowspan="2">• Utility Relocation and Road Closure<br>• Abutment Construction<br>• Span Construction</td><td rowspan="2">• Estimated 6 months<br>• Estimated 1 month<br>• Estimated 2 months<br>• Estimated 2 months</td></tr>
<tr><td>Harmony Creek</td><td>Road detours not anticipated</td><td>• Residential houses - 65 m to the northeast, southwest and northwest</td></tr>
</table>

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| | | • Golf course and driving range - 50 m to the southwest and 25 m to the southeast | • Road reinstatement<br>• Site clean up | • Estimated 1 month |
| Green Road | Road detours not anticipated | • Residential apartments - 30 m to the southeast and southwest<br>• Residential houses - 100 m to the west and northwest<br>• Residential houses - 400 m to the northeast | | |

## New Multi-use Crossing - (bridge or tunnel, to be determined)

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Front Street (Michael Starr Trail) | Road detours not anticipated | • Residential houses - 5 m to the northwest and 15 m to the south<br>• Institutional (place of worship and community centre) - 75 m to the southwest | • Utility Relocation and Road Closure<br>• Abutment Construction<br>• Span Construction<br>• Road reinstatement<br>• Site clean up | • Estimated 6 months<br>• Estimated 1 month<br>• Estimated 2 months<br>• Estimated 2 months<br>• Estimated 1 month |

## Bridges - Bridge Replacement

<table>
<tr><th>Location</th><th>Road Detours</th><th>Land Uses / Receptors Adjacent to Project Component Footprint</th><th>Construction Activity</th><th>Estimated Duration of Construction Activities</th></tr>
<tr><td>Simcoe Street</td><td>Potential road detours</td><td>• Commercial - 10 m to 15 m to the east and west<br>• Residential houses - 5 m to the west, 90 m to the east<br>• Institutional (Community services) - 10 m to the east. Institutional (place of worship) - 30 m and 150 m to the northeast</td><td rowspan="3">• Utility Relocation and Road Closure<br>• Demolition of existing bridge<br>• Abutment Construction<br>• Span Construction<br>• Road reinstatement<br>• Site clean up</td><td rowspan="3">• Estimated 6 months<br>• Estimated 1 month<br>• Estimated 1 month<br>• Estimated 2 months<br>• Estimated 2 months<br>• Estimated 1 month</td></tr>
<tr><td>Ritson Road</td><td>Potential road detours</td><td>• Residential houses - 10 m to the east and west, 30 m to the southwest, and 20 to 40 m to the northeast and northwest.<br>• Institutional (places of worship) - 8 m to the west/southwest. Institutional (place of worship and school) - 60 m and 110 m to the north<br>• Commercial - 45 m to the east</td></tr>
<tr><td>Farewell Street</td><td>Road detours not anticipated</td><td>• Residential houses - 20 m to the northeast, 15 m to 20 m to the southeast and southwest<br>• Institutional (place of worship) - 50 m to the northwest and 150 m to the east<br>• Institutional (daycare) - 100 m to the northwest</td></tr>
</table>

## Bridges - Bridge Removal

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Albert Street | Road detours not anticipated | • Residential houses - 10 m to 15 m to the northwest, northeast and southeast<br>• Institutional (place of worship and community centre) 10 m to the east | • Utility Relocation and Road Closure<br>• Demolition of existing bridge<br>• Site clean up | • Estimated 6 months<br>• Estimated 1 month<br>• Estimated 1 month |

## Bridges - Bridge Expansion

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Stevenson Road | Potential road detours | • Agricultural land - 50 m to the northeast<br>• Commercial - 30 m to the northwest, 70 m to the southeast, and 100 m to the northeast<br>• Residential houses - 35 m to the southeast and 80 m to the northwest | • Removals and Site Preparation<br>• New soldier pile with concrete lagging and replacement of the south abutment Site clean up | • Estimated 1 month<br>• Estimated 4 months<br>• Estimated 1 month |
| Park Road | Potential road detours | • Residential houses - 25 m to 40 m to the northeast, northwest, southeast and southwest | | |
| Harmony Road | Potential road detours | • Residential houses - 30 m to the northeast, 15 m to the southwest and 70 m to the southeast and northwest | | |

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| | | • Institutional (place of worship and community centre) 110 m to the northwest | | |
| Courtice Road | Potential road detours | • Residential houses - 250 m to the northwest and southeast, and 300 m to the southwest.<br>• Agricultural land - immediately northeast, northwest and southeast.<br>• Commercial - 50 m to the southwest. | | |

## Widening of At-grade Crossings

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Bloor Street | Potential road detours | • Residential houses - 150 m to the north and southeast<br>• Undeveloped land / park immediately to the southeast, southwest and northwest<br>• Commercial - 100 m to the north | • Removals and Reconstruction (Grading work at the tracks near the crossing, which is part of the construction activities for the Project component. Tracking, Supporting | • Typically, 2-3 days and maximum of 2 weeks per crossing |
| Prestonvale Road (crossing may be closed instead) | Potential road detours | • Residential house - 20 m to the west<br>• Agricultural / undeveloped land immediately to the east and west | | |

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Private crossing for Dom's Auto | Potential road detours | • Residential house - 80 m and 140 m southeast<br>• Industrial - 20 m to the north and south<br>• Agricultural land to the northeast and northwest | Track Infrastructure, and Grading, may occur concurrently with construction for Widening of Crossings.) | |
| Trulls Road | Potential road detours | • Residential house - 80 m to the southwest<br>• Agricultural / undeveloped land immediately to the east and west<br>• Industrial - 30 m to the east<br>• Commercial (storage depot) - 100 m to the west | | |
| Baseline Road (M168.22) | Potential road detours | • Residential house - 55 m to the southwest<br>• Undeveloped land immediately to the northeast and northwest<br>• Industrial - 50 m to the southwest, and 100 m to the southeast | • Removals and Reconstruction (Grading work at the tracks near the crossing, which is part of the construction activities for the Project component. Tracking, Supporting Track Infrastructure, and Grading, may occur concurrently | • Typically, 2-3 days and maximum of 2 weeks per crossing |
| Rundle Road | Road detours not anticipated | • Residential houses - 25 m to the west, 35 m to the southeast, and 50 m to the northwest<br>• Agricultural / undeveloped land immediately east, north and west<br>• Commercial (pigeon racing club) - 20 m to the east | | |

| Location | Road Detours | Land Uses / Receptors Adjacent to Project Component Footprint | Construction Activity | Estimated Duration of Construction Activities |
|---|---|---|---|---|
| Baseline Road (M166.92) | Potential road detours | • Residential houses - 60 m to the north, 100 m to the southeast<br>• Agricultural / undeveloped land immediately east and west | with construction for Widening of Crossings.) | |
| Holt Road | Potential road detours | • Residential houses - 90 m to the west, and 100 m to the southeast | | |
| Private farm crossing west of Maple Grove Road | Potential road detours | • Residential house – 340 m to the south | | |
| Maple Grove Road | Potential road detours | • Residential house - 200 m to the north | | |

The representative locations and construction activity selected for each of the four Project components for the construction phase, along with the rationale for their selection are provided in Table 1.2.

The operations phase will assess all Project components along the entire length of the proposed train corridor between the DC Oshawa GO and the proposed B4 GO Station.

**Table 1.2: Selection of Modelling Assesment Locations - Construction**

| Project Component | Location | Construction Activity | Rationale |
|---|---|---|---|
| Tracking, supporting track infrastructure, grading | 300 m segment of track west of Farewell Street Multi-use Bridge to west of Harmony Road Bridge | Grading | Multiple critical and sensitive receptors were identified to be closest to this segment of the track compared with other locations:<br>• Critical receptors include places of worship located 30 m and 90 m north and a daycare located 145 m north of the proposed track.<br>• Multiple sensitive receptors (residential houses) are located along the proposed track. The closest is within 20 m.<br>Grading was selected for modelling as the worst-case construction equipment fuel combustion emissions are expected from the grading activities (refer to Section 4.1 for additional detail). |
| GO Station | B4 Bowmanville | Land Clearing | Multiple critical and sensitive receptors were identified to be closest to this GO station compared with the other GO station locations:<br>• Critical receptor (senior's residence) located approximately 20 m to the southeast of the proposed GO station footprint.<br>• Multiple sensitive receptors (residential houses and condominiums) are located within 40 m to the east, west and south of the proposed GO station.<br>Land Clearing was selected for modelling as the worst-case fugitive dust emissions and worst-case |

| Project Component | Location | Construction Activity | Rationale |
|---|---|---|---|
| | | | construction equipment fuel combustion emissions are expected from the Land Clearing activity (refer to Section 4.1 for additional detail). |
| Bridges - New / Replacement / Expansion | Simcoe Street Bridge | Road Reinstatement | Multiple critical receptors were identified to be closer to the Simcoe Street Bridge footprint relative to the other bridge locations:<br>• The closest critical receptor is a community centre located 10 m to the north. Places of worship are located approximately 40 m to the north, 170 m to the northeast, 180 m to the east, 180 m and 230 m to the south of the proposed bridge footprint. There are also two schools approximately 370 m to the north and 475 m to the west.<br>Bridge replacement has the longest construction period compared with construction of new bridges or bridge expansions. Bridge replacements require demolition of the existing bridge and road work construction (including profiling, compaction of subgrade, asphalt paving) which are not required when constructing new bridges or bridge expansions.<br>The Simcoe Street bridge is considered to be the worst-case bridge assessment location since the replacement will require demolishing the entire existing bridge (from Fisher Street to Albany Street), and then rebuilding the area. The construction area is also located in a relatively confined area with buildings in close proximity along both sides of the street which can potentially cause disturbance to the nearby properties.<br>Road detours will be required during the Simcoe Street Bridge replacement construction. In addition to receptors near Simcoe Street Bridge, receptors along road detours may be impacted. |

| Project Component | Location | Construction Activity | Rationale |
| --- | --- | --- | --- |
| | | | Road Reinstatement was selected for modelling since it can potentially result in the highest construction equipment fuel combustion emissions and fugitive dust emissions (refer to Section 4.1 for additional detail). |
| At-grade crossing widening | Rundle Road crossing | Removals and Reconstruction | A sensitive receptor was identified to be closest to the Rundle Road crossing compared with other crossing locations:<br>• A residential house is located 25 m to the west of the crossing footprint.<br>Construction equipment, schedule and activities are similar for all at-grade crossing widenings. A worst-case emissions scenario was assumed for the assessment based on available construction details.<br>As a conservative assumption, it was assumed that during the at-grade crossing widening, grading at the tracks may occur at the same time and emissions from grading were included in the assessment. |

Design drawings for each of the modelling assessment locations as well as for the other Project component locations are provided in Appendix A.

## 1.7 Study Area for GHG Assessment

The study area for the GHG assessment encompasses the direct emissions in the Project footprint, as well as indirect emissions from the use of electricity in the Project footprint. Since GHG emissions affect the atmosphere globally, the GHG emissions from the Project are assessed in the context of provincial and national baseline and 2030 emissions targets. This approach aligns with guidance from Environment and Climate Change Canada’s Strategic Assessment of Climate Change document (ECCC 2020a).

# 2.0 Contaminants of Interest and Regulatory Overview

## 2.1 Air Contaminants of Interest

Ambient air quality in the Project study area is influenced by emissions from local residential / commercial / industrial sources and vehicular traffic. The air contaminants of interest (COI) for the Project during construction include the products of diesel and gasoline combustion and dust generated from road traffic and construction equipment. The COI expected during operations come from the combustion of natural gas and diesel combustion products (e.g., from comfort heating units, emergency generators, trains).

The COI selected for the assessment were based on those regularly assessed in construction and transportation assessments in Ontario. Their selection was based on guidance from the Draft Metrolinx Guide (Metrolinx 2019a) and the MTO Guide (MTO 2020).

For this assessment, the COI are therefore:

- nitrogen dioxide ($NO_2$)
- carbon monoxide (CO)
- sulphur dioxide ($SO_2$)
- total suspended particulate matter (TSP)
- particulate matter less than 10 microns ($PM_{10}$)
- particulate matter less than 2.5 microns ($PM_{2.5}$)
- crystalline silica
- acrolein
- benzene
- 1,3-butadiene
- acetaldehyde
- formaldehyde
- benzo(a)pyrene [B(a)P]

## 2.2 Greenhouse Gases

The sources of direct GHG emissions from the Project are expected to be the same fossil fuel combustion sources noted in Section 2.1. The GHG emissions assessment also includes indirect emissions from the use of purchased electricity at the Project site during operation.

ECCC's National Inventory Report (ECCC 2022) identifies the following GHGs:

- carbon dioxide ($CO_2$)
- methane ($CH_4$)
- nitrous oxide ($N_2O$)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- nitrogen trifluoride ($NF_3$)
- sulphur hexafluoride ($SF_6$)

The Project is expected to result in the release of $CO_2$, $CH_4$ and $N_2O$. No significant sources of HFCs, PFCs, $NF_3$ or $SF_6$ are expected during the construction and operation of the Project.

Total GHG emissions are normally reported as carbon dioxide equivalent ($CO_2e$), whereby emissions of each of the specific GHGs are multiplied by their global warming potential (GWP) factors from ECCC's most recent National Inventory Report (ECCC 2022) and are reported as $CO_2e$. A GWP is a measure of the warming effect that the emission of a GHG might have on the atmosphere relative to carbon dioxide (ECCC 2022). The 100-year GWPs for the assessed GHGs are $CO_2$ = 1.0, $CH_4$ = 25, and $N_2O$ = 298 which are consistent with the methods in Canada's submission to the United Nations Framework Convention on Climate Change (ECCC 2022).

## 2.3 Regulatory Framework - Air Contaminants

Table 2.1 presents a summary of the pertinent air quality objectives, guidelines, and standards for the COI according to the following applicable air contaminant guidelines from relevant agencies and organizations in Canada:

- Ontario Ambient Air Quality Criteria (AAQC) (MECP 2020b)
- Canadian Ambient Air Quality Standards (CAAQS) (CCME 2021)
- Metrolinx mitigation thresholds for construction projects (Metrolinx 2019a)

The Metrolinx mitigation thresholds are 15-minute exposure values provided in the Draft Metrolinx Guide (Metrolinx 2019a). The intent of this guideline is for managing temporarily elevated concentrations of particulate matter from construction projects. If the 15-minute threshold is exceeded by more than 20% during two consecutive 15-minute periods, mitigation measures, including stopping the activity generating the emission, will be implemented.

The Ontario AAQC, current 2020 CAAQS, proposed 2025 CAAQS, and Metrolinx mitigation thresholds are listed in Table 2.1. The 2020 CAAQS are applicable to the existing ambient conditions. The proposed 2025 CAAQS will be applicable when the Project begins operations in 2026.

### Table 2.1: Applicable Air Quality Objectives and Mitigation Thresholds

| Air Contaminant | Averaging Time | AAQC ($\mu g/m^3$) | 2020 CAAQS ($\mu g/m^3$) | 2025 CAAQS ($\mu g/m^3$) | Metrolinx Mitigation Threshold ($\mu g/m^3$) |
|---|---|---|---|---|---|
| $NO_2$ | 1-hour | 400 | 119 [a] | 83 [b] | - |
| | 24-hour | 200 | - | - | - |
| | Annual | - | 34 [a] | 24 [b] | - |
| CO | 1-hour | 36,200 | - | - | - |
| | 8-hour | 15,700 | - | - | - |
| $SO_2$ | 10-minute | 180 | | | |
| | 1-hour | 100 | 193 [e] | 179 [f] | - |
| | Annual | 10 | 14 [e] | 11 f | - |
| TSP | 24hour | 120 | - | - | - |
| | Annual | 60 | - | - | - |
| $PM_{10}$ | 15-minute | - | - | - | 150 [c] |
| | 24-hour | 50 | - | - | - |
| $PM_{2.5}$ | 15-minute | - | - | - | 81 [c] |
| | 24-hour | 27 | 27 [d] | - | - |
| | Annual | - | 8.8 [e] | - | - |
| Crystalline Silica | 15-minute | - | - | - | 25 [c] |
| | 24-hour | 5 | - | - | - |
| Benzene | 24-hour | 2.3 | - | - | - |
| | Annual | 0.45 | - | - | - |

| Air Contaminant | Averaging Time | AAQC ($\mu g/m^3$) | 2020 CAAQS ($\mu g/m^3$) | 2025 CAAQS ($\mu g/m^3$) | Metrolinx Mitigation Threshold ($\mu g/m^3$) |
|---|---|---|---|---|---|
| 1, 3 Butadiene | 24-hour | 10 | - | - | - |
| | Annual | 2 | - | - | - |
| B(a)P | 24-hour | 0.00005 | - | - | - |
| | Annual | 0.00001 | - | - | - |
| Acetaldehyde | ½ hour | 500 | - | - | - |
| | 24-hour | 500 | - | - | - |
| Acrolein | 1-hour | 4.5 | - | - | - |
| | 24-hour | 0.4 | - | - | - |
| Formaldehyde | 24-hour | 65 | - | - | - |

Notes:

[a] 1 Hour and Annual CAAQS for $NO_2$, effective by 2020 (CCME 2021). The 1-hour CAAQS is referenced to the 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations. The annual CAAQS is the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to $\mu g/m^3$ based on standard temperature of 10°C and pressure of 1 atm as per MTO Guide (MTO 2020).

[b] 1 hour and annual CAAQS for $NO_2$, effective by 2025 (CCME 2021). The 1-hour CAAQS is referenced to the 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations. The annual CAAQS is the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to $\mu g/m^3$, based on a standard temperature of 10°C and pressure of 1 atm as per MTO Guide (MTO 2020).

[c] Metrolinx 15-minute mitigation threshold for managing temporary but high concentrations of particulate matter from construction projects, based on the Draft Metrolinx Guide (Metrolinx 2019a).

[d] 24 hour and annual CAAQS for respirable particulate matter, effective by 2020 (CCME 2021). The 24-hour CAAQS is referenced to the 98th percentile daily average concentration averaged over 3 consecutive years. The annual CAAQS is referenced to the 3-year average of the annual average concentrations.

[e] 1 Hour and Annual CAAQS for $SO_2$, effective by 2020 (CCME 2021). The 1-hour CAAQS is the 3-year average of the annual 99th percentile of the $SO_2$ daily maximum 1-hour average concentrations. The annual CAAQS is referenced to the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to $\mu g/m^3$ based on a standard temperature of 10°C and pressure of 1 atm as per MTO Guide (MTO 2020).

[f] 1 hour and annual CAAQS for $SO_2$, effective by 2025 (CCME 2021). The 1 Hour CAAQS is the 3-year average of the annual 99th percentile of the $SO_2$ daily maximum 1-hour average concentrations. The annual CAAQS is the average over a single calendar year of all 1-hour average concentrations. The criteria were converted from ppb to $\mu g/m^3$, based on a standard temperature of 10°C and pressure of 1 atm as per MTO Guide (MTO 2020).

## 2.4 Regulatory Framework - Greenhouse Gases

Direct Project construction and operation GHG emission totals are compared to the emission totals from:

- Canada in 2020 (ECCC 2022)
- Ontario in 2020 (ECCC 2022)
- Canadian and Ontario transportation sectors in 2020 (ECCC 2022)
- Federal 2030 and 2050 GHG emissions targets (*Canadian Net-Zero Emissions Accountability Act)*
- Ontario 2030 GHG emission target (MECP 2018c)

There are no provincial or federal GHG emission limits for specific equipment or facilities.

# 3.0 Existing Conditions

Ambient air quality in the Study Area is influenced by emissions from residential, commercial and industrial sources as well as vehicular traffic. Meteorology and climatology play an important role in contaminant formation, dispersion and transport. The local meteorology and ambient air quality data are discussed in this section.

## 3.1 Climate

The following sections describe the general climatology of the Study Area. The climatology is based on 30-year (1981 to 2010) Canadian Climate Normal data obtained from ECCC for the Oshawa Water Pollution Control Plant (WPCP) and Toronto Buttonville Airport meteorological stations which are the closest stations to the Study Area with complete climate normal data.

### 3.1.1 Temperature

A summary of the daily average, daily maximum and daily minimum temperatures on a monthly basis over the period 1981 to 2010 is presented in Table 3.1. The daily average temperature for the area varies from -4.8°C to 20.6°C with an annual average temperature of 8.1°C.

**Table 3.1: Summary of Average Temperature Data**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily Average (°C) | -4.8 | -3.6 | 0.4 | 6.6 | 12.3 | 17.6 | 20.6 | 20 | 15.9 | 9.5 | 4.2 | -1.2 | 8.1 |
| Daily Maximum (°C) | -1.1 | 0.1 | 4.2 | 10.8 | 16.9 | 22.3 | 25.1 | 24.3 | 20.2 | 13.3 | 7.4 | 2.1 | 12.1 |
| Daily Minimum (°C) | -8.5 | -7.3 | -3.5 | 2.5 | 7.7 | 12.9 | 15.9 | 15.6 | 11.7 | 5.6 | 1 | -4.4 | 4.1 |

SOURCE: Environment and Climate Change Canada Canadian Climate Normal - Oshawa WPCP meteorological station

### 3.1.2 Precipitation

A summary of the monthly average rainfall, snowfall, total precipitation (as equivalent rainfall based on a conversion factor for snowfall to equivalent rainfall of 0.1) and average snow depth on a monthly basis over the period 1981 to 2010 is presented in Table 3.2. The annual average total precipitation for the area is about 871.9 millimetres (mm).

**Table 3.2: Summary of Average Precipitation Data**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall (mm) | 30 | 31.7 | 40.7 | 70.6 | 78.9 | 73.9 | 73.1 | 77.4 | 94 | 70 | 80 | 45.8 | 766.1 |
| Snowfall (cm) | 35.6 | 24.9 | 13.5 | 2 | 0 | 0 | 0 | 0 | 0 | 0.1 | 4.7 | 24.9 | 105.8 |
| Precipitation (mm) | 65.6 | 56.6 | 54.2 | 72.7 | 78.9 | 73.9 | 73.1 | 77.4 | 94 | 70.1 | 84.8 | 70.7 | 871.9 |

SOURCE: Environment and Climate Change Canada Canadian Climate Normal - Oshawa WPCP meteorological station

### 3.1.3 Humidity

A summary of the average morning and afternoon relative humidity on a monthly basis over the period 1981 to 2010 is presented in Table 3.3. The annual average relative humidity in the morning is 81.8% and in the afternoon is 60.1%.

**Table 3.3: Summary of Average Relative Humidity Data**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Relative Humidity - 0600LST (%) | 79.6 | 77.6 | 77.2 | 76.1 | 77.9 | 79.3 | 82.5 | 87.4 | 89.6 | 87.6 | 85.1 | 82.1 | 81.8 |
| Average Relative Humidity - 1500 LST [(a)] (%) | 69.6 | 64 | 57.8 | 52.9 | 52.3 | 53.9 | 53.4 | 55.9 | 59.2 | 62.4 | 68.9 | 71.1 | 60.1 |

SOURCE: Environment and Climate Change Canada Canadian Climate Normal - Toronto Buttonville Airport meteorological station

Note:

a) Average relative humidity for 3:00 PM local standard time.

### 3.1.4 Wind Speed and Direction

The climate normal data with respect to wind speed and directionality over the period of 1981 to 2010 are presented in Table 3.4. The annual average wind speed for the area is 12.4 km/h and the most frequent wind direction, on an annual basis, is wind blowing from the northwest.

**Table 3.4: Summary of Wind Data**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Speed (km/h) | 14 | 13.9 | 13.8 | 13.9 | 12.3 | 11.4 | 10.7 | 10 | 10.6 | 11.6 | 12.9 | 13.4 | 12.4 |
| Most Frequent Direction (a) | SW | W | NW | NW | NW | NW | NW | N | N | W | W | W | NW |
| Max Hourly Speed (km/h) | 65 | 65 | 67 | 56 | 57 | 50 | 65 | 56 | 52 | 56 | 80 | 54 | 80 |
| Max Gust Speed (km/h) | 111 | 100 | 111 | 89 | 87 | 111 | 135 | 102 | 83 | 104 | 111 | 93 | 135 |
| Direction of Max Gust (a) | W | N | W | NW | NW | NW | NW | NW | NW | W | SW | W | SW |

SOURCE: Environment and Climate Change Canada Canadian Climate Normal - Toronto Buttonville Airport meteorological station

Note:

a) denotes the direction *from which* the wind is blowing most frequently.

## 3.2 Ambient Air Quality Background Levels

Background concentrations are used in dispersion modelling to represent the cumulative effect of other emissions sources (i.e., both anthropogenic and biogenic) in addition to the sources being included in the dispersion modelling. The Draft Metrolinx Guide (Metrolinx 2019a) and MTO Guide (MTO 2020) recommend that the background pollutant concentration levels to be used in this analysis are the 90$^{th}$ percentile of the most recently measured and complete concentration data from the nearest MECP or ECCC monitoring stations. The use of 90$^{th}$ percentile levels is to account for spatial and temporal variations between the monitoring location(s) and the Study Area, while still providing a conservative assessment. The background levels used in this study were therefore the 90$^{th}$ percentile values for short-term averages. For annual averages, an annual average value was used as the background level.

The background air quality concentrations were based on review and analyses of the most recent five years (2016-2020) of data currently available from the NAPS monitoring stations located closest to or most representative of the Project locations. Ambient monitoring data from the NAPS program provides accurate and long-term air quality data of a uniform standard across Canada. The stations reviewed are listed in Table 3.5 below.

Monitoring data for $PM_{2.5}$, crystalline silica, $NO_2$, $SO_2$, CO, PAHs (benzo(a)pyrene), VOCs (benzene and 1,3-butadiene), and Carbonyls (acrolein, acetaldehyde and formaldehyde) were obtained and reviewed from the identified NAPS stations. Background ozone ($O_3$) concentrations, which are used in the dispersion model predictions of NO to $NO_2$ conversion, were obtained from the Toronto West station.

Background concentrations for TSP and $PM_{10}$ were estimated by assuming a ratio of $PM_{2.5}/PM_{10} = 0.54$ and $PM_{2.5}/TSP = 0.30$ (Lall et al. 2004). Data sets that were not included in the assessment as they were considered invalid per MECP guidelines (MECP, 2018a) are also noted in Table 3.5.

### Table 3.5: NAPS Locations and Data Considered in the Assessment

| NAPS ID | Location | Station Name | COI [a, b] | Availability of Data |
|---|---|---|---|---|
| 060430 | 125 Resources Road | Toronto West | CO | 2016-2020 |
| | | | $NO_2$, $PM_{2.5}$, $O_3$ | 2016-2020 |
| | | | $SO_2$ | 2016-2020 |
| | | | B(a)P | 2016-2018 [c] |
| 060438 | 401W - 125 Resources Road | Roadside 401W Toronto | B(a)P | 2017-2019 [d] |
| | | | 1,3-butadiene, benzene | 2017-2019 [e] |
| | | | formaldehyde, acetaldehyde | 2017-2019 [d] |
| | | | acrolein | 2017-2018 [f] |
| | | | crystalline silica [g] | 2017-2019 [d] |
| 061703 | Britannia Ave West, U of Ontario Property | Oshawa | $NO_2$, $PM_{2.5}$, $O_3$ | 2016-2020 |

Notes:

a) Only air contaminants pertinent to this study are listed.
b) Grey shaded data were selected for the study. Non-shaded data were not selected.
c) No data available for 2019 and 2020. Data availability is less than 75% for 2018.
d) No data available for 2016 and 2020.
e) No data available for 2016. Data availability is less than 75% for 2018 and 2020.
f) No data available for 2016, 2019 and 2020.
g) Background concentration of crystalline silica is conservatively based on ambient monitoring data for silicon converted to $SiO_2$ based on their molecular weights. Crystalline silica ($SiO_2$) molecular weight – 60 g/mol, Silicon (Si) molecular weight – 28 g/mol. This approach is expected to be conservative as it assumes all measured silicon is in the form of crystalline silica.

Background ambient air quality concentrations at the Toronto West and Roadside 401W Toronto stations are expected to be representative of ambient concentrations in the Study Area since the Project is located in close proximity to Highway 401.

The background ambient air quality concentrations are compared with applicable AQ Objectives in Table 3.6. Background levels for the COIs are below their applicable objectives with the noted exceptions of $NO_2$, benzene and B(a)P. The annual background concentration of $NO_2$ exceeds the 2025 CAAQS by 18% and the annual background concentration of benzene exceeds the AAQC by 19%. Background concentrations of B(a)P for both 24-hour and annual averaging periods are almost twice and seven and a half times the applicable criteria, respectively. Exceedances of the AAQC for B(a)P are commonly measured in Ontario.

### Table 3.6: Summary of Background Ambient Air Quality Concentrations

| COI | Averaging Period (hours) | Background Concentration (µg/m³) | Air Quality Objectives (µg/m³) | Source of Objective | % of Criteria [i] |
|---|---|---|---|---|---|
| $NO_2$ [a] | 1 | 55 | 400 | AAQC | 14% |
| | | | 119 | 2020 CAAQS | -[c] |
| | | | 83 | 2025 CAAQS | -[c] |
| | 24 | 45 | 200 | AAQC | 23% |
| | Annual | 28 | 34 | 2020 CAAQS | 84% |
| | | | 24 | 2025 CAAQS | **118%** |
| CO [a] | 1 | 422 | 36,200 | AAQC | 1% |
| | 8 | 402 | 15,700 | AAQC | 3% |
| $SO_2$ [a] | 10-minute | 4.6 [g] | 180 | AAQC | 2% |
| | 1 | 2.8 | 100 | AAQC | 3% |
| | | | 193 | 2020 CAAQS | -[d] |
| | | | 179 | 2025 CAAQS | -[d] |
| | Annual | 1 | 10 | AAQC | 10% |
| | | | 14 | 2020 CAAQS | 8% |
| | | | 11 | 2025 CAAQS | 10% |
| TSP [e] | 24 | 41 | 120 | AAQC | 34% |
| | Annual | 24 | 60 | AAQC | 40% |
| $PM_{10}$ [e] | 15-minute | 38 [g] | 150 | Metrolinx | 25% |
| | 24 | 23 | 50 | AAQC | 45% |
| $PM_{2.5}$ | 15-minute | 21 [g] | 81 | Metrolinx | 25% |
| | 24 | 12 | 27 | 2020 CAAQS | -[f] |
| | Annual | 7.2 | 8.8 | 2020 CAAQS | -[f] |
| Crystalline silica [h] | 15-minute | 7.4 [g] | 25 | Metrolinx | 29% |
| | 24 | 2 | 5 | AAQC | 41% |
| Benzene | 24 | 0.77 | 2.3 | AAQC | 34% |
| | Annual | 0.53 | 0.45 | AAQC | **119%** |
| 1,3-butadiene | 24 | 0.08 | 10 | AAQC | 1% |
| | Annual | 0.06 | 2 | AAQC | 3% |
| B(a)P | 24 | 0.000139 | 0.00005 | AAQC | 278% |
| | Annual | 0.000086 | 0.00001 | AAQC | **858%** |

| COI | Averaging Period (hours) | Background Concentration (µg/m³) | Air Quality Objectives (µg/m³) | Source of Objective | % of Criteria [i] |
|---|---|---|---|---|---|
| Formaldehyde | 24 | 3 | 65 | AAQC | 5% |
| Acetaldehyde | 0.5 [g] | 9 | 500 | AAQC | 2% |
| | 24 | 3 | 500 | AAQC | 1% |
| Acrolein | 1 [g] | 0.2 | 4.5 | AAQC | 4% |
| | 24 | 0.08 | 0.4 | AAQC | 21% |

Notes:

a) The background concentration and CAAQS were converted to µg/m$^3$ based on a standard temperature of 10 °C and pressure of 1 atm.

b) The background 8-hour $O_3$ concentration is not explicitly compared with the CAAQS as the 8-hour CAAQS for $O_3$ is referenced to the 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations while the background concentration is the 90$^{th}$ percentile of the 8-hour values, and therefore the calculation basis for these two parameters is inconsistent.

c) The background hourly $NO_2$ concentration is not explicitly compared with the CAAQS as the 1-hour CAAQS for $NO_2$ is referenced to the three-year average of the annual 98th percentile of the daily maximum one-hour average concentrations while the background concentration is the 90th percentile of hourly values, and therefore the calculation basis for these two parameters is inconsistent.

d) The background hourly $SO_2$ concentration is not explicitly compared with the CAAQS as the 1-hour CAAQS for $SO_2$ is referenced to the three-year average of the annual 99th percentile of the $SO_2$ daily maximum 1-hour average concentrations while the background concentration is the 90th percentile of hourly values, and therefore the calculation basis for these two parameters is inconsistent.

e) Background concentrations of $PM_{10}$ are estimated based on a ratio of $PM_{2.5}/PM_{10}$ = 0.54 (Lall et al 2004) and TSP are estimated based on a ratio of $PM_{2.5}$/TSP = 0.30 (Lall et al 2004).

f) Background concentrations of $PM_{2.5}$ are not explicitly compared with the CAAQS as the 24-hour and annual standards are referenced to the 98th percentile daily average concentration averaged over 3 consecutive years, and 3-year average of the annual average concentrations, respectively. The background concentrations are 90th percentile of hourly values and single year annual averages and therefore the calculation basis for these parameters is inconsistent.

g) Background concentration is converted to the appropriate averaging period following guidance in the Air Dispersion Modelling Guideline of Ontario (ADMGO) (MECP 2017b).

h) Background concentration of crystalline silica is conservatively based on ambient monitoring data for silicon converted to $SiO_2$ based on their molecular weights. Crystalline silica ($SiO_2$) molecular weight - 60, Silicon (Si) molecular weight - 28. This approach is expected to be conservative as it assumes all measured silicon is in the form of crystalline silica.

i) Bolded values represent exceedances of an air quality objective.

## 3.3 Greenhouse Gas Baseline Levels

The provincial and national GHG emissions from reportable activities in Ontario and Canada for the most recently available year (2020) are provided in Table 3.7, along with national and Ontario transportation sector emissions. Canadian GHG emissions were estimated to be 672,000 kt $CO_2$e in 2020. Ontario's contribution to national GHG emissions is 22%. The Ontario and Canadian transportation sector GHG emissions constitute 8% and 28% of the national total, respectively.

**Table 3.7: Ontario, Canada and Sector GHG Emissions and Government of Canada Reduction Target**

| Region | GHG Emissions (kt $CO_2$e) |
|---|---|
| Canada | 672,000 |
| Ontario | 150,000 |
| Canadian Transportation Sector | 190,000 |
| Ontario Transportation Sector | 52,200 |
| Government of Canada 2030 GHG Target | 401,000 |
| Government of Ontario 2030 GHG Target | 143,000 |

## 3.4 Zoning and Land Use Information

In general, the land use categories surrounding the Project consists of a mix of land uses including industrial, commercial, agricultural, residential, and environmental protection zones. Zoning maps covering the Project footprint up to a 500 m buffer zone are included in Appendix B.

# 4.0 Sources of Air Contaminants and Greenhouse Gases

Air contaminants may be released to the atmosphere from the Project due to:

- Construction related sources/activities including:
  - tailpipe emissions from construction equipment and heavy vehicles
  - fugitive emissions from construction activities such as earth moving and material handling
  - on-road tailpipe and road dust emissions from vehicles travelling on detour roads
- Operation related sources/activities including:
  - locomotive emissions
  - tailpipe and road dust emissions from buses and on-road traffic
  - stationary combustion sources (i.e., generators and comfort heaters)

Descriptions of air contaminant emissions and emission estimation methods for the modelling assessment locations are provided in the sections below and in Appendix C.

## 4.1 Construction Phase

As described in Section 1.6, maximum construction emissions scenarios were developed for four Project components/locations.

The modelling assessment locations were selected based on available information from Metrolinx on the construction zones, laydown and staging areas, construction schedule and construction vehicles/equipment to be used. The following information and assumptions were used for all assessment locations:

- Construction activities will occur from 8:00 a.m. to 5:00 p.m., Monday to Friday with 1 hour assumed for breaks.
- The total number of each type of construction equipment that may be used on-site is estimated by the Project design team.
- Not all equipment will be used on the same day nor for the entire day. The estimated worst-case number of equipment used on the same day and their operating time percentages were estimated by the Project design team.

- Specifics of the construction equipment are not currently available from the project design team. The make/model of each equipment type is selected from commonly used equipment to represent the units that may be used during Project construction.
- The types of construction equipment used and their horsepower ratings are assumed to be similar at each construction site.
- Not all the equipment will continuously operate at full engine load due to periods of idling, operating when not loaded or partially loaded, and while loading/unloading. The average operating load of each type of construction equipment was based on equipment load factors provided in the reference document Federal Highway Administration Roadway Construction Noise Model User's Guide (FHWA 2006). The modelled worst-case emission rates from each source were therefore based on the total emissions estimated from the maximum number of equipment (with assumed horsepower rating and U.S. EPA emissions standards) at their average operating load and considering maximum daily operating times. Detailed assumptions on operating loads, power ratings and operating times of each equipment type are provided in Appendix C.
- Active construction areas for the worst-case emissions scenarios are estimated either based on design drawings or assumptions provided by the Project design team.
- Dust control in the construction zone using water / chemical dust suppression and limiting on-site vehicle speed to less than 20 km/hour was assumed to have a control efficiency of 50% (WRAP 2006, and ECCC 2017).

### 4.1.1 Construction Equipment Tailpipe Emission Estimation

Tailpipe emissions from non-road equipment used for construction were estimated based on the U.S. EPA reference document "Nonroad Compression-Ignition Engines - Exhaust Emission Standards" (U.S. EPA, 2016) for NOx, TSP, CO and HC, and U.S. EPA AP-42 reference document “Speciation Profiles and Toxic Emission Factors for Nonroad Engines” (U.S. EPA, 2015a) for the key speciated VOCs and B(a)P. The $SO_2$ emission factor is based on the maximum sulphur content in diesel fuel and assuming all of the sulphur will be oxidized to $SO_2$. Detailed tailpipe emission calculations are provided in Appendix C.

### 4.1.2 Construction Dust Emissions

The Project construction activities for each selected Project component/location that would generate dust emissions will include:

**Track and Grading - Farewell Street Multi-use Bridge to west of Harmony Road Bridge**

- Grading including excavation and backfill
- Laying tracks

**GO Station - B4 Bowmanville**

- Land Clearing
- Parking lot construction
- Building/platform construction

**Simcoe Street Bridge Replacement**

- Utility relocation and road closure
- Demolition of existing bridge
- Abutment construction
- Span construction
- Road reinstatement
- Site clean up

**At Grade Track Widening - Rundle Road Crossing**

- Removals[6] and reconstruction
- Grading work at the tracks near the crossing. This is part of the construction activities for the Project component Tracking, Supporting Track Infrastructure, and Grading. However, as it may occur at the same time as construction for Widening of Crossings, emissions associated with grading work at the tracks near the crossing were conservatively included in the modelling assessment for Widening of Crossings.

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[6] Removal of asphalt, the existing rail crossing surface, and if applicable curb, gutter and sidewalk. The new track(s) are built through the crossing, the crossing surface installed (usually rubber), the road approaches are regraded and paved. If there is a curb, gutter and sidewalk, they are replaced.

The methodology and emission factor for $PM_{10}$ used to estimate the overall area-wide construction dust emissions were based on the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP 2006), Chapter 3: Construction and Demolition. Dust control using water suppression was assumed with a 50% control efficiency. Due to the preliminary nature of the construction information and schedules available at the time of the assessment a control efficiency of 50% was assumed to be a reasonable minimum control level, with additional mitigation measures being recommended where required in Section 8.0. TSP and $PM_{2.5}$ emission rates were estimated based on scaling factors from the WRAP Fugitive Dust Handbook (WRAP, 2006) and the California Environmental Protection Agency Air Resources Board's Miscellaneous Processes Methodologies - Construction and Demolition, Section 7.7: Building Construction Dust (CARB 2002).

The emission rates of respirable crystalline silica are estimated by speciating the estimated $PM_{10}$ emissions from construction activities by a typical percentage of crystalline silica in ambient particulate (5.22%) provided in the ECCC/Health Canada (HC) document "Screening Assessment for the Challenge, Quartz Chemical Abstracts Service Registry Number 14808-60-7, Cristobalite Chemical Abstracts Service Registry Number 14464-46-1" (ECCC/HC, 2013). Detailed construction dust emission calculations are provided in Appendix C.

### 4.1.3 Road Detour Vehicle Emissions

During the construction phase, local traffic may be diverted onto detour routes in the event of a road closure. Direct on-road vehicle emissions (exhaust, brake wear and tire wear) during vehicle travel were estimated using the U.S. EPA Motor Vehicle Emission Simulator (MOVES) estimation tool for year 2023. MOVES3 is the U.S. EPA's tool for estimating vehicle emissions due to the combustion of fuel, brake and tire wear, fuel evaporation, and permeation and refueling leaks. MOVES3 was used to estimate vehicle emissions based on vehicle type, road type, model year, and vehicle speed. Traffic data were provided by the project design team (Stantec 2022).

Emission rates for on-road traffic were estimated based on the projected traffic volumes for the major roads affected by the Simcoe Street Bridge Road closure. Vehicle distribution/vehicle mix assumptions for these roads were provided by the Project traffic engineering group. The U.S. EPA's default distributions for vehicle age were used in the estimates. A summary of the MOVES inputs is provided in Appendix C.

To predict maximum one-hour average concentrations, emissions were conservatively based on peak hourly traffic data, while average daily traffic (ADT) was used to estimate 24-hour average concentrations. Full vehicle tailpipe emissions calculations are provided in Appendix C.

### 4.1.4 Road Detour Dust Emissions

In addition to exhaust, tire wear, brake and evaporative emissions, the re-entrainment of road dust is considered as a particulate matter emission source from vehicles travelling over paved roads. Emissions resulting from travel on paved roads were quantified following U.S. EPA AP-42, Chapter 13.2.1 Paved Roads (U.S. EPA 2011).

The assumptions and parameters used for the emission estimation, including the number of vehicles and distances travelled are provided in Appendix C.

Crystalline silica emissions rates due to road traffic were estimated based on 5.22% of the $PM_{10}$ emissions from paved roads being crystalline silica (ECCC/HC, 2013). The particulate resuspension emissions calculated with the above equation were aggregated with the tailpipe emissions generated from MOVES for $PM_{2.5}$, $PM_{10}$, and TSP. Detailed emissions calculations are presented in Appendix C.

## 4.2 Operation Phase

Air contaminant emissions from Project operation are due to vehicular traffic in parking lots, bus traffic and diesel locomotives travelling the length of the Study Area corridor. The air quality assessment considered incremental changes of the Project, with the increase in train and bus services and parking at the proposed GO stations. Three scenarios were assessed for the entire length of the proposed tracks including:

- Baseline (2021) - existing conditions
- Future (2031) No Build - future conditions without the Project
- Future (2031) Build - future conditions with the Project

Descriptions of air emissions sources and emission estimation methods for the entire length of the proposed tracks are provided in the sections below and in Appendix C.

### 4.2.1 Baseline/Future No Build Operation Sources

Baseline and Future No Build operations sources consist of CP and GM train locomotives, GO buses, and Metrolinx parking lots in Courtice (Courtice Road/Baseline Road) and in Bowmanville (Clarington Blvd./Durham Hwy 2).

Train locomotive emissions in the Study Area were estimated using time spent in the Study Area and an emission factor approach. Information used to estimate the locomotive emissions includes the following:

- Each CP train was assumed to consist of 3 locomotives and 85 cars with the locomotives conservatively assumed to be all Tier 2 engines, as provided by Metrolinx (Metrolinx, 2021b, 2021c).
- Each GM train was assumed to consist of 1 locomotive and 6 cars as provided by Metrolinx (Metrolinx, 2021b, 2021c). Stantec assumed that the locomotives are also all Tier 2 engines.
- For the CP and GM locomotives, Tier 2 emission factors were used for NOx, CO, TSP, and VOCs. For train auxiliary engines, load factors supplied by Metrolinx (Metrolinx, 2021a, 2021b) at the assumed load (notch 6) for trains travelling at steady state were used.
- Emissions of $SO_2$ were estimated using an emission factor based on the maximum sulphur content in diesel fuel (ECCC, 2020), assuming all the sulphur will be oxidized to $SO_2$.
- Key VOCs emissions were assessed based on the fraction of the individual species over total VOC per U.S. EPA "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), including the following:
  - Benzene - 0.0541 x VOC emission factor
  - 1,3 Butadiene - 0.00186 x VOC emission factor
  - Acrolein - 0.0187 x VOC emission factor
  - Acetaldehyde - 0.104 x VOC emission factor
  - Formaldehyde - 0.292 x VOC emission factor
- The $PM_{2.5}$ and $PM_{10}$ emissions were estimated based on the TSP emission factor and applying the ratios of $PM_{2.5}/TSP = 0.90$, and $PM_{10}/TSP = 0.96$ provided in U.S. EPA AP-42, Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines (U.S. EPA, 1995).
- B(a)P emissions were estimated by speciating the TSP emissions using a factor of $6.67 \times 10^{-6}$ x TSP, as provided in U.S. EPA Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015).

Tailpipe emissions from GO buses travelling within existing bus loops and private vehicles travelling within the existing Metrolinx parking lots in Courtice (Courtice Road/Baseline Road) and Bowmanville (Clarington Blvd./Durham Hwy 2) were estimated using MOVES3 emission factors from the U.S. EPA model (U.S. EPA 2020b). GO Bus volumes were derived from the weekday schedule for Route 88 Peterborough/Oshawa effective September 2020 while parking lot volumes were assumed based on the parking lot capacity. Emissions resulting from travel on paved roads were also quantified following U.S. EPA AP-42, Chapter 13.2.1 Paved Roads (U.S. EPA 2011).

### 4.2.2 Future Build Operations Sources

For the Future Build scenario, GO train locomotives will be operational in addition to the CP and GM train locomotives discussed in Section 4.2.1. Each GO train will consist of 12 cars and 2 locomotives, with each locomotive consisting of one engine for traction and one engine for head-end power (HEP) - electricity for heating, lighting and other electrical needs for the cars. The locomotive fleet is estimated to consist of 70% Tier 2, 10% Tier 3 and 20% Tier 4 engines (Metrolinx, 2021b). However, as Tier 4 emissions data for the GO locomotives were not available, the fleet was conservatively assumed to be 70% Tier 2 and 30% Tier 3 engines. HEP engines were conservatively assumed to consist of Tier 2 engines (Metrolinx 2021a). Emissions were estimated using the same methodology as the GM and CP train locomotives, with detailed calculations provided in Appendix C.

The GO bus traffic volumes are expected to increase at the Clarington Blvd/Durham Hwy 2 bus loop which is also the proposed location of the B4 Bowmanville GO Station. Tailpipe emissions from GO buses were estimated using future bus volumes provided by Metrolinx (Metrolinx 2021c) and MOVES3 emission factors. Road dust emissions were estimated for bus travel within the proposed bus loop following U.S. EPA AP-42, Chapter 13.2.1 Paved Roads (U.S. EPA 2011). The assumptions and parameters used for the emission estimation, including the number of vehicles, distances travelled, and MOVES3 inputs are provided in Appendix C.

## 4.3 Greenhouse Gas Emissions

Emissions sources from the Project during the construction and operation phases are summarized in Sections 4.1 and 4.2 and are provided in more detail in Appendix G. Emission sources associated with each phase of the Project are identified in the following sections, along with the assessment approach for GHG emissions.

### 4.3.1 Assessment Approach

The GHG emissions from the Project were estimated based on the following guidance documents:

- Strategic Assessment of Climate Change (ECCC 2020a)
- Draft Technical Guide Related to the Strategic Assessment of Climate Change (ECCC 2021)
- MECP's Considering Climate Change in the Environmental Assessment Process (MECP 2017a).

These guidance documents consider the following emission sources:

- direct GHG emissions, including:
  - point and areas sources such as combustion, flaring, incineration, venting and fugitive emissions
  - change in land use and burning of vegetation during land clearing
- third-party (indirect) GHG emissions arising from electrical or energy requirements to operate the Project. These emissions would occur outside the Project footprint but are attributed to the Project operation.
- avoided domestic GHG emissions as a result of the Project, such as the emissions avoided due to a decrease in private vehicle kilometres travelled as a result of the Project

In accordance with the Strategic Assessment of Climate Change (ECCC 2020a), direct and third-party (indirect) emissions from electricity that occur during both the construction and operation phases of the Project have been considered and are detailed in the following sections. Avoided private vehicle kilometres travelled were independently estimated and provided by Metrolinx (Metrolinx 2022c).

Early works activities are expected to begin in 2022 with the major construction commencing in late 2023. Construction will take approximately three years, finishing in 2026. A preliminary construction schedule was used to calculate the emissions during the construction phase. The three-year annual average GHG emissions were used for comparison to the provincial and national annual GHG emissions levels. A summary of the construction schedule is provided in Appendix G.

### 4.3.2 Direct Greenhouse Gas Emission Sources and Emission Estimates

Estimates of direct GHG emissions from the Project are included in Appendix G. During construction, these include emissions released due to construction vehicles and equipment used during land clearing activities and construction of the Project.

The loss of carbon sequestration sinks due to vegetation removal and the emissions due to decay of that vegetation after being cut were considered. Because the area of land expected to be cleared during construction does not contain significant quantities of mature tree growth, the loss of carbon sink and the associated emissions has been assessed to be negligible and is not included in the total emissions scenario during construction of the Project. Metrolinx also has a revegetation plan in place to replace the negligible loss of carbon sink expected during removal of vegetation during construction.

Furthermore, there is not expected to be any burning of vegetation during the construction of the Project and, therefore, no emissions from vegetation burning are included in this assessment.

Direct GHG emissions during the operation phase from GO trains, GO buses and testing of emergency equipment are expected to occur.

Table 4.1 provides a detailed list of the activities included in the assessment and the calculation methods used for construction and operation.

**Table 4.1: Calculation Methods for GHG Emission Estimates**

| Project Activities | Emissions Calculation Method |
|---|---|
| **Direct Emissions - Construction** | |
| Off-Road Equipment | Emissions were quantified using the ECCC national inventory emission factors (ECCC 2022), an assumed list of representative off-road and on-road construction equipment, and the preliminary construction schedule provided by the project design team. |
| On-Road Equipment | |
| **Direct Emissions - Operation** | |
| GO Trains | Emissions were quantified using the ECCC national inventory emission factors (ECCC 2022) for diesel trains and fuel usage rates for the proposed line haul and HEP engines provided by Metrolinx (Metrolinx, 2021b). |

| Project Activities | Emissions Calculation Method |
|---|---|
| GO Buses | Emissions were quantified using the ECCC national inventory emission factors (ECCC 2022) for heavy-duty diesel vehicles (HDDVs) with moderate control and calculated fuel usage rates for the additional buses added to the future schedule. |
| Stationary fuel combustion equipment | Emissions were quantified using the ECCC national inventory emission factors (ECCC 2022) for off-road diesel equipment, the fuel usage rates for the proposed standby power units and assumed operating hours. |

### 4.3.3 Indirect (Third-Party) GHG Emission Sources and Emission Estimates

Indirect (third-party) GHG emissions from electricity consumption by the Project operation were quantified using the ECCC national inventory emission factors (ECCC 2022) for electricity consumption intensity (Ontario) and are included in Appendix G. During operation, these include emissions released as a result of providing electrical power to each of the four stations and two wayside power cabinets at B4 Bowmanville station. Plugging the train in to the power cabinets allows the locomotive to be shut down overnight, while maintaining climate control on the train (prevents freezing during winter).

### 4.3.4 Avoided GHG Emission Estimation

The implementation of the Project is expected to result in a decrease in the use of private vehicles by the public; therefore, there is expected to be a corresponding decrease in GHG emissions from the combustion of gasoline and diesel in private vehicles in and near the Project Study Area. A year-by-year breakdown of the avoided domestic private vehicle kilometers travelled was provided by Metrolinx (Metrolinx, 2022c). Metrolinx estimates the Project can reduce annual vehicle kilometers travelled by up to 31 million kilometers. This is equivalent to approximately 6.4 kt $CO_2e$ per year. The reduction is estimated using a Canada specific average fuel consumption emission factor per kilometer travelled for light duty vehicles (IEA 2019). Over the 60-year lifecycle, the Project is expected to reduce private vehicle travel by 1.7 billion kilometers and is an equivalent reduction of GHG emissions in the amount of 353 kt of $CO_2e$, assuming consistent use of diesel and gasoline. It is expected that over time, more electric vehicles will be deployed in the area and further, the electricity GHG intensity is also expected to decline as power utilities shift to using less hydrocarbon fuels to generate power. These shifts are likely to lead to less GHG savings from the Project annually over time.

# 5.0 Air Dispersion Modelling Methodology

This section presents an overview of the dispersion modelling methodologies used in the study to assess potential impacts on air quality.

## 5.1 Modelling Assessment Approach

The Project activities assessed using dispersion modelling are expected to represent maximum construction and operation emissions for each Project component/location. In this study, four dispersion modelling scenarios were assessed to represent different construction components of the Project.

For operation, the Project was segmented into three separate model runs to match the geographical extents of the site-specific meteorological data sets provided by the MECP. The site-specific meteorological data sets were prepared for Oshawa, Courtice and Bowmanville near where the proposed railway corridor will be extended/built. Source groups were used to reflect the Baseline, Future No Build and Future Build operating scenarios within each of the modelled segments. A summary of the dispersion modelling scenarios assessed in this study is presented in Table 5.1.

**Table 5.1: Summary of Dispersion Modelling Scenarios Assessed**

| Phase | Project Component/ Location | Scenario | Emission Sources |
|---|---|---|---|
| Construction | At Grade Crossing Widening - Rundle Road Crossing | Baseline | • Construction equipment (tailpipe emissions)<br>• Construction dust<br>• It was assumed that during widening of the at-grade crossing, grading at the tracks may occur at the same time. Emissions associated with grading work at the tracks were included in the modelling assessment for Crossing Widening. |
| | GO Station - B4 Bowmanville | Baseline | • Construction equipment (tailpipe emissions)<br>• Construction dust |

| Phase | Project Component/ Location | Scenario | Emission Sources |
|---|---|---|---|
| | Bridge Replacement - Simcoe Street Bridge | Baseline | • Construction equipment (tailpipe emissions)<br>• Construction dust<br>• On-road vehicles on detour roads (tailpipe emissions and road dust) |
| | Trackwork and Grading - west of Farewell St. Ped. Bridge to west of Harmony Rd Bridge | Baseline | • Construction equipment (tailpipe emissions)<br>• Construction dust |
| Operation | Entire length of the Project | Baseline (2021) | • Existing CP rail traffic<br>• Existing GM rail traffic<br>• Existing GO bus and private vehicle traffic (tailpipe and paved road dust emissions) within existing stations |
| | | Future (2031) No Build [1] | • Existing CP rail traffic<br>• Existing GM rail traffic<br>• Existing GO bus and private vehicle traffic (tailpipe and paved road dust emissions) within existing stations |
| | | Future (2031) Build | • Existing CP rail traffic<br>• Existing GM rail traffic<br>• Future GO rail traffic<br>• Future GO bus and private vehicle traffic (tailpipe and paved road dust emissions) within the proposed GO station locations |

Note:

1. It is assumed that there are no differences in the GO bus counts and private vehicle traffic counts travelling within the existing GO parking lots in Courtice (Courtice Road/Baseline Road) and Bowmanville (Clarington Blvd./Durham Hwy 2) for the baseline (2021) and future (2031) no build scenarios. The basis for this assumption is that the GO bus system is already at capacity and that there is no room for passenger/bus/car increases without expansion of the station.

Rationales for the location selections and assumptions used for the maximum construction emissions scenarios are provided in Section 1.6 and Section 4.0. The emissions sources described in Section 4.0 and the COIs listed in Section 2.1 were included in the assessment.

Summaries of the emission source parameters used in the AERMOD dispersion modelling are provided in Appendix C. The locations of the emission sources are also shown in Appendix C. Summaries of the air dispersion modelling inputs are provided in Appendix E.

Modelling results are compared with the AQ Objectives that are described in Section 2.3. For $PM_{2.5}$, the 24-hour CAAQS is referenced to the 98$^{th}$ percentile daily average concentration averaged over 3 consecutive years. The 1-hour $NO_2$ CAAQS is referenced to the 3-year average of the annual 98$^{th}$ percentile of the daily maximum 1-hour average concentrations; and the 1-hour $SO_2$ CAAQS is the 3-year average of the annual 99$^{th}$ percentile of the $SO_2$ daily maximum 1-hour average concentrations. As construction activities are not anticipated to last longer than 24 months at any of the sites, comparing the maximum model predictions to CAAQS that are based on 3-year averages will be conservative as this assumes the activity occurs for three years.

Assumptions used in this air dispersion modelling assessment were based on information available at the time of the study and best estimates using that information. At the time of this study, the Project is still in the preliminary planning stages and details regarding Project construction activities, schedule, and operations are limited.

## 5.2 Air Dispersion Modelling Methodology

### 5.2.1 Dispersion Model Used

The U.S. EPA atmospheric dispersion model AERMOD was used for the assessment as recommended in the Draft Metrolinx Guide (Metrolinx 2019a). The AERMOD Version 19191 was used in the assessment as this is the current MECP regulatory version adopted in April 2020.

AERMOD is a steady-state plume model that is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources). In the Stable Boundary Layer, the concentration distribution is assumed to be Gaussian in both vertically and horizontally. Vertical profiles of wind speed wind direction, turbulence temperature, and temperature gradient are estimated using available meteorological observations. AERMOD accounts for the vertical inhomogeneity of the Planetary Boundary Layer (PBL). This is accomplished by "averaging" the parameters of the actual Stable Boundary Layer into "effective" parameters of an equivalent homogeneous PBL. With these effective parameters, AERMOD accounts for the inhomogeneity of the PBL, in an averaged sense.

Parameters that directly influence the dispersion of pollutants include wind speed and direction, atmospheric stability, and mixing layer depth. For example, high concentrations predicted from low elevated sources, from elevated sources with building or topography effects, or from volume sources are typically due to stable atmospheric stability conditions with light winds.

The dispersion model was used to predict maximum 1-hour, 8-hour, 24-hour and annual average ground level concentrations (GLCs) for each COI at the selected receptors for the assessed scenario. The predicted Project Alone concentrations were added to their corresponding background concentrations to estimate cumulative air quality levels at the special and gridded receptors. For COIs with other averaging periods (i.e., 15-minute or half-hour), the predicted 1-hour concentrations were converted to the appropriate averaging period using the MECP recommended conversion factor per Chapter 7 of the MECP’s “Procedure for Preparing an Emission Summary and Dispersion Modelling Report” (MECP 2018b).

### 5.2.2 Special Receptors and Receptor Grid

Special receptors are locations where human activity more regularly takes place. The Draft Metrolinx Guide (Metrolinx, 2019a) recommends a study area of 300 m to 500 m radius surrounding the Project footprint for transit projects depending on the type of project/emission sources. The MTO Guide recommends that the local air quality impacts be studied within a distance of 500 m from the transportation facility at both sensitive (residences) and critical receptors (hospitals, retirement homes, childcare centres). No specific guidance is provided for study areas for construction projects in either guide; therefore, a study area with a radius of up to 500 m was used.

Land uses that contain critical receptors such as schools, day cares, long-term care facilities or other institutional uses, if any, and representative sensitive receptors (residential dwellings), within the Study Area were selected as special receptors for the air quality study. A list of the special receptors identified for the Project (and their designation as either sensitive or critical) are provided in Appendix D. The locations of these receptors are also presented in Appendix D.

In addition to special receptors, gridded receptors were placed at the following spacings from a rectangle bounding the main construction activities (active construction zone and construction vehicles):

- 10 m spacing within 50 m of the rectangle bounding the main construction activities
- 25 m spacing from 50 - 200 m of the boundary
- 50 m spacing from 200 - 500 m of the boundary
- 75 m spacing from 500 - 700 m of the boundary

For the Operations Phase air dispersion modelling of the entire proposed rail corridor (18.6 km of track), the following grid extension and spacing were used:

- a minimum 500 m distance from the Project footprint which includes the entire proposed corridor (per MTO guidance)
- 20 m spacing within 200 m of the Project footprint along the entire proposed corridor
- 50 m spacing from 200 - 500 m of the Project footprint

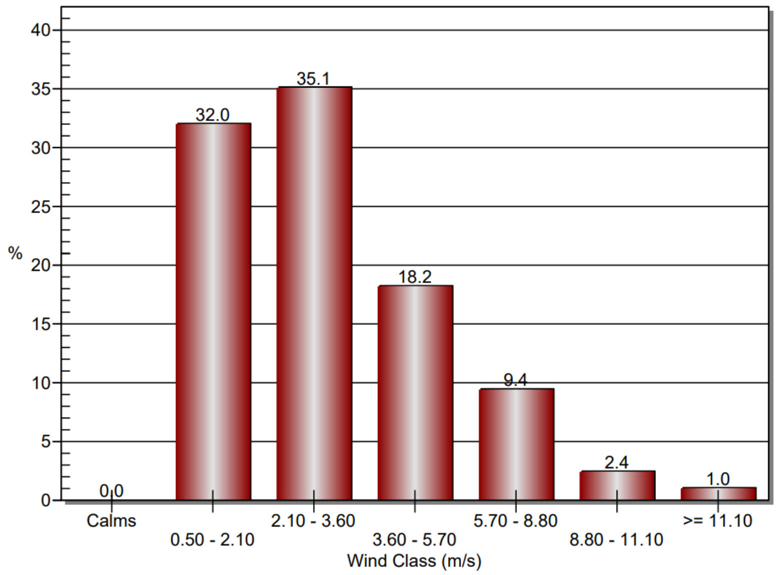
### 5.2.3 Meteorological Data Sources

The local meteorology of the region must be characterized to evaluate the short-term atmospheric dispersion and transport of emissions released by the Project. Five-year (2016-2020) site-specific meteorological data sets pre-processed by the MECP (MECP 2021) were used as inputs to the dispersion model. The MECP provided a separate dataset for each of the four construction components listed in Table 5.1 and three datasets for the three operations phase model segments (Oshawa, Courtice and Bowmanville).

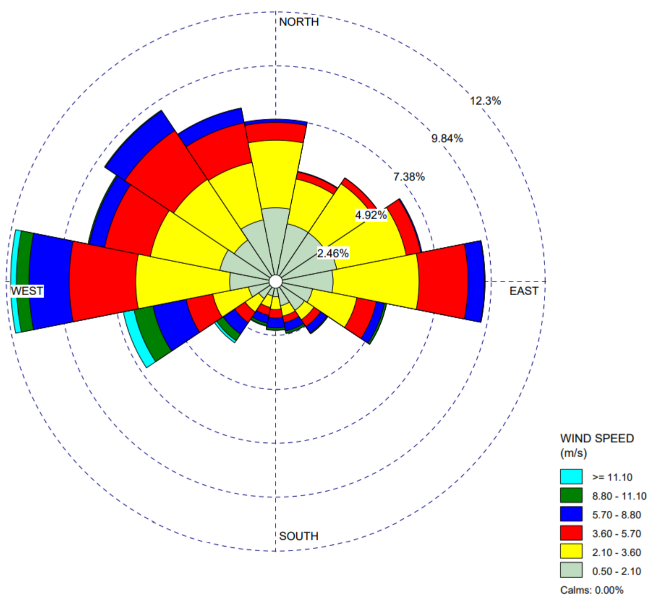
The Rundle Road Crossing and Courtice Segment site specific meteorological datasets use upper air data from Buffalo NY, surface data from the Cobourg Station, and cloud cover data from the Canadian Forces Base Trenton Airport and Toronto Pearson International Airport stations.

The frequency distribution of wind speeds from the site-specific meteorological data set for the Rundle Road Crossing and Courtice Segment is shown in Figure 5.1. High wind speeds greater than 8.8 m/s occur infrequently, while wind speeds between 2.1 - 3.6 m/s occur the most frequently. A wind rose plot is presented in Figure 5.2. Wind roses are an efficient and convenient means of presenting wind data. The length of the radial barbs gives the total percent frequency of winds blowing from the indicated direction, while portions of the barbs of different widths indicate the frequency associated with each wind speed category. Winds blow most frequently from the west with northwesterly and easterly directions also being relatively frequent.

## Figure 5.1: Rundle Road/Courtice Segment Site-Specific Wind Class Frequency Distribution (2016-2020)




## Figure 5.2: Rundle Road/Courtice Segment Site-Specific Wind Rose (2016-2020)



The meteorological data sets used to model emissions from the construction of B4 Bowmanville GO Station, Simcoe Street Bridge, Track and Grading Railway Track (Farewell Street Multi-use Bridge to west of Harmony Road Bridge), and operation of the Oshawa and Bowmanville Segment all used upper air data from Buffalo NY, surface data from the Oshawa airport, and cloud cover data from the Toronto Pearson International Airport station.

The frequency distribution of wind speeds from this site-specific meteorological data set is shown in Figure 5.3. Wind speeds greater than 8.8 m/s occur infrequently, while wind speeds between 3.6 - 5.7 m/s occur the most frequently. A wind rose plot is presented in Figure 5.4 and shows that winds blow most frequently from northwesterly and easterly directions and are relatively uniform in frequency from northwesterly to southwesterly directions.

**Figure 5.3: Other Construction and Operations Site Specific Meteorology - Wind Class Frequency Distribution (2016-2020)**

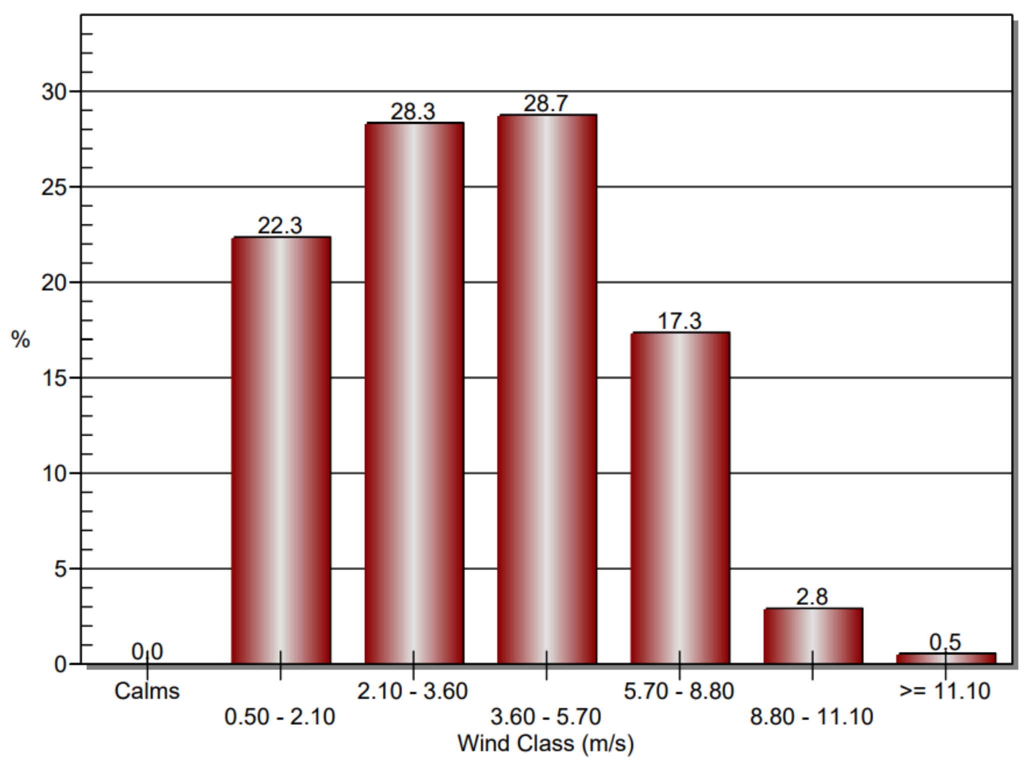
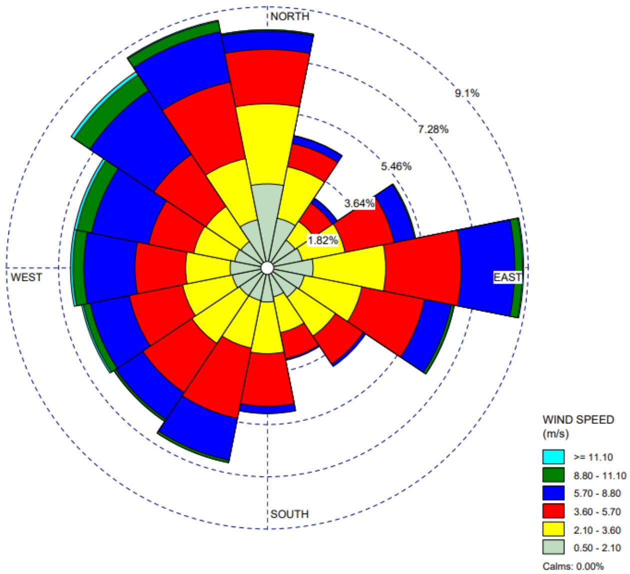


**Figure 5.4: Other Construction and Operations Phase Site Specific Wind Rose (2016-2020)**




## 5.2.4 Building Downwash

Wind dependent building/obstacle dimensions are an input to AERMOD for use in the building wake and building downwash calculations for point source emissions. As all emissions sources were modelled as area, line or volume sources, building downwash data was not required.

## 5.2.5 Topographic Data

Terrain data used for the modelling domain is the Canadian digital elevation model mosaic (CDEM) data covering Ontario, suitable for use with AERMOD, and available at the MECP's website (MECP, 2020a).

## 5.2.6 Averaging Periods

AERMOD can predict concentrations for a variety of averaging times for 1-hour and greater. For this Project, the models were run for 1-hour, 8-hour, 24-hour, and annual averaging times to give results that can be directly compared to the relevant air quality objectives for each COI.

For other averaging periods, predicted concentrations from the nearest averaging period were converted using the conversion methodology recommended by MECP (MECP, 2018b).

### 5.2.7 Conversion of Nitrogen Oxides to Nitrogen Dioxide

Nitrogen oxides (NOx) from fuel combustion processes are comprised mainly of nitrous oxide (NO) and nitrogen dioxide ($NO_2$). Only $NO_2$ has ambient air quality criteria. In combustion emissions, typically most of the NOx emissions are NO and only a small percentage are $NO_2$. Once in the ambient air, NO is irreversibly oxidized by ground level ozone ($O_3$) to produce nitrogen dioxide ($NO_2$) as follows:

$$\mathrm{NO} + \mathrm{O_3} \rightarrow \mathrm{NO_2} + \mathrm{O_2}$$

The Metrolinx Environmental Guide (Metrolinx, 2019a) specifies that the Ozone Limiting Method (OLM) method is to be used to predict ambient $NO_2$ concentrations. According to the OLM method, the conversion of NO to $NO_2$ is limited by the ambient concentration of ozone ($O_3$) in the atmosphere. If it is assumed that 10% (by volume) of the $NO_X$ emissions released from each source is $NO_2$ then the remaining 90% may be converted to $NO_2$ (U.S. EPA 2015b) as follows:

- If 90% of the $NO_X$ concentration is less than the ambient $O_3$ concentration, then $[NO_2] = [NO_X]$ (complete conversion).
- If 90% of the $NO_X$ concentration is greater than the ambient $O_3$ concentration, then $[NO_2] = 10\% [NO_X] + [O_3]$ (limited conversion).

In the application of the OLM, the above relationships assume that all concentrations are expressed in parts per million (ppm).

The use of the OLM approach in AERMOD requires the specification of an in-stack ratio (ISR) of $NO_2/NO_X$. U.S. EPA guidance (U.S. EPA, 2014) notes that in-stack ratios used with the OLM option can be justified based on the specific application. As the NOx emissions from the Project are associated with tailpipe emissions from diesel-fired equipment, a site specific ISR was determined from a review of data available from U.S. EPA ($NO_2$ _ISR_database.xlsx, available from https://www.epa.gov/scram/nitrogen-dioxidenitrogen-oxide-stack-ratio-isr-database). The ISR values for relevant listed diesel engines are low, with an average $NO_2/NO_X$ ratio of 0.1. An in-stack $NO_2$/NOx ratio of 0.2 was conservatively used in the assessment.

The OLM method was implemented in the AERMOD model to predict hourly average $NO_2$ concentrations using the predicted hourly average $NO_X$ concentrations and seasonal hourly background ozone values (provided in Appendix E).

### 5.2.8 Emission Source Data

The emissions sources were modelled following the protocols and procedures outlined in MECP Guideline A-11 (MECP 2017b). Construction tailpipe emissions were modelled as volume sources and construction dust emissions were modelled as area sources. Emissions from construction activities were assumed to occur 8 hours a day with a one-hour break (8AM to 5PM) on weekdays. Emissions from on-road vehicle traffic were modelled as line sources with parameters determined based on the recommended approach by the U.S. EPA Haul Road Workgroup Final Report (U.S. EPA 2012). Emissions from these sources were conservatively assumed to occur 24 hours a day. As a conservative modelling approach, and consistent with MECP guidance (MECP 2017b), deposition was not considered for predicting TSP, $PM_{10}$ and $PM_{2.5}$ concentrations for the construction and operation scenarios. Given the close proximity of the nearest special receptors to the construction and operation emission sources, it is expected that the deposition from the exhaust plume would be minimal.

A summary of the emission source parameters used in the AERMOD dispersion modelling is provided in Appendix D. The locations of the emissions sources are shown in Appendix E.

# 6.0 Air Dispersion Modelling Impact Assessment

This section presents the results of the air dispersion modelling for the construction and operation of the Project components described in Section 4.0.

A summary of the maximum modelled predictions for the Project emissions only (Project Alone) and cumulatively with the addition of background concentrations (Project plus background) that are presented in Section 3.2 are compared to the applicable air quality objectives presented in Section 2.3.

A summary of the maximum modelled predictions at the special receptor locations as well as gridded receptors are discussed separately below. A tabular summary of the results at special receptor locations are presented in Table 6.1, Table 6.3, Table 6.5, Table 6.7, and Table 6.10. Predicted exceedance charts for special receptors are presented in Figure 6.1 to Figure 6.6.

Concentration contour plots are presented in Appendix F for each Project component.

## 6.1 Construction Phase

The modelling results presented in this section are based on a maximum construction emissions scenario for each Project component with standard mitigation measures applied. Standard mitigation measures include dust control such as watering and limiting on-site vehicle speed to less than 20 km/hr. Each modelled maximum emissions scenario is not expected to occur consistently throughout the entire construction period. The intent of these predictions is to help identify potential air quality impacts and whether additional mitigation measures (discussed in Section 8.0) may be required to reduce these impacts.

For each construction component assessed, the maximum distance from the construction area to where an air quality objective is predicted to be exceeded (concentration impact zone for that contaminant) is determined from the gridded receptor predictions. These impact zone distances, presented in Table 6.2, Table 6.4, Table 6.6, and Table 6.8, were used to assess the potential for adverse impacts at the other construction component locations by determining if there will be any sensitive/critical receptors falling within the impact zone(s).

### 6.1.1 At Grade Crossing Widening - Rundle Road

#### 6.1.1.1 Special Receptor Predictions - Project Alone

The Project Alone and maximum cumulative concentrations of COIs at special receptor locations near the Rundle Road Crossing are presented in Table 6.1.

The Project Alone maximum predicted $NO_2$ concentration exceeds the 1-hour average 2025 CAAQS by 9% but is below the 2020 CAAQS and the AAQC. The AAQC is currently used by the MECP. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. The maximum predicted Project Alone $PM_{10}$ concentration exceeds the 15-minute Metrolinx mitigation threshold by 64%. The frequency of exceedance of the Metrolinx mitigation threshold is predicted to be no more than 7 hours over a 5-year period or approximately 0.016% of the time. The main contributor to $PM_{10}$ emissions is construction dust.

The maximum predicted concentrations for all other COIs and averaging periods for the Project Alone are below their AQ Objectives and mitigation thresholds.

#### 6.1.1.2 Special Receptor Predictions - Cumulative Concentrations

Maximum predicted cumulative concentrations (i.e., Project plus background concentrations) of COIs are below their respective air quality objectives at special receptors except for the following:

- The maximum predicted 1-hour average 98$^{th}$ percentile cumulative $NO_2$ concentration is 176%of the 2025 CAAQS, while the maximum predicted cumulative annual average concentration is 122% of the 2025 CAAQS. However, the 1-hour and annual average background concentrations used are by themselves 67% and 118% of the 1-hour and annual CAAQS, respectively. The main contributor to $NO_2$ emissions is from construction vehicle/equipment tailpipe emissions. It is expected that the modelled maximum emissions scenario will not occur consistently throughout the entire construction period. Ambient $NO_2$ levels from construction will be lower during periods when fewer construction vehicles or equipment are being operated concurrently.
- The maximum predicted 15-minute average cumulative $PM_{10}$ concentration is 189% of the Metrolinx mitigation threshold and is mainly due to the Project.
- The maximum predicted annual average cumulative benzene concentration is 119% AAQC. However, the annual average background benzene concentration alone is above the AAQC, with the maximum annual Project Alone prediction being only 1% of the AAQC.

- Maximum predicted cumulative 24-hour and annual average Benzo(a)pyrene concentrations are 293% and 863% of their respective criteria. However, background concentrations are almost two times higher than the 24-hour AAQC and over seven and a half times the annual AAQC. Project Alone concentrations are only 15% and 3% of the 24-hour and annual criteria respectively and therefore the Project is a minor contributor the cumulative concentrations.

The maximum cumulative concentrations of the other COIs and averaging periods are below their AQ objectives or mitigation thresholds.

Figure 6.1 graphically presents the relative contributions of Project Alone (blue portion of each bar) and Background concentrations (grey portion of each bar) to the maximum cumulative concentration of each COI that is predicted to be above an applicable air quality objective at a special receptor. As discussed above, benzene, benzo(a)pyrene and annual $NO_2$ cumulative concentrations can be seen to be dominated by the background concentrations.

**Table 6.1: Summary of Construction Phase Air Dispersion Modelling Results at Special Receptors - Rundle Road Crossing Widening**

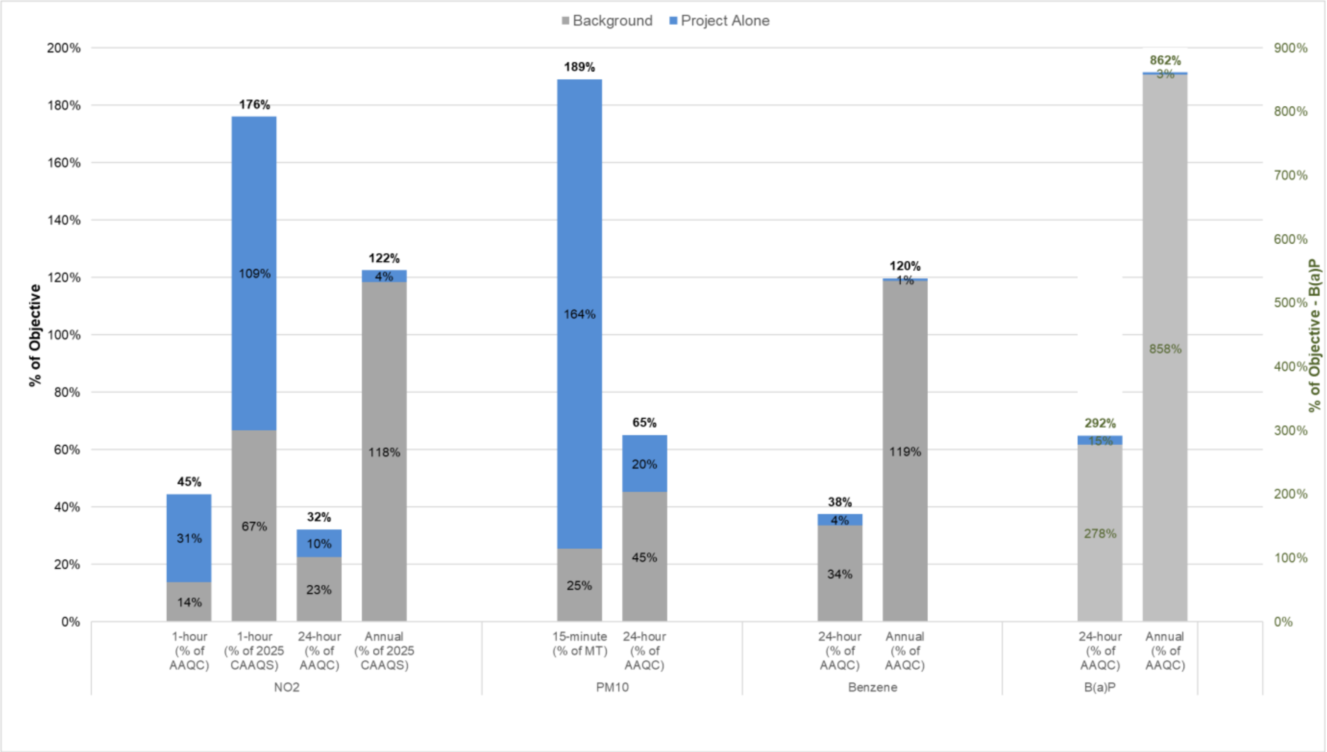
| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] (µg/m³) | Background Concentration (µg/m³) | Maximum Cumulative Concentration (µg/m³) | Air Quality Objective | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project Alone + Background) |
|---|---|---|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour | 95_S | 123 | 55 | 178 | 400 | AAQC | 31% | 45% |
| | | 95_S | 91 [2] | | 146 | 119 | 2020 CAAQS | 76% | **123%** |
| | | | | | | 83 | 2025 CAAQS | **109%** | **176%** |
| | 24-hour | 95_S | 19 | 45 | 64 | 200 | AAQC | 10% | 32% |
| | Annual | 95_S | 0.96 | 28 | 29 | 34 | 2020 CAAQS | 3% | 86% |
| | | | | | | 24 | 2025 CAAQS | 4% | **122%** |
| CO | 1-hour | 95_S | 562 | 422 | 984 | 36,200 | AAQC | 2% | 3% |
| | 8-hour | 94_S | 143 | 402 | 545 | 15,700 | AAQC | 1% | 3% |
| $SO_2$ | 10-minute | 95_S | 1.1 | 4.6 | 6 | 180 | AAQC | 1% | 3% |
| | 1-hour | 95_S | 0.69 | 2.8 | 3.5 | 100 | AAQC | 1% | 3% |
| | | | | | | 193 | 2020 CAAQS | 0% | 2% |
| | | | | | | 179 | 2025 CAAQS | 0% | 2% |
| | Annual | 95_S | 0.003 | 1 | 1 | 10 | AAQC | 0% | 10% |
| | | | | | | 14 | 2020 CAAQS | 0% | 8% |
| | | | | | | 11 | 2025 CAAQS | 0% | 10% |
| TSP | 24-hour | 95_S | 14.8 | 41 | 55.8 | 120 | AAQC | 12% | 46% |
| | Annual | 95_S | 0.32 | 24 | 24.3 | 60 | AAQC | 1% | 41% |
| $PM_{10}$ | 15-minute | 95_S | 245 | 38 | 283 | 150 | Metrolinx Mitigation Threshold | **164%** | **189%** |
| | 24-hour | 95_S | 10 | 23 | 33 | 50 | AAQC | 20% | 65% |
| $PM_{2.5}$ | 15-minute | 95_S | 42 | 21 | 63 | 81 | Metrolinx Mitigation Threshold | 52% | 78% |
| | 24-hour | 95_S | 2.2 | 12 | 14.2 | 27 | CAAQS | 8% | 53% |
| | Annual | 95_S | 0.08 | 7.2 | 7.3 | 8.8 | CAAQS | 1% | 83% |
| Crystalline Silica | 15-minute | 95_S | 11.7 | 7.4 | 19.1 | 25 | Metrolinx Mitigation Threshold | 47% | 76% |
| | 24-hour | 95_S | 0.44 | 2 | 2.4 | 5 | AAQC | 9% | 50% |
| Benzene | 24-hour | 95_S | 0.09 | 0.77 | 0.9 | 2.3 | AAQC | 4% | 38% |
| | Annual | 95_S | 4.1E-03 | 0.53 | 0.5 | 0.45 | AAQC | 1% | **120%** |

| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] (µg/m³) | Background Concentration (µg/m³) | Maximum Cumulative Concentration (µg/m³) | Air Quality Objective | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project Alone + Background) |
|---|---|---|---|---|---|---|---|---|---|
| 1, 3 Butadiene | 24-hour | 95_S | 3.7E-03 | 0.08 | 0.1 | 10 | AAQC | 0% | 1% |
| | Annual | 95_S | 1.7E-04 | 0.06 | 0.1 | 2 | AAQC | 0% | 3% |
| B(a)P | 24-hour | 95_S | 7.3E-06 | 1.4E-04 | 0.0 | 0.00005 | AAQC | 15% | **292%** |
| | Annual | 95_S | 3.3E-07 | 8.6E-05 | 0.0 | 0.00001 | AAQC | 3% | **862%** |
| Formaldehyde | 24-hour | 95_S | 0.71 | 3 | 3.7 | 65 | AAQC | 1% | 6% |
| Acetaldehyde | ½-hour | 95_S | 2.8 | 9 | 11.8 | 500 | AAQC | 1% | 2% |
| | 24-hour | 95_S | 0.24 | 3 | 3.2 | 500 | AAQC | 0% | 1% |
| Acrolein | 1-hour | 95_S | 0.38 | 0.20 | 0.6 | 4.5 | AAQC | 9% | 13% |
| | 24-hour | 95_S | 0.04 | 0.08 | 0.1 | 0.4 | AAQC | 10% | 31% |

Notes:

1. The maximum predicted concentration (meteorological anomalies included) is conservatively used for comparison to all Air Quality Objectives unless otherwise noted.
2. Value is the 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations at a special receptor for comparison to the current (2020) and future (2025)CAAQS for 1-hour $NO_2$.

## Figure 6.1: Comparison of Selected Construction Phase Cumulative COI Predictions to Air Quality Objectives - Rundle Road Crossing




Notes:
The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.
Air Quality Objectives:
AAQC - Ontario Ambient Air Quality Criteria
CAAQS - Canadian Ambient Air Quality Standards
MT - Metrolinx mitigation threshold

#### 6.1.1.3 Gridded Receptor Predictions

To predict air quality impact zones due to the maximum construction emissions scenario for this component, modelling was conducted using gridded receptors at the Rundle Road Crossing. The results of the gridded receptor modelling were used to develop recommendations for mitigation for the other crossing locations where required.

Table 6.2 presents the dispersion modelling results of the gridded receptors for the maximum construction emissions scenario with standard mitigation measures implemented. The table presents the distances from the Project footprint where exceedances of an AQ objective are predicted to occur. COIs included in the table are predicted to have maximum GLCs above the AQ objectives at gridded receptor locations. All other COIs and averaging periods are predicted to remain below their respective AQ objective.

**Table 6.2: Rundle Road Crossing Construction Scenario - Predicted Impact Zones**

| COI | Averaging Period | AQ Objective (µg/m$^3$) | Source of Objective | Distance from Project footprint (m) |
|---|---|---|---|---|
| $NO_2$ | 1-hour | 83 | 2025 CAAQS | 60 |
| TSP | 24-hour | 120 | AAQC | 5 |
| $PM_{10}$ | 15-minute | 150 | Metrolinx Mitigation Threshold | 150 |
| | 24-hour | 50 | AAQC | 20 |
| $PM_{2.5}$ | 15-minute | 81 | Metrolinx Mitigation Threshold | 5 |
| Crystalline silica | 15-minute | 25 | Metrolinx Mitigation Threshold | 25 |

It is noted that the intent of the15-minute Metrolinx mitigation thresholds is to manage periods of temporarily high particulate crystalline silica concentrations due to construction projects. Mitigation measures should be implemented, and/or the construction activity should be reduced or stopped when the threshold is exceeded by more than 20% during two consecutive 15-minute periods (Metrolinx, 2019a).

During the course of the Project, if mitigation measures are implemented to meet the Metrolinx mitigation thresholds for $PM_{10}$ and $PM_{2.5}$, it is expected that construction emissions will not cause exceedances of the AAQCs.

### 6.1.2 GO Station - B4 Bowmanville

The Project Alone and maximum cumulative concentrations of COIs at special receptor locations near the B4 Bowmanville GO Station are presented in Table 6.3.

#### 6.1.2.1 Special Receptor Predictions - Project Alone

The Project Alone maximum predicted 15-minute average $PM_{10}$, $PM_{2.5}$ and crystalline silica concentrations exceed their respective Metrolinx mitigation thresholds. $PM_{10}$ is also predicted to exceed the 24-hour average AAQC. The main contributor to these exceedances is dust that is generated from construction activities - emissions from which are estimated based on the active construction area. The maximum predicted ambient particulate concentrations from station construction are higher compared to other Project components due to its much larger active construction area.

The maximum predicted Project Alone 15-minute average $PM_{10}$ concentration is 696% of the Metrolinx mitigation threshold. However, the frequency of exceedance is predicted to be no more than 40 hours over a 5-year period or approximately 0.09% of the time. The maximum predicted 24-hour average $PM_{10}$ concentration is 112% of the AAQC, with an exceedance occurring only 1 day over a 5-year period or approximately 0.05% of the time.

The maximum predicted Project Alone 15-minute average $PM_{2.5}$ concentration is 133% of the Metrolinx mitigation threshold. The mitigation threshold is predicted to be exceeded no more than 3 hours over a 5-year period or approximately 0.007% of the time.

Crystalline silica is predicted to exceed its 15-minute Metrolinx mitigation threshold by 117%, but for no more than 11 hours over a 5-year period or approximately 0.03% of the time.

The maximum predicted concentrations for all other COIs and averaging periods for the Project Alone are below their AQ Objectives and mitigation thresholds.

#### 6.1.2.2 Special Receptor Predictions - Cumulative Concentrations

The maximum cumulative concentrations of COIs are below their respective air quality objectives except for the following:

- The maximum predicted 1-hour average cumulative $98^{th}$ percentile $NO_2$ concentration is 112% of the 2025 CAAQS and the maximum predicted annual concentration is 121% of the 2025 CAAQS. The main contributor to $NO_2$ emissions is from construction vehicle/equipment tailpipe emissions. It is expected that the modelled maximum emissions scenario will not occur consistently throughout the entire construction period. Ambient $NO_2$ levels from construction will be lower during periods when fewer construction vehicles or equipment are being operated concurrently. As land clearing construction activities are not anticipated to last longer than 1 month at this site, comparing the 98th percentile model predictions to the CAAQS that are based on 3-year averages is conservative.

- The maximum predicted 24-hour average cumulative TSP concentration is 107% of the AAQC.
- Maximum predicted cumulative $PM_{10}$, $PM_{2.5}$ and crystalline silica concentrations exceed their Metrolinx Mitigation thresholds, as did their Project Alone predictions.
- The maximum predicted annual average cumulative benzene concentration is 118% AAQC, but is dominated by the background concentrations, as the maximum annual Project Alone prediction is only 1% of the AAQC.
- Maximum predicted 24-hour and annual cumulative benzo(a)pyrene concentrations are above the AAQCs, but the predictions are dominated by background levels, with the Project Alone predicted concentrations being only 8% and 2% of the 24-hour and annual AAQCs, respectively.

Figure 6.2 graphically presents the relative contributions of Project Alone and Background concentrations to the maximum cumulative concentration of each COI that is predicted to be above an applicable air quality objective at a special receptor. As discussed above, benzene, benzo(a)pyrene and annual $NO_2$ cumulative concentrations can be seen to be dominated by the background concentrations. Predicted cumulative exceedances of TSP, $PM_{10}$, $PM_{2.5}$ and silica concentrations are mainly due to the Project.

**Table 6.3: Summary of Construction Phase Air Dispersion Modelling Results at Special Receptors - B4 Bowmanville GO Station**

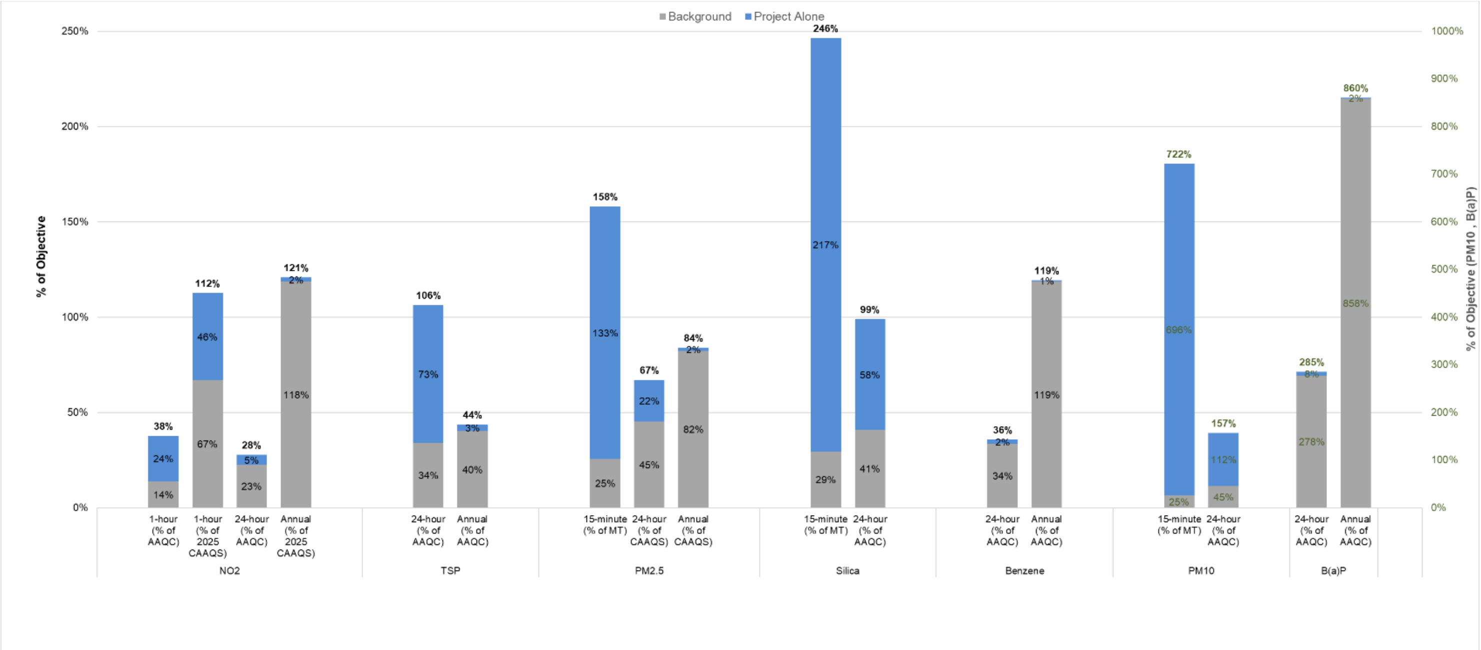
| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration at Special Receptors [1] (µg/m³) | Background Concentration (µg/m³) | Maximum Cumulative Concentration at Special Receptors (µg/m³) | Air Quality Objective (µg/m³) | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [2] | 127_S | 95 | 55 | 151 | 400 | AAQC | 24% | 38% |
| | | | 38 | | 93 | 119 | 2020 CAAQS | 32% | 78% |
| | | | | | | 83 | 2025 CAAQS | 46% | **112%** |
| | 24-hour | 116_S | 10 | 45 | 55 | 200 | AAQC | 5% | 28% |
| | Annual | 116_S | 0.53 | 28 | 29 | 34 | 2020 CAAQS | 2% | 85% |
| | | | | | | 24 | 2025 CAAQS | 2% | **121%** |
| CO | 1-hour | 127_S | 217 | 422 | 639 | 36,200 | AAQC | 1% | 2% |
| | 8-hour | 116_S | 64 | 402 | 466 | 15,700 | AAQC | 0% | 3% |
| $SO_2$ | 10-minute | 127_S | 0.6 | 4.6 | 5 | 180 | AAQC | 0% | 3% |
| | 1-hour | 127_S | 0.339 | 2.8 | 3 | 100 | AAQC | 0% | 3% |
| | | | | | | 193 | 2020 CAAQS | 0% | 2% |
| | | | | | | 179 | 2025 CAAQS | 0% | 2% |
| | Annual | 116_S | 0.002 | 1 | 1 | 10 | AAQC | 0% | 10% |
| | | | | | | 14 | 2020 CAAQS | 0% | 8% |
| | | | | | | 11 | 2025 CAAQS | 0% | 10% |
| TSP | 24-hour | 117_S | 87.0 | 41 | 128 | 120 | AAQC | 73% | **106%** |
| | Annual | 117_S | 2.03 | 24 | 26 | 60 | AAQC | 3% | 44% |
| $PM_{10}$ | 15-minute | 116_S | 1044.3 | 38 | 1082 | 150 | Metrolinx Mitigation Threshold | **696%** | **722%** |
| | 24-hour | 117_S | 55.8 | 23 | 78.5 | 50 | AAQC | **112%** | **157%** |
| $PM_{2.5}$ | 15-minute | 116_S | 107.4 | 21 | 128 | 81 | Metrolinx Mitigation Threshold | **133%** | **158%** |
| | 24-hour | 117_S | 5.9 | 12 | 18 | 27 | CAAQS | 22% | 67% |
| | Annual | 117_S | 0.15 | 7.2 | 7 | 8.8 | CAAQS | 2% | 84% |
| Crystalline Silica | 15-minute | 116_S | 54.2 | 7.4 | 62 | 25 | Metrolinx Mitigation Threshold | **217%** | **246%** |
| | 24-hour | 117_S | 2.89 | 2 | 5 | 5 | AAQC | 58% | 99% |
| Benzene | 24-hour | 116_S | 0.05 | 0.77 | 0.8 | 2.3 | AAQC | 2% | 36% |
| | Annual | 116_S | 2.3E-03 | 0.53 | 0.5 | 0.45 | AAQC | 1% | **119%** |
| 1, 3 Butadiene | 24-hour | 116_S | 1.9E-03 | 0.08 | 0.08 | 10 | AAQC | 0% | 1% |
| | Annual | 116_S | 9.2E-05 | 0.05 | 0.06 | 2 | AAQC | 0% | 3% |

| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration at Special Receptors [1] ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Maximum Cumulative Concentration at Special Receptors ($\mu g/m^3$) | Air Quality Objective ($\mu g/m^3$) | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|
| B(a)P | 24-hour | 116_S | 3.8E-06 | 0.000139 | 0.000143 | 0.00005 | AAQC | 8% | **285%** |
| | Annual | 116_S | 1.8E-07 | 0.000086 | 0.000086 | 0.00001 | AAQC | 2% | **860%** |
| Formaldehyde | 24-hour | 116_S | 0.37 | 3 | 3.5 | 65 | AAQC | 1% | 5% |
| Acetaldehyde | ½-hour | 127_S | 1.4 | 9 | 10.6 | 500 | AAQC | 0% | 2% |
| | 24-hour | 116_S | 0.13 | 3 | 3.3 | 500 | AAQC | 0% | 1% |
| Acrolein | 1-hour | 127_S | 0.19 | 0.2 | 0.39 | 4.5 | AAQC | 4% | 9% |
| | 24-hour | 116_S | 0.02 | 0.08 | 0.10 | 0.4 | AAQC | 5% | 26% |

Notes:

1. The maximum predicted concentration (meteorological anomalies included) is conservatively used for comparison to all Air Quality Objectives unless otherwise noted.
2. The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations at a special receptor for comparison to the current (2020) and future (2025) CAAQS for 1-hour $NO_2$.

## Figure 6.2: Comparison of Selected Construction Phase Cumulative COI Predictions to Air Quality Objectives - B4 Bowmanville GO Station




Notes:

The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.

Air Quality Objectives:

AAQC - Ontario Ambient Air Quality Criteria

CAAQS - Canadian Ambient Air Quality Standards

MT - Metrolinx mitigation threshold

#### 6.1.2.3 Gridded Receptor Predictions

Table 6.4 presents the dispersion modelling predictions using gridded receptors for the B4 Bowmanville GO Station construction scenario. The table presents the distances from the Project footprint where exceedances of an AQ objective are predicted to occur. COIs included in the table are predicted to have maximum GLC above the AQ objectives at gridded receptor locations. All other contaminants and averaging periods are predicted to remain below their respective AQ objective. The main contributor to these exceedances is dust that is generated from construction activities whose emission rate is estimated based on the size of the active construction area. The predicted impacts from the station construction are higher compared to other Project components as it has a much larger active construction area.

**Table 6.4: B4 Bowmanville GO Station Construction Scenario - Predicted Impact Zones**

| COI | Averaging Period | AQ Objective ($\mu g/m^3$) | Source of Objective | Distance from Project footprint (m) |
|---|---|---|---|---|
| TSP | 24-hour | 120 | AAQC | 30 |
| $PM_{10}$ | 15-minute | 150 | Metrolinx Mitigation Threshold | 680 |
| | 24-hour | 50 | AAQC | 100 |
| $PM_{2.5}$ | 15-minute | 81 | Metrolinx Mitigation Threshold | 110 |
| Crystalline silica | 15-minute | 25 | Metrolinx Mitigation Threshold | 220 |

### 6.1.3 Trackwork and Grading - Farewell Street Multi-use Bridge to West of Harmony Road Bridge

The maximum Project Alone and cumulative concentrations of COIs for the trackwork and grading construction scenario are presented in Table 6.5. The following sub-sections discuss the results of the dispersion modelling.

#### 6.1.3.1 Special Receptor Predictions - Project Alone

For the Project Alone, the maximum predicted concentrations of COIs are below their respective air quality objectives at special receptor locations except for $PM_{10}$. The maximum predicted Project Alone 15-minute average $PM_{10}$ concentration is 126% of the Metrolinx mitigation threshold with a frequency of exceedance of no more than 39 hours over a 5-year period or approximately 0.09% of the time. The main contributor to $PM_{10}$ emissions is construction dust.

#### 6.1.3.2 Special Receptor Predictions - Cumulative Concentrations

The maximum cumulative concentrations of COIs are below their respective air quality objectives except for $NO_2$, $PM_{10}$, benzene and benzo(a)pyrene. As previously discussed, background annual benzene and 24-hour and annual benzo(a)pyrene concentrations are above their respective criteria with the Project having only a minor contribution to the cumulative levels.

The maximum predicted 1-hour average 98$^{th}$ percentile cumulative $NO_2$ concentration is 121% of the 2025 CAAQS and the maximum annual average cumulative concentration is 128% of the 2025 CAAQS. As construction activities are not anticipated to last longer than 18 months for the entire Project footprint, comparing the maximum model predictions to CAAQS that are based on 3-year averages is conservative. Ambient $NO_2$ levels from construction will be lower during periods when fewer construction vehicles or equipment are being operated concurrently than conservatively assumed in this assessment.

The maximum predicted 15-minute average cumulative $PM_{10}$ concentration is 151% of the Metrolinx mitigation threshold, which is 25% higher than the Project Alone prediction that also exceeded the mitigation threshold.

Figure 6.3 graphically presents the relative contributions of Project Alone and Background concentrations to the maximum cumulative concentration of each COI that is predicted to be above an applicable air quality objective at a special receptor. Benzene, benzo(a)pyrene and annual $NO_2$ cumulative concentrations can be seen to be dominated by the background concentrations whereas 1-hour $NO_2$ and 15-minute $PM_{2.5}$ cumulative concentrations are mainly due to the Project.

**Table 6.5: Summary of Construction Phase Air Dispersion Modelling Results at Special Receptors - Track and Grading Construction (west of Farewell Street to west of Harmony Road)**

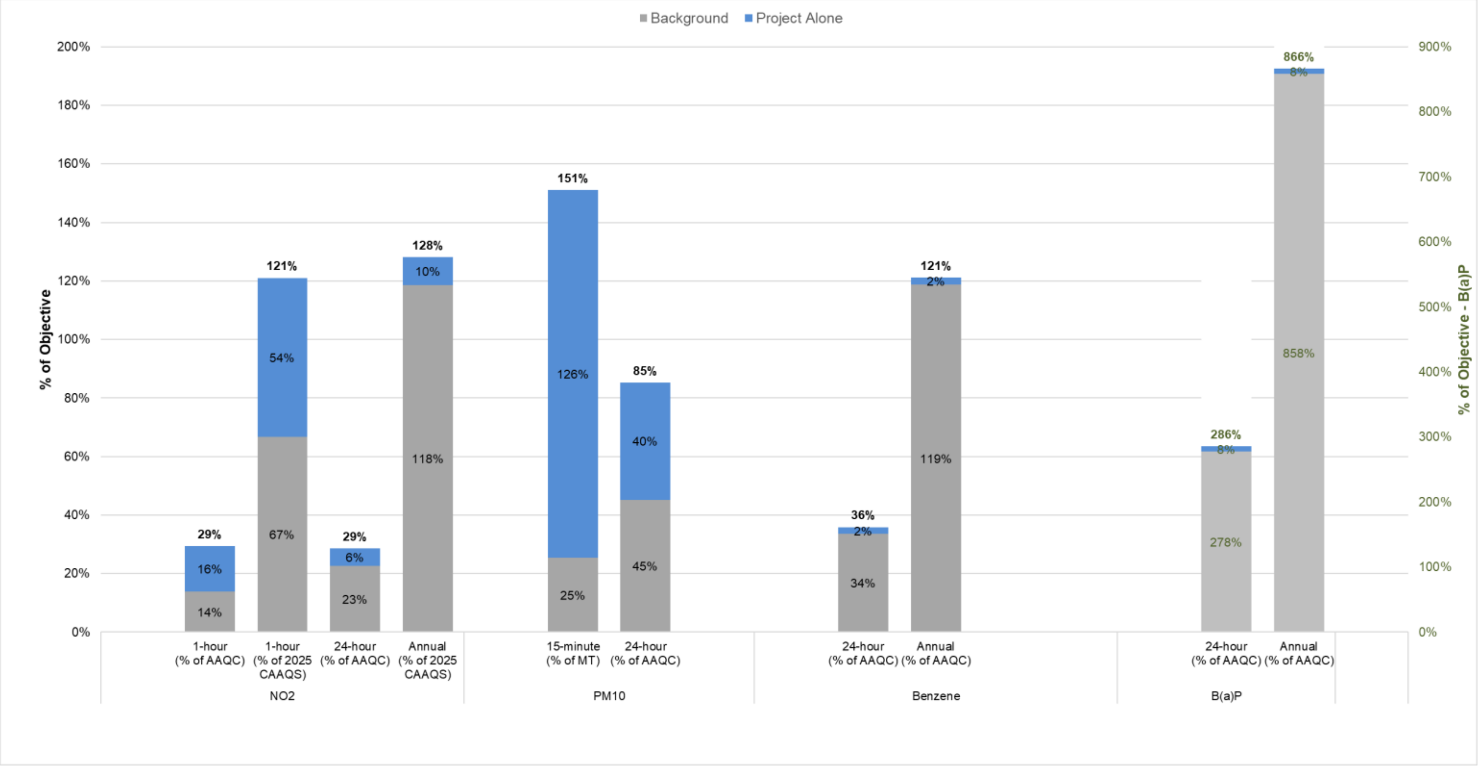
| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration at Special Receptors[1] (µg/m³) | Background Concentration (µg/m³) | Maximum Cumulative Concentration at Special Receptors (µg/m³) | Air Quality Objective (µg/m³) | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [2] | 140_S | 62 | 55 | 118 | 400 | AAQC | 16% | 29% |
| | | 140_S | 45 | | 100 | 119 | 2020 CAAQS | 38% | 84% |
| | | | | | | 83 | 2025 CAAQS | 54% | **121%** |
| | 24-hour | 140_S | 12 | 45 | 57 | 200 | AAQC | 6% | 29% |
| | Annual | 54_C | 2.3 | 28 | 30 | 34 | 2020 CAAQS | 7% | 90% |
| | | | | | | 24 | 2025 CAAQS | 10% | **128%** |
| CO | 1-hour | 140_S | 135 | 422 | 557 | 36,200 | AAQC | 0% | 2% |
| | 8-hour | 140_S | 69 | 402 | 472 | 15,700 | AAQC | 0% | 3% |
| $SO_2$ | 10-minute | 140_S | 0.3 | 4.6 | 5 | 180 | AAQC | 0% | 3% |
| | 1-hour | 140_S | 0.210 | 2.8 | 3 | 100 | AAQC | 0% | 3% |
| | | | | | | 193 | 2020 CAAQS | 0% | 2% |
| | | | | | | 179 | 2025 CAAQS | 0% | 2% |
| | Annual | 54_C | 0.008 | 1 | 1 | 10 | AAQC | 0% | 10% |
| | | | | | | 14 | 2020 CAAQS | 0% | 8% |
| | | | | | | 11 | 2025 CAAQS | 0% | 10% |
| TSP | 24-hour | 140_S | 31.0 | 41 | 72.0 | 120 | AAQC | 26% | 60% |
| | Annual | 54_C | 4.67 | 24 | 28.8 | 60 | AAQC | 8% | 48% |
| $PM_{10}$ | 15-minute | 52_S | 188.3 | 38 | 227 | 150 | Metrolinx Mitigation Threshold | **126%** | **151%** |
| | 24-hour | 140_S | 20.0 | 23 | 43.0 | 50 | AAQC | 40% | 85% |
| $PM_{2.5}$ | 15-minute | 52_S | 21.7 | 21 | 43 | 81 | Metrolinx Mitigation Threshold | 27% | 52% |
| | 24-hour | 140_S | 2.4 | 12 | 15 | 27 | CAAQS | 9% | 54% |
| | Annual | 54_C | 0.41 | 7.2 | 8 | 8.8 | CAAQS | 5% | 87% |
| Crystalline Silica | 15-minute | 52_S | 9.6 | 7.4 | 17 | 25 | Metrolinx Mitigation Threshold | 39% | 68% |
| | 24-hour | 140_S | 1.02 | 2 | 3 | 5 | AAQC | 20% | 61% |
| Benzene | 24-hour | 140_S | 0.05 | 0.77 | 0.8 | 2.3 | AAQC | 2% | 36% |
| | Annual | 54_C | 1.0E-02 | 0.53 | 0.5 | 0.45 | AAQC | 2% | **121%** |
| 1, 3 Butadiene | 24-hour | 140_S | 2.1E-03 | 0.08 | 0.08 | 10 | AAQC | 0% | 1% |
| | Annual | 140_S | 4.1E-04 | 0.05 | 0.06 | 2 | AAQC | 0% | 3% |

| Contaminant | Averaging Period | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration at Special Receptors[1] (µg/m³) | Background Concentration (µg/m³) | Maximum Cumulative Concentration at Special Receptors (µg/m³) | Air Quality Objective (µg/m³) | Source of Objective | Percentage of Objective (%) Project Alone | Percentage of Objective (%) Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|
| B(a)P | 24-hour | 140_S | 4.2E-06 | 0.000139 | 0.000143 | 0.00005 | AAQC | 8% | **286%** |
| | Annual | 54_C | 8.1E-07 | 0.000086 | 0.000087 | 0.00001 | AAQC | 8% | **868%** |
| Formaldehyde | 24-hour | 140_S | 0.41 | 3 | 3.4 | 65 | AAQC | 1% | 5% |
| Acetaldehyde | ½-hour | 140_S | 0.9 | 9 | 9.9 | 500 | AAQC | 0% | 2% |
| | 24-hour | 140_S | 0.14 | 3 | 3.1 | 500 | AAQC | 0% | 1% |
| Acrolein | 1-hour | 140_S | 0.12 | 0.2 | 0.32 | 4.5 | AAQC | 3% | 7% |
| | 24-hour | 140_S | 0.02 | 0.08 | 0.10 | 0.4 | AAQC | 6% | 26% |

Notes:

1. The maximum predicted concentration (meteorological anomalies included) is conservatively used for comparison to all Air Quality Objectives unless otherwise noted.
2. The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations at a special receptor for comparison to the current (2020) and future (2025) CAAQS for 1-hour $NO_2$.

**Figure 6.3: Comparison of Selected Construction Phase Cumulative COI Predictions to Air Quality Objectives - Track and Grading Construction (west of Farewell Street to west of Harmony Road)**




Notes:
The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.
Air Quality Objectives:
AAQC - Ontario Ambient Air Quality Criteria
CAAQS - Canadian Ambient Air Quality Standards
MT - Metrolinx mitigation threshold

#### 6.1.3.3 Gridded Receptor Predictions

Table 6.6 presents the dispersion modelling predictions for the trackwork and grading scenario with gridded receptors. The table presents the distances from the Project footprint where exceedances of an AQ objective are predicted to occur. The two COIs included in the table are predicted to have maximum GLCs above their AQ objectives at gridded receptor locations. All other contaminants and averaging periods are predicted to remain below their respective AQ objective.

**Table 6.6: Track and Grading Construction Scenario - Predicted Impact Zones**

| COI | Averaging Period | AQ Objective ($\mu g/m^3$) | Source of Objective | Distance from Project footprint (m) |
|---|---|---|---|---|
| $NO_2$ | 1-hour | 83 | 2025 CAAQS | 10 |
| $PM_{10}$ | 15-minute | 150 | Metrolinx Mitigation Threshold | 30 |
| | 24-hour | 50 | AAQC | 5 |

### 6.1.4 Bridge Reconstruction - Simcoe Street Bridge

The maximum predicted Project Alone and cumulative COI concentrations for the Simcoe Street Bridge Reconstruction scenario are presented in Table 6.7. For this sub-Project location, modelling was conducted for the following two cases:

1. Bridge Reconstruction including Simcoe Street traffic being re-routed onto detour roads
2. Bridge Reconstruction without considering emissions from re-routed traffic detour roads

The results of the construction impact for Case 1 represents the worst-case construction scenario for the Simcoe Street Bridge Construction, whereas the construction impacts without detour roads (Case 2) predicts the impact of the bridge reconstruction equipment/activities alone. The results of Case 2 are used to predict the impacts of bridge reconstruction activities for the other bridge sub-Project locations.

#### 6.1.4.1 Special Receptors Predictions - Project Alone

Maximum Project Alone 1-hour 98$^{th}$ percentile and annual average $NO_2$ concentrations are predicted to exceed the 1-hour and annual 2025 CAAQS by 46% and 11% respectively for Case 1. For Case 2, the predicted 1-hour 98$^{th}$ percentile concentration is 100% of the 1-hour CAAQS. It is expected that the maximum emissions scenario modelled for each Case will not occur consistently throughout the entire construction period. Ambient $NO_2$ levels from construction will be lower during periods when fewer construction vehicles or equipment are being operated concurrently than that modelled. Additionally, as road reinstatement construction activities are not anticipated to last longer than 2 months at this site, comparing the 98$^{th}$ percentile model predictions to the CAAQS that are based on a 3-year average will be conservative.

The maximum predicted Project Alone 15-minute average $PM_{10}$ concentration is 144% of the Metrolinx mitigation threshold for Case 1 (including re-routed vehicle traffic) and 143% of the objective for Case 2 (construction activities without re-routed traffic emissions). The frequency of exceedance for either case is no more than 44 hours over a 5-year period or approximately 0.1% of the time. The main contributor to the maximum Project Alone $PM_{10}$ concentration is construction dust generated at the Simcoe Street Bridge reconstruction.

The maximum predicted 24-hour and annual average Project Alone benzo(a)pyrene concentrations for Case 1 (with traffic on detour roads) are 197% and 329% of their respective AAQC. For Case 2, which does not include emissions from detoured vehicle traffic the maximum predicted Project Alone concentrations are only 19% and 21% of the 24-hour and annual AAQCs. The main contributor to the Project Alone exceedances is from vehicles travelling on detour roads during the bridge closure. Construction vehicles operating at the Simcoe Street bridge are not predicted to cause benzo(a)pyrene exceedances at the special receptors for the Project Alone.

The maximum predicted concentrations for all other COIs and averaging periods for the Project Alone are below their AQ Objectives and mitigation thresholds.

#### 6.1.4.2 Special Receptor Predictions - Cumulative Concentrations

As Project Alone $NO_2$ and $PM_{10}$ concentrations at some special receptors were predicted to exceed some AQ objectives, cumulative concentrations for these COIs also exceeded their objectives. For $NO_2$ the maximum predicted cumulative 1-hour and annual concentrations are 213% and 230% of the 2025 CAAQS for Case 1 (including detoured vehicle traffic) and 166% and 143% for Case 2 (excluding detoured vehicle traffic). For $PM_{10}$, the maximum cumulative 15-minute concentrations exceeded the Metrolinx mitigation threshold by about 70%.

Background annual benzene and 24-hour and annual benzo(a)pyrene cumulative concentrations are above their respective criteria, with the bridge reconstruction activities (not including detoured traffic) having only a minor contribution to the cumulative levels.

The maximum cumulative concentrations of the other COIs and averaging periods are below their AQ objectives or mitigation thresholds.

Figure 6.4 and Figure 6.5 graphically presents the relative contributions of Project Alone and Background concentrations to the maximum cumulative concentration of each COI that is predicted to be above an applicable air quality objective at a special receptor. For Case 1 (including re-routed vehicle traffic) and Case 2 (without re-routed vehicle traffic), benzene, benzo(a)pyrene and annual $NO_2$ cumulative concentrations can be seen to be dominated by the background concentrations whereas 1-hour $NO_2$ cumulative concentrations are mainly due to the operation of construction vehicles and equipment. 15-minute cumulative concentrations of $PM_{10}$ are similar for Case 1 and Case 2 and the predicted Project Alone exceedance is due to construction dust generation rather than re-routed vehicle traffic. Project Alone concentrations of benzene are identical for Case 1 and Case 2 since the main emissions source is the operation of construction vehicles and equipment.

**Table 6.7: Summary of Construction Phase Air Dispersion Modelling Results at Special Receptors - Simcoe Street - Bridge Replacement**

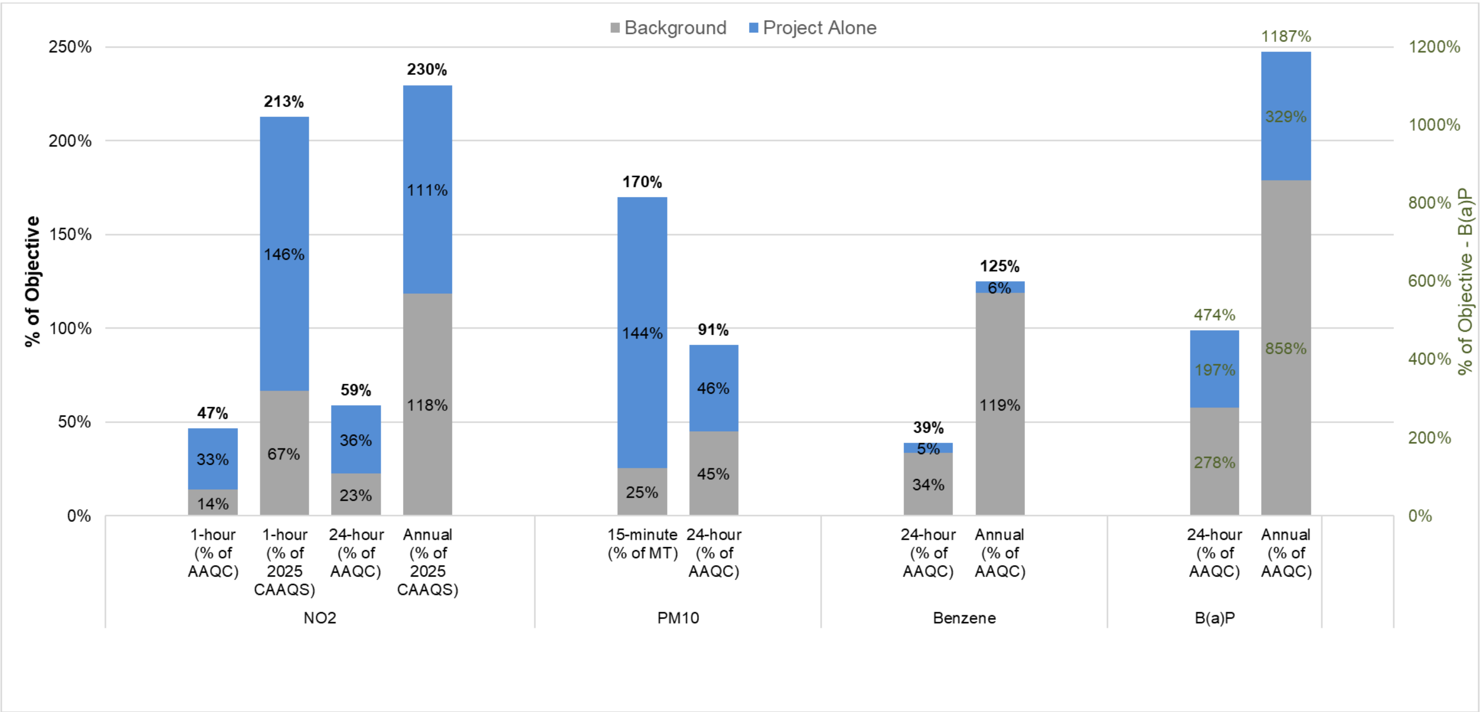
| Contaminant | Averaging Period | Location of Maximum Concentration Case 1 | Location of Maximum Concentration Case 2 | Project Alone Maximum Predicted Concentration at Special Receptors [1] ($\mu g/m^3$) Case 1 | Project Alone Maximum Predicted Concentration at Special Receptors [1] ($\mu g/m^3$) Case 2 | Background Concentration ($\mu g/m^3$) | Maximum Cumulative Concentration at Special Receptors ($\mu g/m3$) Case 1 | Maximum Cumulative Concentration at Special Receptors ($\mu g/m^3$) Case 2 | Air Quality Objective ($\mu g/m^3$) | Source of Objective | Percentage of Objective (%) Case 1 Project Alone | Percentage of Objective (%) Case 1 Cumulative (Project + Background) | Percentage of Objective (%) Case 2 Project Alone | Percentage of Objective (%) Case 2 Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [2] | 41_S | 145_C | 131 | 104 | 55 | 187 | 160 | 400 | AAQC | 33% | 47% | 26% | 40% |
| | | 41_S | 145_C | 121 | 83 | | 177 | 138 | 119 | 2020 CAAQS | **102%** | **148%** | 69% | **116%** |
| | | | | | | | | | 83 | 2025 CAAQS | **146%** | **213%** | **100%** | **166%** |
| | 24-hour | 180_S | 145_C | 72 | 27 | 45 | 117 | 72 | 200 | AAQC | 36% | 59% | 13% | 36% |
| | Annual | 41_S | 145_C | 26.7 | 5.9 | 28 | 55 | 34 | 34 | 2020 CAAQS | 79% | **162%** | 17% | 101% |
| | | | | | | | | | 24 | 2025 CAAQS | **111%** | **230%** | 25% | **143%** |
| CO | 1-hour | 181_C | 145_C | 1262 | 301 | 422 | 1684 | 723 | 36,200 | AAQC | 3% | 5% | 1% | 2% |
| | 8-hour | 181_C | 145_C | 1009 | 143 | 402 | 1411 | 545 | 15,700 | AAQC | 6% | 9% | 1% | 3% |
| $SO_2$ | 10-minute | 181_C | 145_C | 1.5 | 0.8 | 4.6 | 6 | 5 | 180 | AAQC | 1% | 3% | 0% | 3% |
| | 1-hour | 181_C | 145_C | 0.894 | 0.479 | 2.8 | 4 | 3 | 100 | AAQC | 1% | 4% | 0% | 3% |
| | | | | | | | | | 193 | 2020 CAAQS | 0% | 2% | 0% | 2% |
| | | | | | | | | | 179 | 2025 CAAQS | 0% | 2% | 0% | 2% |
| | Annual | 190_S | 145_C | 0.179 | 0.020 | 1 | 1 | 1 | 10 | AAQC | 2% | 11% | 0% | 10% |
| | | | | | | | | | 14 | 2020 CAAQS | 1% | 9% | 0% | 8% |
| | | | | | | | | | 11 | 2025 CAAQS | 2% | 11% | 0% | 10% |
| TSP | 24-hour | 194_S | 145_C | 47.3 | 35.0 | 41 | 88.3 | 76.0 | 120 | AAQC | 39% | 73% | 29% | 63% |
| | Annual | 194_S | 145_C | 15.08 | 5.19 | 24 | 39.1 | 29.2 | 60 | AAQC | 25% | 65% | 9% | 49% |
| $PM_{10}$ | 15-minute | 145_C | 145_C | 216.7 | 214.9 | 38 | 255 | 253 | 150 | Metrolinx Mitigation Threshold | **144%** | **170%** | **143%** | **169%** |
| | 24-hour | 145_C | 145_C | 23.0 | 22.8 | 23 | 46.0 | 45.8 | 50 | AAQC | 46% | 91% | 46% | 91% |

| Contaminant | Averaging Period | Location of Maximum Concentration Case 1 | Location of Maximum Concentration Case 2 | Project Alone Maximum Predicted Concentration at Special Receptors [1] (μg/m³) Case 1 | Project Alone Maximum Predicted Concentration at Special Receptors [1] (μg/m³) Case 2 | Background Concentration (μg/m³) | Maximum Cumulative Concentration at Special Receptors (μg/m3) Case 1 | Maximum Cumulative Concentration at Special Receptors (μg/m³) Case 2 | Air Quality Objective (μg/m³) | Source of Objective | Percentage of Objective (%) Case 1 Project Alone | Percentage of Objective (%) Case 1 Cumulative (Project + Background) | Percentage of Objective (%) Case 2 Project Alone | Percentage of Objective (%) Case 2 Cumulative (Project + Background) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $PM_{2.5}$ | 15-minute | 145_C | 145_C | 28.7 | 28.2 | 21 | 50 | 49 | 81 | Metrolinx Mitigation Threshold | 35% | 61% | 35% | 60% |
| | 24-hour | 145_C | 145_C | 3.5 | 3.3 | 12 | 16 | 15 | 27 | CAAQS | 13% | 58% | 12% | 57% |
| | Annual | 145_C | 145_C | 1.17 | 0.61 | 7.2 | 8 | 8 | 8.8 | CAAQS | 13% | 96% | 7% | 89% |
| Crystalline Silica | 15-minute | 145_C | 145_C | 10.8 | 10.8 | 7.4 | 18 | 18 | 25 | Metrolinx Mitigation Threshold | 43% | 73% | 43% | 73% |
| | 24-hour | 145_C | 145_C | 1.14 | 1.13 | 2 | 3 | 3 | 5 | AAQC | 23% | 64% | 23% | 64% |
| Benzene | 24-hour | 145_C | 145_C | 0.12 | 0.12 | 0.77 | 0.9 | 0.9 | 2.3 | AAQC | 5% | 39% | 5% | 39% |
| | Annual | 145_C | 145_C | 2.8E-02 | 2.6E-02 | 0.53 | 0.6 | 0.6 | 0.45 | AAQC | 6% | **125%** | 6% | **125%** |
| 1, 3 Butadiene | 24-hour | 180_S | 145_C | 7.1E-03 | 4.8E-03 | 0.08 | 0.09 | 0.08 | 10 | AAQC | 0% | 1% | 0% | 1% |
| | Annual | 190_S | 145_C | 2.4E-03 | 1.0E-03 | 0.05 | 0.05 | 0.05 | 2 | AAQC | 0% | 3% | 0% | 3% |
| B(a)P | 24-hour | 185_S | 145_C | 9.8E-05 | 9.6E-06 | 0.000139 | 0.000237 | 0.000149 | 0.00005 | AAQC | **197%** | **474%** | 19% | **297%** |
| | Annual | 190_S | 145_C | 3.3E-05 | 2.1E-06 | 0.000086 | 0.000119 | 0.000088 | 0.00001 | AAQC | **329%** | **1189%** | 21% | **879%** |
| Formaldehyde | 24-hour | 145_C | 145_C | 0.94 | 0.93 | 3 | 3.9 | 3.9 | 65 | AAQC | 1% | 6% | 1% | 6% |
| Acetaldehyde | ½-hour | 145_C | 145_C | 2.0 | 2.0 | 9 | 11.0 | 11.0 | 500 | AAQC | 0% | 2% | 0% | 2% |
| | 24-hour | 145_C | 145_C | 0.32 | 0.32 | 3 | 3.3 | 3.3 | 500 | AAQC | 0% | 1% | 0% | 1% |
| Acrolein | 1-hour | 145_C | 145_C | 0.27 | 0.27 | 0.2 | 0.47 | 0.47 | 4.5 | AAQC | 6% | 10% | 6% | 10% |
| | 24-hour | 145_C | 145_C | 0.05 | 0.05 | 0.08 | 0.13 | 0.13 | 0.4 | AAQC | 13% | 33% | 13% | 34% |

Notes:

1. The maximum predicted concentration (meteorological anomalies included) is conservatively used for comparison to all Air Quality Objectives unless otherwise noted.
2. The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations at a special receptor for comparison to the current (2020) and future (2025) CAAQS for 1-hour $NO_2$.

## Figure 6.4: Comparison of Selected Construction Phase Cumulative COI Predictions to Air Quality Objectives - Simcoe Street Bridge Construction (Case 1)




Notes:

The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.

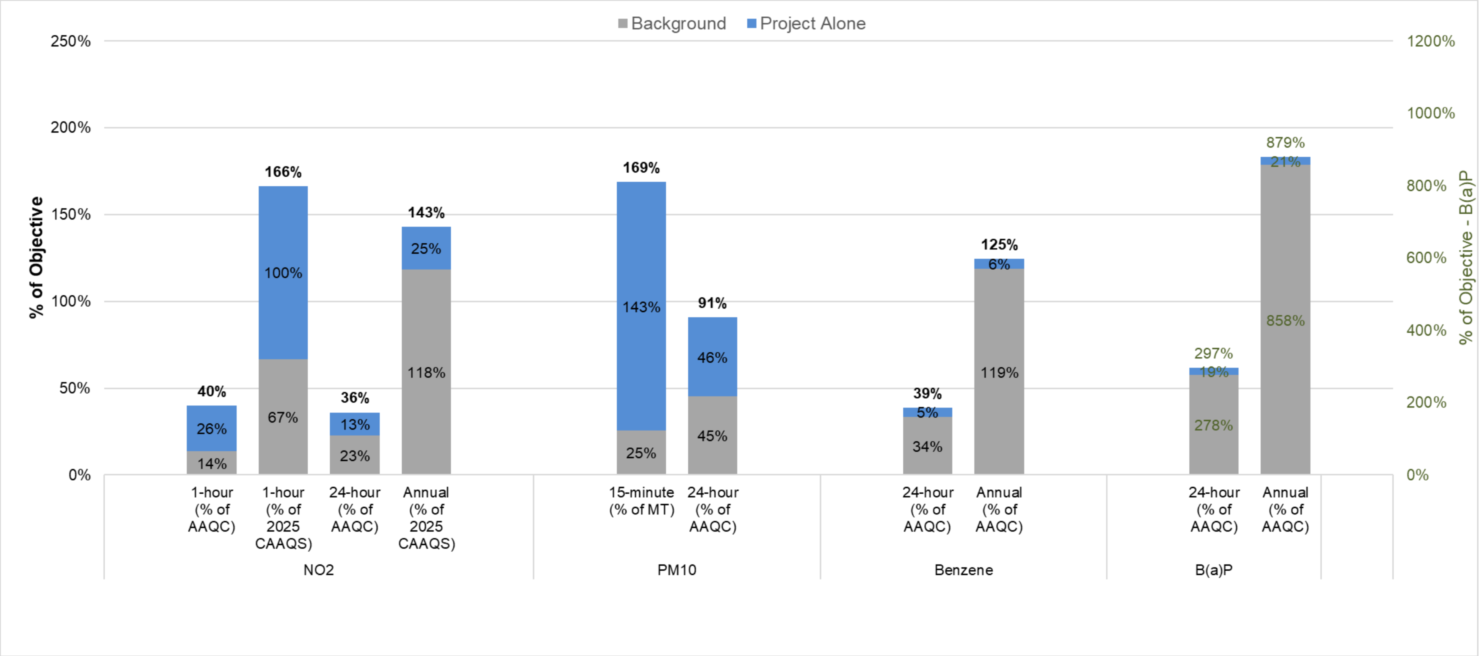
Air Quality Objectives:

AAQC - Ontario Ambient Air Quality Criteria

CAAQS - Canadian Ambient Air Quality Standards

MT - Metrolinx mitigation threshold

**Figure 6.5: Comparison of Selected Construction Phase Cumulative COI Predictions to Air Quality Objectives - Simcoe Street Bridge Construction (Case 2)**




Notes:

The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.

Air Quality Objectives:

AAQC - Ontario Ambient Air Quality Criteria

CAAQS - Canadian Ambient Air Quality Standards

MT - Metrolinx mitigation threshold

#### 6.1.4.3 Gridded Receptor Predictions

Table 6.8 presents the dispersion modelling results of the gridded receptors for the Simcoe Street Bridge re-construction maximum emissions scenario (with standard mitigation measures). The table presents the distances from the Project footprint where exceedances of an AQ objective are predicted to occur for Case 2 (i.e., construction impacts without assessing vehicle emissions on detour roads). COIs included in the table are predicted to have maximum GLCs above their AQ objectives at gridded receptor locations. All other contaminants and averaging periods are predicted to remain below their respective AQ objective.

**Table 6.8: Simcoe Street Bridge Construction Case 2 - Predicted Impact Zones**

| COI | Averaging Period | AQ Objective ($\mu g/m^3$) | Source of Objective | Distance from Project footprint (m) |
|---|---|---|---|---|
| $NO_2$ | 1-hour | 83 | 2025 CAAQS | 25 |
| $PM_{10}$ | 15-minute | 150 | Metrolinx Mitigation Threshold | 20 |

## 6.2 Operations Phase

Dispersion modelling analyses were conducted for emissions from the three scenarios for the operation phase: Baseline (2021), Future No Build (2031) and Future Build (2031). This section presents the results of those analyses. Dispersion model predictions at the identified special receptors for each COI were compared to the applicable Air Quality Objectives. Dispersion modelling of selected COIs over gridded receptors was also conducted to generate concentration contour plots.

The maximum Project Alone and cumulative concentrations of COIs for the Operations Phase are presented in Table 6.10 for the Baseline, Future No Build and Future Build Scenarios. The following sub-sections discuss the results of the dispersion modelling.

### 6.2.1 Project Alone Predictions - Special Receptors

The maximum predicted concentrations for all COIs and averaging periods for the Project Alone Baseline and Future No Build scenarios are below their AQ Objectives. The maximum Project Alone 1-hour average 98$^{th}$ percentile and annual $NO_2$ concentrations for both the Baseline and Future No Build scenarios are predicted to be 90% and 12% of the 2025 CAAQS, respectively.

For the Future Build scenario, the maximum Project Alone concentrations of all COIs and averaging periods other than $NO_2$ are predicted to increase relative to the Baseline and Future No Build scenarios, but remain below their AQ Objectives. The maximum predicted 1-hour average 98$^{th}$ percentile and annual $NO_2$ concentrations are predicted to exceed the 2025 CAAQS by 145% and 6%, respectively.

### 6.2.2 Cumulative Concentration Predictions - Special Receptors

When background concentrations are added to the Project Alone predictions, the following observations can be made:

- Cumulative $NO_2$ concentrations at 127 of 171 special receptors located in Oshawa segment are predicted to exceed the 1-hour and annual 2025 CAAQS by a maximum of 96% and 122%, respectively, but remain below the Ontario $NO_2$ AAQC.
- Cumulative annual average benzene and 24-hour and annual average benzo(a)pyrene concentrations in Oshawa segment are above their respective criteria by 30%, 248% and 844%, respectively, with the Project having only a minor contribution (<20%) to the cumulative levels.
- Cumulative $NO_2$ concentrations at 39 of 39 special receptors located in Courtice segment are predicted to exceed the 1-hour and annual 2025 CAAQS by a maximum of 150% and 83%, respectively, but remain below the Ontario $NO_2$ AAQC.
- Cumulative annual average benzene and 24-hour and annual average benzo(a)pyrene concentrations in Courtice segment are above their respective criteria by 24%, 193% and 777%, respectively, with the Project having only a minor contribution (<5%) to the cumulative levels.
- Cumulative $NO_2$ concentrations at 56 of 56 special receptors located in Bowmanville are predicted to exceed the 1-hour and annual 2025 CAAQS by a maximum of 212% and 125%, respectively, but remain below the Ontario $NO_2$ AAQC.
- Cumulative annual average benzene and 24-hour and annual average benzo(a)pyrene concentrations in Bowmanville segment are above their respective criteria by 32%, 252% and 818%, respectively, with the Project having only a minor contribution (<21%) to the cumulative levels.
- The maximum predicted cumulative concentrations of the other COIs at all three segments are below their AQ objectives for the Existing, Future No Build and Future Build scenarios.

Figure 6.6 graphically presents the relative contributions of Project Alone (blue portion of each bar) and Background concentrations (grey portion of each bar) to the maximum Future No Build and Future Build cumulative concentrations of each COI that is predicted to be above an applicable air quality objective at a special receptor. As discussed above, benzene, benzo(a) pyrene and annual $NO_2$ cumulative concentrations can be seen to be dominated by the background concentrations.

### 6.2.3 Gridded Receptor Predictions

Table 6.9 presents the dispersion modelling results of the gridded receptors for the operation scenario. The table presents the location of the maximum concentrations and distances from the Project footprint where exceedances of the 1-hour $NO_2$ CAAQS are predicted to occur based on the 1-hour 98$^{th}$ percentile $NO_2$ concentration contour plots for the Oshawa, Courtice and Bowmanville segments presented in Appendix F. COIs included in the table are predicted to have Project Alone maximum GLCs above their AQ objectives at gridded receptor locations. All other contaminants and averaging periods are predicted to remain below their respective AQ objective.

It should be noted that the 1-hour and 24-hour Project Alone and cumulative $NO_2$ concentrations for the Baseline, Future No Build and Future Build scenarios are predicted to be below the AAQC which are currently used by the MECP. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects.

**Table 6.9: Operation - Predicted Impact Zones**

| COI | Averaging Period | AQ Objective (µg/m$^3$) | Operation Model Segment | Predicted Maximum Location | Distance from Project footprint (m) |
|---|---|---|---|---|---|
| $NO_2$ | 1-hour | 83<br>(2025 CAAQS) | Oshawa | B2 GO Station | 43 |
| | | | Courtice | B3 GO Station | >500 |
| | | | Bowmanville | B4 GO Station | 250 |

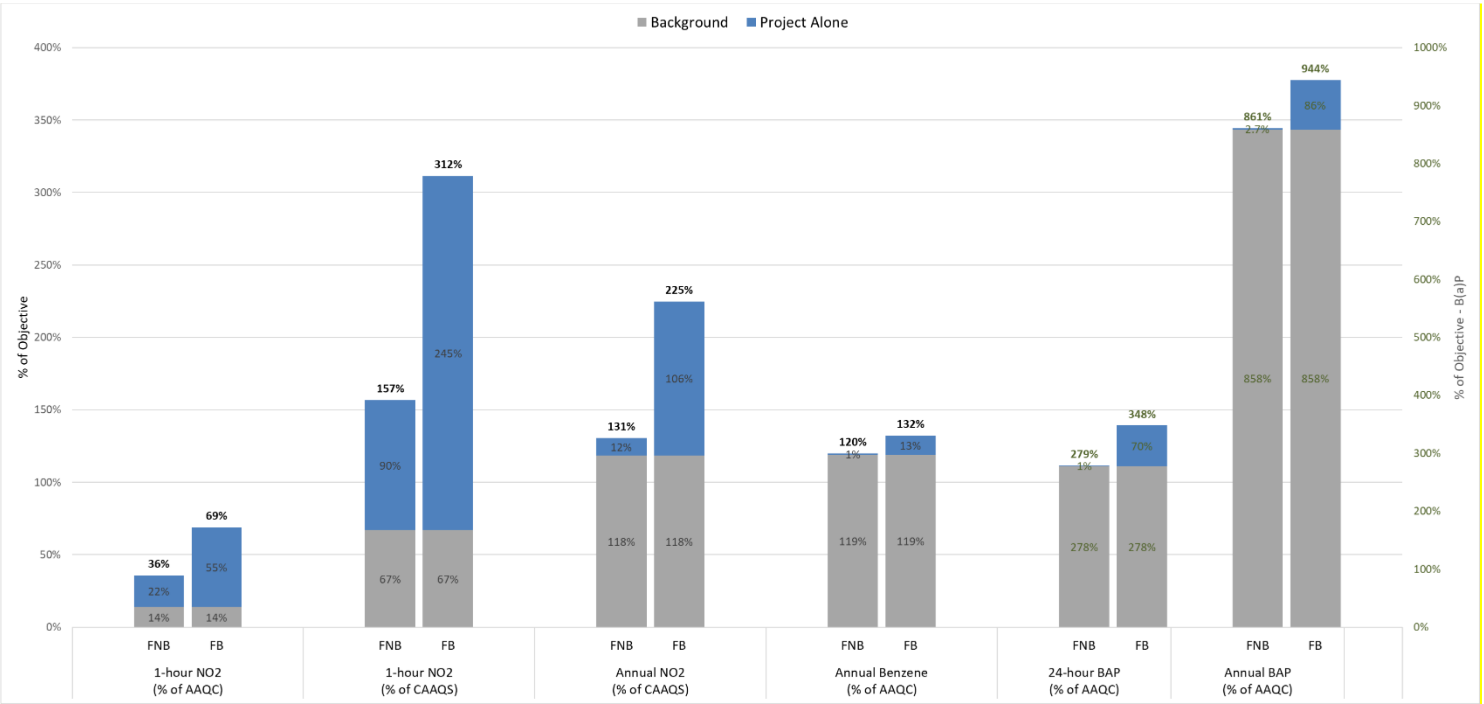
### Table 6.10: Summary of Operations Phase Air Dispersion Modelling Results at Special Receptors – DC Oshawa GO to Bowmanville

| Contaminant | Averaging Period | Background Concentration | Air Quality Objective | Source of Objective | Baseline/Future No Build Scenario | | | | | Future Build Scenario | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] | Maximum Cumulative Concentration | Percentage of Objective (%) | | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] | Maximum Cumulative Concentration | Percentage of Objective (%) | |
| | | (µg/m³) | (µg/m³) | | | (µg/m³) | (µg/m³) | Project Alone | Cumulative (Project + Background) | | (µg/m³) | (µg/m³) | Project Alone | Cumulative (Project + Background) |
| $NO_2$ | 1-hour [2] | 55 | 400 | AAQC | 100_S | 88 | 143 | 22% | 36% | POR079 | 220 | 275 | 55% | 69% |
| | | | 119 | 2020 CAAQS | 80_S | 75 | 130 | 74% | **109%** | | 203 | 259 | **171%** | **217%** |
| | | | 83 | 2025 CAAQS | | | | 90% | **157%** | POR079 | | | **245%** | **312%** |
| | 24-hour | 45 | 200 | AAQC | 93_S | 11 | 56 | 5% | 28% | POR079 | 91 | 136 | 45% | 68% |
| | Annual | 28 | 34 | 2020 CAAQS | POR062 | 3 | 31 | 9% | 92% | POR079 | 25 | 54 | 75% | **159%** |
| | | | 24 | 2025 CAAQS | | | | 12% | **131%** | | | | **106%** | **225%** |
| CO | 1-hour | 422 | 36,200 | AAQC | POR080A | 180 | 602 | 0.5% | 2% | 35_S | 362 | 784 | 1.0% | 2% |
| | 8-hour | 402 | 15,700 | AAQC | POR080A | 101 | 503 | 0.6% | 3% | 35_S | 226 | 629 | 1.4% | 4% |
| $SO_2$ | 10-minute | 4.6 | 180 | AAQC | 78_S | 0.63 | 5 | 0.3% | 3% | POR079 | 1.50 | 6 | 0.8% | 3% |
| | 1-hour | 2.8 | 100 | AAQC | 78_S | 0.38 | 3 | 0.3% | 3% | POR079 | 0.91 | 4 | 0.9% | 4% |
| | | | 193 | 2020 CAAQS | | | | 0.2% | 2% | | | | 0.5% | 2% |
| | | | 179 | 2025 CAAQS | | | | 0.2% | 2% | | | | 0.5% | 2% |
| | Annual | 1.0 | 10 | AAQC | POR062 | 0.0078 | 1 | <0.1% | 10% | 35_S | 0.057 | 1 | 0.5% | 10% |
| | | | 14 | 2020 CAAQS | | | | <0.1% | 8% | | | | 0.4% | 8% |
| | | | 11 | 2025 CAAQS | | | | <0.1% | 10% | | | | 0.5% | 10% |
| TSP | 24-hour | 41 | 120 | AAQC | POR080A | 3 | 43.4 | 2.2% | 36% | POR079 | 6.9 | 47.6 | 5.8% | 40% |
| | Annual | 24 | 60 | AAQC | POR080A | 0.48 | 24.6 | 0.8% | 41% | POR079 | 1.41 | 25.5 | 2.3% | 43% |
| $PM_{10}$ | 24-hour | 23 | 50 | AAQC | POR080A | 0.63 | 23.2 | 1.3% | 46% | POR079 | 4.83 | 27.4 | 9.7% | 55% |
| $PM_{2.5}$ | 24-hour | 12 | 27 | CAAQS | POR080A | 0.23 | 12 | 0.8% | 46% | POR079 | 4.26 | 16 | 15.8% | 61% |
| | Annual | 7.2 | 8.8 | CAAQS | POR080A | 0.055 | 7 | 0.6% | 83% | POR079 | 0.732 | 8 | 8.3% | 91% |
| Benzene | 24-hour | 0.77 | 2.3 | AAQC | POR080A | 0.020 | 0.8 | 0.9% | 34% | POR079 | 0.345 | 1.1 | 15.0% | 49% |

| Contaminant | Averaging Period | Background Concentration | Air Quality Objective | Source of Objective | Baseline/Future No Build Scenario | | | | | Future Build Scenario | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] | Maximum Cumulative Concentration | Percentage of Objective (%) | | Location of Maximum Concentration | Project Alone Maximum Predicted Concentration [1] | Maximum Cumulative Concentration | Percentage of Objective (%) | |
| | | (µg/m³) | (µg/m³) | | | (µg/m³) | (µg/m³) | Project Alone | Cumulative (Project + Background) | | (µg/m³) | (µg/m³) | Project Alone | Cumulative (Project + Background) |
| | Annual | 0.53 | 0.45 | AAQC | POR080A | 0.0048 | 0.5 | 1.1% | **120%** | POR079 | 0.060 | 0.6 | 13.4% | **132%** |
| 1, 3 Butadiene | 24-hour | 0.082 | 10 | AAQC | POR080A | 0.0029 | 0.08 | <0.1% | 1% | POR079 | 0.012 | 0.09 | 0.1% | 1% |
| | Annual | 0.055 | 2 | AAQC | POR080A | 0.00047 | 0.06 | <0.1% | 3% | POR079 | 0.0021 | 0.06 | 0.1% | 3% |
| B(a)P | 24-hour | 0.000139 | 0.00005 | AAQC | POR080A | 1.51E-05 | 1.54E-04 | 30.2% | **308%** | POR079 | 3.70E-05 | 1.76E-04 | 74.0% | **352%** |
| | Annual | 0.000086 | 0.00001 | AAQC | POR080A | 2.25E-06 | 8.81E-05 | 22.5% | **881%** | 35_S | 8.55E-06 | 9.44E-05 | 85.5% | **944%** |
| Formaldehyde | 24-hour | 3 | 65 | AAQC | 100_S | 0.091 | 3.2 | 0.1% | 5% | POR079 | 1.83 | 4.9 | 2.8% | 8% |
| Acetaldehyde | ½-hour | 9 | 500 | AAQC | 78_S | 0.67 | 9.9 | 0.1% | 2% | POR079 | 3.52 | 12.8 | 0.7% | 3% |
| | 24-hour | 3 | 500 | AAQC | 100_S | 0.032 | 3.2 | <0.1% | 1% | POR079 | 0.65 | 3.8 | 0.1% | 1% |
| Acrolein | 1-hour | 0.20 | 4.5 | AAQC | 78_S | 0.10 | 0.30 | 2.2% | 7% | POR079 | 0.52 | 0.72 | 11.6% | 16% |
| | 24-hour | 0.082 | 0.4 | AAQC | 100_S | 0.0058 | 0.09 | 1.4% | 22% | POR079 | 0.12 | 0.20 | 29.3% | 50% |

Notes:
1. The maximum predicted concentration (meteorological anomalies included) is conservatively used for comparison to all Air Quality Objectives unless otherwise noted.
2. The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations at a special receptor for comparison to the current (2020) and future (2025) CAAQS for 1-hour $NO_2$.

## Figure 6.6: Comparison of Selected Operation Phase Cumulative COI Predictions to Air Quality Objectives – DC Oshawa GO to Bowmanville




Notes:
The maximum predicted concentrations (meteorological anomalies included) at special receptors are presented for comparison with Air Quality Objectives.
Air Quality Objectives:
AAQC - Ontario Ambient Air Quality Criteria
CAAQS - Canadian Ambient Air Quality Standards
FNB - Future No Build
FB - Future Build

# 7.0 Greenhouse Gas Impact Assessment

Emissions of GHGs act cumulatively in the atmosphere on a global scale to affect climate change. Because the effect on climate change from the contribution of a single project cannot be accurately measured or attributed, it is not reasonable to determine the significance of residual impacts on atmospheric GHG concentrations or climate change from a single project's GHG emissions. Instead, evaluation of Project impacts focuses on estimation of GHG releases, mitigation, and evaluation of Project GHG releases in relation to provincial, national and sector-based GHG totals and the Government of Canada's and Ontario's GHG reduction targets, following the guidance in ECCC's Strategic Assessment of Climate Change (ECCC 2020a) and guidance from the MECP's Considering Climate Change in the Environmental Assessment Process (MECP 2017a).

## 7.1 Direct GHG Emissions During Construction

Direct GHG emission sources during construction include combustion of fossil fuels in vehicles and equipment used in Project construction. GHG emissions for Project construction were estimated for each year of construction, based on typical on-road and off-road equipment, assumed equipment operating loads (FHWA 2006), equipment percent operating time and a preliminary construction schedule (Stantec 2021). ECCC emission factors for $CO_2$, $CH_4$, and $N_2O$ due to diesel combustion were applied (ECCC 2022).

The estimated annual direct GHG emissions from Project construction are 4.1 kt $CO_2e$ and is presented in Table 7.1. Detailed emissions calculations for each year of construction are presented in Appendix G.

The 2020 Canada, Ontario and sector (ECCC - Transportation) GHG emission totals are used as a comparison to the predicted Project construction GHG emissions and are presented in Table 7.2 and Table 7.3. Annual direct Project construction GHG emissions represent 0.003% of Ontario's total annual emissions, 0.001% of Canada's total annual emissions, 0.002% of the Canadian annual transportation sector emissions, and 0.008% of the Ontario annual transportation sector emissions.

**Table 7.1: Estimated Direct GHG Emissions from Project (Construction)**

| Source | Emissions (kt/y) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
| On-road and off-road construction equipment | 2.83 | 1.48E-04 | 8.67E-05 | 4.1 |

**Table 7.2: Comparison of Estimated Direct GHG Emissions from Project (Construction) to National Baseline and Target Levels**

| Canada | | Canadian Sector (ECCC Transportation) | | Canada's 2030 GHG Reduction Target | |
|---|---|---|---|---|---|
| $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) |
| 672,000 | 0.001% | 190,000 | 0.002% | 401,000 | 0.001% |

**Table 7.3: Comparison of Estimated Direct GHG Emissions from Project (Construction) to Provincial Baseline and Target Levels**

| Ontario | | Ontario Sector (ECCC Transportation) | | Ontario's 2030 GHG Reduction Target | |
|---|---|---|---|---|---|
| $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) |
| 150,000 | 0.003% | 52,200 | 0.008% | 143,000 | 0.003% |

## 7.2 Direct GHG Emissions During Operation

Sources of direct GHG emissions during operation include trains, buses and stationary fuel combustion equipment burning hydrocarbon fuel.

The estimated Project GHG emissions during operation are 14.7 kt $CO_2e$ per year (Table 7.4).

The 2020 Canada, Ontario and sector (ECCC - Transportation) GHG emission totals are used as a comparison to the predicted Project GHG emissions during operation and are presented in Table 7.5 and Table 7.6. Direct Project GHG emissions from operation represent 0.009% of Ontario's total annual emissions, 0.002% of Canada's total annual emissions, 0.008% of the Canadian annual transportation sector emissions and 0.03% of the Ontario annual transportation sector emissions.

**Table 7.4: Estimated Direct GHG Emissions from Project (Operation)**

| Source | Emissions (kt/y) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
| Diesel Trains | 12.14 | 6.75E-04 | 4.66E-03 | 13.55 |
| Diesel Bus | 1.14 | 5.96E-05 | 3.49E-05 | 1.15 |
| Stationary combustion | 5.08E-03 | 1.38E-07 | 4.17E-08 | 5.10E-03 |
| Total | 13.29 | 7.35E-04 | 4.70E-03 | 14.71 |

**Table 7.5: Comparison of Estimated Direct GHG Emissions from Project (Operation) to National Baseline and Target Levels**

| Canada | | Canadian Sector (ECCC Transportation) | | Canada's 2030 GHG Reduction Target | |
|---|---|---|---|---|---|
| $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) |
| 672,000 | 0.002% | 190,000 | 0.008% | 401,000 | 0.004% |

**Table 7.6: Comparison of Estimated Direct GHG Emissions from Project (Operation) to Provincial Baseline and Target Levels**

| Ontario | | Ontario Sector (ECCC Transportation) | | Ontario's 2030 GHG Reduction Target | |
|---|---|---|---|---|---|
| $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) | $CO_2e$ kt/y) | Project Contribution (%) |
| 150,000 | 0.0098% | 52,200 | 0.03% | 143,000 | 0.01% |

## 7.3 Third Party (Indirect) Emissions During Operations

Sources of indirect GHG emissions are from the additional electricity consumption required to operate the stations and the two wayside power cabinets. The estimated third-party GHG emissions from electricity consumption is 0.4 kt $CO_2e$ per year (Table 7.7). This is based on grid GHG intensity from 2020 in Ontario. As the intensity of electricity is expected to decline over time, these indirect emissions would also decline.

**Table 7.7: Estimated Project Indirect GHG Emissions (Operation)**

| Annual Electricity Consumption (kWh) | Electricity Consumption Emission Factor (g CO2e/kWh) | Indirect Emissions (kt CO2e/y) |
|---|---|---|
| 13,866,496 | 28 | 0.4 |

## 7.4 Assessment of Cumulative Impacts

Cumulative impacts associated with the releases of GHGs are a global issue and are not limited to provincial or national borders. The GHG sources, sinks, and reservoirs around the world contribute to the cumulative effect. The Intergovernmental Panel on Climate Change (IPCC) forecasts global GHG emissions in various scenarios and determines the impacts of the forecasts. The detailed assessment of cumulative impacts to climate change is beyond the scope of this Project; however, based on the small magnitude of GHG emissions from the Project as compared to Ontario and Canadian totals, the contribution is considered negligible.

## 7.5 Determination of Significance and Prediction Confidence

Because the effect on climate change from the contribution of any single project cannot be accurately measured or attributed, it is not reasonable to determine the significance of residual impacts on climate change from a single project’s GHG emissions. Instead, evaluation of Project residual impacts focuses on estimation of GHG releases, mitigation, and evaluation of Project GHG releases in relation to provincial, national and sector based GHG totals and the federal and provincial GHG reduction targets. The quantitative assessment has been conducted with the latest information available at the time of the study using conservative approaches and assumptions where detailed information was not available and is therefore expected to provide conservative estimates of GHG emissions.

At the time of this study, the construction project is still in the preliminary planning stages and details regarding construction activities, schedule, and operations are limited. Assumptions used in the GHG assessment were based on information available at the time of the study and best estimates. If the actual construction and operations differ significantly from the emissions scenario parameters and assumptions used in this study, the GHG impacts of the Project should be re-assessed.

## 7.6 The Project and Canada's Efforts to Reduce GHG Emissions

The Project will release GHG emissions during the construction and operation phases. The GHG emissions from Project operation will be accounted for in annual provincial and federal GHG totals.

Direct and indirect GHGs released by the Project during operation are estimated to be 14.7 and 0.4 kt $CO_2$e/year, respectively, which is 0.004% of the Government of Canada's emission target in 2030. The preliminary GHG emissions are estimated assuming that diesel locomotives will be used for the 60-year lifecycle of the Project and is conservative as electric vehicles will be considered as technologies improve.

Metrolinx (2022c) predicts that during operation, the Project could reduce private automobile vehicle kilometers travelled by up to 31 million km per year, corresponding to a reduction in GHG emissions of 6.4 kt $CO_2$e per year. The reduction is estimated using a Canada specific average fuel consumption emission factor per kilometer travelled for light duty vehicles (IEA 2019). It is expected that over time, more electric vehicles will be deployed in the area and the electricity GHG intensity will decline, leading to less GHG savings from the project annually over time.

There is therefore expected to be a small net increase in GHG emissions as a result of the operation of the Project. The operation of the Project is therefore not expected to help the Government of Canada to meet it's 2030 GHG emissions target.

# 8.0 Effects Assessment

The following sections provide an indication of the anticipated potential effects associated with construction and operation of the Project. Section 8.1 presents potential effects, recommended mitigation and monitoring measures for each phase of the construction and operations for the overall Project, while Section 8.2 provides additional considerations for mitigation and monitoring for each specific Project location.

## 8.1 Potential Effects, Mitigation and Monitoring

Based on the results of the dispersion modelling assessment, potential air quality exceedances were identified if the maximum construction and operations emissions scenario assumed for the modelling was to occur and coincide with worst-case meteorology.

Scheduling construction activities to avoid the maximum emissions scenario occurring (i.e., reducing the number of activities/equipment operating concurrently as much as possible) will aid in reducing the potential for adverse effects. Additionally, mitigation measures have been identified in this section to avoid or reduce potential adverse effects. The suggested monitoring activities are to confirm that the Project is executed as proposed and that mitigation measures are effectively implemented. The mitigation and dust control measures will conform to recognized standard specifications such as Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (Cheminfo Services Inc. 2005), and the Draft Metrolinx Guide (Metrolinx 2019a).

Recommended mitigation measures for each potential effect for construction and operation are discussed in Table 8.1 below.

**Table 8.1: Summary of Potential Effects, Mitigation and Monitoring for All Project Locations**

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| **Construction** | | | |
| **Construction - Planning** | • Construction-related air pollution may pose risks to human health and wellbeing | • Prior to commencement of construction, develop and submit a detailed Construction Air Quality Management Plan (AQMP) to Metrolinx. Implement the AQMP after receipt of approval from Metrolinx. The AQMP will:<br>– Identify specific air quality objectives relevant to the Project identified in this Air Quality Study and as outlined in the Metrolinx *Environmental Guide for Air Quality and Greenhouse Gas Emissions Assessment* (2019).<br>– Define the Project's air quality impact zone and identify all sensitive/critical receptors within this area.<br>– Include requirements for assessing baseline air quality by continuous measurement of local ambient concentrations of $PM_{2.5}$ and $PM_{10}$ over a minimum period of one week, for locations where large local sources of pollution (such as highways), directly affect air quality in the zone of influence of the Project.<br>– Estimate and document the predictable worst-case air quality impacts of the Project on sensitive/critical receptors within the air quality impact zone, develop appropriate mitigation measures for each relevant construction activity, describe how to record and demonstrate their effectiveness, and commit to their timely implementation.<br>– Include requirements for continuously monitoring $PM_{2.5}$ and $PM_{10}$ and for monitoring any other contaminant that is predicted to exceed its relevant air quality objective during any phase of the Project and at any receptor (utilizing continuous monitoring where available or non-continuous monitoring otherwise).<br>– Establish specific protocols for action items when relevant air quality objectives are exceeded, including an investigation procedure when exceedances are identified, determining mitigation measures and timeframes for their implementation.<br>– Specify reporting requirements and timeframes, including reporting any exceedance of a continuously monitored ambient air quality objective at any location to Metrolinx within a one hour (or a timeframe established in AQMP) of the occurrence; reporting an exceedance of a non-continuously monitored contaminant within 24-hours of receipt of the data.<br>– Establish specific protocols for documenting, reporting and addressing public complaints.<br>– Establish a communication protocol with nearby sensitive/critical receptors to provide alerts when monitoring indicates that air contaminant concentrations may be elevated for a prolonged period of time (e.g., over 8 hours), and also provide guidance on methods to minimize exposure (e.g., remaining indoors with windows closed during periods of adverse air quality, ensure heating, ventilation and air conditioning (HVAC) systems are maintained following manufacturer's recommendations, etc.) | • Develop and submit to Metrolinx for approval a template for Weekly Air Quality Monitoring Reports (WAQMR). Implement the WAQMR after receipt of approval from Metrolinx and start of construction. The WAQMR will document how air quality monitoring has been conducted and compliance assessed to effectively prevent unacceptable rates of air emissions in accordance with the following considerations:<br>– The construction related air contaminants of primary concern are in the form of particulate matter, with the principal construction related fractions of $PM_{2.5}$ and $PM_{10}$ - particulate matter of less than 2.5 and 10 micron in diameter, respectively. Other contaminants of concern include crystalline silica and oxides of nitrogen. The list of contaminants will be expanded with any and all air pollutants that may be produced as a result of the work.<br>– Criteria for $PM_{2.5}$, $PM_{10}$ and crystalline silica are provided in Metrolinx's *Environmental Guide for Air Quality and Greenhouse Gas Emissions Assessment* (2019). The other applicable objectives for air contaminants of interest include the AAQC and CAAQS.<br>• The WAQMR shall include:<br>– planned construction activities;<br>– daily documentation of weather forecasts, and any Air Quality Health Index/Special Air Quality Statements/Smog and Air Health Advisory issued by ECCC or MECP;<br>– measured wind conditions by an on-site meteorological station; and<br>– documentation of observations of on-site activities and conditions, monitoring activities, any exceedances of applicable air quality objectives and mitigation thresholds, remedial actions/mitigation measures as well as observations after implementation of mitigation measures. |
| | | • Include an explicit commitment to the implementation of the applicable best practices identified in the Environment Canada document, *Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* (2005). | • Siting of the air quality monitors should generally follow the guidelines provided in the Ministry of the Environment, Conservation and Parks (MECP) *Operations Manual for Air Quality Monitoring in Ontario* (2018) as much as practicable. For pre-construction, only one location needs to be monitored to establish baseline air quality levels. During construction, ideally a minimum of two monitoring locations should be used, one located upwind to assess background concentrations and one located downwind of the active construction zone. |
| | | • Prior to construction, identify all adjacent critical receptors (e.g., hospitals, senior's residences, day care facilities, schools, residences) that may be impacted by construction-related air emissions. | |
| | | • Prior to construction, select methods, operations, materials and equipment to minimize air pollution. Plan the layout of construction sites, including access roads, site entrances/exits, staging and laydown areas to minimize air quality impacts at adjacent sensitive/critical receptors. | |

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| **Construction - Site Preparation** | • Grade preparation (such as earth moving activities, excavation, soil stripping, clearing and grubbing, backfilling, landscaping) related dust emissions may pose risks to human health and wellbeing | • Grade construction site in phases to maintain vegetation and cover intact until just prior to construction. | • For Project locations that are considered short-duration projects (i.e., less than 30 days), periodic opacity monitoring at the active construction zone boundary and at closest sensitive receptor is recommended where there is a predicted exceedance of an AAQC. |
| | | • Use temporary wind fencing (windbreaks and/or fabric fences) for projects with a fixed geographical location and duration of over one year. Fencing should be 1-2 metres high, have a 50% or less porosity, should be maintained in an upright and functional condition, and should be periodically washed to maintain effectiveness. | • Continuous monitoring of $PM_{10}$ and $PM_{2.5}$ is recommended at locations upwind and downwind of the active construction zone. If modelling results predict $PM_{10}$ and/or $PM_{2.5}$ may exceed the 24-hour AAQC at a critical receptor that is located within the impact zone (refer to Table 8.2), an additional monitoring station should be considered at the closest critical receptor to the construction zone. Monitoring should commence for more than one week prior to the start of any construction activities to establish pre-Project levels and continue through the active phase of the construction project. As the active construction zone moves or changes, the locations of the monitoring equipment will follow to maintain relevance. |
| | | • Apply water (or approved chemical dust suppressant) in sufficient quantity to prevent generation of dust plumes. Frequency of water/dust suppressant application will depend on ambient conditions (wind/humidity), effectiveness of the suppressant, and the construction activities. If using water, it should be applied more than twice a day during dry/windy conditions. | • In addition to the AAQC and CAAQS, the 15-minute Metrolinx mitigation threshold should be applied to $PM_{10}$ and $PM_{2.5}$ monitoring. The contractor shall report any exceedance of AQ Objectives to Metrolinx within one hour (or a timeframe established in AQMP) of reported exceedance. If monitoring results indicate exceedance of the 15-minute Metrolinx mitigation threshold, the contractor shall investigate the potential cause for the exceedance. If the cause is known to be unrelated to the Project, no action is required. If it is suspected that the exceedance is due to Project activities, mitigation actions (per AQMP) shall be implemented. When the 15-minute mitigation threshold is exceeded by more than 20% during two consecutive 15-minute periods, the contractor shall stop the operation that is likely causing the exceedance, implement mitigation, and resume only after Metrolinx approval. |
| | | • When using chemical suppressants, MECP recommends use of non-chloride dust suppressants. | • All monitoring results shall be made available to Metrolinx at all times. |
| | | • Compact and stabilize disturbed soil throughout the construction site. | • As part of the monitoring program, the Contractor shall arrange for the calibration of the instruments |
| | | • Maintain stability of soil through pre-watering prior to clearing and grubbing as well as cut and fill activities and stabilize soil during and immediately after. | • Real-time portable, continuous ambient particulate monitors (such as DustTrak™ DRX Aerosol Monitor 8533 or E-Sampler Particulate Monitor or equivalent) configured to record 15-minute and hourly average readings for $PM_{10}$ and $PM_{2.5}$ are recommended. Contractor should include meteorological station (for measuring wind speed and direction) and datalogger/modem for downloading data, power/battery source, and capability to send alarm notifications at mitigation thresholds. |
| | | • Stabilize surface soils where trencher, excavator or support equipment will operate and at the completion of trenching operations. | • Preparation and submission of WAQMRs to Metrolinx to document air quality monitoring activities, assessment of compliance and effectiveness of mitigation activities. |
| | | • Maintain soil moisture content at a minimum of 12% for all earthmoving activities, as measured by the ASTM D-2216 method or equivalent. | • Document and monitor public complaints and provide monthly reports to Metrolinx for review. |

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| | | • Apply non-toxic chemical stabilizers within 5 working days of grading or apply water to at least 80% of all inactive disturbed surfaces on a daily basis when there is evidence of wind driven fugitive dust. | |
| | | • Stabilize surfaces of completed earthworks with stone/soil/geotextiles within 10 days or vegetation within 21 days after active operations have ceased. | |
| | | • On the last day of active operations prior to an inactive period of 4 or more days, disturbed surface areas should be stabilized with stabilizer diluted with water to not less than 1/20 of the concentration needed to maintain a stabilized surface for a period of 6 months or apply stabilizer prior to a wind event or apply water to all unstabilized surfaces 3 times per day or any combination of the above that will ensure compliance with the 20% maximum opacity criterion at all times (Metrolinx, 2019a). | |
| | | • Based on available information, construction activities in this assessment were assumed to occur from 8 a.m. to 5 p.m. Monday to Friday. Construction during nighttime or weekends should be limited as much as possible and should occur only for essential high priority activities. If the construction schedule is different from that assumed in this report, the Contractor should provide/present that schedule and specific mitigation measures to Metrolinx well in advance for consideration. The Contractor will review air quality monitoring results continuously to ensure that air contaminant concentrations are below the applicable AQ Objectives and mitigation thresholds. If monitoring results indicate exceedance of AQ Objectives and mitigation thresholds, the Contractor should re-assess the construction activities and schedule, and plan to reduce these activities to the point where measured concentrations do not exceed the AQ Objectives and thresholds. | |
| **Construction - Demolition and Deconstruction** | • Demolition and deconstruction related dust emissions may pose risks to human health and wellbeing | • Stabilize wind erodible surfaces, surfaces where equipment and vehicles will operate, and loose soil and demolition debris | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| | | • Deconstruct rather than demolish | |
| | | • Minimize drop heights for debris during demolition and loading | |
| | | • Enclose chutes and cover bins | |
| | | • Use fogging systems | |
| | | • Avoid blasting | |
| | | • Vacuum debris | |
| **Construction - Screening** | • Dust emissions related to screening activities may pose risks to human health and wellbeing | • Pre-water material before screening and immediately after screening | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| | | • Limit fugitive dust to the opacity standard of 20% over 3 minutes in any 60-minute period | |
| **Construction - Storage Piles** | • Dust emissions from storage piles may pose risks to human health and wellbeing | • Conduct storage pile activities on the downwind side of the storage pile | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| | | • Use enclosures/coverings or wind fences/screens/vegetation as wind breaks or apply chemical stabilizers/water to at least 80% of the surface area of the pile on a daily basis when there is evidence of wind driven fugitive dust | |
| | | • Stockpiles within 30 m of offsite occupied buildings must not be greater than 3 m in height or must have a road bladed to the top to allow water truck access or must have an operational water irrigation system that is capable of complete stockpile coverage | |
| **Construction - Material** | | • Apply water to soil not more than 15 minutes prior to moving | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| | | • Stabilize material while loading, transporting, and unloading | |

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| **Handling and Transfer** | • Material handling and transfer related dust emissions may pose risks to human health and wellbeing | • Maintain at least 15 cm of freeboard on haul vehicles<br>• Limit material drop heights to 2 metres at transfer points and use enclosures wherever practical<br>• Secure and cover loads on haul trucks<br>• Minimize material handling operations, particularly under windy conditions<br>• When instantaneous wind gusts exceed 50 km/h, the frequency of watering will be increased, or other additional fugitive dust mitigation measures will be implemented<br>• When instantaneous wind gusts exceed 50 km/h and fugitive dust cannot be curtailed to achieve the 20% maximum opacity criterion, even with additional dust mitigation, construction activities on unpaved surfaces shall be discontinued<br>• During sustained winds (3 minutes over a 60-minute period) exceeding 30km/h, earth moving activities will be ceased | |
| **Construction - Road Surfaces within and around Construction Sites** | • Dust emissions related to resuspension of dust on paved or unpaved road surfaces may pose risks to human health and wellbeing | • Establish on-site vehicle restrictions<br>• Apply and maintain surface improvements to unpaved road surfaces<br>• Minimize fugitive dust from de-icing operations by minimizing use of de-icers through careful planning, minimizing silt content and silt formation, plowing instead of sanding, and sweeping up de-icing materials for re-use<br>• Stabilize all off-road traffic and parking areas as well as haul routes<br>• Direct construction traffic over established haul routes<br>• Water all unpaved roads under active use by vehicle traffic 3 times per 8-hour work period or restrict vehicle speeds to 20 km/h or apply chemical stabilizer in sufficient quantity and frequency to maintain a stabilized surface<br>• Place gravel on access road approaches and track-out control devices such as shaker plates at the intersection of unpaved access roads and paved roads<br>• Conduct a visual inspection of vehicle wheels and wheels of the equipment loaded upon each vehicle to assess the presence of dirt. If caked dirt or mud is present, it shall be removed to the extent feasible<br>• Track-out onto adjacent public roads shall be removed at the conclusion of the workday or evening shift with water sweepers if visible soil material from the construction site or unpaved access road is observed<br>• Track-out onto paved roads that exceeds 10 metres in length shall be removed immediately | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| **Construction - Staging and Laydown Sites** | • Dust emissions related to dust emissions in staging and laydown sites may pose risks to human health and wellbeing | • Stabilize staging areas during use and at project completion | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |
| **Construction - On-site Fabrication Processes** | • Dust emissions from fabrication processes may pose risks to human health and wellbeing | • Minimize dust from cutting, grinding and drilling by applying water sprays/dust extraction and using prefabricated materials<br>• Perform cutting and grinding with appropriate tolerances/interfaces, optimum concrete pour volumes, using bonding agents, and using wet grit blasting<br>• Use curtains or shrouds to surround the work area | • See Construction - Site Preparation section above for recommendations on monitoring activities for dust emissions |

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| | | • Use pre-mixed, pre-cast and prefabricated materials and components where possible | |
| | | • Clean fabrication site frequently | |
| **Construction Vehicles and Equipment** | • Tailpipe emissions from construction vehicles or exhaust from equipment used for site preparation activities may pose risks to human health and wellbeing | • Use electricity powered equipment, and minimize the use of diesel and gasoline powered equipment. | |
| | | • Maintain diesel and electric equipment and their emissions control systems to manufacturers' specifications. | • Continuous monitoring results shall be made available to Metrolinx on a weekly basis. Non-continuous monitoring results shall be made available to Metrolinx within 7 days after lab results are received. |
| | | • All off-road diesel-powered equipment used during the Project must meet the Canadian Non-Road (Off-Road) Compression Ignition Engine Exhaust Emission Standards or Canadian Non-Road (Off-Road) Spark Ignition Engine Exhaust Emission Standards. These standards are aligned with corresponding U.S. EPA standards. | • As part of the monitoring program, the Contractor shall arrange for the regular periodic calibration of the instruments following manufacturer specifications or the MECP Operation Manual (MECP, 2018). |
| | | • All on-road vehicles will meet applicable Canadian road vehicle exhaust and evaporative emission standards. | |
| | | • The Contractor must certify that all equipment meets applicable emissions standards and are maintained to manufacturers' specifications. | • Preparation and submission of WAQMR to Metrolinx to document air quality monitoring activities, assessment of compliance and effectiveness of mitigation activities within 3 to 4 days after end of previous week or timeline approved by Metrolinx. |
| | | • Where feasible, and where sensitive receptors are identified in close proximity (within 50 m) to the construction area, minimize the number, or limit the usage time, of construction vehicles and equipment or schedule their use at different times. | • Document and monitor public complaints and provide monthly reports to Metrolinx for review. |
| | | • All heavy-duty diesel equipment shall pass an annual emissions test demonstrating compliance with original equipment emission standards within a tolerance of 10%. | • For combustion emissions of COIs other than $NO_2$, monitoring is not recommended if predicted concentrations based on maximum modelled scenario from construction only sources are below their respective AQ Objectives. However, if actual construction operations are significantly different from the assumed maximum modelled scenario, this should be reassessed. |
| | | • Limit equipment and vehicle idling time to less than 10 minutes. | |
| | | • Deploy less polluting alternatives to vehicle main engine idling for heating and air conditioning. These alternatives include cab heaters and HVAC units powered by auxiliary electricity generators. | |
| | | • Based on available information, construction activities in this assessment were assumed to occur from 8 a.m. to 5 p.m. Monday to Friday. Construction during nighttime or weekends should be limited as much as possible and should occur only for essential high priority activities. If the construction schedule is different from that assumed in this report, the Contractor should provide/present that schedule and specific mitigation measures to Metrolinx well in advance for consideration. The Contractor will review air quality monitoring results continuously to ensure that air contaminant concentrations are below the applicable AQ Objectives and mitigation thresholds. If monitoring results indicate exceedance of AQ Objectives and mitigation thresholds, the Contractor should re-assess the construction activities and schedule, and plan to reduce these activities to the point where measured concentrations do not exceed the AQ Objectives and thresholds. | |

| Feature | Description of Potential Effects | Mitigation Measures | Monitoring Activities |
|---|---|---|---|
| **Construction - contaminated soils/materials** | • Construction activities could expose contaminated soils/materials and/or result in the spreading of contaminated materials. Emissions from the contaminated materials may pose risks to human health and wellbeing. | • Visual and olfactory inspections should be conducted during excavation or for incoming loads to screen for odour, visible staining or debris per the MECP's Management of Excess Soils: A Guide for Best Management Practices (MECP 2019). If contaminated soil or materials are suspected, the contractor shall conduct further investigation and soil analysis to confirm if contamination is present and what contaminants are present. The contractor will take appropriate preventive actions or suspend activities to minimize potential adverse effects, including odour or air emissions, from contaminated materials. As indicated in the EPR, prior to commencement of construction, the contractor shall develop a Soil and Excavated Materials Management Plan (SEMMP) for the handling, management and disposal of all excavated material (i.e., soil, rock and waste). The SEMMP will describe how to address the management of the excavated or imported materials, including contaminated materials. The contractor shall follow appropriate best management practices to manage, transport, or dispose of the contaminated materials. | • Additional ambient air monitoring may be required if contaminated soils are encountered during construction activities. The list of contaminants and monitoring requirements should be re-assessed at that time based on the results of investigation and soil/material analysis. |
| **Operation** | • Air quality impacts from operations may pose risks to human health and wellbeing. Potential air quality impacts could include effects from fuel combustion equipment at GO stations, train operations and maintenance activities. | • Air approvals should be obtained for the GO station operations and air emission sources as applicable. Significant emissions from the GO station should be assessed and modelled following MECP guidance and must comply with applicable Ontario Regulation 419/05 standards.<br>• A detailed Operations Air Quality Management Plan should be developed to document the controls and methods that Metrolinx will implement during project operations to limit the generation and dispersion of airborne particulate matter and air contaminants associated with the project operations.<br>• Where practicable, the following mitigation measures should be implemented to reduce air contaminant emissions from train and GO station operations:<br>– Selecting a less polluting form of energy or fuel (i.e., electricity or hydrogen rather than diesel fuel) for equipment used at the GO station<br>– Selecting equipment (such as backup generators and locomotives) with engines and propulsion systems that meet higher emission standards, meaning lower emissions (i.e., Tier 4 rather than a lower tier)<br>– When selecting new train fleet, consider designs that reduce/limit non-exhaust particulate emissions, such as automatic train control/braking systems, wheel and track materials and design, optimizing the wheel profile and applying friction modifiers on wheels or rails to decrease wear particles, choice of brake pad materials<br>– Maintaining engines and emission control equipment to manufacturers' specifications.<br>– Preventive maintenance programs to ensure materials and equipment remain in a state of good repair<br>– Procedures to respond to employee or passenger concerns<br>– Explore planting of trees/vegetation in areas where highest dust impacts are expected | • On-site inspections should be undertaken to confirm the implementation of the mitigation measures and identify corrective actions if required.<br>• The expected impacts from operations should be effectively mitigated provided that mitigation measures established in the Air Quality Management Plan are followed. Ambient air quality monitoring is not expected to be required. |

## 8.2 Mitigation and Monitoring Considerations at Each Project Location

Based on the special receptors identified and the project design and duration at each location, additional considerations for mitigation and monitoring for each specific Project location are presented in Table 8.2 below for the construction phase.

The potential for adverse impacts is assessed at each Project location based on the model predictions discussed in Section 6.0. Adverse impacts are assigned a grade of A, B, or C which are defined as follows:

- A = One or more critical receptors are located within a COI impact zone for which AQ objective exceedances are predicted.
- B = One or more sensitive receptors are located within a COI impact zone for which AQ objective exceedances are predicted. Critical receptors are not identified within the impact zone.
- C = Critical/sensitive receptors are not identified within a COI impact zone for which AQ objective exceedances are predicted or the modelling does not predict any exceedances of the AQ objectives.

Note that the standard mitigation measures assumed for the modelling assessment at each sub-Project location includes dust control measures such as water suppression and limiting on-site vehicle speeds to less than 20 km/hr.

### Table 8.2: Construction Mitigation and Monitoring Considerations at each Project Location

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **Widening of At-Grade Crossings** | | | | |
| **Rundle Road Crossing Construction** | • Sensitive receptors identified at this Project location include residences within 250 m northeast, 60 m northwest, 45 m southeast and 25 m west of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted $PM_{10}$ concentrations at the residence to the west and southeast may exceed the 15-minute mitigation threshold but will remain below the 24-hour AAQC.<br>• The 98$^{th}$ percentile predicted $NO_2$ concentrations at the sensitive receptor to the west may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. | Potential for Adverse Impacts - B:<br>• Project Alone $NO_2$ is predicted to exceed the 1-hour 2025 CAAQS within60 m of the Project footprint and at a sensitive receptor.<br>• Project Alone $PM_{10}$ is predicted to exceed the 15-minute mitigation threshold 2% of the time within 150 m of the Project footprint and 0.016% of the time at a sensitive receptor over a five-year period.<br>• There are no critical receptors identified within 500 m of the Project footprint. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to the receptors.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **Bloor Street Crossing Construction** | • Sensitive receptors identified at this Project location include residences within 140 m east, a hotel located 200 m southwest and residences within 150 - 160 m to the north and northeast of the Project footprint.<br>• Critical receptors identified at this Project location includes a senior's residence 330 m to the east of the Project footprint.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted TSP, $PM_{10}$, $PM_{2.5}$ and crystalline silica concentrations are not expected to exceed the applicable AAQC or CAAQS at the identified sensitive and critical receptors. However, there may be exceedances of the 15-minute mitigation | Potential for Adverse Impacts - B:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 150 m of the Project footprint.<br>• Sensitive receptors are identified within the 150 m impact zone.<br>• There are no critical receptors identified within the impact zone. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |

[7] Criteria for assessing potential adverse impacts
A = One or more critical receptors are located within a COI impact zone for which AQ objective exceedances are predicted.
B = One or more sensitive receptors are located within a COI impact zone for which AQ objective exceedances are predicted. Critical receptors are not identified within the impact zone.
C = Critical /sensitive receptors are not identified within a COI impact zone for which AQ objective exceedances are predicted or the modelling does not predict any exceedances of the AQ objectives.

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| | threshold for $PM_{10}$ at the residences to the east. | | | |
| **Prestonvale Road Crossing Construction** | • Sensitive receptors identified at this Project location include residences 25 m west, 120 m east and 150 m north of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted TSP, $PM_{10}$, $PM_{2.5}$ and crystalline silica concentrations are not expected to exceed the applicable AAQC at the identified sensitive receptors.<br>The $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 150 m of the Project footprint which may impact the closest residences to the east and west.<br>The crystalline silica concentrations may also exceed the 15-minute mitigation thresholds within 25 m from the Project footprint and therefore may impact the residence to the west.<br>• Based on the model results from the construction activities for the Rundle Road Crossing, the 98th percentile predicted $NO_2$ concentrations may exceed the 1-hour CAAQS within 60 m of the active construction zone which may impact the residence to the west, but the maximum predicted concentrations are expected to remain below the 1-hour and 24-hour AAQCs and annual CAAQS. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 60 m and 150 m respectively, of the Project footprint at a crossing.<br>• Crystalline silica is predicted to exceed the 15-minute mitigation threshold 0.08% of the time within 25 m of the Project footprint over a five-year period.<br>• Sensitive receptors are identified within the impact zones identified above.<br>• There are no critical receptors identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| **Private crossing for Dom's Auto** | • Sensitive receptors identified at this Project location include residences 80 m and 140 m to the southeast.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on the model results from the construction activities for the Rundle Road Crossing, the maximum predicted $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 150 m of the active construction zone which may impact the residence to the south but is expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 150 m of the Project footprint at a crossing.<br>• A sensitive receptor is identified within the impact zone identified above.<br>• There are no critical receptors identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **Trulls Road Crossing Construction** | • Sensitive receptors identified at this Project location include residences within 350 m north, 80 m south and 140 m southeast of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 150 m and may impact the residence to the south but is expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 150 m of the Project footprint at a crossing.<br>• Sensitive receptors are identified within the impact zone of 150 m.<br>• There are no critical receptors identified within the impact zone of 150 m. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **Baseline Road Crossing (Mile 168.22) Construction** | • Sensitive receptors identified at this Project location include a residence within 50 m west of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted $PM_{10}$ concentration may exceed the 15-minute mitigation threshold within 150 m and may impact the residence to the west but is expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 60m and 150 m, respectively, of the Project footprint at a crossing.<br>• Sensitive receptors are identified within the impact zones identified above.<br>• There are no critical receptors identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | • Based on the model results from the construction activities for the Rundle Road Crossing, the 1-hour 98th percentile predicted $NO_2$ concentrations may exceed the 1-hour CAAQS within 60 m of the active construction zone which may impact the residence to the west. The maximum $NO_2$ concentrations are expected to remain below the 1-hour and 24-hour AAQCs and annual CAAQS. | | | |
| **Baseline Road Crossing (Mile 166.92) Construction** | • Sensitive receptors identified at this Project location include a residence within 65 m north and 120 m east of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on modelling results from construction activities for the Rundle Road Crossing, the maximum predicted $PM_{10}$ concentration may exceed the 15-minute mitigation threshold within 150 m of the Project footprint and may impact the residence to the north and east but is expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 50 m of the Project footprint at a crossing.<br>• A sensitive receptor is identified within the impact zones identified above.<br>• There are no critical receptors identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **Holt Road Crossing Construction** | • Sensitive receptors identified at this Project location include residences within 95 m west, 95 and 230 m south, and 210 m southeast of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on the model results from the construction activities for the Rundle Road Crossing, the 15-minute mitigation threshold for $PM_{10}$ may be exceeded at the receptors to the west and south. $PM_{10}$ concentrations are expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 150 m of the Project footprint at a crossing.<br>• Sensitive receptors are identified within the impact zone of 150 m.<br>• There are no critical receptors identified within the impact zone of 150 m. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| **Private farm crossing west of Maple Grove Road Construction** | • A residence is located 340 m south of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on the model results from the construction activities for the Rundle Road Crossing, there are no expected exceedances of mitigation thresholds, AAQCs or CAAQS. | Potential for Adverse Impacts - C:<br>There are no sensitive or critical receptors identified within impact zones based on model results. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **Maple Grove Road Crossing Construction** | • A residence is located within 200 m north of the Project footprint.<br>• There are no critical receptors identified within 500 m of the crossing.<br>• Based on the model results from the construction activities for the Rundle Road Crossing, there are no expected exceedances of mitigation thresholds, AAQCs or CAAQS. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within impact zones based on model results. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize air quality impacts to the area.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Due to the short duration of construction activities at the crossing (i.e., < 2 weeks), monitoring is not recommended at this location. |
| **GO Stations** | | | | |
| **B4 Bowmanville GO Station Construction** | • Sensitive receptors identified at this Project location include residences 30 m and 220 m to the southwest, between 30 and 40 m to the south, and 40 m and 100 m to the east of the Project footprint. There is also a recreation complex located 300 m to the northwest.<br>• The critical receptors identified at this Project location include a senior's residence located 20 and 80 m west, 295 m north, and a school located 400 m to the southeast of the Project footprint.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, the maximum predicted $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold at both the sensitive and | Potential for Adverse Impacts - A:<br>• Project Alone $PM_{10}$ is predicted to exceed the 15-minute mitigation threshold 0.8% of the time within 680 m of the Project footprint and 0.09% of the time at a sensitive receptor over a five year period.<br>• Project Alone $PM_{10}$ is also predicted to exceed the 24-hour AAQC 0.7% of the time within 100 m of the Project footprint and 0.05% of the time at a sensitive receptor over a five-year period.<br>• Project Alone $PM_{2.5}$ is predicted to exceed the 15-minute mitigation threshold 0.05% of the time within 110 m of the Project footprint and 0.007% | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ and crystalline silica are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives.<br>• Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | critical receptors. The 24-hour AAQC may be exceeded at a residential receptor located to the south of the Project footprint.<br>The maximum predicted concentrations of $PM_{2.5}$ may exceed the 15-minute mitigation thresholds at the nearest residences to the south.<br>The maximum predicted concentrations of crystalline silica may exceed the 15-minute mitigation thresholds at the nearest residences to the south, southwest and east, and the senior's residence to the west. | of the time at a sensitive receptor over a five-year period.<br>• Project Alone crystalline silica is predicted to exceed the 15-minute mitigation threshold 0.08% of the time within 220 m of the Project footprint and 0.03% of the time at a sensitive receptor over a five-year period.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, maximum predicted $PM_{10}$, $PM_{2.5}$, and crystalline silica concentrations may exceed the AQ objectives at sensitive receptors.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, maximum predicted $PM_{10}$, $PM_{2.5}$, and crystalline silica concentrations may exceed the AQ objectives at critical receptors. | equipment or schedule their use at different times. | |
| **B1 Thornton's Corners East GO Station Construction** | • Sensitive receptors identified at this Project location include residences 320 m to the west, 70 m to the north, 110 m to the northeast, and 300 m to the east of the Project footprint. Two hotels are also located just outside of the Study Area at 560 m to the southeast of the Project footprint.<br>• The critical receptors identified for this Project location includes a recreation complex 535 m to the northwest and a school located 685 m to the east.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, the maximum predicted $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 680 m of the Project footprint which may impact the identified sensitive and critical receptors. The 24-hour AAQC may be exceeded 100 m from the Project footprint and may impact the residence to the north.<br>$PM_{2.5}$ concentrations may exceed the 15-minute mitigation threshold within 110 m of the Project footprint and may impact the residences to the north and | Potential for Adverse Impacts - A:<br>• $PM_{10}$, $PM_{2.5}$, and crystalline silica are predicted to exceed the AQ objectives within 680 m, 110 m and 220 m, respectively, of the Project footprint for a GO station.<br>• Sensitive receptors are identified within the impact zones identified above.<br>• Critical receptors are identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ and crystalline silica are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives.<br>• Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | northeast but are expected to remain below the CAAQS for other averaging periods.<br>Crystalline silica concentrations may exceed the 15-minute mitigation thresholds within 220 m of the Project footprint and may also impact the residences to the north and northeast but is expected to remain below the 24-hour AAQC. | | | |
| **B2 Ritson GO Station Construction** | • Sensitive receptors identified at this Project location include residences located 10 m and 90 m to the north, 15 m to the west, and 125 and 255 m to the south and 20 m to the east of the Project footprint.<br>• The are places of worship located 65 m and 180 m to the west, 145 m northwest, 260 m east and 320 m northeast of the Project footprint. There is also a school located 320 m to the northeast.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, the maximum predicted TSP concentrations may exceed the 24-hour AAQC within 30 m of the Project footprint and therefore may impact the nearest residences to the north, east and west.<br>$PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 680 m of the Project footprint and therefore may impact all sensitive and critical receptors identified at this location. There may also be exceedances of the 24-hour AAQC within 100 m of the Project footprint which may impact the closest residences to the north, east and west.<br>$PM_{2.5}$ concentrations may exceed the 15-minute mitigation threshold within 110 m of the Project footprint and may impact the sensitive receptors to the north, east and west. | Potential for Adverse Impacts - A:<br>• TSP, $PM_{10}$, $PM_{2.5}$, and crystalline silica are predicted to exceed the AQ objectives within 30 m, 680 m, 110 m and 220 m, respectively, of the Project footprint for a GO station.<br>• Sensitive receptors are identified within the impact zones identified above.<br>• Critical receptors are identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ and crystalline silica are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | Crystalline silica concentrations may exceed the 15-minute mitigation thresholds within 220 m of the Project footprint and may impact the residences to the north, east, west and south and the places of worship to the west, southwest and northeast but is expected to remain below the 24-hour AAQC. | | | |
| **B3 Courtice GO Station Construction** | • Sensitive receptors identified at this Project location include residences located within 20 m to the north, 230 m to the southeast 315 m and 360 m to the south of the Project footprint.<br>• The are no critical receptors identified for this Project location.<br>• Based on modelling results from construction activities for the B4 Bowmanville GO Station, the maximum predicted TSP concentrations may exceed the 24-hour AAQC at the residence to the north. $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold all sensitive residences and may also exceed the 24-hour AAQC at the residence to the north.<br>$PM_{2.5}$ concentrations may exceed the 15-minute mitigation threshold within 110 m of the Project footprint and may impact the residence to the north but are expected to remain below the CAAQS for other averaging periods<br>Crystalline silica concentrations may exceed the 15-minute mitigation thresholds within 220 m of the Project footprint and may also impact the residence to the north but are expected to remain below the 24-hour AAQC. | Potential for Adverse Impacts - B:<br>• TSP, $PM_{10}$, $PM_{2.5}$, and crystalline silica are predicted to exceed the AQ objectives within 30 m, 680 m, 110 m and 220 m, respectively, of the Project footprint for a GO station.<br>• Sensitive receptors are identified within the impact zones identified above.<br>• There are no critical receptors identified within the impact zones identified above. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ and crystalline silica are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives.<br>• Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| **Trackwork and Grading** | | | | |
| **West of Farewell Street to west of Harmony Road** | • Sensitive receptors identified at this location include residences located within 20 m to the south and 40 m to the north of the Project footprint.<br>• The closest critical receptors include two places of worship located 30 m and 80 m north and a daycare located 140 m to the north of the Project footprint.<br>• Based on modelling results from construction activities on this segment of the Project, the maximum predicted $PM_{10}$ concentrations may exceed the 15-minute mitigation threshold within 30 m of the Project footprint and may impact the sensitive residences to the south and the place of worship 20 m to the north. | Potential for Adverse Impacts - A:<br>• Project Alone $PM_{10}$ is predicted to exceed the 15-minute mitigation threshold 2.2% of the time within 30 m of the Project footprint for Trackwork and Grading at Farewell Street/Harmony Road and 0.09% of the time at a special receptor.<br>• Based on modelling results from construction activities for the Trackwork and Grading at Farewell Street/Harmony Road, maximum predicted $PM_{10}$ concentrations may exceed the AQ objectives at sensitive receptors.<br>• Based on modelling results from construction activities for the Trackwork and Grading at Farewell Street/Harmony Road, maximum predicted $PM_{10}$ concentrations may exceed the AQ objectives at a critical receptor. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Track and grading along the length of the Project** | • Representative sensitive receptors have been identified at varying distances from the Project footprint with the closest residences measuring 30 m to the north and 20 m to the south of the proposed tracks.<br>• Critical receptors have been identified within 500 m of the Project footprint with the closest (54C - a place of worship) measuring 30 m to the north and (28C - a place of worship) 80 m to the south of the proposed tracks.<br>• Based on the modelled results from construction activities on a 300 m segment of the Project footprint from west of Farewell St. to west of Harmony Rd., the 15-minute mitigation threshold for $PM_{10}$ may be exceeded at special receptor locations within 30 m of the Project footprint (i.e., generally, residences located nearest to the proposed tracks) including: | Potential for Adverse Impacts - A:<br>• $PM_{10}$ is predicted to exceed the AQ objectives within 30 m of the Project footprint for Trackwork and Grading at Farewell Street/Harmony Road.<br>• Sensitive receptors are identified within the impact zone of 30 m.<br>• A critical receptor is identified within the impact zone of 30 m. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | – Residences north of B1 Thornton's Corners East GO Station and west of Stevenson Rd Bridge represented by receptors 1_S and 6_S<br>– Residences south of the proposed tracks between Stevenson Rd Bridge and Park Rd S represented by receptors 10_S and 15_S<br>– Residences north and south of the proposed tracks between Park Rd S and Simcoe St. Bridge represented by receptors 16_S to 19_S and 21_S to 24_S<br>– Residences north of the proposed track between Ritson St. Bridge and Wilson St. Bridge represented by receptor 42_S<br>– Residences south of the proposed tracks between Wilson St. Bridge and Farewell St. Bridge represented by receptors 49_S and 52_S<br>– Residences north of the tracks east of Bloor St. Crossing and west of Townline Rd S represented by receptor 77_S<br>• Exceedances of the 24-hour AAQC are not expected at these locations. | | | |
| **Bridge Replacement** | | | | |
| **Simcoe Street Bridge** | • The closest sensitive receptors identified at this Project location include a hotel 5 m to the west, and residences 5 m to the west, 120 m to the east and 75 m to the south of the Project footprint.<br>• The closest critical receptor is a community services located 10 m to the east. Places of worship are located approximately 30 m and 150 m to the northeast, 180 m to the east, 180 m and 230 m to the southwest and southeast of the proposed bridge footprint. There are also two schools approximately 360 m to the north and 460 m to the west.<br>• Sensitive and critical receptors along the detour roads were also included.<br>• Predicted $PM_{10}$ concentrations at the hotel to the west may exceed the | Potential for Adverse Impacts - A:<br>• $NO_2$, $PM_{10}$ and B(a)P concentrations are predicted to exceed the AQ objectives at sensitive and critical receptors. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. An additional monitoring station should be considered at the closest critical receptor to the construction zone to ensure that standard mitigation is effective. Additional mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles | • Predicted $NO_2$ concentrations may exceed the 1-hour and annual CAAQS but will remain below the 24-hour AAQC. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
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| | 15-minute mitigation threshold but will remain below the 24-hour AAQC.<br>• Predicted $NO_2$ concentrations due to re-routing traffic may exceed the 1-hour CAAQS (but remain below the 1-hour and 24-hour AAQCs) at 14 sensitive .receptors and 3 critical receptors located near the Project footprint and along Ritson Road, Bloor Street and Albert Street. The annual CAAQS is predicted to be exceeded at 4 sensitive and 1 critical receptor located Ritson Road.<br>Predicted B(a)P concentrations due to re-routed traffic may occasionally exceed the 24-hour AAQC and exceeds the annual AAQC at multiple critical and sensitive receptors along the detour roads. | | and equipment or schedule their use at different times. | $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Ritson Road** | • Sensitive receptors identified at this Project location include residential houses located 10 m to the east and west, 30 m to the southwest, and 20 to40 m to the northeast and northwest of the Project footprint.<br>• Critical receptors (places of worship) were identified to be located 8 m to the west/southwest. Critical receptors (place of worship and school) were also identified to be located 60 m and 110 m to the north.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case 2), the maximum predicted 1-hour 98$^{th}$ percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the identified residences to the northwest. | Potential for Adverse Impacts - A:<br>• $NO_2$ is predicted to exceed the AQ objectives within 25 m of the Project footprint at a bridge.<br>• Sensitive receptors are identified within the impact zone of 25 m.<br>• There is a critical receptor identified within the impact zone of 25 m. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **Farewell Street** | • Sensitive receptors identified at this location include residential houses located 20 m to the northeast, 15 m to 20 m to the southeast and southwest of the Project footprint.<br>• Critical receptors include places of worship located 50 m to the northwest and 150 m to the east, and a daycare located 100 m to the northwest.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the identified residences. $PM_{10}$ concentrations may also exceed the 15-minute mitigation threshold at the identified residences. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 25 m and 20 m, respectively, of the Project footprint for a bride.<br>• Sensitive receptors are identified within the impact zones of 20 m and 25 m.<br>• There are no critical receptors identified within the impact zones. | • The Contractor shall consider and use all applicable mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Bridge Removal** | | | | |
| **Albert Street** | • Sensitive receptors identified include residential houses located 10 m to 15 m to the northwest, northeast and southeast of the Project footprint.<br>• A critical receptor (place of worship and community centre) was identified to be located 10 m to the east.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS within 25 m of the Project footprint and may impact the identified residences. $PM_{10}$ concentrations may also exceed the 15-minute mitigation threshold at the same residences. | Potential for Adverse Impacts - A:<br>• $NO_2$ and $PM_{10}$ is predicted to exceed the AQ objectives within 25 m and 20 m, respectively, of the Project footprint at a bridge.<br>• Sensitive receptors are identified within the impact zones of 20 m and 25 m.<br>• A critical receptor identified within the impact zones of 20 m and 25 m. | • The Contractor shall consider and use all applicable standard mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **New Bridges** | | | | |
| **Highway 401** | • Sensitive receptors identified at this location include hotels located at 150 m and 230 m to the southeast of the Project footprint.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile $NO_2$ or $PM_{10}$ 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Monitoring is not recommended for this location. |
| **GM Spur** | • There are no special receptors identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Monitoring is not recommended for this location. |
| **Oshawa Creek** | • Sensitive receptors identified at this location include residential houses located over 100 m to the northeast, southeast, southwest and northwest of the Project footprint.<br>• A critical receptor was identified at this location - a school located 200 m to the northwest with a sports field located 45 m to the northwest.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Monitoring is not recommended for this location. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **Wilson Road** | • Sensitive receptors identified at this location include residential houses located 6 m to the west and 20 m to the east of the Project footprint.<br>• A critical receptor (school) is located 50 m to the southwest.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the identified residences. $PM_{10}$ concentrations may also exceed the 15-minute mitigation threshold at the identified residences. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 25 m and 20 m, respectively, of the Project footprint for a bridge.<br>• Sensitive receptors are identified within the impact zones of 20 m and 25 m.<br>• There are no critical receptors identified within the impact zones. | • The Contractor shall consider and use all applicable mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. However, the $NO_2$ CAAQS are not intended for assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Farewell Creek** | • Sensitive receptors identified at this location include residential houses located 120 m to the northeast and 250 m to the northwest of the Project footprint.<br>• Critical receptors were not identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the identified residences. $PM_{10}$ concentrations may also exceed the 15-minute mitigation threshold at the identified residences. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Monitoring is not recommended for this location. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | |
| **Harmony Creek** | • Sensitive receptors identified at this location include residential houses located 65 m to the northeast, southwest and northwest of the Project footprint.<br>• Critical receptor (place of worship) was identified 400 m to the northwest.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Monitoring is not recommended for this location. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **Green Road Bridge** | • Sensitive receptors identified at this location include residential apartments located 30 m to the southeast and southwest, and residential houses located 100 m to the west and northwest of the Project footprint. Residential houses are located 70 m to the northeast.<br>• Critical receptors were not identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Monitoring is not recommended for this location. |
| **New Multi-Use Crossing - (bridge or tunnel, to be determined)** | | | | |
| **Front Street (Michael Starr Trail)** | • Sensitive receptors identified at this location include residential houses located 5 m to the northwest and 15 m to the south of the Project footprint.<br>• A critical receptor (place of worship and community centre) is located 75 m to the southwest of the Project footprint.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case 2), there are no predicted exceedances of the 1-hour 98th percentile $NO_2$ or $PM_{10}$ 15-minute mitigation thresholds at this location. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 25 m and 20 m, respectively, of the Project footprint for a bride.<br>• Sensitive receptors are identified within the impact zones of 20 m and 25 m.<br>• There are no critical receptors identified within the impact zones.<br>• . | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives.<br>• Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Bridge Expansions** | | | | |
| **Stevenson Road** | • Sensitive receptors identified at this location include residential houses located 35 m to the southeast and 80 m to the northwest of the Project footprint.<br>• Critical receptors were not identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards. | • Monitoring is not recommended for this location. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| | 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | | • Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | |
| **Park Road** | • Sensitive receptors identified at this location include residential houses located 25 m to 40 m to the northeast, northwest, southeast and southwest of the Project footprint.<br>• Critical receptors were not identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the identified residences. | Potential for Adverse Impacts - B:<br>• $NO_2$ is predicted to infrequently exceed the AQ objectives within 25 m of the Project footprint for a bridge.<br>• Sensitive receptors are identified within the impact zone of 25 m.<br>• There are no critical receptors identified within the impact zone. | • The Contractor shall consider and use all applicable mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |
| **Harmony Road** | • Sensitive receptors identified at this location include residential houses located 30 m to the northeast, 15 m to the southwest and 70 m to the southeast and northwest of the Project footprint.<br>• A critical receptor (place of worship and community centre) is located 110 m to the northwest of the Project footprint.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), the maximum predicted 1-hour 98th percentile $NO_2$ concentrations may exceed the 2025 CAAQS at the residence to the southwest. $PM_{10}$ concentrations may also exceed the 15-minute mitigation threshold at the same residence. | Potential for Adverse Impacts - B:<br>• $NO_2$ and $PM_{10}$ are predicted to exceed the AQ objectives within 25 m and 20 m, respectively, of the Project footprint for a bridge.<br>• Sensitive receptors are identified within the impact zones of 20 m and 25 m.<br>• There are no critical receptors identified within the impact zones. | • The Contractor shall consider and use all applicable mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity. | • Per the Draft Metrolinx Guide (Metrolinx, 2019a), as a best practice for long duration projects (i.e., longer than 30 days), monitoring for $PM_{10}$, $PM_{2.5}$ are recommended at upwind and downwind monitoring locations of the active construction zone. Mitigation measures should be taken if measured data indicate concentrations are approaching mitigation thresholds or AQ Objectives. |
| | | | • Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Predicted $NO_2$ concentrations may exceed the 1-hour CAAQS but will remain below the 1-hour and 24-hour AAQCs and annual CAAQS. The $NO_2$ CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Since there are no predicted exceedances of the $NO_2$ AAQC, monitoring for $NO_2$ is not recommended. |

| Feature | Description of Potential Effects | Potential for Adverse Impacts (with Standard Mitigation Measures)[7] | Mitigation Measures | Monitoring Activities |
|---|---|---|---|---|
| **Courtice Road** | • Sensitive receptors identified at this location include residential houses located 250 m to the northwest and southeast, and 300 m to the southwest of the Project footprint.<br>• Critical receptors were not identified within 500 m.<br>• Based on modelling results from construction activities for the Simcoe Street Bridge (Case2), there are no predicted exceedances of the 1-hour 98th percentile NO2 or PM10 15-minute mitigation threshold at this location. | Potential for Adverse Impacts - C:<br>• There are no sensitive or critical receptors identified within the predicted impact zones. | • The Contractor shall consider and use a reasonable combination of mitigation measures listed in Table 7.1 to minimize impacts to receptors within close proximity.<br>• Where feasible, consider using construction vehicles and an equipment fleet that meets U.S. EPA Tier 4 emission standards.<br>• Minimize the number or limit the usage time of construction vehicles and equipment or schedule their use at different times. | • Monitoring is not recommended for this location. |

# 9.0 Permits and Approvals

Environmental Compliance Approval(s) are required for equipment held by contractors, owners and operators of that equipment, and these Approvals would be obtained in advance of construction, as applicable.

Approvals (i.e., Environmental Compliance Approval or Environmental Sector Activity Registry) for the GO station air emission sources, with the exception of equipment or activities exempted by O. Reg. 524/98 Environmental Compliance Approvals - Exemptions from Section 9 of the Act, are required prior to their construction and operation. The application for approvals will be conducted when the designs are finalized and prior to installation/start of operations.

# 10.0 Conclusions

## 10.1 Air Quality Assessment - Construction

A representative worst-case location for each of the four Project components was selected for the detailed quantitative assessment (including air dispersion modelling) based on a review of the available Project design, construction activity and duration, the expected construction equipment to be used, the expected Project footprint and the receptor types and their proximities to the construction area. Rationales for their selection are provided in Table 1.2. For all modelling assessment locations, maximum construction activity levels that result in maximum emissions were assessed. Ground level concentrations (GLCs) were predicted at sensitive (residential) and critical (schools, hospitals, retirement homes, childcare centres, and similar institutional buildings) receptors identified in the vicinity of the representative locations.

Additionally, GLCs were predicted over a receptor grid extending 500-m around each location to:

- develop concentration contour plots
- identify concentration impact zones[8]
- support recommendations for mitigation where required

The results of the detailed assessment for each worst-case Project component location were applied to the other Project component locations to develop site-specific recommendations.

**Project Alone Predictions**

The dispersion modelling of air contaminants generated during construction activities predicted that applicable provincial and national ambient air quality criteria and standards are met for 10 of the 12 COIs. For the two that exceeded the standard, $NO_2$ and $PM_{10}$ the maximum predicted concentrations at both sensitive and critical receptors are below their applicable criteria 99.9% of the time. These predictions assume a maximum construction emissions scenario in which no additional mitigation measures other than standard methods are applied. When a construction phase exceedance is

[8] A concentration impact zone is the maximum distance from the Project footprint or construction activity to where an air quality objective is predicted to be exceeded.

predicted to occur, the area of exceedance around the Project component is predicted to extend no greater than:

- 60 m for widening of at-grade crossings
- 100 m for GO station construction
- 10 m for tracking and grading construction
- 25 m for bridge construction

**Cumulative Predictions**

Maximum predicted cumulative concentrations (i.e., Project plus background concentrations) of COIs at sensitive and critical receptors are predicted to remain below the applicable provincial and national ambient air quality criteria and standards for 7 of the 12 COIs. For those that exceeded a standard, $NO_2$, TSP, $PM_{10}$, benzene and benzo(a)pyrene, it is noted that: i) the 1-hour and annual average background $NO_2$ concentrations used are by themselves 67% and 118% of the 1-hour and annual CAAQS respectively; ii) background annual benzene and 24-hour and annual benzo(a)pyrene concentrations are 119%, 278% and 858% of their respective criteria with the Project having only a minor contribution to the cumulative levels.

**Construction Mitigation and Monitoring Recommendations**

Based on the results of the air quality assessment, Stantec has recommended additional mitigation measures beyond those included in the modelling assessment. With the implementation of the additional mitigation measures recommended in Section 8.0 of this report, no significant adverse effects from the Project construction phase are expected. Additionally, scheduling construction activities to minimize activities that generate emissions from occurring concurrently will aid in reducing the potential for adverse effects.

Monitoring activities recommended in Section 8.0 of this report for Project construction will be implemented to verify that mitigation measures are effectively being implemented. The contractor will monitor the air quality and the weather in the vicinity of the construction activities and review the measurements on an on-going basis. When the ambient measurements indicate that concentrations are increasing and approaching an air quality action threshold, criteria or standard, remedial actions to reduce construction related emissions will be implemented by the contractor. For example, the contractor may need to apply additional dust suppressant (e.g., increasing watering amounts or frequency of application), and/or reduce the number of vehicles/equipment operating at the site.

At the time of this study, the construction project is still in the preliminary planning stages and details regarding construction activities, schedule, and operations are limited. Assumptions used in the air dispersion modelling were based on information available at the time of the study and best estimates. If the actual construction operations differ significantly from the maximum emissions scenario parameters and assumptions used in this study, the air quality impacts of the Project should be re-assessed to guide the contractor's planning of mitigation measures.

## 10.2 Air Quality Assessment - Operation

The air quality assessment for the operation phase considered Project related incremental changes in air quality due to the addition of GO trains, GO bus service and parking at the proposed GO stations. Three scenarios were assessed for Project operations:

- Baseline (2021) (i.e., existing conditions)
- Future (2031) No Build (i.e., future conditions without the Project)
- Future (2031) Build (i.e., future conditions with the Project)

**Project Alone Predictions**

Project Alone concentrations at special/critical receptors for the COIs are predicted to be higher in the Future Build scenario compared to the Existing and Future No Build scenarios, but below their respective AQ objectives except for nitrogen dioxide ($NO_2$) concentrations for the Future Build scenario. There is a predicted exceedance of the 1-hour average 98$^{th}$ percentile and annual CAAQS by 145% and 6% respectively. No Project Alone exceedances were predicted to occur at special receptors for the Existing and Future No Build scenarios.

**Cumulative Predictions**

With the addition of background concentrations, the maximum cumulative concentrations of COIs remain below their AQ objectives at sensitive and critical receptor locations for the Existing, Future No Build and Future Build scenarios other than:

- $NO_2$ for the Future Build Scenario (exceeds the 1-hour and annual 2025 CAAQS by 212% and 125%, respectively)
- Benzene for the Existing/Future No Build (exceeds the annual AAQC by 20%) and Future Build scenarios (exceeds the annual AAQC by 32%)

- Benzo(a)pyrene for the Existing/Future No Build (exceeds the 24-hour and annual AAQC by 208% and 781%) and Future Build scenarios (exceeds the 24-hour and annual AAQC by 252% and 844%)

Background levels of benzene and benzo(a)pyrene are above their respective air quality objectives, with the Project only contributing a small amount (less than 21%) to the cumulative levels.

## 10.3 Greenhouse Gases Assessment - Construction and Operation

Direct and indirect (third-party) GHG emissions are estimated for the Project activities during construction and operation of the Project.

Direct GHG emissions are expected during construction and operation as a result of equipment and vehicles burning hydrocarbon fuel. Direct construction phase emissions are estimated to be 4.1 kilotonnes of carbon dioxide equivalent (kt $CO_2e$) per year. Direct operation phase emissions are estimated to be 14.7 kt $CO_2e$/year.

Following implementation of mitigation measures, direct Project contributions to GHG emissions from annual construction and operation are estimated to be:

- 0.001% (construction) and 0.002% (operation) of Canada’s total GHG emissions
- 0.003% (construction) and 0.009% (operation) of Ontario’s total GHG emissions
- 0.002% (construction) and 0.008% (operation) of the Canadian Transportation sector emission total
- 0.008% (construction) and 0.03% (operation) of the Ontario Transportation sector emission total

Indirect (third-party) GHG emissions from electricity may be released during operation as a result of additional electrical power required to operate the stations and for wayside power. Predicted annual indirect (third-party) electricity operation emissions are estimated to be 0.4 kt $CO_2e$/year.

The GHGs released by the Project are expected to comprise 0.004% and 0.01% of the Government of Canada’s and Province of Ontario’s 2030 emission target, respectively.

The implementation of the Project is predicted to reduce the use of private vehicles in and near the Project footprint. Over a 60-year lifecycle, Metrolinx estimates that the Project can result in a reduction of 1.7 billion vehicle kilometers travelled and is equivalent to a reduction of up to 353 kt $CO_2e$. The reduction is estimated using a Canada specific average fuel consumption emission factor per kilometer travelled for light duty vehicles (IEA, 2019). On an annual basis, the Project can reduce up to 31 million vehicle kilometers traveled which is equivalent to 6.4 kt $CO_2e$. It is expected that over time, more electric vehicles will be deployed in the area and the electricity GHG intensity will decline, leading to less GHG savings from the project annually over time.

The preliminary GHG emissions are estimated assuming that diesel locomotives will be used for the 60-year lifecycle of the Project. This is likely to change over time toward the use of some electrically driven locomotives. This assumption for GHG emissions from the Project is therefore conservative. Nevertheless, there is expected to be a small net overall increase in GHG emissions as a result of the operation of the Project. The operation of the Project is therefore not expected to help the Government of Canada to meet its future GHG emissions targets.

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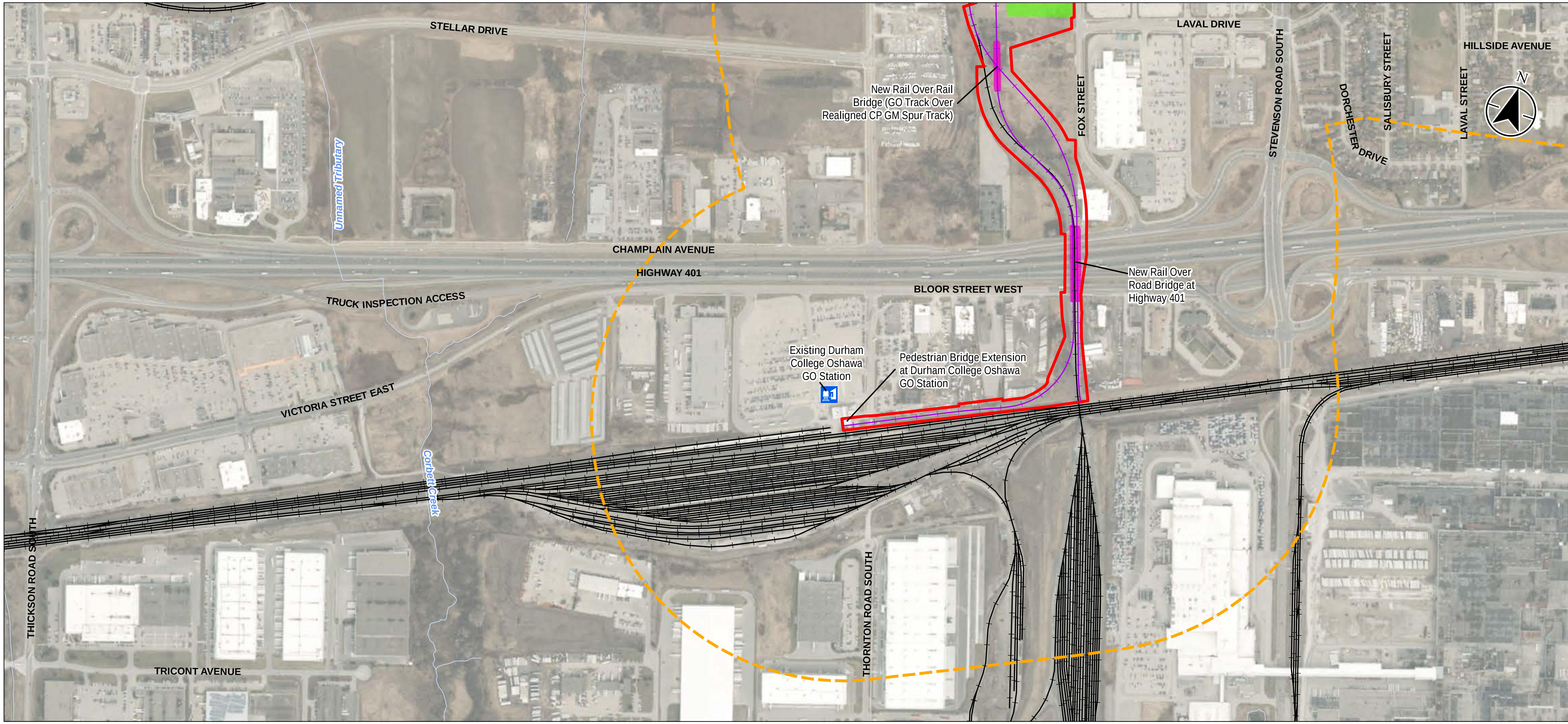
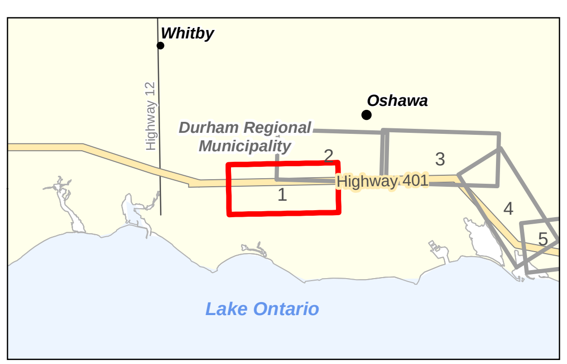
# Appendix A
## Project Footprint and Components




Legend

- Project Footprint
- Study Area
- Existing Durham College Oshawa GO Station
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

**Notes**

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Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-08-22
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.1**

Title
**Study Area**

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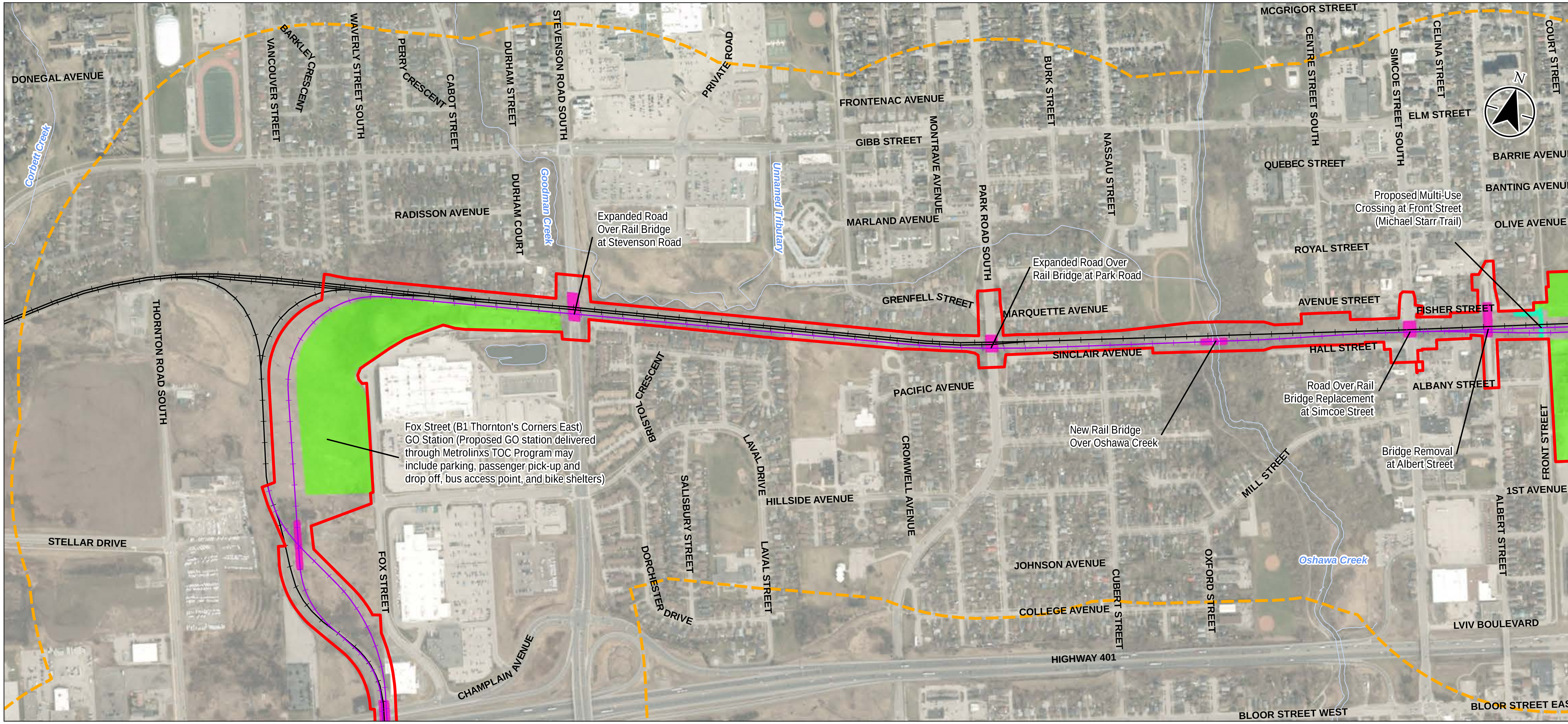
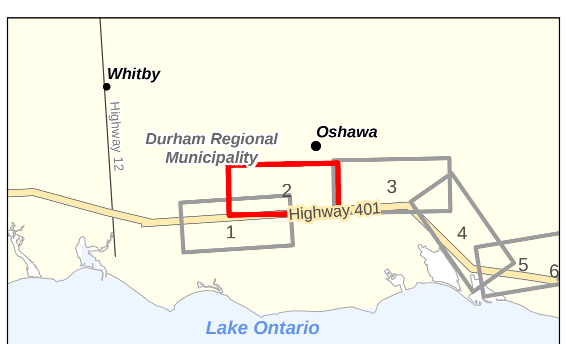
\\ca0215-ppfss01\work_group\01650\active\165011019 - Bowmanville\02_Amendment2_Assignment\11_data\gis_cad\gis\mxds\air\report_figures\20230412_Air_Report_rev\165011019_AR_Fig4-1_StudyArea_Mapbook.mxd Revised: 2023-08-22 By: bcowper




Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Multi-Use Crossing
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

**Notes**

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Project Location
Regioan Municipality of Durham

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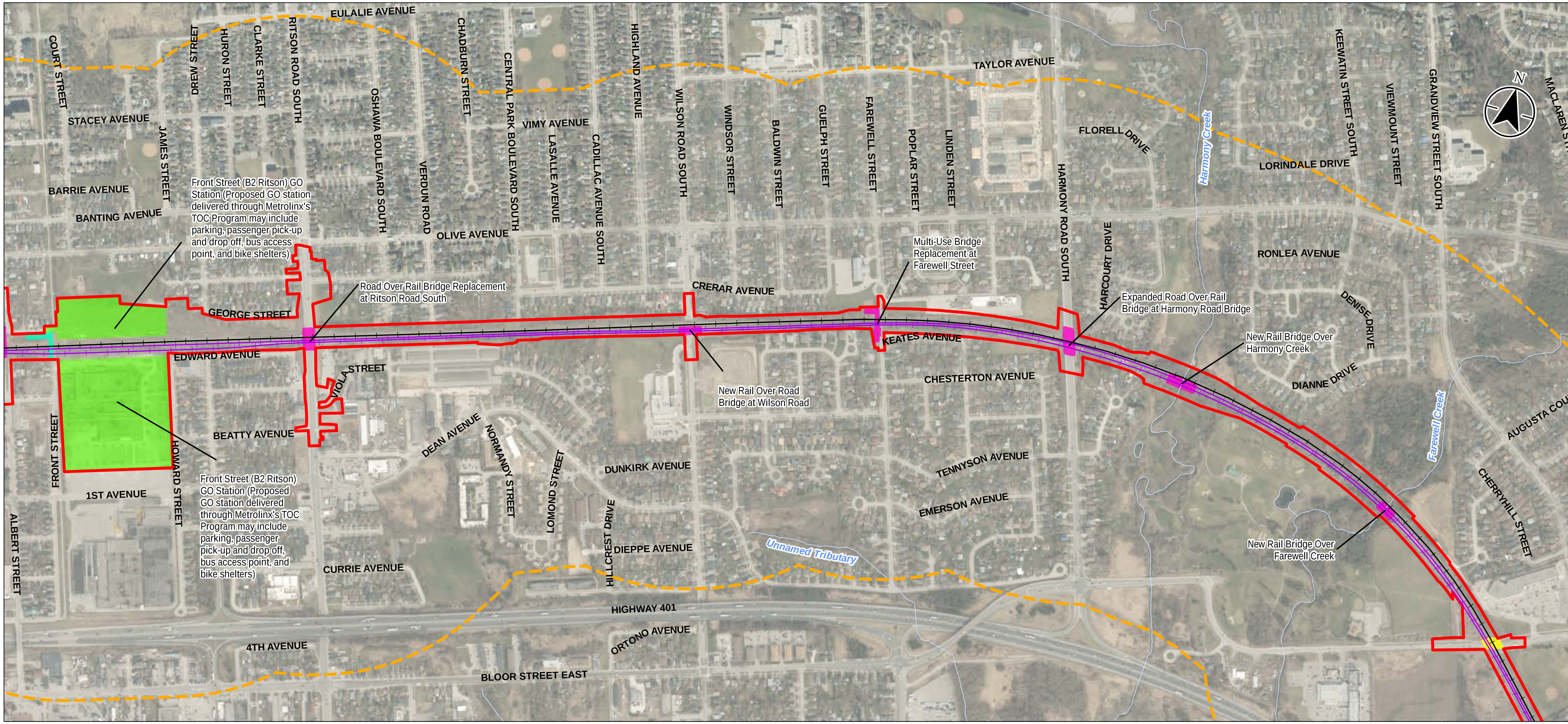
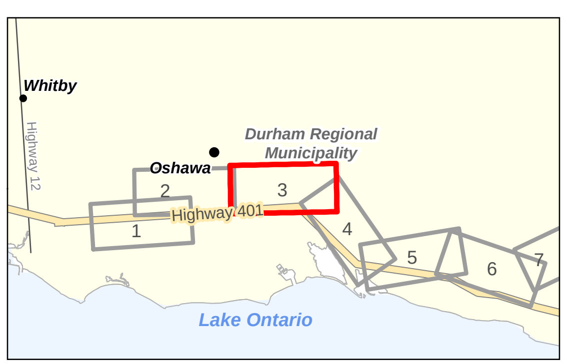
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.2**

Title
**Study Area**




**Legend**

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Multi-Use Crossing
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody

**Notes**

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0 220 440 m

1:8,750 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.3**

Title
**Study Area**

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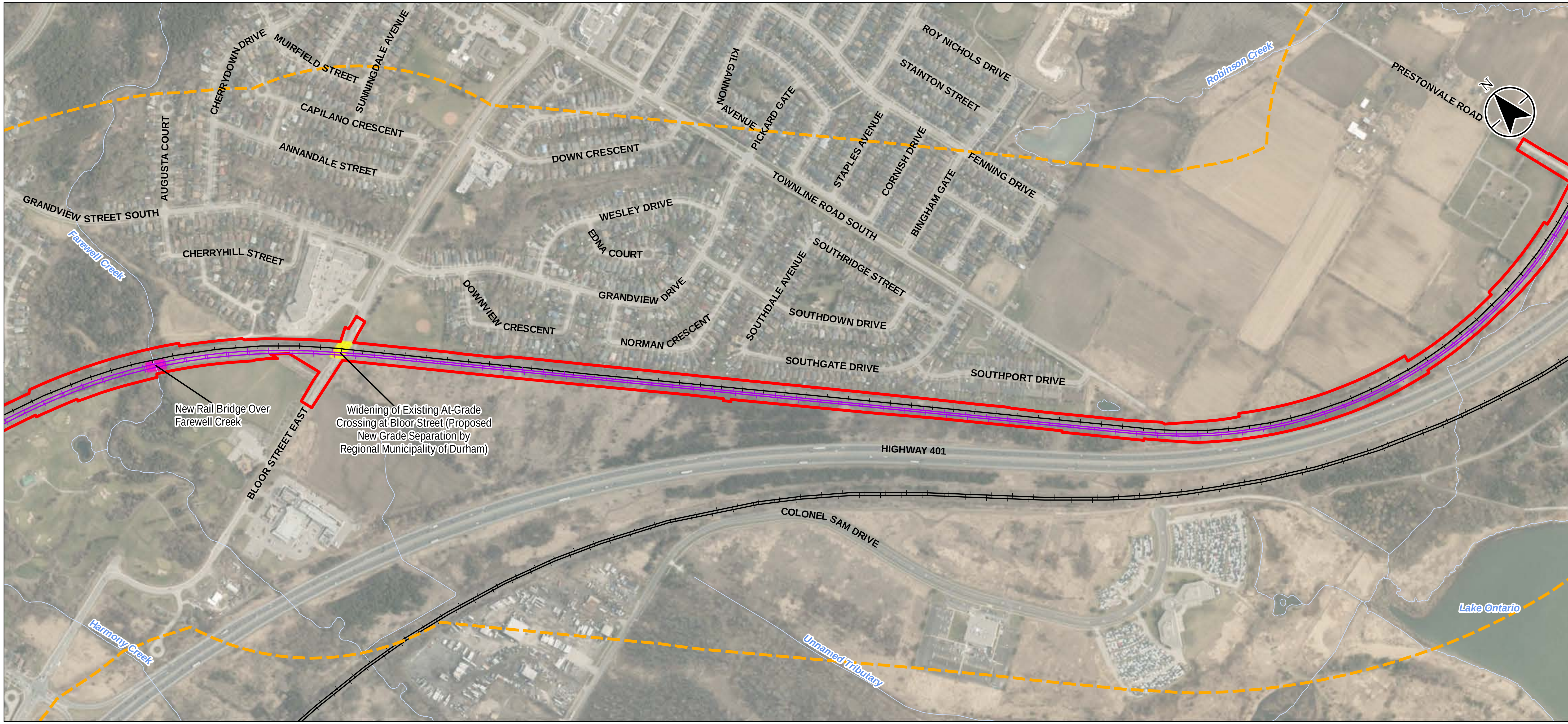


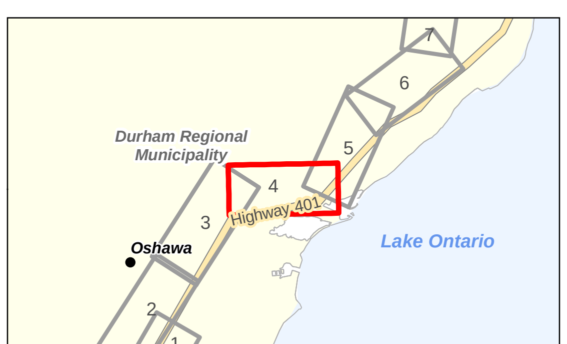


Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

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of Durham

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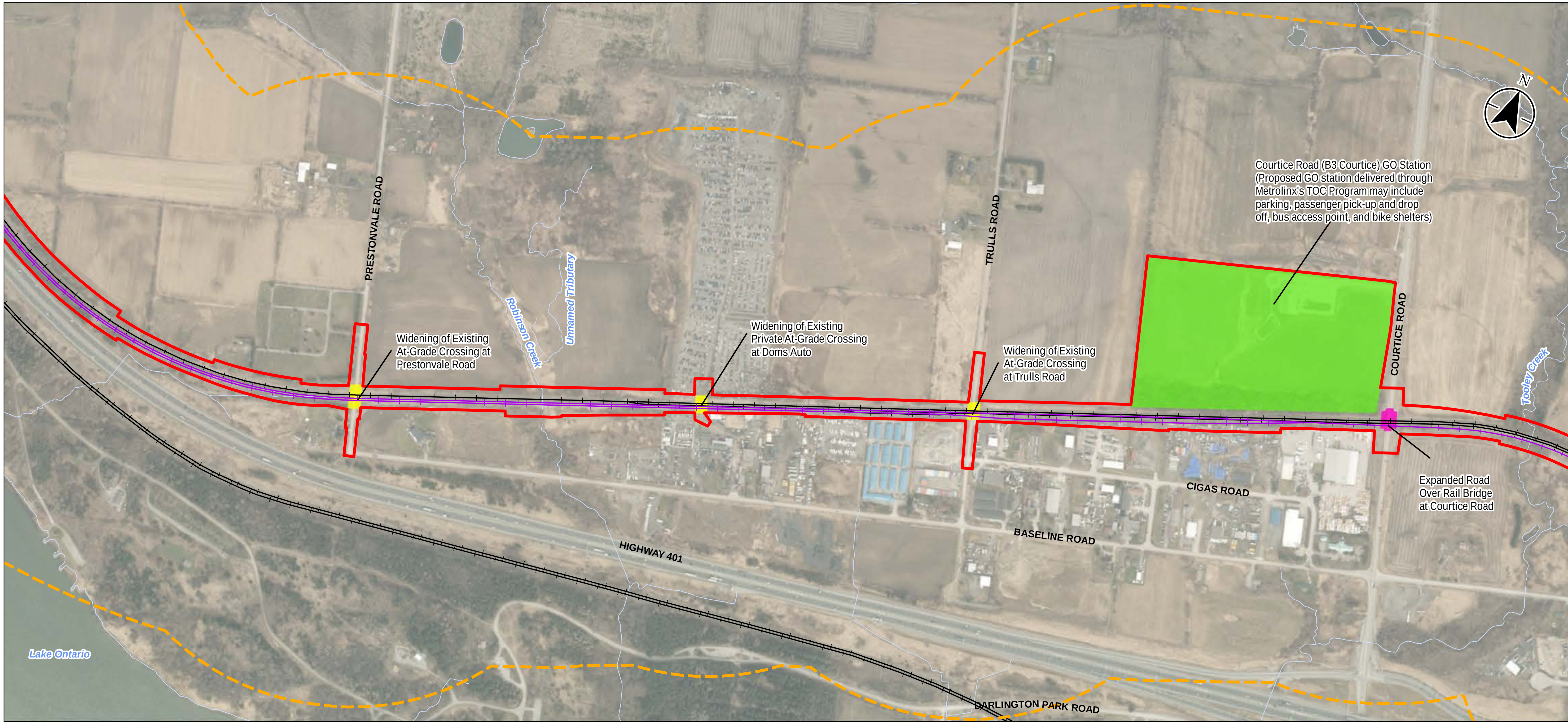
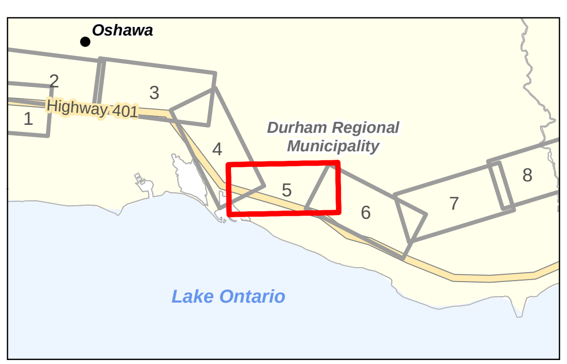
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.4**

Title
**Study Area**




Legend
- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody

**Notes**
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0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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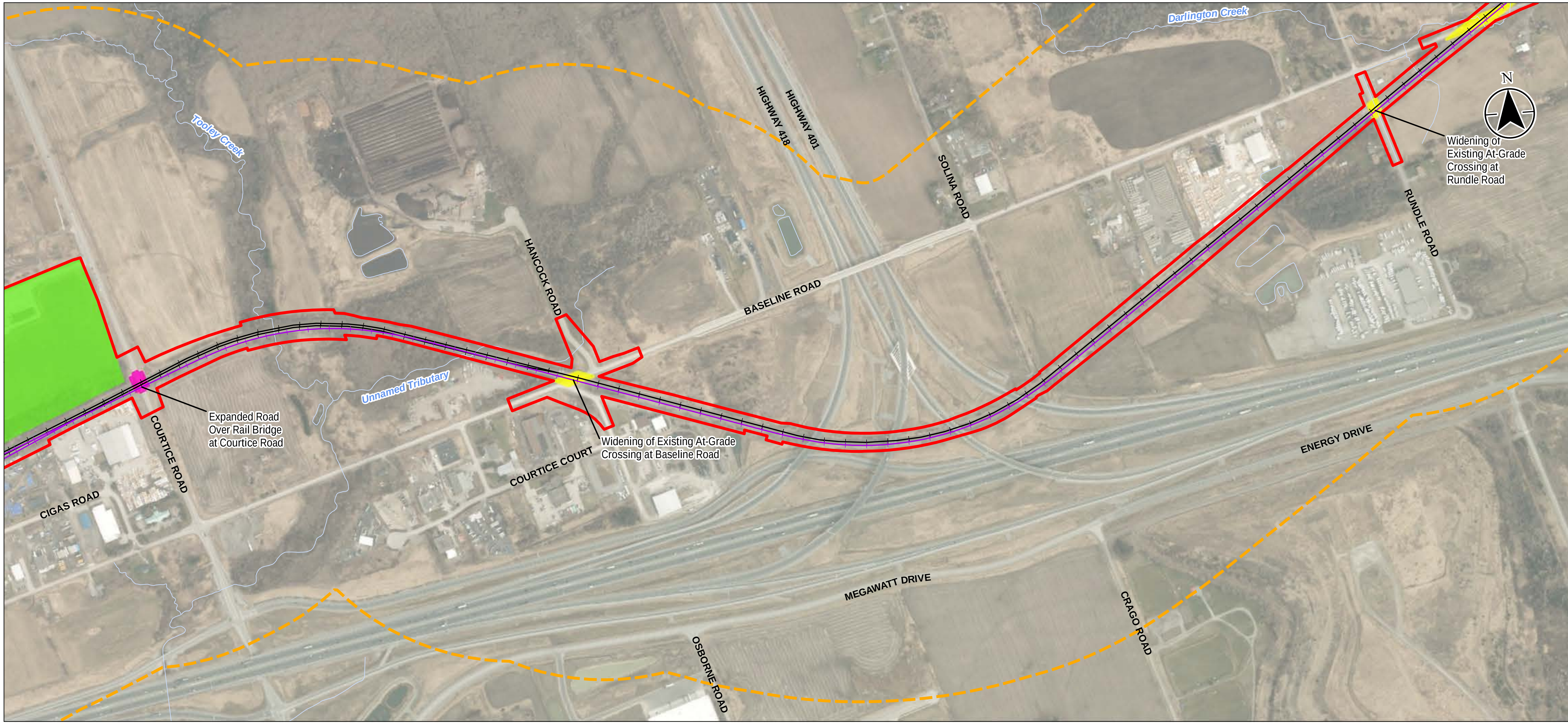
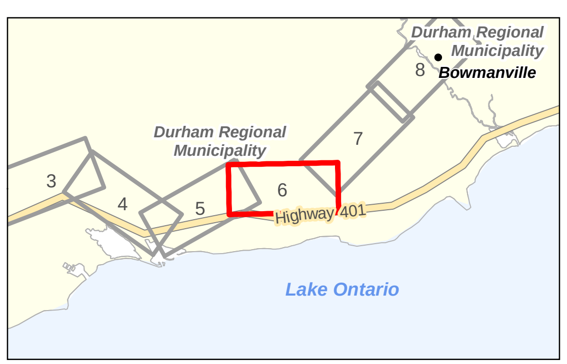
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.5**

Title
**Study Area**




Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
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of Durham

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Prepared by BCC on 2023-08-22
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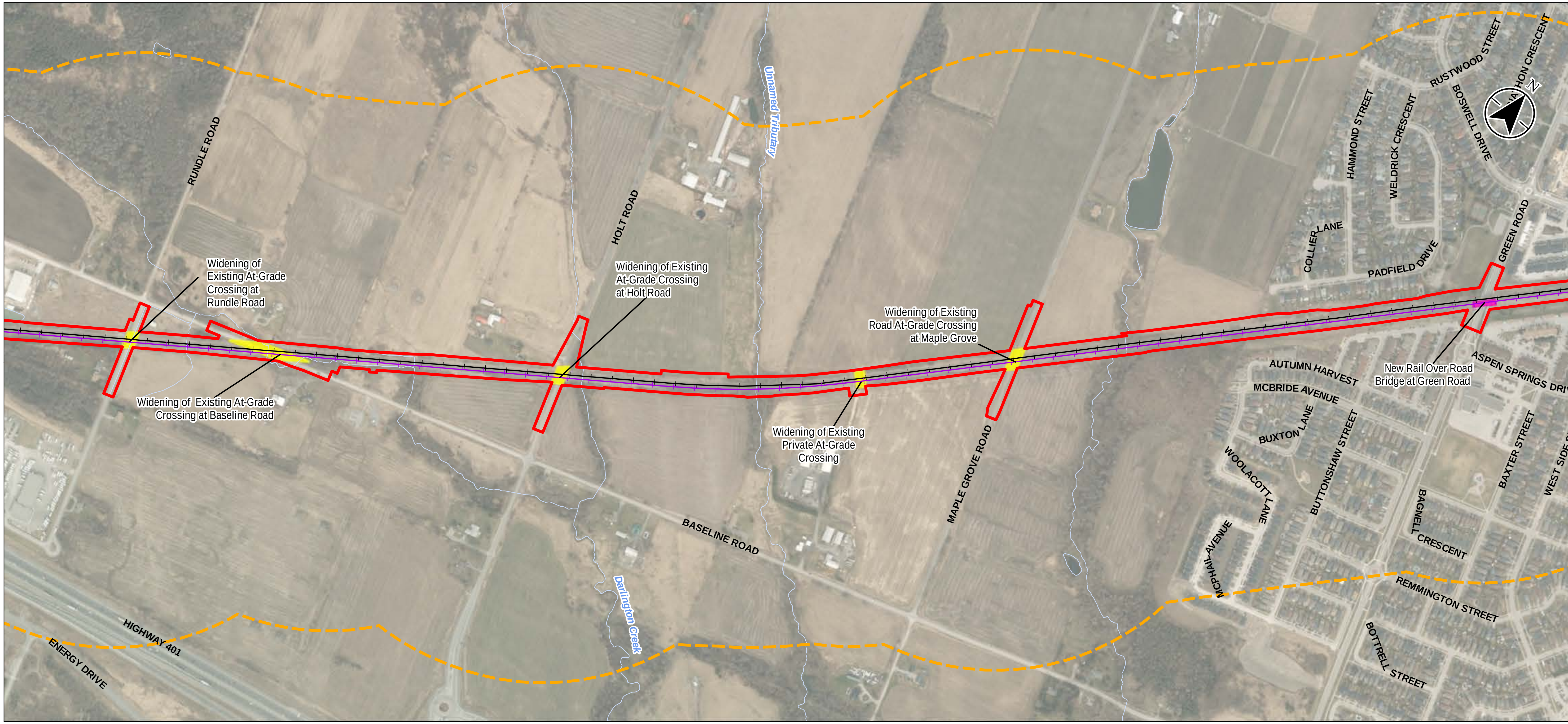
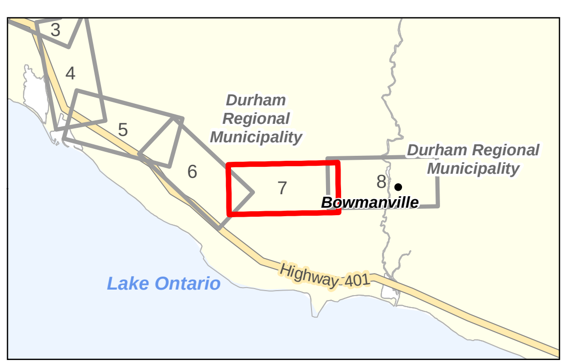
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.6**

Title
**Study Area**

Revised: 2023-08-22 By: bcowper




Legend
- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.7**

Title
**Study Area**

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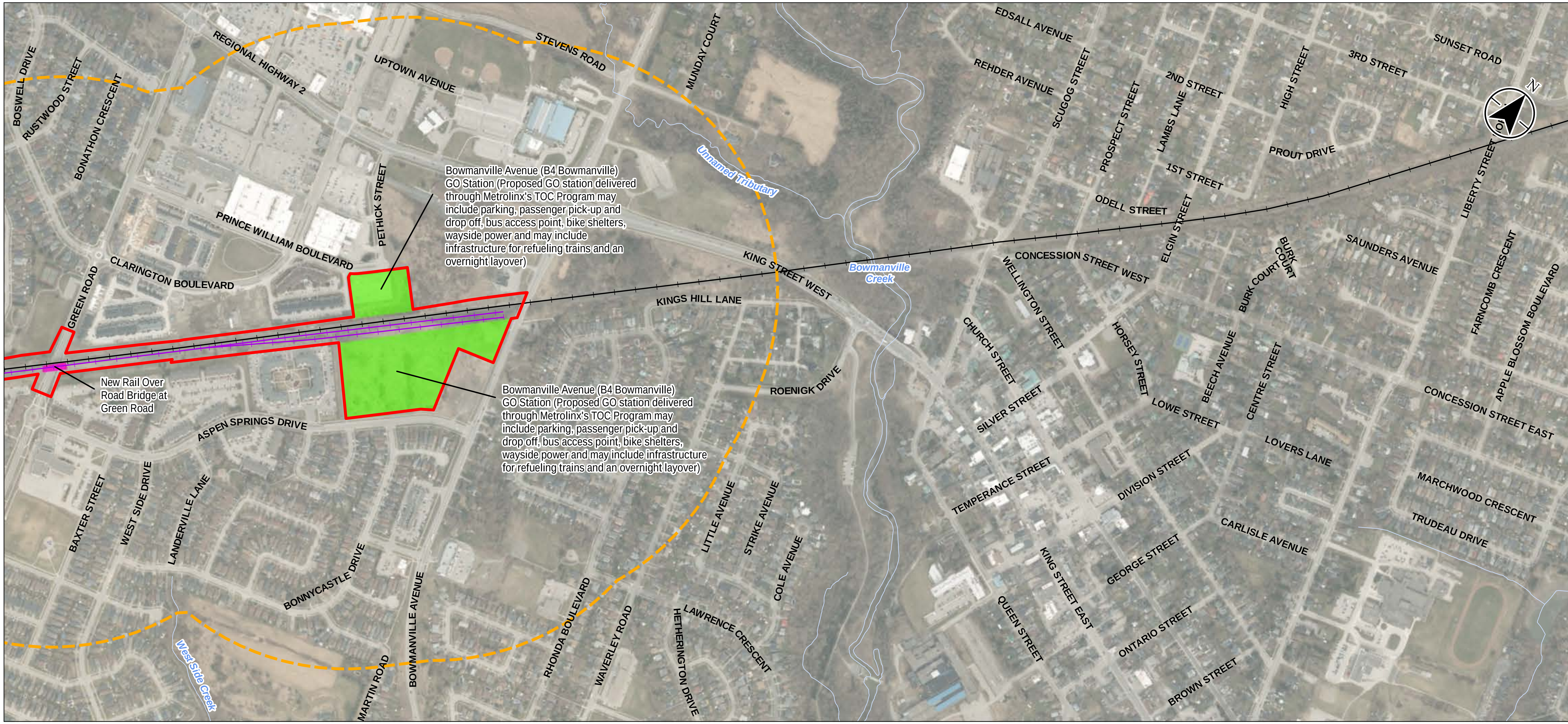


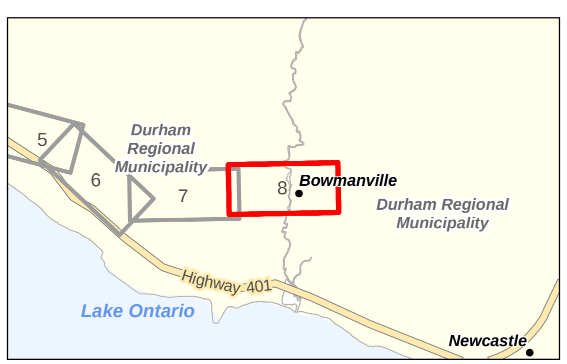


Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Bridge Structure
- Watercourse
- Waterbody

0 200 400 m

1:8,000 (At original document size of 11x17)

Stantec

Project Location
Regioan Municipality
of Durham

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Prepared by BCC on 2023-08-22
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**A.1.8**

Title
**Study Area**

**Notes**
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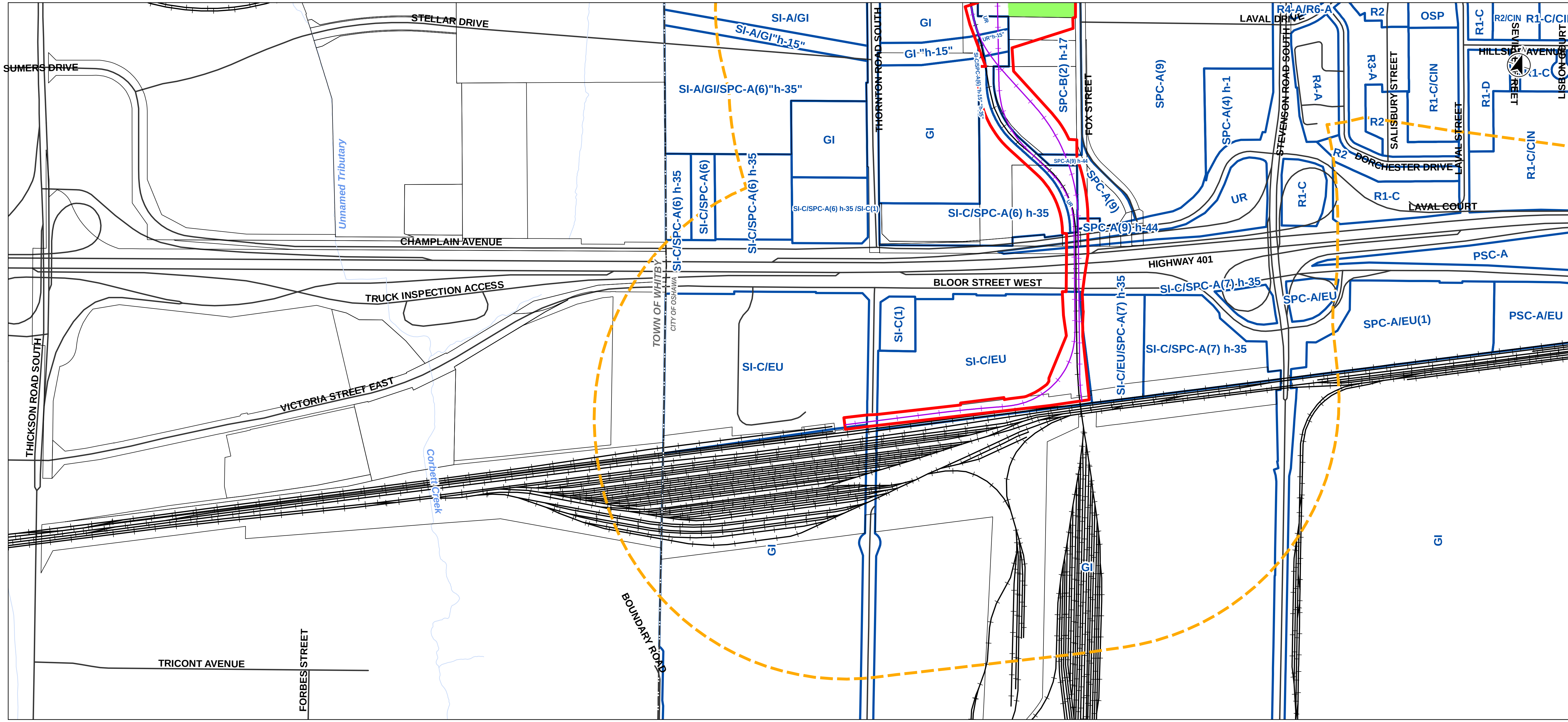
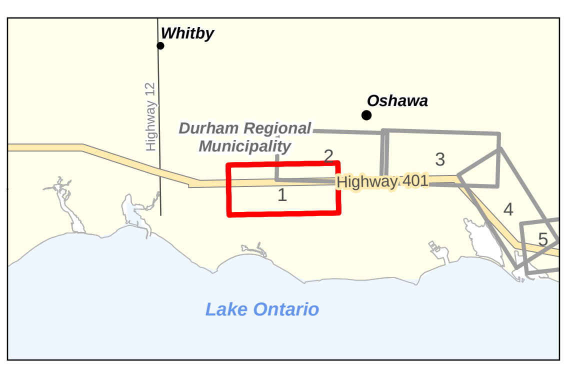
# Appendix B
## Zoning Maps




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower
- Zoning Categories (City of Oshawa)

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

**Notes**
1. Coordinate System: NAD 1983 CSRS MTM 10
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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

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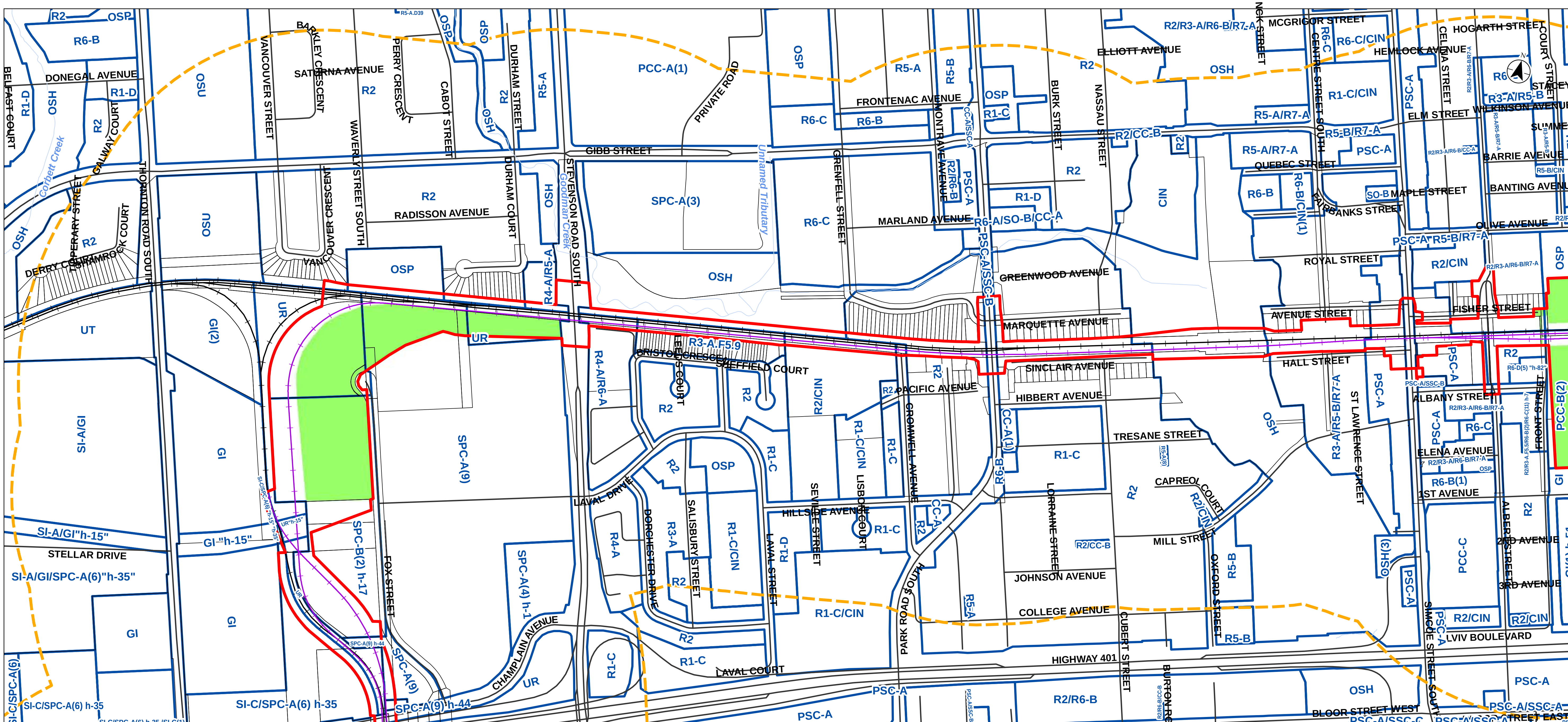
Project Location: Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

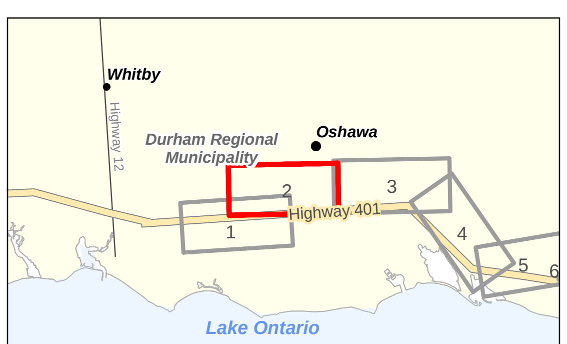
Figure No.
**B.1.1**

Title
**City of Oshawa Zoning Categories**




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower
- Zoning Categories (City of Oshawa)

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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

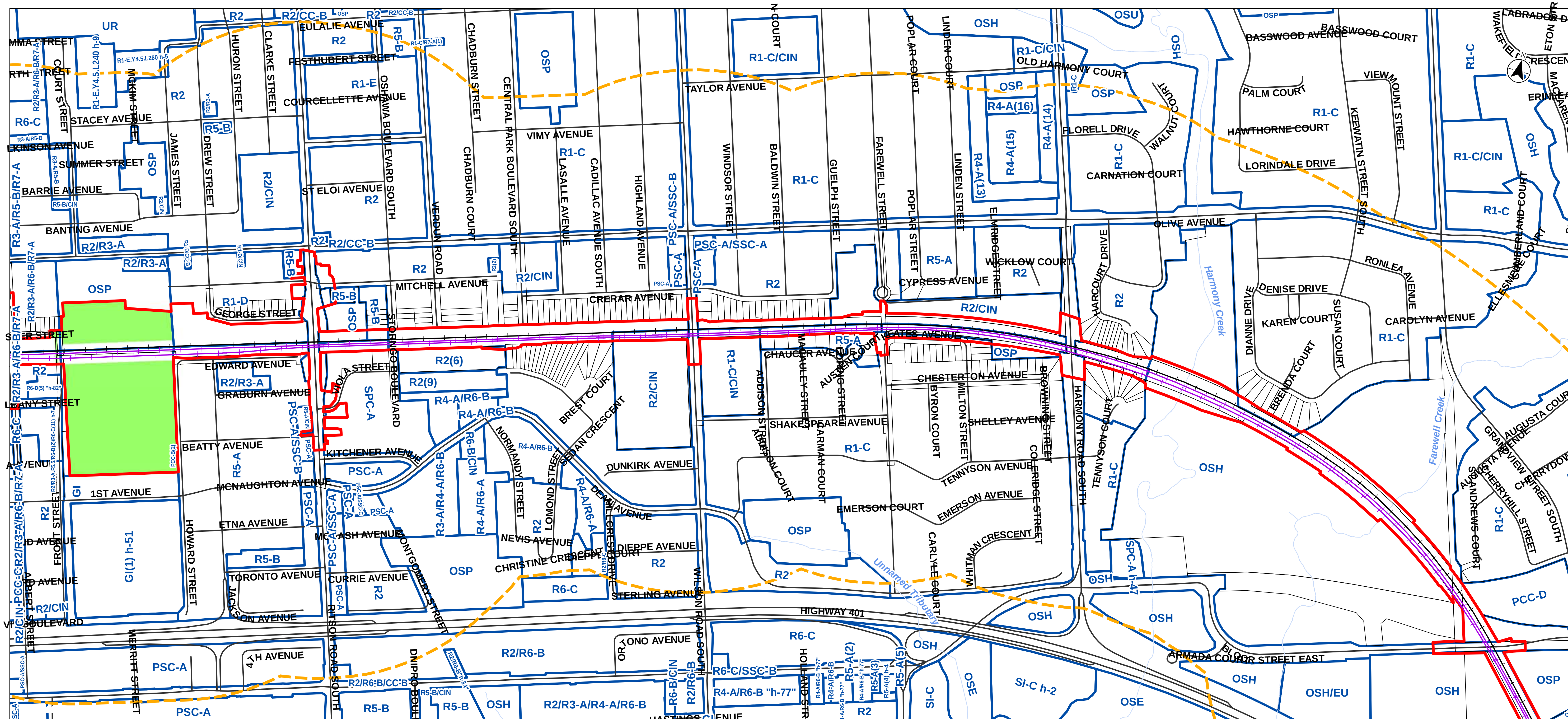
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.1.2**

Title
**City of Oshawa Zoning Categories**

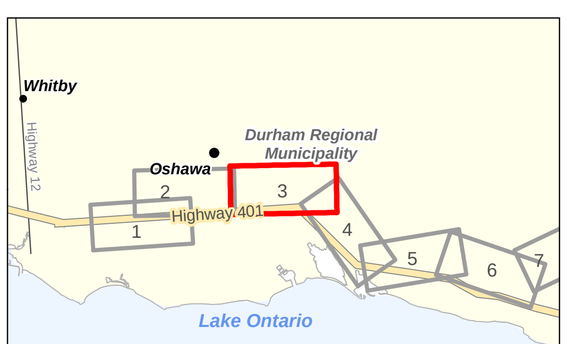


\\ca0215-ppfss01\work_group\01650\active\165011019 - Bowmanville\02_Amendment2_Assignment11_data\gis_cad\gis\mxds\air\report_figures\20230412_Air_Report_rev\165011019_AR_FigB1_Oshawa_Zoning_Mapbook.mxd Revised: 2023-05-12 By: bcowper




## Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower
- Zoning Categories (City of Oshawa)

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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

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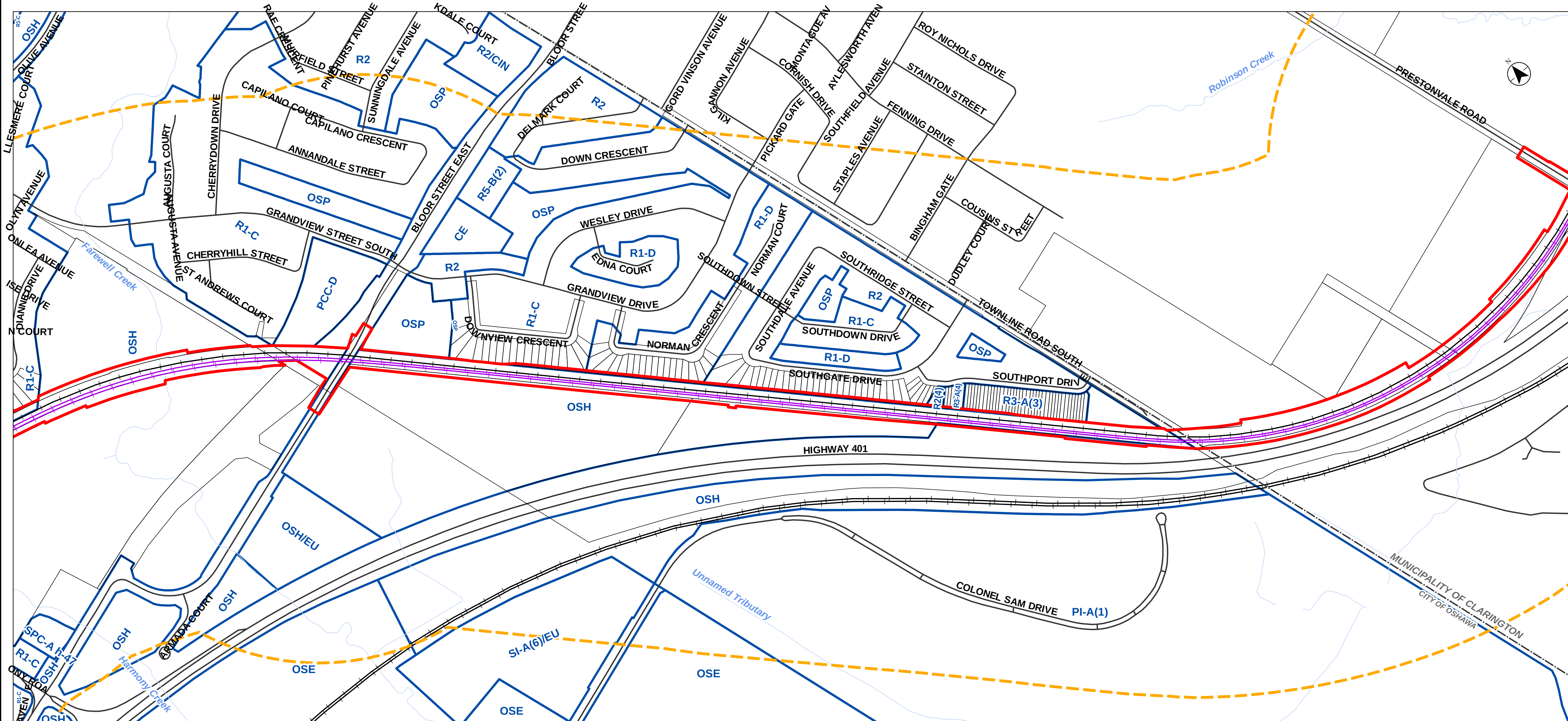
Project Location
Regioan Municipality of Durham

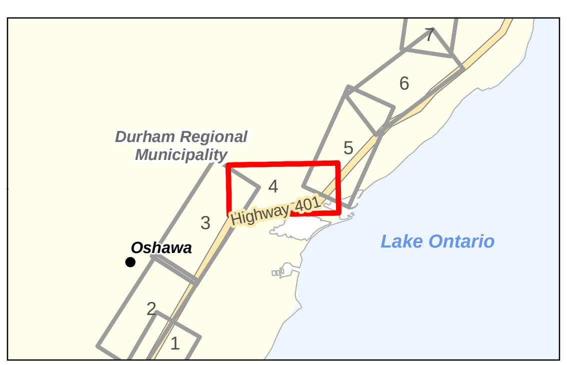
165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.1.3**

Title
**City of Oshawa Zoning Categories**




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Watercourse
- Property Boundary
- Municipal Boundary, Lower
- Zoning Categories (City of Oshawa)

**Notes**

1. Coordinate System: NAD 1983 CSRS MTM 10
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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

Stantec

Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

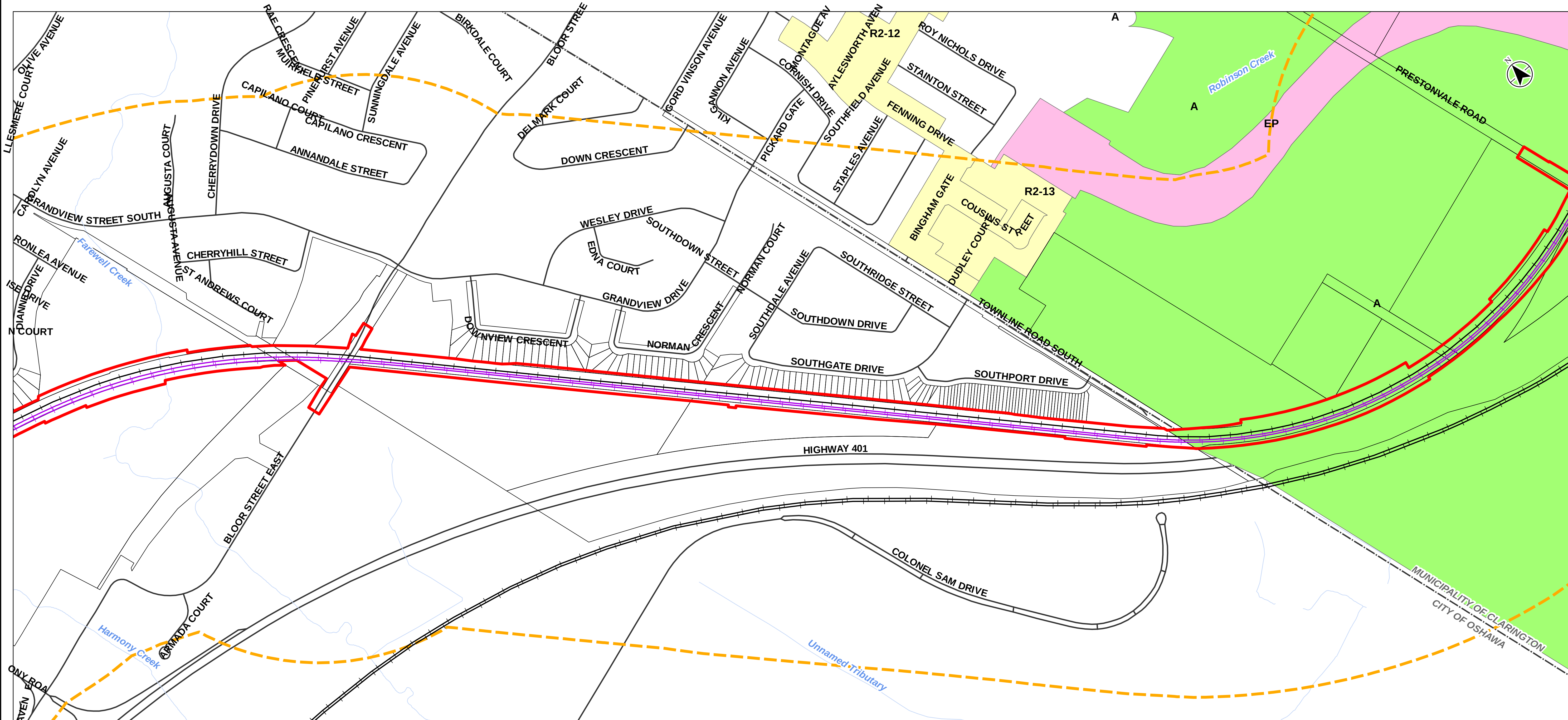
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

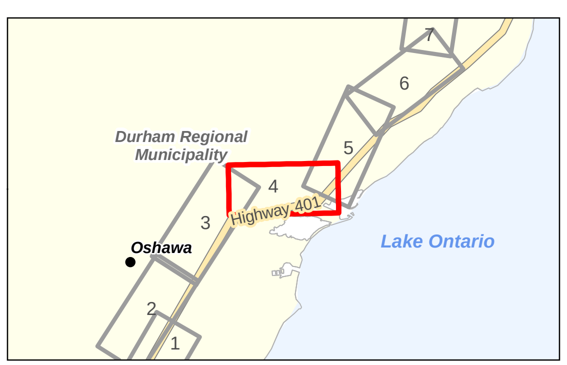
Figure No.
**B.1.4**

Title
**City of Oshawa Zoning Categories**



Revised: 2023-05-12 By: bcowper




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Watercourse
- Property Boundary
- Municipal Boundary, Lower

**Zoning and Landuse (City of Clarington)**

- Agriculture
- Environmental Protection
- Residential

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

**Notes**

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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

Disclaimer: This figure has been prepared based on information provided by others as cited under the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

Stantec

Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.2.1**

Title
**City of Clarington Zoning and Land Use Categories**

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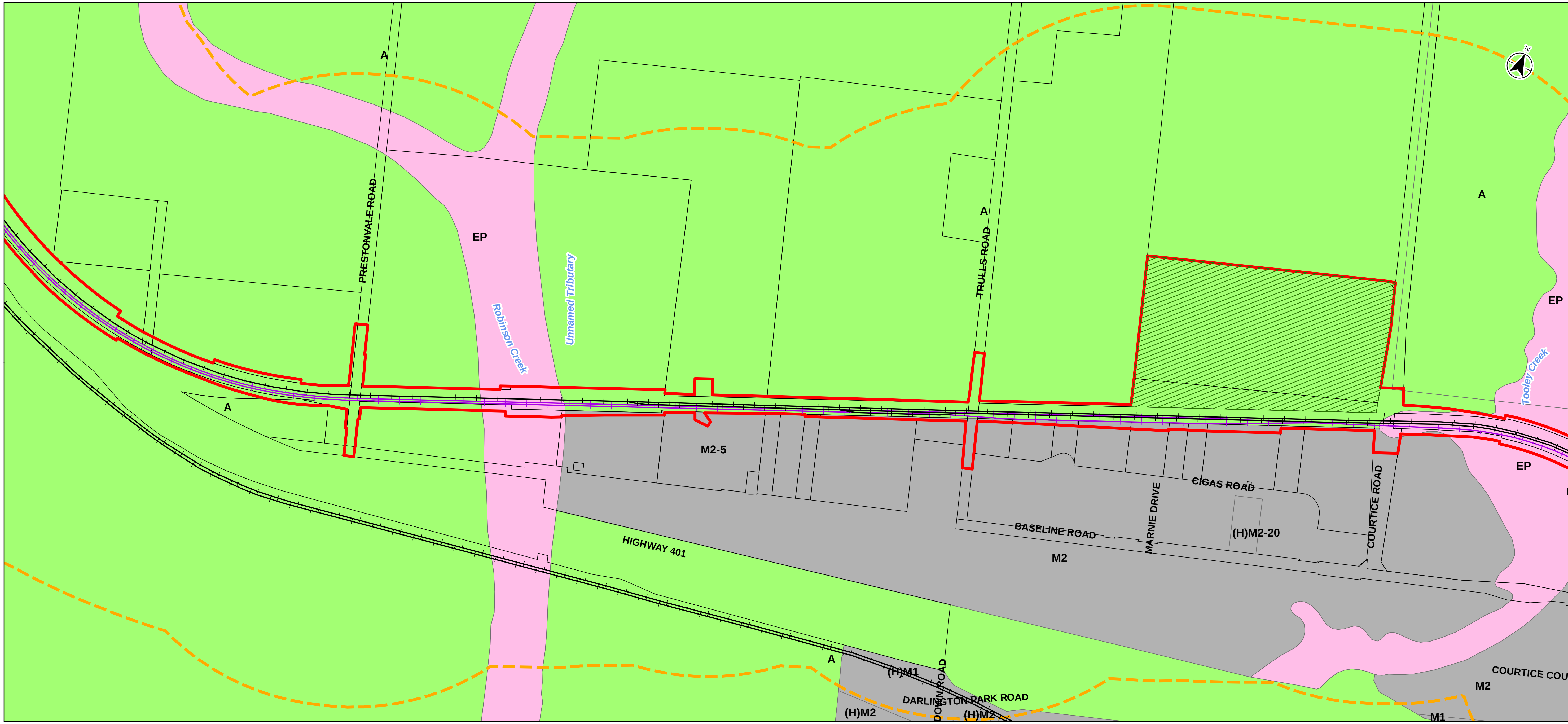
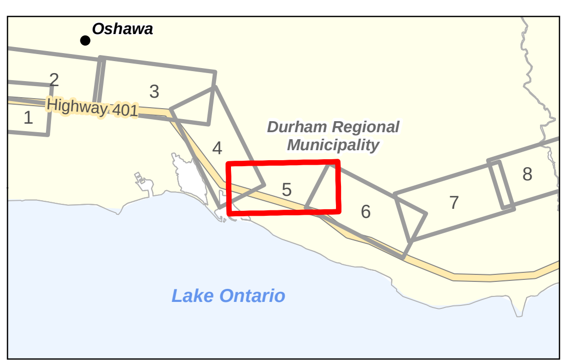



Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower

**Zoning and Landuse (City of Clarington)**

- Agriculture
- Environmental Protection
- Industrial

**Notes**

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

Stantec

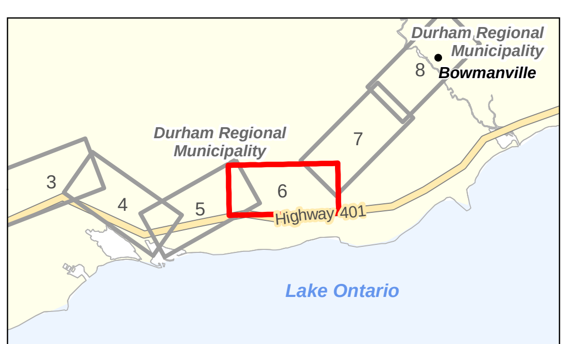
Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.2.2**

Title
**City of Clarington Zoning and Land Use Categories**


Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower

**Zoning and Landuse (City of Clarington)**

- Agriculture
- Environmental Protection
- Industrial

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

**Notes**

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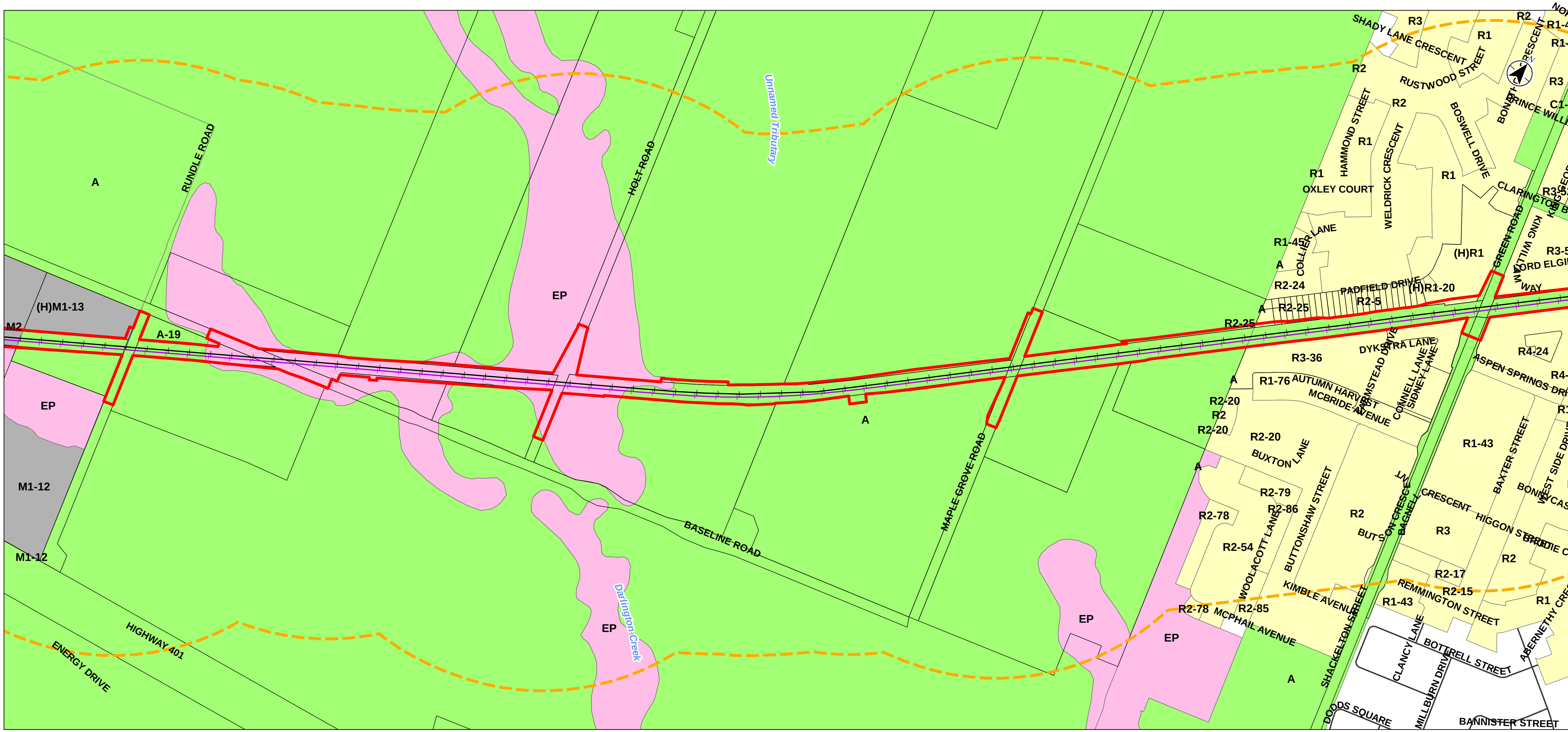
Project Location
Regioan Municipality of Durham

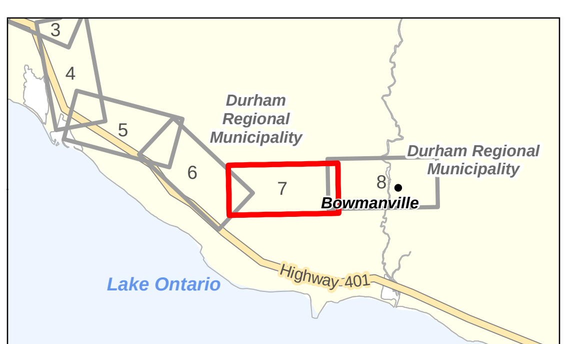
165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.2.3**

Title
**City of Clarington Zoning and Land Use Categories**




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Watercourse
- Property Boundary
- Municipal Boundary, Lower

**Zoning and Landuse (City of Clarington)**

- Agriculture
- Commercial
- Environmental Protection
- Industrial
- Residential

0 0.2 0.4 KM

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**Notes**

1. Coordinate System: NAD 1983 CSRS MTM 10
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3. Zoning layer source City of Oshawa, Open Data Licence Agreement 2021.

Stantec

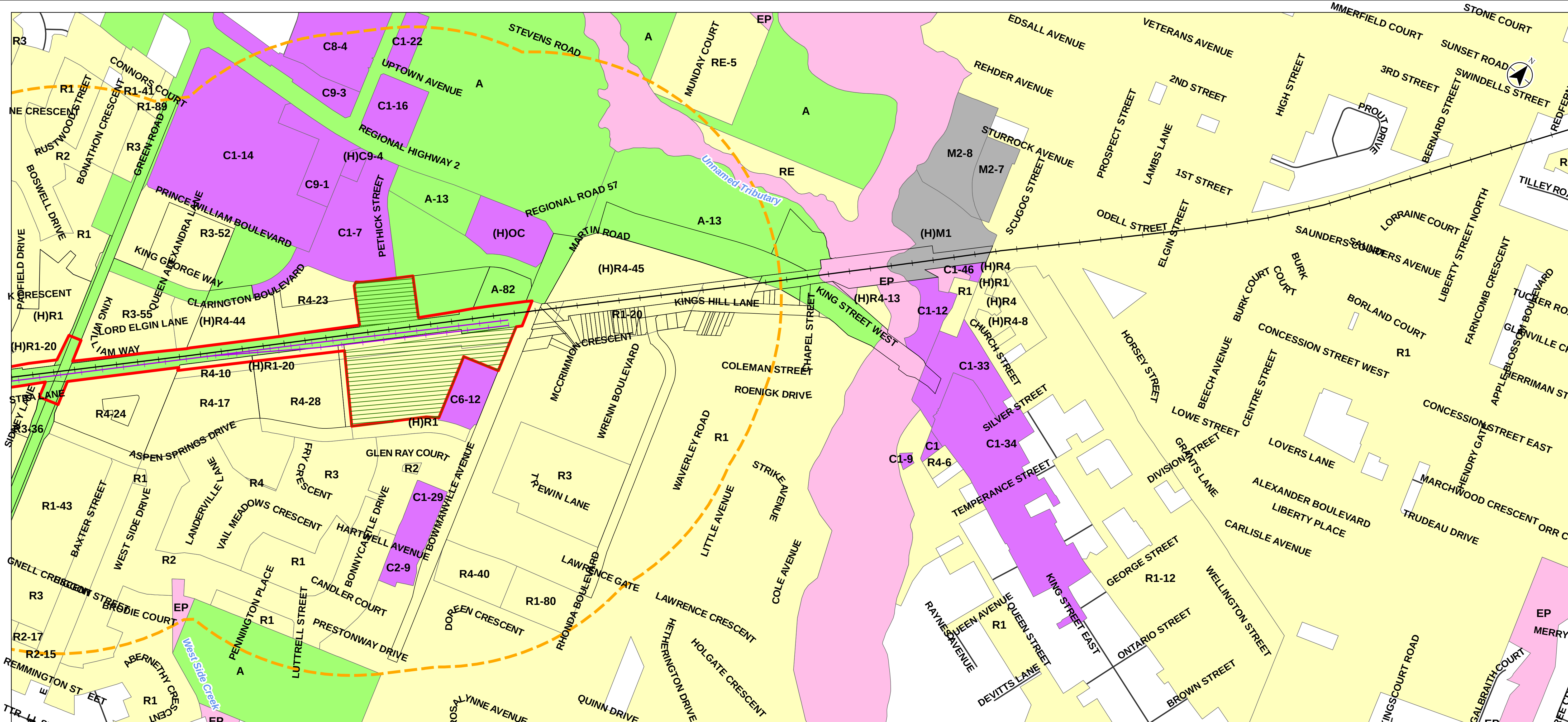
Project Location
Regioan Municipality of Durham

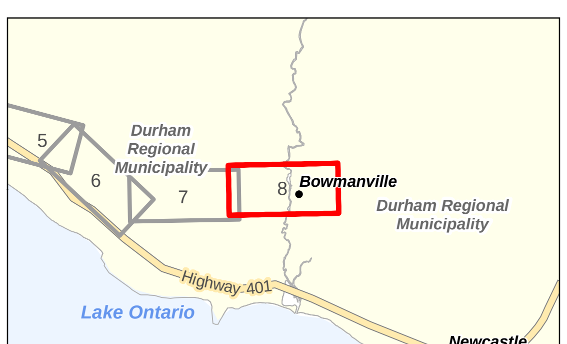
165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.2.4**

Title
**City of Clarington Zoning and Land Use Categories**




Legend

- Project Footprint
- Study Area (500 m Buffer)
- Existing Railway
- Proposed Tracks
- Proposed GO Station Location
- Watercourse
- Property Boundary
- Municipal Boundary, Lower

**Zoning and Landuse (City of Clarington)**

- Agriculture
- Commercial
- Environmental Protection
- Industrial
- Residential

0 0.2 0.4 KM

1:8,000 (At original document size of 11x17)

**Notes**
1. Coordinate System: NAD 1983 CSRS MTM 10
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Stantec

Project Location
Regioan Municipality of Durham

165011019 REVA
Prepared by BCC on 2023-05-12
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**B.2.5**

Title
**City of Clarington Zoning and Land Use Categories**

# Appendix C

## Air Quality Emission Sources and Emission Estimation

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Rundle Road - Widen Crossing***

**Source: Construction Non-Road Mobile Equipment Emissions**

**Description:**
Non-road equipment will be used during construction of the Rundle Road Crossing Widening. Tailpipe emissions due to the fuel combustion would be generated from these sources.
The Rundle Road Crossing Widening will include removals and reconstruction.

**Table 1 - List of Construction Equipment and Usage**

| Construction Phase | Removals and Reconstruction | | | Unit Power Rating (hp) | Fuel | Reference/Note [3] | Worst-case Operating Scenario | |
|---|---|---|---|---|---|---|---|---|
| **Type of Equipment** | **Total Number of Equipment to be Used Onsite[1]** | **Total Number of Equipment Used at the same time [2]** | **% time used [2]** | | | | **Number of Equipment Used** | **Operating Time [4]** |
| Asphalt spreader | | | | 142 | Diesel | Assumed AP500F (142 hp) | 0 | day |
| Augers/Drill Rigs | | | | 260 | Diesel | Assumed Atlas Copco PowerROC T45 Drill (260 h) | 0 | day |
| Backhoe | 1 | 1 | 50% | 120 | Diesel | Assumed Caterpillar 440, 450 Backhoe Loaders (120 hp) | 1 | day |
| Bobcat | 1 | 1 | 50% | 115 | Diesel | Assumed Bobcat E145 Large Excavator (115 hp) | 1 | day |
| Boom truck | 1 | 0 | 10% | 500 | Diesel | Assume Manitex 40124SHL mounted on Peterbilt 567 | 0 | day |
| Compactor | 1 | 1 | 10% | 100 | Diesel | Assumed Caterpillar CP433E Vibratory Compactor | 1 | day |
| Concrete breaker | | | | 68 | Diesel | Assume hydraulic breaker on Bobcat S62 | 0 | day |
| Concrete pump | | | | 100 | Diesel | Assumed Ajax ASP7011 | 0 | day |
| Concrete Saw | 1 | 1 | 10% | 50 | Diesel | Assumed Husqvarna FS 5000 D walk behind saw | 1 | day |
| Concrete truck | 1 | 0 | 10% | 500 | Diesel | Assume truck mounted concrete mixer, International HX515. https://www.internationaltrucks.com/en/trucks/hx-series | 0 | day |
| Crane | | | | 270 | Diesel | Assumed Tadnano GR-1000SL-2 (270 hp) | 0 | day |
| Dump Truck | 2 | 2 | 13% | 600 | Diesel | Assumed Caterpillar 772G dump truck (600 hp) | 2 | day |
| Flatbed truck | | | | 360 | Diesel | Assumed Hino XL Series 360HP | 0 | day |
| Pavement saw | 1 | 1 | 10% | 50 | Diesel | Assumed Husqvarna FS 5000 D walk behind saw | 1 | day |
| Paving roller | 1 | 0 | 10% | 100 | Diesel | Assumed CAT CCS7 Combination Asphalt Compactor, https://www.cat.com/en_US/products/new/equipment/compactors/tandem-vibratory-rollers.html?page=2 | 0 | day |
| Pile Driver | | | | 240 | Diesel | Assume Junttan Pile Driving Rig PM23, Cummins QSB6,7 EU Stage IV / US EPA | 0 | day |
| Water truck | 1 | 1 | 10% | 285 | Diesel | Assumed John Deere 300D water truck (285 hp) | 1 | day |
| Zoomboom | | | | 110 | Diesel | Assume Skytrak Model 8042 Telehandler, Engine Cummins QSB4.5T Turbo | 0 | day |
| Total number of equipment | | 8 | | | | Total | 8 | |
| Total HP - weighted (5) | | 316 | | | | Avg HP | 233.8 | |

**Notes:**
1) The total number of each type of construction equipment that may be used onsite is estimated by the project design team.
2) Not all equipment will be used on the same day and for the entire day. The estimated worst-case of equipment used on the same day and the percent of time used that day was estimated by the project design team.
Some equipment are not likely to be used on the same day as the other equipment.

3) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday.

5) Total HP weighted by percent the equipment was assumed to be used per note 2.

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in the equipment engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
**Table 2: $SO_2$ Emission Factor Calculation**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment. $SO_2$ emission factor is calculated below.

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$. |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

**Table 3: Emission factors for NOx, PM, CO, NMHC**

| | | Emission Factor (1) (2) (g/kWhr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 < 75 HP | | | 75 < 175 HP | | | 175 < 600 HP | | | 600 < 750 HP | | |
| | | Tier 3 (50-100 HP) | Tier 4 (50-75 HP) | Weighted (2) | Tier 3 (100-175 HP) | Tier 4 (75-175 HP) | Weighted (2) | Tier 3 (100-600 HP) | Tier 4 (175-750 HP) | Weighted (2) | Tier 3 (600-750 HP) | Tier 4 (175-750 HP) | Weighted (2) |
| Nox (3) | 10102-44-0 | 4.7 | 4.7 | 4.7 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 |
| PM | N/A (pm) | 0.40 | 0.030 | 0.18 | 0.30 | 0.020 | 0.13 | 0.20 | 0.020 | 0.09 | 0.20 | 0.020 | 0.09 |
| PM10 | N/A (pm10) | 0.38 | 0.03 | 0.17 | 0.29 | 0.02 | 0.13 | 0.19 | 0.02 | 0.09 | 0.19 | 0.02 | 0.09 |
| PM2.5 | N/A (pm2.5) | 0.36 | 0.03 | 0.16 | 0.27 | 0.02 | 0.12 | 0.18 | 0.02 | 0.08 | 0.18 | 0.02 | 0.08 |
| CO | 630-08-0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| NMHC (3) | N/A | 4.7 | 4.7 | 4.7 | 4.00 | 0.19 | 1.7 | 4.00 | 0.2 | 1.7 | 4.00 | 0.2 | 1.7 |

**Notes:**

1) NOx, CO, PM emission factors: Tier 3 and Tier 4 emission standard in US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards" and "US EPA Tier 1-3 engines" are used.
PM10 and PM2.5: Based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

2) It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%
Tier 4 60%

3) Where emission factors were provided for NMHC + Nox in the US EPA reference document (i.e. not provided separately for NOx and NMHC, the emission factor was conservatively used for both Nox and NMHC.

**Table 4: Speciated VOC emission factors**

| Diesel Engine Tier | Tier3 | | Tier4 | | Weighted (1) |
|---|---|---|---|---|---|
| **VOC Emission Factor** | 0.2 | g/hp-h | 0.142 | g/hp-h | |
| **PM Emission Factor** | 0.1500 | g/hp-h | 0.015 | g/hp-h | |
| **Key VOCs and PAH** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Emission Factor (g/hph)** |
| Benzene | 0.054100 | 1.08E-02 | 0.012910 | 1.83E-03 | 5.43E-03 |
| 1,3-Butadiene | 0.001860 | 3.72E-04 | 0.000800 | 1.13E-04 | 2.17E-04 |
| Acrolein | 0.018700 | 3.74E-03 | 0.009990 | 1.42E-03 | 2.35E-03 |
| Acetaldehyde | 0.104000 | 2.08E-02 | 0.069340 | 9.82E-03 | 1.42E-02 |
| Formaldehyde | 0.292000 | 5.84E-02 | 0.217440 | 3.08E-02 | 4.18E-02 |
| Benzo(a)pyrene | 6.67E-06 | 1.00E-06 | 3.30E-06 | 4.92E-08 | 4.30E-07 |

**Notes:**
Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12
1) It is assumed that construction equipment used are Tier 3 and Tier 4 with the ratios shown in note 2 in the section above.

**Emission Calculations:**

SO2 emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment.
NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite equipment tailpipe exhausts are calculated based on the US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards".
Key VOCs emission factors are derived from the data in US EPA AP-42 reference “Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)” as shown above.

**Table 5: Worst-case construction phase**

| Source Group | Contaminant | CAS# | Emission Factor | | Unit Power Rating (hp) | Operating Load [1] [2] | % of Time Operating [3] | Emission Rate - Each Equipment (g/s) | Worst-case Scenario for Modelling | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Value | Unit | | | | | Number of Equipment | Emission Rate - All Equipment[4] (g/s) |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 120 | 40% | 50% | 2.8E-05 | 1 | 2.8E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 120 | 40% | 50% | 9.1E-03 | 1 | 9.1E-03 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.6E-04 | 1 | 6.6E-04 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.3E-04 | 1 | 6.3E-04 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 120 | 40% | 50% | 5.9E-04 | 1 | 5.9E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 120 | 40% | 50% | 2.5E-02 | 1 | 2.5E-02 |
| Backhoe | NMHC | N/A | 1.7 | g/kWhr | 120 | 40% | 50% | 8.5E-03 | 1 | 8.5E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 120 | 40% | 50% | 3.6E-05 | 1 | 3.6E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 120 | 40% | 50% | 1.4E-06 | 1 | 1.4E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 120 | 40% | 50% | 1.6E-05 | 1 | 1.6E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 120 | 40% | 50% | 9.5E-05 | 1 | 9.5E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 120 | 40% | 50% | 2.8E-04 | 1 | 2.8E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 120 | 40% | 50% | 2.9E-09 | 1 | 2.9E-09 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 115 | 40% | 50% | 2.7E-05 | 1 | 2.7E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 115 | 40% | 50% | 8.8E-03 | 1 | 8.8E-03 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 115 | 40% | 50% | 6.3E-04 | 1 | 6.3E-04 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 115 | 40% | 50% | 6.0E-04 | 1 | 6.0E-04 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 115 | 40% | 50% | 5.7E-04 | 1 | 5.7E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 115 | 40% | 50% | 2.4E-02 | 1 | 2.4E-02 |
| Bobcat | NMHC | N/A | 1.7 | g/kWhr | 115 | 40% | 50% | 8.2E-03 | 1 | 8.2E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 115 | 40% | 50% | 3.5E-05 | 1 | 3.5E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 115 | 40% | 50% | 1.4E-06 | 1 | 1.4E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 115 | 40% | 50% | 1.5E-05 | 1 | 1.5E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 115 | 40% | 50% | 9.1E-05 | 1 | 9.1E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 115 | 40% | 50% | 2.7E-04 | 1 | 2.7E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 115 | 40% | 50% | 2.7E-09 | 1 | 2.7E-09 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 500 | 50% | 10% | 2.9E-05 | 0 | 0.0E+00 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 500 | 50% | 10% | 9.5E-03 | 0 | 0.0E+00 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 500 | 50% | 10% | 4.8E-04 | 0 | 0.0E+00 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 500 | 50% | 10% | 4.6E-04 | 0 | 0.0E+00 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 500 | 50% | 10% | 4.3E-04 | 0 | 0.0E+00 |
| | CO | 630-08-0 | 3.50 | g/kWhr | 500 | 50% | 10% | 1.8E-02 | 0 | 0.0E+00 |
| Boom truck | NMHC | N/A | 1.71 | g/kWhr | 500 | 50% | 10% | 8.9E-03 | 0 | 0.0E+00 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 500 | 50% | 10% | 3.8E-05 | 0 | 0.0E+00 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 500 | 50% | 10% | 1.5E-06 | 0 | 0.0E+00 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 500 | 50% | 10% | 1.6E-05 | 0 | 0.0E+00 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 500 | 50% | 10% | 9.9E-05 | 0 | 0.0E+00 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 500 | 50% | 10% | 2.9E-04 | 0 | 0.0E+00 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 500 | 50% | 10% | 3.0E-09 | 0 | 0.0E+00 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 100 | 20% | 10% | 2.3E-06 | 1 | 2.3E-06 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 100 | 20% | 10% | 7.6E-04 | 1 | 7.6E-04 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.5E-05 | 1 | 5.5E-05 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.2E-05 | 1 | 5.2E-05 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 100 | 20% | 10% | 4.9E-05 | 1 | 4.9E-05 |
| | CO | 630-08-0 | 5.00 | g/kWhr | 100 | 20% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| Compactor | NMHC | N/A | 1.71 | g/kWhr | 100 | 20% | 10% | 7.1E-04 | 1 | 7.1E-04 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 100 | 20% | 10% | 3.0E-06 | 1 | 3.0E-06 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 100 | 20% | 10% | 1.2E-07 | 1 | 1.2E-07 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 100 | 20% | 10% | 1.3E-06 | 1 | 1.3E-06 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 100 | 20% | 10% | 7.9E-06 | 1 | 7.9E-06 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 100 | 20% | 10% | 2.3E-05 | 1 | 2.3E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 100 | 20% | 10% | 2.4E-10 | 1 | 2.4E-10 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 50 | 20% | 10% | 1.2E-06 | 1 | 1.2E-06 |
| | $NO_x$ | 10102-44-0 | 4.7 | g/kWhr | 50 | 20% | 10% | 9.7E-04 | 1 | 9.7E-04 |
| | PM | N/A (pm) | 0.18 | g/kWhr | 50 | 20% | 10% | 3.7E-05 | 1 | 3.7E-05 |
| | PM10 | N/A (pm10) | 0.17 | g/kWhr | 50 | 20% | 10% | 3.5E-05 | 1 | 3.5E-05 |
| | PM2.5 | N/A (pm2.5) | 0.16 | g/kWhr | 50 | 20% | 10% | 3.3E-05 | 1 | 3.3E-05 |
| | CO | 630-08-0 | 5.00 | g/kWhr | 50 | 20% | 10% | 1.0E-03 | 1 | 1.0E-03 |
| Concrete Saw | NMHC | N/A | 4.70 | g/kWhr | 50 | 20% | 10% | 9.7E-04 | 1 | 9.7E-04 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 50 | 20% | 10% | 1.5E-06 | 1 | 1.5E-06 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 50 | 20% | 10% | 6.0E-08 | 1 | 6.0E-08 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 50 | 20% | 10% | 6.5E-07 | 1 | 6.5E-07 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 50 | 20% | 10% | 3.9E-06 | 1 | 3.9E-06 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 50 | 20% | 10% | 1.2E-05 | 1 | 1.2E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 50 | 20% | 10% | 1.2E-10 | 1 | 1.2E-10 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 500 | 40% | 10% | 2.3E-05 | 0 | 0.0E+00 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 500 | 40% | 10% | 7.6E-03 | 0 | 0.0E+00 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 500 | 40% | 10% | 3.8E-04 | 0 | 0.0E+00 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 500 | 40% | 10% | 3.7E-04 | 0 | 0.0E+00 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 500 | 40% | 10% | 3.4E-04 | 0 | 0.0E+00 |
| | CO | 630-08-0 | 3.50 | g/kWhr | 500 | 40% | 10% | 1.4E-02 | 0 | 0.0E+00 |
| Concrete Truck | NMHC | N/A | 1.71 | g/kWhr | 500 | 40% | 10% | 7.1E-03 | 0 | 0.0E+00 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 500 | 40% | 10% | 3.0E-05 | 0 | 0.0E+00 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 500 | 40% | 10% | 1.2E-06 | 0 | 0.0E+00 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 500 | 40% | 10% | 1.3E-05 | 0 | 0.0E+00 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 500 | 40% | 10% | 7.9E-05 | 0 | 0.0E+00 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 500 | 40% | 10% | 2.3E-04 | 0 | 0.0E+00 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 500 | 40% | 10% | 2.4E-09 | 0 | 0.0E+00 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 600 | 40% | 13% | 3.5E-05 | 2 | 7.0E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 600 | 40% | 13% | 1.1E-02 | 2 | 2.3E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 600 | 40% | 13% | 5.7E-04 | 2 | 1.1E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 600 | 40% | 13% | 5.5E-04 | 2 | 1.1E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 600 | 40% | 13% | 5.1E-04 | 2 | 1.0E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 600 | 40% | 13% | 2.2E-02 | 2 | 4.3E-02 |
| Dump Truck | NMHC | N/A | 1.7 | g/kWhr | 600 | 40% | 13% | 1.1E-02 | 2 | 2.1E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 600 | 40% | 13% | 4.5E-05 | 2 | 9.0E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 600 | 40% | 13% | 1.8E-06 | 2 | 3.6E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 600 | 40% | 13% | 2.0E-05 | 2 | 3.9E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 600 | 40% | 13% | 1.2E-04 | 2 | 2.4E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 600 | 40% | 13% | 3.5E-04 | 2 | 7.0E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 600 | 40% | 13% | 3.6E-09 | 2 | 7.2E-09 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 50 | 20% | 10% | 1.2E-06 | 1 | 1.2E-06 |
| | $NO_x$ | 10102-44-0 | 4.7 | g/kWhr | 50 | 20% | 10% | 9.7E-04 | 1 | 9.7E-04 |
| | PM | N/A (pm) | 0.18 | g/kWhr | 50 | 20% | 10% | 3.7E-05 | 1 | 3.7E-05 |
| | PM10 | N/A (pm10) | 0.17 | g/kWhr | 50 | 20% | 10% | 3.5E-05 | 1 | 3.5E-05 |
| | PM2.5 | N/A (pm2.5) | 0.16 | g/kWhr | 50 | 20% | 10% | 3.3E-05 | 1 | 3.3E-05 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 50 | 20% | 10% | 1.0E-03 | 1 | 1.0E-03 |
| Pavement Saw | NMHC | N/A | 4.7 | g/kWhr | 50 | 20% | 10% | 9.7E-04 | 1 | 9.7E-04 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 50 | 20% | 10% | 1.5E-06 | 1 | 1.5E-06 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 50 | 20% | 10% | 6.0E-08 | 1 | 6.0E-08 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 50 | 20% | 10% | 6.5E-07 | 1 | 6.5E-07 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 50 | 20% | 10% | 3.9E-06 | 1 | 3.9E-06 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 50 | 20% | 10% | 1.2E-05 | 1 | 1.2E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 50 | 20% | 10% | 1.2E-10 | 1 | 1.2E-10 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 100 | 20% | 10% | 2.3E-06 | 0 | 0.0E+00 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 100 | 20% | 10% | 7.6E-04 | 0 | 0.0E+00 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.5E-05 | 0 | 0.0E+00 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.2E-05 | 0 | 0.0E+00 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 100 | 20% | 10% | 4.9E-05 | 0 | 0.0E+00 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 100 | 20% | 10% | 2.1E-03 | 0 | 0.0E+00 |
| Paving roller | NMHC | N/A | 1.7 | g/kWhr | 100 | 20% | 10% | 7.1E-04 | 0 | 0.0E+00 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 100 | 20% | 10% | 3.0E-06 | 0 | 0.0E+00 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 100 | 20% | 10% | 1.2E-07 | 0 | 0.0E+00 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 100 | 20% | 10% | 1.3E-06 | 0 | 0.0E+00 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 100 | 20% | 10% | 7.9E-06 | 0 | 0.0E+00 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 100 | 20% | 10% | 2.3E-05 | 0 | 0.0E+00 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 100 | 20% | 10% | 2.4E-10 | 0 | 0.0E+00 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 285 | 40% | 10% | 1.3E-04 | 1 | 1.3E-04 |
| | $NO_x$ | 10102-44-0 | 1.8400 | g/kWhr | 285 | 40% | 10% | 4.3E-02 | 1 | 4.3E-02 |
| | PM | N/A (pm) | 0.1320 | g/kWhr | 285 | 40% | 10% | 3.1E-03 | 1 | 3.1E-03 |
| | PM10 | N/A (pm10) | 0.1267 | g/kWhr | 285 | 40% | 10% | 3.0E-03 | 1 | 3.0E-03 |
| | PM2.5 | N/A (pm2.5) | 0.1188 | g/kWhr | 285 | 40% | 10% | 2.8E-03 | 1 | 2.8E-03 |
| | CO | 630-08-0 | 5.0000 | g/kWhr | 285 | 40% | 10% | 1.2E-01 | 1 | 1.2E-01 |
| Water Truck | NMHC | N/A | 1.7140 | g/kWhr | 285 | 40% | 10% | 4.0E-02 | 1 | 4.0E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 285 | 40% | 10% | 1.7E-04 | 1 | 1.7E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 285 | 40% | 10% | 6.9E-06 | 1 | 6.9E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 285 | 40% | 10% | 7.4E-05 | 1 | 7.4E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 285 | 40% | 10% | 4.5E-04 | 1 | 4.5E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 285 | 40% | 10% | 1.3E-03 | 1 | 1.3E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 285 | 40% | 10% | 1.4E-08 | 1 | 1.4E-08 |

**Notes:**

1) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

The Construction Noise and Vibration Assessment for this Project uses the load factors in the FHWA Guide as this is the recommended reference in the Metrolinx Environmental Guide for Noise and Vibration Assessment. The Air Quality Assessment is therefore using the same reference to be consistent with assumptions used in the Noise and Vibration Assessment.
In addition, the following two references were reviewed, and the load factors in these documents are in similar ranges as the FHWA Guide:
U. S. EPA, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA-420-R-10-016. July 2010.
Hawthorne CAT, Estimating Owning and Operating Costs, Caterpillar Performance Handbook Edition 44. Available at
https://www.hawthornecat.com/sites/default/files/content/download/pdfs/Estimating_Owning_Operating_Costs_CPH_v1.1_03.13.14.pdf. Accessed in January 2020.

2) Water truck average operating load is not available from above U.S. Federal Highway Administration guide. The load for dump truck was assumed for the water truck.

3) Percent of time used were assumed based on information from the design team (per Table 1 above).

4) The calculated emission rate is for all equipment that were assumed to operate at the same time.

**Sample Calculation - NOx emissions from each backhoe:**

NOx emissions (g/s) = 1.8 g/kWh x 1 kWh/1.341hph x power of each equipment (hph) x % of load x % of time operating x 1 hour/3600 s
1.8 g/kWh x 1 kWh/1.341hph x 120 (hph) x 40% x 50% x 1 hour/3600 s = 0.009 g/s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the maximum estimated number of equipment operating at the same time during the worst-case scenario. The calculated emission rate should be conservative.

**Table 6: Summary of Overall Emissions**

| Contaminant | CAS# | Worst-case Scenario Hourly Emission Rate [1] (g/s) | | Emission Rate for each volume source (g/s) | |
|---|---|---|---|---|---|
| | | Daytime (8AM-5PM) | Nighttime | No. of volume sources | 9 |
| $SO_2$ | 7446-09-5 | 2.62E-04 | 0.0000 | | 2.91E-05 |
| $NO_x$ | 10102-44-0 | 8.69E-02 | 0.0000 | | 9.66E-03 |
| PM | N/A (pm) | 5.67E-03 | 0.0000 | | 6.30E-04 |
| PM10 | N/A (pm10) | 5.45E-03 | 0.0000 | | 6.05E-04 |
| PM2.5 | N/A (pm2.5) | 5.11E-03 | 0.0000 | | 5.67E-04 |
| CO | 630-08-0 | 2.14E-01 | 0.0000 | | 2.38E-02 |
| NMHC | N/A | 8.11E-02 | 0.0000 | | 9.01E-03 |
| Benzene | 71-43-2 | 3.39E-04 | 0.0000 | | 3.77E-05 |
| 1,3-Butadiene | 106-99-0 | 1.36E-05 | 0.0000 | | 1.51E-06 |
| Acrolein | 107-02-8 | 1.47E-04 | 0.0000 | | 1.63E-05 |
| Acetaldehyde | 75-07-0 | 8.88E-04 | 0.0000 | | 9.87E-05 |
| Formaldehyde | 50-00-0 | 2.62E-03 | 0.0000 | | 2.91E-04 |
| Benzo(a)pyrene | 50-32-8 | 2.69E-08 | 0.0000 | | 2.98E-09 |

**Notes:**

1. Total emission rate for each contaminant for worst-case scenario during construction phase is the total of the above emission rates from each type of equipment assumed to be operated at the same time and their assumed operating time and operating load.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Rundle Road - Widen Crossing***

## Source: Construction Activities Dust Emissions

**Description:**

Construction activities would generate dust emissions and may have substantial temporary impact on the local air quality.

Quantity of dust emissions depends on the area of land being worked, type of equipment onsite and level of construction activities. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The Rundle Road Crossing Widening will include removals and reconstruction.

**Contaminant(s) of Concern:**

Particulate matter (including TSP, PM10 and PM2.5) emissions are the contaminants of concern from construction activities.

**Methodology: Emission Factor (EF) and Engineering Calculation (EC)**

Emission factors from the following references are used to estimate the overall area-wide dust emissions.

•**Reference A**: Western Reginal Air Partnership, Fugitive Dust Handbook, Chapter 3: Construction and Demolition (09/03/06), https://www.wrapair.org/forums/dejf/fdh/

•**Reference B**: California Environmental Protection Agency Air Resources Board. 2002. Section 7.7: Building Construction Dust.

Based on the site plan and drawings for the Rundle Road Crossing Widening, the active construction area is shown below. It is estimated based on drawing CPG-SCL3756-C6106. Rev 0, which shows the active construction area, including road grading on both sides of the track, extends approximately 55 m. Grading work may be conducted in the immediate area of the crossing at the same time which is conservatively included as part of the active construction area.

| Construction Phases [1] | Active Construction Area for Worst-case Scenario [2, 3] | | Potential Operating Time [4] |
|---|---|---|---|
| | Area (m2) | Area (acre) | |
| Removals and Reconstruction [2] | 330.0 | 0.082 | daytime |
| Grading work at the tracks [3] | 150.0 | 0.037 | |
| Total | 480.0 | 0.119 | |

**Notes:**

1. Construction phases are estimated by the design team.
2. Based on drawing CPG-SCL3756-C6106. Rev 0, the length of the active construction area at Rundle Road Crossing, including road grading on both sides of the track, is approximately 55 m. The total width of the road is approximately 6 m wide.
3. It was conservatively assumed that some grading work may be conducted in the immediate area of the crossing at the same time, and approximately 15 m on each side of the road surface was added as part of the active construction area.
4. Construction activities will occur during 8:00 a.m. to 5:00 p.m. (8 working hours), Monday to Friday.

**Emission Calculation**

Level 1 emission estimation method shown in Table 3-2 of Reference A is used.

| Contaminant | Emission Factor for Construction Area[(1)] | Dust Control Efficiency[(2)] | PM Scaling Factor[(3)] | Emission Factor[(4)] (g/s-m2) | Worst-case Scenario | | Operating Time |
|---|---|---|---|---|---|---|---|
| | (ton/acre-month of activity) | | | | Active Area of Site (acre) | Emission Rate in Working Area[5] (g/s) | |
| PM | - | 50% | 1.56 | 6.68E-05 | 0.119 | 0.032 | 8 working hours per day, from 8AM - 5 PM |
| PM10 | 0.11 | | 1 | 4.28E-05 | | 0.021 | |
| PM2.5 | - | | 0.1 | 4.28E-06 | | 0.002 | |
| Crystalline silica | | | 0.0522 | 2.23E-06 | | 0.001 | |

**Notes:**

(1) Emission factor from Table 3-2 Level 1 of the Reference A.
This value is used for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is applicable to construction operations with:
- a dust control effectiveness of 50%
- 8 hours per day and 5 days per week for construction schedule

(2) Dust control measures (such as water suppression and limiting on-site vehicle speed to less than 20 km/hour) will be implemented to control dust emissions. The control efficiency is assumed for the project construction.

(3) PM and PM2.5 factors relative to PM10 from References A and B.

(4) Emission factors are estimated based on 20 days per month, 8 hours a day with the assumed dust control efficiency.

(5) Average emission rates are estimated for the 8 hours per day.

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for the construction activities is based on the emissions factors and operating time. The calculated emission rate should be conservative due to the assumed active area of both construction scenarios.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Bowmanville Station Construction***

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

**Description:**
Non-road equipment will be used during construction of the Bowmanville Station. Tailpipe emissions due to the fuel combustion would be generated from these sources.

The B4 Station Construction will include:
•Clearing
•Parking Construction
•Building / Platform Construction

**Table 1 - List of Construction Equipment and Usage**

| Construction Phase | Clearing | | | Parking construction | | | Building / Platform construction | | | Unit Power Rating (hp) | Fuel | Reference/Note[3] | Worst-case Operating Scenario [4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment | Total Number of Equipment to be Used Onsite[1] | Total Number of Equipment Used at the same time [2] | % time used [2] | Total Number of Equipment to be Used Onsite[1] | Total Number of Equipment Used at the same time [2] | % time used [2] | Total Number of Equipment to be Used Onsite[1] | Total Number of Equipment Used at the same time [2] | % time used [2] | | | | Number of Equipment Used | Operating Time [5] |
| Asphalt spreader | | | | 1 | | 10% | | | | 142 | Diesel | Assumed AP500F (142 hp) | 0 | day |
| Augers/Drill Rigs | | | | | | | | | | 260 | Diesel | Assumed Atlas Copco PowerROC T45 Drill (260 hp) | 0 | day |
| Backhoe | 1 | 1 | 50% | 1 | 0 | 10% | 1 | 1 | 10% | 120 | Diesel | Assumed Caterpillar 440, 450 Backhoe Loaders (120 hp) | 1 | day |
| Bobcat | | | | | | | 1 | 0 | 50% | 115 | Diesel | Assumed Bobcat E145 Large Excavator (115 hp) | 0 | day |
| Boom truck | | | | | | | | | | 500 | Diesel | Assume Manitex 40124SHL mounted on Peterbilt 567 | 0 | day |
| Caisson auger | | | | | | | 1 | 1 | 10% | 300 | Diesel | Assume Texoma 500 with Cummins Diesel Motor 300 HP | 0 | day |
| Compactor | | | | 1 | 1 | 50% | 1 | 0 | 10% | 100 | Diesel | Assumed Caterpillar CP433E Vibratory Compactor | 0 | day |
| Concrete breaker | | | | | | | | | | 68 | Diesel | Assume hydraulic breaker on Bobcat S62 | 0 | day |
| Concrete pump | | | | | | | | | | 100 | Diesel | Assumed Ajax ASP7011 | 0 | day |
| Concrete truck | | | | 1 | | 10% | 1 | 1 | 10% | 500 | Diesel | Assume truck mounted concrete mixer, International HX515. https://www.internationaltrucks.com/en/trucks/hx-series | 0 | day |
| Crane | | | | 1 | | 0% | 1 | 0 | 10% | 270 | Diesel | Assumed Tadnano GR-1000SL-2 (270 hp) | 0 | day |
| Dump Truck | 1 | 1 | 50% | 2 | 2 | 13% | 1 | 1 | 10% | 600 | Diesel | Assumed Caterpillar 772G dump truck (600 hp) | 1 | day |
| Earth scraper | 1 | 1 | 50% | | | | | | | 600 | Diesel | Assumed Caterpillar 657G Scraper | 1 | day |
| Flatbed truck | | | | 1 | | 10% | 1 | 0 | 50% | 360 | Diesel | Assumed Hino XL Series 360HP | 0 | day |
| Front end loader | | | | 1 | 1 | 50% | | | | 300 | Diesel | Assume Caterpillar 972M Loader | 0 | day |
| Grader | | | | 1 | 1 | 50% | | | | 200 | Diesel | Assumed Cat 150/150 AWD Motor Graders, conservatively adjusted hp (200 hp) | 0 | day |
| Pavement saw | | | | | | | | | | 50 | Diesel | Assumed Husqvarna FS 5000 D walk behind saw | 0 | day |
| Paving roller | | | | 2 | 0 | 10% | | | | 100 | Diesel | Assumed CAT CCS7 Combination Asphalt Compactor, https://www.cat.com/en_US/products/new/equipment/compactor | 0 | day |
| Pile Driver | | | | | | | | | | 240 | Diesel | Assume Junttan Pile Driving Rig PM23, Cummins QSB6,7 EU Stage IV / US EPA | 0 | day |
| Water truck | 1 | 1 | 10% | 1 | 1 | 10% | 1 | 1 | 10% | 285 | Diesel | Assumed John Deere 300D water truck (285 hp) | 1 | day |
| Welder | | | | | | | 1 | 0 | 10% | 210 | Diesel | Assume Progress Rail Containerized Rail Welder Model K930 | 0 | day |
| Zoomboom | | | | | | | 1 | 0 | 50% | 110 | Diesel | Assume Skytrak Model 8042 Telehandler, Engine Cummins QSB4.5T Turbo | 0 | day |
| Total number of equipment | 4 | 4 | | 13 | 6 | | 11 | 5 | | | | Total | 4 | |
| Total HP - weighted (6) | | 688.5 | | | 478.5 | | | 180.5 | | | | Avg HP | 401.3 | |

**Notes:**
1) Total number of each type of construction equipment that may be used onsite is estimated by the project design team.

2) Not all equipment will be used on the same day and for the entire day. The estimated worst-case of equipment used on the same day and the percent of time used that day was estimated by the project design team. Some equipment are not likely to be used on the same day as the other equipment, and their usage were assumed to be 0%.

3) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.
4) The worst-case scenario is based on the highest power rating of all the construction vehicles used for that phase and weighted by the percent of time used.
5) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday.

6) Total HP weighted by percent the equipment was assumed to be used per note 2.

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in the equipment engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
**Table 2: $SO_2$ Emission Factor Calculation**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment. $SO_2$ emission factor is calculated below.

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$. |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

**Table 3: Emission factors for NOx, PM, CO, NMHC**

| | | Emission Factor (1) (2) (g/kWhr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 < 75 HP | | | 75 < 175 HP | | | 175 < 600 HP | | | 600 < 750 HP | | |
| | | Tier 3 (50-100 HP) | Tier 4 (50-75 HP) | Weighted (2) | Tier 3 (100-175 HP) | Tier 4 (75-175 HP) | Weighted (2) | Tier 3 (100-600 HP) | Tier 4 (175-750 HP) | Weighted (2) | Tier 3 (600-750 HP) | Tier 4 (175-750 HP) | Weighted (2) |
| Nox (3) | 10102-44-0 | 4.7 | 4.7 | 4.7 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 |
| PM | N/A (pm) | 0.40 | 0.030 | 0.18 | 0.30 | 0.020 | 0.13 | 0.20 | 0.020 | 0.09 | 0.20 | 0.020 | 0.09 |
| PM10 | N/A (pm10) | 0.38 | 0.03 | 0.17 | 0.29 | 0.02 | 0.13 | 0.19 | 0.02 | 0.09 | 0.19 | 0.02 | 0.09 |
| PM2.5 | N/A (pm2.5) | 0.36 | 0.03 | 0.16 | 0.27 | 0.02 | 0.12 | 0.18 | 0.02 | 0.08 | 0.18 | 0.02 | 0.08 |
| CO | 630-08-0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| NMHC (3) | N/A | 4.7 | 4.7 | 4.7 | 4.00 | 0.19 | 1.7 | 4.00 | 0.2 | 1.7 | 4.00 | 0.2 | 1.7 |

**Notes:**

1) NOx, CO, PM emission factors: Tier 3 and Tier 4 emission standard in US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards" and "US EPA Tier 1-3 engines" are used.
PM10 and PM2.5: Based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

2) It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%
Tier 4 60%
3) Where emission factors were provided for NMHC + Nox in the US EPA reference document (i.e. not provided separately for NOx and NMHC, the emission factor was conservatively used for both Nox and NMHC.

**Table 4: Speciated VOC emission factors**

| Diesel Engine Tier | Tier3 | | Tier4 | | Weighted (1) |
|---|---|---|---|---|---|
| **VOC Emission Factor** | 0.2 | g/hp-h | 0.142 | g/hp-h | |
| **PM Emission Factor** | 0.1500 | g/hp-h | 0.015 | g/hp-h | |
| **Key VOCs and PAH** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Emission Factor (g/hph)** |
| Benzene | 0.054100 | 1.08E-02 | 0.012910 | 1.83E-03 | 5.43E-03 |
| 1,3-Butadiene | 0.001860 | 3.72E-04 | 0.000800 | 1.13E-04 | 2.17E-04 |
| Acrolein | 0.018700 | 3.74E-03 | 0.009990 | 1.42E-03 | 2.35E-03 |
| Acetaldehyde | 0.104000 | 2.08E-02 | 0.069340 | 9.82E-03 | 1.42E-02 |
| Formaldehyde | 0.292000 | 5.84E-02 | 0.217440 | 3.08E-02 | 4.18E-02 |
| Benzo(a)pyrene | 6.67E-06 | 1.00E-06 | 3.30E-06 | 4.92E-08 | 4.30E-07 |

**Notes:**
Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12
1) It is assumed that construction equipment used are Tier 3 and Tier 4 with the ratios shown in note 2 in the section above.

**Emission Calculations:**

SO2 emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment.
NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite equipment tailpipe exhausts are calculated based on the US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards".
Key VOCs emission factors are derived from the data in US EPA AP-42 reference “Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)” as shown above.

**Table 5: Worst-case construction phase - Clearing**

| Source Group | Contaminant | CAS# | Emission Factor | | Unit Power Rating (hp) | Operating Load (1) | % of Time Operating (2) | Emission Rate - Each Equipment (g/s) | Worst-case Scenario for Modelling | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Value | Unit | | | | | Number of Equipment | Emission Rate - All Equipment(3) (g/s) |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 120 | 40% | 50% | 2.8E-05 | 1 | 2.8E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 120 | 40% | 50% | 9.1E-03 | 1 | 9.1E-03 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.6E-04 | 1 | 6.6E-04 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.3E-04 | 1 | 6.3E-04 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 120 | 40% | 50% | 5.9E-04 | 1 | 5.9E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 120 | 40% | 50% | 2.5E-02 | 1 | 2.5E-02 |
| Backhoe | NMHC | N/A | 1.7 | g/kWhr | 120 | 40% | 50% | 8.5E-03 | 1 | 8.5E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 120 | 40% | 50% | 3.6E-05 | 1 | 3.6E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 120 | 40% | 50% | 1.4E-06 | 1 | 1.4E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 120 | 40% | 50% | 1.6E-05 | 1 | 1.6E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 120 | 40% | 50% | 9.5E-05 | 1 | 9.5E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 120 | 40% | 50% | 2.8E-04 | 1 | 2.8E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 120 | 40% | 50% | 2.9E-09 | 1 | 2.9E-09 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 600 | 40% | 50% | 1.4E-04 | 1 | 1.4E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 600 | 40% | 50% | 4.6E-02 | 1 | 4.6E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.3E-03 | 1 | 2.3E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.2E-03 | 1 | 2.2E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 600 | 40% | 50% | 2.1E-03 | 1 | 2.1E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 600 | 40% | 50% | 8.7E-02 | 1 | 8.7E-02 |
| Dump Truck | NMHC | N/A | 1.7 | g/kWhr | 600 | 40% | 50% | 4.3E-02 | 1 | 4.3E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 600 | 40% | 50% | 1.8E-04 | 1 | 1.8E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 600 | 40% | 50% | 7.2E-06 | 1 | 7.2E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 600 | 40% | 50% | 7.8E-05 | 1 | 7.8E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 600 | 40% | 50% | 4.7E-04 | 1 | 4.7E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 600 | 40% | 50% | 1.4E-03 | 1 | 1.4E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 600 | 40% | 50% | 1.4E-08 | 1 | 1.4E-08 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 600 | 40% | 50% | 1.4E-04 | 1 | 1.4E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 600 | 40% | 50% | 4.6E-02 | 1 | 4.6E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.3E-03 | 1 | 2.3E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.2E-03 | 1 | 2.2E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 600 | 40% | 50% | 2.1E-03 | 1 | 2.1E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 600 | 40% | 50% | 8.7E-02 | 1 | 8.7E-02 |
| Earth scraper | NMHC | N/A | 1.7 | g/kWhr | 600 | 40% | 50% | 4.3E-02 | 1 | 4.3E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 600 | 40% | 50% | 1.8E-04 | 1 | 1.8E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 600 | 40% | 50% | 7.2E-06 | 1 | 7.2E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 600 | 40% | 50% | 7.8E-05 | 1 | 7.8E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 600 | 40% | 50% | 4.7E-04 | 1 | 4.7E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 600 | 40% | 50% | 1.4E-03 | 1 | 1.4E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 600 | 40% | 50% | 1.4E-08 | 1 | 1.4E-08 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 285 | 40% | 10% | 1.3E-04 | 1 | 1.3E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 285 | 40% | 10% | 4.3E-02 | 1 | 4.3E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.2E-03 | 1 | 2.2E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 285 | 40% | 10% | 2.0E-03 | 1 | 2.0E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 285 | 40% | 10% | 8.3E-02 | 1 | 8.3E-02 |
| Water truck | NMHC | N/A | 1.7 | g/kWhr | 285 | 40% | 10% | 4.0E-02 | 1 | 4.0E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 285 | 40% | 10% | 1.7E-04 | 1 | 1.7E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 285 | 40% | 10% | 6.9E-06 | 1 | 6.9E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 285 | 40% | 10% | 7.4E-05 | 1 | 7.4E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 285 | 40% | 10% | 4.5E-04 | 1 | 4.5E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 285 | 40% | 10% | 1.3E-03 | 1 | 1.3E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 285 | 40% | 10% | 1.4E-08 | 1 | 1.4E-08 |

**Notes:**

1) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

The Construction Noise and Vibration Assessment for this Project uses the load factors in the FHWA Guide as this is the recommended reference in the Metrolinx Environmental Guide for Noise and Vibration Assessment. The Air Quality Assessment is therefore using the same reference to be consistent with assumptions used in the Noise and Vibration Assessment.
In addition, the following two references were reviewed, and the load factors in these documents are in similar ranges as the FHWA Guide:
U. S. EPA, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA-420-R-10-016. July 2010.
Hawthorne CAT, Estimating Owning and Operating Costs, Caterpillar Performance Handbook Edition 44. Available at
https://www.hawthornecat.com/sites/default/files/content/download/pdfs/Estimating_Owning_Operating_Costs_CPH_v1.1_03.13.14.pdf. Accessed in January 2020.

Water truck average operating load is not available from above U.S. Federal Highway Administration guide. The load for dump truck was assumed for the water truck.

2) Percent of time used were assumed based on information from the design team.
3) The calculated emission rate is for all equipment that were assumed to operate at the same time.

**Sample Calculation - NOx emissions from each backhoe:**

NOx emissions (g/s) = 1.8 g/kWh x 1 kWh/1.341hph x power of each equipment (hph) x % of load x % of operating time x 1 hour/3600 s
1.8 g/kWh x 1 kWh/1.341hph x 120 (hph) x 40% x 50% x 1 hour/3600 s = 0.009 g/s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the maximum estimated number of equipment operating consistently during construction. The calculated emission rate should be conservative.

**Table 6: Summary of Overall Emissions**

| Contaminant | CAS# | Worst-case Scenario Emission Rate² (g/s) | | Emission Rate for each volume source (g/s) | |
|---|---|---|---|---|---|
| | | Daytime (8AM-5PM) | Nighttime | No. of volume sources | 5 |
| $SO_2$ | 7446-09-5 | 4.40E-04 | 0.0000 | | 8.81E-05 |
| $NO_x$ | 10102-44-0 | 1.44E-01 | 0.0000 | | 2.88E-02 |
| PM | N/A (pm) | 7.40E-03 | 0.0000 | | 1.48E-03 |
| PM10 | N/A (pm10) | 7.11E-03 | 0.0000 | | 1.42E-03 |
| PM2.5 | N/A (pm2.5) | 6.66E-03 | 0.0000 | | 1.33E-03 |
| CO | 630-08-0 | 2.82E-01 | 0.0000 | | 5.63E-02 |
| NMHC | N/A | 1.34E-01 | 0.0000 | | 2.68E-02 |
| Benzene | 71-43-2 | 5.70E-04 | 0.0000 | | 1.14E-04 |
| 1,3-Butadiene | 106-99-0 | 2.28E-05 | 0.0000 | | 4.55E-06 |
| Acrolein | 107-02-8 | 2.46E-04 | 0.0000 | | 4.93E-05 |
| Acetaldehyde | 75-07-0 | 1.49E-03 | 0.0000 | | 2.99E-04 |
| Formaldehyde | 50-00-0 | 4.39E-03 | 0.0000 | | 8.79E-04 |
| Benzo(a)pyrene | 50-32-8 | 4.51E-08 | 0.0000 | | 9.02E-09 |

**Notes:**

1. Total emission rate for each contaminant for worst-case scenario during construction phase is the total of the above emission rates from each type of equipment assumed to be operated at the same time and their assumed operating time and operating load.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 Station (at Bowmanville) Construction***

## Source: Construction Activities Dust Emissions

**Description:**
Construction activities would generate dust emissions and may have substantial temporary impact on the local air quality.

Quantity of dust emissions depends on the area of land being worked, type of equipment onsite and level of construction activities. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The B4 Station Construction will include:
•Clearing
•Parking Construction
•Building / Platform Construction

**Contaminant(s) of Concern:**
Particulate matter (including TSP, PM10 and PM2.5) emissions are the contaminants of concern from construction activities.

**Methodology: Emission Factor (EF) and Engineering Calculation (EC)**

Emission factors from the following references are used to estimate the overall area-wide dust emissions.
•**Reference A**: Western Reginal Air Partnership, Fugitive Dust Handbook, Chapter 3: Construction and Demolition (09/03/06), https://www.wrapair.org/forums/dejf/fdh/
•**Reference B**: California Environmental Protection Agency Air Resources Board. 2002. Section 7.7: Building Construction Dust.

Based on the footprint drawings and available design information for the B4 Station Construction, the construction area is assumed to occur within the station property boundary and is estimated below. It is estimated for a worst-case scenario that 15% of the construction area is the active construction area.

| Construction Stages[1] | Estimated Total Area[2] (acre) | Active Construction Area for Worst-case Scenario [3] | | Potential Operating Time[4] |
|---|---|---|---|---|
| | | % | Area (acre) | |
| Clearing | 13.82 | 15% | 2.07 | daytime |
| Parking Construction | | | | daytime |
| Building / Platform Construction | | | | daytime |

**Notes:**
1. Construction phases are estimated by the design team.
2. The total area is estimated based on the station property boundary provided by GIS Stantec design team.
3. Only a portion of the construction area will be active (e.g., earth disturbance) at one time, it is conservatively assumed that 15% of the main construction area is active at one time for a worst-case scenario.
4. Construction activities will occur during 8:00 a.m. to 5:00 p.m., Monday to Friday.

**Emission Calculation**
Level 1 emission estimation method shown in Table 3-2 of Reference A is used.

| Contaminant | Emission Factor for Construction Area(1) | Dust Control Efficiency(2) | PM Scaling Factor(3) | Emission Factor(4) (g/s-m2) | Worst-case Scenario | | Operating Time |
|---|---|---|---|---|---|---|---|
| | (ton/acre-month of activity) | | | | Active Area of Site (acre) | Emission Rate in Working Area[5] (g/s) | |
| PM | - | 50% | 1.56 | 6.68E-05 | 2.07 | 0.560 | 8 hours per day, from 8AM - 5 PM |
| PM10 | 0.11 | | 1 | 4.28E-05 | | 0.359 | |
| PM2.5 | - | | 0.1 | 4.28E-06 | | 0.036 | |
| Crystalline silica | | | 0.0522 | 2.23E-06 | | 0.019 | |

**Notes:**
(1) Emission factor from Table 3-2 Level 1 of the Reference A.
This value is used for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is applicable to construction operations with:
• a dust control effectiveness of 50%
• 8 hours per day and 5 days per week for construction schedule
(2) Dust control measures (such as water suppression and limiting on-site vehicle speed to less than 20 km/hour) will be implemented to control dust emissions. The control efficiency is assumed for the project construction.
(3) PM and PM2.5 factors relative to PM10 from References A and B.
(4) Emission factors are estimated based on 20 days per month, 8 hours a day with the assumed dust control efficiency.
(5) Average emission rates are estimated for the 8 hours per day.

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for the construction activities is based on the emissions factors and operating time. The calculated emission rate should be conservative due to the assumed active area of both construction scenarios.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Track and Grading Construction (Farewell Street to Harmony Road)***

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

**Description:**
Non-road equipment will be used for Track and Grading. Tailpipe emissions due to the fuel combustion would be generated from these sources.

The Track and Grading will include:
•Grading
•Track

**Table 1 - List of Construction Equipment and Usage**

| Construction Phase | Grading [1] | | | Track [1] | | | Unit Power Rating (hp) | Fuel | Reference/Note[3] | Worst-case Operating Scenario [4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment | Total Number of Equipment to be Used Onsite [2] | Total Number of Equipment to be at the same time [1] | % time used [3] | Total Number of Equipment to be Used Onsite [2] | Total Number of Equipment to be at the same time [1] | % time used [3] | | | | Number of Equipment Used | Operating Time [5] |
| Asphalt spreader | | | | | | | 142 | Diesel | Assumed AP500F (142 hp, Tier 4) | 0 | day |
| Augers/Drill Rigs | | | | | | | 260 | Diesel | Assumed Atlas Copco PowerROC T45 Drill (260 hp, Tier 4) | 0 | day |
| Backhoe | 2 | 1 | 50% | | | | 120 | Diesel | Assumed Caterpillar 440, 450 Backhoe Loaders (120 hp, Tier 4) | 1 | day |
| Ballast regulator | | | | 2 | 0 | 50% | 250 | Diesel | Assumed Kershaw 4600 Ballast Regulator. Engine - CAT C7.1, 250 HP | 0 | day |
| Bobcat | | | | 1 | 0 | 20% | 115 | Diesel | Assumed Bobcat E145 Large Excavator (115 hp, Tier 4) | 0 | day |
| Boom truck | | | | | | | 500 | Diesel | Assume Manitex 40124SHL mounted on Peterbilt 567 Tier 4 | 0 | day |
| Caisson auger | | | | | | | 300 | Diesel | Assume Texoma 500 with Cummins Diesel Motor 300 HP | 0 | day |
| Compactor | 2 | 1 | 50% | | | | 100 | Diesel | Assumed Caterpillar CP433E Vibratory Compactor | 1 | day |
| Concrete breaker | | | | | | | 68 | Diesel | Assume hydraulic breaker on Bobcat S62 Tier 4 | 0 | day |
| Concrete pump | | | | | | | 100 | Diesel | Assumed Ajax ASP7011 | 0 | day |
| Concrete truck | 4 | 0 | 50% | | | | 500 | Diesel | Assume truck mounted concrete mixer, International HX515. https://www.internationaltrucks.com/en/trucks/hx-series | 0 | day |
| Crane | 1 | 0 | 10% | 1 | 0 | 10% | 270 | Diesel | Assumed Tadnano GR-1000SL-2 (270 hp, Tier 3) | 0 | day |
| Dump Truck | 4 | 1 | 50% | 2 | 2 | 10% | 600 | Diesel | Assumed Caterpillar 772G dump truck (600 hp, Tier 4) | 1 | day |
| Dynamic stabilizer | | | | 1 | 0 | 25% | 450 | Diesel | https://www.plasseramerican.com/en/machines-systems/stabilization-consolidation-pts-62.html | 0 | day |
| Earth scraper | | | | | | | 600 | Diesel | Assumed Caterpillar 657G Scraper | 0 | day |
| Flatbed truck | 1 | 0 | 10% | 1 | 0 | 10% | 360 | Diesel | Assumed Hino XL Series 360HP | 0 | day |
| Flash butt rail welder | | | | 1 | 0 | 20% | 402 | Diesel | http://rail-welding.vaiacar.com/p/en/railroad-welder.html | 0 | day |
| Front end loader | 2 | 1 | 50% | 1 | 1 | 10% | 300 | Diesel | Assume Caterpillar 972M Loader Tier 4 | 1 | day |
| Grader | 2 | 1 | 50% | | | | 200 | Diesel | Assumed Cat 150/150 AWD Motor Graders, conservatively adjusted hp (200 hp, Tier 3) | 1 | day |
| Locomotive / rail cars | | | | 1 | 0 | 10% | 3000 | Diesel | | 0 | day |
| Pavement saw | | | | | | | 50 | Diesel | Assumed Husqvarna FS 5000 D walk behind saw, Tier 4 | 0 | day |
| Paving roller | | | | | | | 100 | Diesel | Assumed CAT CCS7 Combination Asphalt Compactor, https://www.cat.com/en_US/products/new/equipment/compactors/tandem-vibratory-rollers.html?page=2 | 0 | day |
| Pickup truck | 4 | 4 | 10% | 6 | 0 | 10% | 290 | Diesel | Assumed Ford F-150 | 4 | day |
| Pile Driver | | | | | | | 240 | Diesel | Assume Junttan Pile Driving Rig PM23, Cummins QSB6,7 EU Stage IV / US EPA Tier 4F | 0 | day |
| Rail drill | | | | 1 | 0 | 10% | 4 | Diesel | https://www.trak-star.com/hydraulic-rail-drill | 0 | day |
| Rail grinder | | | | 1 | 0 | 75% | 30 | Diesel | https://www.loram.com/products/rail-grinding/specialty-rail-grinding/rgt-quick-deploy-rail-grinder/ | 0 | day |
| Rail saw | | | | 1 | 0 | 10% | 50 | Diesel | Assumed walk behind saw Husqvarna FS 5000 D, Tier 4 | 0 | day |
| Speedswing | | | | 1 | 0 | 10% | 163 | Diesel | https://www.gopettibone.com/products/speed-swing-445f/ | 0 | day |
| Spike machine | | | | 1 | 0 | 20% | 140 | Diesel | https://www.nordco.com/products-catalog/roadway-work-equipment/Spike-Driving-Machines/Production-Spike-Driver-SE- | 0 | day |
| Track liner / tamper | | | | 2 | 0 | 50% | 270 | Diesel | https://www.plasseramerican.com/en/machines-systems/tamping-grm3000t.html | 0 | day |
| Water truck | 1 | 1 | 10% | 1 | 0 | 10% | 285 | Diesel | Assumed John Deere 300D water truck (285 hp, Tier 3) | 1 | day |
| Welder | | | | | | | 210 | Diesel | Assume Progress Rail Containerized Rail Welder Model K930 | 0 | day |
| Zoomboom | | | | 1 | 0 | 10% | 110 | Diesel | Assume Skytrak Model 8042 Telehandler, Engine Cummins QSB4.5T Turbo Tier 3 | 0 | day |
| Total number of equipment | 23 | 10 | | 26 | 3 | | | | Total | 10 | |
| Total HP - weighted (6) | | 804.5 | | | 150 | | | | Avg HP | 140.5 | |

**Notes:**

1) Number of construction equipment used at the same time is estimated by the project design team.
For the Grading phase, the work is typically spread out over several kilometers of track under three separate contracts. The equipment used and construction activities are not concentrated in one area (one section of the track). The number of equipment estimated here is based on the maximum number of equipment used at the same time in one section of the track.
For the Track phase, the number of construction equipment is estimated for the worst-case task (ballast dumping) within the Track Phase.

2) Total number of each type of construction equipment that may be used onsite is estimated by the project design team.
3) Percent of time used is the percent of time each piece of equipment is used during the same day and is estimated by the project design team.

3) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

4) The worst-case scenario is based on the highest power rating of all the construction vehicles used for that phase and weighted by the percent of time used.
5) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday.
6) Total HP weighted by percent the equipment was assumed to be used per note 2.

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in the equipment engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
**Table 2: $SO_2$ Emission Factor Calculation**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment. $SO_2$ emission factor is calculated below.

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$. |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

**Table 3: Emission factors for NOx, PM, CO, NMHC**

| | | **Emission Factor (1) (2) (g/kWhr)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 < 75 HP | | | 75 < 175 HP | | | 175 < 600 HP | | | 600 < 750 HP | | |
| | | Tier 3 (50-100 HP) | Tier 4 (50-75 HP) | Weighted (2) | Tier 3 (100-175 HP) | Tier 4 (75-175 HP) | Weighted (2) | Tier 3 (100-600 HP) | Tier 4 (175-750 HP) | Weighted (2) | Tier 3 (600-750 HP) | Tier 4 (175-750 HP) | Weighted (2) |
| NOx (3) | 10102-44-0 | 4.7 | 4.7 | 4.7 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 |
| PM | N/A (pm) | 0.40 | 0.030 | 0.18 | 0.30 | 0.020 | 0.13 | 0.20 | 0.020 | 0.09 | 0.20 | 0.020 | 0.09 |
| PM10 | N/A (pm10) | 0.38 | 0.03 | 0.17 | 0.29 | 0.02 | 0.13 | 0.19 | 0.02 | 0.09 | 0.19 | 0.02 | 0.09 |
| PM2.5 | N/A (pm2.5) | 0.36 | 0.03 | 0.16 | 0.27 | 0.02 | 0.12 | 0.18 | 0.02 | 0.08 | 0.18 | 0.02 | 0.08 |
| CO | 630-08-0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| NMHC (3) | N/A | 4.7 | 4.7 | 4.7 | 4.00 | 0.19 | 1.7 | 4.00 | 0.2 | 1.7 | 4.00 | 0.2 | 1.7 |

**Notes:**

1) NOx, CO, PM emission factors: Tier 3 and Tier 4 emission standard in US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards" and "US EPA Tier 1-3 engines" are used.
PM10 and PM2.5: Based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

2) It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%
Tier 4 60%

3) Where emission factors were provided for NMHC + NOx in the US EPA reference document (i.e. not provided separately for NOx and NMHC, the emission factor was conservatively used for both NOx and NMHC.

**Table 4: Speciated VOC emission factors**

| Diesel Engine Tier | Tier3 | | Tier4 | | Weighted (1) |
|---|---|---|---|---|---|
| VOC Emission Factor | 0.2 | g/hp-h | 0.142 | g/hp-h | |
| PM Emission Factor | 0.1500 | g/hp-h | 0.015 | g/hp-h | |
| **Key VOCs and PAH** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Emission Factor (g/hph)** |
| Benzene | 0.054100 | 1.08E-02 | 0.012910 | 1.83E-03 | 5.43E-03 |
| 1,3-Butadiene | 0.001860 | 3.72E-04 | 0.000800 | 1.13E-04 | 2.17E-04 |
| Acrolein | 0.018700 | 3.74E-03 | 0.009990 | 1.42E-03 | 2.35E-03 |
| Acetaldehyde | 0.104000 | 2.08E-02 | 0.069340 | 9.82E-03 | 1.42E-02 |
| Formaldehyde | 0.292000 | 5.84E-02 | 0.217440 | 3.08E-02 | 4.18E-02 |
| Benzo(a)pyrene | 6.67E-06 | 1.00E-06 | 3.30E-06 | 4.92E-08 | 4.30E-07 |

**Notes:**

Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12

1) It is assumed that construction equipment used are Tier 3 and Tier 4 with the ratios shown in note 2 in the section above.

**Emission Calculations:**

SO2 emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment.
NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite equipment tailpipe exhausts are calculated based on the US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards".
Key VOCs emission factors are derived from the data in US EPA AP-42 reference "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)" as shown above.

**Table 5: Worst-case construction phase - Demolition of existing bridge**

| Source Group | Contaminant | CAS# | Emission Factor | | Unit Power Rating (hp) | Operating Load (1) | % of Time Operating (2) | Emission Rate - Each Equipment (g/s) | Worst-case Scenario for Modelling | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Value | Unit | | | | | Number of Equipment | Emission Rate - All Equipment(3) (g/s) |
| Backhoe | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 120 | 40% | 50% | 2.8E-05 | 1 | 2.8E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 120 | 40% | 50% | 9.1E-03 | 1 | 9.1E-03 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.6E-04 | 1 | 6.6E-04 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 120 | 40% | 50% | 6.3E-04 | 1 | 6.3E-04 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 120 | 40% | 50% | 5.9E-04 | 1 | 5.9E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 120 | 40% | 50% | 2.5E-02 | 1 | 2.5E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 120 | 40% | 50% | 8.5E-03 | 1 | 8.5E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 120 | 40% | 50% | 3.6E-05 | 1 | 3.6E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 120 | 40% | 50% | 1.4E-06 | 1 | 1.4E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 120 | 40% | 50% | 1.6E-05 | 1 | 1.6E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 120 | 40% | 50% | 9.5E-05 | 1 | 9.5E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 120 | 40% | 50% | 2.8E-04 | 1 | 2.8E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 120 | 40% | 50% | 2.9E-09 | 1 | 2.9E-09 |
| Grader | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 200 | 40% | 50% | 4.7E-05 | 1 | 4.7E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 200 | 40% | 50% | 1.5E-02 | 1 | 1.5E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 200 | 40% | 50% | 7.6E-04 | 1 | 7.6E-04 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 200 | 40% | 50% | 7.3E-04 | 1 | 7.3E-04 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 200 | 40% | 50% | 6.9E-04 | 1 | 6.9E-04 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 200 | 40% | 50% | 2.9E-02 | 1 | 2.9E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 200 | 40% | 50% | 1.4E-02 | 1 | 1.4E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 200 | 40% | 50% | 6.0E-05 | 1 | 6.0E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 200 | 40% | 50% | 2.4E-06 | 1 | 2.4E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 200 | 40% | 50% | 2.6E-05 | 1 | 2.6E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 200 | 40% | 50% | 1.6E-04 | 1 | 1.6E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 200 | 40% | 50% | 4.6E-04 | 1 | 4.6E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 200 | 40% | 50% | 4.8E-09 | 1 | 4.8E-09 |
| Front end loader | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 300 | 40% | 50% | 7.0E-05 | 1 | 7.0E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 300 | 40% | 50% | 2.3E-02 | 1 | 2.3E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 300 | 40% | 50% | 1.1E-03 | 1 | 1.1E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 300 | 40% | 50% | 1.1E-03 | 1 | 1.1E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 300 | 40% | 50% | 1.0E-03 | 1 | 1.0E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 300 | 40% | 50% | 4.3E-02 | 1 | 4.3E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 300 | 40% | 50% | 2.1E-02 | 1 | 2.1E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 300 | 40% | 50% | 9.0E-05 | 1 | 9.0E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 300 | 40% | 50% | 3.6E-06 | 1 | 3.6E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 300 | 40% | 50% | 3.9E-05 | 1 | 3.9E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 300 | 40% | 50% | 2.4E-04 | 1 | 2.4E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 300 | 40% | 50% | 7.0E-04 | 1 | 7.0E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 300 | 40% | 50% | 7.2E-09 | 1 | 7.2E-09 |
| Dump Truck | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 600 | 40% | 50% | 1.4E-04 | 1 | 1.4E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 600 | 40% | 50% | 4.6E-02 | 1 | 4.6E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.3E-03 | 1 | 2.3E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.2E-03 | 1 | 2.2E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 600 | 40% | 50% | 2.1E-03 | 1 | 2.1E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 600 | 40% | 50% | 8.7E-02 | 1 | 8.7E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 600 | 40% | 50% | 4.3E-02 | 1 | 4.3E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 600 | 40% | 50% | 1.8E-04 | 1 | 1.8E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 600 | 40% | 50% | 7.2E-06 | 1 | 7.2E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 600 | 40% | 50% | 7.8E-05 | 1 | 7.8E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 600 | 40% | 50% | 4.7E-04 | 1 | 4.7E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 600 | 40% | 50% | 1.4E-03 | 1 | 1.4E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 600 | 40% | 50% | 1.4E-08 | 1 | 1.4E-08 |
| Compactor | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 100 | 20% | 50% | 1.2E-05 | 1 | 1.2E-05 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 100 | 20% | 50% | 3.8E-03 | 1 | 3.8E-03 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 100 | 20% | 50% | 2.7E-04 | 1 | 2.7E-04 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 100 | 20% | 50% | 2.6E-04 | 1 | 2.6E-04 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 100 | 20% | 50% | 2.5E-04 | 1 | 2.5E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 100 | 20% | 50% | 1.0E-02 | 1 | 1.0E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 100 | 20% | 50% | 3.6E-03 | 1 | 3.6E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 100 | 20% | 50% | 1.5E-05 | 1 | 1.5E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 100 | 20% | 50% | 6.0E-07 | 1 | 6.0E-07 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 100 | 20% | 50% | 6.5E-06 | 1 | 6.5E-06 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 100 | 20% | 50% | 3.9E-05 | 1 | 3.9E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 100 | 20% | 50% | 1.2E-04 | 1 | 1.2E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 100 | 20% | 50% | 1.2E-09 | 1 | 1.2E-09 |
| Pickup truck | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 290 | 40% | 10% | 1.4E-05 | 4 | 5.4E-05 |
| | $NO_x$ | 10102-44-0 | 1.84 | g/kWhr | 290 | 40% | 10% | 4.4E-03 | 4 | 1.8E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 290 | 40% | 10% | 2.2E-04 | 4 | 8.8E-04 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 290 | 40% | 10% | 2.1E-04 | 4 | 8.5E-04 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 290 | 40% | 10% | 2.0E-04 | 4 | 8.0E-04 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 290 | 40% | 10% | 8.4E-03 | 4 | 3.4E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 290 | 40% | 10% | 4.1E-03 | 4 | 1.6E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 290 | 40% | 10% | 1.7E-05 | 4 | 7.0E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 290 | 40% | 10% | 7.0E-07 | 4 | 2.8E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 290 | 40% | 10% | 7.6E-06 | 4 | 3.0E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 290 | 40% | 10% | 4.6E-05 | 4 | 1.8E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 290 | 40% | 10% | 1.3E-04 | 4 | 5.4E-04 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 290 | 40% | 10% | 1.4E-09 | 4 | 5.5E-09 |
| Water truck | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 285 | 40% | 10% | 1.3E-04 | 1 | 1.3E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 285 | 40% | 10% | 4.3E-02 | 1 | 4.3E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.2E-03 | 1 | 2.2E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 285 | 40% | 10% | 2.0E-03 | 1 | 2.0E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 285 | 40% | 10% | 8.3E-02 | 1 | 8.3E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 285 | 40% | 10% | 4.0E-02 | 1 | 4.0E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 285 | 40% | 10% | 1.7E-04 | 1 | 1.7E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 285 | 40% | 10% | 6.9E-06 | 1 | 6.9E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 285 | 40% | 10% | 7.4E-05 | 1 | 7.4E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 285 | 40% | 10% | 4.5E-04 | 1 | 4.5E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 285 | 40% | 10% | 1.3E-03 | 1 | 1.3E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 285 | 40% | 10% | 1.4E-08 | 1 | 1.4E-08 |

**Notes:**

1) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

The Construction Noise and Vibration Assessment for this Project uses the load factors in the FHWA Guide as this is the recommended reference in the Metrolinx Environmental Guide for Noise and Vibration Assessment. The Air Quality Assessment is therefore using the same reference to be consistent with assumptions used in the Noise and Vibration Assessment.
In addition, the following two references were reviewed, and the load factors in these documents are in similar ranges as the FHWA Guide:
U. S. EPA, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA-420-R-10-016. July 2010.
Hawthorne CAT, Estimating Owning and Operating Costs, Caterpillar Performance Handbook Edition 44. Available at
https://www.hawthornecat.com/sites/default/files/content/download/pdfs/Estimating_Owning_Operating_Costs_CPH_v1.1_03.13.14.pdf. Accessed in January 2020.

Water truck average operating load is not available from above U.S. Federal Highway Administration guide. The load for dump truck was assumed for the water truck.

2) Percent of time used were assumed based on information from the design team.

3) The calculated emission rate is for all equipment, assuming operating at the same time.

**Sample Calculation - NOx emissions from each backhoe:**

NOx emissions (g/s) = 1.8 g/kWh x 1 kWh/1.341hph x power of each equipment (hph) x % of load x % of operating time x 1 hour/3600 s

1.8 g/kWh x 1 kWh/1.341hph x 120 (hph) x 40% x 50% x 1 hour/3600 s = 0.009 g/s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the maximum estimated number of equipment operating consistently during the facility operating time. The calculated emission rate should be conservative.

**Table 6: Summary of Overall Emissions**

| Contaminant | CAS# | Worst-case Scenario Emission Rate[1] (g/s) | | Emission Rate for each volume source (g/s) |
|---|---|---|---|---|
| | | Daytime (8AM-5PM) | Nighttime | No. of volume sources: 12 |
| $SO_2$ | 7446-09-5 | 4.83E-04 | 0.0000 | 4.02E-05 |
| $NO_x$ | 10102-44-0 | 1.58E-01 | 0.0000 | 1.32E-02 |
| PM | N/A (pm) | 8.18E-03 | 0.0000 | 6.82E-04 |
| PM10 | N/A (pm10) | 7.85E-03 | 0.0000 | 6.54E-04 |
| PM2.5 | N/A (pm2.5) | 7.36E-03 | 0.0000 | 6.13E-04 |
| CO | 630-08-0 | 3.11E-01 | 0.0000 | 2.59E-02 |
| NMHC | N/A | 1.47E-01 | 0.0000 | 1.23E-02 |
| Benzene | 71-43-2 | 6.25E-04 | 0.0000 | 5.20E-05 |
| 1,3-Butadiene | 106-99-0 | 2.50E-05 | 0.0000 | 2.08E-06 |
| Acrolein | 107-02-8 | 2.70E-04 | 0.0000 | 2.25E-05 |
| Acetaldehyde | 75-07-0 | 1.64E-03 | 0.0000 | 1.36E-04 |
| Formaldehyde | 50-00-0 | 4.82E-03 | 0.0000 | 4.01E-04 |
| Benzo(a)pyrene | 50-32-8 | 4.95E-08 | 0.0000 | 4.12E-09 |

**Notes:**

1. Total emission rate for each contaminant for worst-case scenario during construction phase is the total of the above emission rates from each type of equipment assumed to be operated at the same time and their assumed operating time and operating load.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Track and Grading Construction (west of Farewell Street to west of Harmony Road)***

## Source: Construction Activities Dust Emissions

**Description:**
Construction activities would generate dust emissions and may have substantial temporary impact on the local air quality.

Quantity of dust emissions depends on the area of land being worked, type of equipment onsite and level of construction activities. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The Track and Grading Construction will include:
•Grading
•Trackwork

**Contaminant(s) of Concern:**
Particulate matter (including TSP, PM10 and PM2.5) emissions are the contaminants of concern from construction activities.

**Methodology: Emission Factor (EF) and Engineering Calculation (EC)**

Emission factors from the following references are used to estimate the overall area-wide dust emissions.
•**Reference A**: Western Reginal Air Partnership, Fugitive Dust Handbook, Chapter 3: Construction and Demolition (09/03/06), https://www.wrapair.org/forums/dejf/fdh/
•**Reference B**: California Environmental Protection Agency Air Resources Board. 2002. Section 7.7: Building Construction Dust.

It is estimated for a worst-case scenario that the active daily construction area is 300m x 10m along the railway.

| Construction Stages[1] | Estimated Total Area[2] (acre) | Active Construction Area for Worst-case Scenario [3] | | Potential Operating Time[4] |
|---|---|---|---|---|
| | | % | Area (acre) | |
| Trackwork and Grading | 0.74 | 100% | 0.74 | daytime |

**Notes:**
1. Construction phases are estimated by the design team.
2. The total area is assumed to be the worst case scenario and is provided by the project design team.
3. Only a portion of the entire length of the track will be the active construction area at a time.
4. Construction activities will occur during 8:00 a.m. to 5:00 p.m., Monday to Friday.

**Emission Calculation**
Level 1 emission estimation method shown in Table 3-2 of Reference A is used.

| Contaminant | Emission Factor for Construction Area[(1)] | Dust Control Efficiency[(2)] | PM Scaling Factor[(3)] | Emission Factor[(4)] (g/s-m2) | Worst-case Scenario | | Operating Time |
|---|---|---|---|---|---|---|---|
| | (ton/acre-month of activity) | | | | Active Area of Site (acre) | Emission Rate in Working Area[5] (g/s) | |
| PM | - | 50% | 1.56 | 6.68E-05 | 0.74 | 0.200 | 8 hours per day, from 8AM - 5 PM |
| PM10 | 0.11 | | 1 | 4.28E-05 | | 0.128 | |
| PM2.5 | - | | 0.1 | 4.28E-06 | | 0.013 | |
| Crystalline silica | | | 0.0522 | 2.23E-06 | | 0.007 | |

**Notes:**
(1) Emission factor from Table 3-2 Level 1 of the Reference A.
This value is used for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is applicable to construction operations with:
• a dust control effectiveness of 50%
• 8 hours per day and 5 days per week for construction schedule
(2) Dust control measures (such as water suppression and limiting on-site vehicle speed to less than 20 km/hour) will be implemented to control dust emissions. The control efficiency is assumed for the project construction.
(3) PM and PM2.5 factors relative to PM10 from References A and B.
(4) Emission factors are estimated based on 20 days per month, 8 hours a day with the assumed dust control efficiency.
(5) Average emission rates are estimated for the 8 hours per day.

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for the construction activities is based on the emissions factors and operating time. The calculated emission rate should be conservative due to the assumed active area.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Description:**
Non-road equipment will be used during construction of the Simcoe Street Bridge. Tailpipe emissions due to the fuel combustion would be generated from these sources.

The Simcoe Street Bridge Replacement will include:
•Utility relocation and road closure
•Demolition of existing bridge
•Abutment construction
•Span construction
•Road reinstatement
•Site cleanup

**Table 1 - List of Construction Equipment and Usage**

| Construction Phase | Utility relocation and road closure | | Demolition of existing bridge | | Abutment construction | | Span construction | | Road reinstatement | | Site clean up | | Unit Power Rating (hp) | Fuel | Reference/Note[3] | Worst-case Operating Scenario [4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of Equipment** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [2]** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [2]** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [2]** | **Total Number of Equipment to be Used** | **% time used [2]** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [2]** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [2]** | | | | **Number of Equipment Used** | **Operating Time [5]** |
| Asphalt spreader | | | | | | | | | 1 | 10% | | | 142 | Diesel | Assumed AP500F (142 hp) | 1 | day |
| Augers/Drill Rigs | | | | | 1 | 50% | | | | | | | 260 | Diesel | Assumed Atlas Copco PowerROC T45 Drill (260 hp) | 0 | day |
| Backhoe | 1 | 50% | 2 | 100% | 2 | 50% | | | | | | | 120 | Diesel | Assumed Caterpillar 440, 450 Backhoe Loaders (120 hp) | 0 | day |
| Bobcat | 1 | 50% | 1 | 100% | | | | | | | 1 | 50% | 115 | Diesel | Assumed Bobcat E145 Large Excavator (115 hp) | 0 | day |
| Boom truck | 1 | 0% | | | | | 1 | 10% | 1 | 50% | | | 500 | Diesel | Assume Manitex 40124SHL mounted on Peterbilt 567 | 1 | day |
| Compactor | 1 | 10% | | | | | | | 1 | 10% | | | 100 | Diesel | Assumed Caterpillar CP433E Vibratory Compactor | 1 | day |
| Concrete breaker | | | 2 | 100% | | | | | | | | | 68 | Diesel | Assume hydraulic breaker on Bobcat S62 | 0 | day |
| Concrete pump | | | | | 1 | 10% | 1 | 10% | | | | | 100 | Diesel | Assumed Ajax ASP7011 | 0 | day |
| Concrete truck | | | | | 2 | 10% | 2 | 10% | | | | | 500 | Diesel | Assume truck mounted concrete mixer, International HX515. https://www.internationaltrucks.com/en/truc | 0 | day |
| Crane | | | 1 | 0% | | | | | | | | | 270 | Diesel | Assumed Tadnano GR-1000SL-2 (270 hp) | 0 | day |
| Dump Truck | 2 | 50% | 2 | 13% | 1 | 10% | | | 2 | 50% | 1 | 10% | 600 | Diesel | Assumed Caterpillar 772G dump truck (600 hp) | 2 | day |
| Flatbed truck | | | | | 1 | 10% | 1 | 10% | | | | | 360 | Diesel | Assumed Hino XL Series 360HP | 0 | day |
| Pavement saw | 1 | 10% | | | | | | | | | | | 50 | Diesel | Assumed Husqvarna FS 5000 D walk behind saw | 0 | day |
| Paving roller | 1 | 0% | | | | | | | 1 | 10% | | | 100 | Diesel | Assumed CAT CCS7 Combination Asphalt Compactor, https://www.cat.com/en_US/products/new/ | 1 | day |
| Pile Driver | | | | | 1 | 50% | | | | | | | 240 | Diesel | Assume Junttan Pile Driving Rig PM23, Cummins QSB6,7 EU Stage IV / US EPA | 0 | day |
| Water truck | 1 | 10% | 1 | 10% | 1 | 10% | 1 | 10% | 1 | 10% | 1 | 10% | 285 | Diesel | Assumed John Deere 300D water truck (285 hp) | 1 | day |
| Zoomboom | | | | | | | 1 | 50% | | | | | 110 | Diesel | Assume Skytrak Model 8042 Telehandler, Engine Cummins QSB4.5T Turbo | 0 | day |
| Total number of equipment | 9 | | 9 | | 10 | | 7 | | 7 | | 3 | | | | Total | 7 | |
| Total HP - weighted (6) | 761 | | 669.5 | | 604.5 | | 279.5 | | 912.7 | | 146 | | | | Avg HP | 332.4 | |

**Notes:**
1) Total number of each type of construction equipment that may be used onsite is estimated by the project design team.
2) Not all equipment will be used on the same day and for the entire day. The estimated worst-case of equipment used on the same day and the percent of time used that day was estimated by the project design team. Some equipment are not likely to be used on the same day as the other equipment, and their usage were assumed to be 0%.
3) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.
4) The worst-case scenario is based on the highest power rating of all the construction vehicles used for that phase and weighted by the percent of time used (per note 2).
5) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday.
6) Total HP weighted by percent the equipment was assumed to be used per note 2.

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in the equipment engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
**Table 2: $SO_2$ Emission Factor Calculation**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment. $SO_2$ emission factor is calculated below.

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$ |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

**Table 3: Emission factors for NOx, PM, CO, NMHC**

| | | Emission Factor (1) (2) (g/kWhr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 < 75 HP | | | 75 < 175 HP | | | 175 < 600 HP | | | 600 < 750 HP | | |
| | | Tier 3 (50-100 HP) | Tier 4 (50-75 HP) | Weighted (2) | Tier 3 (100-175 HP) | Tier 4 (75-175 HP) | Weighted (2) | Tier 3 (100-600 HP) | Tier 4 (175-750 HP) | Weighted (2) | Tier 3 (600-750 HP) | Tier 4 (175-750 HP) | Weighted (2) |
| Nox (3) | 10102-44-0 | 4.7 | 4.7 | 4.7 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 | 4.0 | 0.4 | 1.8 |
| PM | N/A (pm) | 0.40 | 0.030 | 0.18 | 0.30 | 0.020 | 0.13 | 0.20 | 0.020 | 0.09 | 0.20 | 0.020 | 0.09 |
| PM10 | N/A (pm10) | 0.38 | 0.03 | 0.17 | 0.29 | 0.02 | 0.13 | 0.19 | 0.02 | 0.09 | 0.19 | 0.02 | 0.09 |
| PM2.5 | N/A (pm2.5) | 0.36 | 0.03 | 0.16 | 0.27 | 0.02 | 0.12 | 0.18 | 0.02 | 0.08 | 0.18 | 0.02 | 0.08 |
| CO | 630-08-0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| NMHC (3) | N/A | 4.7 | 4.7 | 4.7 | 4.00 | 0.19 | 1.7 | 4.00 | 0.2 | 1.7 | 4.00 | 0.2 | 1.7 |

**Notes:**

1) NOx, CO, PM emission factors: Tier 3 and Tier 4 emission standard in US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards" and "US EPA Tier 1-3 engines" are used.
PM10 and PM2.5: Based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

2) It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios:

| | |
|---|---|
| Tier 3 | 40% |
| Tier 4 | 60% |

3) Where emission factors were provided for NMHC + Nox in the US EPA reference document (i.e. not provided separatedly for NOx and NMHC, the emission factor was conservatively used for both Nox and NMHC.

**Table 4: Speciated VOC emission factors**

| Diesel Engine Tier | Tier3 | | Tier4 | | Weighted (1) |
|---|---|---|---|---|---|
| **VOC Emission Factor** | 0.2 | g/hp-h | 0.142 | g/hp-h | |
| **PM Emission Factor** | 0.1500 | g/hp-h | 0.015 | g/hp-h | |
| **Key VOCs and PAH** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Toxic Fraction of VOC/PM** | **Emission Factor (g/hph)** | **Emission Factor (g/hph)** |
| Benzene | 0.054100 | 1.08E-02 | 0.012910 | 1.83E-03 | 5.43E-03 |
| 1,3-Butadiene | 0.001860 | 3.72E-04 | 0.000800 | 1.13E-04 | 2.17E-04 |
| Acrolein | 0.018700 | 3.74E-03 | 0.009990 | 1.42E-03 | 2.35E-03 |
| Acetaldehyde | 0.104000 | 2.08E-02 | 0.069340 | 9.82E-03 | 1.42E-02 |
| Formaldehyde | 0.292000 | 5.84E-02 | 0.217440 | 3.08E-02 | 4.18E-02 |
| Benzo(a)pyrene | 6.67E-06 | 1.00E-06 | 3.30E-06 | 4.92E-08 | 4.30E-07 |

**Notes:**

Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12

1) It is assumed that construction equipment used are Tier 3 and Tier 4 with the ratios shown in note 2 in the section above.

**Emission Calculations:**

SO2 emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the equipment.
NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite equipment tailpipe exhausts are calculated based on the US EPA reference document "Nonroad Compression-Ignition Engines -- Exhaust Emission Standards".
Key VOCs emission factors are derived from the data in US EPA AP-42 reference "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)" as shown above.

**Table 5: Worst-case construction phase - Road Reinstatement**

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

| Source Group | Contaminant | CAS# | Emission Factor | | Unit Power Rating (hp) | Operating Load [1] [2] | % of Time Operating [3] | Emission Rate - Each Equipment (g/s) | Worst-case Scenario for Modelling | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Value | Unit | | | | | Number of Equipment | Emission Rate - All Equipment[4] (g/s) |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 142 | 50% | 10% | 8.3E-06 | 1 | 8.3E-06 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 142 | 50% | 10% | 2.7E-03 | 1 | 2.7E-03 |
| | PM | N/A (pm) | 0.1 | g/kWhr | 142 | 50% | 10% | 1.9E-04 | 1 | 1.9E-04 |
| | PM10 | N/A (pm10) | 0.1 | g/kWhr | 142 | 50% | 10% | 1.9E-04 | 1 | 1.9E-04 |
| | PM2.5 | N/A (pm2.5) | 0.1 | g/kWhr | 142 | 50% | 10% | 1.7E-04 | 1 | 1.7E-04 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 142 | 50% | 10% | 7.4E-03 | 1 | 7.4E-03 |
| Asphalt spreader | NMHC | N/A | 1.7 | g/kWhr | 142 | 50% | 10% | 2.5E-03 | 1 | 2.5E-03 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 142 | 50% | 10% | 1.1E-05 | 1 | 1.1E-05 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 142 | 50% | 10% | 4.3E-07 | 1 | 4.3E-07 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 142 | 50% | 10% | 4.6E-06 | 1 | 4.6E-06 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 142 | 50% | 10% | 2.8E-05 | 1 | 2.8E-05 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 142 | 50% | 10% | 8.3E-05 | 1 | 8.3E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 142 | 50% | 10% | 8.5E-10 | 1 | 8.5E-10 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 500 | 50% | 50% | 1.5E-04 | 1 | 1.5E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 500 | 50% | 50% | 4.8E-02 | 1 | 4.8E-02 |
| | PM | N/A (pm) | 0.1 | g/kWhr | 500 | 50% | 50% | 2.4E-03 | 1 | 2.4E-03 |
| | PM10 | N/A (pm10) | 0.1 | g/kWhr | 500 | 50% | 50% | 2.3E-03 | 1 | 2.3E-03 |
| | PM2.5 | N/A (pm2.5) | 0.1 | g/kWhr | 500 | 50% | 50% | 2.1E-03 | 1 | 2.1E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 500 | 50% | 50% | 9.1E-02 | 1 | 9.1E-02 |
| Boom truck | NMHC | N/A | 1.7 | g/kWhr | 500 | 50% | 50% | 4.4E-02 | 1 | 4.4E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 500 | 50% | 50% | 1.9E-04 | 1 | 1.9E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 500 | 50% | 50% | 7.5E-06 | 1 | 7.5E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 500 | 50% | 50% | 8.1E-05 | 1 | 8.1E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 500 | 50% | 50% | 4.9E-04 | 1 | 4.9E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 500 | 50% | 50% | 1.5E-03 | 1 | 1.5E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 500 | 50% | 50% | 1.5E-08 | 1 | 1.5E-08 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 100 | 20% | 10% | 2.3E-06 | 1 | 2.3E-06 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 100 | 20% | 10% | 7.6E-04 | 1 | 7.6E-04 |
| | PM | N/A (pm) | 0.1 | g/kWhr | 100 | 20% | 10% | 5.5E-05 | 1 | 5.5E-05 |
| | PM10 | N/A (pm10) | 0.1 | g/kWhr | 100 | 20% | 10% | 5.2E-05 | 1 | 5.2E-05 |
| | PM2.5 | N/A (pm2.5) | 0.1 | g/kWhr | 100 | 20% | 10% | 4.9E-05 | 1 | 4.9E-05 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 100 | 20% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| Compactor | NMHC | N/A | 1.7 | g/kWhr | 100 | 20% | 10% | 7.1E-04 | 1 | 7.1E-04 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 100 | 20% | 10% | 3.0E-06 | 1 | 3.0E-06 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 100 | 20% | 10% | 1.2E-07 | 1 | 1.2E-07 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 100 | 20% | 10% | 1.3E-06 | 1 | 1.3E-06 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 100 | 20% | 10% | 7.9E-06 | 1 | 7.9E-06 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 100 | 20% | 10% | 2.3E-05 | 1 | 2.3E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 100 | 20% | 10% | 2.4E-10 | 1 | 2.4E-10 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 600 | 40% | 50% | 1.4E-04 | 2 | 2.8E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 600 | 40% | 50% | 4.6E-02 | 2 | 9.1E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.3E-03 | 2 | 4.6E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 600 | 40% | 50% | 2.2E-03 | 2 | 4.4E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 600 | 40% | 50% | 2.1E-03 | 2 | 4.1E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 600 | 40% | 50% | 8.7E-02 | 2 | 1.7E-01 |
| Dump truck | NMHC | N/A | 1.7 | g/kWhr | 600 | 40% | 50% | 4.3E-02 | 2 | 8.5E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 600 | 40% | 50% | 1.8E-04 | 2 | 3.6E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 600 | 40% | 50% | 7.2E-06 | 2 | 1.4E-05 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 600 | 40% | 50% | 7.8E-05 | 2 | 1.6E-04 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 600 | 40% | 50% | 4.7E-04 | 2 | 9.5E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 600 | 40% | 50% | 1.4E-03 | 2 | 2.8E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 600 | 40% | 50% | 1.4E-08 | 2 | 2.9E-08 |
| | $SO_2$ | 7446-09-5 | 0.0056 | g/kWhr | 100 | 20% | 10% | 2.3E-06 | 1 | 2.3E-06 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 100 | 20% | 10% | 7.6E-04 | 1 | 7.6E-04 |
| | PM | N/A (pm) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.5E-05 | 1 | 5.5E-05 |
| | PM10 | N/A (pm10) | 0.13 | g/kWhr | 100 | 20% | 10% | 5.2E-05 | 1 | 5.2E-05 |
| | PM2.5 | N/A (pm2.5) | 0.12 | g/kWhr | 100 | 20% | 10% | 4.9E-05 | 1 | 4.9E-05 |
| | CO | 630-08-0 | 5.0 | g/kWhr | 100 | 20% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| Paving roller | NMHC | N/A | 1.7 | g/kWhr | 100 | 20% | 10% | 7.1E-04 | 1 | 7.1E-04 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 100 | 20% | 10% | 3.0E-06 | 1 | 3.0E-06 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 100 | 20% | 10% | 1.2E-07 | 1 | 1.2E-07 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 100 | 20% | 10% | 1.3E-06 | 1 | 1.3E-06 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 100 | 20% | 10% | 7.9E-06 | 1 | 7.9E-06 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 100 | 20% | 10% | 2.3E-05 | 1 | 2.3E-05 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 100 | 20% | 10% | 2.4E-10 | 1 | 2.4E-10 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Truck | $SO_2$ | 7446-09-5 | 5.62E-03 | g/kWhr | 285 | 40% | 10% | 1.3E-04 | 1 | 1.3E-04 |
| | $NO_x$ | 10102-44-0 | 1.8 | g/kWhr | 285 | 40% | 10% | 4.3E-02 | 1 | 4.3E-02 |
| | PM | N/A (pm) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.2E-03 | 1 | 2.2E-03 |
| | PM10 | N/A (pm10) | 0.09 | g/kWhr | 285 | 40% | 10% | 2.1E-03 | 1 | 2.1E-03 |
| | PM2.5 | N/A (pm2.5) | 0.08 | g/kWhr | 285 | 40% | 10% | 2.0E-03 | 1 | 2.0E-03 |
| | CO | 630-08-0 | 3.5 | g/kWhr | 285 | 40% | 10% | 8.3E-02 | 1 | 8.3E-02 |
| | NMHC | N/A | 1.7 | g/kWhr | 285 | 40% | 10% | 4.0E-02 | 1 | 4.0E-02 |
| | Benzene | 71-43-2 | 5.43E-03 | g/hp-h | 285 | 40% | 10% | 1.7E-04 | 1 | 1.7E-04 |
| | 1,3-Butadiene | 106-99-0 | 2.17E-04 | g/hp-h | 285 | 40% | 10% | 6.9E-06 | 1 | 6.9E-06 |
| | Acrolein | 107-02-8 | 2.35E-03 | g/hp-h | 285 | 40% | 10% | 7.4E-05 | 1 | 7.4E-05 |
| | Acetaldehyde | 75-07-0 | 1.42E-02 | g/hp-h | 285 | 40% | 10% | 4.5E-04 | 1 | 4.5E-04 |
| | Formaldehyde | 50-00-0 | 4.18E-02 | g/hp-h | 285 | 40% | 10% | 1.3E-03 | 1 | 1.3E-03 |
| | Benzo(a)pyrene | 50-32-8 | 4.30E-07 | g/hp-h | 285 | 40% | 10% | 1.4E-08 | 1 | 1.4E-08 |

**Notes:**

1) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An “acoustical usage factor” for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

The Construction Noise and Vibration Assessment for this Project uses the load factors in the FHWA Guide as this is the recommended reference in the Metrolinx Environmental Guide for Noise and Vibration Assessment. The Air Quality Assessment is therefore using the same reference to be consistent with assumptions used in the Noise and Vibration Assessment.
In addition, the following two references were reviewed, and the load factors in these documents are in similar ranges as the FHWA Guide:
U. S. EPA, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA-420-R-10-016. July 2010.
Hawthorne CAT, Estimating Owning and Operating Costs, Caterpillar Performance Handbook Edition 44. Available at
https://www.hawthornecat.com/sites/default/files/content/download/pdfs/Estimating_Owning_Operating_Costs_CPH_v1.1_03.13.14.pdf. Accessed in January 2020.

2) Water truck average operating load is not available from above U.S. Federal Highway Administration guide. The load for dump truck was assumed for the water truck.
3) Percent of time used were assumed based on information from the design team (per Table 1 above).
4) The calculated emission rate is for all equipment, assuming operating at the same time.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

**Sample Calculation - NOx emissions from each asphalt spreader:**

NOx emissions (g/s) = 1.8 g/kWh x 1 kWh/1.341hph x power of each equipment (hph) x % of load x % operating time x 1 hour/3600 s
1.8 g/kWh x 1 kWh/1.341hph x 142 (hph) x 40% x 50% x 1 hour/3600 s = 0.0027 g/s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the maximum estimated number of equipment operating consistently during the facility operating time. The calculated emission rate should be conservative.

**Table 6: Summary of Overall Emissions**

| Contaminant | CAS# | Worst-case Scenario Emission Rate[1] (g/s) | |
|---|---|---|---|
| | | Daytime (8AM-5PM) | Nighttime |
| $SO_2$ | 7446-09-5 | 5.71E-04 | 0.0000 |
| $NO_x$ | 10102-44-0 | 1.87E-01 | 0.0000 |
| PM | N/A (pm) | 9.43E-03 | 0.0000 |
| PM10 | N/A (pm10) | 9.05E-03 | 0.0000 |
| PM2.5 | N/A (pm2.5) | 8.49E-03 | 0.0000 |
| CO | 630-08-0 | 3.59E-01 | 0.0000 |
| NMHC | N/A | 1.74E-01 | 0.0000 |
| Benzene | 71-43-2 | 7.39E-04 | 0.0000 |
| 1,3-Butadiene | 106-99-0 | 2.95E-05 | 0.0000 |
| Acrolein | 107-02-8 | 3.19E-04 | 0.0000 |
| Acetaldehyde | 75-07-0 | 1.94E-03 | 0.0000 |
| Formaldehyde | 50-00-0 | 5.70E-03 | 0.0000 |
| Benzo(a)pyrene | 50-32-8 | 5.85E-08 | 0.0000 |

| Emission Rate for each volume source (g/s) | |
|---|---|
| No. of volume sources | 11 |
| | 5.19E-05 |
| | 1.70E-02 |
| | 8.57E-04 |
| | 8.23E-04 |
| | 7.72E-04 |
| | 3.26E-02 |
| | 1.58E-02 |
| | 6.71E-05 |
| | 2.68E-06 |
| | 2.90E-05 |
| | 1.76E-04 |
| | 5.18E-04 |
| | 5.32E-09 |

**Notes:**

1. Total emission rate for each contaminant for worst-case scenario during construction phase is the total of the above emission rates from each type of equipment assumed to be operated at the same time and their assumed operating time and operating load.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## Source: Construction Activities Dust Emissions

**Description:**
Construction activities would generate dust emissions and may have substantial temporary impact on the local air quality.

Quantity of dust emissions depends on the area of land being worked, type of equipment onsite and level of construction activities. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The Simcoe Street Bridge Replacement will include:
•Utility relocation and road closure
•Demolition of existing bridge
•Abutment construction
•Span construction
•Road reinstatement
•Site cleanup

**Contaminant(s) of Concern:**
Particulate matter (including TSP, PM10 and PM2.5) emissions are the contaminants of concern from construction activities.

**Methodology: Emission Factor (EF) and Engineering Calculation (EC)**

Emission factors from the following references are used to estimate the overall area-wide dust emissions.
•**Reference A**: Western Reginal Air Partnership, Fugitive Dust Handbook, Chapter 3: Construction and Demolition (09/03/06), https://www.wrapair.org/forums/dejf/fdh/
•**Reference B**: California Environmental Protection Agency Air Resources Board. 2002. Section 7.7: Building Construction Dust.

| Construction Stages[1] | Estimated Total Area[2] (acre) | Active Construction Area for Worst-case Scenario [3] | | Potential Operating Time[4] |
|---|---|---|---|---|
| | | % | Area (acre) | |
| Utility relocation and road closure | 0.5 | 30% | 0.2 | daytime |
| Demolition of existing bridge | | | | daytime |
| Abutment construction | | | | daytime |
| Span construction | | | | daytime |
| Road reinstatement | | | | daytime |
| Site cleanup | | | | daytime |

**Notes:**
1. Construction phases are estimated by the design team.
2. The total area is estimated based on drawing No. CPG_SCL3756_C0500 in BMV PD Civil Package.pdf.
3. It is conservatively assumed that 30% of the construction area is active at one time during the road reinstatement phase.
4. Construction activities will occur during 8:00 a.m. to 5:00 p.m., Monday to Friday.

**Emission Calculation**
Level 1 emission estimation method shown in Table 3-2 of Reference A is used.

| Contaminant | Emission Factor for Construction Area[(1)] (ton/acre-month of activity) | Dust Control Efficiency[(2)] | PM Scaling Factor[(3)] | Emission Factor[(4)] (g/s-m2) | Worst-case Scenario | | Operating Time |
|---|---|---|---|---|---|---|---|
| | | | | | Active Area of Site (acre) | Emission Rate in Working Area[5] (g/s) | |
| PM | - | 50% | 1.56 | 6.68E-05 | 0.2 | 0.042 | 8 hours per day, from 8AM - 5 PM |
| PM10 | 0.11 | | 1 | 4.28E-05 | | 0.027 | |
| PM2.5 | - | | 0.1 | 4.28E-06 | | 0.003 | |
| Crystalline silica | | | 0.0522 | 2.23E-06 | | 0.001 | |

**Notes:**

(1) Emission factor from Table 3-2 Level 1 of the Reference A.
This value is used for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is applicable to construction operations with:
• a dust control effectiveness of 50%
• 8 hours per day and 5 days per week for construction schedule

(2) Dust control measures (such as water suppression and limiting on-site vehicle speed to less than 20 km/hour) will be implemented to control dust emissions. The control efficiency is assumed for the project construction.
(3) PM and PM2.5 factors relative to PM10 from References A and B.
(4) Emission factors are estimated based on 20 days per month, 8 hours a day with the assumed dust control efficiency.
(5) Average emission rates are estimated for the 8 hours per day.

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for the construction activities is based on the emissions factors and operating time. The calculated emission rate should be conservative due to the assumed active area of both construction scenarios.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

**Description:**
Local road traffic will be affected during the Simcoe Street bridge reconstruction due to the road closure.
Traffic emissions from the following roads are expected to change during construction. Their location and traffic data are also listed below.
Traffic Data:

| Road Source ID | Description | Link Type | Modelled Road Length (m) [1] | Average Speed [2] (km/h) | Projected Traffic Volume for 2023 [3] | | Distribution - Cars [5] | Distribution - Trucks [5] |
|---|---|---|---|---|---|---|---|---|
| | | | | | ADT | Peak Hourly [4] | 97% | 3% |
| R1a_Q | NB/SB Simcoe / Gibb (queue link) | Queue | 35 | 19 | 5,592 | 671 | 5,424 | 168 |
| R1b_Q | NB/SB Simcoe / Gibb (queue link) | Queue | 35 | 19 | 5,333 | 640 | 5,173 | 160 |
| R2a_Q | EB/WB Gibb / Simcoe (queue link) | Queue | 38 | 20 | 6,392 | 767 | 6,200 | 192 |
| R2b_Q | EB/WB Gibb / Simcoe (queue link) | Queue | 38 | 20 | 2,650 | 318 | 2,571 | 80 |
| R3_C | EB/WB Gibb (cruise link) | Cruise | 75 | 50 | 6,192 | 743 | 6,006 | 186 |
| R4a_Q | EB/WB Gibb / Centre (queue link) | Queue | 54 | 18 | 9,275 | 1,113 | 8,997 | 278 |
| R4b_Q | EB/WB Gibb / Centre (queue link) | Queue | 54 | 18 | 6,267 | 752 | 6,079 | 188 |
| R5_C | EB/WB Gibb (cruise link) | Cruise | 526 | 50 | 9,883 | 1,186 | 9,587 | 296 |
| R6a_Q | EB/WB Park Rd / Gibb (queue link) | Queue | 88 | 14 | 10,983 | 1,318 | 10,654 | 329 |
| R6b_Q | EB/WB Park Rd / Gibb (queue link) | Queue | 88 | 14 | 9,933 | 1,192 | 9,635 | 298 |
| R7a_Q | NB/SB Park Rd / Gibb (queue link) | Queue | 113 | 19 | 15,467 | 1,856 | 15,003 | 464 |
| R7b_Q | NB/SB Park Rd / Gibb (queue link) | Queue | 113 | 19 | 13,283 | 1,594 | 12,885 | 398 |
| R8_C | NB/SB Park Rd (cruise link) | Cruise | 503 | 50 | 15,342 | 1,841 | 14,882 | 460 |
| R9_C | NB/SB Park Rd (cruise link) | Cruise | 70 | 50 | 15,342 | 1,841 | 14,882 | 460 |
| R10a_Q | NB/SB Park Rd / Hillside (queue link) | Queue | 67 | 32 | 12,608 | 1,513 | 12,230 | 378 |
| R10b_Q | NB/SB Park Rd / Hillside (queue link) | Queue | 67 | 32 | 15,183 | 1,822 | 14,728 | 455 |
| R11_C | NB/SB Park Rd (cruise link) | Cruise | 105 | 50 | 13,517 | 1,622 | 13,111 | 406 |
| R12_C | NB/SB Park Rd (cruise link) | Cruise | 195 | 50 | 13,517 | 1,622 | 13,111 | 406 |
| R13_Q | NB/SB Park Rd / Bloor (queue link) | Queue | 123 | 11 | 12,658 | 1,519 | 12,278 | 380 |
| R14a_Q | EB/WB Bloor / Park Rd (queue link) | Queue | 89 | 20 | 15,833 | 1,900 | 15,358 | 475 |
| R14b_Q | EB/WB Bloor / Park Rd (queue link) | Queue | 89 | 20 | 17,183 | 2,062 | 16,668 | 515 |
| R15a_Q | EB/WB Bloor (queue link) | Queue | 125 | 19 | 19,033 | 2,284 | 18,462 | 571 |
| R15b_Q | EB/WB Bloor (queue link) | Queue | 87 | 19 | 11,325 | 1,359 | 10,985 | 340 |
| R16_C | EB/WB Bloor (cruise link) | Cruise | 423 | 50 | 11,483 | 1,378 | 11,139 | 344 |
| R17a_Q | EB/WB Bloor / Simcoe (queue link) | Queue | 184 | 21 | 15,158 | 1,819 | 14,703 | 455 |
| R17b_Q | EB/WB Bloor / Simcoe (queue link) | Queue | 184 | 21 | 15,700 | 1,884 | 15,229 | 471 |
| R18_C | EB/WB Bloor (cruise link) | Cruise | 312 | 50 | 13,433 | 1,612 | 13,030 | 403 |
| R19a_Q | EB/WB Bloor / 401 EB ramps (queue link) | Queue | 83 | 18 | 10,567 | 1,268 | 10,250 | 317 |
| R19b_Q | EB/WB Bloor / 401 EB ramps (queue link) | Queue | 83 | 18 | 13,450 | 1,614 | 13,047 | 404 |
| R20a_Q | EB/WB Bloor / Ritson (queue link) | Queue | 160 | 18 | 16,217 | 1,946 | 15,730 | 487 |
| R20b_Q | EB/WB Bloor / Ritson (queue link) | Queue | 126 | 18 | 9,342 | 1,121 | 9,062 | 280 |
| R21a_Q | NB/SB Ritson / Bloor (queue link) | Queue | 105 | 18 | 9,675 | 1,161 | 9,385 | 290 |
| R21b_Q | NB/SB Ritson / Bloor (queue link) | Queue | 105 | 18 | 18,617 | 2,234 | 18,058 | 559 |
| R22_C | NB/SB Ritson (cruise link) | Cruise | 156 | 50 | 21,183 | 2,542 | 20,548 | 635 |
| R23a_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | Queue | 187 | 28 | 22,125 | 2,655 | 21,461 | 664 |
| R23b_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | Queue | 187 | 28 | 21,092 | 2,531 | 20,459 | 633 |
| R24_C | NB/SB Ritson (cruise link) | Cruise | 168 | 50 | 21,000 | 2,520 | 20,370 | 630 |
| R25a_Q | NB/SB Ritson / Olive (queue link) | Queue | 165 | 22 | 21,283 | 2,554 | 20,645 | 638 |
| R25b_Q | NB/SB Ritson / Olive (queue link) | Queue | 165 | 22 | 16,592 | 1,991 | 16,094 | 498 |
| R26a_Q | EB/WB Olive / Ritson (queue link) | Queue | 163 | 16 | 8,058 | 967 | 7,816 | 242 |
| R26b_Q | EB/WB Olive / Ritson (queue link) | Queue | 163 | 16 | 9,950 | 1,194 | 9,652 | 299 |
| R27_C | EB/WB Olive (cruise link) | Cruise | 331 | 50 | 9,242 | 1,109 | 8,965 | 277 |
| R28a_Q | EB/WB Olive/Albert (queue link) | Queue | 118 | 31 | 9,808 | 1,177 | 9,514 | 294 |
| R28b_Q | EB/WB Olive/Albert (queue link) | Queue | 164 | 31 | 7,617 | 914 | 7,388 | 229 |
| R29a_Q | NB Albert (queue link) | Queue | 56 | 11 | 4,875 | 585 | 4,729 | 146 |
| R29b_Q | NB Albert (queue link) | Queue | 56 | 11 | 1,967 | 236 | 1,908 | 59 |
| R30_Q | EB/WB Olive / Simcoe (queue link) | Queue | 45 | 12 | 5,333 | 640 | 5,173 | 160 |
| R31_C | NB/SB Albert (cruise link) | Cruise | 58 | 50 | 5,275 | 633 | 5,117 | 158 |
| R32_C | NB/SB Albert (cruise link) | Cruise | 360 | 50 | 5,275 | 633 | 5,117 | 158 |
| R33a_Q | NB/SB Albert (queue link) | Queue | 54 | 18 | 4,617 | 554 | 4,478 | 139 |
| R33b_Q | NB/SB Albert (queue link) | Queue | 54 | 18 | 5,667 | 680 | 5,497 | 170 |
| R34_Q | EB/WB First (queue link) | Queue | 313 | 23 | 2,733 | 328 | 2,651 | 82 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R35_C | NB/SB Albert (cruise link) | Cruise | 339 | 50 | 4,617 | 554 | 4,478 | 139 |
| R36_Q | NB/SB Albert (queue link) | Queue | 30 | 10 | 4,617 | 554 | 4,478 | 139 |
| R37_C | NB Albert (cruise link) | Cruise | 172 | 50 | 1,967 | 236 | 1,908 | 59 |

**Notes:**
(1) Source length in AERMOD.
(2) Posted speed limits assumed for cruise links and average speed determined using signal cycle data at intersections for queue links. Signal cycle data provided by project traffic team.
(3) Average Daily Traffic (ADT), AM Peak and PM peak data and vehicle distribution data provided by project transportation team. Note that ADT are estimated by applying a K-Factor of 0.12 or the application of an expansion factor of 12 to PM Peak Hour volumes.
(4) The higher traffic counts between the AM and PM Peak Hour traffic are used for peak hourly traffic for emission estimation. Note that PM peak volumes are two-way volumes.
(5) Data assumed by the project traffic team.

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in the mobile equipment engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the

**Emission Calculations:**

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

**Methodology: U.S. EPA MOVES program**
EPA’s MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria pollutants, greenhouse gases, and
**Key Input Data to MOVES3**

| Parameter | Input Description |
|---|---|
| Modelling Scale | Project level |
| Contaminants | CO, NOx, $SO_2$, PM, PM10, PM2.5, Acetaldehyde, Formaldehyde, 1,3-Butadiene, Benzene, Acrolein, and Benzo(a)pyrene |
| Construction Year | 2023 |
| Evaluation Month and Time | January or July 4PM-5PM - the higher emission factors out of the two months are conservatively used |
| Meteorology (ambient temp., relative humidity) | Canadian Climate Normals, 1981-2010 for Oshawa WPCP<br>Daily Average temperatures:<br>January -4.8 degrees C<br>July 20.6 degrees C<br>Canadian Climate Normals, 1981-2021 for Toronto Buttonville Airport<br>Average relative humidity:<br>January 79.6% (AM) and 69.6% (PM)<br>July 82.5% (AM) and 53.4% (PM) |
| Road Type | All Urban Unrestricted Access |
| Fuel Type | Assumed gasoline for cars and diesel for trucks |
| Fuel Data | Ontario |
| Traffic Volume | See table above |
| Traffic Speed | See table above |
| Vehicle Age Distribution | U.S. EPA default for the modelling year |

Detailed MOVES input and output data are saved in the project folder. Summary of the emission data from the modelling for each of the road links are presented below.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

**Emission Data for Onsite Roads:**

| Road Source ID | Contaminant | CAS# | NB/SB Simcoe / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R1a_Q | NOx | 10102-44-0 | 6.23E-01 | 5,592 | 123 | 8.87E-04 | 671 | 15 | 2.55E-03 |
| R1a_Q | CO | 630-08-0 | 5.31E+00 | | | 7.56E-03 | | | 2.18E-02 |
| R1a_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 5.37E-06 | | | 1.55E-05 |
| R1a_Q | PM | N/A (pm) | 1.44E-01 | | | 2.05E-04 | | | 5.91E-04 |
| R1a_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 2.05E-04 | | | 5.91E-04 |
| R1a_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 5.38E-05 | | | 1.55E-04 |
| R1a_Q | Benzene | 71-43-2 | 1.55E-03 | | | 2.21E-06 | | | 6.36E-06 |
| R1a_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 2.12E-07 | | | 6.11E-07 |
| R1a_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 3.31E-07 | | | 9.53E-07 |
| R1a_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 2.28E-06 | | | 6.56E-06 |
| R1a_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 4.25E-06 | | | 1.22E-05 |
| R1a_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 2.79E-09 | | | 8.04E-09 |

| Road Source ID | Contaminant | CAS# | NB/SB Simcoe / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R1b_Q | NOx | 10102-44-0 | 6.23E-01 | 5,333 | 117 | 8.46E-04 | 640 | 14 | 2.44E-03 |
| R1b_Q | CO | 630-08-0 | 5.31E+00 | | | 7.21E-03 | | | 2.08E-02 |
| R1b_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 5.12E-06 | | | 1.48E-05 |
| R1b_Q | PM | N/A (pm) | 1.44E-01 | | | 1.96E-04 | | | 5.64E-04 |
| R1b_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 1.96E-04 | | | 5.64E-04 |
| R1b_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 5.13E-05 | | | 1.48E-04 |
| R1b_Q | Benzene | 71-43-2 | 1.55E-03 | | | 2.11E-06 | | | 6.06E-06 |
| R1b_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 2.02E-07 | | | 5.83E-07 |
| R1b_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 3.16E-07 | | | 9.09E-07 |
| R1b_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 2.17E-06 | | | 6.25E-06 |
| R1b_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 4.05E-06 | | | 1.17E-05 |
| R1b_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 2.66E-09 | | | 7.67E-09 |

| Road Source ID | Contaminant | CAS# | EB/WB Gibb / Simcoe (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R2a_Q | NOx | 10102-44-0 | 6.11E-01 | 6,392 | 150 | 1.06E-03 | 767 | 18 | 3.05E-03 |
| R2a_Q | CO | 630-08-0 | 5.22E+00 | | | 9.04E-03 | | | 2.60E-02 |
| R2a_Q | $SO_2$ | 7446-09-5 | 3.67E-03 | | | 6.36E-06 | | | 1.83E-05 |
| R2a_Q | PM | N/A (pm) | 1.39E-01 | | | 2.40E-04 | | | 6.92E-04 |
| R2a_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 2.40E-04 | | | 6.92E-04 |
| R2a_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 6.41E-05 | | | 1.85E-04 |
| R2a_Q | Benzene | 71-43-2 | 1.51E-03 | | | 2.62E-06 | | | 7.55E-06 |
| R2a_Q | 1,3-Butadiene | 106-99-0 | 1.44E-04 | | | 2.49E-07 | | | 7.17E-07 |
| R2a_Q | Acrolein | 107-02-8 | 2.23E-04 | | | 3.86E-07 | | | 1.11E-06 |
| R2a_Q | Acetaldehyde | 75-07-0 | 1.54E-03 | | | 2.66E-06 | | | 7.67E-06 |
| R2a_Q | Formaldehyde | 50-00-0 | 2.86E-03 | | | 4.95E-06 | | | 1.43E-05 |
| R2a_Q | Benzo(a)pyrene | 50-32-8 | 1.94E-06 | | | 3.35E-09 | | | 9.66E-09 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Gibb / Simcoe (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R2b_Q | NOx | 10102-44-0 | 6.11E-01 | 2,650 | 62 | 4.39E-04 | 318 | 7 | 1.26E-03 |
| R2b_Q | CO | 630-08-0 | 5.22E+00 | | | 3.75E-03 | | | 1.08E-02 |
| R2b_Q | $SO_2$ | 7446-09-5 | 3.67E-03 | | | 2.64E-06 | | | 7.59E-06 |
| R2b_Q | PM | N/A (pm) | 1.39E-01 | | | 9.97E-05 | | | 2.87E-04 |
| R2b_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 9.97E-05 | | | 2.87E-04 |
| R2b_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 2.66E-05 | | | 7.66E-05 |
| R2b_Q | Benzene | 71-43-2 | 1.51E-03 | | | 1.09E-06 | | | 3.13E-06 |
| R2b_Q | 1,3-Butadiene | 106-99-0 | 1.44E-04 | | | 1.03E-07 | | | 2.97E-07 |
| R2b_Q | Acrolein | 107-02-8 | 2.23E-04 | | | 1.60E-07 | | | 4.60E-07 |
| R2b_Q | Acetaldehyde | 75-07-0 | 1.54E-03 | | | 1.10E-06 | | | 3.18E-06 |
| R2b_Q | Formaldehyde | 50-00-0 | 2.86E-03 | | | 2.05E-06 | | | 5.91E-06 |
| R2b_Q | Benzo(a)pyrene | 50-32-8 | 1.94E-06 | | | 1.39E-09 | | | 4.00E-09 |

| Road Source ID | Contaminant | CAS# | EB/WB Gibb (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R3_C | NOx | 10102-44-0 | 4.34E-01 | 6,192 | 289 | 1.45E-03 | 743 | 35 | 4.17E-03 |
| R3_C | CO | 630-08-0 | 3.41E+00 | | | 1.14E-02 | | | 3.28E-02 |
| R3_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 7.77E-06 | | | 2.24E-05 |
| R3_C | PM | N/A (pm) | 7.32E-02 | | | 2.45E-04 | | | 7.04E-04 |
| R3_C | PM10 | N/A (pm10) | 7.32E-02 | | | 2.45E-04 | | | 7.04E-04 |
| R3_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 8.22E-05 | | | 2.37E-04 |
| R3_C | Benzene | 71-43-2 | 9.60E-04 | | | 3.21E-06 | | | 9.24E-06 |
| R3_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 2.66E-07 | | | 7.65E-07 |
| R3_C | Acrolein | 107-02-8 | 1.12E-04 | | | 3.75E-07 | | | 1.08E-06 |
| R3_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 2.72E-06 | | | 7.82E-06 |
| R3_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 4.90E-06 | | | 1.41E-05 |
| R3_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 4.32E-09 | | | 1.24E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Gibb / Centre (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R4a_Q | NOx | 10102-44-0 | 6.36E-01 | 9,275 | 312 | 2.30E-03 | 1,113 | 37 | 6.61E-03 |
| R4a_Q | CO | 630-08-0 | 5.41E+00 | | | 1.95E-02 | | | 5.62E-02 |
| R4a_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 1.40E-05 | | | 4.04E-05 |
| R4a_Q | PM | N/A (pm) | 1.50E-01 | | | 5.41E-04 | | | 1.56E-03 |
| R4a_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 5.41E-04 | | | 1.56E-03 |
| R4a_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 1.39E-04 | | | 4.01E-04 |
| R4a_Q | Benzene | 71-43-2 | 1.59E-03 | | | 5.74E-06 | | | 1.65E-05 |
| R4a_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 5.59E-07 | | | 1.61E-06 |
| R4a_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 8.78E-07 | | | 2.53E-06 |
| R4a_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 6.02E-06 | | | 1.73E-05 |
| R4a_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 1.12E-05 | | | 3.24E-05 |
| R4a_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 7.17E-09 | | | 2.06E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Gibb / Centre (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R4b_Q | NOx | 10102-44-0 | 6.36E-01 | 6,267 | 211 | 1.55E-03 | 752 | 25 | 4.47E-03 |
| R4b_Q | CO | 630-08-0 | 5.41E+00 | | | 1.32E-02 | | | 3.80E-02 |
| R4b_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 9.48E-06 | | | 2.73E-05 |
| R4b_Q | PM | N/A (pm) | 1.50E-01 | | | 3.66E-04 | | | 1.05E-03 |
| R4b_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 3.66E-04 | | | 1.05E-03 |
| R4b_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 9.41E-05 | | | 2.71E-04 |
| R4b_Q | Benzene | 71-43-2 | 1.59E-03 | | | 3.88E-06 | | | 1.12E-05 |
| R4b_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 3.77E-07 | | | 1.09E-06 |
| R4b_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 5.93E-07 | | | 1.71E-06 |
| R4b_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 4.07E-06 | | | 1.17E-05 |
| R4b_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 7.60E-06 | | | 2.19E-05 |
| R4b_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 4.84E-09 | | | 1.39E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Gibb (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R5_C | NOx | 10102-44-0 | 4.34E-01 | 9,883 | 3,230 | 1.62E-02 | 1,186 | 388 | 4.67E-02 |
| R5_C | CO | 630-08-0 | 3.41E+00 | | | 1.28E-01 | | | 3.68E-01 |
| R5_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 8.70E-05 | | | 2.51E-04 |
| R5_C | PM | N/A (pm) | 7.32E-02 | | | 2.74E-03 | | | 7.88E-03 |
| R5_C | PM10 | N/A (pm10) | 7.32E-02 | | | 2.74E-03 | | | 7.88E-03 |
| R5_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 9.20E-04 | | | 2.65E-03 |
| R5_C | Benzene | 71-43-2 | 9.60E-04 | | | 3.59E-05 | | | 1.03E-04 |
| R5_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 2.97E-06 | | | 8.57E-06 |
| R5_C | Acrolein | 107-02-8 | 1.12E-04 | | | 4.20E-06 | | | 1.21E-05 |
| R5_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 3.04E-05 | | | 8.75E-05 |
| R5_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 5.49E-05 | | | 1.58E-04 |
| R5_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 4.84E-08 | | | 1.39E-07 |

| Road Source ID | Contaminant | CAS# | EB/WB Park Rd / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R6a_Q | NOx | 10102-44-0 | 3.02E-01 | 10,983 | 603 | 2.11E-03 | 1,318 | 72 | 6.07E-03 |
| R6a_Q | CO | 630-08-0 | 3.08E+00 | | | 2.15E-02 | | | 6.19E-02 |
| R6a_Q | $SO_2$ | 7446-09-5 | 2.98E-03 | | | 2.08E-05 | | | 5.99E-05 |
| R6a_Q | PM | N/A (pm) | 4.56E-01 | | | 3.18E-03 | | | 9.16E-03 |
| R6a_Q | PM10 | N/A (pm10) | 4.56E-01 | | | 3.18E-03 | | | 9.16E-03 |
| R6a_Q | PM2.5 | N/A (pm2.5) | 6.89E-02 | | | 4.81E-04 | | | 1.38E-03 |
| R6a_Q | Benzene | 71-43-2 | 1.50E-03 | | | 1.04E-05 | | | 3.01E-05 |
| R6a_Q | 1,3-Butadiene | 106-99-0 | 1.56E-04 | | | 1.09E-06 | | | 3.14E-06 |
| R6a_Q | Acrolein | 107-02-8 | 2.54E-04 | | | 1.77E-06 | | | 5.09E-06 |
| R6a_Q | Acetaldehyde | 75-07-0 | 1.70E-03 | | | 1.18E-05 | | | 3.41E-05 |
| R6a_Q | Formaldehyde | 50-00-0 | 3.23E-03 | | | 2.25E-05 | | | 6.48E-05 |
| R6a_Q | Benzo(a)pyrene | 50-32-8 | 1.41E-06 | | | 9.83E-09 | | | 2.83E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Park Rd / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R6b_Q | NOx | 10102-44-0 | 3.02E-01 | 9,933 | 545 | 1.91E-03 | 1,192 | 65 | 5.49E-03 |
| R6b_Q | CO | 630-08-0 | 3.08E+00 | | | 1.94E-02 | | | 5.60E-02 |
| R6b_Q | $SO_2$ | 7446-09-5 | 2.98E-03 | | | 1.88E-05 | | | 5.42E-05 |
| R6b_Q | PM | N/A (pm) | 4.56E-01 | | | 2.88E-03 | | | 8.28E-03 |
| R6b_Q | PM10 | N/A (pm10) | 4.56E-01 | | | 2.88E-03 | | | 8.28E-03 |
| R6b_Q | PM2.5 | N/A (pm2.5) | 6.89E-02 | | | 4.35E-04 | | | 1.25E-03 |
| R6b_Q | Benzene | 71-43-2 | 1.50E-03 | | | 9.44E-06 | | | 2.72E-05 |
| R6b_Q | 1,3-Butadiene | 106-99-0 | 1.56E-04 | | | 9.87E-07 | | | 2.84E-06 |
| R6b_Q | Acrolein | 107-02-8 | 2.54E-04 | | | 1.60E-06 | | | 4.61E-06 |
| R6b_Q | Acetaldehyde | 75-07-0 | 1.70E-03 | | | 1.07E-05 | | | 3.08E-05 |
| R6b_Q | Formaldehyde | 50-00-0 | 3.23E-03 | | | 2.03E-05 | | | 5.86E-05 |
| R6b_Q | Benzo(a)pyrene | 50-32-8 | 1.41E-06 | | | 8.89E-09 | | | 2.56E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R7a_Q | NOx | 10102-44-0 | 6.23E-01 | 15,467 | 1,087 | 7.84E-03 | 1,856 | 130 | 2.26E-02 |
| R7a_Q | CO | 630-08-0 | 5.31E+00 | | | 6.68E-02 | | | 1.92E-01 |
| R7a_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 4.75E-05 | | | 1.37E-04 |
| R7a_Q | PM | N/A (pm) | 1.44E-01 | | | 1.81E-03 | | | 5.22E-03 |
| R7a_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 1.81E-03 | | | 5.22E-03 |
| R7a_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 4.75E-04 | | | 1.37E-03 |
| R7a_Q | Benzene | 71-43-2 | 1.55E-03 | | | 1.95E-05 | | | 5.62E-05 |
| R7a_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 1.87E-06 | | | 5.40E-06 |
| R7a_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 2.92E-06 | | | 8.42E-06 |
| R7a_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 2.01E-05 | | | 5.79E-05 |
| R7a_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 3.75E-05 | | | 1.08E-04 |
| R7a_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 2.47E-08 | | | 7.10E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd / Gibb (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R7b_Q | NOx | 10102-44-0 | 6.23E-01 | 13,283 | 933 | 6.73E-03 | 1,594 | 112 | 1.94E-02 |
| R7b_Q | CO | 630-08-0 | 5.31E+00 | | | 5.74E-02 | | | 1.65E-01 |
| R7b_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 4.08E-05 | | | 1.17E-04 |
| R7b_Q | PM | N/A (pm) | 1.44E-01 | | | 1.56E-03 | | | 4.48E-03 |
| R7b_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 1.56E-03 | | | 4.48E-03 |
| R7b_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 4.08E-04 | | | 1.18E-03 |
| R7b_Q | Benzene | 71-43-2 | 1.55E-03 | | | 1.67E-05 | | | 4.82E-05 |
| R7b_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 1.61E-06 | | | 4.64E-06 |
| R7b_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 2.51E-06 | | | 7.23E-06 |
| R7b_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 1.73E-05 | | | 4.97E-05 |
| R7b_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 3.22E-05 | | | 9.28E-05 |
| R7b_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 2.12E-08 | | | 6.10E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## **Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R8_C | NOx | 10102-44-0 | 4.34E-01 | 15,342 | 4,795 | 2.41E-02 | 1,841 | 575 | 6.93E-02 |
| R8_C | CO | 630-08-0 | 3.41E+00 | | | 1.89E-01 | | | 5.46E-01 |
| R8_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 1.29E-04 | | | 3.72E-04 |
| R8_C | PM | N/A (pm) | 7.32E-02 | | | 4.06E-03 | | | 1.17E-02 |
| R8_C | PM10 | N/A (pm10) | 7.32E-02 | | | 4.06E-03 | | | 1.17E-02 |
| R8_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 1.37E-03 | | | 3.94E-03 |
| R8_C | Benzene | 71-43-2 | 9.60E-04 | | | 5.33E-05 | | | 1.53E-04 |
| R8_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 4.42E-06 | | | 1.27E-05 |
| R8_C | Acrolein | 107-02-8 | 1.12E-04 | | | 6.23E-06 | | | 1.79E-05 |
| R8_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 4.51E-05 | | | 1.30E-04 |
| R8_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 8.14E-05 | | | 2.35E-04 |
| R8_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 7.18E-08 | | | 2.07E-07 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R9_C | NOx | 10102-44-0 | 4.34E-01 | 15,342 | 667 | 3.35E-03 | 1,841 | 80 | 9.65E-03 |
| R9_C | CO | 630-08-0 | 3.41E+00 | | | 2.64E-02 | | | 7.59E-02 |
| R9_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 1.80E-05 | | | 5.18E-05 |
| R9_C | PM | N/A (pm) | 7.32E-02 | | | 5.65E-04 | | | 1.63E-03 |
| R9_C | PM10 | N/A (pm10) | 7.32E-02 | | | 5.65E-04 | | | 1.63E-03 |
| R9_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 1.90E-04 | | | 5.48E-04 |
| R9_C | Benzene | 71-43-2 | 9.60E-04 | | | 7.42E-06 | | | 2.14E-05 |
| R9_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 6.14E-07 | | | 1.77E-06 |
| R9_C | Acrolein | 107-02-8 | 1.12E-04 | | | 8.67E-07 | | | 2.50E-06 |
| R9_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 6.28E-06 | | | 1.81E-05 |
| R9_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 1.13E-05 | | | 3.26E-05 |
| R9_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 1.00E-08 | | | 2.88E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd / Hillside (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R10a_Q | NOx | 10102-44-0 | 5.07E-01 | 12,608 | 526 | 3.09E-03 | 1,513 | 63 | 8.89E-03 |
| R10a_Q | CO | 630-08-0 | 4.40E+00 | | | 2.68E-02 | | | 7.72E-02 |
| R10a_Q | $SO_2$ | 7446-09-5 | 2.91E-03 | | | 1.77E-05 | | | 5.10E-05 |
| R10a_Q | PM | N/A (pm) | 1.04E-01 | | | 6.36E-04 | | | 1.83E-03 |
| R10a_Q | PM10 | N/A (pm10) | 1.04E-01 | | | 6.36E-04 | | | 1.83E-03 |
| R10a_Q | PM2.5 | N/A (pm2.5) | 3.05E-02 | | | 1.86E-04 | | | 5.36E-04 |
| R10a_Q | Benzene | 71-43-2 | 1.25E-03 | | | 7.59E-06 | | | 2.19E-05 |
| R10a_Q | 1,3-Butadiene | 106-99-0 | 1.06E-04 | | | 6.48E-07 | | | 1.86E-06 |
| R10a_Q | Acrolein | 107-02-8 | 1.52E-04 | | | 9.28E-07 | | | 2.67E-06 |
| R10a_Q | Acetaldehyde | 75-07-0 | 1.09E-03 | | | 6.65E-06 | | | 1.91E-05 |
| R10a_Q | Formaldehyde | 50-00-0 | 1.99E-03 | | | 1.21E-05 | | | 3.49E-05 |
| R10a_Q | Benzo(a)pyrene | 50-32-8 | 1.64E-06 | | | 9.98E-09 | | | 2.87E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd / Hillside (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R10b_Q | NOx | 10102-44-0 | 5.07E-01 | 15,183 | 634 | 3.72E-03 | 1,822 | 76 | 1.07E-02 |
| R10b_Q | CO | 630-08-0 | 4.40E+00 | | | 3.23E-02 | | | 9.29E-02 |
| R10b_Q | $SO_2$ | 7446-09-5 | 2.91E-03 | | | 2.13E-05 | | | 6.14E-05 |
| R10b_Q | PM | N/A (pm) | 1.04E-01 | | | 7.66E-04 | | | 2.21E-03 |
| R10b_Q | PM10 | N/A (pm10) | 1.04E-01 | | | 7.66E-04 | | | 2.21E-03 |
| R10b_Q | PM2.5 | N/A (pm2.5) | 3.05E-02 | | | 2.24E-04 | | | 6.45E-04 |
| R10b_Q | Benzene | 71-43-2 | 1.25E-03 | | | 9.14E-06 | | | 2.63E-05 |
| R10b_Q | 1,3-Butadiene | 106-99-0 | 1.06E-04 | | | 7.80E-07 | | | 2.25E-06 |
| R10b_Q | Acrolein | 107-02-8 | 1.52E-04 | | | 1.12E-06 | | | 3.22E-06 |
| R10b_Q | Acetaldehyde | 75-07-0 | 1.09E-03 | | | 8.00E-06 | | | 2.31E-05 |
| R10b_Q | Formaldehyde | 50-00-0 | 1.99E-03 | | | 1.46E-05 | | | 4.20E-05 |
| R10b_Q | Benzo(a)pyrene | 50-32-8 | 1.64E-06 | | | 1.20E-08 | | | 3.46E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R11_C | NOx | 10102-44-0 | 4.34E-01 | 13,517 | 882 | 4.43E-03 | 1,622 | 106 | 1.28E-02 |
| R11_C | CO | 630-08-0 | 3.41E+00 | | | 3.48E-02 | | | 1.00E-01 |
| R11_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 2.38E-05 | | | 6.84E-05 |
| R11_C | PM | N/A (pm) | 7.32E-02 | | | 7.47E-04 | | | 2.15E-03 |
| R11_C | PM10 | N/A (pm10) | 7.32E-02 | | | 7.47E-04 | | | 2.15E-03 |
| R11_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 2.51E-04 | | | 7.24E-04 |
| R11_C | Benzene | 71-43-2 | 9.60E-04 | | | 9.80E-06 | | | 2.82E-05 |
| R11_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 8.12E-07 | | | 2.34E-06 |
| R11_C | Acrolein | 107-02-8 | 1.12E-04 | | | 1.15E-06 | | | 3.30E-06 |
| R11_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 8.30E-06 | | | 2.39E-05 |
| R11_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 1.50E-05 | | | 4.31E-05 |
| R11_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 1.32E-08 | | | 3.80E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R12_C | NOx | 10102-44-0 | 4.34E-01 | 13,517 | 1,638 | 8.22E-03 | 1,622 | 197 | 2.37E-02 |
| R12_C | CO | 630-08-0 | 3.41E+00 | | | 6.47E-02 | | | 1.86E-01 |
| R12_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 4.41E-05 | | | 1.27E-04 |
| R12_C | PM | N/A (pm) | 7.32E-02 | | | 1.39E-03 | | | 4.00E-03 |
| R12_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.39E-03 | | | 4.00E-03 |
| R12_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 4.67E-04 | | | 1.34E-03 |
| R12_C | Benzene | 71-43-2 | 9.60E-04 | | | 1.82E-05 | | | 5.24E-05 |
| R12_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.51E-06 | | | 4.34E-06 |
| R12_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.13E-06 | | | 6.13E-06 |
| R12_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.54E-05 | | | 4.44E-05 |
| R12_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 2.78E-05 | | | 8.01E-05 |
| R12_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 2.45E-08 | | | 7.07E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB/SB Park Rd / Bloor (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R13_Q | NOx | 10102-44-0 | 8.51E-01 | 12,658 | 971 | 9.56E-03 | 1,519 | 116 | 2.75E-02 |
| R13_Q | CO | 630-08-0 | 6.59E+00 | | | 7.40E-02 | | | 2.13E-01 |
| R13_Q | $SO_2$ | 7446-09-5 | 5.35E-03 | | | 6.01E-05 | | | 1.73E-04 |
| R13_Q | PM | N/A (pm) | 2.14E-01 | | | 2.40E-03 | | | 6.92E-03 |
| R13_Q | PM10 | N/A (pm10) | 2.14E-01 | | | 2.40E-03 | | | 6.92E-03 |
| R13_Q | PM2.5 | N/A (pm2.5) | 5.26E-02 | | | 5.91E-04 | | | 1.70E-03 |
| R13_Q | Benzene | 71-43-2 | 2.06E-03 | | | 2.32E-05 | | | 6.67E-05 |
| R13_Q | 1,3-Butadiene | 106-99-0 | 2.22E-04 | | | 2.50E-06 | | | 7.20E-06 |
| R13_Q | Acrolein | 107-02-8 | 3.71E-04 | | | 4.17E-06 | | | 1.20E-05 |
| R13_Q | Acetaldehyde | 75-07-0 | 2.47E-03 | | | 2.78E-05 | | | 8.00E-05 |
| R13_Q | Formaldehyde | 50-00-0 | 4.69E-03 | | | 5.27E-05 | | | 1.52E-04 |
| R13_Q | Benzo(a)pyrene | 50-32-8 | 2.60E-06 | | | 2.92E-08 | | | 8.42E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Park Rd (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R14a_Q | NOx | 10102-44-0 | 6.11E-01 | 15,833 | 874 | 6.18E-03 | 1,900 | 105 | 1.78E-02 |
| R14a_Q | CO | 630-08-0 | 5.22E+00 | | | 5.28E-02 | | | 1.52E-01 |
| R14a_Q | $SO_2$ | 7446-09-5 | 3.67E-03 | | | 3.71E-05 | | | 1.07E-04 |
| R14a_Q | PM | N/A (pm) | 1.39E-01 | | | 1.40E-03 | | | 4.04E-03 |
| R14a_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 1.40E-03 | | | 4.04E-03 |
| R14a_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 3.75E-04 | | | 1.08E-03 |
| R14a_Q | Benzene | 71-43-2 | 1.51E-03 | | | 1.53E-05 | | | 4.41E-05 |
| R14a_Q | 1,3-Butadiene | 106-99-0 | 1.44E-04 | | | 1.46E-06 | | | 4.19E-06 |
| R14a_Q | Acrolein | 107-02-8 | 2.23E-04 | | | 2.25E-06 | | | 6.49E-06 |
| R14a_Q | Acetaldehyde | 75-07-0 | 1.54E-03 | | | 1.56E-05 | | | 4.48E-05 |
| R14a_Q | Formaldehyde | 50-00-0 | 2.86E-03 | | | 2.89E-05 | | | 8.33E-05 |
| R14a_Q | Benzo(a)pyrene | 50-32-8 | 1.94E-06 | | | 1.96E-08 | | | 5.64E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Park Rd (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R14b_Q | NOx | 10102-44-0 | 6.11E-01 | 17,183 | 948 | 6.71E-03 | 2,062 | 114 | 1.93E-02 |
| R14b_Q | CO | 630-08-0 | 5.22E+00 | | | 5.73E-02 | | | 1.65E-01 |
| R14b_Q | $SO_2$ | 7446-09-5 | 3.67E-03 | | | 4.03E-05 | | | 1.16E-04 |
| R14b_Q | PM | N/A (pm) | 1.39E-01 | | | 1.52E-03 | | | 4.39E-03 |
| R14b_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 1.52E-03 | | | 4.39E-03 |
| R14b_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 4.07E-04 | | | 1.17E-03 |
| R14b_Q | Benzene | 71-43-2 | 1.51E-03 | | | 1.66E-05 | | | 4.79E-05 |
| R14b_Q | 1,3-Butadiene | 106-99-0 | 1.44E-04 | | | 1.58E-06 | | | 4.55E-06 |
| R14b_Q | Acrolein | 107-02-8 | 2.23E-04 | | | 2.44E-06 | | | 7.04E-06 |
| R14b_Q | Acetaldehyde | 75-07-0 | 1.54E-03 | | | 1.69E-05 | | | 4.86E-05 |
| R14b_Q | Formaldehyde | 50-00-0 | 2.86E-03 | | | 3.14E-05 | | | 9.04E-05 |
| R14b_Q | Benzo(a)pyrene | 50-32-8 | 1.94E-06 | | | 2.13E-08 | | | 6.12E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Bloor (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R15a_Q | NOx | 10102-44-0 | 6.23E-01 | 19,033 | 1,478 | 1.07E-02 | 2,284 | 177 | 3.07E-02 |
| R15a_Q | CO | 630-08-0 | 5.31E+00 | | | 9.09E-02 | | | 2.62E-01 |
| R15a_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 6.46E-05 | | | 1.86E-04 |
| R15a_Q | PM | N/A (pm) | 1.44E-01 | | | 2.47E-03 | | | 7.10E-03 |
| R15a_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 2.47E-03 | | | 7.10E-03 |
| R15a_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 6.46E-04 | | | 1.86E-03 |
| R15a_Q | Benzene | 71-43-2 | 1.55E-03 | | | 2.65E-05 | | | 7.64E-05 |
| R15a_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 2.55E-06 | | | 7.34E-06 |
| R15a_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 3.98E-06 | | | 1.15E-05 |
| R15a_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 2.74E-05 | | | 7.88E-05 |
| R15a_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 5.10E-05 | | | 1.47E-04 |
| R15a_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 3.35E-08 | | | 9.66E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R15b_Q | NOx | 10102-44-0 | 6.23E-01 | 11,325 | 610 | 4.40E-03 | 1,359 | 73 | 1.27E-02 |
| R15b_Q | CO | 630-08-0 | 5.31E+00 | | | 3.75E-02 | | | 1.08E-01 |
| R15b_Q | $SO_2$ | 7446-09-5 | 3.77E-03 | | | 2.67E-05 | | | 7.68E-05 |
| R15b_Q | PM | N/A (pm) | 1.44E-01 | | | 1.02E-03 | | | 2.93E-03 |
| R15b_Q | PM10 | N/A (pm10) | 1.44E-01 | | | 1.02E-03 | | | 2.93E-03 |
| R15b_Q | PM2.5 | N/A (pm2.5) | 3.78E-02 | | | 2.67E-04 | | | 7.69E-04 |
| R15b_Q | Benzene | 71-43-2 | 1.55E-03 | | | 1.10E-05 | | | 3.15E-05 |
| R15b_Q | 1,3-Butadiene | 106-99-0 | 1.49E-04 | | | 1.05E-06 | | | 3.03E-06 |
| R15b_Q | Acrolein | 107-02-8 | 2.33E-04 | | | 1.64E-06 | | | 4.73E-06 |
| R15b_Q | Acetaldehyde | 75-07-0 | 1.60E-03 | | | 1.13E-05 | | | 3.25E-05 |
| R15b_Q | Formaldehyde | 50-00-0 | 2.98E-03 | | | 2.11E-05 | | | 6.07E-05 |
| R15b_Q | Benzo(a)pyrene | 50-32-8 | 1.96E-06 | | | 1.39E-08 | | | 3.99E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R16_C | NOx | 10102-44-0 | 4.34E-01 | 11,483 | 3,018 | 1.52E-02 | 1,378 | 362 | 4.36E-02 |
| R16_C | CO | 630-08-0 | 3.41E+00 | | | 1.19E-01 | | | 3.43E-01 |
| R16_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 8.13E-05 | | | 2.34E-04 |
| R16_C | PM | N/A (pm) | 7.32E-02 | | | 2.56E-03 | | | 7.37E-03 |
| R16_C | PM10 | N/A (pm10) | 7.32E-02 | | | 2.56E-03 | | | 7.37E-03 |
| R16_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 8.60E-04 | | | 2.48E-03 |
| R16_C | Benzene | 71-43-2 | 9.60E-04 | | | 3.35E-05 | | | 9.66E-05 |
| R16_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 2.78E-06 | | | 8.00E-06 |
| R16_C | Acrolein | 107-02-8 | 1.12E-04 | | | 3.92E-06 | | | 1.13E-05 |
| R16_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 2.84E-05 | | | 8.18E-05 |
| R16_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 5.13E-05 | | | 1.48E-04 |
| R16_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 4.52E-08 | | | 1.30E-07 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Simcoe (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R17a_Q | NOx | 10102-44-0 | 6.01E-01 | 15,158 | 1,733 | 1.21E-02 | 1,819 | 208 | 3.47E-02 |
| R17a_Q | CO | 630-08-0 | 5.14E+00 | | | 1.03E-01 | | | 2.97E-01 |
| R17a_Q | $SO_2$ | 7446-09-5 | 3.58E-03 | | | 7.19E-05 | | | 2.07E-04 |
| R17a_Q | PM | N/A (pm) | 1.39E-01 | | | 2.79E-03 | | | 8.03E-03 |
| R17a_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 2.79E-03 | | | 8.03E-03 |
| R17a_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 7.45E-04 | | | 2.14E-03 |
| R17a_Q | Benzene | 71-43-2 | 1.48E-03 | | | 2.97E-05 | | | 8.57E-05 |
| R17a_Q | 1,3-Butadiene | 106-99-0 | 1.39E-04 | | | 2.79E-06 | | | 8.04E-06 |
| R17a_Q | Acrolein | 107-02-8 | 2.14E-04 | | | 4.29E-06 | | | 1.24E-05 |
| R17a_Q | Acetaldehyde | 75-07-0 | 1.48E-03 | | | 2.97E-05 | | | 8.57E-05 |
| R17a_Q | Formaldehyde | 50-00-0 | 2.75E-03 | | | 5.52E-05 | | | 1.59E-04 |
| R17a_Q | Benzo(a)pyrene | 50-32-8 | 1.92E-06 | | | 3.84E-08 | | | 1.11E-07 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Simcoe (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R17b_Q | NOx | 10102-44-0 | 6.01E-01 | 15,700 | 1,795 | 1.25E-02 | 1,884 | 215 | 3.60E-02 |
| R17b_Q | CO | 630-08-0 | 5.14E+00 | | | 1.07E-01 | | | 3.08E-01 |
| R17b_Q | $SO_2$ | 7446-09-5 | 3.58E-03 | | | 7.44E-05 | | | 2.14E-04 |
| R17b_Q | PM | N/A (pm) | 1.39E-01 | | | 2.89E-03 | | | 8.31E-03 |
| R17b_Q | PM10 | N/A (pm10) | 1.39E-01 | | | 2.89E-03 | | | 8.31E-03 |
| R17b_Q | PM2.5 | N/A (pm2.5) | 3.71E-02 | | | 7.71E-04 | | | 2.22E-03 |
| R17b_Q | Benzene | 71-43-2 | 1.48E-03 | | | 3.08E-05 | | | 8.87E-05 |
| R17b_Q | 1,3-Butadiene | 106-99-0 | 1.39E-04 | | | 2.89E-06 | | | 8.33E-06 |
| R17b_Q | Acrolein | 107-02-8 | 2.14E-04 | | | 4.45E-06 | | | 1.28E-05 |
| R17b_Q | Acetaldehyde | 75-07-0 | 1.48E-03 | | | 3.08E-05 | | | 8.87E-05 |
| R17b_Q | Formaldehyde | 50-00-0 | 2.75E-03 | | | 5.72E-05 | | | 1.65E-04 |
| R17b_Q | Benzo(a)pyrene | 50-32-8 | 1.92E-06 | | | 3.98E-08 | | | 1.15E-07 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R18_C | NOx | 10102-44-0 | 4.34E-01 | 13,433 | 2,604 | 1.31E-02 | 1,612 | 313 | 3.77E-02 |
| R18_C | CO | 630-08-0 | 3.41E+00 | | | 1.03E-01 | | | 2.96E-01 |
| R18_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 7.01E-05 | | | 2.02E-04 |
| R18_C | PM | N/A (pm) | 7.32E-02 | | | 2.21E-03 | | | 6.36E-03 |
| R18_C | PM10 | N/A (pm10) | 7.32E-02 | | | 2.21E-03 | | | 6.36E-03 |
| R18_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 7.42E-04 | | | 2.14E-03 |
| R18_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.89E-05 | | | 8.34E-05 |
| R18_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 2.40E-06 | | | 6.91E-06 |
| R18_C | Acrolein | 107-02-8 | 1.12E-04 | | | 3.38E-06 | | | 9.74E-06 |
| R18_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 2.45E-05 | | | 7.06E-05 |
| R18_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 4.42E-05 | | | 1.27E-04 |
| R18_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 3.90E-08 | | | 1.12E-07 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / 401 EB ramps (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R19a_Q | NOx | 10102-44-0 | 6.36E-01 | 10,567 | 545 | 4.01E-03 | 1,268 | 65 | 1.16E-02 |
| R19a_Q | CO | 630-08-0 | 5.41E+00 | | | 3.41E-02 | | | 9.82E-02 |
| R19a_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 2.45E-05 | | | 7.06E-05 |
| R19a_Q | PM | N/A (pm) | 1.50E-01 | | | 9.46E-04 | | | 2.73E-03 |
| R19a_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 9.46E-04 | | | 2.73E-03 |
| R19a_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 2.43E-04 | | | 7.01E-04 |
| R19a_Q | Benzene | 71-43-2 | 1.59E-03 | | | 1.00E-05 | | | 2.89E-05 |
| R19a_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 9.76E-07 | | | 2.81E-06 |
| R19a_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 1.53E-06 | | | 4.42E-06 |
| R19a_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 1.05E-05 | | | 3.03E-05 |
| R19a_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 1.97E-05 | | | 5.66E-05 |
| R19a_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 1.25E-08 | | | 3.61E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / 401 EB ramps (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R19b_Q | NOx | 10102-44-0 | 6.36E-01 | 13,450 | 694 | 5.11E-03 | 1,614 | 83 | 1.47E-02 |
| R19b_Q | CO | 630-08-0 | 5.41E+00 | | | 4.34E-02 | | | 1.25E-01 |
| R19b_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 3.12E-05 | | | 8.99E-05 |
| R19b_Q | PM | N/A (pm) | 1.50E-01 | | | 1.20E-03 | | | 3.47E-03 |
| R19b_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 1.20E-03 | | | 3.47E-03 |
| R19b_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 3.10E-04 | | | 8.92E-04 |
| R19b_Q | Benzene | 71-43-2 | 1.59E-03 | | | 1.28E-05 | | | 3.68E-05 |
| R19b_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 1.24E-06 | | | 3.58E-06 |
| R19b_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 1.95E-06 | | | 5.63E-06 |
| R19b_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 1.34E-05 | | | 3.85E-05 |
| R19b_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 2.50E-05 | | | 7.21E-05 |
| R19b_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 1.59E-08 | | | 4.59E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Ritson (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R20a_Q | NOx | 10102-44-0 | 6.36E-01 | 16,217 | 1,612 | 1.19E-02 | 1,946 | 193 | 3.42E-02 |
| R20a_Q | CO | 630-08-0 | 5.41E+00 | | | 1.01E-01 | | | 2.91E-01 |
| R20a_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 7.25E-05 | | | 2.09E-04 |
| R20a_Q | PM | N/A (pm) | 1.50E-01 | | | 2.80E-03 | | | 8.06E-03 |
| R20a_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 2.80E-03 | | | 8.06E-03 |
| R20a_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 7.20E-04 | | | 2.07E-03 |
| R20a_Q | Benzene | 71-43-2 | 1.59E-03 | | | 2.97E-05 | | | 8.54E-05 |
| R20a_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 2.89E-06 | | | 8.32E-06 |
| R20a_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 4.54E-06 | | | 1.31E-05 |
| R20a_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 3.11E-05 | | | 8.96E-05 |
| R20a_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 5.82E-05 | | | 1.67E-04 |
| R20a_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 3.71E-08 | | | 1.07E-07 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

| Road Source ID | Contaminant | CAS# | EB/WB Bloor / Ritson (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R20b_Q | NOx | 10102-44-0 | 6.36E-01 | 9,342 | 731 | 5.38E-03 | 1,121 | 88 | 1.55E-02 |
| R20b_Q | CO | 630-08-0 | 5.41E+00 | | | 4.57E-02 | | | 1.32E-01 |
| R20b_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 3.29E-05 | | | 9.47E-05 |
| R20b_Q | PM | N/A (pm) | 1.50E-01 | | | 1.27E-03 | | | 3.65E-03 |
| R20b_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 1.27E-03 | | | 3.65E-03 |
| R20b_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 3.26E-04 | | | 9.40E-04 |
| R20b_Q | Benzene | 71-43-2 | 1.59E-03 | | | 1.34E-05 | | | 3.87E-05 |
| R20b_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 1.31E-06 | | | 3.77E-06 |
| R20b_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 2.06E-06 | | | 5.93E-06 |
| R20b_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 1.41E-05 | | | 4.06E-05 |
| R20b_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 2.64E-05 | | | 7.59E-05 |
| R20b_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 1.68E-08 | | | 4.84E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Bloor (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R21a_Q | NOx | 10102-44-0 | 6.36E-01 | 9,675 | 630 | 4.64E-03 | 1,161 | 76 | 1.34E-02 |
| R21a_Q | CO | 630-08-0 | 5.41E+00 | | | 3.94E-02 | | | 1.14E-01 |
| R21a_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 2.83E-05 | | | 8.16E-05 |
| R21a_Q | PM | N/A (pm) | 1.50E-01 | | | 1.09E-03 | | | 3.15E-03 |
| R21a_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 1.09E-03 | | | 3.15E-03 |
| R21a_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 2.81E-04 | | | 8.10E-04 |
| R21a_Q | Benzene | 71-43-2 | 1.59E-03 | | | 1.16E-05 | | | 3.34E-05 |
| R21a_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 1.13E-06 | | | 3.25E-06 |
| R21a_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 1.77E-06 | | | 5.11E-06 |
| R21a_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 1.22E-05 | | | 3.50E-05 |
| R21a_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 2.27E-05 | | | 6.54E-05 |
| R21a_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 1.45E-08 | | | 4.17E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Bloor (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R21b_Q | NOx | 10102-44-0 | 6.36E-01 | 18,617 | 1,212 | 8.92E-03 | 2,234 | 145 | 2.57E-02 |
| R21b_Q | CO | 630-08-0 | 5.41E+00 | | | 7.59E-02 | | | 2.18E-01 |
| R21b_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 5.45E-05 | | | 1.57E-04 |
| R21b_Q | PM | N/A (pm) | 1.50E-01 | | | 2.10E-03 | | | 6.06E-03 |
| R21b_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 2.10E-03 | | | 6.06E-03 |
| R21b_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 5.41E-04 | | | 1.56E-03 |
| R21b_Q | Benzene | 71-43-2 | 1.59E-03 | | | 2.23E-05 | | | 6.42E-05 |
| R21b_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 2.17E-06 | | | 6.25E-06 |
| R21b_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 3.41E-06 | | | 9.83E-06 |
| R21b_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 2.34E-05 | | | 6.73E-05 |
| R21b_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 4.37E-05 | | | 1.26E-04 |
| R21b_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 2.79E-08 | | | 8.02E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB/SB Ritson (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R22_C | NOx | 10102-44-0 | 4.34E-01 | 21,183 | 2,053 | 1.03E-02 | 2,542 | 246 | 2.97E-02 |
| R22_C | CO | 630-08-0 | 3.41E+00 | | | 8.11E-02 | | | 2.34E-01 |
| R22_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 5.53E-05 | | | 1.59E-04 |
| R22_C | PM | N/A (pm) | 7.32E-02 | | | 1.74E-03 | | | 5.01E-03 |
| R22_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.74E-03 | | | 5.01E-03 |
| R22_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 5.85E-04 | | | 1.69E-03 |
| R22_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.28E-05 | | | 6.57E-05 |
| R22_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.89E-06 | | | 5.45E-06 |
| R22_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.67E-06 | | | 7.68E-06 |
| R22_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.93E-05 | | | 5.56E-05 |
| R22_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 3.49E-05 | | | 1.00E-04 |
| R22_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 3.08E-08 | | | 8.86E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Mc Naughton / Dean (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R23a_Q | NOx | 10102-44-0 | 5.38E-01 | 22,125 | 2,566 | 1.60E-02 | 2,655 | 308 | 4.60E-02 |
| R23a_Q | CO | 630-08-0 | 4.74E+00 | | | 1.41E-01 | | | 4.05E-01 |
| R23a_Q | $SO_2$ | 7446-09-5 | 3.11E-03 | | | 9.23E-05 | | | 2.66E-04 |
| R23a_Q | PM | N/A (pm) | 1.12E-01 | | | 3.34E-03 | | | 9.62E-03 |
| R23a_Q | PM10 | N/A (pm10) | 1.12E-01 | | | 3.34E-03 | | | 9.62E-03 |
| R23a_Q | PM2.5 | N/A (pm2.5) | 3.26E-02 | | | 9.68E-04 | | | 2.79E-03 |
| R23a_Q | Benzene | 71-43-2 | 1.32E-03 | | | 3.93E-05 | | | 1.13E-04 |
| R23a_Q | 1,3-Butadiene | 106-99-0 | 1.16E-04 | | | 3.44E-06 | | | 9.90E-06 |
| R23a_Q | Acrolein | 107-02-8 | 1.69E-04 | | | 5.03E-06 | | | 1.45E-05 |
| R23a_Q | Acetaldehyde | 75-07-0 | 1.20E-03 | | | 3.57E-05 | | | 1.03E-04 |
| R23a_Q | Formaldehyde | 50-00-0 | 2.20E-03 | | | 6.53E-05 | | | 1.88E-04 |
| R23a_Q | Benzo(a)pyrene | 50-32-8 | 1.77E-06 | | | 5.25E-08 | | | 1.51E-07 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Mc Naughton / Dean (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[(1)] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [(2)] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [(3)] (g/s) |
| R23b_Q | NOx | 10102-44-0 | 5.38E-01 | 21,092 | 2,446 | 1.52E-02 | 2,531 | 294 | 4.39E-02 |
| R23b_Q | CO | 630-08-0 | 4.74E+00 | | | 1.34E-01 | | | 3.86E-01 |
| R23b_Q | $SO_2$ | 7446-09-5 | 3.11E-03 | | | 8.80E-05 | | | 2.54E-04 |
| R23b_Q | PM | N/A (pm) | 1.12E-01 | | | 3.18E-03 | | | 9.17E-03 |
| R23b_Q | PM10 | N/A (pm10) | 1.12E-01 | | | 3.18E-03 | | | 9.17E-03 |
| R23b_Q | PM2.5 | N/A (pm2.5) | 3.26E-02 | | | 9.23E-04 | | | 2.66E-03 |
| R23b_Q | Benzene | 71-43-2 | 1.32E-03 | | | 3.74E-05 | | | 1.08E-04 |
| R23b_Q | 1,3-Butadiene | 106-99-0 | 1.16E-04 | | | 3.28E-06 | | | 9.44E-06 |
| R23b_Q | Acrolein | 107-02-8 | 1.69E-04 | | | 4.79E-06 | | | 1.38E-05 |
| R23b_Q | Acetaldehyde | 75-07-0 | 1.20E-03 | | | 3.40E-05 | | | 9.80E-05 |
| R23b_Q | Formaldehyde | 50-00-0 | 2.20E-03 | | | 6.23E-05 | | | 1.79E-04 |
| R23b_Q | Benzo(a)pyrene | 50-32-8 | 1.77E-06 | | | 5.01E-08 | | | 1.44E-07 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB/SB Ritson (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R24_C | NOx | 10102-44-0 | 4.34E-01 | 21,000 | 2,192 | 1.10E-02 | 2,520 | 263 | 3.17E-02 |
| R24_C | CO | 630-08-0 | 3.41E+00 | | | 8.66E-02 | | | 2.49E-01 |
| R24_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 5.90E-05 | | | 1.70E-04 |
| R24_C | PM | N/A (pm) | 7.32E-02 | | | 1.86E-03 | | | 5.35E-03 |
| R24_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.86E-03 | | | 5.35E-03 |
| R24_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 6.25E-04 | | | 1.80E-03 |
| R24_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.44E-05 | | | 7.02E-05 |
| R24_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 2.02E-06 | | | 5.81E-06 |
| R24_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.85E-06 | | | 8.20E-06 |
| R24_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 2.06E-05 | | | 5.94E-05 |
| R24_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 3.72E-05 | | | 1.07E-04 |
| R24_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 3.28E-08 | | | 9.46E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Olive (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R25a_Q | NOx | 10102-44-0 | 5.91E-01 | 21,283 | 2,183 | 1.49E-02 | 2,554 | 262 | 4.30E-02 |
| R25a_Q | CO | 630-08-0 | 5.07E+00 | | | 1.28E-01 | | | 3.69E-01 |
| R25a_Q | $SO_2$ | 7446-09-5 | 3.50E-03 | | | 8.84E-05 | | | 2.55E-04 |
| R25a_Q | PM | N/A (pm) | 1.34E-01 | | | 3.40E-03 | | | 9.78E-03 |
| R25a_Q | PM10 | N/A (pm10) | 1.34E-01 | | | 3.40E-03 | | | 9.78E-03 |
| R25a_Q | PM2.5 | N/A (pm2.5) | 3.65E-02 | | | 9.22E-04 | | | 2.66E-03 |
| R25a_Q | Benzene | 71-43-2 | 1.45E-03 | | | 3.67E-05 | | | 1.06E-04 |
| R25a_Q | 1,3-Butadiene | 106-99-0 | 1.35E-04 | | | 3.41E-06 | | | 9.82E-06 |
| R25a_Q | Acrolein | 107-02-8 | 2.06E-04 | | | 5.20E-06 | | | 1.50E-05 |
| R25a_Q | Acetaldehyde | 75-07-0 | 1.43E-03 | | | 3.62E-05 | | | 1.04E-04 |
| R25a_Q | Formaldehyde | 50-00-0 | 2.65E-03 | | | 6.70E-05 | | | 1.93E-04 |
| R25a_Q | Benzo(a)pyrene | 50-32-8 | 1.90E-06 | | | 4.80E-08 | | | 1.38E-07 |

| Road Source ID | Contaminant | CAS# | NB/SB Ritson / Olive (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R25b_Q | NOx | 10102-44-0 | 5.91E-01 | 16,592 | 1,702 | 1.16E-02 | 1,991 | 204 | 3.35E-02 |
| R25b_Q | CO | 630-08-0 | 5.07E+00 | | | 9.99E-02 | | | 2.88E-01 |
| R25b_Q | $SO_2$ | 7446-09-5 | 3.50E-03 | | | 6.89E-05 | | | 1.98E-04 |
| R25b_Q | PM | N/A (pm) | 1.34E-01 | | | 2.65E-03 | | | 7.62E-03 |
| R25b_Q | PM10 | N/A (pm10) | 1.34E-01 | | | 2.65E-03 | | | 7.62E-03 |
| R25b_Q | PM2.5 | N/A (pm2.5) | 3.65E-02 | | | 7.19E-04 | | | 2.07E-03 |
| R25b_Q | Benzene | 71-43-2 | 1.45E-03 | | | 2.86E-05 | | | 8.25E-05 |
| R25b_Q | 1,3-Butadiene | 106-99-0 | 1.35E-04 | | | 2.66E-06 | | | 7.66E-06 |
| R25b_Q | Acrolein | 107-02-8 | 2.06E-04 | | | 4.06E-06 | | | 1.17E-05 |
| R25b_Q | Acetaldehyde | 75-07-0 | 1.43E-03 | | | 2.82E-05 | | | 8.13E-05 |
| R25b_Q | Formaldehyde | 50-00-0 | 2.65E-03 | | | 5.22E-05 | | | 1.50E-04 |
| R25b_Q | Benzo(a)pyrene | 50-32-8 | 1.90E-06 | | | 3.74E-08 | | | 1.08E-07 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Olive / Ritson (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R26a_Q | NOx | 10102-44-0 | 6.78E-01 | 8,058 | 815 | 6.40E-03 | 967 | 98 | 1.84E-02 |
| R26a_Q | CO | 630-08-0 | 5.64E+00 | | | 5.32E-02 | | | 1.53E-01 |
| R26a_Q | $SO_2$ | 7446-09-5 | 4.18E-03 | | | 3.94E-05 | | | 1.13E-04 |
| R26a_Q | PM | N/A (pm) | 1.65E-01 | | | 1.55E-03 | | | 4.47E-03 |
| R26a_Q | PM10 | N/A (pm10) | 1.65E-01 | | | 1.55E-03 | | | 4.47E-03 |
| R26a_Q | PM2.5 | N/A (pm2.5) | 4.17E-02 | | | 3.93E-04 | | | 1.13E-03 |
| R26a_Q | Benzene | 71-43-2 | 1.68E-03 | | | 1.59E-05 | | | 4.57E-05 |
| R26a_Q | 1,3-Butadiene | 106-99-0 | 1.68E-04 | | | 1.59E-06 | | | 4.57E-06 |
| R26a_Q | Acrolein | 107-02-8 | 2.68E-04 | | | 2.53E-06 | | | 7.29E-06 |
| R26a_Q | Acetaldehyde | 75-07-0 | 1.83E-03 | | | 1.72E-05 | | | 4.96E-05 |
| R26a_Q | Formaldehyde | 50-00-0 | 3.43E-03 | | | 3.23E-05 | | | 9.31E-05 |
| R26a_Q | Benzo(a)pyrene | 50-32-8 | 2.11E-06 | | | 1.99E-08 | | | 5.72E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Olive / Ritson (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R26b_Q | NOx | 10102-44-0 | 6.78E-01 | 9,950 | 1,006 | 7.90E-03 | 1,194 | 121 | 2.28E-02 |
| R26b_Q | CO | 630-08-0 | 5.64E+00 | | | 6.57E-02 | | | 1.89E-01 |
| R26b_Q | $SO_2$ | 7446-09-5 | 4.18E-03 | | | 4.86E-05 | | | 1.40E-04 |
| R26b_Q | PM | N/A (pm) | 1.65E-01 | | | 1.92E-03 | | | 5.52E-03 |
| R26b_Q | PM10 | N/A (pm10) | 1.65E-01 | | | 1.92E-03 | | | 5.52E-03 |
| R26b_Q | PM2.5 | N/A (pm2.5) | 4.17E-02 | | | 4.85E-04 | | | 1.40E-03 |
| R26b_Q | Benzene | 71-43-2 | 1.68E-03 | | | 1.96E-05 | | | 5.64E-05 |
| R26b_Q | 1,3-Butadiene | 106-99-0 | 1.68E-04 | | | 1.96E-06 | | | 5.64E-06 |
| R26b_Q | Acrolein | 107-02-8 | 2.68E-04 | | | 3.13E-06 | | | 9.00E-06 |
| R26b_Q | Acetaldehyde | 75-07-0 | 1.83E-03 | | | 2.13E-05 | | | 6.12E-05 |
| R26b_Q | Formaldehyde | 50-00-0 | 3.43E-03 | | | 3.99E-05 | | | 1.15E-04 |
| R26b_Q | Benzo(a)pyrene | 50-32-8 | 2.11E-06 | | | 2.45E-08 | | | 7.07E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Olive (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor(1) (g/VMT) | ADT | Daily VMT | Daily Emission Rate (2) (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate (3) (g/s) |
| R27_C | NOx | 10102-44-0 | 4.34E-01 | 9,242 | 1,901 | 9.54E-03 | 1,109 | 228 | 2.75E-02 |
| R27_C | CO | 630-08-0 | 3.41E+00 | | | 7.51E-02 | | | 2.16E-01 |
| R27_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 5.12E-05 | | | 1.47E-04 |
| R27_C | PM | N/A (pm) | 7.32E-02 | | | 1.61E-03 | | | 4.64E-03 |
| R27_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.61E-03 | | | 4.64E-03 |
| R27_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 5.42E-04 | | | 1.56E-03 |
| R27_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.11E-05 | | | 6.08E-05 |
| R27_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.75E-06 | | | 5.04E-06 |
| R27_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.47E-06 | | | 7.11E-06 |
| R27_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.79E-05 | | | 5.15E-05 |
| R27_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 3.23E-05 | | | 9.30E-05 |
| R27_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 2.85E-08 | | | 8.20E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | EB/WB Olive/Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R28a_Q | NOx | 10102-44-0 | 5.14E-01 | 9,808 | 719 | 4.28E-03 | 1,177 | 86 | 1.23E-02 |
| R28a_Q | CO | 630-08-0 | 4.52E+00 | | | 3.76E-02 | | | 1.08E-01 |
| R28a_Q | $SO_2$ | 7446-09-5 | 2.96E-03 | | | 2.46E-05 | | | 7.09E-05 |
| R28a_Q | PM | N/A (pm) | 1.07E-01 | | | 8.87E-04 | | | 2.55E-03 |
| R28a_Q | PM10 | N/A (pm10) | 1.07E-01 | | | 8.87E-04 | | | 2.55E-03 |
| R28a_Q | PM2.5 | N/A (pm2.5) | 3.10E-02 | | | 2.58E-04 | | | 7.44E-04 |
| R28a_Q | Benzene | 71-43-2 | 1.27E-03 | | | 1.05E-05 | | | 3.04E-05 |
| R28a_Q | 1,3-Butadiene | 106-99-0 | 1.08E-04 | | | 9.03E-07 | | | 2.60E-06 |
| R28a_Q | Acrolein | 107-02-8 | 1.56E-04 | | | 1.30E-06 | | | 3.74E-06 |
| R28a_Q | Acetaldehyde | 75-07-0 | 1.11E-03 | | | 9.28E-06 | | | 2.67E-05 |
| R28a_Q | Formaldehyde | 50-00-0 | 2.03E-03 | | | 1.69E-05 | | | 4.87E-05 |
| R28a_Q | Benzo(a)pyrene | 50-32-8 | 1.68E-06 | | | 1.40E-08 | | | 4.02E-08 |

| Road Source ID | Contaminant | CAS# | EB/WB Olive/Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R28b_Q | NOx | 10102-44-0 | 5.14E-01 | 7,617 | 776 | 4.62E-03 | 914 | 93 | 1.33E-02 |
| R28b_Q | CO | 630-08-0 | 4.52E+00 | | | 4.06E-02 | | | 1.17E-01 |
| R28b_Q | $SO_2$ | 7446-09-5 | 2.96E-03 | | | 2.65E-05 | | | 7.65E-05 |
| R28b_Q | PM | N/A (pm) | 1.07E-01 | | | 9.57E-04 | | | 2.76E-03 |
| R28b_Q | PM10 | N/A (pm10) | 1.07E-01 | | | 9.57E-04 | | | 2.76E-03 |
| R28b_Q | PM2.5 | N/A (pm2.5) | 3.10E-02 | | | 2.79E-04 | | | 8.03E-04 |
| R28b_Q | Benzene | 71-43-2 | 1.27E-03 | | | 1.14E-05 | | | 3.27E-05 |
| R28b_Q | 1,3-Butadiene | 106-99-0 | 1.08E-04 | | | 9.74E-07 | | | 2.81E-06 |
| R28b_Q | Acrolein | 107-02-8 | 1.56E-04 | | | 1.40E-06 | | | 4.03E-06 |
| R28b_Q | Acetaldehyde | 75-07-0 | 1.11E-03 | | | 1.00E-05 | | | 2.88E-05 |
| R28b_Q | Formaldehyde | 50-00-0 | 2.03E-03 | | | 1.82E-05 | | | 5.25E-05 |
| R28b_Q | Benzo(a)pyrene | 50-32-8 | 1.68E-06 | | | 1.51E-08 | | | 4.34E-08 |

| Road Source ID | Contaminant | CAS# | NB Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R29a_Q | NOx | 10102-44-0 | 8.51E-01 | 4,875 | 171 | 1.68E-03 | 585 | 21 | 4.85E-03 |
| R29a_Q | CO | 630-08-0 | 6.59E+00 | | | 1.30E-02 | | | 3.75E-02 |
| R29a_Q | $SO_2$ | 7446-09-5 | 5.35E-03 | | | 1.06E-05 | | | 3.05E-05 |
| R29a_Q | PM | N/A (pm) | 2.14E-01 | | | 4.23E-04 | | | 1.22E-03 |
| R29a_Q | PM10 | N/A (pm10) | 2.14E-01 | | | 4.23E-04 | | | 1.22E-03 |
| R29a_Q | PM2.5 | N/A (pm2.5) | 5.26E-02 | | | 1.04E-04 | | | 3.00E-04 |
| R29a_Q | Benzene | 71-43-2 | 2.06E-03 | | | 4.08E-06 | | | 1.17E-05 |
| R29a_Q | 1,3-Butadiene | 106-99-0 | 2.22E-04 | | | 4.40E-07 | | | 1.27E-06 |
| R29a_Q | Acrolein | 107-02-8 | 3.71E-04 | | | 7.33E-07 | | | 2.11E-06 |
| R29a_Q | Acetaldehyde | 75-07-0 | 2.47E-03 | | | 4.89E-06 | | | 1.41E-05 |
| R29a_Q | Formaldehyde | 50-00-0 | 4.69E-03 | | | 9.28E-06 | | | 2.67E-05 |
| R29a_Q | Benzo(a)pyrene | 50-32-8 | 2.60E-06 | | | 5.14E-09 | | | 1.48E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R29b_Q | NOx | 10102-44-0 | 8.51E-01 | 1,967 | 69 | 6.79E-04 | 236 | 8 | 1.96E-03 |
| R29b_Q | CO | 630-08-0 | 6.59E+00 | | | 5.26E-03 | | | 1.51E-02 |
| R29b_Q | $SO_2$ | 7446-09-5 | 5.35E-03 | | | 4.27E-06 | | | 1.23E-05 |
| R29b_Q | PM | N/A (pm) | 2.14E-01 | | | 1.71E-04 | | | 4.92E-04 |
| R29b_Q | PM10 | N/A (pm10) | 2.14E-01 | | | 1.71E-04 | | | 4.92E-04 |
| R29b_Q | PM2.5 | N/A (pm2.5) | 5.26E-02 | | | 4.20E-05 | | | 1.21E-04 |
| R29b_Q | Benzene | 71-43-2 | 2.06E-03 | | | 1.65E-06 | | | 4.74E-06 |
| R29b_Q | 1,3-Butadiene | 106-99-0 | 2.22E-04 | | | 1.78E-07 | | | 5.11E-07 |
| R29b_Q | Acrolein | 107-02-8 | 3.71E-04 | | | 2.96E-07 | | | 8.52E-07 |
| R29b_Q | Acetaldehyde | 75-07-0 | 2.47E-03 | | | 1.97E-06 | | | 5.68E-06 |
| R29b_Q | Formaldehyde | 50-00-0 | 4.69E-03 | | | 3.75E-06 | | | 1.08E-05 |
| R29b_Q | Benzo(a)pyrene | 50-32-8 | 2.60E-06 | | | 2.08E-09 | | | 5.98E-09 |

| Road Source ID | Contaminant | CAS# | EB/WB Olive / Simcoe (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R30_Q | NOx | 10102-44-0 | 8.05E-01 | 5,333 | 150 | 1.40E-03 | 640 | 18 | 4.03E-03 |
| R30_Q | CO | 630-08-0 | 6.34E+00 | | | 1.10E-02 | | | 3.17E-02 |
| R30_Q | $SO_2$ | 7446-09-5 | 5.04E-03 | | | 8.76E-06 | | | 2.52E-05 |
| R30_Q | PM | N/A (pm) | 1.99E-01 | | | 3.45E-04 | | | 9.95E-04 |
| R30_Q | PM10 | N/A (pm10) | 1.99E-01 | | | 3.45E-04 | | | 9.95E-04 |
| R30_Q | PM2.5 | N/A (pm2.5) | 4.94E-02 | | | 8.58E-05 | | | 2.47E-04 |
| R30_Q | Benzene | 71-43-2 | 1.96E-03 | | | 3.41E-06 | | | 9.81E-06 |
| R30_Q | 1,3-Butadiene | 106-99-0 | 2.08E-04 | | | 3.61E-07 | | | 1.04E-06 |
| R30_Q | Acrolein | 107-02-8 | 3.43E-04 | | | 5.97E-07 | | | 1.72E-06 |
| R30_Q | Acetaldehyde | 75-07-0 | 2.30E-03 | | | 4.00E-06 | | | 1.15E-05 |
| R30_Q | Formaldehyde | 50-00-0 | 4.36E-03 | | | 7.57E-06 | | | 2.18E-05 |
| R30_Q | Benzo(a)pyrene | 50-32-8 | 2.47E-06 | | | 4.29E-09 | | | 1.24E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Albert (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R31_C | NOx | 10102-44-0 | 4.34E-01 | 5,275 | 190 | 9.54E-04 | 633 | 23 | 2.75E-03 |
| R31_C | CO | 630-08-0 | 3.41E+00 | | | 7.51E-03 | | | 2.16E-02 |
| R31_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 5.12E-06 | | | 1.47E-05 |
| R31_C | PM | N/A (pm) | 7.32E-02 | | | 1.61E-04 | | | 4.64E-04 |
| R31_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.61E-04 | | | 4.64E-04 |
| R31_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 5.42E-05 | | | 1.56E-04 |
| R31_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.11E-06 | | | 6.08E-06 |
| R31_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.75E-07 | | | 5.04E-07 |
| R31_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.47E-07 | | | 7.11E-07 |
| R31_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.79E-06 | | | 5.15E-06 |
| R31_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 3.23E-06 | | | 9.30E-06 |
| R31_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 2.85E-09 | | | 8.20E-09 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

| Road Source ID | Contaminant | CAS# | NB/SB Albert (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R32_C | NOx | 10102-44-0 | 4.34E-01 | 5,275 | 1,180 | 5.92E-03 | 633 | 142 | 1.71E-02 |
| R32_C | CO | 630-08-0 | 3.41E+00 | | | 4.66E-02 | | | 1.34E-01 |
| R32_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 3.18E-05 | | | 9.15E-05 |
| R32_C | PM | N/A (pm) | 7.32E-02 | | | 1.00E-03 | | | 2.88E-03 |
| R32_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.00E-03 | | | 2.88E-03 |
| R32_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 3.36E-04 | | | 9.68E-04 |
| R32_C | Benzene | 71-43-2 | 9.60E-04 | | | 1.31E-05 | | | 3.78E-05 |
| R32_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.09E-06 | | | 3.13E-06 |
| R32_C | Acrolein | 107-02-8 | 1.12E-04 | | | 1.53E-06 | | | 4.42E-06 |
| R32_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.11E-05 | | | 3.20E-05 |
| R32_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 2.00E-05 | | | 5.77E-05 |
| R32_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 1.77E-08 | | | 5.09E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R33a_Q | NOx | 10102-44-0 | 6.36E-01 | 4,617 | 155 | 1.14E-03 | 554 | 19 | 3.28E-03 |
| R33a_Q | CO | 630-08-0 | 5.41E+00 | | | 9.68E-03 | | | 2.79E-02 |
| R33a_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 6.96E-06 | | | 2.00E-05 |
| R33a_Q | PM | N/A (pm) | 1.50E-01 | | | 2.68E-04 | | | 7.73E-04 |
| R33a_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 2.68E-04 | | | 7.73E-04 |
| R33a_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 6.91E-05 | | | 1.99E-04 |
| R33a_Q | Benzene | 71-43-2 | 1.59E-03 | | | 2.85E-06 | | | 8.19E-06 |
| R33a_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 2.77E-07 | | | 7.98E-07 |
| R33a_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 4.35E-07 | | | 1.25E-06 |
| R33a_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 2.98E-06 | | | 8.59E-06 |
| R33a_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 5.58E-06 | | | 1.61E-05 |
| R33a_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 3.55E-09 | | | 1.02E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R33b_Q | NOx | 10102-44-0 | 6.36E-01 | 5,667 | 190 | 1.40E-03 | 680 | 23 | 4.02E-03 |
| R33b_Q | CO | 630-08-0 | 5.41E+00 | | | 1.19E-02 | | | 3.42E-02 |
| R33b_Q | $SO_2$ | 7446-09-5 | 3.89E-03 | | | 8.54E-06 | | | 2.46E-05 |
| R33b_Q | PM | N/A (pm) | 1.50E-01 | | | 3.30E-04 | | | 9.49E-04 |
| R33b_Q | PM10 | N/A (pm10) | 1.50E-01 | | | 3.30E-04 | | | 9.49E-04 |
| R33b_Q | PM2.5 | N/A (pm2.5) | 3.86E-02 | | | 8.48E-05 | | | 2.44E-04 |
| R33b_Q | Benzene | 71-43-2 | 1.59E-03 | | | 3.49E-06 | | | 1.01E-05 |
| R33b_Q | 1,3-Butadiene | 106-99-0 | 1.55E-04 | | | 3.40E-07 | | | 9.79E-07 |
| R33b_Q | Acrolein | 107-02-8 | 2.43E-04 | | | 5.35E-07 | | | 1.54E-06 |
| R33b_Q | Acetaldehyde | 75-07-0 | 1.67E-03 | | | 3.66E-06 | | | 1.05E-05 |
| R33b_Q | Formaldehyde | 50-00-0 | 3.12E-03 | | | 6.85E-06 | | | 1.97E-05 |
| R33b_Q | Benzo(a)pyrene | 50-32-8 | 1.99E-06 | | | 4.36E-09 | | | 1.26E-08 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

## Source: On-Road Vehicle Emissions on Detour Routes During Construction

| Road Source ID | Contaminant | CAS# | EB/WB First (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R34_Q | NOx | 10102-44-0 | 5.83E-01 | 2,733 | 531 | 3.58E-03 | 328 | 64 | 1.03E-02 |
| R34_Q | CO | 630-08-0 | 5.00E+00 | | | 3.08E-02 | | | 8.86E-02 |
| R34_Q | $SO_2$ | 7446-09-5 | 3.42E-03 | | | 2.11E-05 | | | 6.06E-05 |
| R34_Q | PM | N/A (pm) | 1.30E-01 | | | 8.01E-04 | | | 2.31E-03 |
| R34_Q | PM10 | N/A (pm10) | 1.30E-01 | | | 8.01E-04 | | | 2.31E-03 |
| R34_Q | PM2.5 | N/A (pm2.5) | 3.59E-02 | | | 2.21E-04 | | | 6.36E-04 |
| R34_Q | Benzene | 71-43-2 | 1.43E-03 | | | 8.78E-06 | | | 2.53E-05 |
| R34_Q | 1,3-Butadiene | 106-99-0 | 1.31E-04 | | | 8.07E-07 | | | 2.32E-06 |
| R34_Q | Acrolein | 107-02-8 | 1.99E-04 | | | 1.22E-06 | | | 3.52E-06 |
| R34_Q | Acetaldehyde | 75-07-0 | 1.39E-03 | | | 8.53E-06 | | | 2.46E-05 |
| R34_Q | Formaldehyde | 50-00-0 | 2.56E-03 | | | 1.58E-05 | | | 4.54E-05 |
| R34_Q | Benzo(a)pyrene | 50-32-8 | 1.88E-06 | | | 1.16E-08 | | | 3.33E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Albert (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R35_C | NOx | 10102-44-0 | 4.34E-01 | 4,617 | 973 | 4.88E-03 | 554 | 117 | 1.41E-02 |
| R35_C | CO | 630-08-0 | 3.41E+00 | | | 3.84E-02 | | | 1.11E-01 |
| R35_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 2.62E-05 | | | 7.54E-05 |
| R35_C | PM | N/A (pm) | 7.32E-02 | | | 8.24E-04 | | | 2.37E-03 |
| R35_C | PM10 | N/A (pm10) | 7.32E-02 | | | 8.24E-04 | | | 2.37E-03 |
| R35_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 2.77E-04 | | | 7.98E-04 |
| R35_C | Benzene | 71-43-2 | 9.60E-04 | | | 1.08E-05 | | | 3.11E-05 |
| R35_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 8.96E-07 | | | 2.58E-06 |
| R35_C | Acrolein | 107-02-8 | 1.12E-04 | | | 1.26E-06 | | | 3.64E-06 |
| R35_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 9.15E-06 | | | 2.64E-05 |
| R35_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 1.65E-05 | | | 4.76E-05 |
| R35_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 1.46E-08 | | | 4.20E-08 |

| Road Source ID | Contaminant | CAS# | NB/SB Albert (queue link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R36_Q | NOx | 10102-44-0 | 9.06E-01 | 4,617 | 86 | 9.03E-04 | 554 | 10 | 2.60E-03 |
| R36_Q | CO | 630-08-0 | 6.90E+00 | | | 6.87E-03 | | | 1.98E-02 |
| R36_Q | $SO_2$ | 7446-09-5 | 5.73E-03 | | | 5.71E-06 | | | 1.64E-05 |
| R36_Q | PM | N/A (pm) | 2.32E-01 | | | 2.31E-04 | | | 6.66E-04 |
| R36_Q | PM10 | N/A (pm10) | 2.32E-01 | | | 2.31E-04 | | | 6.66E-04 |
| R36_Q | PM2.5 | N/A (pm2.5) | 5.65E-02 | | | 5.63E-05 | | | 1.62E-04 |
| R36_Q | Benzene | 71-43-2 | 2.18E-03 | | | 2.18E-06 | | | 6.26E-06 |
| R36_Q | 1,3-Butadiene | 106-99-0 | 2.40E-04 | | | 2.39E-07 | | | 6.88E-07 |
| R36_Q | Acrolein | 107-02-8 | 4.04E-04 | | | 4.02E-07 | | | 1.16E-06 |
| R36_Q | Acetaldehyde | 75-07-0 | 2.68E-03 | | | 2.67E-06 | | | 7.69E-06 |
| R36_Q | Formaldehyde | 50-00-0 | 5.10E-03 | | | 5.08E-06 | | | 1.46E-05 |
| R36_Q | Benzo(a)pyrene | 50-32-8 | 2.76E-06 | | | 2.75E-09 | | | 7.92E-09 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***

**Source: On-Road Vehicle Emissions on Detour Routes During Construction**

| Road Source ID | Contaminant | CAS# | NB Albert (cruise link) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Emission Factor[1] (g/VMT) | ADT | Daily VMT | Daily Emission Rate [2] (g/s) | Peak Hourly | Hourly VMT | Hourly Emission Rate [3] (g/s) |
| R37_C | NOx | 10102-44-0 | 4.34E-01 | 1,967 | 210 | 1.06E-03 | 236 | 25 | 3.04E-03 |
| R37_C | CO | 630-08-0 | 3.41E+00 | | | 8.31E-03 | | | 2.39E-02 |
| R37_C | $SO_2$ | 7446-09-5 | 2.33E-03 | | | 5.66E-06 | | | 1.63E-05 |
| R37_C | PM | N/A (pm) | 7.32E-02 | | | 1.78E-04 | | | 5.13E-04 |
| R37_C | PM10 | N/A (pm10) | 7.32E-02 | | | 1.78E-04 | | | 5.13E-04 |
| R37_C | PM2.5 | N/A (pm2.5) | 2.46E-02 | | | 5.99E-05 | | | 1.72E-04 |
| R37_C | Benzene | 71-43-2 | 9.60E-04 | | | 2.34E-06 | | | 6.73E-06 |
| R37_C | 1,3-Butadiene | 106-99-0 | 7.96E-05 | | | 1.94E-07 | | | 5.57E-07 |
| R37_C | Acrolein | 107-02-8 | 1.12E-04 | | | 2.73E-07 | | | 7.86E-07 |
| R37_C | Acetaldehyde | 75-07-0 | 8.13E-04 | | | 1.98E-06 | | | 5.70E-06 |
| R37_C | Formaldehyde | 50-00-0 | 1.47E-03 | | | 3.57E-06 | | | 1.03E-05 |
| R37_C | Benzo(a)pyrene | 50-32-8 | 1.29E-06 | | | 3.15E-09 | | | 9.07E-09 |

**Notes:**
(1) Emission factor data are produced using MOVES3.
(2) Daily emission rate (g/s) = Emission factor (g/VMT) x Daily VMT x 1day/24hours x 1hour/3600s
(3) Hourly emission rate (g/s) = Emission factor (g/VMT) x Hourly VMT x 1hour/3600s

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on future traffic data and assumed travelling speeds along the major detour routes around the construction area. Meteorological data (temperature and humidity) in January are used in the model. The calculated emission rate should be conservative.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: Traffic Emissions from Paved Road during Construction

**Description:**
Dust emissions from public road traffic during construction period are estimated in this sheet. The detour roads are paved.

**Contaminant(s) of Concern:**
Particulate matter, including PM, $PM_{10}$, and $PM_{2.5}$ emissions are the contaminants of concern due to the traffic on paved road.
Resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface of roads.

**Methodology: Emission Factor (EF)**
Emission factor was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.1. (Paved Road). The equation is:

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

where:
E = particulate emission factor (g/VMT)
k = particle size multiplier for particle size range and units of interest (g/VMT)
sL = road surface silt loading (g/m$^2$)
W = average weight of vehicles traveling the road (tons)

**Vehicle Weight Calculation:**

| Road Source ID | Road and Direction | Weight of Vehicle[1], (tons) | | Percentage of Vehicle | | Average Weight[2] (tons) |
|---|---|---|---|---|---|---|
| | | Car | Truck | Car | Truck | |
| R1a_Q | NB/SB Simcoe / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R1b_Q | NB/SB Simcoe / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R2a_Q | EB/WB Gibb / Simcoe (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R2b_Q | EB/WB Gibb / Simcoe (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R3_C | EB/WB Gibb (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R4a_Q | EB/WB Gibb / Centre (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R4b_Q | EB/WB Gibb / Centre (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R5_C | EB/WB Gibb (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R6a_Q | EB/WB Park Rd / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R6b_Q | EB/WB Park Rd / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R7a_Q | NB/SB Park Rd / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R7b_Q | NB/SB Park Rd / Gibb (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R8_C | NB/SB Park Rd (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R9_C | NB/SB Park Rd (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R10a_Q | NB/SB Park Rd / Hillside (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R10b_Q | NB/SB Park Rd / Hillside (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R11_C | NB/SB Park Rd (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R12_C | NB/SB Park Rd (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R13_Q | NB/SB Park Rd / Bloor (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R14a_Q | EB/WB Bloor / Park Rd (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R14b_Q | EB/WB Bloor / Park Rd (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R15a_Q | EB/WB Bloor (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R15b_Q | EB/WB Bloor (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R16_C | EB/WB Bloor (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R17a_Q | EB/WB Bloor / Simcoe (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R17b_Q | EB/WB Bloor / Simcoe (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R18_C | EB/WB Bloor (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R19a_Q | EB/WB Bloor / 401 EB ramps (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R19b_Q | EB/WB Bloor / 401 EB ramps (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R20a_Q | EB/WB Bloor / Ritson (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R20b_Q | EB/WB Bloor / Ritson (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R21a_Q | NB/SB Ritson / Bloor (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R21b_Q | NB/SB Ritson / Bloor (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R22_C | NB/SB Ritson (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R23a_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R23b_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R24_C | NB/SB Ritson (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R25a_Q | NB/SB Ritson / Olive (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R25b_Q | NB/SB Ritson / Olive (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R26a_Q | EB/WB Olive / Ritson (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R26b_Q | EB/WB Olive / Ritson (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

**Source: Traffic Emissions from Paved Road during Construction**

| | | | | | | |
|---|---|---|---|---|---|---|
| R27_C | EB/WB Olive (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R28a_Q | EB/WB Olive/Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R28b_Q | EB/WB Olive/Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R29a_Q | NB Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R29b_Q | NB Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R30_Q | EB/WB Olive / Simcoe (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R31_C | NB/SB Albert (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R32_C | NB/SB Albert (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R33a_Q | NB/SB Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R33b_Q | NB/SB Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R34_Q | EB/WB First (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R35_C | NB/SB Albert (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R36_Q | NB/SB Albert (queue link) | 1.8 | 20 | 97% | 3% | 2.3 |
| R37_C | NB Albert (cruise link) | 1.8 | 20 | 97% | 3% | 2.3 |

**Notes:**
(1) Average weight of each type of vehicle is assumed (trucks will include empty load and full load of containers)
(2) Since there are different vehicles running on different schedules and the estimation methodology suggested by US. EPA is intended for a "fleet" average weight of all vehicles travelling on the road, a weighted (based on weight of each vehicle and travelled distance) vehicle mass is used for emissions estimation. Therefore, the average weight on each road is estimated based on the traffic data.

**Emission Factor Calculation:**

| Road Source ID | Road and Direction | Average Vehicle Weight (tons) | Particle Size Factor k[1] (g/VMT) | | | ADT | Silt Loading[2] | Emission Factor[3] (g/VMT) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | PM | PM10 | PM2.5 | | $g/m^2$ | PM | PM10 | PM2.5 |
| R1a_Q | NB/SB Simcoe / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 5,592 | 0.06 | 0.966 | 0.184 | 0.046 |
| R1b_Q | NB/SB Simcoe / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 5,333 | 0.06 | 0.966 | 0.184 | 0.046 |
| R2a_Q | EB/WB Gibb / Simcoe (queue link) | 2.3 | 5.24 | 1 | 0.25 | 6,392 | 0.06 | 0.966 | 0.184 | 0.046 |
| R2b_Q | EB/WB Gibb / Simcoe (queue link) | 2.3 | 5.24 | 1 | 0.25 | 2,650 | 0.20 | 2.891 | 0.552 | 0.138 |
| R3_C | EB/WB Gibb (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 6,192 | 0.06 | 0.966 | 0.184 | 0.046 |
| R4a_Q | EB/WB Gibb / Centre (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,275 | 0.06 | 0.966 | 0.184 | 0.046 |
| R4b_Q | EB/WB Gibb / Centre (queue link) | 2.3 | 5.24 | 1 | 0.25 | 6,267 | 0.06 | 0.966 | 0.184 | 0.046 |
| R5_C | EB/WB Gibb (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 9,883 | 0.06 | 0.966 | 0.184 | 0.046 |
| R6a_Q | EB/WB Park Rd / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 10,983 | 0.03 | 0.514 | 0.098 | 0.025 |
| R6b_Q | EB/WB Park Rd / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,933 | 0.06 | 0.966 | 0.184 | 0.046 |
| R7a_Q | NB/SB Park Rd / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 15,467 | 0.03 | 0.514 | 0.098 | 0.025 |
| R7b_Q | NB/SB Park Rd / Gibb (queue link) | 2.3 | 5.24 | 1 | 0.25 | 13,283 | 0.03 | 0.514 | 0.098 | 0.025 |
| R8_C | NB/SB Park Rd (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 15,342 | 0.03 | 0.514 | 0.098 | 0.025 |
| R9_C | NB/SB Park Rd (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 15,342 | 0.03 | 0.514 | 0.098 | 0.025 |
| R10a_Q | NB/SB Park Rd / Hillside (queue link) | 2.3 | 5.24 | 1 | 0.25 | 12,608 | 0.03 | 0.514 | 0.098 | 0.025 |
| R10b_Q | NB/SB Park Rd / Hillside (queue link) | 2.3 | 5.24 | 1 | 0.25 | 15,183 | 0.03 | 0.514 | 0.098 | 0.025 |
| R11_C | NB/SB Park Rd (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 13,517 | 0.03 | 0.514 | 0.098 | 0.025 |
| R12_C | NB/SB Park Rd (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 13,517 | 0.03 | 0.514 | 0.098 | 0.025 |
| R13_Q | NB/SB Park Rd / Bloor (queue link) | 2.3 | 5.24 | 1 | 0.25 | 12,658 | 0.03 | 0.514 | 0.098 | 0.025 |
| R14a_Q | EB/WB Bloor / Park Rd (queue link) | 2.3 | 5.24 | 1 | 0.25 | 15,833 | 0.03 | 0.514 | 0.098 | 0.025 |
| R14b_Q | EB/WB Bloor / Park Rd (queue link) | 2.3 | 5.24 | 1 | 0.25 | 17,183 | 0.03 | 0.514 | 0.098 | 0.025 |
| R15a_Q | EB/WB Bloor (queue link) | 2.3 | 5.24 | 1 | 0.25 | 19,033 | 0.03 | 0.514 | 0.098 | 0.025 |
| R15b_Q | EB/WB Bloor (queue link) | 2.3 | 5.24 | 1 | 0.25 | 11,325 | 0.03 | 0.514 | 0.098 | 0.025 |
| R16_C | EB/WB Bloor (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 11,483 | 0.03 | 0.514 | 0.098 | 0.025 |
| R17a_Q | EB/WB Bloor / Simcoe (queue link) | 2.3 | 5.24 | 1 | 0.25 | 15,158 | 0.03 | 0.514 | 0.098 | 0.025 |
| R17b_Q | EB/WB Bloor / Simcoe (queue link) | 2.3 | 5.24 | 1 | 0.25 | 15,700 | 0.03 | 0.514 | 0.098 | 0.025 |
| R18_C | EB/WB Bloor (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 13,433 | 0.03 | 0.514 | 0.098 | 0.025 |
| R19a_Q | EB/WB Bloor / 401 EB ramps (queue link) | 2.3 | 5.24 | 1 | 0.25 | 10,567 | 0.03 | 0.514 | 0.098 | 0.025 |
| R19b_Q | EB/WB Bloor / 401 EB ramps (queue link) | 2.3 | 5.24 | 1 | 0.25 | 13,450 | 0.03 | 0.514 | 0.098 | 0.025 |
| R20a_Q | EB/WB Bloor / Ritson (queue link) | 2.3 | 5.24 | 1 | 0.25 | 16,217 | 0.03 | 0.514 | 0.098 | 0.025 |
| R20b_Q | EB/WB Bloor / Ritson (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,342 | 0.06 | 0.966 | 0.184 | 0.046 |
| R21a_Q | NB/SB Ritson / Bloor (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,675 | 0.06 | 0.966 | 0.184 | 0.046 |
| R21b_Q | NB/SB Ritson / Bloor (queue link) | 2.3 | 5.24 | 1 | 0.25 | 18,617 | 0.03 | 0.514 | 0.098 | 0.025 |
| R22_C | NB/SB Ritson (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 21,183 | 0.03 | 0.514 | 0.098 | 0.025 |
| R23a_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 2.3 | 5.24 | 1 | 0.25 | 22,125 | 0.03 | 0.514 | 0.098 | 0.025 |
| R23b_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 2.3 | 5.24 | 1 | 0.25 | 21,092 | 0.03 | 0.514 | 0.098 | 0.025 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

**Source: Traffic Emissions from Paved Road during Construction**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| R24_C | NB/SB Ritson (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 21,000 | 0.03 | 0.514 | 0.098 | 0.025 |
| R25a_Q | NB/SB Ritson / Olive (queue link) | 2.3 | 5.24 | 1 | 0.25 | 21,283 | 0.03 | 0.514 | 0.098 | 0.025 |
| R25b_Q | NB/SB Ritson / Olive (queue link) | 2.3 | 5.24 | 1 | 0.25 | 16,592 | 0.03 | 0.514 | 0.098 | 0.025 |
| R26a_Q | EB/WB Olive / Ritson (queue link) | 2.3 | 5.24 | 1 | 0.25 | 8,058 | 0.06 | 0.966 | 0.184 | 0.046 |
| R26b_Q | EB/WB Olive / Ritson (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,950 | 0.06 | 0.966 | 0.184 | 0.046 |
| R27_C | EB/WB Olive (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 9,242 | 0.06 | 0.966 | 0.184 | 0.046 |
| R28a_Q | EB/WB Olive/Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 9,808 | 0.06 | 0.966 | 0.184 | 0.046 |
| R28b_Q | EB/WB Olive/Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 7,617 | 0.06 | 0.966 | 0.184 | 0.046 |
| R29a_Q | NB Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 4,875 | 0.20 | 2.891 | 0.552 | 0.138 |
| R29b_Q | NB Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 1,967 | 0.20 | 2.891 | 0.552 | 0.138 |
| R30_Q | EB/WB Olive / Simcoe (queue link) | 2.3 | 5.24 | 1 | 0.25 | 5,333 | 0.06 | 0.966 | 0.184 | 0.046 |
| R31_C | NB/SB Albert (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 5,275 | 0.06 | 0.966 | 0.184 | 0.046 |
| R32_C | NB/SB Albert (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 5,275 | 0.06 | 0.966 | 0.184 | 0.046 |
| R33a_Q | NB/SB Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 4,617 | 0.20 | 2.891 | 0.552 | 0.138 |
| R33b_Q | NB/SB Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 5,667 | 0.06 | 0.966 | 0.184 | 0.046 |
| R34_Q | EB/WB First (queue link) | 2.3 | 5.24 | 1 | 0.25 | 2,733 | 0.20 | 2.891 | 0.552 | 0.138 |
| R35_C | NB/SB Albert (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 4,617 | 0.20 | 2.891 | 0.552 | 0.138 |
| R36_Q | NB/SB Albert (queue link) | 2.3 | 5.24 | 1 | 0.25 | 4,617 | 0.20 | 2.891 | 0.552 | 0.138 |
| R37_C | NB Albert (cruise link) | 2.3 | 5.24 | 1 | 0.25 | 1,967 | 0.20 | 2.891 | 0.552 | 0.138 |

**Notes:**
(1) Reference: USEPA AP-42 Table 13.2.1-1
(2) Ubiquitous Silt Loading Default Values (AP-42 Chapter 13.2.1 - T2). The ADT of future traffic on the subject road is used in the evaluation.

| ADT Category | sL ($g/m^2$) |
|---|---|
| <500 | 0.6 |
| 500-5,000 | 0.2 |
| 5,000-10,000 | 0.06 |
| >10,000 | 0.03 |

(3) Emission factors are calculated using the above equation.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: Traffic Emissions from Paved Road during Construction

**Emission Calculation:**

| Road Source ID | Road and Direction | Road Length (mile) | Traffic Volume per Day[1] | Total Travel Distance (mile/day) | Emission Rate[2,3] (g/s) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | PM | PM10 | PM2.5 | Crystalline silica |
| R1a_Q | NB/SB Simcoe / Gibb (queue link) | 0.02 | 5,592 | 123 | 0.0014 | 0.0003 | 0.0001 | 0.00001 |
| R1b_Q | NB/SB Simcoe / Gibb (queue link) | 0.02 | 5,333 | 117 | 0.0013 | 0.0003 | 0.0001 | 0.00001 |
| R2a_Q | EB/WB Gibb / Simcoe (queue link) | 0.02 | 6,392 | 150 | 0.0017 | 0.0003 | 0.0001 | 0.00002 |
| R2b_Q | EB/WB Gibb / Simcoe (queue link) | 0.02 | 2,650 | 62 | 0.0021 | 0.0004 | 0.0001 | 0.00002 |
| R3_C | EB/WB Gibb (cruise link) | 0.05 | 6,192 | 289 | 0.0032 | 0.0006 | 0.0002 | 0.00003 |
| R4a_Q | EB/WB Gibb / Centre (queue link) | 0.03 | 9,275 | 312 | 0.0035 | 0.0007 | 0.0002 | 0.00003 |
| R4b_Q | EB/WB Gibb / Centre (queue link) | 0.03 | 6,267 | 211 | 0.0024 | 0.0004 | 0.0001 | 0.00002 |
| R5_C | EB/WB Gibb (cruise link) | 0.33 | 9,883 | 3,230 | 0.0361 | 0.0069 | 0.0017 | 0.00036 |
| R6a_Q | EB/WB Park Rd / Gibb (queue link) | 0.05 | 10,983 | 603 | 0.0036 | 0.0007 | 0.0002 | 0.00004 |
| R6b_Q | EB/WB Park Rd / Gibb (queue link) | 0.05 | 9,933 | 545 | 0.0061 | 0.0012 | 0.0003 | 0.00006 |
| R7a_Q | NB/SB Park Rd / Gibb (queue link) | 0.07 | 15,467 | 1,087 | 0.0065 | 0.0012 | 0.0003 | 0.00006 |
| R7b_Q | NB/SB Park Rd / Gibb (queue link) | 0.07 | 13,283 | 933 | 0.0056 | 0.0011 | 0.0003 | 0.00006 |
| R8_C | NB/SB Park Rd (cruise link) | 0.31 | 15,342 | 4,795 | 0.0285 | 0.0054 | 0.0014 | 0.00028 |
| R9_C | NB/SB Park Rd (cruise link) | 0.04 | 15,342 | 667 | 0.0040 | 0.0008 | 0.0002 | 0.00004 |
| R10a_Q | NB/SB Park Rd / Hillside (queue link) | 0.04 | 12,608 | 526 | 0.0031 | 0.0006 | 0.0001 | 0.00003 |
| R10b_Q | NB/SB Park Rd / Hillside (queue link) | 0.04 | 15,183 | 634 | 0.0038 | 0.0007 | 0.0002 | 0.00004 |
| R11_C | NB/SB Park Rd (cruise link) | 0.07 | 13,517 | 882 | 0.0053 | 0.0010 | 0.0003 | 0.00005 |
| R12_C | NB/SB Park Rd (cruise link) | 0.12 | 13,517 | 1,638 | 0.0098 | 0.0019 | 0.0005 | 0.00010 |
| R13_Q | NB/SB Park Rd / Bloor (queue link) | 0.08 | 12,658 | 971 | 0.0058 | 0.0011 | 0.0003 | 0.00006 |
| R14a_Q | EB/WB Bloor / Park Rd (queue link) | 0.06 | 15,833 | 874 | 0.0052 | 0.0010 | 0.0002 | 0.00005 |
| R14b_Q | EB/WB Bloor / Park Rd (queue link) | 0.06 | 17,183 | 948 | 0.0056 | 0.0011 | 0.0003 | 0.00006 |
| R15a_Q | EB/WB Bloor (queue link) | 0.08 | 19,033 | 1,478 | 0.0088 | 0.0017 | 0.0004 | 0.00009 |
| R15b_Q | EB/WB Bloor (queue link) | 0.05 | 11,325 | 610 | 0.0036 | 0.0007 | 0.0002 | 0.00004 |
| R16_C | EB/WB Bloor (cruise link) | 0.26 | 11,483 | 3,018 | 0.0180 | 0.0034 | 0.0009 | 0.00018 |
| R17a_Q | EB/WB Bloor / Simcoe (queue link) | 0.11 | 15,158 | 1,733 | 0.0103 | 0.0020 | 0.0005 | 0.00010 |
| R17b_Q | EB/WB Bloor / Simcoe (queue link) | 0.11 | 15,700 | 1,795 | 0.0107 | 0.0020 | 0.0005 | 0.00011 |
| R18_C | EB/WB Bloor (cruise link) | 0.19 | 13,433 | 2,604 | 0.0155 | 0.0030 | 0.0007 | 0.00015 |
| R19a_Q | EB/WB Bloor / 401 EB ramps (queue link) | 0.05 | 10,567 | 545 | 0.0032 | 0.0006 | 0.0002 | 0.00003 |
| R19b_Q | EB/WB Bloor / 401 EB ramps (queue link) | 0.05 | 13,450 | 694 | 0.0041 | 0.0008 | 0.0002 | 0.00004 |
| R20a_Q | EB/WB Bloor / Ritson (queue link) | 0.10 | 16,217 | 1,612 | 0.0096 | 0.0018 | 0.0005 | 0.00010 |
| R20b_Q | EB/WB Bloor / Ritson (queue link) | 0.08 | 9,342 | 731 | 0.0082 | 0.0016 | 0.0004 | 0.00008 |
| R21a_Q | NB/SB Ritson / Bloor (queue link) | 0.07 | 9,675 | 630 | 0.0070 | 0.0013 | 0.0003 | 0.00007 |
| R21b_Q | NB/SB Ritson / Bloor (queue link) | 0.07 | 18,617 | 1,212 | 0.0072 | 0.0014 | 0.0003 | 0.00007 |
| R22_C | NB/SB Ritson (cruise link) | 0.10 | 21,183 | 2,053 | 0.0122 | 0.0023 | 0.0006 | 0.00012 |
| R23a_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 0.12 | 22,125 | 2,566 | 0.0153 | 0.0029 | 0.0007 | 0.00015 |
| R23b_Q | NB/SB Ritson / Mc Naughton / Dean (queue link) | 0.12 | 21,092 | 2,446 | 0.0146 | 0.0028 | 0.0007 | 0.00015 |
| R24_C | NB/SB Ritson (cruise link) | 0.10 | 21,000 | 2,192 | 0.0131 | 0.0025 | 0.0006 | 0.00013 |
| R25a_Q | NB/SB Ritson / Olive (queue link) | 0.10 | 21,283 | 2,183 | 0.0130 | 0.0025 | 0.0006 | 0.00013 |
| R25b_Q | NB/SB Ritson / Olive (queue link) | 0.10 | 16,592 | 1,702 | 0.0101 | 0.0019 | 0.0005 | 0.00010 |
| R26a_Q | EB/WB Olive / Ritson (queue link) | 0.10 | 8,058 | 815 | 0.0091 | 0.0017 | 0.0004 | 0.00009 |
| R26b_Q | EB/WB Olive / Ritson (queue link) | 0.10 | 9,950 | 1,006 | 0.0113 | 0.0021 | 0.0005 | 0.00011 |
| R27_C | EB/WB Olive (cruise link) | 0.21 | 9,242 | 1,901 | 0.0213 | 0.0041 | 0.0010 | 0.00021 |
| R28a_Q | EB/WB Olive/Albert (queue link) | 0.07 | 9,808 | 719 | 0.0080 | 0.0015 | 0.0004 | 0.00008 |
| R28b_Q | EB/WB Olive/Albert (queue link) | 0.10 | 7,617 | 776 | 0.0087 | 0.0017 | 0.0004 | 0.00009 |
| R29a_Q | NB Albert (queue link) | 0.04 | 4,875 | 171 | 0.0057 | 0.0011 | 0.0003 | 0.00006 |
| R29b_Q | NB Albert (queue link) | 0.04 | 1,967 | 69 | 0.0023 | 0.0004 | 0.0001 | 0.00002 |
| R30_Q | EB/WB Olive / Simcoe (queue link) | 0.03 | 5,333 | 150 | 0.0017 | 0.0003 | 0.0001 | 0.00002 |
| R31_C | NB/SB Albert (cruise link) | 0.04 | 5,275 | 190 | 0.0021 | 0.0004 | 0.0001 | 0.00002 |
| R32_C | NB/SB Albert (cruise link) | 0.22 | 5,275 | 1,180 | 0.0132 | 0.0025 | 0.0006 | 0.00013 |
| R33a_Q | NB/SB Albert (queue link) | 0.03 | 4,617 | 155 | 0.0052 | 0.0010 | 0.0002 | 0.00005 |
| R33b_Q | NB/SB Albert (queue link) | 0.03 | 5,667 | 190 | 0.0021 | 0.0004 | 0.0001 | 0.00002 |
| R34_Q | EB/WB First (queue link) | 0.19 | 2,733 | 531 | 0.0178 | 0.0034 | 0.0008 | 0.00018 |
| R35_C | NB/SB Albert (cruise link) | 0.21 | 4,617 | 973 | 0.0325 | 0.0062 | 0.0016 | 0.00032 |
| R36_Q | NB/SB Albert (queue link) | 0.02 | 4,617 | 86 | 0.0029 | 0.0005 | 0.0001 | 0.00003 |
| R37_C | NB Albert (cruise link) | 0.11 | 1,967 | 210 | 0.0070 | 0.0013 | 0.0003 | 0.00007 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*

## Source: Traffic Emissions from Paved Road during Construction

**Notes:**

(1) Average Daily Traffic (ADT), AM Peak and PM peak data and vehicle distribution data provided by project transportation team. Note that ADT are estimated by applying a K-Factor of 0.12 or the application of an

(2) Emission control efficiency is not applied to the dust quantification.

(3) Crystalline silica emission rate is based on 5.22% of PM10 from road dust and from dust from construction activities. Percent of silicon oxide ($SiO_2$) from Table 4 in "Screening Assessment for the Challenge, Quartz Chemical Abstracts Service Registry Number 14808-60-7, Cristobalite Chemical Abstracts Service Registry Number 14464-46-1", Environment Canada / Health Canada, June 2013

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

## Source: Emissions from GM Diesel Trains During Operation

**SOURCE ID:**
CP0, GM1, GM2, CP1A, CP1B, CP2A, CP2B, CP2C, CP3, CP4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.
The study area is divided into three model segments including the Oshawa, Courtice and Bowmanville segments to match the area of coverage specified by the MECP site specific meteorological data sets.
It is assumed that GM and CP trains within the study area are only travelling / passing by at constant speed.
There are no GO trains operating within the study area during the baseline and future no build scenario.

The train data are summarized below.

| | | | |
|---|---|---|---|
| **Number of Trains** | | | |
| GM trains | 3 | trains/day | Maximum daily trains provided by PM team (daytime 3) |
| | 1 | trains/hour | Assumed maximum hourly trains |
| **Number of Engines per Locomotive** | | | |
| GM locomotive | 1 | engine | Average one (1) locomotive and 6 cars |
| **Total Number of Engines** | | | |
| GM locomotive | 3 | engines /day | calculated |
| **Power rating of locomotive** | 4245 | hp/each | Train engine based on 201075-STANTEC-RFI-00017. Tier 2 engine data (notch 8). |
| **Fuel type in locomotive** | Diesel | - | - |
| **Line volume source lengths in Oshawa segment** | | | |
| CP0 | 1.09 | km | EX/FNB/FB - CP and GM trains west of study area |
| GM1 | 1.29 | km | EX/FNB - GM Trains on Existing Railway Tracks |
| GM2 | 1.29 | km | FB - GM Trains on Future Build Railway Tracks |
| CP1A | 1.36 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Oshawa |
| CP1B | 6.22 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Oshawa |
| **Line volume source lengths in Courtice segment** | | | |
| CP2A | 3.79 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| CP2B | 2.36 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| CP2C | 3.44 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| **Line volume source lengths in Bowmanville segment** | | | |
| CP3 | 4.54 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Bowmanville |
| CP4 | 1.00 | km | EX/FNB/FB - CP and GM trains east of study area |
| **Travel Speeds** | | | |
| Along main rail corridor | 55 | mph | Assumed 55 mph (88.5 km/h) for CP and GM trains |
| Connecting line between CP and CN | 25 | mph | Assumed 25 mph (40 km/h) for GM trains and GO trains |

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in locomotive engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the vehicle. $SO_2$ emission factor is calculated below.

**SO2 Emission Factor Calculation:**

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$ |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

**Source: Emissions from GM Diesel Trains During Operation**

NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite travelling train tailpipe exhausts are calculated based on the document "201075-STANTEC-RFI-00017" provided by Metrolinx. Tier 2 engine emission rates are conservatively used. These emission factors are listed below along with the emission calculations for both maximum hourly and daily emission rates.

**Emission Calculations - Criteria Contaminants: Diesel Trains Travelling**

| Source ID | Contaminant | CAS# | Tier 2 Engine Maximum Power Rating (hp each) | Tier 2 Engine Emission Factor[1] | | Tier 2 Engine Operating Load[2] | Peak Emission Rate per Equipment[4] (g/s) | Number of Equipment per Hour | Number of Equipment per Day | Onsite Travelling Time[3] (hour/train) | Hourly Emission Rate (g/s) | Daily Average Emission Rate (g/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CP0 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.012 | 7.48E-05 | 9.35E-06 |
| CP0 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.012 | 4.58E-02 | 5.72E-03 |
| CP0 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.012 | 6.22E-04 | 7.77E-05 |
| CP0 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.012 | 5.97E-04 | 7.46E-05 |
| CP0 | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 1 | 3 | 0.012 | 5.60E-04 | 6.99E-05 |
| CP0 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.012 | 7.66E-04 | 9.57E-05 |
| CP0 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.012 | 1.04E-03 | 1.31E-04 |
| GM1 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.032 | 1.95E-04 | 2.44E-05 |
| GM1 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.032 | 1.20E-01 | 1.49E-02 |
| GM1 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.032 | 1.62E-03 | 2.03E-04 |
| GM1 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.032 | 1.56E-03 | 1.95E-04 |
| GM1 | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.032 | 1.46E-03 | 1.83E-04 |
| GM1 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.032 | 2.00E-03 | 2.50E-04 |
| GM1 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.032 | 2.73E-03 | 3.41E-04 |
| GM2 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.032 | 1.95E-04 | 2.44E-05 |
| GM2 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.032 | 1.20E-01 | 1.49E-02 |
| GM2 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.032 | 1.62E-03 | 2.03E-04 |
| GM2 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.032 | 1.56E-03 | 1.95E-04 |
| GM2 | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.032 | 1.46E-03 | 1.83E-04 |
| GM2 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.032 | 2.00E-03 | 2.50E-04 |
| GM2 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.032 | 2.73E-03 | 3.41E-04 |
| CP1A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.015 | 9.35E-05 | 1.17E-05 |
| CP1A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.015 | 5.72E-02 | 7.15E-03 |
| CP1A | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.015 | 7.77E-04 | 9.71E-05 |
| CP1A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.015 | 7.46E-04 | 9.33E-05 |
| CP1A | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.015 | 6.99E-04 | 8.74E-05 |
| CP1A | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.015 | 9.57E-04 | 1.20E-04 |
| CP1A | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.015 | 1.31E-03 | 1.63E-04 |
| CP1B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.070 | 4.28E-04 | 5.35E-05 |
| CP1B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.070 | 2.62E-01 | 3.27E-02 |
| CP1B | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.070 | 3.56E-03 | 4.45E-04 |
| CP1B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.070 | 3.42E-03 | 4.27E-04 |
| CP1B | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.070 | 3.20E-03 | 4.00E-04 |
| CP1B | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.070 | 4.38E-03 | 5.48E-04 |
| CP1B | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.070 | 5.98E-03 | 7.47E-04 |
| CP2A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.043 | 2.61E-04 | 3.26E-05 |
| CP2A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.043 | 1.60E-01 | 1.99E-02 |
| CP2A | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.043 | 2.17E-03 | 2.71E-04 |
| CP2A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.043 | 2.08E-03 | 2.60E-04 |
| CP2A | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.043 | 1.95E-03 | 2.44E-04 |
| CP2A | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.043 | 2.67E-03 | 3.34E-04 |
| CP2A | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.043 | 3.64E-03 | 4.55E-04 |
| CP2B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.027 | 1.63E-04 | 2.03E-05 |
| CP2B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.027 | 9.95E-02 | 1.24E-02 |
| CP2B | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.027 | 1.35E-03 | 1.69E-04 |
| CP2B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.027 | 1.30E-03 | 1.62E-04 |
| CP2B | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.027 | 1.22E-03 | 1.52E-04 |
| CP2B | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.027 | 1.66E-03 | 2.08E-04 |
| CP2B | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.027 | 2.27E-03 | 2.84E-04 |
| CP2C | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.039 | 2.37E-04 | 2.96E-05 |
| CP2C | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.039 | 1.45E-01 | 1.81E-02 |
| CP2C | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.039 | 1.97E-03 | 2.46E-04 |
| CP2C | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.039 | 1.89E-03 | 2.36E-04 |
| CP2C | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.039 | 1.77E-03 | 2.21E-04 |
| CP2C | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.039 | 2.42E-03 | 3.03E-04 |
| CP2C | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.039 | 3.31E-03 | 4.13E-04 |
| CP3 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.051 | 3.13E-04 | 3.91E-05 |
| CP3 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.051 | 1.91E-01 | 2.39E-02 |
| CP3 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.051 | 2.60E-03 | 3.25E-04 |
| CP3 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.051 | 2.50E-03 | 3.12E-04 |
| CP3 | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.051 | 2.34E-03 | 2.93E-04 |
| CP3 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.051 | 3.20E-03 | 4.00E-04 |
| CP3 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.051 | 4.37E-03 | 5.46E-04 |
| CP4 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 1 | 3 | 0.011 | 6.91E-05 | 8.64E-06 |
| CP4 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 1 | 3 | 0.011 | 4.23E-02 | 5.29E-03 |
| CP4 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 1 | 3 | 0.011 | 5.74E-04 | 7.18E-05 |
| CP4 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 1 | 3 | 0.011 | 5.52E-04 | 6.89E-05 |
| CP4 | PM2.5 | N/A (pm2.5) | 4245 | 164.2 | g/h | 69% | 0.0456 | 1 | 3 | 0.011 | 5.17E-04 | 6.46E-05 |
| CP4 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 1 | 3 | 0.011 | 7.07E-04 | 8.84E-05 |
| CP4 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 1 | 3 | 0.011 | 9.65E-04 | 1.21E-04 |

**Notes:**
(1) $SO_2$ emission factor is calculated in above table and based on the fuel sulphur content. Other emission factors were provided by Metrolinx. Tier 2 engines are conservatively used.
(2) An average operating load of Notch 6 is assumed for train engines during travelling on rail way (not in full speed) and at steady state. An operating load of 50% is assumed for HEP engines as per the Draft Mx AQ Guide dated Noveber 2019.
(3) Onsite travelling time is estimated based on the railway length assessed and the train travel speed.
(4) $SO_2$ emission rates are estimated based on the train passing time, emission factor, power rating and number of locomotives. Emission rates of other contaminants are from 201075-STANTEC-RFI-00014 - Locomotive Information_Attachment.pdf provided by Metrolinx.
(5) For PM emissions from the tailpipe of the equipment, based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

Key volatile organic compounds emissions from tailpipe exhausts are estimated based on the related reference emission factor data. These emission factors are listed below along with the emission calculations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

**Source: Emissions from GM Diesel Trains During Operation**

**Emission Calculations - Key VOCs: Diesel Trains Travelling**

| Source ID | Contaminant | CAS# | Emission Factor[1] (g/hr) | Peak Emission Rate per Equipment[3] (g/s) | Number of Equipment | | Travelling Time[2] (hour/train) | Hourly Emission Rate[3] (g/s) | Daily Average Emission Rate[3] (g/s) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | per Hour | per Day | | | |
| CP0 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.012 | 5.65E-05 | 7.06E-06 |
| CP0 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.012 | 1.94E-06 | 2.43E-07 |
| CP0 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.012 | 1.95E-05 | 2.44E-06 |
| CP0 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.012 | 1.09E-04 | 1.36E-05 |
| CP0 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.012 | 3.05E-04 | 3.81E-05 |
| CP0 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.012 | 4.15E-09 | 5.18E-10 |
| GM1 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.032 | 1.48E-04 | 1.84E-05 |
| GM1 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.032 | 5.07E-06 | 6.34E-07 |
| GM1 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.032 | 5.10E-05 | 6.38E-06 |
| GM1 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.032 | 2.84E-04 | 3.55E-05 |
| GM1 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.032 | 7.97E-04 | 9.96E-05 |
| GM1 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.032 | 1.08E-08 | 1.35E-09 |
| GM2 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.032 | 1.48E-04 | 1.85E-05 |
| GM2 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.032 | 5.08E-06 | 6.35E-07 |
| GM2 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.032 | 5.10E-05 | 6.38E-06 |
| GM2 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.032 | 2.84E-04 | 3.55E-05 |
| GM2 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.032 | 7.97E-04 | 9.96E-05 |
| GM2 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.032 | 1.08E-08 | 1.35E-09 |
| CP1A | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.015 | 7.06E-05 | 8.83E-06 |
| CP1A | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.015 | 2.43E-06 | 3.04E-07 |
| CP1A | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.015 | 2.44E-05 | 3.05E-06 |
| CP1A | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.015 | 1.36E-04 | 1.70E-05 |
| CP1A | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.015 | 3.81E-04 | 4.77E-05 |
| CP1A | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.015 | 5.18E-09 | 6.48E-10 |
| CP1B | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.070 | 3.23E-04 | 4.04E-05 |
| CP1B | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.070 | 1.11E-05 | 1.39E-06 |
| CP1B | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.070 | 1.12E-04 | 1.40E-05 |
| CP1B | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.070 | 6.22E-04 | 7.77E-05 |
| CP1B | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.070 | 1.75E-03 | 2.18E-04 |
| CP1B | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.070 | 2.37E-08 | 2.97E-09 |
| CP2A | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.043 | 1.97E-04 | 2.46E-05 |
| CP2A | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.043 | 6.77E-06 | 8.46E-07 |
| CP2A | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.043 | 6.81E-05 | 8.51E-06 |
| CP2A | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.043 | 3.79E-04 | 4.73E-05 |
| CP2A | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.043 | 1.06E-03 | 1.33E-04 |
| CP2A | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.043 | 1.45E-08 | 1.81E-09 |
| CP2B | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.027 | 1.23E-04 | 1.54E-05 |
| CP2B | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.027 | 4.22E-06 | 5.28E-07 |
| CP2B | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.027 | 4.25E-05 | 5.31E-06 |
| CP2B | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.027 | 2.36E-04 | 2.95E-05 |
| CP2B | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.027 | 6.63E-04 | 8.29E-05 |
| CP2B | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.027 | 9.02E-09 | 1.13E-09 |
| CP2C | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.039 | 1.79E-04 | 2.24E-05 |
| CP2C | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.039 | 6.15E-06 | 7.68E-07 |
| CP2C | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.039 | 6.18E-05 | 7.73E-06 |
| CP2C | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.039 | 3.44E-04 | 4.30E-05 |
| CP2C | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.039 | 9.65E-04 | 1.21E-04 |
| CP2C | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.039 | 1.31E-08 | 1.64E-09 |
| CP3 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.051 | 2.36E-04 | 2.95E-05 |
| CP3 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.051 | 8.13E-06 | 1.02E-06 |
| CP3 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.051 | 8.17E-05 | 1.02E-05 |
| CP3 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.051 | 4.54E-04 | 5.68E-05 |
| CP3 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.051 | 1.28E-03 | 1.59E-04 |
| CP3 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.051 | 1.73E-08 | 2.17E-09 |
| CP4 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 1 | 3 | 0.011 | 5.22E-05 | 6.53E-06 |
| CP4 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 1 | 3 | 0.011 | 1.79E-06 | 2.24E-07 |
| CP4 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 1 | 3 | 0.011 | 1.80E-05 | 2.26E-06 |
| CP4 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 1 | 3 | 0.011 | 1.00E-04 | 1.25E-05 |
| CP4 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 1 | 3 | 0.011 | 2.82E-04 | 3.52E-05 |
| CP4 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 1 | 3 | 0.011 | 3.83E-09 | 4.79E-10 |

**Notes:**
(1) Key VOCs emission factors are calculated from the data in US EPA "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)". The emission rates of the VOC and PAH substances are estimated based on their fractions of VOC/PM and the related VOC and PM emission rates used in table above.

**Speciated VOC estimation:**
Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12

| Key VOCs and PAH | Toxic Fraction of VOC/PM (Tiers 2 & 3) | Note |
|---|---|---|
| Benzene | 0.054100 | VOC fraction |
| 1,3-Butadiene | 0.001860 | VOC fraction |
| Acrolein | 0.018700 | VOC fraction |
| Acetaldehyde | 0.104000 | VOC fraction |
| Formaldehyde | 0.292000 | VOC fraction |
| Benzo(a)pyrene | 6.67E-06 | PM fraction |

(2) Onsite travelling time is estimated based on the modelled train travel length for a specific scenario and the train speed.
(3) Emission rates are estimated based on the train onsite travel time, emission factor, power rating and number of locomotives.

**Sample Calculation - Benzene emissions from train engines**

| | | |
|---|---|---|
| Peak emission rate of each locomotive (g/s) = | (Tier 2 HC Engine EF (g/h) x Toxic Fraction of VOC (benzene) x 1 hour/3600 s = | 4.60E-03 g/s |
| Maximum hourly emission rate (g/s) = | peak emission rate of each engine (g/hr) x onsite traveling time (hour) x number of train engine/hour x 1hr/3600s = | 5.65E-05 g/s |
| Daily average emission rate (g/s) = | peak short-term emission rate (g/hr) x onsite traveling time (hour) x 1 day/24 hour x number of equipment/day x 1hour/3600s = | 7.06E-06 g/s |

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the maximum number of equipment operating in the study area and reference exhaust emission standard. The calculated emission rate should be conservative.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

## Source: Emissions from CP Diesel Trains During Operation

**Source ID:**
CP0, CP1A, CP1B, CP2A, CP2B, CP2C, CP3, CP4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.
The study area is divided into three model segments including the Oshawa, Courtice and Bowmanville segments to match the area of coverage specified by the MECP site specific meteorological data sets.
It is assumed that GM and CP trains within the study area are only travelling / passing by at constant speed.
There are no GO trains operating within the study area during the baseline and future no build scenario.

The train data are summarized below.

| | | | |
|---|---|---|---|
| **Number of Trains** | | | |
| CP trains | 9 | trains/day | Maximum daily trains provided by PM team (daytime 5 and nighttime 4) |
| | 2 | trains/hour | Assumed maximum hourly trains |
| **Number of Engines per Locomotive** | | | |
| CP locomotive | 3 | engines | Average three (3) locomotives and 85 cars |
| **Total Number of Engines** | | | |
| CP locomotive | 27 | engines /day | calculated |
| **Power rating of locomotive** | 4245 | hp/each | Train engine based on 201075-STANTEC-RFI-00017. Tier 2 engine data (notch 8). |
| **Fuel type in locomotive** | Diesel | - | - |
| **Line volume source lengths in Oshawa segment** | | | |
| CP0 | 1.09 | km | EX/FNB/FB - CP and GM trains west of study area |
| CP1A | 1.36 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Oshawa |
| CP1B | 6.22 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Oshawa |
| **Line volume source lengths in Courtice segment** | | | |
| CP2A | 3.79 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| CP2B | 2.36 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| CP2C | 3.44 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Courtice |
| **Line volume source lengths in Bowmanville segment** | | | |
| CP3 | 4.54 | km | EX/FNB/FB - CP and GM trains along main railway corridor in Bowmanville |
| CP4 | 1.00 | km | FB - GO trains idling at B4 Station |
| **Travel Speeds** | | | |
| Along main rail corridor | 55 | mph | Assumed 55 mph (88.5 km/h) |

**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in locomotive engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**
$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the vehicle. $SO_2$ emission factor is calculated below.

**SO2 Emission Factor Calculation:**

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department of Energy |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$ |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

## Source: Emissions from CP Diesel Trains During Operation

NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite travelling train tailpipe exhausts are calculated based on the document "201075-STANTEC-RFI-00017" provided by Metrolinx. Tier 2 engine emission rates are conservatively used. These emission factors are listed below along with the emission calculations for both maximum hourly and daily emission rates.

**Emission Calculations - Criteria Contaminants: Diesel Trains Travelling**

| Source ID | Contaminant | CAS# | Tier 2 Engine Maximum Power Rating (hp each) | Tier 2 Engine Emission Factor[1] | | Tier 2 Engine Operating Load[2] | Peak Emission Rate per Equipment[4] (g/s) | Number of Equipment | | Onsite Travelling Time[3] (hour/train) | Hourly Emission Rate (g/s) | Daily Average Emission Rate (g/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | per Hour | per Day | | | |
| CP0 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.012 | 4.49E-04 | 8.42E-05 |
| CP0 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.012 | 2.75E-01 | 5.15E-02 |
| CP0 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.012 | 3.73E-03 | 6.99E-04 |
| CP0 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.012 | 3.58E-03 | 6.72E-04 |
| CP0 | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.012 | 3.36E-03 | 6.30E-04 |
| CP0 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.012 | 4.59E-03 | 8.61E-04 |
| CP0 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.012 | 6.27E-03 | 1.18E-03 |
| CP1A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.015 | 5.61E-04 | 1.05E-04 |
| CP1A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.015 | 3.43E-01 | 6.44E-02 |
| CP1A | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.015 | 4.66E-03 | 8.74E-04 |
| CP1A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.015 | 4.48E-03 | 8.39E-04 |
| CP1A | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.015 | 4.20E-03 | 7.87E-04 |
| CP1A | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.015 | 5.74E-03 | 1.08E-03 |
| CP1A | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.015 | 7.83E-03 | 1.47E-03 |
| CP1B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.070 | 2.57E-03 | 4.82E-04 |
| CP1B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.070 | 1.57E+00 | 2.95E-01 |
| CP1B | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.070 | 2.14E-02 | 4.00E-03 |
| CP1B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.070 | 2.05E-02 | 3.84E-03 |
| CP1B | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.070 | 1.92E-02 | 3.60E-03 |
| CP1B | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.070 | 2.63E-02 | 4.93E-03 |
| CP1B | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.070 | 3.59E-02 | 6.72E-03 |
| CP2A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.043 | 1.56E-03 | 2.93E-04 |
| CP2A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.043 | 9.57E-01 | 1.79E-01 |
| CP2A | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.043 | 1.30E-02 | 2.44E-03 |
| CP2A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.043 | 1.25E-02 | 2.34E-03 |
| CP2A | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.043 | 1.17E-02 | 2.19E-03 |
| CP2A | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.043 | 1.60E-02 | 3.00E-03 |
| CP2A | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.043 | 2.18E-02 | 4.10E-03 |
| CP2B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.043 | 1.56E-03 | 2.93E-04 |
| CP2B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.043 | 9.57E-01 | 1.79E-01 |
| CP2B | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.043 | 1.30E-02 | 2.44E-03 |
| CP2B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.043 | 1.25E-02 | 2.34E-03 |
| CP2B | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.043 | 1.17E-02 | 2.19E-03 |
| CP2B | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.043 | 1.60E-02 | 3.00E-03 |
| CP2B | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.043 | 2.18E-02 | 4.10E-03 |
| CP2C | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.043 | 1.56E-03 | 2.93E-04 |
| CP2C | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.043 | 9.57E-01 | 1.79E-01 |
| CP2C | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.043 | 1.30E-02 | 2.44E-03 |
| CP2C | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.043 | 1.25E-02 | 2.34E-03 |
| CP2C | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.043 | 1.17E-02 | 2.19E-03 |
| CP2C | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.043 | 1.60E-02 | 3.00E-03 |
| CP2C | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.043 | 2.18E-02 | 4.10E-03 |
| CP3 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.051 | 1.88E-03 | 3.52E-04 |
| CP3 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.051 | 1.15E+00 | 2.15E-01 |
| CP3 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.051 | 1.56E-02 | 2.93E-03 |
| CP3 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.051 | 1.50E-02 | 2.81E-03 |
| CP3 | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.051 | 1.40E-02 | 2.63E-03 |
| CP3 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.051 | 1.92E-02 | 3.60E-03 |
| CP3 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.051 | 2.62E-02 | 4.91E-03 |
| CP4 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 69% | 0.0061 | 6 | 27 | 0.011 | 4.15E-04 | 7.78E-05 |
| CP4 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 69% | 3.7292 | 6 | 27 | 0.011 | 2.54E-01 | 4.76E-02 |
| CP4 | PM | N/A (pm) | 4245 | 182.4 | g/h | 69% | 0.0507 | 6 | 27 | 0.011 | 3.45E-03 | 6.46E-04 |
| CP4 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 69% | 0.0486 | 6 | 27 | 0.011 | 3.31E-03 | 6.20E-04 |
| CP4 | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 69% | 0.0456 | 6 | 27 | 0.011 | 3.10E-03 | 5.82E-04 |
| CP4 | CO | 630-08-0 | 4245 | 224.6 | g/h | 69% | 0.0624 | 6 | 27 | 0.011 | 4.24E-03 | 7.96E-04 |
| CP4 | HC | N/A | 4245 | 306.4 | g/h | 69% | 0.0851 | 6 | 27 | 0.011 | 5.79E-03 | 1.09E-03 |

**Notes:**
(1) $SO_2$ emission factor is calculated in above table and based on the fuel sulphur content. Other emission factors were provided by Metrolinx. Tier 2 engines are conservatively used.
(2) An average operating load of Notch 6 is assumed for train engines during travelling on rail way (not in full speed) and at steady state. An operating load of 50% is assumed for HEP engines as per the Draft Mx AQ Guide dated November 2019.
(3) Onsite travelling time is estimated based on the railway length assessed and the train travel speed.
(4) $SO_2$ emission rates are estimated based on the train passing time, emission factor, power rating and number of locomotives. Emission rates of other contaminants are from 201075-STANTEC-RFI-00014 - Locomotive Information_Attachment.pdf provided by Metrolinx.
(5) For PM emissions from the tailpipe of the equipment, based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

Key volatile organic compounds emissions from tailpipe exhausts are estimated based on the related reference emission factor data. These emission factors are listed below along with the emission calculations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Baseline / Future No Build / Future Build*

## Source: Emissions from CP Diesel Trains During Operation

**Emission Calculations - Key VOCs: Diesel Trains Travelling**

| Source ID | Contaminant | CAS# | Emission Factor[1] (g/hr) | Peak Emission Rate per Equipment[3] (g/s) | Number of Equipment per Hour | Number of Equipment per Day | Travelling Time[2] (hour/train) | Hourly Emission Rate[3] (g/s) | Daily Average Emission Rate[3] (g/s) |
|---|---|---|---|---|---|---|---|---|---|
| CP0 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.012 | 3.39E-04 | 6.36E-05 |
| CP0 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.012 | 1.17E-05 | 2.19E-06 |
| CP0 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.012 | 1.17E-04 | 2.20E-05 |
| CP0 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.012 | 6.52E-04 | 1.22E-04 |
| CP0 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.012 | 1.83E-03 | 3.43E-04 |
| CP0 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.012 | 2.49E-08 | 4.67E-09 |
| CP1A | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.015 | 4.24E-04 | 7.95E-05 |
| CP1A | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.015 | 1.46E-05 | 2.73E-06 |
| CP1A | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.015 | 1.46E-04 | 2.75E-05 |
| CP1A | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.015 | 8.15E-04 | 1.53E-04 |
| CP1A | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.015 | 2.29E-03 | 4.29E-04 |
| CP1A | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.015 | 3.11E-08 | 5.83E-09 |
| CP1B | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.070 | 1.94E-03 | 3.64E-04 |
| CP1B | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.070 | 6.67E-05 | 1.25E-05 |
| CP1B | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.070 | 6.71E-04 | 1.26E-04 |
| CP1B | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.070 | 3.73E-03 | 6.99E-04 |
| CP1B | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.070 | 1.05E-02 | 1.96E-03 |
| CP1B | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.070 | 1.42E-07 | 2.67E-08 |
| CP2A | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.043 | 1.18E-03 | 2.22E-04 |
| CP2A | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.043 | 4.06E-05 | 7.62E-06 |
| CP2A | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.043 | 4.08E-04 | 7.66E-05 |
| CP2A | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.043 | 2.27E-03 | 4.26E-04 |
| CP2A | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.043 | 6.38E-03 | 1.20E-03 |
| CP2A | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.043 | 8.67E-08 | 1.63E-08 |
| CP2B | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.043 | 1.18E-03 | 2.22E-04 |
| CP2B | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.043 | 4.06E-05 | 7.62E-06 |
| CP2B | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.043 | 4.08E-04 | 7.66E-05 |
| CP2B | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.043 | 2.27E-03 | 4.26E-04 |
| CP2B | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.043 | 6.38E-03 | 1.20E-03 |
| CP2B | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.043 | 8.67E-08 | 1.63E-08 |
| CP2C | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.043 | 1.18E-03 | 2.22E-04 |
| CP2C | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.043 | 4.06E-05 | 7.62E-06 |
| CP2C | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.043 | 4.08E-04 | 7.66E-05 |
| CP2C | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.043 | 2.27E-03 | 4.26E-04 |
| CP2C | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.043 | 6.38E-03 | 1.20E-03 |
| CP2C | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.043 | 8.67E-08 | 1.63E-08 |
| CP3 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.051 | 1.42E-03 | 2.66E-04 |
| CP3 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.051 | 4.88E-05 | 9.14E-06 |
| CP3 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.051 | 4.90E-04 | 9.19E-05 |
| CP3 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.051 | 2.73E-03 | 5.11E-04 |
| CP3 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.051 | 7.65E-03 | 1.44E-03 |
| CP3 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.051 | 1.04E-07 | 1.95E-08 |
| CP4 | Benzene | 71-43-2 | 1.66E+01 | 4.60E-03 | 6 | 27 | 0.011 | 3.13E-04 | 5.87E-05 |
| CP4 | 1,3-Butadiene | 106-99-0 | 5.70E-01 | 1.58E-04 | 6 | 27 | 0.011 | 1.08E-05 | 2.02E-06 |
| CP4 | Acrolein | 107-02-8 | 5.73E+00 | 1.59E-03 | 6 | 27 | 0.011 | 1.08E-04 | 2.03E-05 |
| CP4 | Acetaldehyde | 75-07-0 | 3.19E+01 | 8.85E-03 | 6 | 27 | 0.011 | 6.02E-04 | 1.13E-04 |
| CP4 | Formaldehyde | 50-00-0 | 8.95E+01 | 2.49E-02 | 6 | 27 | 0.011 | 1.69E-03 | 3.17E-04 |
| CP4 | Benzo(a)pyrene | 50-32-8 | 1.22E-03 | 3.38E-07 | 6 | 27 | 0.011 | 2.30E-08 | 4.31E-09 |

**Notes:**
(1) Key VOCs emission factors are calculated from the data in US EPA "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)". The emission rates of the VOC and PAH substances are estimated based on their fractions of VOC/PM and the related VOC and PM emission rates used in table above.
**Speciated VOC estimation:**
Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12

| Key VOCs and PAH | Toxic Fraction of VOC/PM (Tiers 2 & 3) | Note |
|---|---|---|
| Benzene | 0.054100 | VOC fraction |
| 1,3-Butadiene | 0.001860 | VOC fraction |
| Acrolein | 0.018700 | VOC fraction |
| Acetaldehyde | 0.104000 | VOC fraction |
| Formaldehyde | 0.292000 | VOC fraction |
| Benzo(a)pyrene | 6.67E-06 | PM fraction |

(2) Onsite travelling time is estimated based on the modelled train travel length for a specific scenario and the train speed.
(3) Emission rates are estimated based on the train onsite travel time, emission factor, power rating and number of locomotives.

**Sample Calculation - Benzene emissions from train engines**

| | | |
|---|---|---|
| Peak emission rate of each locomotive (g/s) = | (Tier 2 HC Engine EF (g/h) x Toxic Fraction of VOC (benzene) x 1 hour/3600 s = | 4.60E-03 g/s |
| Maximum hourly emission rate (g/s) = | peak emission rate of each engine (g/hr) x onsite traveling time (hour) x number of train engine/hour x 1hr/3600s = | 3.39E-04 g/s |
| Daily average emission rate (g/s) = | peak short-term emission rate (g/hr) x onsite traveling time (hour) x 1 day/24 hour x number of equipment/day x 1hour/3600s = | 6.36E-05 g/s |

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the maximum number of equipment operating in the study area and reference exhaust emission standard. The calculated emission rate should be conservative.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

## Source: Emissions from Diesel GO Trains During Operation

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.
The study area is divided into three model segments including the Oshawa, Courtice and Bowmanville segments that match the area of coverage specified by the MECP site specific meteorological data sets.
GO trains are operational during the future build scenario. Within the study area, they are either travelling at steady state, decelerating/accelerating and idling at the 4 proposed stations. It is assumed that the GO trains do not stop at the crossings.

The train data are summarized below.

| | | | |
|---|---|---|---|
| **Number of Trains** | | | |
| GO trains | 54 | trains/day | email from Metrolinx November 24, 2021 |
| | 3 | trains/hour | Assumed maximum hourly trains (half-hourly trains in peak direction and hourly trains in counter-peak direction) |
| **Number of locomotives per train** | | | |
| GO locomotive | 2 | locomotives | Two locomotives per train 201075-STANTEC-RFI-00017 |
| **Number of Engines per Locomotive** | | | |
| One GO locomotive consists of: | 1 | MP 40 engine | One (1) line haul locomotive for traction. |
| | 1 | HEP engine | One (1) engine for Head End Power (HEP). |
| **Total Number of Engines** | | | |
| Number of GO line haul locomotive engines | 108 | engines /day | calculated |
| Number of GO HEP engines | 108 | engines /day | calculated |
| **Power rating of locomotive** | 4245 | hp/each | Train engine based on 201075-STANTEC-RFI-00017. Tier 2 engine data (notch 8). |
| | 4317 | hp/each | Train engine based on 201075-STANTEC-RFI-00017. Tier 3 engine data (notch 8). |
| | 1105 | hp/each | Train engine based on 201075-STANTEC-RFI-00017. HEP data (100% load). |
| **Fuel use in locomotive** | Diesel | - | - |
| **Line volume source lengths in Oshawa segment** | | | |
| GO1 | 2.86 | km | FB - GO Trains from Oshawa GO Station to main railway corridor in Oshawa |
| GO2A | 2.00 | km | FB - GO Trains along main railway corridor in Oshawa |
| GO2B | 5.58 | km | FB - GO Trains along main railway corridor in Oshawa |
| **Line volume source lengths in Courtice segment** | | | |
| GO3A | 6.15 | km | FB - GO trains along main railway corridor in Courtice |
| GO3B | 3.45 | km | FB - GO trains along main railway corridor in Courtice |
| **Line volume source lengths in Bowmanville segment** | | | |
| GO4A | 3.99 | km | FB - GO trains along main railway corridor in Bowmanville |
| GO4B | 0.55 | km | FB - GO trains along main railway corridor in Bowmanville |
| **Travel Speeds** | | | |
| Travel speed along main corridor | 55 | mph | Assumed 55 mph (88.5 km/h) along the corridor |
| Adjusted average speed along main corridor | 51 | mph | Stantec assumed a weighted average travel speed which considers acceleration and deceleration of the GO Trains at the 4 stations. |
| Travel speed for the connecting line between CP and CN | 25 | mph | Assumed 25 mph (40 km/h) along the north/south corridor |
| **Idling Time at Stations** | 1.5 | minutes | Assumed GO train idling time to pick up/drop off passengers at each proposed station |

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**Contaminant(s) of Concern:**
NOx, PM, CO, hydrocarbons, and $SO_2$ emissions are the contaminants of concern from fuel combustions in locomotive engines. Primary speciated VOCs and a key PAH (Benzo(a) pyrene) are also included in the assessment.

**Methodology: Mass Balance (MB) and Emission Factor (EF)**

$SO_2$ emission is based on the maximum allowable sulfur content in diesel and fuel consumption of the vehicle. $SO_2$ emission factor is calculated below.

**SO2 Emission Factor Calculation:**

| Data | Value | Unit | Reference |
|---|---|---|---|
| Sulphur content in diesel | 15 | ppm | Sulphur in Diesel Fuel Regulations, Environment and Climate Change Canada (ECCC) |
| Diesel Engine Efficiency | 45% | | "Just the basics: Diesel Energy". US department of energy |
| Lower Heating Value | 128,450 | BTU/gal | "Alternative Fuels Data Center – Fuel Properties Comparison " from the US Department |
| Unit Conversion | 0.00029 | kWh/BTU | - |
| | 454 | g/lb | - |
| Density of diesel | 7.00 | lb/gal | - |
| Energy output | 16.94 | kWh/gal | Calculated |
| $SO_2$/ gallon of diesel | 0.0953 | g $SO_2$/gal | A factor of 2 is applied to convert sulfur to $SO_2$, assuming all the sulfur will be oxidized to $SO_2$. |
| Emission Factor | 0.0056 | g/kWh | - |

**Note:** Emissions are calculated based on sulphur content in diesel as per Sulphur in Diesel Fuel Regulations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

**Source: Emissions from Diesel GO Trains During Operation**

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.
NOx, PM, CO, and non-methane hydrocarbon (NMHC) emissions from onsite travelling train tailpipe exhausts are calculated based on the document "201075-STANTEC-RFI-00017" provided by Metrolinx. Tier 2 engine emission rates are conservatively used for GM and CP. These emission factors are listed below along with the emission calculations for both maximum hourly and daily emission rates.

**Emission Calculations Diesel Trains Travelling - CACs**

| | | | | | | | | | | | | | | | Number of Equipment | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source Group | Source ID | Contaminant | CAS# | Tier 2 Engine Maximum Power Rating (hp each) | Tier 2 Engine Emission Factor(1) | | % Tier 2 (1) | Tier 2 Operating Load(2) | Tier 3 Engine Maximum Power Rating (hp each) | Tier 3 Engine Emission Factor(1) | | % Tier 3 (1) | Tier 3 Operating Load(2) | Peak Emission Rate per Equipment(4) (g/s) | per Hour | per Day | Onsite Travelling Time(3) (hour/train) | Hourly Emission Rate (g/s) | Daily Average Emission Rate (g/s) |
| | GO1 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.071 | 2.47E-03 | 1.85E-03 |
| | GO1 | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.071 | 1.51E+00 | 1.13E+00 |
| | GO1 | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.071 | 1.89E-02 | 1.41E-02 |
| | GO1 | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.071 | 1.81E-02 | 1.36E-02 |
| | GO1 | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.071 | 1.70E-02 | 1.27E-02 |
| | GO1 | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.071 | 2.30E-02 | 1.73E-02 |
| | GO1 | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.071 | 3.40E-02 | 2.55E-02 |
| | GO2A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.024 | 8.42E-04 | 6.32E-04 |
| | GO2A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.024 | 5.16E-01 | 3.87E-01 |
| | GO2A | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.024 | 6.43E-03 | 4.82E-03 |
| | GO2A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.024 | 6.17E-03 | 4.63E-03 |
| | GO2A | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.024 | 5.79E-03 | 4.34E-03 |
| | GO2A | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.024 | 7.85E-03 | 5.89E-03 |
| | GO2A | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.024 | 1.16E-02 | 8.70E-03 |
| | GO2B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.068 | 2.36E-03 | 1.77E-03 |
| | GO2B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.068 | 1.44E+00 | 1.08E+00 |
| | GO2B | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.068 | 1.80E-02 | 1.35E-02 |
| | GO2B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.068 | 1.73E-02 | 1.29E-02 |
| | GO2B | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.068 | 1.62E-02 | 1.21E-02 |
| | GO2B | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.068 | 2.20E-02 | 1.65E-02 |
| | GO2B | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.068 | 3.25E-02 | 2.43E-02 |
| | GO3A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.075 | 2.60E-03 | 1.95E-03 |
| | GO3A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.075 | 1.59E+00 | 1.19E+00 |
| GO line haul engines | GO3A | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.075 | 1.98E-02 | 1.49E-02 |
| | GO3A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.075 | 1.90E-02 | 1.43E-02 |
| | GO3A | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.075 | 1.78E-02 | 1.34E-02 |
| | GO3A | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.075 | 2.42E-02 | 1.82E-02 |
| | GO3A | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.075 | 3.58E-02 | 2.68E-02 |
| | GO3B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.042 | 1.46E-03 | 1.09E-03 |
| | GO3B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.042 | 8.91E-01 | 6.68E-01 |
| | GO3B | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.042 | 1.11E-02 | 8.33E-03 |
| | GO3B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.042 | 1.07E-02 | 8.00E-03 |
| | GO3B | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.042 | 1.00E-02 | 7.50E-03 |
| | GO3B | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.042 | 1.36E-02 | 1.02E-02 |
| | GO3B | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.042 | 2.00E-02 | 1.50E-02 |
| | GO4A | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.048 | 1.68E-03 | 1.26E-03 |
| | GO4A | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.048 | 1.03E+00 | 7.73E-01 |
| | GO4A | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.048 | 1.28E-02 | 9.64E-03 |
| | GO4A | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.048 | 1.23E-02 | 9.25E-03 |
| | GO4A | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.048 | 1.16E-02 | 8.67E-03 |
| | GO4A | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.048 | 1.57E-02 | 1.18E-02 |
| | GO4A | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.048 | 2.32E-02 | 1.74E-02 |
| | GO4B | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 69% | 4317 | 0.0075 | g/bhp-h | 30% | 56% | 0.0058 | 6 | 108 | 0.007 | 2.33E-04 | 1.74E-04 |
| | GO4B | $NO_x$ | 10102-44-0 | 4245 | 13425.2 | g/h | 70% | 69% | 4317 | 11193.0 | g/h | 30% | 56% | 3.5432 | 6 | 108 | 0.007 | 1.42E-01 | 1.07E-01 |
| | GO4B | PM | N/A (pm) | 4245 | 182.4 | g/h | 70% | 69% | 4317 | 104.5 | g/h | 30% | 56% | 0.0442 | 6 | 108 | 0.007 | 1.77E-03 | 1.33E-03 |
| | GO4B | PM10 | N/A (pm10) | 4245 | 175.1 | g/h | 70% | 69% | 4317 | 100.3 | g/h | 30% | 56% | 0.0424 | 6 | 108 | 0.007 | 1.70E-03 | 1.28E-03 |
| | GO4B | PM2.5 | N/A (pm2.5) | 4245 | 164.16 | g/h | 70% | 69% | 4317 | 94.05 | g/h | 30% | 56% | 0.0398 | 6 | 108 | 0.007 | 1.60E-03 | 1.20E-03 |
| | GO4B | CO | 630-08-0 | 4245 | 224.6 | g/h | 70% | 69% | 4317 | 123.6 | g/h | 30% | 56% | 0.0540 | 6 | 108 | 0.007 | 2.17E-03 | 1.63E-03 |
| | GO4B | HC | N/A | 4245 | 306.4 | g/h | 70% | 69% | 4317 | 241.9 | g/h | 30% | 56% | 0.0797 | 6 | 108 | 0.007 | 3.20E-03 | 2.40E-03 |
| | GO1 | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.071 | 4.94E-04 | 3.70E-04 |
| | GO1 | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.071 | 3.15E-01 | 2.36E-01 |
| | GO1 | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.071 | 1.09E-02 | 8.19E-03 |
| | GO1 | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.071 | 1.05E-02 | 7.86E-03 |
| | GO1 | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.071 | 9.83E-03 | 7.37E-03 |
| | GO1 | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.071 | 7.30E-02 | 5.48E-02 |
| | GO1 | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.071 | 1.04E-02 | 7.82E-03 |
| | GO2A | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.024 | 1.68E-04 | 1.26E-04 |
| | GO2A | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.024 | 1.07E-01 | 8.05E-02 |
| | GO2A | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.024 | 3.72E-03 | 2.79E-03 |
| | GO2A | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.024 | 3.57E-03 | 2.68E-03 |
| | GO2A | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.024 | 3.35E-03 | 2.51E-03 |
| | GO2A | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.024 | 2.49E-02 | 1.87E-02 |
| | GO2A | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.024 | 3.56E-03 | 2.67E-03 |
| | GO2B | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.068 | 4.71E-04 | 3.53E-04 |
| | GO2B | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.068 | 3.00E-01 | 2.25E-01 |
| | GO2B | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.068 | 1.04E-02 | 7.81E-03 |
| | GO2B | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.068 | 1.00E-02 | 7.50E-03 |
| | GO2B | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.068 | 9.37E-03 | 7.03E-03 |
| | GO2B | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.068 | 6.97E-02 | 5.22E-02 |
| | GO2B | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.068 | 9.95E-03 | 7.46E-03 |
| | GO3A | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.075 | 5.19E-04 | 3.89E-04 |
| | GO3A | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.075 | 3.31E-01 | 2.48E-01 |
| GO HEP engines | GO3A | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.075 | 1.15E-02 | 8.60E-03 |
| | GO3A | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.075 | 1.10E-02 | 8.26E-03 |
| | GO3A | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.075 | 1.03E-02 | 7.74E-03 |
| | GO3A | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.075 | 7.67E-02 | 5.75E-02 |
| | GO3A | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.075 | 1.10E-02 | 8.22E-03 |
| | GO3B | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.042 | 2.91E-04 | 2.18E-04 |
| | GO3B | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.042 | 1.85E-01 | 1.39E-01 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

**Source: Emissions from Diesel GO Trains During Operation**

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GO3B** | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.042 | 6.43E-03 | 4.82E-03 |
| **GO3B** | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.042 | 6.18E-03 | 4.63E-03 |
| **GO3B** | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.042 | 5.79E-03 | 4.34E-03 |
| **GO3B** | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.042 | 4.30E-02 | 3.23E-02 |
| **GO3B** | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.042 | 6.15E-03 | 4.61E-03 |
| **GO4A** | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.048 | 3.36E-04 | 2.52E-04 |
| **GO4A** | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.048 | 2.15E-01 | 1.61E-01 |
| **GO4A** | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.048 | 7.44E-03 | 5.58E-03 |
| **GO4A** | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.048 | 7.14E-03 | 5.36E-03 |
| **GO4A** | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.048 | 6.70E-03 | 5.02E-03 |
| **GO4A** | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.048 | 4.98E-02 | 3.73E-02 |
| **GO4A** | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.048 | 7.11E-03 | 5.33E-03 |
| **GO4B** | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.0012 | 6 | 108 | 0.007 | 4.65E-05 | 3.49E-05 |
| **GO4B** | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.7375 | 6 | 108 | 0.007 | 2.96E-02 | 2.22E-02 |
| **GO4B** | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.0256 | 6 | 108 | 0.007 | 1.03E-03 | 7.71E-04 |
| **GO4B** | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.0246 | 6 | 108 | 0.007 | 9.87E-04 | 7.40E-04 |
| **GO4B** | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.0230 | 6 | 108 | 0.007 | 9.25E-04 | 6.94E-04 |
| **GO4B** | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.1711 | 6 | 108 | 0.007 | 6.88E-03 | 5.16E-03 |
| **GO4B** | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.0244 | 6 | 108 | 0.007 | 9.82E-04 | 7.37E-04 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

**Source: Emissions from Diesel GO Trains During Operation**

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.

**Emission Calculations Diesel Trains Idling - CACs**

| Source Group | Source ID | Contaminant | CAS# | Tier 2 Engine Maximum Power Rating (hp each) | Tier 2 Engine Emission Factor(1) | | % Tier 2 (1) | Tier 2 Operating Load(2) | Tier 3 Engine Maximum Power Rating (hp each) | Tier 3 Engine Emission Factor(1) | | % Tier 3 (1) | Tier 3 Operating Load(2) | Peak Emission Rate per Equipment(4) (g/s) | Number of Equipment | | Idling Time(3) (hour/train) | Hourly Emission Rate (g/s) | Daily Average Emission Rate (g/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | per Hour | per Day | | | |
| GO line haul engines | GO_IDLEB1 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 0.4% | 4317 | 0.0075 | g/bhp-h | 30% | 0.4% | 0.00003 | 6 | 108 | 0.025 | 5.03E-06 | 3.77E-06 |
| | GO_IDLEB1 | $NO_x$ | 10102-44-0 | 4245 | 1203.9 | g/h | 70% | 0.4% | 4317 | 1199.6 | g/h | 30% | 0.4% | 0.33406 | 6 | 108 | 0.025 | 5.01E-02 | 3.76E-02 |
| | GO_IDLEB1 | PM | N/A (pm) | 4245 | 26.7 | g/h | 70% | 0.4% | 4317 | 9.3 | g/h | 30% | 0.4% | 0.00597 | 6 | 108 | 0.025 | 8.95E-04 | 6.71E-04 |
| | GO_IDLEB1 | PM10 | N/A (pm10) | 4245 | 25.6 | g/h | 70% | 0.4% | 4317 | 8.9 | g/h | 30% | 0.4% | 0.00573 | 6 | 108 | 0.025 | 8.59E-04 | 6.44E-04 |
| | GO_IDLEB1 | PM2.5 | N/A (pm2.5) | 4245 | 24.03 | g/h | 70% | 0.4% | 4317 | 8.37 | g/h | 30% | 0.4% | 0.00537 | 6 | 108 | 0.025 | 8.06E-04 | 6.04E-04 |
| | GO_IDLEB1 | CO | 630-08-0 | 4245 | 76.8 | g/h | 70% | 0.4% | 4317 | 67.5 | g/h | 30% | 0.4% | 0.02056 | 6 | 108 | 0.025 | 3.08E-03 | 2.31E-03 |
| | GO_IDLEB1 | HC | N/A | 4245 | 59.0 | g/h | 70% | 0.4% | 4317 | 71.4 | g/h | 30% | 0.4% | 0.01742 | 6 | 108 | 0.025 | 2.61E-03 | 1.96E-03 |
| | GO_IDLEB2 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 0.4% | 4317 | 0.0075 | g/bhp-h | 30% | 0.4% | 0.00003 | 6 | 108 | 0.025 | 5.03E-06 | 3.77E-06 |
| | GO_IDLEB2 | $NO_x$ | 10102-44-0 | 4245 | 1203.9 | g/h | 70% | 0.4% | 4317 | 1199.6 | g/h | 30% | 0.4% | 0.33406 | 6 | 108 | 0.025 | 5.01E-02 | 3.76E-02 |
| | GO_IDLEB2 | PM | N/A (pm) | 4245 | 26.7 | g/h | 70% | 0.4% | 4317 | 9.3 | g/h | 30% | 0.4% | 0.00597 | 6 | 108 | 0.025 | 8.95E-04 | 6.71E-04 |
| | GO_IDLEB2 | PM10 | N/A (pm10) | 4245 | 25.6 | g/h | 70% | 0.4% | 4317 | 8.9 | g/h | 30% | 0.4% | 0.00573 | 6 | 108 | 0.025 | 8.59E-04 | 6.44E-04 |
| | GO_IDLEB2 | PM2.5 | N/A (pm2.5) | 4245 | 24.0 | g/h | 70% | 0.4% | 4317 | 8.4 | g/h | 30% | 0.4% | 0.00537 | 6 | 108 | 0.025 | 8.06E-04 | 6.04E-04 |
| | GO_IDLEB2 | CO | 630-08-0 | 4245 | 76.8 | g/h | 70% | 0.4% | 4317 | 67.5 | g/h | 30% | 0.4% | 0.02056 | 6 | 108 | 0.025 | 3.08E-03 | 2.31E-03 |
| | GO_IDLEB2 | HC | N/A | 4245 | 59.0 | g/h | 70% | 0.4% | 4317 | 71.4 | g/h | 30% | 0.4% | 0.01742 | 6 | 108 | 0.025 | 2.61E-03 | 1.96E-03 |
| | GO_IDLEB3 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 0.4% | 4317 | 0.0075 | g/bhp-h | 30% | 0.4% | 0.00003 | 6 | 108 | 0.025 | 5.03E-06 | 3.77E-06 |
| | GO_IDLEB3 | $NO_x$ | 10102-44-0 | 4245 | 1203.9 | g/h | 70% | 0.4% | 4317 | 1199.6 | g/h | 30% | 0.4% | 0.33406 | 6 | 108 | 0.025 | 5.01E-02 | 3.76E-02 |
| | GO_IDLEB3 | PM | N/A (pm) | 4245 | 26.7 | g/h | 70% | 0.4% | 4317 | 9.3 | g/h | 30% | 0.4% | 0.00597 | 6 | 108 | 0.025 | 8.95E-04 | 6.71E-04 |
| | GO_IDLEB3 | PM10 | N/A (pm10) | 4245 | 25.6 | g/h | 70% | 0.4% | 4317 | 8.9 | g/h | 30% | 0.4% | 0.00573 | 6 | 108 | 0.025 | 8.59E-04 | 6.44E-04 |
| | GO_IDLEB3 | PM2.5 | N/A (pm2.5) | 4245 | 24.0 | g/h | 70% | 0.4% | 4317 | 8.4 | g/h | 30% | 0.4% | 0.00537 | 6 | 108 | 0.025 | 8.06E-04 | 6.04E-04 |
| | GO_IDLEB3 | CO | 630-08-0 | 4245 | 76.8 | g/h | 70% | 0.4% | 4317 | 67.5 | g/h | 30% | 0.4% | 0.02056 | 6 | 108 | 0.025 | 3.08E-03 | 2.31E-03 |
| | GO_IDLEB3 | HC | N/A | 4245 | 59.0 | g/h | 70% | 0.4% | 4317 | 71.4 | g/h | 30% | 0.4% | 0.01742 | 6 | 108 | 0.025 | 2.61E-03 | 1.96E-03 |
| | GO_IDLEB4 | $SO_2$ | 7446-09-5 | 4245 | 0.0075 | g/bhp-h | 70% | 0.4% | 4317 | 0.0075 | g/bhp-h | 30% | 0.4% | 0.00003 | 6 | 108 | 0.025 | 5.03E-06 | 3.77E-06 |
| | GO_IDLEB4 | $NO_x$ | 10102-44-0 | 4245 | 1203.9 | g/h | 70% | 0.4% | 4317 | 1199.6 | g/h | 30% | 0.4% | 0.33406 | 6 | 108 | 0.025 | 5.01E-02 | 3.76E-02 |
| | GO_IDLEB4 | PM | N/A (pm) | 4245 | 26.7 | g/h | 70% | 0.4% | 4317 | 9.3 | g/h | 30% | 0.4% | 0.00597 | 6 | 108 | 0.025 | 8.95E-04 | 6.71E-04 |
| | GO_IDLEB4 | PM10 | N/A (pm10) | 4245 | 25.6 | g/h | 70% | 0.4% | 4317 | 8.9 | g/h | 30% | 0.4% | 0.00573 | 6 | 108 | 0.025 | 8.59E-04 | 6.44E-04 |
| | GO_IDLEB4 | PM2.5 | N/A (pm2.5) | 4245 | 24.0 | g/h | 70% | 0.4% | 4317 | 8.4 | g/h | 30% | 0.4% | 0.00537 | 6 | 108 | 0.025 | 8.06E-04 | 6.04E-04 |
| | GO_IDLEB4 | CO | 630-08-0 | 4245 | 76.8 | g/h | 70% | 0.4% | 4317 | 67.5 | g/h | 30% | 0.4% | 0.02056 | 6 | 108 | 0.025 | 3.08E-03 | 2.31E-03 |
| | GO_IDLEB4 | HC | N/A | 4245 | 59.0 | g/h | 70% | 0.4% | 4317 | 71.4 | g/h | 30% | 0.4% | 0.01742 | 6 | 108 | 0.025 | 2.61E-03 | 1.96E-03 |
| GO HEP engines | GO_IDLEB1 | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.00116 | 6 | 108 | 0.025 | 1.74E-04 | 1.30E-04 |
| | GO_IDLEB1 | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.73750 | 6 | 108 | 0.025 | 1.11E-01 | 8.30E-02 |
| | GO_IDLEB1 | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.02558 | 6 | 108 | 0.025 | 3.84E-03 | 2.88E-03 |
| | GO_IDLEB1 | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.02456 | 6 | 108 | 0.025 | 3.68E-03 | 2.76E-03 |
| | GO_IDLEB1 | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.02303 | 6 | 108 | 0.025 | 3.45E-03 | 2.59E-03 |
| | GO_IDLEB1 | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.17111 | 6 | 108 | 0.025 | 2.57E-02 | 1.93E-02 |
| | GO_IDLEB1 | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.02444 | 6 | 108 | 0.025 | 3.67E-03 | 2.75E-03 |
| | GO_IDLEB2 | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.00116 | 6 | 108 | 0.025 | 1.74E-04 | 1.30E-04 |
| | GO_IDLEB2 | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.73750 | 6 | 108 | 0.025 | 1.11E-01 | 8.30E-02 |
| | GO_IDLEB2 | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.02558 | 6 | 108 | 0.025 | 3.84E-03 | 2.88E-03 |
| | GO_IDLEB2 | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.02456 | 6 | 108 | 0.025 | 3.68E-03 | 2.76E-03 |
| | GO_IDLEB2 | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.02303 | 6 | 108 | 0.025 | 3.45E-03 | 2.59E-03 |
| | GO_IDLEB2 | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.17111 | 6 | 108 | 0.025 | 2.57E-02 | 1.93E-02 |
| | GO_IDLEB2 | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.02444 | 6 | 108 | 0.025 | 3.67E-03 | 2.75E-03 |
| | GO_IDLEB3 | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.00116 | 6 | 108 | 0.025 | 1.74E-04 | 1.30E-04 |
| | GO_IDLEB3 | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.73750 | 6 | 108 | 0.025 | 1.11E-01 | 8.30E-02 |
| | GO_IDLEB3 | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.02558 | 6 | 108 | 0.025 | 3.84E-03 | 2.88E-03 |
| | GO_IDLEB3 | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.02456 | 6 | 108 | 0.025 | 3.68E-03 | 2.76E-03 |
| | GO_IDLEB3 | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.02303 | 6 | 108 | 0.025 | 3.45E-03 | 2.59E-03 |
| | GO_IDLEB3 | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.17111 | 6 | 108 | 0.025 | 2.57E-02 | 1.93E-02 |
| | GO_IDLEB3 | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.02444 | 6 | 108 | 0.025 | 3.67E-03 | 2.75E-03 |
| | GO_IDLEB4 | $SO_2$ | 7446-09-5 | 1105 | 0.0075 | g/bhp-h | 100% | 50% | - | - | - | - | - | 0.00116 | 6 | 108 | 0.025 | 1.74E-04 | 1.30E-04 |
| | GO_IDLEB4 | $NO_x$ | 10102-44-0 | 1105 | 2655.0 | g/h | 100% | - | - | - | - | - | - | 0.73750 | 6 | 108 | 0.025 | 1.11E-01 | 8.30E-02 |
| | GO_IDLEB4 | PM | N/A (pm) | 1105 | 92.1 | g/h | 100% | - | - | - | - | - | - | 0.02558 | 6 | 108 | 0.025 | 3.84E-03 | 2.88E-03 |
| | GO_IDLEB4 | PM10 | N/A (pm10) | 1105 | 88.4 | g/h | 100% | - | - | - | - | - | - | 0.02456 | 6 | 108 | 0.025 | 3.68E-03 | 2.76E-03 |
| | GO_IDLEB4 | PM2.5 | N/A (pm2.5) | 1105 | 82.89 | g/h | 100% | - | - | - | - | - | - | 0.02303 | 6 | 108 | 0.025 | 3.45E-03 | 2.59E-03 |
| | GO_IDLEB4 | CO | 630-08-0 | 1105 | 616.0 | g/h | 100% | - | - | - | - | - | - | 0.17111 | 6 | 108 | 0.025 | 2.57E-02 | 1.93E-02 |
| | GO_IDLEB4 | HC | N/A | 1105 | 88.0 | g/h | 100% | - | - | - | - | - | - | 0.02444 | 6 | 108 | 0.025 | 3.67E-03 | 2.75E-03 |

**Notes:**
(1) $SO_2$ emission factor is calculated in above table and based on the fuel sulphur content. Other emission factors are provided by Metrolinx.
(2) An average operating load of Notch 6 is assumed for train engines during travelling on rail way (not in full speed) and at steady state. 50% load for HEP engines is assumed based on the Draft Metrolinx Air Quality Environmental Guide (November 2019). Emission data for HEP engines at this load are used in the emission estimation.
(3) Onsite travelling time is estimated based on the railway length assessed and the train travelling speed. On-site idling time is provided by Metrolinx.
(4) $SO_2$ emission rates are estimated based on the train passing or idling time, emission factor, power rating and number of locomotives. Emission rates of other contaminants are from 201075-STANTEC-RFI-00014 - Locomotive Information_Attachment.pdf provided by Metrolinx.
(5) For PM emissions from the tailpipe of the equipment, based on US EPA AP-42 Appendix B.2 Generalized Particle Size Distributions for gasoline and diesel fuel combustion engines, PM10 = 96% PM; PM2.5 = 90% PM.

Key volatile organic compounds emissions from tailpipe exhausts are estimated based on the related reference emission factor data. These emission factors are listed below along with the emission calculations.

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

**Source: Emissions from Diesel GO Trains During Operation**

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.

**Emission Calculations Diesel Trains Passing - Key VOCs**

| Source Group | Source ID | Contaminant | CAS# | Emission Factor(1) (g/hr) | Peak Emission Rate per Equipment(3) (g/s) | Number of Equipment per Hour | Number of Equipment per Day | Onsite Travelling Time(2) (hour/train) | Hourly Emission Rate(3) (g/s) | Daily Average Emission Rate(3) (g/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **GO1** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.071 | 1.84E-03 | 1.38E-03 |
| | **GO1** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.071 | 6.33E-05 | 4.75E-05 |
| | **GO1** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.071 | 6.36E-04 | 4.77E-04 |
| | **GO1** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.071 | 3.54E-03 | 2.65E-03 |
| | **GO1** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.071 | 9.94E-03 | 7.45E-03 |
| | **GO1** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.071 | 1.26E-07 | 9.43E-08 |
| | **GO2A** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.024 | 6.28E-04 | 4.71E-04 |
| | **GO2A** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.024 | 2.16E-05 | 1.62E-05 |
| | **GO2A** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.024 | 2.17E-04 | 1.63E-04 |
| | **GO2A** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.024 | 1.21E-03 | 9.05E-04 |
| | **GO2A** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.024 | 3.39E-03 | 2.54E-03 |
| | **GO2A** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.024 | 4.29E-08 | 3.22E-08 |
| | **GO2B** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.068 | 1.76E-03 | 1.32E-03 |
| | **GO2B** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.068 | 6.04E-05 | 4.53E-05 |
| | **GO2B** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.068 | 6.07E-04 | 4.55E-04 |
| | **GO2B** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.068 | 3.38E-03 | 2.53E-03 |
| | **GO2B** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.068 | 9.48E-03 | 7.11E-03 |
| | **GO2B** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.068 | 1.20E-07 | 9.00E-08 |
| | **GO3A** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.075 | 1.93E-03 | 1.45E-03 |
| | **GO3A** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.075 | 6.65E-05 | 4.99E-05 |
| | **GO3A** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.075 | 6.69E-04 | 5.01E-04 |
| **GO line haul engines** | **GO3A** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.075 | 3.72E-03 | 2.79E-03 |
| | **GO3A** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.075 | 1.04E-02 | 7.83E-03 |
| | **GO3A** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.075 | 1.32E-07 | 9.91E-08 |
| | **GO3B** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.042 | 1.08E-03 | 8.13E-04 |
| | **GO3B** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.042 | 3.73E-05 | 2.80E-05 |
| | **GO3B** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.042 | 3.75E-04 | 2.81E-04 |
| | **GO3B** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.042 | 2.09E-03 | 1.56E-03 |
| | **GO3B** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.042 | 5.85E-03 | 4.39E-03 |
| | **GO3B** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.042 | 7.41E-08 | 5.56E-08 |
| | **GO4A** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.048 | 1.25E-03 | 9.41E-04 |
| | **GO4A** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.048 | 4.31E-05 | 3.24E-05 |
| | **GO4A** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.048 | 4.34E-04 | 3.25E-04 |
| | **GO4A** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.048 | 2.41E-03 | 1.81E-03 |
| | **GO4A** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.048 | 6.77E-03 | 5.08E-03 |
| | **GO4A** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.048 | 8.57E-08 | 6.43E-08 |
| | **GO4B** | Benzene | 71-43-2 | 1.55E+01 | 4.31E-03 | 6 | 108 | 0.007 | 1.73E-04 | 1.30E-04 |
| | **GO4B** | 1,3-Butadiene | 106-99-0 | 5.34E-01 | 1.48E-04 | 6 | 108 | 0.007 | 5.96E-06 | 4.47E-06 |
| | **GO4B** | Acrolein | 107-02-8 | 5.37E+00 | 1.49E-03 | 6 | 108 | 0.007 | 5.99E-05 | 4.49E-05 |
| | **GO4B** | Acetaldehyde | 75-07-0 | 2.99E+01 | 8.29E-03 | 6 | 108 | 0.007 | 3.33E-04 | 2.50E-04 |
| | **GO4B** | Formaldehyde | 50-00-0 | 8.38E+01 | 2.33E-02 | 6 | 108 | 0.007 | 9.35E-04 | 7.02E-04 |
| | **GO4B** | Benzo(a)pyrene | 50-32-8 | 1.06E-03 | 2.95E-07 | 6 | 108 | 0.007 | 1.18E-08 | 8.88E-09 |
| | **GO1** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.071 | 5.64E-04 | 4.23E-04 |
| | **GO1** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.071 | 1.94E-05 | 1.46E-05 |
| | **GO1** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.071 | 1.95E-04 | 1.46E-04 |
| | **GO1** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.071 | 1.08E-03 | 8.14E-04 |
| | **GO1** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.071 | 3.05E-03 | 2.28E-03 |
| | **GO1** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.071 | 7.28E-08 | 5.46E-08 |
| | **GO2A** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.024 | 1.92E-04 | 1.44E-04 |
| | **GO2A** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.024 | 6.62E-06 | 4.96E-06 |
| | **GO2A** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.024 | 6.65E-05 | 4.99E-05 |
| | **GO2A** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.024 | 3.70E-04 | 2.77E-04 |
| | **GO2A** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.024 | 1.04E-03 | 7.79E-04 |
| | **GO2A** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.024 | 2.48E-08 | 1.86E-08 |
| | **GO2B** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.068 | 5.38E-04 | 4.04E-04 |
| | **GO2B** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.068 | 1.85E-05 | 1.39E-05 |
| | **GO2B** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.068 | 1.86E-04 | 1.40E-04 |
| | **GO2B** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.068 | 1.03E-03 | 7.76E-04 |
| | **GO2B** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.068 | 2.91E-03 | 2.18E-03 |
| | **GO2B** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.068 | 6.95E-08 | 5.21E-08 |
| | **GO3A** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.075 | 5.93E-04 | 4.45E-04 |
| | **GO3A** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.075 | 2.04E-05 | 1.53E-05 |
| | **GO3A** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.075 | 2.05E-04 | 1.54E-04 |
| **GO HEP engines** | **GO3A** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.075 | 1.14E-03 | 8.55E-04 |
| | **GO3A** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.075 | 3.20E-03 | 2.40E-03 |
| | **GO3A** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.075 | 7.65E-08 | 5.74E-08 |
| | **GO3B** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.042 | 3.33E-04 | 2.49E-04 |
| | **GO3B** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.042 | 1.14E-05 | 8.57E-06 |
| | **GO3B** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.042 | 1.15E-04 | 8.62E-05 |
| | **GO3B** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.042 | 6.39E-04 | 4.79E-04 |
| | **GO3B** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.042 | 1.79E-03 | 1.35E-03 |
| | **GO3B** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.042 | 4.29E-08 | 3.22E-08 |
| | **GO4A** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.048 | 3.85E-04 | 2.88E-04 |
| | **GO4A** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.048 | 1.32E-05 | 9.92E-06 |
| | **GO4A** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.048 | 1.33E-04 | 9.97E-05 |
| | **GO4A** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.048 | 7.39E-04 | 5.55E-04 |
| | **GO4A** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.048 | 2.08E-03 | 1.56E-03 |
| | **GO4A** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.048 | 4.96E-08 | 3.72E-08 |
| | **GO4B** | Benzene | 71-43-2 | 4.76E+00 | 1.32E-03 | 6 | 108 | 0.007 | 5.31E-05 | 3.99E-05 |
| | **GO4B** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 4.55E-05 | 6 | 108 | 0.007 | 1.83E-06 | 1.37E-06 |
| | **GO4B** | Acrolein | 107-02-8 | 1.65E+00 | 4.57E-04 | 6 | 108 | 0.007 | 1.84E-05 | 1.38E-05 |
| | **GO4B** | Acetaldehyde | 75-07-0 | 9.15E+00 | 2.54E-03 | 6 | 108 | 0.007 | 1.02E-04 | 7.66E-05 |
| | **GO4B** | Formaldehyde | 50-00-0 | 2.57E+01 | 7.14E-03 | 6 | 108 | 0.007 | 2.87E-04 | 2.15E-04 |
| | **GO4B** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 1.71E-07 | 6 | 108 | 0.007 | 6.86E-09 | 5.14E-09 |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Operation Scenario - Future Build*

## Source: Emissions from Diesel GO Trains During Operation

**Source ID:**
GO1, GO2A, GO2B, GO3A, GO3B, GO4A and GO4B
GO_IDLE_B1, GO_IDLE_B2, GO_IDLE_B3, GO_IDLE_B4

**Description:**
Tailpipe emissions from locomotives travelling through the study area during operation are estimated in this sheet.
The study area is between the existing Oshawa GO station and the proposed future B4 Bowmanville GO station.

**Emission Calculations Diesel Trains Idling - Key VOCs**

| Source Group | Source ID | Contaminant | CAS# | Emission Factor(1) (g/hr) | Idling Time(2) (hour/train) | Peak Emission Rate per Equipment(3) (g/s) | Number of Equipment per Hour | Number of Equipment per Day | Hourly Emission Rate(3) (g/s) | Daily Average Emission Rate(3) (g/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| GO line haul engines | **GO_IDLEB1** | Benzene | 71-43-2 | 3.39E+00 | 0.025 | 9.43E-04 | 6 | 108 | 1.41E-04 | 1.06E-04 |
| | **GO_IDLEB1** | 1,3-Butadiene | 106-99-0 | 1.17E-01 | 0.025 | 3.24E-05 | 6 | 108 | 4.86E-06 | 3.65E-06 |
| | **GO_IDLEB1** | Acrolein | 107-02-8 | 1.17E+00 | 0.025 | 3.26E-04 | 6 | 108 | 4.89E-05 | 3.67E-05 |
| | **GO_IDLEB1** | Acetaldehyde | 75-07-0 | 6.52E+00 | 0.025 | 1.81E-03 | 6 | 108 | 2.72E-04 | 2.04E-04 |
| | **GO_IDLEB1** | Formaldehyde | 50-00-0 | 1.83E+01 | 0.025 | 5.09E-03 | 6 | 108 | 7.63E-04 | 5.72E-04 |
| | **GO_IDLEB1** | Benzo(a)pyrene | 50-32-8 | 1.43E-04 | 0.025 | 3.98E-08 | 6 | 108 | 5.97E-09 | 4.48E-09 |
| | **GO_IDLEB2** | Benzene | 71-43-2 | 3.39E+00 | 0.025 | 9.43E-04 | 6 | 108 | 1.41E-04 | 1.06E-04 |
| | **GO_IDLEB2** | 1,3-Butadiene | 106-99-0 | 1.17E-01 | 0.025 | 3.24E-05 | 6 | 108 | 4.86E-06 | 3.65E-06 |
| | **GO_IDLEB2** | Acrolein | 107-02-8 | 1.17E+00 | 0.025 | 3.26E-04 | 6 | 108 | 4.89E-05 | 3.67E-05 |
| | **GO_IDLEB2** | Acetaldehyde | 75-07-0 | 6.52E+00 | 0.025 | 1.81E-03 | 6 | 108 | 2.72E-04 | 2.04E-04 |
| | **GO_IDLEB2** | Formaldehyde | 50-00-0 | 1.83E+01 | 0.025 | 5.09E-03 | 6 | 108 | 7.63E-04 | 5.72E-04 |
| | **GO_IDLEB2** | Benzo(a)pyrene | 50-32-8 | 1.43E-04 | 0.025 | 3.98E-08 | 6 | 108 | 5.97E-09 | 4.48E-09 |
| | **GO_IDLEB3** | Benzene | 71-43-2 | 3.39E+00 | 0.025 | 9.43E-04 | 6 | 108 | 1.41E-04 | 1.06E-04 |
| | **GO_IDLEB3** | 1,3-Butadiene | 106-99-0 | 1.17E-01 | 0.025 | 3.24E-05 | 6 | 108 | 4.86E-06 | 3.65E-06 |
| | **GO_IDLEB3** | Acrolein | 107-02-8 | 1.17E+00 | 0.025 | 3.26E-04 | 6 | 108 | 4.89E-05 | 3.67E-05 |
| | **GO_IDLEB3** | Acetaldehyde | 75-07-0 | 6.52E+00 | 0.025 | 1.81E-03 | 6 | 108 | 2.72E-04 | 2.04E-04 |
| | **GO_IDLEB3** | Formaldehyde | 50-00-0 | 1.83E+01 | 0.025 | 5.09E-03 | 6 | 108 | 7.63E-04 | 5.72E-04 |
| | **GO_IDLEB3** | Benzo(a)pyrene | 50-32-8 | 1.43E-04 | 0.025 | 3.98E-08 | 6 | 108 | 5.97E-09 | 4.48E-09 |
| | **GO_IDLEB4** | Benzene | 71-43-2 | 3.39E+00 | 0.025 | 9.43E-04 | 6 | 108 | 1.41E-04 | 1.06E-04 |
| | **GO_IDLEB4** | 1,3-Butadiene | 106-99-0 | 1.17E-01 | 0.025 | 3.24E-05 | 6 | 108 | 4.86E-06 | 3.65E-06 |
| | **GO_IDLEB4** | Acrolein | 107-02-8 | 1.17E+00 | 0.025 | 3.26E-04 | 6 | 108 | 4.89E-05 | 3.67E-05 |
| | **GO_IDLEB4** | Acetaldehyde | 75-07-0 | 6.52E+00 | 0.025 | 1.81E-03 | 6 | 108 | 2.72E-04 | 2.04E-04 |
| | **GO_IDLEB4** | Formaldehyde | 50-00-0 | 1.83E+01 | 0.025 | 5.09E-03 | 6 | 108 | 7.63E-04 | 5.72E-04 |
| | **GO_IDLEB4** | Benzo(a)pyrene | 50-32-8 | 1.43E-04 | 0.025 | 3.98E-08 | 6 | 108 | 5.97E-09 | 4.48E-09 |
| GO HEP engines | **GO_IDLEB1** | Benzene | 71-43-2 | 4.76E+00 | 0.025 | 1.32E-03 | 6 | 108 | 1.98E-04 | 1.49E-04 |
| | **GO_IDLEB1** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 0.025 | 4.55E-05 | 6 | 108 | 6.82E-06 | 5.12E-06 |
| | **GO_IDLEB1** | Acrolein | 107-02-8 | 1.65E+00 | 0.025 | 4.57E-04 | 6 | 108 | 6.86E-05 | 5.14E-05 |
| | **GO_IDLEB1** | Acetaldehyde | 75-07-0 | 9.15E+00 | 0.025 | 2.54E-03 | 6 | 108 | 3.81E-04 | 2.86E-04 |
| | **GO_IDLEB1** | Formaldehyde | 50-00-0 | 2.57E+01 | 0.025 | 7.14E-03 | 6 | 108 | 1.07E-03 | 8.03E-04 |
| | **GO_IDLEB1** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 0.025 | 1.71E-07 | 6 | 108 | 2.56E-08 | 1.92E-08 |
| | **GO_IDLEB2** | Benzene | 71-43-2 | 4.76E+00 | 0.025 | 1.32E-03 | 6 | 108 | 1.98E-04 | 1.49E-04 |
| | **GO_IDLEB2** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 0.025 | 4.55E-05 | 6 | 108 | 6.82E-06 | 5.12E-06 |
| | **GO_IDLEB2** | Acrolein | 107-02-8 | 1.65E+00 | 0.025 | 4.57E-04 | 6 | 108 | 6.86E-05 | 5.14E-05 |
| | **GO_IDLEB2** | Acetaldehyde | 75-07-0 | 9.15E+00 | 0.025 | 2.54E-03 | 6 | 108 | 3.81E-04 | 2.86E-04 |
| | **GO_IDLEB2** | Formaldehyde | 50-00-0 | 2.57E+01 | 0.025 | 7.14E-03 | 6 | 108 | 1.07E-03 | 8.03E-04 |
| | **GO_IDLEB2** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 0.025 | 1.71E-07 | 6 | 108 | 2.56E-08 | 1.92E-08 |
| | **GO_IDLEB3** | Benzene | 71-43-2 | 4.76E+00 | 0.025 | 1.32E-03 | 6 | 108 | 1.98E-04 | 1.49E-04 |
| | **GO_IDLEB3** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 0.025 | 4.55E-05 | 6 | 108 | 6.82E-06 | 5.12E-06 |
| | **GO_IDLEB3** | Acrolein | 107-02-8 | 1.65E+00 | 0.025 | 4.57E-04 | 6 | 108 | 6.86E-05 | 5.14E-05 |
| | **GO_IDLEB3** | Acetaldehyde | 75-07-0 | 9.15E+00 | 0.025 | 2.54E-03 | 6 | 108 | 3.81E-04 | 2.86E-04 |
| | **GO_IDLEB3** | Formaldehyde | 50-00-0 | 2.57E+01 | 0.025 | 7.14E-03 | 6 | 108 | 1.07E-03 | 8.03E-04 |
| | **GO_IDLEB3** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 0.025 | 1.71E-07 | 6 | 108 | 2.56E-08 | 1.92E-08 |
| | **GO_IDLEB4** | Benzene | 71-43-2 | 4.76E+00 | 0.025 | 1.32E-03 | 6 | 108 | 1.98E-04 | 1.49E-04 |
| | **GO_IDLEB4** | 1,3-Butadiene | 106-99-0 | 1.64E-01 | 0.025 | 4.55E-05 | 6 | 108 | 6.82E-06 | 5.12E-06 |
| | **GO_IDLEB4** | Acrolein | 107-02-8 | 1.65E+00 | 0.025 | 4.57E-04 | 6 | 108 | 6.86E-05 | 5.14E-05 |
| | **GO_IDLEB4** | Acetaldehyde | 75-07-0 | 9.15E+00 | 0.025 | 2.54E-03 | 6 | 108 | 3.81E-04 | 2.86E-04 |
| | **GO_IDLEB4** | Formaldehyde | 50-00-0 | 2.57E+01 | 0.025 | 7.14E-03 | 6 | 108 | 1.07E-03 | 8.03E-04 |
| | **GO_IDLEB4** | Benzo(a)pyrene | 50-32-8 | 6.14E-04 | 0.025 | 1.71E-07 | 6 | 108 | 2.56E-08 | 1.92E-08 |

**Notes:**
(1) Key VOCs emission factors are calculated from the data in US EPA "Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015)". The emission rates of the VOC and PAH substances are estimated based on their fractions of VOC/PM and the related VOC and PM emission rates used in table above.
**Speciated VOC estimation:**
Reference: Speciation Profiles and Toxic Emission Factors for Nonroad Engines (Nov 2015), Tables 11 & 12

| Key VOCs and PAH | Toxic Fraction of VOC/PM (Tiers 2 & 3) | Note |
|---|---|---|
| Benzene | 0.054100 | VOC fraction |
| 1,3-Butadiene | 0.001860 | VOC fraction |
| Acrolein | 0.018700 | VOC fraction |
| Acetaldehyde | 0.104000 | VOC fraction |
| Formaldehyde | 0.292000 | VOC fraction |
| Benzo(a)pyrene | 6.67E-06 | PM fraction |

(2) Onsite travelling time is estimated based on the modelled train travel length for a specific scenario and the train speed. On-site idling time is based on 1.5 minute stop at each station to pick up and drop off passengers.
(3) Emission rates are estimated based on the train passing or idling time, emission factor, power rating and number of locomotives.

**Sample Calculation - Benzene emissions from train engines idling**

| | | | |
|---|---|---|---|
| Peak emission rate of each locomotive (g/s) = | (Tier 2 HC Engine EF (g/h) x 70% Tier 2 fleet + Tier 3 HC Engine EF (g/h) x 30% Tier 3 fleet) x Toxic Fraction of VOC (benzene) x 1 hour/3600 s | 9.43E-04 | g/s |
| Maximum hourly emission rate (g/s) = | peak emission rate of each engine (g/hr) x onsite traveling time (hour) x number of train engine/hour x 1/3600s = | 1.41E-04 | g/s |
| Daily average emission rate (g/s) = | peak short-term emission rate (g/hr) x onsite traveling time (hour) x 1 day/24 hour x number of equipment/day x 1hour/3600s = | 1.41E-04 | g/s |

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the maximum number of equipment operating onsite and reference exhaust emission standard. The calculated emission rate should be conservative.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B1 TOC Operation***

**Source: Passenger Vehicle Tailpipe Emissions in Parking Lot - Future Build Scenario**

### Source ID:
B1_PPUDO

### Description:
Vehicle tailpipe (travelling and idling) emission estimation for the future build passenger pick up and drop off area. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Emissions calculated here only accounts for vehicular traffic within the future B1 station. Assumptions used in the calculation are detailed below.

### Contaminant(s) of Concern:
NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input | | |
|---|---|---|---|
| **Future Build** | | | |
| Vehicle idling time in PPUDO | 10 | minutes | Stantec assumption is that the total time that each spot is occupied for each train arrival is 10 |
| Future Build PPUDO | 19 | spots | Based on concept design figure for B1 |
| Vehicle travelling speed in PPUDO | 20 | km/hour | Stantec assumption, typically low travelling speeds in parking lots |
| Vehicle travelling distance | 0.24 | miles | travel distance from PPUDO entrance to PPUDO area x 2 (loop) |
| GO Trains per Hour | 3 | two way | Based on information provided by Metrolinx |
| GO Trains per Day | 44 | two way | Based on information provided by Metrolinx - total train passes per day minus 10 equipment moves which occur during nighttime hours. |
| PPUDO Vehicles during Peak Hour | 57 | per hour | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour (19 spots x 3 trains) |
| PPUDO Vehicles per Day | 836 | per day | Calculated assuming all PPUDO spots are full with every GO train (19 spots x 44 train trips). |

**Emission Calculation for Vehicles Travelling in the PPUDO area:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [(1)] | Hourly Emission Rate [(2)] | | Daily Emission Rate [(3)] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 2.6E-01 | 7.3E-05 | 3.8E+00 | 4.4E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 4.2E-02 | 1.2E-05 | 6.2E-01 | 7.1E-06 |
| CO | 630-08-0 | 2.9E+00 | 4.0E+01 | 1.1E-02 | 5.9E+02 | 6.8E-03 |
| PM2.5 | N/A | 1.4E-02 | 1.9E-01 | 5.2E-05 | 2.8E+00 | 3.2E-05 |
| PM10 | N/A | 9.5E-02 | 1.3E+00 | 3.6E-04 | 1.9E+01 | 2.2E-04 |
| PM | N/A | 9.5E-02 | 1.3E+00 | 3.6E-04 | 1.9E+01 | 2.2E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 3.5E-02 | 9.7E-06 | 5.1E-01 | 5.9E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 8.2E-03 | 2.3E-06 | 1.2E-01 | 1.4E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 1.8E-03 | 5.0E-07 | 2.6E-02 | 3.1E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 1.6E-04 | 4.3E-08 | 2.3E-03 | 2.6E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 6.4E-06 | 1.8E-09 | 9.4E-05 | 1.1E-09 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 6.4E-07 | 1.8E-10 | 9.3E-06 | 1.1E-10 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 3.4E-03 | 9.3E-07 | 4.9E-02 | 5.7E-07 |

**Emission Calculation for Vehicles Idling in PPUDO area:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [(1)] | Hourly Emission Rate [(2)] | | Daily Emission Rate [(3)] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 5.4E-01 | 1.5E-04 | 8.0E+00 | 9.2E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 8.7E-02 | 2.4E-05 | 1.3E+00 | 1.5E-05 |
| CO | 630-08-0 | 3.3E+01 | 1.5E+02 | 4.3E-02 | 2.3E+03 | 2.6E-02 |
| PM2.5 | N/A | 2.9E-02 | 1.4E-01 | 3.8E-05 | 2.0E+00 | 2.3E-05 |
| PM10 | N/A | 3.2E-02 | 1.5E-01 | 4.3E-05 | 2.3E+00 | 2.6E-05 |
| PM | N/A | 3.2E-02 | 1.5E-01 | 4.3E-05 | 2.3E+00 | 2.6E-05 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 2.0E-01 | 5.6E-05 | 3.0E+00 | 3.5E-05 |
| Benzene | 71-43-2 | 7.0E-03 | 3.3E-02 | 9.3E-06 | 4.9E-01 | 5.7E-06 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 7.2E-03 | 2.0E-06 | 1.1E-01 | 1.2E-06 |
| Acrolein | 107-02-8 | 1.3E-04 | 6.2E-04 | 1.7E-07 | 9.1E-03 | 1.1E-07 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 3.3E-05 | 9.3E-09 | 4.9E-04 | 5.7E-09 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 2.5E-06 | 7.1E-10 | 3.7E-05 | 4.3E-10 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 1.3E-02 | 3.7E-06 | 2.0E-01 | 2.3E-06 |

**Notes:**
(1) Emission rates are based on MOVES outputs for year 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph.
The emission rate is therefore calculated based on the car in the PPUDO travelling 0.08 miles in a span of 10-minutes or 0.17 hours.
(2) Hourly emission rates are based on an assumed maximum number of vehicles arriving or leaving the PPUDO within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation - Vehicle Travelling**

Hourly Emission Rate = Emission Factor (g/VMT) x miles travelled (miles) x Number of vehicles (V/hour) x 1 hour/3600 s

Daily Emission Rate = Emission Factor (g/VMT) x miles travelled (miles) x Number of vehicles (V/day) x 1day/24 hr x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the assumed number of vehicles using the parking lot based on proposed future train schedule, and proposed parking lot capacity.

**Summary of Emissions**

| Source Group | Contaminant | CAS# | Hourly Emission Rate | Daily Emission Rate |
|---|---|---|---|---|
| | | | g/s | g/s |
| B1_PPUDO | NOx | 10102-44-0 | 2.2E-04 | 1.4E-04 |
| | NO2 | 10102-44-0 | 3.6E-05 | 2.2E-05 |
| | CO | 630-08-0 | 5.4E-02 | 3.3E-02 |
| | PM2.5 | N/A | 9.0E-05 | 5.5E-05 |
| | PM10 | N/A | 4.0E-04 | 2.5E-04 |
| | PM | N/A | 4.0E-04 | 2.5E-04 |
| | $SO_2$ | 7446-09-5 | 6.6E-05 | 4.0E-05 |
| | Benzene | 71-43-2 | 1.2E-05 | 7.1E-06 |
| | Acetaldehyde | 75-07-0 | 2.5E-06 | 1.5E-06 |
| | Acrolein | 107-02-8 | 2.2E-07 | 1.3E-07 |
| | Benzo(a)pyrene | 50-32-8 | 1.1E-08 | 6.7E-09 |
| | 1,3-Butadiene | 106-99-0 | 8.8E-10 | 5.4E-10 |
| | Formaldehyde | 50-00-0 | 4.7E-06 | 2.9E-06 |

*Appendix E: Summary of Air Dispersion Modelling Inputs*
*Location: B1, B2, B3 and B4 TOC*

**Source: On-Road Vehicle Emissions**

| MOVES ID | Description | Travel Speed (km/hr) |
|---|---|---|
| 1 | 100% passenger cars | Start up |
| 2 | 100% passenger cars | Idle |
| 3 | 100% passenger cars | 20 |
| 4 | 100% transit bus | Start up |
| 5 | 100% transit bus | Idle |
| 6 | 100% transit bus | 20 |

Note: Idle emission factors for passenger cars and buses were modelled using a low travel speed of 0.5 mph.

**Key Input Data to MOVES3**

| Parameter | Input Description |
|---|---|
| Modelling Scale | Project level |
| Contaminants | CO, NOx, $SO_2$, PM, PM10, PM2.5, Acetaldehyde, Formaldehyde, 1,3-Butadiene, Benzene, Acrolein, Benzo(a)pyrene and CO2eq |
| Construction Year | 2021, 2031 |
| Evaluation Month and Time | January or July 6AM-9AM - the higher emission factors out of the two months are conservatively used |
| Meteorology (ambient temp., relative humidity) | Canadian Climate Normals, 1981-2010 for Oshawa WPCP<br>Daily Average temperatures:<br>January -4.8 degrees C<br>July 20.6 degrees C<br>Canadian Climate Normals, 1981-2021 for Toronto Buttonville Airport<br>Average relative humidity:<br>January 79.6% (AM) and 69.6% (PM)<br>July 82.5% (AM) and 53.4% (PM) |
| Road Type | All Urban Unrestricted Access |
| Fuel Type | Assumed gasoline for cars and diesel for transit bus |
| Fuel Data | Ontario |
| Traffic Volume | See calculation tabs |
| Traffic Speed | Start up, Idle and 20 km/hr |
| Vehicle Age Distribution | U.S. EPA default for the modelling year |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B2 TOC Operation***

**Source: Passenger Vehicle Tailpipe Emissions in PPUDO Areas and Parking Lot - Future Build Scenario**

### Source ID:
B2_LOT, B2_PPUDO1, B2_PPUDO2

### Description:
Vehicle tailpipe (travelling, idling and start up) emission estimation for the future build passenger pick up and drop off area and parking lot. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Emissions calculated here only accounts for vehicular traffic within the future B2 station. Assumptions used in the calculation are detailed below.

### Contaminant(s) of Concern:
NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input | | |
|---|---|---|---|
| **Future Build** | | | |
| Vehicle idling time in parking lot | 1.5 | minutes | Based on information provided by Metrolinx |
| Maximum number of vehicles in lot during rush hour | 298 | per hour | Stantec assumption is that 1/3 of the parking lot is filled during worst case peak hour |
| Parking lot capacity | 893 | spots | Based on concept design figure and includes standard parking spots & AODA |
| PPUDO Area 1 | 21 | spots | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour, half in area 1 (north of tracks) |
| PPUDO Area 2 | 21 | spots | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour, half in area 2 (south of tracks) |
| Vehicle travelling speed in parking lot | 20 | km/hour | Stantec assumption, typically low speeds travelling in parking lots |
| Vehicle travelling distance in lot | 0.13 | miles | measured travel distance from entrance to the parking lot to the middle of the lot |
| Vehicle travelling distance in PPUDO areas | 0.08 | miles | travel distance from PPUDO entrance to PPUDO area x 2 (loop) |
| GO Trains per Hour | 3 | two way | Based on information provide by Metrolinx |
| GO Trains per Day | 44 | two way | Based on information provided by Metrolinx - total train passes per day minus 10 equipment moves which occur during nighttime hours. |
| PPUDO Vehicles during Peak Hour | 126 | per hour | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour (42 spots x 3 trains) |
| PPUDO Vehicles per Day | 1848 | per day | Calculated assuming all PPUDO spots are full with every GO train (42 spots x 44 train trips). |
| Vehicle idling time in PPUDO | 10 | minutes | Stantec assumption is that the total time that each spot is occupied for each train arrival is 10 minutes. |

**Emission Calculation for Vehicles Travelling in Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 7.4E-01 | 2.1E-04 | 4.4E+00 | 5.1E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 1.2E-01 | 3.3E-05 | 7.1E-01 | 8.3E-06 |
| CO | 630-08-0 | 2.9E+00 | 1.1E+02 | 3.1E-02 | 6.8E+02 | 7.9E-03 |
| PM2.5 | N/A | 1.4E-02 | 5.3E-01 | 1.5E-04 | 3.2E+00 | 3.7E-05 |
| PM10 | N/A | 9.5E-02 | 3.7E+00 | 1.0E-03 | 2.2E+01 | 2.5E-04 |
| PM | N/A | 9.5E-02 | 3.7E+00 | 1.0E-03 | 2.2E+01 | 2.5E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 9.9E-02 | 2.8E-05 | 5.9E-01 | 6.9E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 2.3E-02 | 6.5E-06 | 1.4E-01 | 1.6E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 5.1E-03 | 1.4E-06 | 3.1E-02 | 3.5E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 4.4E-04 | 1.2E-07 | 2.6E-03 | 3.1E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 1.8E-05 | 5.0E-09 | 1.1E-04 | 1.3E-09 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 1.8E-06 | 5.0E-10 | 1.1E-05 | 1.3E-10 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 9.5E-03 | 2.6E-06 | 5.7E-02 | 6.6E-07 |

**Emission Calculation for Vehicles Idling in Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 4.2E-01 | 1.2E-04 | 1.3E+00 | 1.5E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 6.8E-02 | 1.9E-05 | 2.1E-01 | 2.4E-06 |
| CO | 630-08-0 | 3.3E+01 | 1.2E+02 | 3.4E-02 | 3.6E+02 | 4.2E-03 |
| PM2.5 | N/A | 2.9E-02 | 1.1E-01 | 3.0E-05 | 3.2E-01 | 3.7E-06 |
| PM10 | N/A | 3.2E-02 | 1.2E-01 | 3.3E-05 | 3.6E-01 | 4.2E-06 |
| PM | N/A | 3.2E-02 | 1.2E-01 | 3.3E-05 | 3.6E-01 | 4.2E-06 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 1.6E-01 | 4.4E-05 | 4.8E-01 | 5.5E-06 |
| Benzene | 71-43-2 | 7.0E-03 | 2.6E-02 | 7.3E-06 | 7.8E-02 | 9.1E-07 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 5.6E-03 | 1.6E-06 | 1.7E-02 | 2.0E-07 |
| Acrolein | 107-02-8 | 1.3E-04 | 4.9E-04 | 1.4E-07 | 1.5E-03 | 1.7E-08 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 2.6E-05 | 7.2E-09 | 7.8E-05 | 9.1E-10 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 2.0E-06 | 5.5E-10 | 6.0E-06 | 6.9E-11 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 1.1E-02 | 2.9E-06 | 3.2E-02 | 3.7E-07 |

**Emission Calculation for Vehicles - Start-up Emissions in Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ Start Up | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/V-start | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 7.5E-02 | 2.2E+01 | 6.2E-03 | 6.7E+01 | 7.8E-04 |
| NO2 | 10102-44-0 | 3.1E-03 | 9.3E-01 | 2.6E-04 | 2.8E+00 | 3.2E-05 |
| CO | 630-08-0 | 5.6E-01 | 1.7E+02 | 4.6E-02 | 5.0E+02 | 5.7E-03 |
| PM2.5 | N/A | 1.3E-02 | 3.7E+00 | 1.0E-03 | 1.1E+01 | 1.3E-04 |
| PM10 | N/A | 1.4E-02 | 4.2E+00 | 1.2E-03 | 1.3E+01 | 1.5E-04 |
| PM | N/A | 1.4E-02 | 4.2E+00 | 1.2E-03 | 1.3E+01 | 1.5E-04 |
| $SO_2$ | 7446-09-5 | 3.8E-05 | 1.1E-02 | 3.2E-06 | 3.4E-02 | 3.9E-07 |
| Benzene | 71-43-2 | 4.5E-03 | 1.3E+00 | 3.7E-04 | 4.0E+00 | 4.7E-05 |
| Acetaldehyde | 75-07-0 | 2.0E-03 | 5.9E-01 | 1.6E-04 | 1.8E+00 | 2.1E-05 |
| Acrolein | 107-02-8 | 1.3E-04 | 3.8E-02 | 1.1E-05 | 1.1E-01 | 1.3E-06 |
| Benzo(a)pyrene | 50-32-8 | 3.6E-06 | 1.1E-03 | 2.9E-07 | 3.2E-03 | 3.7E-08 |
| 1,3-Butadiene | 106-99-0 | 5.8E-04 | 1.7E-01 | 4.8E-05 | 5.1E-01 | 5.9E-06 |
| Formaldehyde | 50-00-0 | 9.8E-04 | 2.9E-01 | 8.1E-05 | 8.8E-01 | 1.0E-05 |

**Emission Calculation for Vehicles Travelling in B2_PPUDO1 or B2_PPUDO2:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 1.9E-01 | 5.3E-05 | 2.8E+00 | 3.3E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 3.1E-02 | 8.6E-06 | 4.5E-01 | 5.3E-06 |
| CO | 630-08-0 | 2.9E+00 | 2.9E+01 | 8.2E-03 | 4.3E+02 | 5.0E-03 |
| PM2.5 | N/A | 1.4E-02 | 1.4E-01 | 3.9E-05 | 2.0E+00 | 2.4E-05 |
| PM10 | N/A | 9.5E-02 | 9.5E-01 | 2.6E-04 | 1.4E+01 | 1.6E-04 |
| PM | N/A | 9.5E-02 | 9.5E-01 | 2.6E-04 | 1.4E+01 | 1.6E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 2.6E-02 | 7.2E-06 | 3.8E-01 | 4.4E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 6.1E-03 | 1.7E-06 | 8.9E-02 | 1.0E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 1.3E-03 | 3.7E-07 | 1.9E-02 | 2.2E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 1.2E-04 | 3.2E-08 | 1.7E-03 | 2.0E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 4.7E-06 | 1.3E-09 | 6.9E-05 | 8.0E-10 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 4.7E-07 | 1.3E-10 | 6.9E-06 | 8.0E-11 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 2.5E-03 | 6.9E-07 | 3.6E-02 | 4.2E-07 |

**Emission Calculation for Vehicles Idling in B2_PPUDO1 or B2_PPUDO2:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 1.2E+00 | 3.3E-04 | 1.8E+01 | 2.0E-04 |
| NO2 | 10102-44-0 | 1.8E-02 | 1.9E-01 | 5.4E-05 | 2.8E+00 | 3.3E-05 |
| CO | 630-08-0 | 3.3E+01 | 3.4E+02 | 9.5E-02 | 5.0E+03 | 5.8E-02 |
| PM2.5 | N/A | 2.9E-02 | 3.0E-01 | 8.4E-05 | 4.4E+00 | 5.1E-05 |
| PM10 | N/A | 3.2E-02 | 3.4E-01 | 9.5E-05 | 5.0E+00 | 5.8E-05 |
| PM | N/A | 3.2E-02 | 3.4E-01 | 9.5E-05 | 5.0E+00 | 5.8E-05 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 4.5E-01 | 1.2E-04 | 6.6E+00 | 7.6E-05 |
| Benzene | 71-43-2 | 7.0E-03 | 7.4E-02 | 2.0E-05 | 1.1E+00 | 1.3E-05 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 1.6E-02 | 4.4E-06 | 2.3E-01 | 2.7E-06 |
| Acrolein | 107-02-8 | 1.3E-04 | 1.4E-03 | 3.8E-07 | 2.0E-02 | 2.3E-07 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 7.4E-05 | 2.0E-08 | 1.1E-03 | 1.3E-08 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 5.6E-06 | 1.6E-09 | 8.2E-05 | 9.5E-10 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 3.0E-02 | 8.3E-06 | 4.4E-01 | 5.0E-06 |

**Notes:**

(1) Emission rates are based on MOVES run outputs for year 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph.
The emission rate is therefore calculated based on: a) the car in the lot travelling 0.0125 miles in a span of 1.5-minutes or 0.025 hours or
b) the car in the PPUDO travelling 0.08 miles in a span of 10-minutes or 0.17 hours.
(2) Hourly emission rates are based on assumed maximum number of vehicles arriving or leaving the parking lot and PPUDO areas within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation - Vehicle Travelling in B2_LOT**

Hourly Emission Rate = Emission Factor (g/VMT) x one way miles travelled (miles) x Number of vehicles (V/hour) x 1 hour/3600 s
Daily Emission Rate = Emission Factor (g/VMT) x two way miles travelled (miles) x Number of vehicles (V/day) x 1day/24 hr x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on an assumed number of vehicles using the parking lot and PPUDO areas.

**Summary of Emissions**

| Source Group | Contaminant | CAS# | Morning Rush Hour | | Evening Rush Hour | | Total Daily |
|---|---|---|---|---|---|---|---|
| | | | Hourly Emission Rate | Daily Emission Rate (entering) | Hourly Emission Rate | Daily Emission Rate (leaving) | Daily Emission Rate |
| | | | g/s | g/s | g/s | g/s | g/s |
| B2_LOT (1) | NOx | 10102-44-0 | 2.1E-04 | 5.1E-05 | 6.5E-03 | 8.4E-04 | 9.0E-04 |
| | NO2 | 10102-44-0 | 3.3E-05 | 8.3E-06 | 3.1E-04 | 4.3E-05 | 5.1E-05 |
| | CO | 630-08-0 | 3.1E-02 | 7.9E-03 | 1.1E-01 | 1.8E-02 | 2.6E-02 |
| | PM2.5 | N/A | 1.5E-04 | 3.7E-05 | 1.2E-03 | 1.7E-04 | 2.1E-04 |
| | PM10 | N/A | 1.0E-03 | 2.5E-04 | 2.2E-03 | 4.0E-04 | 6.6E-04 |
| | PM | N/A | 1.0E-03 | 2.5E-04 | 2.2E-03 | 4.0E-04 | 6.6E-04 |
| | $SO_2$ | 7446-09-5 | 2.8E-05 | 6.9E-06 | 7.5E-05 | 1.3E-05 | 2.0E-05 |
| | Benzene | 71-43-2 | 6.5E-06 | 1.6E-06 | 3.9E-04 | 4.9E-05 | 5.1E-05 |
| | Acetaldehyde | 75-07-0 | 1.4E-06 | 3.5E-07 | 1.7E-04 | 2.1E-05 | 2.2E-05 |
| | Acrolein | 107-02-8 | 1.2E-07 | 3.1E-08 | 1.1E-05 | 1.4E-06 | 1.4E-06 |
| | Benzo(a)pyrene | 50-32-8 | 5.0E-09 | 1.3E-09 | 3.1E-07 | 3.9E-08 | 4.0E-08 |
| | 1,3-Butadiene | 106-99-0 | 5.0E-10 | 1.3E-10 | 4.8E-05 | 5.9E-06 | 5.9E-06 |
| | Formaldehyde | 50-00-0 | 2.6E-06 | 6.6E-07 | 8.7E-05 | 1.1E-05 | 1.2E-05 |
| B2_PPUDO1 (2) | NOx | 10102-44-0 | 3.9E-04 | 2.4E-04 | 3.9E-04 | 2.4E-04 | 4.7E-04 |
| | NO2 | 10102-44-0 | 6.2E-05 | 3.8E-05 | 6.2E-05 | 3.8E-05 | 7.6E-05 |
| | CO | 630-08-0 | 1.0E-01 | 6.3E-02 | 1.0E-01 | 6.3E-02 | 1.3E-01 |
| | PM2.5 | N/A | 1.2E-04 | 7.5E-05 | 1.2E-04 | 7.5E-05 | 1.5E-04 |
| | PM10 | N/A | 3.6E-04 | 2.2E-04 | 3.6E-04 | 2.2E-04 | 4.4E-04 |
| | PM | N/A | 3.6E-04 | 2.2E-04 | 3.6E-04 | 2.2E-04 | 4.4E-04 |
| | $SO_2$ | 7446-09-5 | 1.3E-04 | 8.1E-05 | 1.3E-04 | 8.1E-05 | 1.6E-04 |
| | Benzene | 71-43-2 | 2.2E-05 | 1.4E-05 | 2.2E-05 | 1.4E-05 | 2.7E-05 |
| | Acetaldehyde | 75-07-0 | 4.8E-06 | 2.9E-06 | 4.8E-06 | 2.9E-06 | 5.8E-06 |
| | Acrolein | 107-02-8 | 4.1E-07 | 2.5E-07 | 4.1E-07 | 2.5E-07 | 5.1E-07 |
| | Benzo(a)pyrene | 50-32-8 | 2.2E-08 | 1.3E-08 | 2.2E-08 | 1.3E-08 | 2.7E-08 |
| | 1,3-Butadiene | 106-99-0 | 1.7E-09 | 1.0E-09 | 1.7E-09 | 1.0E-09 | 2.1E-09 |
| | Formaldehyde | 50-00-0 | 8.9E-06 | 5.5E-06 | 8.9E-06 | 5.5E-06 | 1.1E-05 |
| B2_PPUDO2 (2) | NOx | 10102-44-0 | 3.9E-04 | 2.4E-04 | 3.9E-04 | 2.4E-04 | 4.7E-04 |
| | NO2 | 10102-44-0 | 6.2E-05 | 3.8E-05 | 6.2E-05 | 3.8E-05 | 7.6E-05 |
| | CO | 630-08-0 | 1.0E-01 | 6.3E-02 | 1.0E-01 | 6.3E-02 | 1.3E-01 |
| | PM2.5 | N/A | 1.2E-04 | 7.5E-05 | 1.2E-04 | 7.5E-05 | 1.5E-04 |
| | PM10 | N/A | 3.6E-04 | 2.2E-04 | 3.6E-04 | 2.2E-04 | 4.4E-04 |
| | PM | N/A | 3.6E-04 | 2.2E-04 | 3.6E-04 | 2.2E-04 | 4.4E-04 |
| | $SO_2$ | 7446-09-5 | 1.3E-04 | 8.1E-05 | 1.3E-04 | 8.1E-05 | 1.6E-04 |
| | Benzene | 71-43-2 | 2.2E-05 | 1.4E-05 | 2.2E-05 | 1.4E-05 | 2.7E-05 |
| | Acetaldehyde | 75-07-0 | 4.8E-06 | 2.9E-06 | 4.8E-06 | 2.9E-06 | 5.8E-06 |
| | Acrolein | 107-02-8 | 4.1E-07 | 2.5E-07 | 4.1E-07 | 2.5E-07 | 5.1E-07 |
| | Benzo(a)pyrene | 50-32-8 | 2.2E-08 | 1.3E-08 | 2.2E-08 | 1.3E-08 | 2.7E-08 |
| | 1,3-Butadiene | 106-99-0 | 1.7E-09 | 1.0E-09 | 1.7E-09 | 1.0E-09 | 2.1E-09 |
| | Formaldehyde | 50-00-0 | 8.9E-06 | 5.5E-06 | 8.9E-06 | 5.5E-06 | 1.1E-05 |

**Notes:**
(1) For vehicles in parking lot:
morning rush hour - assume vehicles entering to park = travelling emissions only
evening - assume vehicles are leaving parking lot = startup + idling + travelling emissions
total daily emissions = emissions in parking lot during morning rush hour + emissions during evening rush hour
(2) For vehicles in PPUDO:
morning rush hour and evening rush hour = travelling emissions + idling emissions
total daily emissions = emissions in PPUDO during morning rush hour + emissions during evening rush hour

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B3 TOC Operation***

**Source: Passenger Vehicle Tailpipe Emissions in PPUDO Area and Parking Lot - Existing / Future No Build / Future Build Scenario**

### Source ID:
EX_LOT1, B3_LOT

### Description:
Vehicle tailpipe (travelling, idling and start up) emission estimation for the existing and future build passenger pick up and drop off area and parking lot. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Emissions calculated here only accounts for vehicular traffic within the future B3 station. Assumptions used in the calculation are detailed below.

### Contaminant(s) of Concern:
NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input | | |
|---|---|---|---|
| **Existing / Future No Build** | | | |
| Vehicle idling time in parking lot | 1.5 | minutes | Based on information provided by Metrolinx |
| Existing Parking lot capacity | 106 | spots | Based on counts from Google Earth satellite imagery in 2021. |
| Maximum number of vehicles per hour during existing rush hour | 35 | per hour | Stantec assumption is that 1/3 of the parking lot is filled during worst case peak |
| Vehicle travelling speed in parking lot | 20 | km/hour | Stantec assumption, typically low speeds travelling in parking lots |
| Vehicle travelling distance | 0.16 | miles | measured travel distance from entrance to the parking lot to the middle of the lot |
| **Future Build** | | | |
| Vehicle idling time in parking lot | 1.5 | minutes | Based on information provided by Metrolinx |
| Future Build Parking lot capacity | 716 | spots | Based on concept design figure and includes proposed AODA, standard parking spots and existing parking spots. |
| Maximum number of vehicles per hour during future rush hour | 239 | per hour | Stantec assumption is that 1/3 of the parking lot is filled during worst case peak |
| Vehicle travelling speed in parking lot | 20 | km/hour | Stantec assumption, typically low speeds travelling in parking lots |
| Vehicle travelling distance | 0.25 | miles | Stantec assumption |
| Future Build PPUDO capacity | 12 | spots | Based on concept design figure |
| Future Build PPUDO vehicle travelling distance | 0.44 | miles | travel distance from PPUDO entrance to PPUDO area x 2 (loop) |
| GO Trains per Hour | 3 | two way | Based on information provide by Metrolinx |
| GO Trains per Day | 44 | two way | Based on information provided by Metrolinx. Total train passes per day minus 10 equipment moves which occur during nighttime hours. |
| PPUDO Vehicles during Peak Hour | 36 | per hour | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour (12 spots x 3 trains) |
| PPUDO Vehicles per Day | 528 | per day | Calculated assuming all PPUDO spots are full with every GO train (12 spots x 44 train trips). |
| Vehicle idling time in PPUDO | 10 | minutes | Stantec assumption is that the total time that each spot is occupied for each train arrival is 10 minutes. |

**Emission Calculation for Vehicles Travelling in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.6E-01 | 8.8E-01 | 2.5E-04 | 5.3E+00 | 6.1E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 1.0E-01 | 2.9E-05 | 6.2E-01 | 7.2E-06 |
| CO | 630-08-0 | 6.0E+00 | 3.4E+01 | 9.5E-03 | 2.0E+02 | 2.4E-03 |
| PM2.5 | N/A | 1.5E-02 | 8.6E-02 | 2.4E-05 | 5.1E-01 | 5.9E-06 |
| PM10 | N/A | 9.6E-02 | 5.4E-01 | 1.5E-04 | 3.3E+00 | 3.8E-05 |
| PM | N/A | 9.6E-02 | 5.4E-01 | 1.5E-04 | 3.3E+00 | 3.8E-05 |
| $SO_2$ | 7446-09-5 | 3.3E-03 | 1.9E-02 | 5.2E-06 | 1.1E-01 | 1.3E-06 |
| Benzene | 71-43-2 | 2.0E-03 | 1.1E-02 | 3.1E-06 | 6.7E-02 | 7.7E-07 |
| Acetaldehyde | 75-07-0 | 7.0E-04 | 4.0E-03 | 1.1E-06 | 2.4E-02 | 2.8E-07 |
| Acrolein | 107-02-8 | 4.5E-05 | 2.6E-04 | 7.1E-08 | 1.5E-03 | 1.8E-08 |
| Benzo(a)pyrene | 50-32-8 | 1.5E-06 | 8.2E-06 | 2.3E-09 | 4.9E-05 | 5.7E-10 |
| 1,3-Butadiene | 106-99-0 | 1.5E-04 | 8.6E-04 | 2.4E-07 | 5.1E-03 | 5.9E-08 |
| Formaldehyde | 50-00-0 | 8.1E-04 | 4.6E-03 | 1.3E-06 | 2.8E-02 | 3.2E-07 |

**Emission Calculation for Vehicles Idling in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 8.7E-01 | 3.9E-01 | 1.1E-04 | 1.2E+00 | 1.3E-05 |
| NO2 | 10102-44-0 | 9.6E-02 | 4.3E-02 | 1.2E-05 | 1.3E-01 | 1.5E-06 |
| CO | 630-08-0 | 6.7E+01 | 3.0E+01 | 8.2E-03 | 8.9E+01 | 1.0E-03 |
| PM2.5 | N/A | 4.1E-02 | 1.8E-02 | 5.1E-06 | 5.5E-02 | 6.3E-07 |
| PM10 | N/A | 4.7E-02 | 2.1E-02 | 5.7E-06 | 6.2E-02 | 7.2E-07 |
| PM | N/A | 4.7E-02 | 2.1E-02 | 5.7E-06 | 6.2E-02 | 7.2E-07 |
| $SO_2$ | 7446-09-5 | 5.6E-02 | 2.5E-02 | 6.8E-06 | 7.4E-02 | 8.5E-07 |
| Benzene | 71-43-2 | 2.5E-02 | 1.1E-02 | 3.0E-06 | 3.3E-02 | 3.8E-07 |
| Acetaldehyde | 75-07-0 | 9.0E-03 | 4.0E-03 | 1.1E-06 | 1.2E-02 | 1.4E-07 |
| Acrolein | 107-02-8 | 5.7E-04 | 2.5E-04 | 7.0E-08 | 7.6E-04 | 8.8E-09 |
| Benzo(a)pyrene | 50-32-8 | 1.8E-05 | 7.7E-06 | 2.2E-09 | 2.3E-05 | 2.7E-10 |
| 1,3-Butadiene | 106-99-0 | 2.0E-03 | 8.9E-04 | 2.5E-07 | 2.7E-03 | 3.1E-08 |
| Formaldehyde | 50-00-0 | 1.0E-02 | 4.5E-03 | 1.2E-06 | 1.3E-02 | 1.6E-07 |

**Emission Calculation for Vehicles - Start-up Emissions in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ Start Up | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/V-start | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.0E-01 | 3.5E+00 | 9.8E-04 | 1.1E+01 | 1.2E-04 |
| NO2 | 10102-44-0 | 4.0E-03 | 1.4E-01 | 4.0E-05 | 4.3E-01 | 5.0E-06 |
| CO | 630-08-0 | 9.8E-01 | 3.4E+01 | 9.6E-03 | 1.0E+02 | 1.2E-03 |
| PM2.5 | N/A | 1.1E-02 | 3.9E-01 | 1.1E-04 | 1.2E+00 | 1.4E-05 |
| PM10 | N/A | 1.2E-02 | 4.4E-01 | 1.2E-04 | 1.3E+00 | 1.5E-05 |
| PM | N/A | 1.2E-02 | 4.4E-01 | 1.2E-04 | 1.3E+00 | 1.5E-05 |
| $SO_2$ | 7446-09-5 | 4.1E-05 | 1.5E-03 | 4.1E-07 | 4.4E-03 | 5.1E-08 |
| Benzene | 71-43-2 | 6.2E-03 | 2.2E-01 | 6.0E-05 | 6.5E-01 | 7.5E-06 |
| Acetaldehyde | 75-07-0 | 2.6E-03 | 9.0E-02 | 2.5E-05 | 2.7E-01 | 3.1E-06 |
| Acrolein | 107-02-8 | 1.7E-04 | 6.0E-03 | 1.7E-06 | 1.8E-02 | 2.1E-07 |
| Benzo(a)pyrene | 50-32-8 | 4.2E-06 | 1.5E-04 | 4.1E-08 | 4.4E-04 | 5.1E-09 |
| 1,3-Butadiene | 106-99-0 | 7.9E-04 | 2.8E-02 | 7.8E-06 | 8.4E-02 | 9.7E-07 |
| Formaldehyde | 50-00-0 | 1.6E-03 | 5.7E-02 | 1.6E-05 | 1.7E-01 | 2.0E-06 |

**Emission Calculation for Vehicles Travelling in Future Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 1.1E+00 | 3.2E-04 | 6.8E+00 | 7.9E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 1.8E-01 | 5.1E-05 | 1.1E+00 | 1.3E-05 |
| CO | 630-08-0 | 2.9E+00 | 1.7E+02 | 4.8E-02 | 1.0E+03 | 1.2E-02 |
| PM2.5 | N/A | 1.4E-02 | 8.2E-01 | 2.3E-04 | 4.9E+00 | 5.7E-05 |
| PM10 | N/A | 9.5E-02 | 5.6E+00 | 1.6E-03 | 3.4E+01 | 3.9E-04 |
| PM | N/A | 9.5E-02 | 5.6E+00 | 1.6E-03 | 3.4E+01 | 3.9E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 1.5E-01 | 4.2E-05 | 9.2E-01 | 1.1E-05 |
| Benzene | 71-43-2 | 6.0E-04 | 3.6E-02 | 1.0E-05 | 2.2E-01 | 2.5E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 7.8E-03 | 2.2E-06 | 4.7E-02 | 5.4E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 6.8E-04 | 1.9E-07 | 4.1E-03 | 4.7E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 2.8E-05 | 7.8E-09 | 1.7E-04 | 1.9E-09 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 2.8E-06 | 7.7E-10 | 1.7E-05 | 1.9E-10 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 1.5E-02 | 4.1E-06 | 8.8E-02 | 1.0E-06 |

**Emission Calculation for Vehicles Idling in Future Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 3.4E-01 | 9.5E-05 | 1.0E+00 | 1.2E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 5.5E-02 | 1.5E-05 | 1.6E-01 | 1.9E-06 |
| CO | 630-08-0 | 3.3E+01 | 9.7E+01 | 2.7E-02 | 2.9E+02 | 3.4E-03 |
| PM2.5 | N/A | 2.9E-02 | 8.6E-02 | 2.4E-05 | 2.6E-01 | 3.0E-06 |
| PM10 | N/A | 3.2E-02 | 9.7E-02 | 2.7E-05 | 2.9E-01 | 3.4E-06 |
| PM | N/A | 3.2E-02 | 9.7E-02 | 2.7E-05 | 2.9E-01 | 3.4E-06 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 1.3E-01 | 3.5E-05 | 3.8E-01 | 4.4E-06 |
| Benzene | 71-43-2 | 7.0E-03 | 2.1E-02 | 5.8E-06 | 6.3E-02 | 7.3E-07 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 4.5E-03 | 1.3E-06 | 1.4E-02 | 1.6E-07 |
| Acrolein | 107-02-8 | 1.3E-04 | 3.9E-04 | 1.1E-07 | 1.2E-03 | 1.4E-08 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 2.1E-05 | 5.8E-09 | 6.3E-05 | 7.3E-10 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 1.6E-06 | 4.4E-10 | 4.8E-06 | 5.5E-11 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 8.4E-03 | 2.3E-06 | 2.5E-02 | 2.9E-07 |

**Emission Calculation for Vehicles - Start-up Emissions in Future Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ Start Up | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/V-start | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 7.5E-02 | 1.8E+01 | 5.0E-03 | 5.4E+01 | 6.2E-04 |
| NO2 | 10102-44-0 | 3.1E-03 | 7.5E-01 | 2.1E-04 | 2.2E+00 | 2.6E-05 |
| CO | 630-08-0 | 5.6E-01 | 1.3E+02 | 3.7E-02 | 4.0E+02 | 4.6E-03 |
| PM2.5 | N/A | 1.3E-02 | 3.0E+00 | 8.3E-04 | 9.0E+00 | 1.0E-04 |
| PM10 | N/A | 1.4E-02 | 3.4E+00 | 9.4E-04 | 1.0E+01 | 1.2E-04 |
| PM | N/A | 1.4E-02 | 3.4E+00 | 9.4E-04 | 1.0E+01 | 1.2E-04 |
| $SO_2$ | 7446-09-5 | 3.8E-05 | 9.1E-03 | 2.5E-06 | 2.7E-02 | 3.2E-07 |
| Benzene | 71-43-2 | 4.5E-03 | 1.1E+00 | 3.0E-04 | 3.2E+00 | 3.7E-05 |
| Acetaldehyde | 75-07-0 | 2.0E-03 | 4.8E-01 | 1.3E-04 | 1.4E+00 | 1.7E-05 |
| Acrolein | 107-02-8 | 1.3E-04 | 3.1E-02 | 8.5E-06 | 9.2E-02 | 1.1E-06 |
| Benzo(a)pyrene | 50-32-8 | 3.6E-06 | 8.5E-04 | 2.4E-07 | 2.5E-03 | 2.9E-08 |
| 1,3-Butadiene | 106-99-0 | 5.8E-04 | 1.4E-01 | 3.8E-05 | 4.1E-01 | 4.8E-06 |
| Formaldehyde | 50-00-0 | 9.8E-04 | 2.3E-01 | 6.5E-05 | 7.0E-01 | 8.1E-06 |

**Emission Calculation for Vehicles Travelling in PPUDO Area:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 3.0E-01 | 8.4E-05 | 4.4E+00 | 5.1E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 4.9E-02 | 1.4E-05 | 7.1E-01 | 8.3E-06 |
| CO | 630-08-0 | 2.9E+00 | 4.6E+01 | 1.3E-02 | 6.8E+02 | 7.9E-03 |
| PM2.5 | N/A | 1.4E-02 | 2.2E-01 | 6.1E-05 | 3.2E+00 | 3.7E-05 |
| PM10 | N/A | 9.5E-02 | 1.5E+00 | 4.2E-04 | 2.2E+01 | 2.5E-04 |
| TSP | N/A | 9.5E-02 | 1.5E+00 | 4.2E-04 | 2.2E+01 | 2.5E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 4.1E-02 | 1.1E-05 | 5.9E-01 | 6.9E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 9.5E-03 | 2.6E-06 | 1.4E-01 | 1.6E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 2.1E-03 | 5.8E-07 | 3.1E-02 | 3.5E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 1.8E-04 | 5.0E-08 | 2.7E-03 | 3.1E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 7.4E-06 | 2.1E-09 | 1.1E-04 | 1.3E-09 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 7.4E-07 | 2.0E-10 | 1.1E-05 | 1.3E-10 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 3.9E-03 | 1.1E-06 | 5.7E-02 | 6.6E-07 |

**Emission Calculation for Vehicles Idling in Future Build PPUDO Area:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 3.4E-01 | 9.5E-05 | 5.0E+00 | 5.8E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 5.5E-02 | 1.5E-05 | 8.1E-01 | 9.4E-06 |
| CO | 630-08-0 | 3.3E+01 | 9.8E+01 | 2.7E-02 | 1.4E+03 | 1.7E-02 |
| PM2.5 | N/A | 2.9E-02 | 8.6E-02 | 2.4E-05 | 1.3E+00 | 1.5E-05 |
| PM10 | N/A | 3.2E-02 | 9.7E-02 | 2.7E-05 | 1.4E+00 | 1.7E-05 |
| TSP | N/A | 3.2E-02 | 9.7E-02 | 2.7E-05 | 1.4E+00 | 1.7E-05 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 1.3E-01 | 3.6E-05 | 1.9E+00 | 2.2E-05 |
| Benzene | 71-43-2 | 7.0E-03 | 2.1E-02 | 5.8E-06 | 3.1E-01 | 3.6E-06 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 4.5E-03 | 1.3E-06 | 6.7E-02 | 7.7E-07 |
| Acrolein | 107-02-8 | 1.3E-04 | 3.9E-04 | 1.1E-07 | 5.8E-03 | 6.7E-08 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 2.1E-05 | 5.8E-09 | 3.1E-04 | 3.6E-09 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 1.6E-06 | 4.5E-10 | 2.4E-05 | 2.7E-10 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 8.5E-03 | 2.4E-06 | 1.2E-01 | 1.4E-06 |

**Notes:**

(1) Emission rates are based on MOVES outputs for years 2021 and 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph.
The emission rate is therefore calculated based on: a) the car in the lot travelling 0.0125 miles in a span of 1.5-minutes or 0.025 hours or
b) the car in the PPUDO travelling 0.08 miles in a span of 10-minutes or 0.17 hours.
(2) Hourly emission rates are based on assumed maximum number of vehicles arriving or leaving the parking lot within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation - Vehicle Travelling**

Hourly Emission Rate = Emission Factor (g/VMT) x one way miles travelled (miles) x Number of vehicles (V/hour) x 1 hour/3600 s
Daily Emission Rate = Emission Factor (g/VMT) x two way miles travelled (miles) x Number of vehicles (V/day) x 1day/24 hr x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the assumed number of vehicles using the parking lot based on proposed future train schedule, and proposed parking lot capacity.

**Summary of Emissions**

| Source Group | Contaminant | CAS# | Morning Rush Hour | | Evening Rush Hour | | Total Daily |
|---|---|---|---|---|---|---|---|
| | | | Hourly Emission Rate | Daily Emission Rate (entering) | Hourly Emission Rate | Daily Emission Rate (leaving) | Daily Emission Rate |
| | | | g/s | g/s | g/s | g/s | g/s |
| EX_LOT1 | NOx | 10102-44-0 | 2.5E-04 | 6.1E-05 | 1.34E-03 | 1.98E-04 | 2.59E-04 |
| | NO2 | 10102-44-0 | 2.9E-05 | 7.2E-06 | 8.0E-05 | 1.4E-05 | 2.08E-05 |
| | CO | 630-08-0 | 9.5E-03 | 2.4E-03 | 2.73E-02 | 4.60E-03 | 6.97E-03 |
| | PM2.5 | N/A | 2.4E-05 | 5.9E-06 | 1.37E-04 | 2.01E-05 | 2.60E-05 |
| | PM10 | N/A | 1.5E-04 | 3.8E-05 | 2.79E-04 | 5.37E-05 | 9.15E-05 |
| | PM | N/A | 1.5E-04 | 3.8E-05 | 2.79E-04 | 5.37E-05 | 9.15E-05 |
| | $SO_2$ | 7446-09-5 | 5.2E-06 | 1.3E-06 | 1.25E-05 | 2.21E-06 | 3.52E-06 |
| | Benzene | 71-43-2 | 3.1E-06 | 7.7E-07 | 6.65E-05 | 8.70E-06 | 9.47E-06 |
| | Acetaldehyde | 75-07-0 | 1.1E-06 | 2.8E-07 | 2.73E-05 | 3.55E-06 | 3.83E-06 |
| | Acrolein | 107-02-8 | 7.1E-08 | 1.8E-08 | 1.81E-06 | 2.36E-07 | 2.54E-07 |
| | Benzo(a)pyrene | 50-32-8 | 2.3E-09 | 5.7E-10 | 4.53E-08 | 5.95E-09 | 6.52E-09 |
| | 1,3-Butadiene | 106-99-0 | 2.4E-07 | 5.9E-08 | 8.28E-06 | 1.07E-06 | 1.12E-06 |
| | Formaldehyde | 50-00-0 | 1.3E-06 | 3.2E-07 | 1.83E-05 | 2.45E-06 | 2.77E-06 |
| B3_LOT | NOx | 10102-44-0 | 3.2E-04 | 7.9E-05 | 5.4E-03 | 7.1E-04 | 7.9E-04 |
| | NO2 | 10102-44-0 | 5.1E-05 | 1.3E-05 | 2.7E-04 | 4.1E-05 | 5.3E-05 |
| | CO | 630-08-0 | 4.8E-02 | 1.2E-02 | 1.1E-01 | 2.0E-02 | 3.2E-02 |
| | PM2.5 | N/A | 2.3E-04 | 5.7E-05 | 1.1E-03 | 1.6E-04 | 2.2E-04 |
| | PM10 | N/A | 1.6E-03 | 3.9E-04 | 2.5E-03 | 5.1E-04 | 9.0E-04 |
| | PM | N/A | 1.6E-03 | 3.9E-04 | 2.5E-03 | 5.1E-04 | 9.0E-04 |
| | $SO_2$ | 7446-09-5 | 4.2E-05 | 1.1E-05 | 8.0E-05 | 1.5E-05 | 2.6E-05 |
| | Benzene | 71-43-2 | 1.0E-05 | 2.5E-06 | 3.2E-04 | 4.1E-05 | 4.3E-05 |
| | Acetaldehyde | 75-07-0 | 2.2E-06 | 5.4E-07 | 1.4E-04 | 1.7E-05 | 1.8E-05 |
| | Acrolein | 107-02-8 | 1.9E-07 | 4.7E-08 | 8.8E-06 | 1.1E-06 | 1.2E-06 |
| | Benzo(a)pyrene | 50-32-8 | 7.8E-09 | 1.9E-09 | 2.5E-07 | 3.2E-08 | 3.4E-08 |
| | 1,3-Butadiene | 106-99-0 | 7.7E-10 | 1.9E-10 | 3.8E-05 | 4.8E-06 | 4.8E-06 |
| | Formaldehyde | 50-00-0 | 4.1E-06 | 1.0E-06 | 7.2E-05 | 9.5E-06 | 1.0E-05 |
| B3_PPUDO | NOx | 10102-44-0 | 1.8E-04 | 1.1E-04 | 1.8E-04 | 1.1E-04 | 2.2E-04 |
| | NO2 | 10102-44-0 | 2.9E-05 | 1.8E-05 | 2.9E-05 | 1.8E-05 | 3.5E-05 |
| | CO | 630-08-0 | 4.0E-02 | 2.4E-02 | 4.0E-02 | 2.4E-02 | 4.9E-02 |
| | PM2.5 | N/A | 8.4E-05 | 5.2E-05 | 8.4E-05 | 5.2E-05 | 1.0E-04 |
| | PM10 | N/A | 4.4E-04 | 2.7E-04 | 4.4E-04 | 2.7E-04 | 5.4E-04 |
| | PM | N/A | 4.4E-04 | 2.7E-04 | 4.4E-04 | 2.7E-04 | 5.4E-04 |
| | $SO_2$ | 7446-09-5 | 4.7E-05 | 2.9E-05 | 4.7E-05 | 2.9E-05 | 5.7E-05 |
| | Benzene | 71-43-2 | 8.5E-06 | 5.2E-06 | 8.5E-06 | 5.2E-06 | 1.0E-05 |
| | Acetaldehyde | 75-07-0 | 1.8E-06 | 1.1E-06 | 1.8E-06 | 1.1E-06 | 2.2E-06 |
| | Acrolein | 107-02-8 | 1.6E-07 | 9.8E-08 | 1.6E-07 | 9.8E-08 | 2.0E-07 |
| | Benzo(a)pyrene | 50-32-8 | 7.9E-09 | 4.8E-09 | 7.9E-09 | 4.8E-09 | 9.7E-09 |
| | 1,3-Butadiene | 106-99-0 | 6.5E-10 | 4.0E-10 | 6.5E-10 | 4.0E-10 | 8.0E-10 |
| | Formaldehyde | 50-00-0 | 3.4E-06 | 2.1E-06 | 3.4E-06 | 2.1E-06 | 4.2E-06 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 TOC Operation***

**Source: Passenger Vehicle Tailpipe Emissions in Parking Lot - Existing / Future No Build / Future Build Scenario**

### Source ID:

EX_LOT2, B4_LOT, B4_PPUDO

### Description:

Vehicle tailpipe (travelling, idling and start up) emission estimation for the existing and future build passenger pick up and drop off area and parking lot. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Emissions calculated here only accounts for vehicular traffic within the future B4 station. Assumptions used in the calculation are detailed below.

### Contaminant(s) of Concern:

NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input | | |
|---|---|---|---|
| **Existing / Future No Build** | | | |
| Vehicle idling time in parking lot | 1.5 | minutes | Based on information provided by Metrolinx |
| Existing Parking lot capacity | 87 | spots | Based on counts from Google Earth satellite imagery in 2021. |
| Maximum number of vehicles per hour during existing rush hour | 29 | per hour | Stantec assumption is that 1/3 of the parking lot is filled during worst case peak hour |
| Vehicle travelling speed in parking lot | 20 | km/hour | Stantec assumption, typically low speeds travelling in parking lots |
| Existing Lot vehicle travelling distance | 0.04 | miles | measured travel distance from entrance to the parking lot to the middle of the lot |
| **Future Build** | | | |
| Vehicle idling time in parking lot | 1.5 | minutes | Based on information provided by Metrolinx |
| Future Build Parking lot capacity | 824 | spots | Based on concept design figure and includes proposed AODA and standard parking spots |
| Maximum number of vehicles per hour during future build rush hour | 275 | per hour | Stantec assumption is that 1/3 of the parking lot is filled during worst case peak hour |
| Future Build Lot vehicle travelling distance | 0.20 | miles | measured travel distance from entrance to the parking lot to the middle of the lot |
| Future Build PPUDO capacity | 36 | spots | Based on concept design figure |
| Future Build PPUDO vehicle travelling distance | 0.06 | miles | travel distance from PPUDO entrance to PPUDO area x 2 (loop) |
| GO Trains per Hour | 3 | two way | Based on information provied by Metrolinx |
| GO Trains per Day | 44 | two way | Based on information provided by Metrolinx. Total train passes per day minus 10 equipment moves which occur during nighttime hours. |
| PPUDO Vehicles during Peak Hour | 108 | per hour | Stantec assumption is that 100% of the PPUDO spots are filled during worst case peak hour (19 spots x 3 trains) |
| PPUDO Vehicles per Day | 1584 | per day | Calculated assuming all PPUDO spots are full with every GO train (36 spots x 44 train trips). |
| Vehicle idling time in PPUDO | 10 | minutes | Stantec assumption is that the total time that each spot is occupied for each train arrival is 10 minutes. |

**Emission Calculation for Vehicles Travelling in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [(1)] | Hourly Emission Rate [(2)] | | Daily Emission Rate [(3)] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.6E-01 | 1.8E-01 | 5.0E-05 | 1.1E+00 | 1.3E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 2.1E-02 | 5.9E-06 | 1.3E-01 | 1.5E-06 |
| CO | 630-08-0 | 6.0E+00 | 7.0E+00 | 1.9E-03 | 4.2E+01 | 4.9E-04 |
| PM2.5 | N/A | 1.5E-02 | 1.8E-02 | 4.9E-06 | 1.1E-01 | 1.2E-06 |
| PM10 | N/A | 9.6E-02 | 1.1E-01 | 3.1E-05 | 6.7E-01 | 7.7E-06 |
| TSP | N/A | 9.6E-02 | 1.1E-01 | 3.1E-05 | 6.7E-01 | 7.7E-06 |
| $SO_2$ | 7446-09-5 | 3.3E-03 | 3.9E-03 | 1.1E-06 | 2.3E-02 | 2.7E-07 |
| Benzene | 71-43-2 | 2.0E-03 | 2.3E-03 | 6.3E-07 | 1.4E-02 | 1.6E-07 |
| Acetaldehyde | 75-07-0 | 7.0E-04 | 8.2E-04 | 2.3E-07 | 4.9E-03 | 5.7E-08 |
| Acrolein | 107-02-8 | 4.5E-05 | 5.3E-05 | 1.5E-08 | 3.2E-04 | 3.7E-09 |
| Benzo(a)pyrene | 50-32-8 | 1.5E-06 | 1.7E-06 | 4.7E-10 | 1.0E-05 | 1.2E-10 |
| 1,3-Butadiene | 106-99-0 | 1.5E-04 | 1.8E-04 | 4.9E-08 | 1.1E-03 | 1.2E-08 |
| Formaldehyde | 50-00-0 | 8.1E-04 | 9.4E-04 | 2.6E-07 | 5.7E-03 | 6.6E-08 |

**Emission Calculation for Vehicles Idling in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [(1)] | Hourly Emission Rate [(2)] | | Daily Emission Rate [(3)] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 8.7E-01 | 3.2E-01 | 8.8E-05 | 9.5E-01 | 1.1E-05 |
| NO2 | 10102-44-0 | 9.6E-02 | 3.5E-02 | 9.7E-06 | 1.0E-01 | 1.2E-06 |
| CO | 630-08-0 | 6.7E+01 | 2.4E+01 | 6.8E-03 | 7.3E+01 | 8.5E-04 |
| PM2.5 | N/A | 4.1E-02 | 1.5E-02 | 4.2E-06 | 4.5E-02 | 5.2E-07 |
| PM10 | N/A | 4.7E-02 | 1.7E-02 | 4.7E-06 | 5.1E-02 | 5.9E-07 |
| TSP | N/A | 4.7E-02 | 1.7E-02 | 4.7E-06 | 5.1E-02 | 5.9E-07 |
| $SO_2$ | 7446-09-5 | 5.6E-02 | 2.0E-02 | 5.6E-06 | 6.0E-02 | 7.0E-07 |
| Benzene | 71-43-2 | 2.5E-02 | 8.9E-03 | 2.5E-06 | 2.7E-02 | 3.1E-07 |
| Acetaldehyde | 75-07-0 | 9.0E-03 | 3.3E-03 | 9.1E-07 | 9.8E-03 | 1.1E-07 |
| Acrolein | 107-02-8 | 5.7E-04 | 2.1E-04 | 5.8E-08 | 6.2E-04 | 7.2E-09 |
| Benzo(a)pyrene | 50-32-8 | 1.8E-05 | 6.4E-06 | 1.8E-09 | 1.9E-05 | 2.2E-10 |
| 1,3-Butadiene | 106-99-0 | 2.0E-03 | 7.3E-04 | 2.0E-07 | 2.2E-03 | 2.5E-08 |
| Formaldehyde | 50-00-0 | 1.0E-02 | 3.7E-03 | 1.0E-06 | 1.1E-02 | 1.3E-07 |

**Emission Calculation for Vehicles - Start-up Emissions in Existing Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ Start Up | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/V-start | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.0E-01 | 2.9E+00 | 8.1E-04 | 8.7E+00 | 1.0E-04 |
| NO2 | 10102-44-0 | 4.0E-03 | 1.2E-01 | 3.3E-05 | 3.5E-01 | 4.1E-06 |
| CO | 630-08-0 | 9.8E-01 | 2.8E+01 | 7.9E-03 | 8.5E+01 | 9.8E-04 |
| PM2.5 | N/A | 1.1E-02 | 3.2E-01 | 8.9E-05 | 9.6E-01 | 1.1E-05 |
| PM10 | N/A | 1.2E-02 | 3.6E-01 | 1.0E-04 | 1.1E+00 | 1.3E-05 |
| TSP | N/A | 1.2E-02 | 3.6E-01 | 1.0E-04 | 1.1E+00 | 1.3E-05 |
| $SO_2$ | 7446-09-5 | 4.1E-05 | 1.2E-03 | 3.3E-07 | 3.6E-03 | 4.2E-08 |
| Benzene | 71-43-2 | 6.2E-03 | 1.8E-01 | 5.0E-05 | 5.4E-01 | 6.2E-06 |
| Acetaldehyde | 75-07-0 | 2.6E-03 | 7.4E-02 | 2.1E-05 | 2.2E-01 | 2.6E-06 |
| Acrolein | 107-02-8 | 1.7E-04 | 4.9E-03 | 1.4E-06 | 1.5E-02 | 1.7E-07 |
| Benzo(a)pyrene | 50-32-8 | 4.2E-06 | 1.2E-04 | 3.4E-08 | 3.6E-04 | 4.2E-09 |
| 1,3-Butadiene | 106-99-0 | 7.9E-04 | 2.3E-02 | 6.4E-06 | 6.9E-02 | 8.0E-07 |
| Formaldehyde | 50-00-0 | 1.6E-03 | 4.7E-02 | 1.3E-05 | 1.4E-01 | 1.6E-06 |

**Emission Calculation for Vehicles Travelling in Future Build Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 1.0E+00 | 2.9E-04 | 6.3E+00 | 7.3E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 1.7E-01 | 4.7E-05 | 1.0E+00 | 1.2E-05 |
| CO | 630-08-0 | 2.9E+00 | 1.6E+02 | 4.5E-02 | 9.6E+02 | 1.1E-02 |
| PM2.5 | N/A | 1.4E-02 | 7.6E-01 | 2.1E-04 | 4.5E+00 | 5.2E-05 |
| PM10 | N/A | 9.5E-02 | 5.2E+00 | 1.4E-03 | 3.1E+01 | 3.6E-04 |
| TSP | N/A | 9.5E-02 | 5.2E+00 | 1.4E-03 | 3.1E+01 | 3.6E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 1.4E-01 | 3.9E-05 | 8.4E-01 | 9.8E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 3.3E-02 | 9.2E-06 | 2.0E-01 | 2.3E-06 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 7.2E-03 | 2.0E-06 | 4.3E-02 | 5.0E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 6.3E-04 | 1.7E-07 | 3.8E-03 | 4.4E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 2.6E-05 | 7.2E-09 | 1.5E-04 | 1.8E-09 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 2.6E-06 | 7.1E-10 | 1.5E-05 | 1.8E-10 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 1.4E-02 | 3.8E-06 | 8.1E-02 | 9.4E-07 |

**Emission Calculation for Vehicles Idling in Future Build Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 3.9E-01 | 1.1E-04 | 1.2E+00 | 1.4E-05 |
| NO2 | 10102-44-0 | 1.8E-02 | 6.3E-02 | 1.8E-05 | 1.9E-01 | 2.2E-06 |
| CO | 630-08-0 | 3.3E+01 | 1.1E+02 | 3.1E-02 | 3.4E+02 | 3.9E-03 |
| PM2.5 | N/A | 2.9E-02 | 9.9E-02 | 2.7E-05 | 3.0E-01 | 3.4E-06 |
| PM10 | N/A | 3.2E-02 | 1.1E-01 | 3.1E-05 | 3.3E-01 | 3.9E-06 |
| TSP | N/A | 3.2E-02 | 1.1E-01 | 3.1E-05 | 3.3E-01 | 3.9E-06 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 1.5E-01 | 4.1E-05 | 4.4E-01 | 5.1E-06 |
| Benzene | 71-43-2 | 7.0E-03 | 2.4E-02 | 6.7E-06 | 7.2E-02 | 8.4E-07 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 5.2E-03 | 1.4E-06 | 1.6E-02 | 1.8E-07 |
| Acrolein | 107-02-8 | 1.3E-04 | 4.5E-04 | 1.3E-07 | 1.4E-03 | 1.6E-08 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 2.4E-05 | 6.7E-09 | 7.2E-05 | 8.4E-10 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 1.8E-06 | 5.1E-10 | 5.5E-06 | 6.4E-11 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 9.7E-03 | 2.7E-06 | 2.9E-02 | 3.4E-07 |

**Emission Calculation for Vehicles - Start-up Emissions in Future Build Parking Lot:**

| Contaminant | CAS# | Passenger Vehicles @ Start Up | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/V-start | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 7.5E-02 | 2.1E+01 | 5.7E-03 | 6.2E+01 | 7.2E-04 |
| NO2 | 10102-44-0 | 3.1E-03 | 8.6E-01 | 2.4E-04 | 2.6E+00 | 3.0E-05 |
| CO | 630-08-0 | 5.6E-01 | 1.5E+02 | 4.2E-02 | 4.6E+02 | 5.3E-03 |
| PM2.5 | N/A | 1.3E-02 | 3.4E+00 | 9.6E-04 | 1.0E+01 | 1.2E-04 |
| PM10 | N/A | 1.4E-02 | 3.9E+00 | 1.1E-03 | 1.2E+01 | 1.4E-04 |
| TSP | N/A | 1.4E-02 | 3.9E+00 | 1.1E-03 | 1.2E+01 | 1.4E-04 |
| $SO_2$ | 7446-09-5 | 3.8E-05 | 1.0E-02 | 2.9E-06 | 3.1E-02 | 3.6E-07 |
| Benzene | 71-43-2 | 4.5E-03 | 1.2E+00 | 3.4E-04 | 3.7E+00 | 4.3E-05 |
| Acetaldehyde | 75-07-0 | 2.0E-03 | 5.5E-01 | 1.5E-04 | 1.6E+00 | 1.9E-05 |
| Acrolein | 107-02-8 | 1.3E-04 | 3.5E-02 | 9.8E-06 | 1.1E-01 | 1.2E-06 |
| Benzo(a)pyrene | 50-32-8 | 3.6E-06 | 9.8E-04 | 2.7E-07 | 2.9E-03 | 3.4E-08 |
| 1,3-Butadiene | 106-99-0 | 5.8E-04 | 1.6E-01 | 4.4E-05 | 4.7E-01 | 5.5E-06 |
| Formaldehyde | 50-00-0 | 9.8E-04 | 2.7E-01 | 7.5E-05 | 8.1E-01 | 9.4E-06 |

**Emission Calculation for Vehicles Travelling in PPUDO Area:**

| Contaminant | CAS# | Passenger Vehicles @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.9E-02 | 1.2E-01 | 3.4E-05 | 1.8E+00 | 2.1E-05 |
| NO2 | 10102-44-0 | 3.1E-03 | 2.0E-02 | 5.5E-06 | 2.9E-01 | 3.4E-06 |
| CO | 630-08-0 | 2.9E+00 | 1.9E+01 | 5.3E-03 | 2.8E+02 | 3.2E-03 |
| PM2.5 | N/A | 1.4E-02 | 8.9E-02 | 2.5E-05 | 1.3E+00 | 1.5E-05 |
| PM10 | N/A | 9.5E-02 | 6.1E-01 | 1.7E-04 | 9.0E+00 | 1.0E-04 |
| TSP | N/A | 9.5E-02 | 6.1E-01 | 1.7E-04 | 9.0E+00 | 1.0E-04 |
| $SO_2$ | 7446-09-5 | 2.6E-03 | 1.7E-02 | 4.6E-06 | 2.4E-01 | 2.8E-06 |
| Benzene | 71-43-2 | 6.0E-04 | 3.9E-03 | 1.1E-06 | 5.7E-02 | 6.6E-07 |
| Acetaldehyde | 75-07-0 | 1.3E-04 | 8.5E-04 | 2.4E-07 | 1.2E-02 | 1.4E-07 |
| Acrolein | 107-02-8 | 1.1E-05 | 7.4E-05 | 2.1E-08 | 1.1E-03 | 1.3E-08 |
| Benzo(a)pyrene | 50-32-8 | 4.7E-07 | 3.0E-06 | 8.4E-10 | 4.5E-05 | 5.2E-10 |
| 1,3-Butadiene | 106-99-0 | 4.7E-08 | 3.0E-07 | 8.4E-11 | 4.4E-06 | 5.1E-11 |
| Formaldehyde | 50-00-0 | 2.5E-04 | 1.6E-03 | 4.4E-07 | 2.3E-02 | 2.7E-07 |

**Emission Calculation for Vehicles Idling in Future Build PPUDO Area:**

| Contaminant | CAS# | Passenger Vehicles @ 0.5 mph | | | | |
|---|---|---|---|---|---|---|
| | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
| | | g/VMT | g/hour | g/s | g/day | g/s |
| NOx | 10102-44-0 | 1.1E-01 | 1.0E+00 | 2.9E-04 | 1.5E+01 | 1.7E-04 |
| NO2 | 10102-44-0 | 1.8E-02 | 1.7E-01 | 4.6E-05 | 2.4E+00 | 2.8E-05 |
| CO | 630-08-0 | 3.3E+01 | 2.9E+02 | 8.1E-02 | 4.3E+03 | 5.0E-02 |
| PM2.5 | N/A | 2.9E-02 | 2.6E-01 | 7.2E-05 | 3.8E+00 | 4.4E-05 |
| PM10 | N/A | 3.2E-02 | 2.9E-01 | 8.1E-05 | 4.3E+00 | 5.0E-05 |
| TSP | N/A | 3.2E-02 | 2.9E-01 | 8.1E-05 | 4.3E+00 | 5.0E-05 |
| $SO_2$ | 7446-09-5 | 4.3E-02 | 3.9E-01 | 1.1E-04 | 5.7E+00 | 6.5E-05 |
| Benzene | 71-43-2 | 7.0E-03 | 6.3E-02 | 1.8E-05 | 9.3E-01 | 1.1E-05 |
| Acetaldehyde | 75-07-0 | 1.5E-03 | 1.4E-02 | 3.8E-06 | 2.0E-01 | 2.3E-06 |
| Acrolein | 107-02-8 | 1.3E-04 | 1.2E-03 | 3.3E-07 | 1.7E-02 | 2.0E-07 |
| Benzo(a)pyrene | 50-32-8 | 7.0E-06 | 6.3E-05 | 1.8E-08 | 9.3E-04 | 1.1E-08 |
| 1,3-Butadiene | 106-99-0 | 5.4E-07 | 4.8E-06 | 1.3E-09 | 7.1E-05 | 8.2E-10 |
| Formaldehyde | 50-00-0 | 2.8E-03 | 2.5E-02 | 7.1E-06 | 3.7E-01 | 4.3E-06 |

**Notes:**

(1) Emission rates are based on MOVES run outputs for years 2021 and 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph.
The emission rate is therefore calculated based on: a) the car in the lot travelling 0.0125 miles in a span of 1.5-minutes or 0.025 hours or
b) the car in the PPUDO travelling 0.08 miles in a span of 10-minutes or 0.17 hours.
(2) Hourly emission rates are based on assumed maximum number of vehicles arriving or leaving the parking lot or PPUDO within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation - Vehicle Travelling in B4_PPUDO**

Hourly Emission Rate = Emission Factor (g/VMT) x loop travel distance (miles) x Number of vehicles (V/hour) x 1 hour/3600 s
Daily Emission Rate = Emission Factor (g/VMT) x loop travel distance (miles) x Number of vehicles (V/day) x 1day/24 hr x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**

The emission rate calculation for this source group is based on the assumed number of vehicles using the parking lot based on proposed future train schedule, and proposed parking lot capacity.

**Summary of Emissions**

| Source Group | Contaminant | CAS# | Morning Rush Hour: Hourly Emission Rate | Morning Rush Hour: Daily Emission Rate (entering) | Evening Rush Hour: Hourly Emission Rate | Evening Rush Hour: Daily Emission Rate (leaving) | Total Daily: Daily Emission Rate |
|---|---|---|---|---|---|---|---|
| | | | g/s | g/s | g/s | g/s | g/s |
| EX_LOT2 | NOx | 10102-44-0 | 5.0E-05 | 1.3E-05 | 9.45E-04 | 1.24E-04 | 1.4E-04 |
| | NO2 | 10102-44-0 | 5.9E-06 | 1.5E-06 | 4.8E-05 | 6.8E-06 | 8.2E-06 |
| | CO | 630-08-0 | 1.9E-03 | 4.9E-04 | 1.66E-02 | 2.31E-03 | 2.8E-03 |
| | PM2.5 | N/A | 4.9E-06 | 1.2E-06 | 9.78E-05 | 1.28E-05 | 1.4E-05 |
| | PM10 | N/A | 3.1E-05 | 7.7E-06 | 1.36E-04 | 2.09E-05 | 2.9E-05 |
| | PM | N/A | 3.1E-05 | 7.7E-06 | 1.36E-04 | 2.09E-05 | 2.9E-05 |
| | $SO_2$ | 7446-09-5 | 1.1E-06 | 2.7E-07 | 7.00E-06 | 1.01E-06 | 1.3E-06 |
| | Benzene | 71-43-2 | 6.3E-07 | 1.6E-07 | 5.27E-05 | 6.66E-06 | 6.8E-06 |
| | Acetaldehyde | 75-07-0 | 2.3E-07 | 5.7E-08 | 2.17E-05 | 2.75E-06 | 2.8E-06 |
| | Acrolein | 107-02-8 | 1.5E-08 | 3.7E-09 | 1.45E-06 | 1.83E-07 | 1.9E-07 |
| | Benzo(a)pyrene | 50-32-8 | 4.7E-10 | 1.2E-10 | 3.58E-08 | 4.53E-09 | 4.6E-09 |
| | 1,3-Butadiene | 106-99-0 | 4.9E-08 | 1.2E-08 | 6.65E-06 | 8.38E-07 | 8.5E-07 |
| | Formaldehyde | 50-00-0 | 2.6E-07 | 6.6E-08 | 1.43E-05 | 1.82E-06 | 1.9E-06 |
| B4_LOT | NOx | 10102-44-0 | 2.9E-04 | 7.3E-05 | 6.1E-03 | 8.0E-04 | 8.8E-04 |
| | NO2 | 10102-44-0 | 4.7E-05 | 1.2E-05 | 3.0E-04 | 4.4E-05 | 5.5E-05 |
| | CO | 630-08-0 | 4.5E-02 | 1.1E-02 | 1.2E-01 | 2.0E-02 | 3.1E-02 |
| | PM2.5 | N/A | 2.1E-04 | 5.2E-05 | 1.2E-03 | 1.8E-04 | 2.3E-04 |
| | PM10 | N/A | 1.4E-03 | 3.6E-04 | 2.6E-03 | 5.0E-04 | 8.6E-04 |
| | PM | N/A | 1.4E-03 | 3.6E-04 | 2.6E-03 | 5.0E-04 | 8.6E-04 |
| | $SO_2$ | 7446-09-5 | 3.9E-05 | 9.8E-06 | 8.3E-05 | 1.5E-05 | 2.5E-05 |
| | Benzene | 71-43-2 | 9.2E-06 | 2.3E-06 | 3.6E-04 | 4.6E-05 | 4.8E-05 |
| | Acetaldehyde | 75-07-0 | 2.0E-06 | 5.0E-07 | 1.6E-04 | 2.0E-05 | 2.0E-05 |
| | Acrolein | 107-02-8 | 1.7E-07 | 4.4E-08 | 1.0E-05 | 1.3E-06 | 1.3E-06 |
| | Benzo(a)pyrene | 50-32-8 | 7.2E-09 | 1.8E-09 | 2.9E-07 | 3.7E-08 | 3.8E-08 |
| | 1,3-Butadiene | 106-99-0 | 7.1E-10 | 1.8E-10 | 4.4E-05 | 5.5E-06 | 5.5E-06 |
| | Formaldehyde | 50-00-0 | 3.8E-06 | 9.4E-07 | 8.1E-05 | 1.1E-05 | 1.2E-05 |
| B4_PPUDO | NOx | 10102-44-0 | 3.2E-04 | 2.0E-04 | 3.2E-04 | 2.0E-04 | 3.9E-04 |
| | NO2 | 10102-44-0 | 5.2E-05 | 3.1E-05 | 5.2E-05 | 3.1E-05 | 6.3E-05 |
| | CO | 630-08-0 | 8.7E-02 | 5.3E-02 | 8.7E-02 | 5.3E-02 | 1.1E-01 |
| | PM2.5 | N/A | 9.6E-05 | 5.9E-05 | 9.6E-05 | 5.9E-05 | 1.2E-04 |
| | PM10 | N/A | 2.5E-04 | 1.5E-04 | 2.5E-04 | 1.5E-04 | 3.1E-04 |
| | PM | N/A | 2.5E-04 | 1.5E-04 | 2.5E-04 | 1.5E-04 | 3.1E-04 |
| | $SO_2$ | 7446-09-5 | 1.1E-04 | 6.8E-05 | 1.1E-04 | 6.8E-05 | 1.4E-04 |
| | Benzene | 71-43-2 | 1.9E-05 | 1.1E-05 | 1.9E-05 | 1.1E-05 | 2.3E-05 |
| | Acetaldehyde | 75-07-0 | 4.0E-06 | 2.5E-06 | 4.0E-06 | 2.5E-06 | 4.9E-06 |
| | Acrolein | 107-02-8 | 3.5E-07 | 2.1E-07 | 3.5E-07 | 2.1E-07 | 4.3E-07 |
| | Benzo(a)pyrene | 50-32-8 | 1.8E-08 | 1.1E-08 | 1.8E-08 | 1.1E-08 | 2.2E-08 |
| | 1,3-Butadiene | 106-99-0 | 1.4E-09 | 8.7E-10 | 1.4E-09 | 8.7E-10 | 1.7E-09 |
| | Formaldehyde | 50-00-0 | 7.5E-06 | 4.6E-06 | 7.5E-06 | 4.6E-06 | 9.2E-06 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 TOC Operation***

## Source: Transit Bus Tailpipe Emissions in Bus Loop - Existing /Future No Build Scenario

### Source ID:

| | |
|---|---|
| EX_BUS1 | Existing GO bus loop Courtice Rd @ Baseline Rd (travelling buses) |
| EX_BUS_IDLE1 | Existing GO bus loop Courtice Rd @ Baseline Rd (idling buses) |

### Description:

Diesel GO Bus emissions at the bus loop include tailpipe emissions due to travelling and idling. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Assumptions used in the calculation are detailed below.
Emissions calculated here only accounts for vehicular traffic travelling within the Station.

### Contaminant(s) of Concern:

NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input /Reference | | |
|---|---|---|---|
| **Existing / Future No Build** | | | |
| GO Bus idling time in bus loop | 3 | minutes | Information confirmed by Metrolinx |
| Maximum number of Buses per hour during peak hour | 1 | per hour | Derived from the 2020 Weekday GO Bus schedule for Route 88 Peterborough/Oshawa. |
| Maximum number of Buses per day | 6 | per day | Derived from the 2020 Weekday GO Bus schedule for Route 88 Peterborough/Oshawa. |
| GO Bus travelling speed in bus loop | 20 | km/hour | Assumed travelling speed in parking lot |
| Existing/ Future No Build Bus loop travel distance | 0.32 | miles | Stantec assumption - AERMOD line volumes source distance |

**Emission Calculation for Diesel Bus Emissions:**

| Source ID | Contaminant | CAS# | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate [3] | |
|---|---|---|---|---|---|---|---|
| | | | g/VMT | g/hour | g/s | g/day | g/s |
| EX_BUS1 | NOx | 10102-44-0 | 16.376 | 5.2 | 1.4E-03 | 31.2 | 3.61E-04 |
| | NO2 | 10102-44-0 | 2.505 | 0.8 | 2.2E-04 | 4.8 | 5.5E-05 |
| | CO | 630-08-0 | 7.342 | 2.3 | 6.5E-04 | 14.0 | 1.62E-04 |
| | PM2.5 | N/A | 0.405 | 0.1 | 3.6E-05 | 0.8 | 8.93E-06 |
| | PM10 | N/A | 0.845 | 0.3 | 7.5E-05 | 1.6 | 1.86E-05 |
| | PM | N/A | 0.845 | 0.3 | 7.5E-05 | 1.6 | 1.86E-05 |
| | $SO_2$ | 7446-09-5 | 0.021 | 0.0 | 1.9E-06 | 0.0 | 4.63E-07 |
| | Benzene | 71-43-2 | 7.98E-03 | 0.0 | 7.0E-07 | 0.0 | 1.76E-07 |
| | Acetaldehyde | 75-07-0 | 3.92E-02 | 0.0 | 3.5E-06 | 0.1 | 8.66E-07 |
| | Acrolein | 107-02-8 | 6.95E-03 | 0.0 | 6.1E-07 | 0.0 | 1.53E-07 |
| | Benzo(a)pyrene | 50-32-8 | 1.75E-05 | 0.0 | 1.5E-09 | 0.0 | 3.87E-10 |
| | 1,3-Butadiene | 106-99-0 | 2.84E-03 | 0.0 | 2.5E-07 | 0.0 | 6.27E-08 |
| | Formaldehyde | 50-00-0 | 8.43E-02 | 0.0 | 7.4E-06 | 0.2 | 1.86E-06 |
| EX_BUS_IDL1 | NOx | 10102-44-0 | 299.587 | 7.5 | 2.1E-03 | 44.94 | 5.20E-04 |
| | NO2 | 10102-44-0 | 46.215 | 1.2 | 3.2E-04 | 6.93 | 8.02E-05 |
| | CO | 630-08-0 | 116.0 | 2.9 | 8.1E-04 | 17.39 | 2.01E-04 |
| | PM2.5 | N/A | 4.773 | 0.1 | 3.3E-05 | 0.72 | 8.29E-06 |
| | PM10 | N/A | 5.188 | 0.1 | 3.6E-05 | 0.78 | 9.01E-06 |
| | PM | N/A | 5.188 | 0.1 | 3.6E-05 | 0.78 | 9.01E-06 |
| | $SO_2$ | 7446-09-5 | 0.2747 | 0.0 | 1.9E-06 | 0.04 | 4.77E-07 |
| | Benzene | 71-43-2 | 1.84E-01 | 0.0 | 1.3E-06 | 0.03 | 3.19E-07 |
| | Acetaldehyde | 75-07-0 | 8.95E-01 | 0.0 | 6.2E-06 | 0.13 | 1.55E-06 |
| | Acrolein | 107-02-8 | 1.59E-01 | 0.0 | 1.1E-06 | 0.02 | 2.76E-07 |
| | Benzo(a)pyrene | 50-32-8 | 2.82E-04 | 0.0 | 2.0E-09 | 0.00 | 4.90E-10 |
| | 1,3-Butadiene | 106-99-0 | 6.52E-02 | 0.0 | 4.5E-07 | 0.01 | 1.13E-07 |
| | Formaldehyde | 50-00-0 | 1.94E+00 | 0.0 | 1.3E-05 | 0.29 | 3.36E-06 |

**Notes:**
(1) Emission rates are based on MOVES3 for year 2021. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph. The emission rate is therefore calculated based on the bus travelling 0.025 miles in a span of 3-minutes or 0.05 hours.
bus idling distance = 0.5 mph x 0.05 hr = 0.025 miles
(2) Hourly emission rates are based on assumed maximum number of vehicles arriving or leaving the bus loop within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation**

Hourly Emission Rate = Emission Factor (g/VKT) x Number of vehicles (V/hour) x Travel distance miles x 1 hour/3600 s

Daily Emission Rate = Emission Factor (g/VKT) x Number of vehicles (V/day) x Travel distance miles x 1day/24hours x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the 2021 Route 88A bus schedule.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 TOC Operation***

**Source: Transit Bus Tailpipe Emissions in Bus Loop - Existing / Future No Build Scenario**

### Source ID:

EX_BUS2 Existing GO bus loop Clarington Blvd @ Durham Hwy 2 (travelling buses)
EX_BUS_IDL2 Existing GO bus loop Clarington Blvd @ Durham Hwy 2 (idling buses)

### Description:

Diesel GO Bus emissions at the bus loop include tailpipe emissions due to travelling and idling. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Assumptions used in the calculation are detailed below.
Emissions calculated here only accounts for vehicular traffic travelling within the Station.

### Contaminant(s) of Concern:

NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input /Reference | | |
|---|---|---|---|
| **Existing / Future No Build** | | | |
| GO Bus idling time in bus loop | 3 | minutes | Information confirmed by Metrolinx |
| Maximum number of Buses per hour during peak hour | 4 | per hour | Derived from the 2020 Weekday GO Bus schedule for Route 88 Peterborough/Oshawa. |
| Maximum number of Buses per day | 28 | per day | Derived from the 202 Weekday GO Bus schedule for Route 88 Peterborough/Oshawa. |
| GO Bus travelling speed in bus loop | 20 | km/hour | Assumed travelling speed in parking lot |
| Existing/ Future No Build Bus loop travel distance | 0.05 | miles | Stantec assumption - AERMOD line volumes source distance |

**Emission Calculation for Diesel Bus Emissions:**

| Source ID | Contaminant | CAS# | Emission Factor (1) | Hourly Emission Rate (2) | | Daily Emission Rate (3) | |
|---|---|---|---|---|---|---|---|
| | | | g/VMT | g/hour | g/s | g/day | g/s |
| EX_BUS2 | NOx | 10102-44-0 | 16.376 | 3.1 | 8.5E-04 | 21.5 | 2.5E-04 |
| | NO2 | 10102-44-0 | 2.505 | 0.5 | 1.3E-04 | 3.3 | 3.8E-05 |
| | CO | 630-08-0 | 7.342 | 1.4 | 3.8E-04 | 9.6 | 1.1E-04 |
| | PM2.5 | N/A | 0.405 | 0.1 | 2.1E-05 | 0.5 | 6.2E-06 |
| | PM10 | N/A | 0.845 | 0.2 | 4.4E-05 | 1.1 | 1.3E-05 |
| | PM | N/A | 0.845 | 0.2 | 4.4E-05 | 1.1 | 1.3E-05 |
| | $SO_2$ | 7446-09-5 | 0.021 | 0.0 | 1.1E-06 | 0.0 | 3.2E-07 |
| | Benzene | 71-43-2 | 7.98E-03 | 0.0 | 4.2E-07 | 0.0 | 1.2E-07 |
| | Acetaldehyde | 75-07-0 | 3.92E-02 | 0.0 | 2.0E-06 | 0.1 | 6.0E-07 |
| | Acrolein | 107-02-8 | 6.95E-03 | 0.0 | 3.6E-07 | 0.0 | 1.1E-07 |
| | Benzo(a)pyrene | 50-32-8 | 1.75E-05 | 0.0 | 9.1E-10 | 0.0 | 2.7E-10 |
| | 1,3-Butadiene | 106-99-0 | 2.84E-03 | 0.0 | 1.5E-07 | 0.0 | 4.3E-08 |
| | Formaldehyde | 50-00-0 | 8.43E-02 | 0.0 | 4.4E-06 | 0.1 | 1.3E-06 |
| EX_BUS_IDL2 | NOx | 10102-44-0 | 299.587 | 30.0 | 8.3E-03 | 209.71 | 2.4E-03 |
| | NO2 | 10102-44-0 | 46.215 | 4.6 | 1.3E-03 | 32.35 | 3.7E-04 |
| | CO | 630-08-0 | 116.0 | 11.6 | 3.2E-03 | 81.17 | 9.4E-04 |
| | PM2.5 | N/A | 4.773 | 0.5 | 1.3E-04 | 3.34 | 3.9E-05 |
| | PM10 | N/A | 5.188 | 0.5 | 1.4E-04 | 3.63 | 4.2E-05 |
| | PM | N/A | 5.188 | 0.5 | 1.4E-04 | 3.63 | 4.2E-05 |
| | $SO_2$ | 7446-09-5 | 0.2747 | 0.0 | 7.6E-06 | 0.19 | 2.2E-06 |
| | Benzene | 71-43-2 | 1.84E-01 | 0.0 | 5.1E-06 | 0.13 | 1.5E-06 |
| | Acetaldehyde | 75-07-0 | 8.95E-01 | 0.1 | 2.5E-05 | 0.63 | 7.3E-06 |
| | Acrolein | 107-02-8 | 1.59E-01 | 0.0 | 4.4E-06 | 0.11 | 1.3E-06 |
| | Benzo(a)pyrene | 50-32-8 | 2.82E-04 | 0.0 | 7.8E-09 | 0.00 | 2.3E-09 |
| | 1,3-Butadiene | 106-99-0 | 6.52E-02 | 0.0 | 1.8E-06 | 0.05 | 5.3E-07 |
| | Formaldehyde | 50-00-0 | 1.94E+00 | 0.2 | 5.4E-05 | 1.36 | 1.6E-05 |

**Notes:**
(1) Emission rates are based on MOVES3 for year 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph. The emission rate is therefore calculated based on the bus travelling 0.025 miles in a span of 3-minutes.
bus idling distance = 0.5 mph x 0.05 hr = 0.025 miles
(2) Hourly emission rates are based on assumed maximum number of vehicles arriving or leaving the bus loop within a 1 hour period.
(3) Daily emission rates are not used in the model, as a variable hourly emission scenario is used in the modelling.

**Sample Calculation**

| | | |
|---|---|---|
| Hourly Emission Rate | = | Emission Factor (g/VKT) x Number of vehicles (V/hour) x Travel distance miles x 1 hour/3600 s |
| Daily Emission Rate | = | Emission Factor (g/VKT) x Number of vehicles (V/day) x Travel distance miles x 1day/24hours x 1 hour/3600 s |

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the peak and off peak bus volumes provided by Metrolinx.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 TOC Operation***

**Source: Transit Bus Tailpipe Emissions in Bus Loop - Future Build Scenario**

### Source ID:

FB_BUS_B4 Future build B4 station GO bus loop (travelling buses)
FB_BUS_IDLE Future build B4 station GO bus loop (idling buses)

### Description:

Diesel GO Bus emissions at the bus loop include tailpipe emissions due to travelling and idling. Emission rates are based on the estimation tool U.S. EPA Motor Vehicle Emission Simulator (MOVES3). Assumptions used in the calculation are detailed below.
Emissions calculated here only accounts for vehicular traffic within the Project site based on the current GO bus schedule.

### Contaminant(s) of Concern:

NO2, SO2, PM2.5, PM10, CO, acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a) pyrene , formaldehyde are included in the estimations.

### Emission Calculations - Parameters Used:

| Parameter | Input /Reference | | |
|---|---|---|---|
| **Future Build** | | | |
| GO Bus idling time in bus loop | 3 | minutes | Information provided by Metrolinx 201075-STANTEC-RFI-00019 |
| Maximum number of Buses per hour during peak hour | 4 | per hour | Information provided by Metrolinx 201075-STANTEC-RFI-00019 |
| Maximum number of Buses per day | 46 | per day | Calculated based on Information provided by Metrolinx 201075-STANTEC-RFI-00019 |
| GO Bus travelling speed in bus loop | 20 | km/hour | Assumed travelling speed in parking lot |
| Future Build Bus loop travel distance | 0.07 | miles | Stantec assumption - AERMOD line volumes source distance |

**Emission Calculation for Diesel Bus Emissions:**

| Source ID | Contaminant | CAS# | GO Buses @ 12.4 mph | | | | |
|---|---|---|---|---|---|---|---|
| | | | Emission Factor [1] | Hourly Emission Rate [2] | | Daily Emission Rate | |
| | | | g/VMT | g/hour | g/s | g/day | g/s |
| FB_BUS_B4 | NOx | 10102-44-0 | 8.603 | 2.5 | 6.97E-04 | 28.9 | 3.34E-04 |
| | NO2 | 10102-44-0 | 2.857 | 0.8 | 2.3E-04 | 9.6 | 1.1E-04 |
| | CO | 630-08-0 | 4.802 | 1.4 | 3.89E-04 | 16.1 | 1.86E-04 |
| | PM2.5 | N/A | 0.133 | 0.0 | 1.07E-05 | 0.4 | 5.15E-06 |
| | PM10 | N/A | 0.554 | 0.2 | 4.49E-05 | 1.9 | 2.15E-05 |
| | PM | N/A | 0.554 | 0.2 | 4.49E-05 | 1.9 | 2.15E-05 |
| | $SO_2$ | 7446-09-5 | 0.018 | 0.0 | 1.48E-06 | 0.1 | 7.11E-07 |
| | Benzene | 71-43-2 | 1.51E-03 | 0.0 | 1.23E-07 | 0.0 | 5.88E-08 |
| | Acetaldehyde | 75-07-0 | 1.05E-02 | 0.0 | 8.48E-07 | 0.0 | 4.06E-07 |
| | Acrolein | 107-02-8 | 1.56E-03 | 0.0 | 1.27E-07 | 0.0 | 6.07E-08 |
| | Benzo(a)pyrene | 50-32-8 | 3.18E-06 | 0.0 | 2.58E-10 | 0.0 | 1.24E-10 |
| | 1,3-Butadiene | 106-99-0 | 5.06E-04 | 0.0 | 4.10E-08 | 0.0 | 1.97E-08 |
| | Formaldehyde | 50-00-0 | 1.86E-02 | 0.0 | 1.51E-06 | 0.1 | 7.21E-07 |
| FB_BUS_IDLE | NOx | 10102-44-0 | 160.529 | 16.1 | 4.5E-03 | 184.61 | 2.1E-03 |
| | NO2 | 10102-44-0 | 54.219 | 5.4 | 1.5E-03 | 62.35 | 7.2E-04 |
| | CO | 630-08-0 | 66.1 | 6.6 | 1.8E-03 | 75.97 | 8.8E-04 |
| | PM2.5 | N/A | 1.035 | 0.1 | 2.9E-05 | 1.19 | 1.4E-05 |
| | PM10 | N/A | 4.279 | 0.4 | 1.2E-04 | 4.92 | 5.7E-05 |
| | PM | N/A | 4.279 | 0.4 | 1.2E-04 | 4.92 | 5.7E-05 |
| | $SO_2$ | 7446-09-5 | 0.2270 | 0.0 | 6.3E-06 | 0.26 | 3.0E-06 |
| | Benzene | 71-43-2 | 3.55E-02 | 0.0 | 9.9E-07 | 0.04 | 4.7E-07 |
| | Acetaldehyde | 75-07-0 | 2.41E-01 | 0.0 | 6.7E-06 | 0.28 | 3.2E-06 |
| | Acrolein | 107-02-8 | 3.63E-02 | 0.0 | 1.0E-06 | 0.04 | 4.8E-07 |
| | Benzo(a)pyrene | 50-32-8 | 5.59E-05 | 0.0 | 1.6E-09 | 0.00 | 7.4E-10 |
| | 1,3-Butadiene | 106-99-0 | 1.18E-02 | 0.0 | 3.3E-07 | 0.01 | 1.6E-07 |
| | Formaldehyde | 50-00-0 | 4.34E-01 | 0.0 | 1.2E-05 | 0.50 | 5.8E-06 |

**Notes:**
(1) Emission rates are based on MOVES3 for year 2031. The more conservative emission rates (higher) between January and July are used in the estimation.
The idling emission factor is based on a MOVES modelled travel speed of 0.5 mph. The emission rate is therefore calculated based on the bus travelling 0.025 miles in a span of 3-minutes.
bus idling distance = 0.5 mph x 0.05 hr = 0.025 miles
(2) Hourly and daily emission rates are based volumes provided by Metrolinx.

**Sample Calculation**

Hourly Emission Rate = Emission Factor (g/VKT) x Number of vehicles (V/hour) x Travel distance miles x 1 hour/3600 s
Daily Emission Rate = Emission Factor (g/VKT) x Number of vehicles (V/day) x Travel distance miles x 1day/24hours x 1 hour/3600 s

**Operating Condition, Individual Maximum Rates of Production:**
The emission rate calculation for this source group is based on the peak and off peak bus volumes provided by Metrolinx.

***Appendix E: Summary of Air Dispersion Modelling Inputs***
***Location: Project Operation within Oshawa, Courtice and Bowmanville***

## Source: Emissions from Paved Roads During Operation

**Description:**
Dust emissions from GO Buses and passenger vehicles travelling on paved roads within the proposed B1, B2, B3 and B4 stations.

**Contaminant(s) of Concern:**
Particulate matter, including PM, $PM_{10}$, and $PM_{2.5}$ emissions are the contaminants of concern due to the vehicles travelling on paved road.
Resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface of roads.

**Methodology: Emission Factor (EF)**
Emission factor was calculated using Equation (1a) in the US EPA AP-42 document Chapter 13.2.1. (Paved Road). The equation is:

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

where:
E = particulate emission factor (g/VMT)
k = particle size multiplier for particle size range and units of interest (g/VMT)
sL = road surface silt loading ($g/m^2$)
W = average weight of vehicles traveling the road (tons)

**Vehicle Weight Calculation:**

| Model Segment | Source ID | Source Description | Weight of Vehicle(1), (tons) | | Percentage of Vehicle | | Average Weight(2) (tons) |
|---|---|---|---|---|---|---|---|
| | | | Car | Bus | Car | Bus | |
| **Existing / Future No Build** | | | | | | | |
| Courtice | EX_LOT1 | vehicles in existing GO parking lot @ Courtice Rd and Baseline Rd. | 1.88 | 20 | 100% | 0% | 1.88 |
| Bowmanville | EX_LOT2 | vehicles in existing GO parking lot @ Clarington Blvd and Hwy 2 | 1.88 | 20 | 100% | 0% | 1.88 |
| Courtice | EX_BUS1 | GO buses in existing bus loop @ Courtice Rd and Baseline Rd. | 1.88 | 20 | 0% | 100% | 20 |
| Bowmanville | EX_BUS2 | GO buses in existing bus loop @ Clarington Blvd and Hwy 2 | 1.88 | 20 | 0% | 100% | 20 |
| **Future Build** | | | | | | | |
| Oshawa | B1_PPUDO | vehicles in B1 TOC passenger pick up and drop off area | 1.88 | 20 | 100% | 0% | 1.88 |
| Oshawa | B2_PPUDO1 | vehicles in B2 TOC passenger pick up and drop off area 1 | 1.88 | 20 | 100% | 0% | 1.88 |
| Oshawa | B2_PPUDO2 | vehicles in B2 TOC passenger pick up and drop off area 2 | 1.88 | 20 | 100% | 0% | 1.88 |
| Oshawa | B2_LOT | vehicles in B2 TOC parking lot | 1.88 | 20 | 100% | 0% | 1.88 |
| Courtice | B3_PPUDO | vehicles in B3 TOC future build PPUDO | 1.88 | 20 | 100% | 0% | 1.88 |
| Courtice | B3_LOT | vehicles in B3 TOC future build parking lot | 1.88 | 20 | 100% | 0% | 1.88 |
| Bowmanville | B4_PPUDO | vehicles in B4 TOC passenger pick up and drop off area | 1.88 | 20 | 100% | 0% | 1.88 |
| Bowmanville | B4_LOT | vehicles in B4 TOC parking lot | 1.88 | 20 | 100% | 0% | 1.88 |
| Bowmanville | FB_BUS_B4 | GO buses in future B4 TOC bus loop | 1.88 | 20 | 0% | 100% | 20 |

**Notes:**
(1) Bus weight per Metrolinx Draft Air Quality Environmental Guide dated November 2019. Average passenger vehicle weight is assumed based on an average weight of a sedan (2900 lbs) and SUV/van (4600 lbs).
(2) Since there are different vehicles running on different schedules and the estimation methodology suggested by US. EPA is intended for a "fleet" average weight of all vehicles travelling on the road, a weighted (based on weight of each vehicle and travelled distance) vehicle mass is used for emissions estimation. Therefore, the average weight on each road is estimated based on the traffic data.

*Appendix E: Summary of Air Dispersion Modelling Inputs*
*Location: Project Operation within Oshawa, Courtice and Bowmanville*

## Source: Emissions from Paved Roads During Operation

**Emission Factor Calculation:**

| Model Segment | Model Source ID | Source Description | Average Vehicle Weight (tons) | Particle Size Factor k(1) (g/VMT) | | | ADT(2) | Silt Loading(3) | Emission Factor(3) (g/VMT) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PM | PM10 | PM2.5 | | g/m² | PM | PM10 | PM2.5 |
| **Existing / Future No Build** | | | | | | | | | | | |
| Courtice | EX_LOT1 | vehicles in existing GO parking lot @ Courtice Rd and Baseline Rd. | 1.88 | 5.24 | 1 | 0.25 | 212 | 0.60 | 6.250 | 1.193 | 0.298 |
| Bowmanville | EX_LOT2 | vehicles in existing GO parking lot @ Clarington Blvd and Hwy 2 | 1.88 | 5.24 | 1 | 0.25 | 174 | 0.60 | 6.250 | 1.193 | 0.298 |
| Courtice | EX_BUS1 | GO buses in existing bus loop @ Courtice Rd and Baseline Rd. | 20 | 5.24 | 1 | 0.25 | 28 | 0.60 | 69.904 | 13.340 | 3.335 |
| Bowmanville | EX_BUS2 | GO buses in existing bus loop @ Clarington Blvd and Hwy 2 | 20 | 5.24 | 1 | 0.25 | 6 | 0.60 | 69.904 | 13.340 | 3.335 |
| **Future Build** | | | | | | | | | | | |
| Oshawa | B1_PPUDO | vehicles in B1 TOC passenger pick up and drop off area | 1.88 | 5.24 | 1 | 0.25 | 836 | 0.20 | 2.300 | 0.439 | 0.110 |
| Oshawa | B2_PPUDO1 | vehicles in B2 TOC passenger pick up and drop off area 1 | 1.88 | 5.24 | 1 | 0.25 | 924 | 0.20 | 2.300 | 0.439 | 0.110 |
| Oshawa | B2_PPUDO2 | vehicles in B2 TOC passenger pick up and drop off area 2 | 1.88 | 5.24 | 1 | 0.25 | 924 | 0.20 | 2.300 | 0.439 | 0.110 |
| Oshawa | B2_LOT | vehicles in B2 TOC parking lot | 1.88 | 5.24 | 1 | 0.25 | 1,786 | 0.20 | 2.300 | 0.439 | 0.110 |
| Courtice | B3_PPUDO | vehicles in B3 TOC future build PPUDO | 1.88 | 5.24 | 1 | 0.25 | 108 | 0.20 | 2.300 | 0.439 | 0.110 |
| Courtice | B3_LOT | vehicles in B3 TOC future build parking lot | 1.88 | 5.24 | 1 | 0.25 | 1,432 | 0.20 | 2.300 | 0.439 | 0.110 |
| Bowmanville | B4_PPUDO | vehicles in B4 TOC passenger pick up and drop off area | 1.88 | 5.24 | 1 | 0.25 | 1,584 | 0.20 | 2.300 | 0.439 | 0.110 |
| Bowmanville | B4_LOT | vehicles in B4 TOC parking lot | 1.88 | 5.24 | 1 | 0.25 | 1,648 | 0.20 | 2.300 | 0.439 | 0.110 |
| Bowmanville | FB_BUS_B4 | GO buses in future B4 TOC bus loop | 20 | 5.24 | 1 | 0.25 | 46 | 0.60 | 69.904 | 13.340 | 3.335 |

**Notes:**
(1) Reference: USEPA AP-42 Table 13.2.1-1
(2) Stantec estimation as follows:
PPUDO ADT calculated based on # of PPUDO spots x # of trains per day
Lot ADT calculated based on # of parking spots x two way travel
Existing Bus ADT derived using 2021 (NB+SB weekday volumes for travel Route 88 and 88A).
Future Build Bus ADT Information provided by Metrolinx 201075-STANTEC-RFI-00019.
(3) Ubiquitous Silt Loading Default Values (AP-42 Chapter 13.2.1 - T2).

| ADT Category | sL (g/VMT) |
|---|---|
| <500 | 0.6 |
| 500-5,000 | 0.2 |
| 5,000-10,000 | 0.06 |
| >10,000 | 0.03 |

(3) Emission factors are calculated using the above equation.

**Emission Calculation:**

| Model Segment | Road Source ID | Road and Direction | Road Length (mile) | Peak Hour Traffic Volume (1) | Traffic Volume per Day(1) | Total Travel Distance (mile/hr) | Total Travel Distance (mile/day) | Peak Hour Emission Rate(2) (g/s) | | | Daily Emission Rate(2, 3) (g/s) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | PM | PM10 | PM2.5 | PM | PM10 | PM2.5 |
| **Existing / Future No Build** | | | | | | | | | | | | | |
| Courtice | EX_LOT1 | vehicles in existing GO parking lot @ Courtice Rd and Baseline Rd. | 0.16 | 35 | 212 | 6 | 34 | 4.1E-04 | 7.8E-05 | 2.0E-05 | 2.5E-03 | 4.7E-04 | 1.2E-04 |
| Bowmanville | EX_LOT2 | vehicles in existing GO parking lot @ Clarington Blvd and Hwy 2 | 0.04 | 29 | 174 | 1 | 7 | 8.4E-05 | 1.6E-05 | 4.0E-06 | 5.0E-04 | 9.6E-05 | 2.4E-05 |
| Courtice | EX_BUS1 | GO buses in existing bus loop @ Courtice Rd and Baseline Rd. | 0.32 | 1 | 6 | 0.3 | 2 | 2.6E-04 | 4.9E-05 | 1.2E-05 | 1.5E-03 | 2.9E-04 | 7.4E-05 |
| Bowmanville | EX_BUS2 | GO buses in existing bus loop @ Clarington Blvd and Hwy 2 | 0.05 | 4 | 28 | 0.2 | 1 | 1.5E-04 | 2.9E-05 | 7.2E-06 | 1.1E-03 | 2.0E-04 | 5.1E-05 |
| **Future Build** | | | | | | | | | | | | | |
| Oshawa | B1_PPUDO | vehicles in B1 TOC passenger pick up and drop off area | 0.24 | 57 | 836 | 14 | 201 | 3.6E-04 | 6.9E-05 | 1.7E-05 | 5.3E-03 | 1.0E-03 | 2.5E-04 |
| Oshawa | B2_PPUDO1 | vehicles in B2 TOC passenger pick up and drop off area 1 | 0.08 | 63 | 924 | 5 | 74 | 1.3E-04 | 2.6E-05 | 6.4E-06 | 2.0E-03 | 3.8E-04 | 9.4E-05 |
| Oshawa | B2_PPUDO2 | vehicles in B2 TOC passenger pick up and drop off area 2 | 0.08 | 63 | 924 | 5 | 74 | 1.3E-04 | 2.6E-05 | 6.4E-06 | 2.0E-03 | 3.8E-04 | 9.4E-05 |
| Oshawa | B2_LOT | vehicles in B2 TOC parking lot | 0.13 | 298 | 1,786 | 39 | 232 | 1.0E-03 | 2.0E-04 | 4.9E-05 | 6.2E-03 | 1.2E-03 | 2.9E-04 |
| Courtice | B3_PPUDO | vehicles in B3 TOC future build PPUDO | 0.44 | 36 | 108 | 16 | 48 | 4.2E-04 | 8.0E-05 | 2.0E-05 | 1.3E-03 | 2.4E-04 | 6.0E-05 |
| Courtice | B3_LOT | vehicles in B3 TOC future build parking lot | 0.25 | 239 | 1,432 | 60 | 358 | 1.6E-03 | 3.0E-04 | 7.6E-05 | 9.5E-03 | 1.8E-03 | 4.5E-04 |
| Bowmanville | B4_PPUDO | vehicles in B4 TOC passenger pick up and drop off area | 0.06 | 108 | 1,584 | 6 | 95 | 1.7E-04 | 3.3E-05 | 8.2E-06 | 2.5E-03 | 4.8E-04 | 1.2E-04 |
| Bowmanville | B4_LOT | vehicles in B4 TOC parking lot | 0.20 | 275 | 1,648 | 55 | 330 | 1.5E-03 | 2.8E-04 | 7.0E-05 | 8.8E-03 | 1.7E-03 | 4.2E-04 |
| Bowmanville | FB_BUS_B4 | GO buses in future B4 TOC bus loop | 0.07 | 4 | 46 | 0 | 3 | 2.4E-04 | 4.5E-05 | 1.1E-05 | 2.7E-03 | 5.2E-04 | 1.3E-04 |

**Notes:**
(1) Stantec estimation as follows:
PPUDO peak hour volume calculated based on # of PPUDO spots x peak # of trains per hour. ADT calculated based on # of PPUDO spots x # of trains per day
Lot peak hour volume is calculated assuming that that 1/3 of the parking lot is filled. ADT calculated based on # of parking spots x two way travel
Existing Bus ADT derived using 2021 (NB+SB weekday volumes for travel Route 88/88A).
Future Build Bus peak hour and ADT Information provided by Metrolinx 201075-STANTEC-RFI-00019.
(2) Emission control efficiency is not applied to the dust quantification.

# Appendix D
## List and Location of Special Receptors

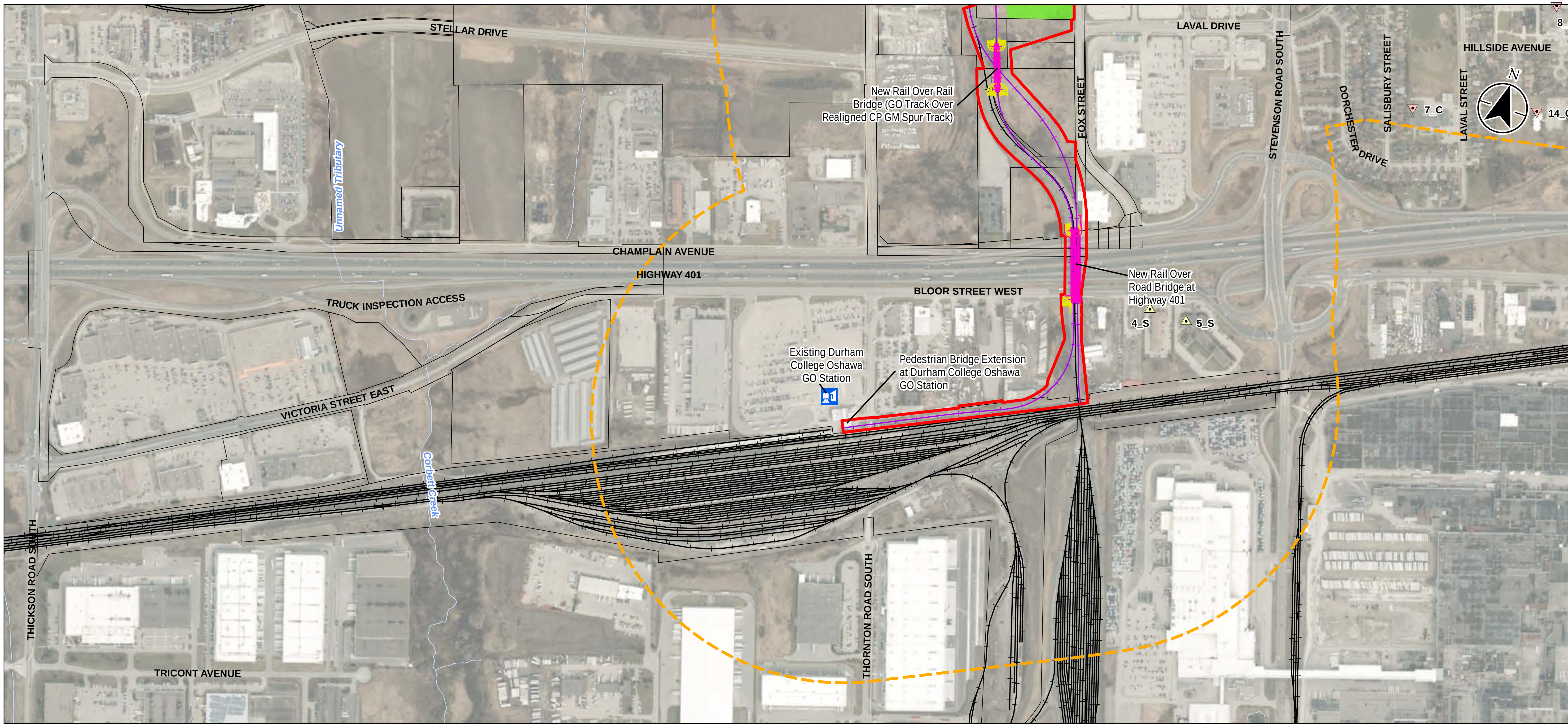
***Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Table D-1 - Special Receptors***

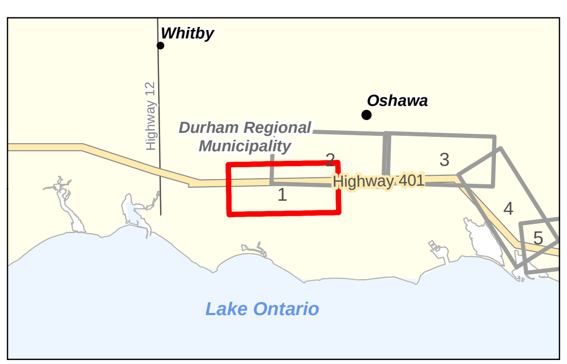
| Receptor ID# | UTM East (m) | UTM North (m) | Description | Details | Location near | Sensitive / Critical |
|---|---|---|---|---|---|---|
| 1_S | 669823 | 4861025 | Residential house | Vancouver Crescent | Thornton Station | Sensitive |
| 2_C | 669493 | 4861348 | Recreation and sports field | Civic Recreation complex | Thornton Station | Critical |
| 3_S | 669508 | 4860949 | Residential house | Shamrock Crescent | Thornton Station | Sensitive |
| 4_S | 670447 | 4860142 | Hotel | Comfort Inn | Thornton Station | Sensitive |
| 5_S | 670523 | 4860143 | Hotel | Best Western | Thornton Station | Sensitive |
| 6_S | 670219 | 4861115 | Residential house | Durham Court | Thornton Station | Sensitive |
| 7_C | 670813 | 4860690 | School | College Hill Public School | Thornton Station | Critical |
| 8_C | 671016 | 4860978 | Place of Worship and School | Parroisse Assomption de Notre Dame, Elementary School Catholic Corpus-Christi | Park Rd Bridge | Critical |
| 9_C | 670992 | 4861109 | School | Saint Thomas Aquinas Catholic School | Park Rd Bridge | Critical |
| 10_S | 670638 | 4861111 | Residential house | Bristol Crescent | Thornton Station | Sensitive |
| 11_S | 670840 | 4861326 | Apartments | Greenfell Street | Park Rd Bridge | Sensitive |
| 12_S | 671055 | 4861281 | Residential house | Greenfell Street | Park Rd Bridge | Sensitive |
| 13_S | 671029 | 4861422 | Apartments | Marland Avenue | Park Rd Bridge | Sensitive |
| 14_C | 671049 | 4860766 | Place of worship | Grace Lutheran Church | Park Rd Bridge | Critical |
| 15_S | 671098 | 4861210 | Residential house | Montrave Avenue | Park Rd Bridge | Sensitive |
| 16_S | 671318 | 4861346 | Residential house | Marquette Avenue | Park Rd Bridge | Sensitive |
| 17_S | 671294 | 4861250 | Residential house | Sinclair Avenue | Park Rd Bridge | Sensitive |
| 18_S | 671523 | 4861325 | Residential house | Sinclair Avenue | Oshawa Creek Bridge | Sensitive |
| 19_S | 671453 | 4861393 | Residential house | Marquette Avenue | Oshawa Creek Bridge | Sensitive |
| 20_C | 671498 | 4861587 | School | Village Union Public School | Oshawa Creek Bridge | Critical |
| 21_S | 671732 | 4861491 | Residential house | Avenue Street | Oshawa Creek Bridge | Sensitive |
| 22_S | 671757 | 4861401 | Residential house | Hall Street | Oshawa Creek Bridge | Sensitive |
| 23_S | 671966 | 4861566 | Hotel | Side Street Inn | Simcoe St Bridge | Sensitive |
| 24_S | 671975 | 4861486 | Residential house | Hall Street | Simcoe St Bridge | Sensitive |
| 25_C | 671987 | 4861638 | Place of Worship | Holy Cross Roman Catholic Church | Simcoe St Bridge | Critical |
| 26_C | 672161 | 4861291 | Place of Worship or Senior's Home | St. George's Ukranian Centre | Albert St Bridge | Critical |
| 27_C | 672079 | 4861745 | Place of Worship | New Life Seventh Day Adventist Church | Albert St Bridge | Critical |
| 28_C | 672207 | 4861523 | Place of worship/Community service | World Life Ministries / Gate 3:16 Outreach Centre | Albert St Bridge | Critical |
| 29_S | 672113 | 4861630 | Residential house | Fisher Street | Albert St Bridge | Sensitive |
| 30_S | 672228 | 4861665 | Residential house | Fisher Street | Oshawa Central Station / Front St Pedestrian Crossing | Sensitive |
| 31_S | 672310 | 4861378 | Residential house | Front Street (N of First Avenue) | Oshawa Central Station / Front St Pedestrian Crossing | Sensitive |
| 32_S | 672552 | 4861598 | Residential house | HowaRoad St | Oshawa Central Station | Sensitive |
| 33_S | 672340 | 4861838 | Residential house | Olive Avenue | Oshawa Central Station | Sensitive |
| 34_C | 672181 | 4861926 | Place of Worship | Church of the Good Shephard | Oshawa Central Station | Critical |
| 35_S | 672530 | 4861799 | Residential house | Drew St | Oshawa Central Station | Sensitive |
| 36_C | 672610 | 4862066 | School | Ritson Public School | Ritson St Bridge | Critical |
| 37_C | 672672 | 4862030 | Place of worship | RCCG Bethel Assemby | Ritson St Bridge | Critical |
| 38_C | 671781 | 4861935 | School | Grove School and Treatment Centre, Durham Alternative Secondary School | Simcoe St Bridge | Critical |
| 39_C | 672811 | 4861643 | Place of worship | Protection of the Mother of God Catholic Church | Ritson St Bridge | Critical |
| 40_C | 672814 | 4861607 | Place of worship | The Corner Church | Ritson St Bridge | Critical |
| 41_S | 672728 | 4861852 | Residential house | George St | Ritson St Bridge | Sensitive |
| 42_S | 672916 | 4861885 | Residential house | Oshawa Blvd South | Ritson St Bridge | Sensitive |
| 43_C | 673241 | 4862062 | School | St. Hedwig Catholic School | Wilson St Bridge | Critical |
| 44_S | 673409 | 4861905 | Residential house | Brest Crescent | Wilson St Bridge | Sensitive |
| 45_C | 673557 | 4861938 | School | David Bouchard Public School | Wilson St Bridge | Critical |
| 46_S | 673667 | 4861866 | Residential house | Wilson Road S | Wilson St Bridge | Sensitive |
| 47_S | 673528 | 4862112 | Residential house | Crerar Avenue | Wilson St Bridge | Sensitive |
| 48_S | 673573 | 4862136 | Residential house | Wilson Road S | Wilson St Bridge | Sensitive |
| 49_S | 673729 | 4862086 | Residential house | Chaucer Avenue | Wilson St Bridge | Sensitive |
| 50_S | 673435 | 4861662 | Townhouses | Dean Avenue | Wilson St Bridge | Sensitive |
| 51_S | 673478 | 4862275 | Residential house | Wilson Road S | Wilson St Bridge | Sensitive |
| 52_S | 673941 | 4862157 | Residential house | Austen Crescent | Farewell St Pedestrian Bridge | Sensitive |
| 53_C | 673899 | 4862270 | Place of worship | Evangel Pentecostal Church | Farewell St Pedestrian Bridge | Critical |
| 54_C | 674112 | 4862268 | Place of worship | Greek Cultural Centre and Church | Farewell St Pedestrian Bridge | Critical |
| 55_S | 673749 | 4862433 | Residential house | Guelph Steet | Farewell St Pedestrian Bridge | Sensitive |
| 56_S | 673911 | 4861998 | Residential house | Loring Street | Farewell St Pedestrian Bridge | Sensitive |
| 57_S | 674298 | 4862370 | Residential house | Wicklow Crescent | Harmony Rd Bridge | Sensitive |
| 58_S | 674431 | 4862320 | Residential house | Harcourt Crescent | Harmony Rd Bridge | Sensitive |
| 59_S | 674338 | 4862207 | Residential house | Chesterton Avenue | Harmony Rd Bridge | Sensitive |
| 60_S | 674476 | 4862206 | Residential house | Tennyson Crescent | Harmony Rd Bridge | Sensitive |
| 61_S | 674482 | 4862477 | Residential house | Florell Drive | Harmony Rd Bridge | Sensitive |
| 62_S | 674315 | 4862108 | Residential house | Shelley Avenue | Harmony Rd Bridge | Sensitive |
| 63_S | 674506 | 4862313 | Residential house | Harcourt Crescent | Harmony Rd Bridge | Sensitive |
| 64_S | 674549 | 4862198 | Residential house | Tennyson Crescent | Harmony Creek Bridge | Sensitive |
| 65_S | 674765 | 4862312 | Residential house | Diane Drive | Harmony Creek Bridge | Sensitive |
| 66_S | 674502 | 4862008 | Residential house | Tennyson Crescent | Harmony Creek Bridge | Sensitive |
| 67_S | 674933 | 4862285 | Residential house | Diane Drive | Farewell Creek Bridge | Sensitive |
| 68_S | 674888 | 4862451 | Residential house | Susan Crescent | Harmony Creek Bridge | Sensitive |
| 69_S | 675310 | 4862129 | Residential house | St. Andrews Crescent | Harmony Creek Bridge | Sensitive |
| 70_S | 675178 | 4861763 | Hotel | Marriott | Bloor St Crossing | Sensitive |
| 71_S | 675358 | 4862044 | Residential house | St. Andrews Crescent | Bloor St Crossing | Sensitive |
| 72_S | 675662 | 4861890 | Residential house | Grandview Dr | Bloor St Crossing | Sensitive |
| 73_S | 675650 | 4861766 | Residential house | Downview Crescent | Bloor St Crossing | Sensitive |
| 74_C | 675833 | 4862004 | Senior's Home | Traditions of Durham Retirement Residence | Bloor St Crossing | Critical |
| 75_S | 675648 | 4862197 | Residential house | Annandale St | Bloor St Crossing | Sensitive |
| 76_S | 675812 | 4861746 | Residential house | Grandview Dr | Bloor St Crossing | Sensitive |
| 77_S | 675963 | 4861444 | Residential house | Norman Crescent | between Bloor St Crossing and Prestonvale Rd crossing | Sensitive |
| 78_S | 676334 | 4861072 | Residential townhouse | Southport Drive | between Bloor St Crossing and Prestonvale Rd crossing | Sensitive |
| 79_S | 677571 | 4860517 | Residential house | Prestonvale Road | Prestonvale Rd Crossing | Sensitive |
| 80_S | 677351 | 4860565 | Residential house | Prestonvale Road | Prestonvale Rd Crossing | Sensitive |
| 81_S | 677724 | 4860565 | Residential house | Baseline Road W | Prestonvale Rd Crossing | Sensitive |
| 82_S | 677518 | 4860858 | Residential house | Prestonvale Road | Prestonvale Rd Crossing | Sensitive |
| 83_S | 677399 | 4860968 | Residential house | Prestonvale Road | Prestonvale Rd Crossing | Sensitive |
| 84_S | 678554 | 4861420 | Residential house | Trulls Road | Trulls Rd Crossing | Sensitive |
| 85_S | 678583 | 4861534 | Residential house | Trulls Road | Trulls Rd Crossing | Sensitive |
| 86_S | 678740 | 4860886 | Residential house | Baseline Road W | Trulls Rd Crossing | Sensitive |
| 87_S | 678806 | 4860837 | Residential house | Trulls Road | Trulls Rd Crossing | Sensitive |
| 88_S | 679673 | 4861215 | Residential house | Baseline Road | Courtice Station / Courtice Rd Bridge | Sensitive |
| 89_S | 679339 | 4861703 | Residential house | Courtice Road | Courtice Station / Courtice Rd Bridge | Sensitive |
| 90_S | 679464 | 4861052 | Residential house | Baseline Road | Courtice Station / Courtice Rd Bridge | Sensitive |
| 91_S | 679569 | 4861049 | Residential house | Courtice Road | Courtice Station / Courtice Rd Bridge | Sensitive |
| 92_S | 679366 | 4861016 | Residential house | Baseline Road | Courtice Station / Courtice Rd Bridge | Sensitive |
| 93_S | 680149 | 4861302 | Residential house | Baseline Road | Baseline Rd crossing (M168.22) | Sensitive |
| 94_S | 681874 | 4861918 | Residential house | Baseline Road | Rundle Rd Station / Rundle Rd Crossing | Sensitive |
| 95_S | 681956 | 4861728 | Residential house | Rundle Road | Rundle Rd Station / Rundle Rd Crossing | Sensitive |
| 96_S | 682037 | 4861697 | Residential house | Rundle Road | Rundle Rd Station / Rundle Rd Crossing | Sensitive |
| 97_S | 681810 | 4861889 | Residential house | Baseline Road | Rundle Rd Station / Rundle Rd Crossing | Sensitive |
| 98_S | 682138 | 4862038 | Residential house | Baseline Road | Baseline Rd crossing (M166.92) | Sensitive |
| 99_S | 682295 | 4861974 | Residential house | Baseline Road | Baseline Rd crossing (M166.92) | Sensitive |
| 100_S | 682557 | 4862313 | Residential house | Holt Road | Holt Rd crossing | Sensitive |
| 101_S | 682750 | 4862149 | Residential house | Baseline Road / Holt Road | Holt Rd crossing | Sensitive |
| 102_S | 682730 | 4861998 | Residential house | Holt Road | Holt Rd crossing | Sensitive |
| 103_S | 682899 | 4862182 | Residential house | Baseline Road | Holt Rd crossing | Sensitive |
| 104_S | 683245 | 4863267 | Residential house | Maple Grove Road | Maple Grove Rd crossing | Sensitive |
| 105_S | 684009 | 4863595 | Condominium/Apartment | Aspen Springs Drive | Green Rd bridge | Sensitive |
| 106_C | 684025 | 4863539 | School / Daycare | Holy Family Catholic School / Compass Early Learning and Care | Green Rd bridge | Critical |
| 107_S | 683953 | 4863562 | Condominium/Apartment | Green Road | Green Rd bridge | Sensitive |
| 108_S | 683830 | 4863594 | Residential house | Padfield Drive | Green Rd bridge | Sensitive |
| 109_S | 683818 | 4863714 | Residential house | Padfield Drive | Green Rd bridge | Sensitive |
| 110_S | 683862 | 4863840 | Residential house | Boswell Drive | Green Rd bridge | Sensitive |
| 111_S | 683665 | 4863676 | Residential house | Weldrick Crescent | Green Rd bridge | Sensitive |
| 112_S | 684050 | 4863663 | Condominium/Apartment | Aspen Springs Drive | Green Rd bridge | Sensitive |
| 113_S | 683895 | 4863465 | Condominium/Apartment | Connell Lane | Green Rd bridge | Sensitive |
| 114_C | 684301 | 4864121 | Senior's Home | Seasons Retirement Communities | Bowmanville Station | Critical |
| 115_S | 684357 | 4864010 | Condominium | Aspen Springs Drive | Bowmanville Station | Sensitive |
| 116_S | 684524 | 4863978 | Residential house | Bonnycastle Drive | Bowmanville Station | Sensitive |
| 117_S | 684583 | 4864024 | Residential house | Glen Ray Court | Bowmanville Station | Sensitive |
| 118_S | 684477 | 4863919 | Residential house | Fry Crescent | Bowmanville Station | Sensitive |
| 119_S | 684547 | 4863827 | Residential house | Fry Crescent | Bowmanville Station | Sensitive |
| 120_S | 684645 | 4863830 | Residential house | Bonnycastle Drive | Bowmanville Station | Sensitive |
| 121_S | 684684 | 4864113 | Residential house | Bowmanville Avenue | Bowmanville Station | Sensitive |
| 122_S | 684228 | 4863881 | Condominium/Apartment | Aspen Springs Drive | Bowmanville Station | Sensitive |
| 123_S | 684448 | 4863750 | Townhouses | Vail Meadows Crescent | Bowmanville Station | Sensitive |
| 124_C | 684322 | 4864400 | Place of worship | The Church of Jesus Christ of Latter-day Saints | Bowmanville Station | Critical |
| 125_C | 684553 | 4864674 | Place of worship | Liberty Pentecostal Church | Bowmanville Station | Critical |
| 126_S | 684388 | 4864613 | Recreation complex | Carnet B. Rickard Recreation Complex | Bowmanville Station | Sensitive |
| 127_S | 684631 | 4864296 | Residential house | Bowmanville Avenue | Bowmanville Station | Sensitive |
| 128_S | 684733 | 4864378 | Residential house | McCrimmon Crescent | Bowmanville Station | Sensitive |

***Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Table D-1 - Special Receptors***

| Receptor ID# | UTM East (m) | UTM North (m) | Description | Details | Location near | Sensitive / Critical |
|---|---|---|---|---|---|---|
| 129_S | 684816 | 4864204 | Residential house | Trewin Lane | Bowmanville Station | Sensitive |
| 130_C | 684242 | 4864139 | Senior's Home | Seasons Retirement Communities | Bowmanville Station | Critical |
| 131_S | 671913 | 4861588 | Apartments | Avenue Street | Simcoe St Bridge | Sensitive |
| 132_S | 672000 | 4861376 | Residential house | Mill Street | Simcoe St Bridge | Sensitive |
| 133_C | 672066 | 4861303 | Place of worship | St. James Presbyterian Church | Simcoe St Bridge | Critical |
| 134_C | 673888 | 4862329 | Daycare | Evangel Daycare | Farewell St Pedestrian Bridge | Critical |
| 135_C | 684970 | 4863976 | School | Blaisdale Montessori School | Bowmanville Station | Critical |
| 136_S | 678282 | 4860763 | Residential house | Baseline Road West | Dom's Auto Crossing | Sensitive |
| 137_S | 678368 | 4860762 | Residential house | Baseline Road West | Dom's Auto Crossing | Sensitive |
| 138_S | 674012 | 4862162 | Residential house | Keates Avenue | Farewell St Pedestrian Bridge | Sensitive |
| 139_S | 674077 | 4862177 | Residential house | Keates Avenue | Farewell St Pedestrian Bridge | Sensitive |
| 140_S | 674183 | 4862223 | Residential house | Milton Street | Farewell St Pedestrian Bridge | Sensitive |
| 141_S | 673980 | 4862264 | Residential house | Elmridge Street | Farewell St Pedestrian Bridge | Sensitive |
| 142_S | 673844 | 4862206 | Residential house | Crerar Avenue | Farewell St Pedestrian Bridge | Sensitive |
| 143_S | 673902 | 4862152 | Residential house | Austen Court | Farewell St Pedestrian Bridge | Sensitive |
| 144_S | 674212 | 4862343 | Residential house | Elmridge Street | Harmony Rd Bridge | Sensitive |
| 145_C | 672000 | 4861601 | Community Service | Simcoe Hall Settlement House | Simcoe St Bridge | Critical |
| 146_C | 671864 | 4861977 | Place of Worship | Church of God 7th Day | Simcoe St Bridge | Critical |
| 147_S | 671896 | 4861910 | Condominium/Apartment | Simcoe Street South | Simcoe St Bridge | Sensitive |
| 148_S | 671883 | 4861836 | Condominium/Apartment | Simcoe Street South | Simcoe St Bridge | Sensitive |
| 149_S | 671746 | 4861869 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 150_S | 671677 | 4861894 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 151_S | 671694 | 4861849 | Condominium/Apartment | Centre Street | Simcoe St Bridge | Sensitive |
| 152_S | 671591 | 4861868 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 153_S | 671605 | 4861838 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 154_S | 671144 | 4861712 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 155_S | 671144 | 4861679 | Residential house | Gibb Street | Simcoe St Bridge | Sensitive |
| 156_S | 671076 | 4861719 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 157_S | 670993 | 4861700 | Residential house | Frontenac Avenue | Simcoe St Bridge | Sensitive |
| 158_S | 671098 | 4861659 | Residential house | Frontenac Avenue | Simcoe St Bridge | Sensitive |
| 158_S | 671074 | 4861590 | Residential house | Frontenac Avenue | Simcoe St Bridge | Sensitive |
| 159_S | 671073 | 4861589 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 160_S | 671014 | 4861623 | Residential house | Montrave Avenue | Simcoe St Bridge | Sensitive |
| 161_S | 671112 | 4861606 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 162_S | 671269 | 4860938 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 163_S | 671248 | 4860998 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 164_S | 671246 | 4860696 | Residential house | College Avenue | Simcoe St Bridge | Sensitive |
| 165_S | 671438 | 4860567 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 166_S | 671477 | 4860585 | Residential house | Park Road South | Simcoe St Bridge | Sensitive |
| 167_S | 671536 | 4860563 | Residential house | Bloor Street West | Simcoe St Bridge | Sensitive |
| 170_S | 671791 | 4860637 | Condominium/Apartment | Bloor Street West | Simcoe St Bridge | Sensitive |
| 171_S | 671780 | 4860683 | Condominium/Apartment | Bloor Street West | Simcoe St Bridge | Sensitive |
| 172_S | 672279 | 4860688 | Residential house | Knights Road | Simcoe St Bridge | Sensitive |
| 173_C | 672351 | 4860827 | Place of worship | St. John the Baptist Church | Simcoe St Bridge | Critical |
| 174_S | 672352 | 4860878 | Residential house | Bloor Street East | Simcoe St Bridge | Sensitive |
| 175_S | 672656 | 4860983 | Residential house | Bloor Street East | Simcoe St Bridge | Sensitive |
| 176_S | 672621 | 4860929 | Residential house | Bloor Street East | Simcoe St Bridge | Sensitive |
| 177_S | 672894 | 4861020 | 2nd Storey Residence | Bloor Street East | Simcoe St Bridge | Sensitive |
| 178_S | 672849 | 4861096 | Condominium/Apartment | Fourth Avenue | Simcoe St Bridge | Sensitive |
| 179_S | 672993 | 4861099 | Residential house | Bloor Street East | Simcoe St Bridge | Sensitive |
| 180_S | 673007 | 4861113 | Residential house | Ritson Road South | Simcoe St Bridge | Sensitive |
| 181_C | 673025 | 4861062 | Place of worship | Ritson Road South | Simcoe St Bridge | Critical |
| 182_S | 673074 | 4861083 | Residential house | Bloor Street East | Simcoe St Bridge | Sensitive |
| 183_S | 673036 | 4861150 | Residential house | Ritson Road South | Simcoe St Bridge | Sensitive |
| 184_S | 672834 | 4861519 | Residential house | McNaughton Avenue | Simcoe St Bridge | Sensitive |
| 185_S | 672879 | 4861487 | Residential house | Ritson Road South | Simcoe St Bridge | Sensitive |
| 186_S | 672923 | 4861601 | Residential house | Kitchener Avenue | Simcoe St Bridge | Sensitive |
| 187_S | 672938 | 4861438 | Residential house | Ritson Road South | Simcoe St Bridge | Sensitive |
| 188_S | 672669 | 4861971 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 189_S | 672714 | 4861948 | Residential house | Ritson Road South | Simcoe St Bridge | Sensitive |
| 190_S | 672738 | 4861993 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 191_S | 672728 | 4862026 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 192_S | 672328 | 4861884 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 193_S | 672100 | 4861809 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 194_S | 672073 | 4861794 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 195_S | 672115 | 4861781 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 196_S | 671946 | 4861750 | 2nd Storey Residence | Olive Avenue | Simcoe St Bridge | Sensitive |
| 197_S | 671912 | 4861732 | Residential house | Simcoe Street South | Simcoe St Bridge | Sensitive |
| 198_S | 671991 | 4861733 | Residential house | Olive Avenue | Simcoe St Bridge | Sensitive |
| 199_S | 672279 | 4861306 | Residential house | Albert Street | Simcoe St Bridge | Sensitive |
| 200_S | 672289 | 4861276 | Residential house | First Avenue | Simcoe St Bridge | Sensitive |
| 201_C | 672371 | 4861057 | Place of worship | St. George's Catholic Church | Simcoe St Bridge | Critical |
| 202_S | 672377 | 4860918 | Residential house | Albert Street | Simcoe St Bridge | Sensitive |
| 203_S | 672405 | 4860930 | Residential house | Albert Street | Simcoe St Bridge | Sensitive |
| 204_S | 683236 | 4862395 | Residential house | Baseline Road | Private farm crossing west of Maple Grove Road | Sensitive |

Figure D.1 Special Receptor Locations




Legend

- Project Footprint
- Study Area
- Existing Durham College Oshawa GO Station
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor

0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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Technical Review by ## on 2021-##-##

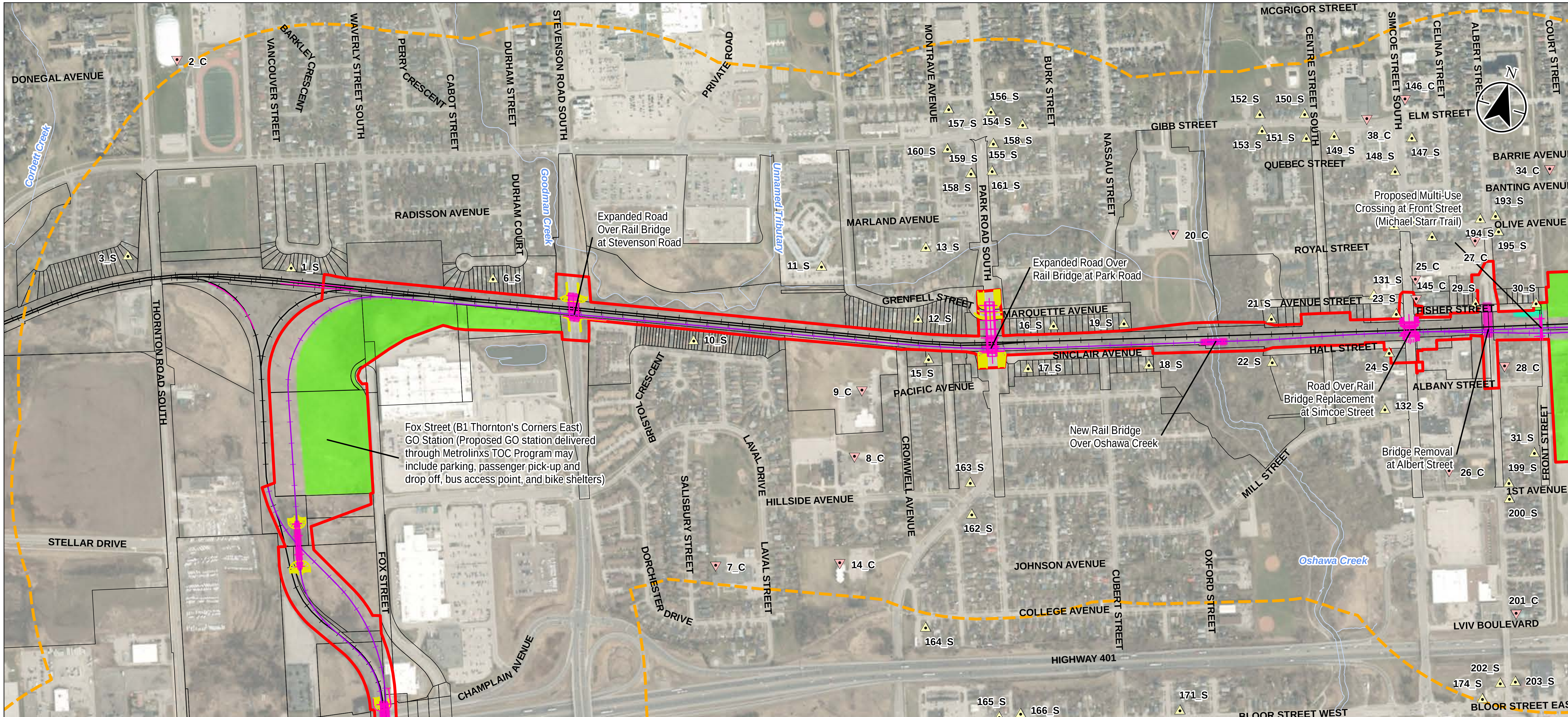
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

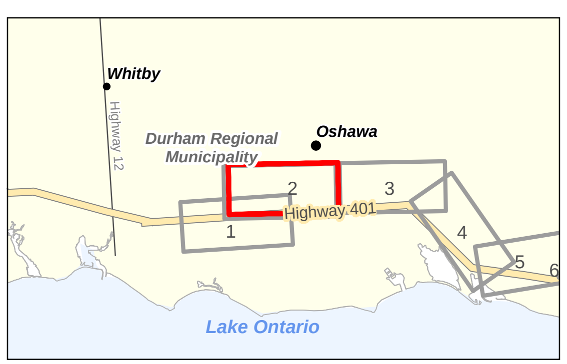
Figure No.
**D.1.1**

Title
**Special Receptor Locations**



Revised: 2023-08-22 By: bcowper




Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Multi-Use Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor

0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.2**

Title
**Special Receptor Locations**

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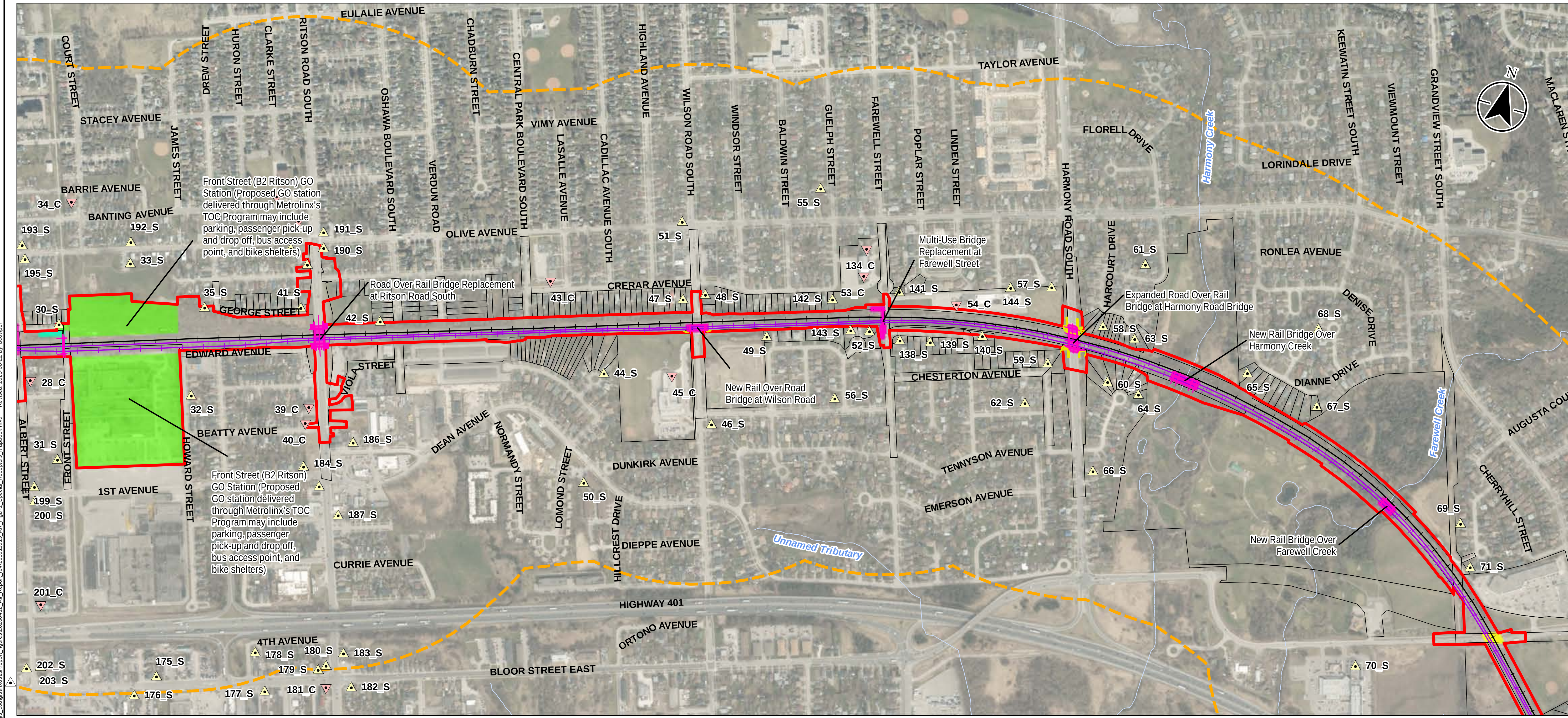
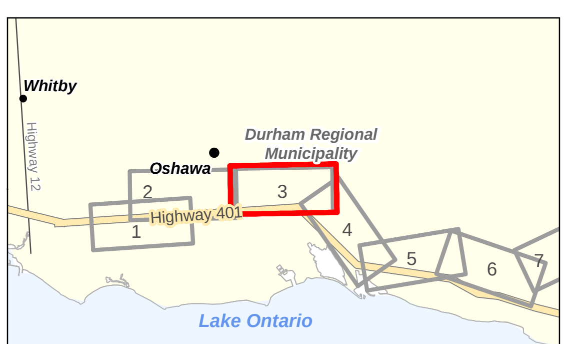



Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Multi-Use Crossing
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor




0 220 440 m

1:8,750 (At original document size of 11x17)

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Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.3**

Title
**Special Receptor Locations**

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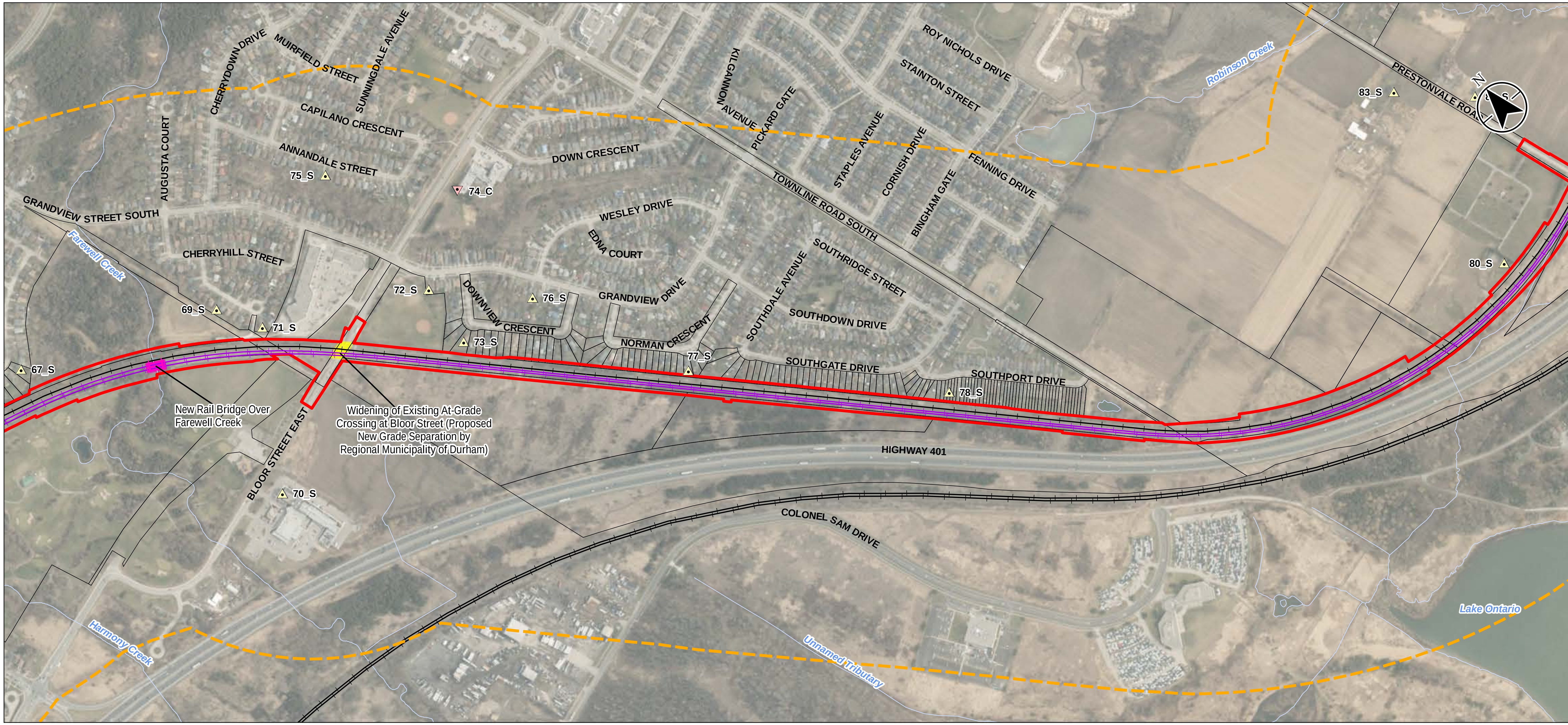


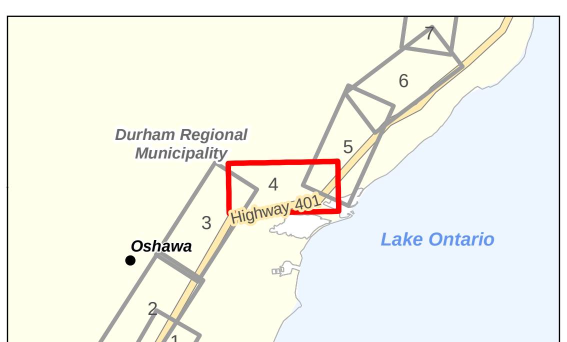


Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor

0 200 400 m

1:8,000 (At original document size of 11x17)

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Project Location
Regioan Municipality of Durham

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Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.4**

Title
**Special Receptor Locations**

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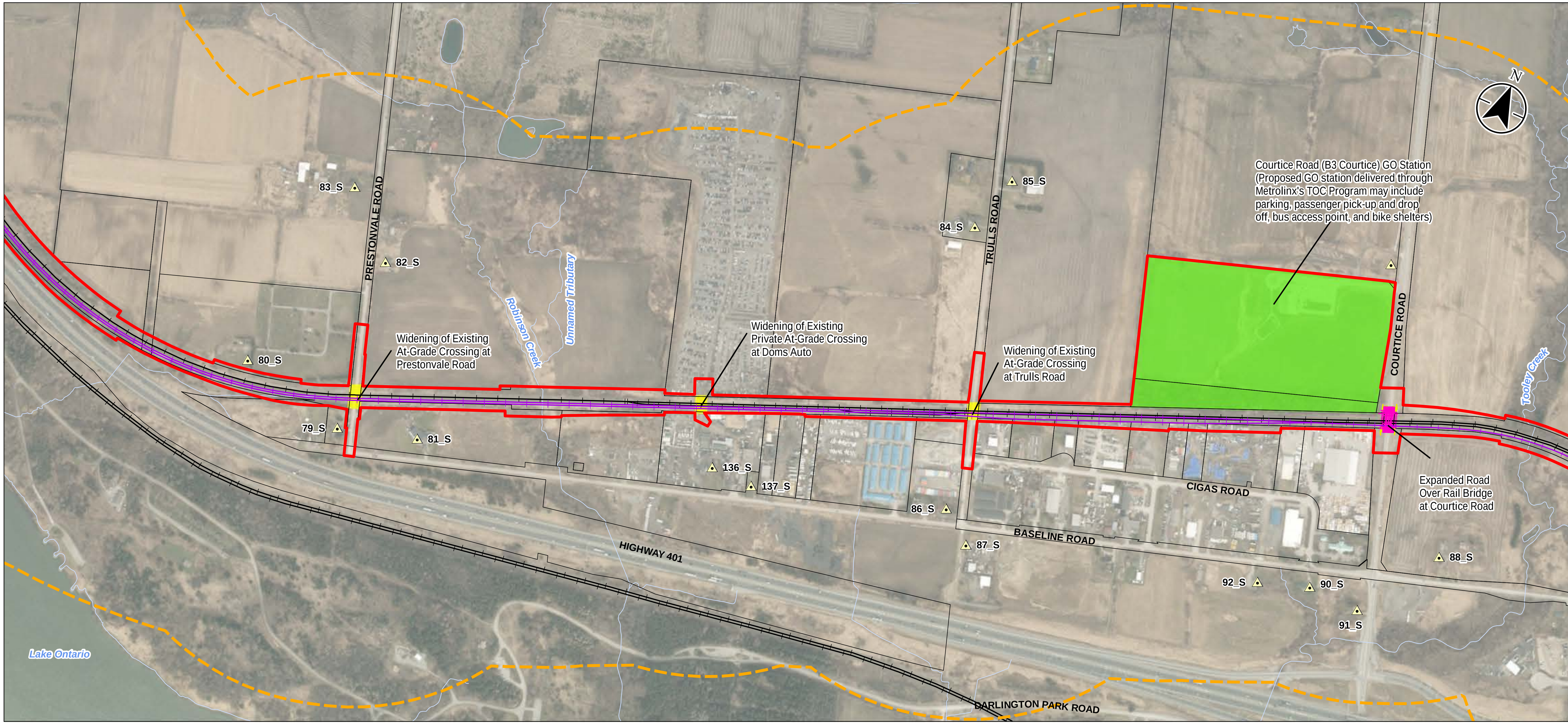


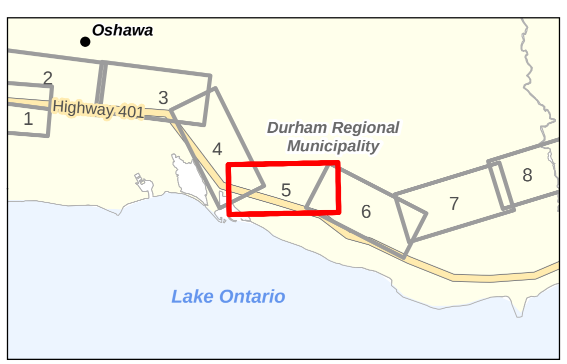


Legend
- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor

0 200 400 m

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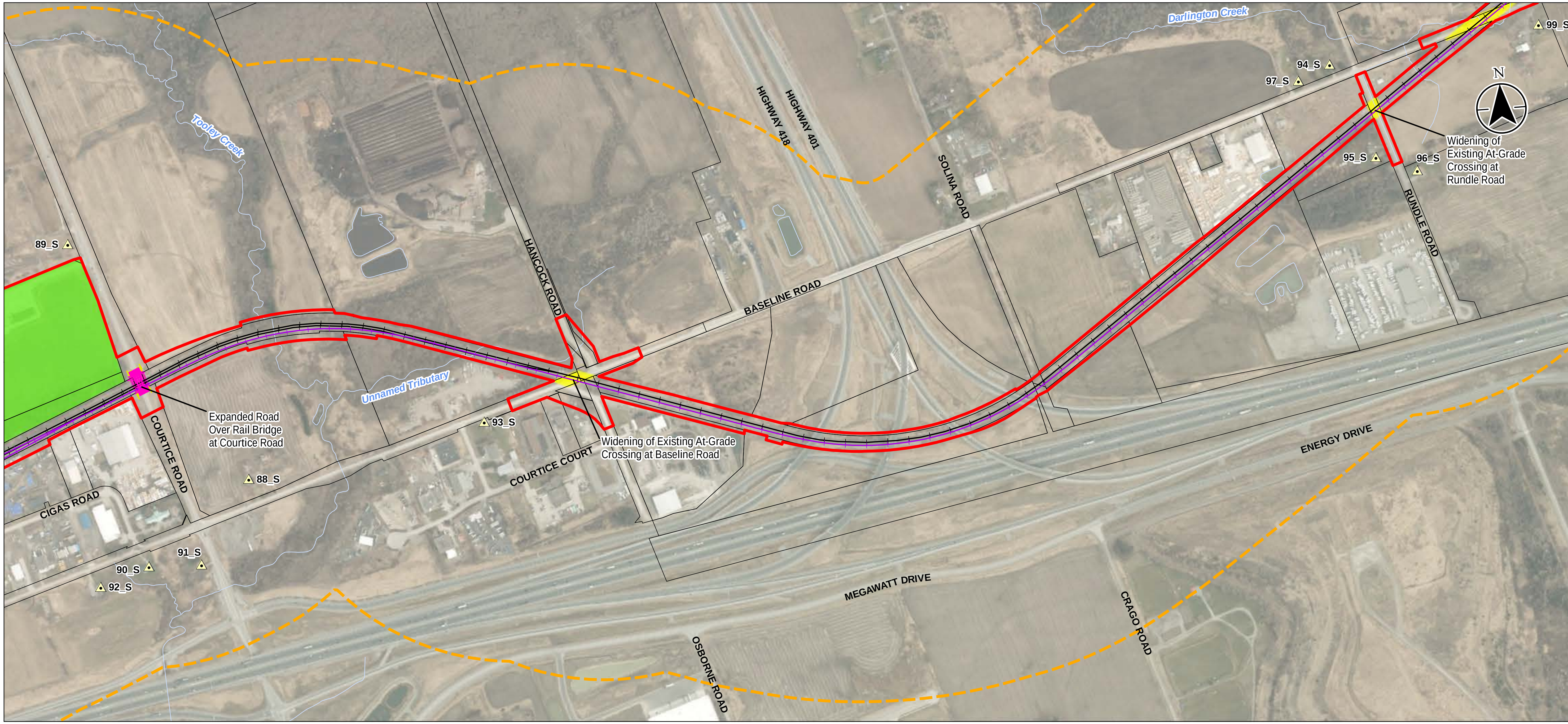
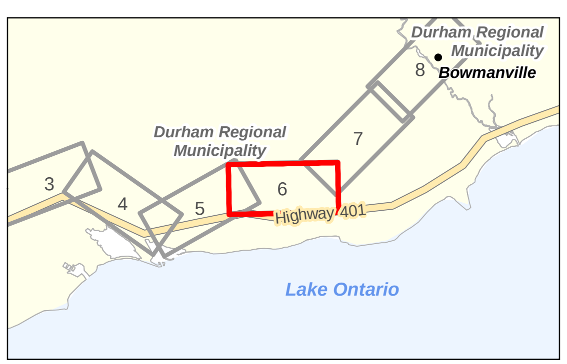
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.5**

Title
**Special Receptor Locations**

Revised: 2023-08-22 By: bcowper




Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor

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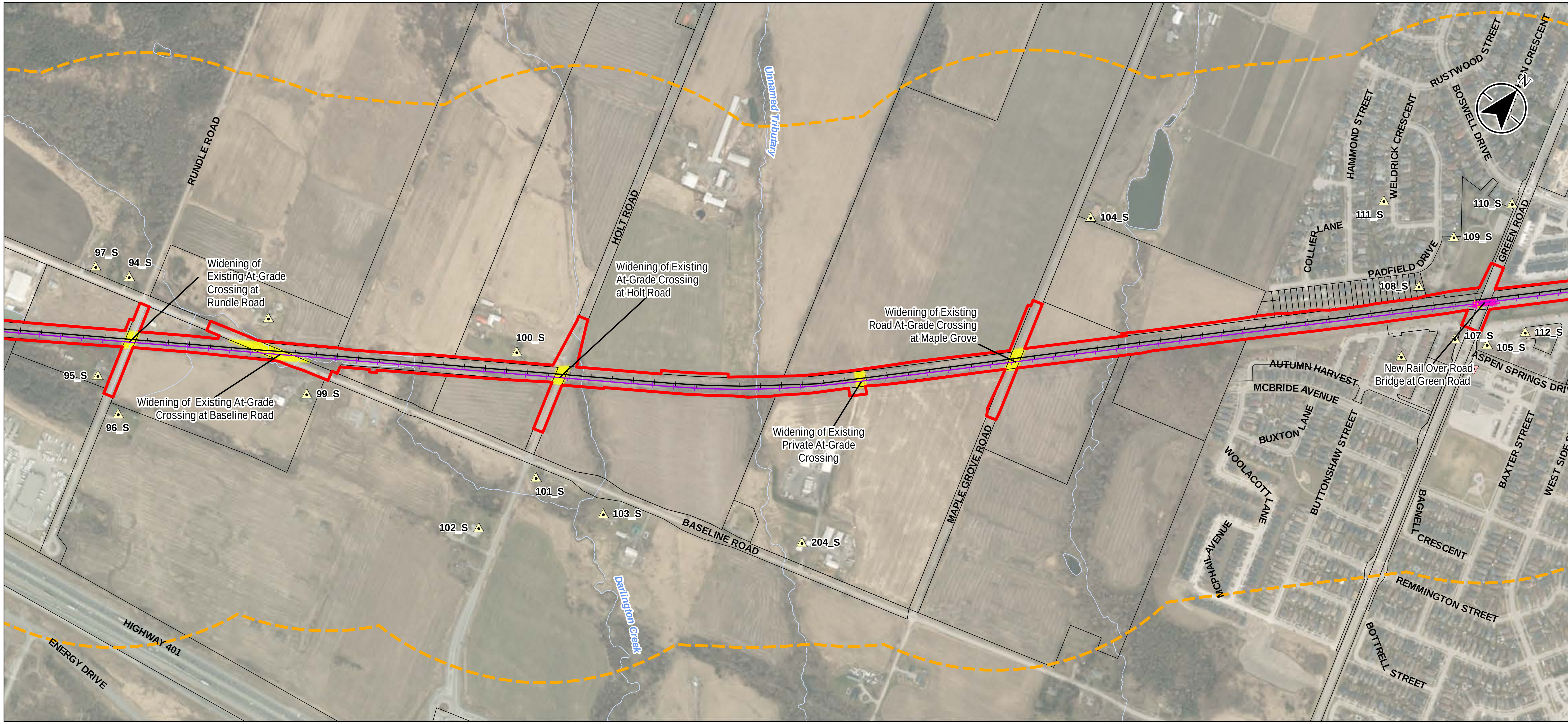
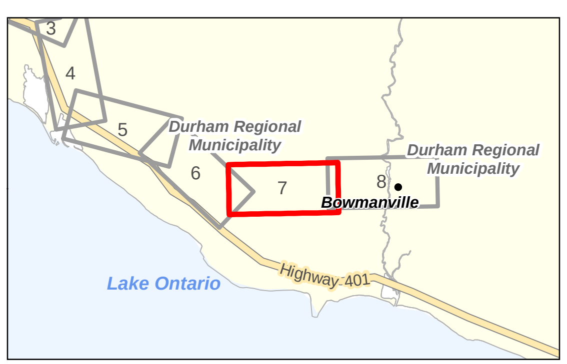
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.6**

Title
**Special Receptor Locations**




Legend

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Level Crossing
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor

0 200 400 m

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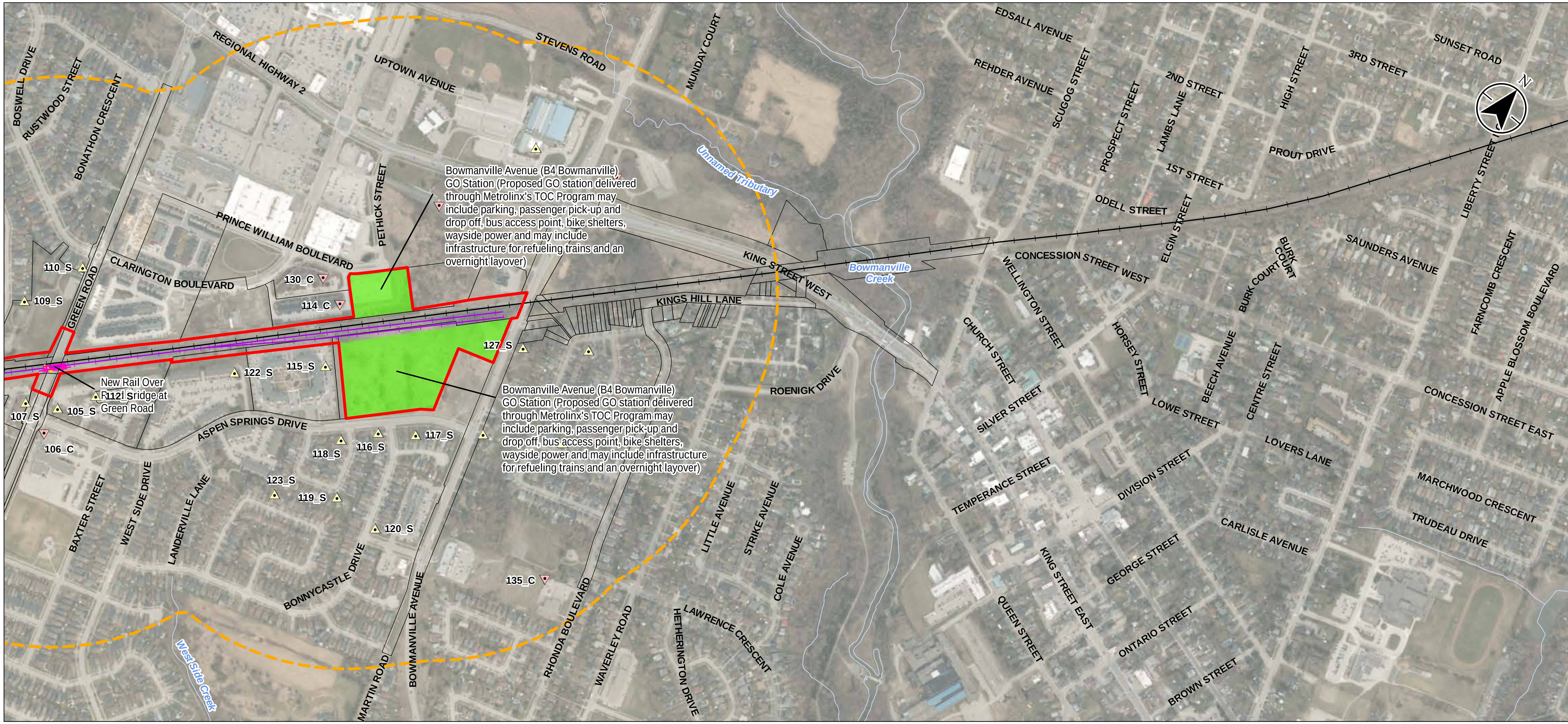
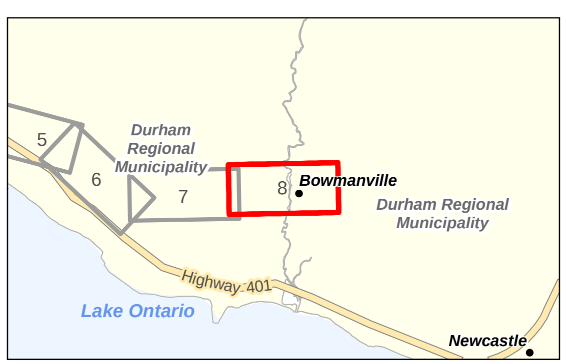
Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.7**

Title
**Special Receptor Locations**




**Legend**

- Project Footprint
- Study Area
- Existing Railway
- Proposed Tracks
- Bridges/Crossings
- Grading
- Proposed GO Station Location
- Bridge Structure
- Watercourse
- Waterbody
- Property Boundary
- Air Sensitive Receptor
- Air Critical Receptor

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0 200 400 m

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Project Location
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of Durham

165011019 REVA
Prepared by BCC on 2023-08-22
Technical Review by ## on 2021-##-##

Client/Project
METROLINX
OSHAWA TO BOWMANVILLE RAIL SERVICE EXTENSION PROJECT

Figure No.
**D.1.8**

Title
**Special Receptor Locations**

# Appendix E
## Summary of Air Dispersion Modelling Inputs

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Rundle Road - Widen Crossing***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario | | Note |
|---|---|---|---|---|---|---|---|
| | | | | | Emission Rate (g/s) | % of Overall Emissions | |
| VOL1-VOL9 | Construction - Nonroad equipment tailpipe | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.91E-05 | 100% | The source (group) operates 8 hours/day (8am-5pm). |
| | | | $NO_x$ | 1, 24, 8760 | 9.66E-03 | 100% | |
| | | | PM | 24, 8760 | 6.30E-04 | 2% | |
| | | | PM10 | 24 | 6.05E-04 | 3% | |
| | | | PM2.5 | 24, 8760 | 5.67E-04 | 22% | |
| | | | CO | 1, 8 | 2.38E-02 | 100% | |
| | | | Benzene | 24, 8760 | 3.77E-05 | 100% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.51E-06 | 100% | |
| | | | Acrolein | 1, 24 | 1.63E-05 | 100% | |
| | | | Acetaldehyde | 30 min, 24 | 9.87E-05 | 100% | |
| | | | Formaldehyde | 24 | 2.91E-04 | 100% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.98E-09 | 100% | |
| AREA1 | Construction - Construction Dust | Area - construction area | PM | 24, 8760 | 3.21E-02 | 98% | |
| | | | PM10 | 24 | 2.05E-02 | 97% | |
| | | | PM2.5 | 24, 8760 | 2.05E-03 | 78% | |
| | | | Crystalline silica | 24 | 1.07E-03 | 100% | |

***Appendix E: Summary of Air Dispersion Modelling Inputs***
***Location: Rundle Road - Widen Crossing***

**Dispersion Modelling Parameters for Area Source**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | AREA1 | | |
| Length of x side | 21.91 | m | |
| Length of y side | 21.91 | m | |
| Area | 480.0 | m2 | active construction area for worst-case scenario |
| Orientation angle from N | 0 | degrees | |
| Release Height | 1.00 | m | assumed release height of dust |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Initial Vertical Dimension | 1.63 | m | (Plume Height) / 2.15 |

**Dispersion Modelling Parameters for Volume Sources**

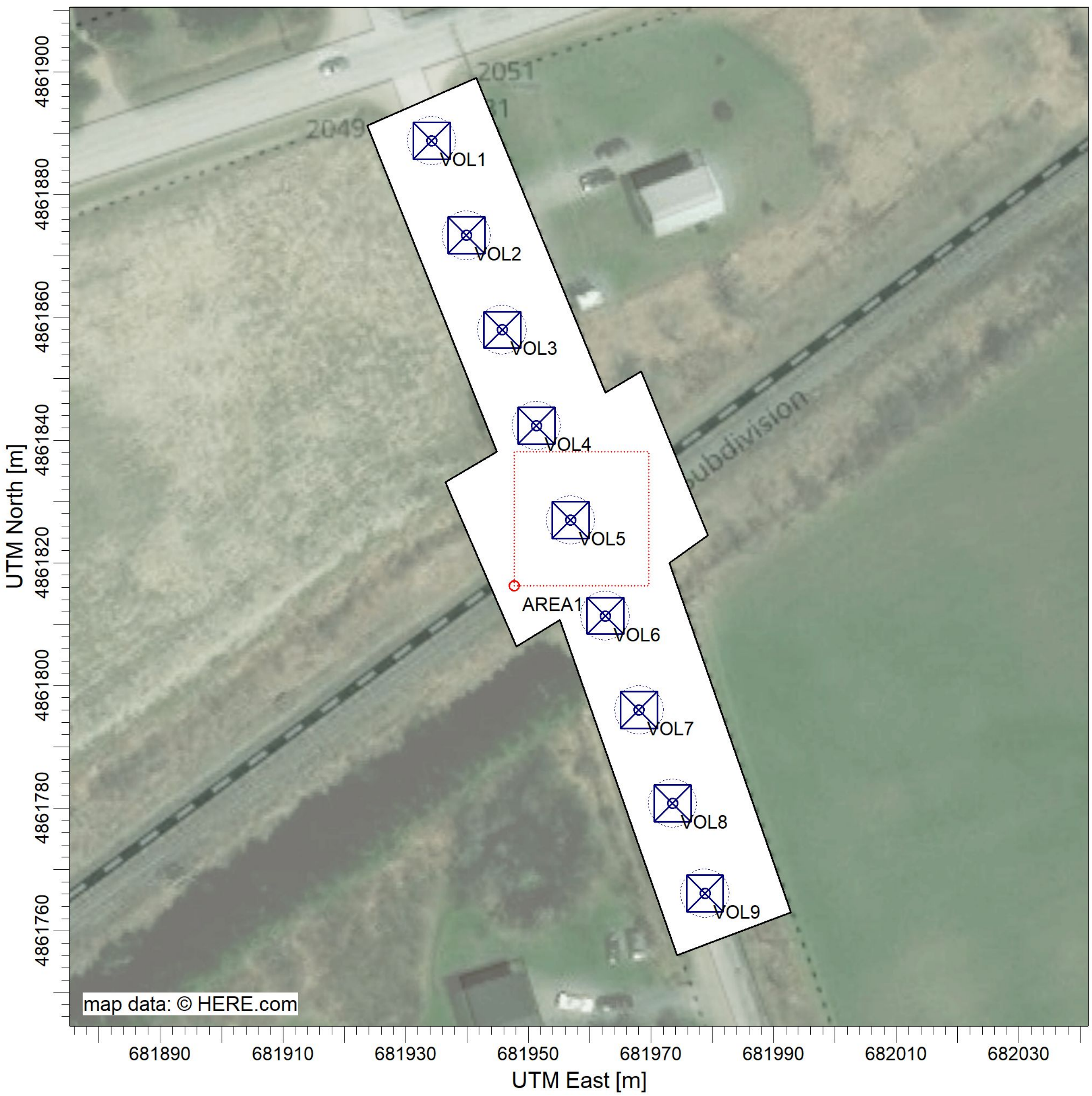
| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | VOL1 - VOL9 | | |
| Length of x side | 6 | m | measured total width of the road |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Release Height | 3.00 | m | assumed height of exhaust for construction vehicles |
| Initial Lateral Dimension | 1.40 | m | (Length of side) / 4.3 |
| Initial Vertical Dimension | 0.81 | m | for elevated release height: (Plume Height) / 4.3 |

**Background Ozone concentrations used for Ozone Limiting Method in AERMOD model**

| | Background ozone concentrations (ppb) | | | |
|---|---|---|---|---|
| **Hour** | **Winter** | **Spring** | **Summer** | **Fall** |
| 1 | 34 | 38 | 33 | 26.4 |
| 2 | 34 | 37 | 32 | 26 |
| 3 | 34 | 36 | 30 | 26 |
| 4 | 33 | 34 | 26 | 26 |
| 5 | 32 | 34 | 24.4 | 25.4 |
| 6 | 30 | 31 | 21 | 24 |
| 7 | 29 | 31 | 21 | 22 |
| 8 | 29 | 33 | 25 | 22 |
| 9 | 31 | 36 | 30.1 | 22 |
| 10 | 33 | 40 | 37.7 | 24 |
| 11 | 34 | 44 | 45 | 27 |
| 12 | 36 | 47 | 49 | 29 |
| 13 | 37 | 50 | 53 | 30 |
| 14 | 39 | 53 | 56 | 31 |
| 15 | 39 | 55 | 55 | 32 |
| 16 | 39 | 54.9 | 56 | 32 |
| 17 | 39 | 54 | 55 | 31 |
| 18 | 37 | 53 | 55 | 28 |
| 19 | 35 | 51 | 51 | 27 |
| 20 | 34 | 48.7 | 46 | 27 |
| 21 | 33 | 44 | 40.4 | 27 |
| 22 | 34 | 41.8 | 37 | 26 |
| 23 | 33.4 | 40 | 35 | 27 |
| 24 | 34 | 39 | 33 | 26 |

PROJECT TITLE:

**Figure E-1: Dispersion Modelling Plan for Rundle Road Crossing Construction Scenario**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red box - area source<br>black line - Project footprint | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**790** | | |
| | | SCALE: 1:1,045<br>0 — 0.03 km | |
| | | DATE:<br>**9/14/2021** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

D:\2021\Mx_BMV\Rundle_base\Rundle_base.isc

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: B4 Station (at Bowmanville) Construction***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario | | Note |
|---|---|---|---|---|---|---|---|
| | | | | | Emission Rate (g/s) | % of Overall Emissions | |
| VOL1-VOL5 | Construction - Nonroad equipment tailpipe | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 8.81E-05 | 100% | The source (group) operates 8 hours/day (8am-5pm). |
| | | | $NO_x$ | 1, 24, 8760 | 2.88E-02 | 100% | |
| | | | PM | 24, 8760 | 1.48E-03 | 0% | |
| | | | PM10 | 24 | 1.42E-03 | 0% | |
| | | | PM2.5 | 24, 8760 | 1.33E-03 | 4% | |
| | | | CO | 1, 8 | 5.63E-02 | 100% | |
| | | | Benzene | 24, 8760 | 1.14E-04 | 100% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.55E-06 | 100% | |
| | | | Acrolein | 1, 24 | 4.93E-05 | 100% | |
| | | | Acetaldehyde | 30 min, 24 | 2.99E-04 | 100% | |
| | | | Formaldehyde | 24 | 8.79E-04 | 100% | |
| | | | Benzo(a)pyrene | 24, 8760 | 9.02E-09 | 100% | |
| AREA1 | Construction - Construction Dust | Area - construction area | PM | 24, 8760 | 5.60E-01 | 100% | |
| | | | PM10 | 24 | 3.59E-01 | 100% | |
| | | | PM2.5 | 24, 8760 | 3.59E-02 | 96% | |
| | | | Crystalline silica | 24 | 1.87E-02 | 100% | |

***Appendix E: Summary of Air Dispersion Modelling Inputs***
***Location: B4 Station (at Bowmanville) Construction***

**Dispersion Modelling Parameters for Area Source**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | AREA1 | | |
| Length of x side | 91.593 | m | |
| Length of y side | 91.593 | m | |
| Area | 8389 | m2 | active construction area for worst-case scenario excluding existing GO facility north of the tracks as it is already developed. |
| Orientation angle from N | 0 | degrees | |
| Release Height | 1.00 | m | assumed release height of dust |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Initial Vertical Dimension | 1.63 | m | (Plume Height) / 2.15 |

**Dispersion Modelling Parameters for Volume Sources**

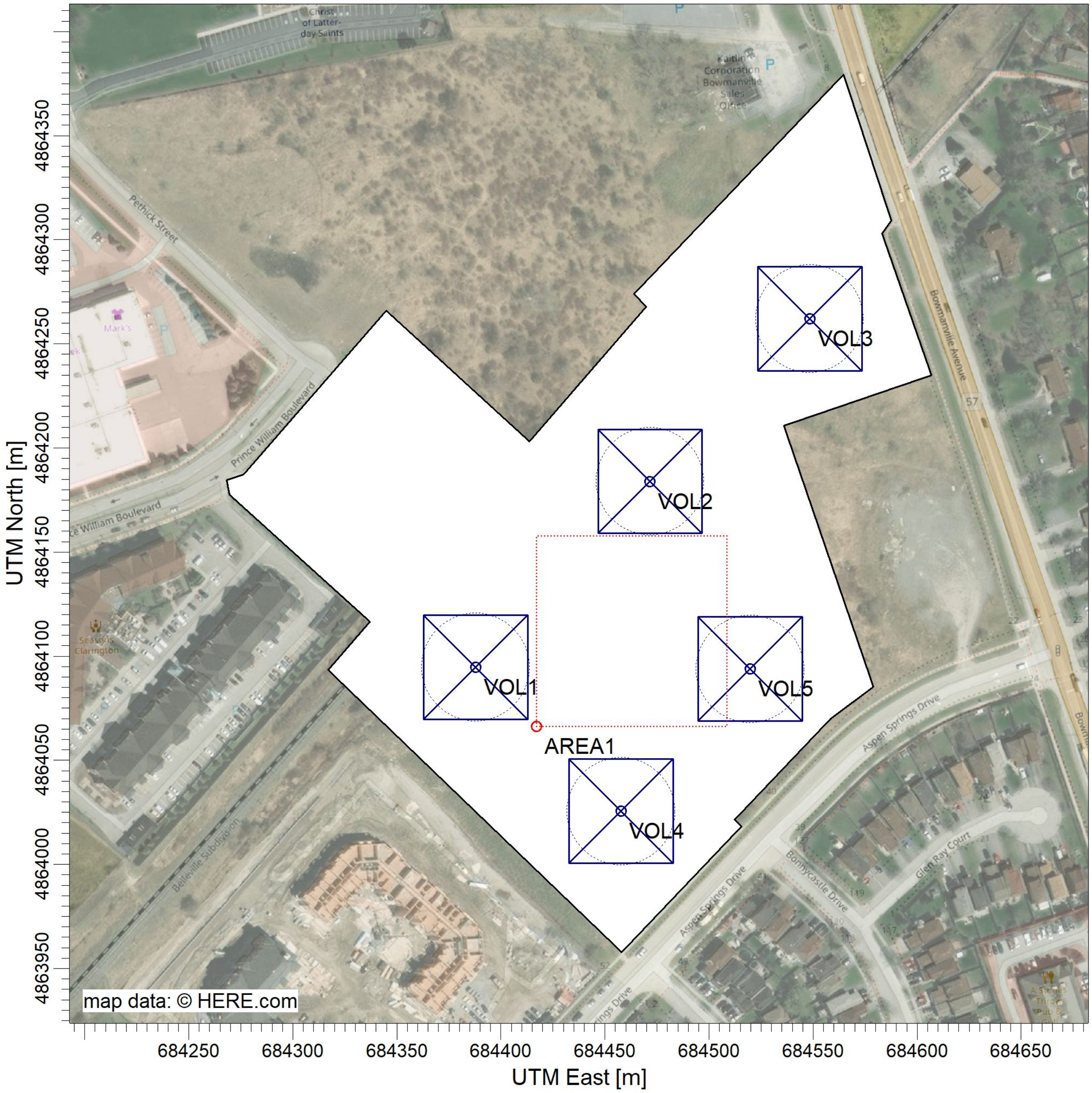
| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | VOL1 - VOL5 | | |
| Length of x side | 50 | m | measured total width of the road |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Release Height | 3.00 | m | assumed height of exhaust for construction |
| Initial Lateral Dimension | 11.63 | m | (Length of side) / 4.3 |
| Initial Vertical Dimension | 0.81 | m | for elevated release height: (Plume Height) / |

**Background Ozone concentrations used for Ozone Limiting Method in AERMOD model**

| | Background ozone concentrations (ppb) | | | |
|---|---|---|---|---|
| **Hour** | **Winter** | **Spring** | **Summer** | **Fall** |
| 1 | 34 | 38 | 33 | 26.4 |
| 2 | 34 | 37 | 32 | 26 |
| 3 | 34 | 36 | 30 | 26 |
| 4 | 33 | 34 | 26 | 26 |
| 5 | 32 | 34 | 24.4 | 25.4 |
| 6 | 30 | 31 | 21 | 24 |
| 7 | 29 | 31 | 21 | 22 |
| 8 | 29 | 33 | 25 | 22 |
| 9 | 31 | 36 | 30.1 | 22 |
| 10 | 33 | 40 | 37.7 | 24 |
| 11 | 34 | 44 | 45 | 27 |
| 12 | 36 | 47 | 49 | 29 |
| 13 | 37 | 50 | 53 | 30 |
| 14 | 39 | 53 | 56 | 31 |
| 15 | 39 | 55 | 55 | 32 |
| 16 | 39 | 54.9 | 56 | 32 |
| 17 | 39 | 54 | 55 | 31 |
| 18 | 37 | 53 | 55 | 28 |
| 19 | 35 | 51 | 51 | 27 |
| 20 | 34 | 48.7 | 46 | 27 |
| 21 | 33 | 44 | 40.4 | 27 |
| 22 | 34 | 41.8 | 37 | 26 |
| 23 | 33.4 | 40 | 35 | 27 |
| 24 | 34 | 39 | 33 | 26 |

PROJECT TITLE:

**Figure E-2: Dispersion Modelling Plan for Bowmanville Station Construction Scenario**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red box - area source<br>black line - Project footprint | **6** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1111** | | |
| | | SCALE: 1:3,079<br>0 — 0.1 km | |
| | | DATE:<br>**9/14/2021** | PROJECT NO.: |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Track and Grading Construction (west of Farewell Street to west of Harmony Road)***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario | | Note |
|---|---|---|---|---|---|---|---|
| | | | | | Emission Rate (g/s) | % of Overall Emissions | |
| VOL1-VOL12 | Construction - Nonroad equipment tailpipe | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 4.02E-05 | 100.0% | The source (group) operates 8 hours/day (8am-5pm). |
| | | | $NO_x$ | 1, 24, 8760 | 1.32E-02 | 100.0% | |
| | | | PM | 24, 8760 | 6.82E-04 | 0.3% | |
| | | | PM10 | 24 | 6.54E-04 | 0.5% | |
| | | | PM2.5 | 24, 8760 | 6.13E-04 | 4.6% | |
| | | | CO | 1, 8 | 2.59E-02 | 100.0% | |
| | | | Benzene | 24, 8760 | 5.20E-05 | 100.0% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.08E-06 | 100.0% | |
| | | | Acrolein | 1, 24 | 2.25E-05 | 100.0% | |
| | | | Acetaldehyde | 30 min, 24 | 1.36E-04 | 100.0% | |
| | | | Formaldehyde | 24 | 4.01E-04 | 100.0% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.12E-09 | 100.0% | |
| PAREA1 | Construction - Construction Dust | Polygonal Area - construction area | PM | 24, 8760 | 2.00E-01 | 99.7% | |
| | | | PM10 | 24 | 1.28E-01 | 99.5% | |
| | | | PM2.5 | 24, 8760 | 1.28E-02 | 95.4% | |
| | | | Crystalline silica | 24 | 6.70E-03 | 100.0% | |

*Appendix E: Summary of Air Dispersion Modelling Inputs*
*Location: Track and Grading Construction (west of Farewell Street to west of Harmony Road)*

**Dispersion Modelling Parameters for Area Polygon Source**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | PAREA1 | | |
| No. Vertices (or sides) | 6 | m | |
| Area | 3000 | m2 | active construction area for worst-case scenario |
| Release Height | 1.00 | m | assumed release height of dust |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Initial Vertical Dimension | 1.63 | m | (Plume Height) / 2.15 |

**Dispersion Modelling Parameters for Volume Sources**

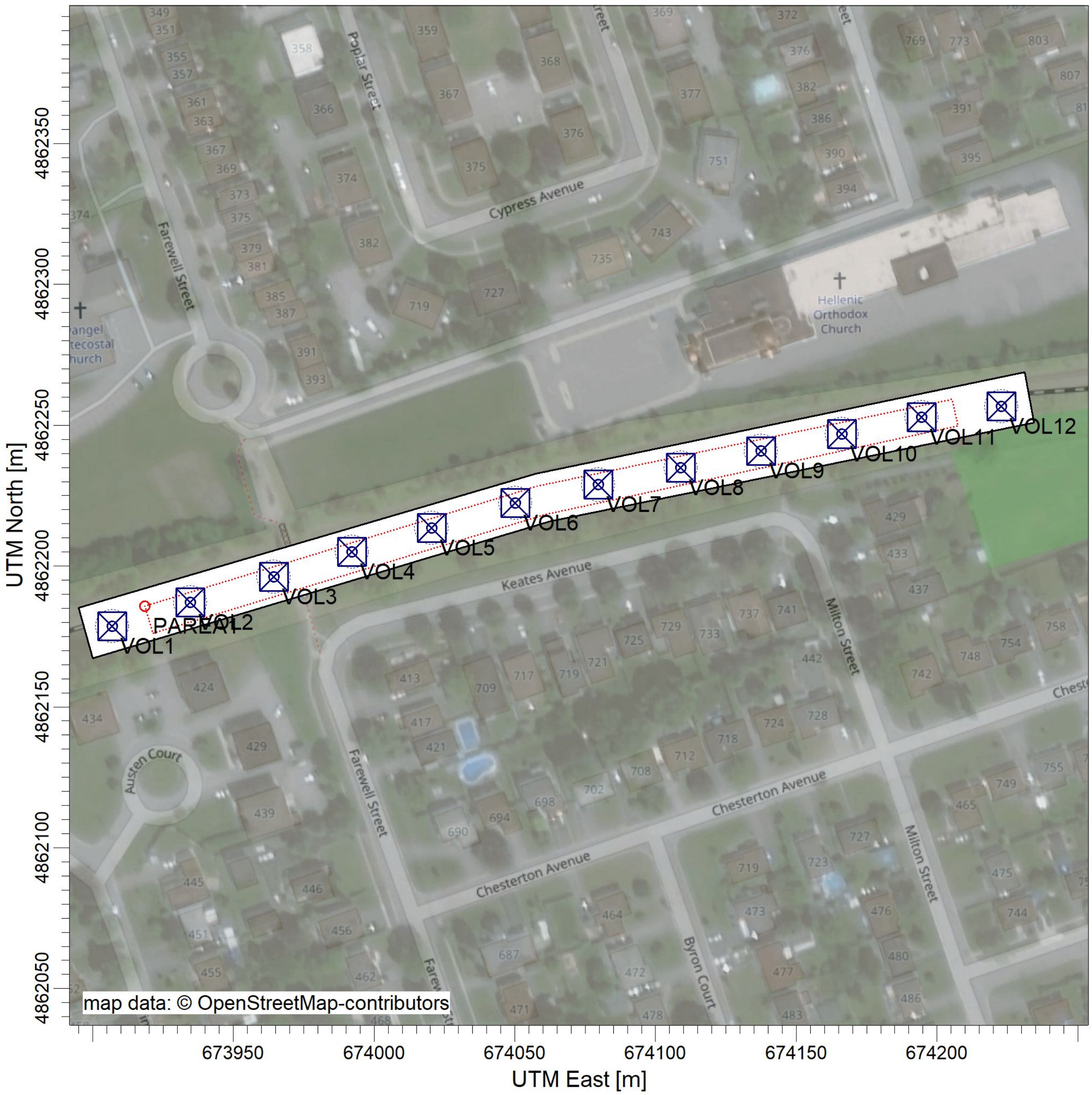
| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | VOL1 - VOL12 | | |
| Length of x side | 10 | m | measured width of vehicle travel in construction area |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Release Height | 3.00 | m | assumed height of exhaust for construction vehicles |
| Initial Lateral Dimension | 2.33 | m | (Length of side) / 4.3 |
| Initial Vertical Dimension | 0.81 | m | for elevated release height: (Plume Height) / 4.3 |

**Background Ozone concentrations used for Ozone Limiting Method in AERMOD model**

| | Background ozone concentrations (ppb) | | | |
|---|---|---|---|---|
| Hour | Winter | Spring | Summer | Fall |
| 1 | 34 | 38 | 33 | 26 |
| 2 | 34 | 37 | 32 | 26 |
| 3 | 34 | 36 | 30 | 26 |
| 4 | 33 | 34 | 26 | 26 |
| 5 | 32 | 34 | 24 | 25 |
| 6 | 30 | 31 | 21 | 24 |
| 7 | 29 | 31 | 21 | 22 |
| 8 | 29 | 33 | 25 | 22 |
| 9 | 31 | 36 | 30 | 22 |
| 10 | 33 | 40 | 38 | 24 |
| 11 | 34 | 44 | 45 | 27 |
| 12 | 36 | 47 | 49 | 29 |
| 13 | 37 | 50 | 53 | 30 |
| 14 | 39 | 53 | 56 | 31 |
| 15 | 39 | 55 | 55 | 32 |
| 16 | 39 | 55 | 56 | 32 |
| 17 | 39 | 54 | 55 | 31 |
| 18 | 37 | 53 | 55 | 28 |
| 19 | 35 | 51 | 51 | 27 |
| 20 | 34 | 49 | 46 | 27 |
| 21 | 33 | 44 | 40 | 27 |
| 22 | 34 | 42 | 37 | 26 |
| 23 | 33 | 40 | 35 | 27 |
| 24 | 34 | 39 | 33 | 26 |

PROJECT TITLE:

**Figure E-3: Dispersion Modelling Plan for Track and Grading (west of Farewell Street to west of Harmony Road) Construction Scenario**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - Project footprint | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1052** | | |
| | | SCALE: 1:2,277<br>0 0.05 km | |
| | | DATE:<br>**11/9/2021** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

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***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| VOL1-VOL11 | Construction - Nonroad equipment tailpipe | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 5.19E-05 | 5.19E-05 | 2% | The source (group) operates 8 hours/day (8am-5pm). |
| | | | $NO_x$ | 1, 24, 8760 | 1.70E-02 | 1.70E-02 | 5% | |
| | | | PM | 24, 8760 | 8.57E-04 | 8.57E-04 | 0% | |
| | | | PM10 | 24 | 8.23E-04 | 8.23E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 7.72E-04 | 7.72E-04 | 2% | |
| | | | CO | 1, 8 | 3.26E-02 | 3.26E-02 | 1% | |
| | | | Benzene | 24, 8760 | 6.71E-05 | 6.71E-05 | 7% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.68E-06 | 2.68E-06 | 3% | |
| | | | Acrolein | 1, 24 | 2.90E-05 | 2.90E-05 | 20% | |
| | | | Acetaldehyde | 30 min, 24 | 1.76E-04 | 1.76E-04 | 18% | |
| | | | Formaldehyde | 24 | 5.18E-04 | 5.18E-04 | 25% | |
| | | | Benzo(a)pyrene | 24, 8760 | 5.32E-09 | 5.32E-09 | 0% | |
| PAREA1 | Construction - Construction Dust | Area - construction area | PM | 24, 8760 | 4.24E-02 | 4.24E-02 | 7% | |
| | | | PM10 | 24 | 2.72E-02 | 2.72E-02 | 14% | |
| | | | PM2.5 | 24, 8760 | 2.72E-03 | 2.72E-03 | 6% | |
| | | | Crystalline silica | 24 | 1.42E-03 | 1.42E-03 | 23% | |
| R1a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.55E-05 | 5.37E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.55E-03 | 8.87E-04 | 1% | |
| | | | PM | 24, 8760 | 1.97E-03 | 1.58E-03 | 0% | |
| | | | PM10 | 24 | 8.54E-04 | 4.68E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 2.21E-04 | 1.19E-04 | 0% | |
| | | | Crystalline silica | 24 | 1.37E-05 | 1.37E-05 | 0% | |
| | | | CO | 1, 8 | 2.18E-02 | 7.56E-03 | 1% | |
| | | | Benzene | 24, 8760 | 6.36E-06 | 2.21E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 6.11E-07 | 2.12E-07 | 1% | |
| | | | Acrolein | 1, 24 | 9.53E-07 | 3.31E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 6.56E-06 | 2.28E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.22E-05 | 4.25E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.04E-09 | 2.79E-09 | 1% | |
| R1b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.48E-05 | 5.12E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.44E-03 | 8.46E-04 | 1% | |
| | | | PM | 24, 8760 | 1.88E-03 | 1.51E-03 | 0% | |
| | | | PM10 | 24 | 8.14E-04 | 4.46E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 2.10E-04 | 1.14E-04 | 0% | |
| | | | Crystalline silica | 24 | 1.31E-05 | 1.31E-05 | 0% | |
| | | | CO | 1, 8 | 2.08E-02 | 7.21E-03 | 1% | |
| | | | Benzene | 24, 8760 | 6.06E-06 | 2.11E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.83E-07 | 2.02E-07 | 1% | |
| | | | Acrolein | 1, 24 | 9.09E-07 | 3.16E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 6.25E-06 | 2.17E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.17E-05 | 4.05E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 7.67E-09 | 2.66E-09 | 1% | |
| R2a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.83E-05 | 6.36E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.05E-03 | 1.06E-03 | 1% | |
| | | | PM | 24, 8760 | 2.37E-03 | 1.91E-03 | 0% | |
| | | | PM10 | 24 | 1.01E-03 | 5.60E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 2.65E-04 | 1.44E-04 | 1% | |
| | | | Crystalline silica | 24 | 1.67E-05 | 1.67E-05 | 0% | |
| | | | CO | 1, 8 | 2.60E-02 | 9.04E-03 | 1% | |
| | | | Benzene | 24, 8760 | 7.55E-06 | 2.62E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.17E-07 | 2.49E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.11E-06 | 3.86E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 7.67E-06 | 2.66E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.43E-05 | 4.95E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 9.66E-09 | 3.35E-09 | 1% | |
| R2b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.59E-06 | 2.64E-06 | 0% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.26E-03 | 4.39E-04 | 0% | |
| | | | PM | 24, 8760 | 2.36E-03 | 2.17E-03 | 0% | |
| | | | PM10 | 24 | 6.83E-04 | 4.96E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 1.76E-04 | 1.26E-04 | 0% | |
| | | | Crystalline silica | 24 | 2.07E-05 | 2.07E-05 | 0% | |
| | | | CO | 1, 8 | 1.08E-02 | 3.75E-03 | 0% | |
| | | | Benzene | 24, 8760 | 3.13E-06 | 1.09E-06 | 0% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.97E-07 | 1.03E-07 | 0% | |
| | | | Acrolein | 1, 24 | 4.60E-07 | 1.60E-07 | 0% | |
| | | | Acetaldehyde | 30 min, 24 | 3.18E-06 | 1.10E-06 | 0% | |
| | | | Formaldehyde | 24 | 5.91E-06 | 2.05E-06 | 0% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.00E-09 | 1.39E-09 | 0% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R3_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.24E-05 | 7.77E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.17E-03 | 1.45E-03 | 1% | |
| | | | PM | 24, 8760 | 3.93E-03 | 3.47E-03 | 1% | |
| | | | PM10 | 24 | 1.32E-03 | 8.61E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 3.91E-04 | 2.36E-04 | 1% | |
| | | | Crystalline silica | 24 | 3.22E-05 | 3.22E-05 | 1% | |
| | | | CO | 1, 8 | 3.28E-02 | 1.14E-02 | 1% | |
| | | | Benzene | 24, 8760 | 9.24E-06 | 3.21E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.65E-07 | 2.66E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.08E-06 | 3.75E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 7.82E-06 | 2.72E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.41E-05 | 4.90E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.24E-08 | 4.32E-09 | 1% | |
| R4a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 4.04E-05 | 1.40E-05 | 2% | |
| | | | $NO_x$ | 1, 24, 8760 | 6.61E-03 | 2.30E-03 | 2% | |
| | | | PM | 24, 8760 | 5.05E-03 | 4.03E-03 | 1% | |
| | | | PM10 | 24 | 2.22E-03 | 1.21E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 5.68E-04 | 3.06E-04 | 1% | |
| | | | Crystalline silica | 24 | 3.47E-05 | 3.47E-05 | 1% | |
| | | | CO | 1, 8 | 5.62E-02 | 1.95E-02 | 2% | |
| | | | Benzene | 24, 8760 | 1.65E-05 | 5.74E-06 | 2% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.61E-06 | 5.59E-07 | 2% | |
| | | | Acrolein | 1, 24 | 2.53E-06 | 8.78E-07 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 1.73E-05 | 6.02E-06 | 2% | |
| | | | Formaldehyde | 24 | 3.24E-05 | 1.12E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.06E-08 | 7.17E-09 | 2% | |
| R4b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.73E-05 | 9.48E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.47E-03 | 1.55E-03 | 1% | |
| | | | PM | 24, 8760 | 3.41E-03 | 2.72E-03 | 1% | |
| | | | PM10 | 24 | 1.50E-03 | 8.16E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 3.83E-04 | 2.07E-04 | 1% | |
| | | | Crystalline silica | 24 | 2.35E-05 | 2.35E-05 | 0% | |
| | | | CO | 1, 8 | 3.80E-02 | 1.32E-02 | 1% | |
| | | | Benzene | 24, 8760 | 1.12E-05 | 3.88E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.09E-06 | 3.77E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.71E-06 | 5.93E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 1.17E-05 | 4.07E-06 | 1% | |
| | | | Formaldehyde | 24 | 2.19E-05 | 7.60E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.39E-08 | 4.84E-09 | 1% | |
| R5_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.51E-04 | 8.70E-05 | 12% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.67E-02 | 1.62E-02 | 13% | |
| | | | PM | 24, 8760 | 4.40E-02 | 3.89E-02 | 7% | |
| | | | PM10 | 24 | 1.48E-02 | 9.63E-03 | 7% | |
| | | | PM2.5 | 24, 8760 | 4.37E-03 | 2.64E-03 | 9% | |
| | | | Crystalline silica | 24 | 3.60E-04 | 3.60E-04 | 6% | |
| | | | CO | 1, 8 | 3.68E-01 | 1.28E-01 | 12% | |
| | | | Benzene | 24, 8760 | 1.03E-04 | 3.59E-05 | 11% | |
| | | | 1,3-Butadiene | 24, 8760 | 8.57E-06 | 2.97E-06 | 11% | |
| | | | Acrolein | 1, 24 | 1.21E-05 | 4.20E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 8.75E-05 | 3.04E-05 | 9% | |
| | | | Formaldehyde | 24 | 1.58E-04 | 5.49E-05 | 8% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.39E-07 | 4.84E-08 | 12% | |
| R6a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 5.99E-05 | 2.08E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 6.07E-03 | 2.11E-03 | 2% | |
| | | | PM | 24, 8760 | 1.27E-02 | 6.77E-03 | 2% | |
| | | | PM10 | 24 | 9.84E-03 | 3.87E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 1.56E-03 | 6.52E-04 | 3% | |
| | | | Crystalline silica | 24 | 3.57E-05 | 3.57E-05 | 1% | |
| | | | CO | 1, 8 | 6.19E-02 | 2.15E-02 | 2% | |
| | | | Benzene | 24, 8760 | 3.01E-05 | 1.04E-05 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.14E-06 | 1.09E-06 | 4% | |
| | | | Acrolein | 1, 24 | 5.09E-06 | 1.77E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.41E-05 | 1.18E-05 | 3% | |
| | | | Formaldehyde | 24 | 6.48E-05 | 2.25E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.83E-08 | 9.83E-09 | 3% | |
| R6b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 5.42E-05 | 1.88E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 5.49E-03 | 1.91E-03 | 1% | |
| | | | PM | 24, 8760 | 1.44E-02 | 8.97E-03 | 2% | |
| | | | PM10 | 24 | 9.45E-03 | 4.04E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 1.54E-03 | 7.26E-04 | 3% | |
| | | | Crystalline silica | 24 | 6.07E-05 | 6.07E-05 | 1% | |
| | | | CO | 1, 8 | 5.60E-02 | 1.94E-02 | 2% | |
| | | | Benzene | 24, 8760 | 2.72E-05 | 9.44E-06 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.84E-06 | 9.87E-07 | 4% | |
| | | | Acrolein | 1, 24 | 4.61E-06 | 1.60E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.08E-05 | 1.07E-05 | 3% | |
| | | | Formaldehyde | 24 | 5.86E-05 | 2.03E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.56E-08 | 8.89E-09 | 2% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R7a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.37E-04 | 4.75E-05 | 6% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.26E-02 | 7.84E-03 | 6% | |
| | | | PM | 24, 8760 | 1.17E-02 | 8.28E-03 | 2% | |
| | | | PM10 | 24 | 6.46E-03 | 3.05E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.68E-03 | 7.84E-04 | 3% | |
| | | | Crystalline silica | 24 | 6.44E-05 | 6.44E-05 | 1% | |
| | | | CO | 1, 8 | 1.92E-01 | 6.68E-02 | 6% | |
| | | | Benzene | 24, 8760 | 5.62E-05 | 1.95E-05 | 6% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.40E-06 | 1.87E-06 | 7% | |
| | | | Acrolein | 1, 24 | 8.42E-06 | 2.92E-06 | 6% | |
| | | | Acetaldehyde | 30 min, 24 | 5.79E-05 | 2.01E-05 | 6% | |
| | | | Formaldehyde | 24 | 1.08E-04 | 3.75E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 7.10E-08 | 2.47E-08 | 6% | |
| R7b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.17E-04 | 4.08E-05 | 6% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.94E-02 | 6.73E-03 | 5% | |
| | | | PM | 24, 8760 | 1.00E-02 | 7.11E-03 | 2% | |
| | | | PM10 | 24 | 5.54E-03 | 2.62E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.44E-03 | 6.73E-04 | 3% | |
| | | | Crystalline silica | 24 | 5.53E-05 | 5.53E-05 | 1% | |
| | | | CO | 1, 8 | 1.65E-01 | 5.74E-02 | 6% | |
| | | | Benzene | 24, 8760 | 4.82E-05 | 1.67E-05 | 5% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.64E-06 | 1.61E-06 | 6% | |
| | | | Acrolein | 1, 24 | 7.23E-06 | 2.51E-06 | 5% | |
| | | | Acetaldehyde | 30 min, 24 | 4.97E-05 | 1.73E-05 | 5% | |
| | | | Formaldehyde | 24 | 9.28E-05 | 3.22E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 6.10E-08 | 2.12E-08 | 5% | |
| R8_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 3.72E-04 | 1.29E-04 | 18% | |
| | | | $NO_x$ | 1, 24, 8760 | 6.93E-02 | 2.41E-02 | 19% | |
| | | | PM | 24, 8760 | 4.02E-02 | 3.26E-02 | 7% | |
| | | | PM10 | 24 | 1.72E-02 | 9.51E-03 | 9% | |
| | | | PM2.5 | 24, 8760 | 5.30E-03 | 2.73E-03 | 11% | |
| | | | Crystalline silica | 24 | 2.84E-04 | 2.84E-04 | 5% | |
| | | | CO | 1, 8 | 5.46E-01 | 1.89E-01 | 18% | |
| | | | Benzene | 24, 8760 | 1.53E-04 | 5.33E-05 | 17% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.27E-05 | 4.42E-06 | 16% | |
| | | | Acrolein | 1, 24 | 1.79E-05 | 6.23E-06 | 12% | |
| | | | Acetaldehyde | 30 min, 24 | 1.30E-04 | 4.51E-05 | 13% | |
| | | | Formaldehyde | 24 | 2.35E-04 | 8.14E-05 | 12% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.07E-07 | 7.18E-08 | 19% | |
| R9_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 5.18E-05 | 1.80E-05 | 2% | |
| | | | $NO_x$ | 1, 24, 8760 | 9.65E-03 | 3.35E-03 | 3% | |
| | | | PM | 24, 8760 | 5.60E-03 | 4.54E-03 | 1% | |
| | | | PM10 | 24 | 2.39E-03 | 1.32E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 7.37E-04 | 3.80E-04 | 2% | |
| | | | Crystalline silica | 24 | 3.96E-05 | 3.96E-05 | 1% | |
| | | | CO | 1, 8 | 7.59E-02 | 2.64E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.14E-05 | 7.42E-06 | 2% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.77E-06 | 6.14E-07 | 2% | |
| | | | Acrolein | 1, 24 | 2.50E-06 | 8.67E-07 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 1.81E-05 | 6.28E-06 | 2% | |
| | | | Formaldehyde | 24 | 3.26E-05 | 1.13E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.88E-08 | 1.00E-08 | 3% | |
| R10a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 5.10E-05 | 1.77E-05 | 2% | |
| | | | $NO_x$ | 1, 24, 8760 | 8.89E-03 | 3.09E-03 | 2% | |
| | | | PM | 24, 8760 | 4.97E-03 | 3.77E-03 | 1% | |
| | | | PM10 | 24 | 2.43E-03 | 1.23E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 6.85E-04 | 3.36E-04 | 1% | |
| | | | Crystalline silica | 24 | 3.12E-05 | 3.12E-05 | 1% | |
| | | | CO | 1, 8 | 7.72E-02 | 2.68E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.19E-05 | 7.59E-06 | 2% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.86E-06 | 6.48E-07 | 2% | |
| | | | Acrolein | 1, 24 | 2.67E-06 | 9.28E-07 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 1.91E-05 | 6.65E-06 | 2% | |
| | | | Formaldehyde | 24 | 3.49E-05 | 1.21E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 2.87E-08 | 9.98E-09 | 3% | |
| R10b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 6.14E-05 | 2.13E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.07E-02 | 3.72E-03 | 3% | |
| | | | PM | 24, 8760 | 5.98E-03 | 4.54E-03 | 1% | |
| | | | PM10 | 24 | 2.93E-03 | 1.49E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 8.25E-04 | 4.04E-04 | 2% | |
| | | | Crystalline silica | 24 | 3.76E-05 | 3.76E-05 | 1% | |
| | | | CO | 1, 8 | 9.29E-02 | 3.23E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.63E-05 | 9.14E-06 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.25E-06 | 7.80E-07 | 3% | |
| | | | Acrolein | 1, 24 | 3.22E-06 | 1.12E-06 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 2.31E-05 | 8.00E-06 | 2% | |
| | | | Formaldehyde | 24 | 4.20E-05 | 1.46E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 3.46E-08 | 1.20E-08 | 3% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R11_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 6.84E-05 | 2.38E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.28E-02 | 4.43E-03 | 3% | |
| | | | PM | 24, 8760 | 7.40E-03 | 6.00E-03 | 1% | |
| | | | PM10 | 24 | 3.15E-03 | 1.75E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 9.74E-04 | 5.02E-04 | 2% | |
| | | | Crystalline silica | 24 | 5.23E-05 | 5.23E-05 | 1% | |
| | | | CO | 1, 8 | 1.00E-01 | 3.48E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.82E-05 | 9.80E-06 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.34E-06 | 8.12E-07 | 3% | |
| | | | Acrolein | 1, 24 | 3.30E-06 | 1.15E-06 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 2.39E-05 | 8.30E-06 | 2% | |
| | | | Formaldehyde | 24 | 4.31E-05 | 1.50E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 3.80E-08 | 1.32E-08 | 3% | |
| R12_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.27E-04 | 4.41E-05 | 6% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.37E-02 | 8.22E-03 | 6% | |
| | | | PM | 24, 8760 | 1.37E-02 | 1.11E-02 | 2% | |
| | | | PM10 | 24 | 5.86E-03 | 3.25E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.81E-03 | 9.32E-04 | 4% | |
| | | | Crystalline silica | 24 | 9.71E-05 | 9.71E-05 | 2% | |
| | | | CO | 1, 8 | 1.86E-01 | 6.47E-02 | 6% | |
| | | | Benzene | 24, 8760 | 5.24E-05 | 1.82E-05 | 6% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.34E-06 | 1.51E-06 | 5% | |
| | | | Acrolein | 1, 24 | 6.13E-06 | 2.13E-06 | 4% | |
| | | | Acetaldehyde | 30 min, 24 | 4.44E-05 | 1.54E-05 | 4% | |
| | | | Formaldehyde | 24 | 8.01E-05 | 2.78E-05 | 4% | |
| | | | Benzo(a)pyrene | 24, 8760 | 7.07E-08 | 2.45E-08 | 6% | |
| R13_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.73E-04 | 6.01E-05 | 8% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.75E-02 | 9.56E-03 | 7% | |
| | | | PM | 24, 8760 | 1.27E-02 | 8.18E-03 | 2% | |
| | | | PM10 | 24 | 8.02E-03 | 3.51E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 1.98E-03 | 8.67E-04 | 4% | |
| | | | Crystalline silica | 24 | 5.76E-05 | 5.76E-05 | 1% | |
| | | | CO | 1, 8 | 2.13E-01 | 7.40E-02 | 7% | |
| | | | Benzene | 24, 8760 | 6.67E-05 | 2.32E-05 | 7% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.20E-06 | 2.50E-06 | 9% | |
| | | | Acrolein | 1, 24 | 1.20E-05 | 4.17E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 8.00E-05 | 2.78E-05 | 8% | |
| | | | Formaldehyde | 24 | 1.52E-04 | 5.27E-05 | 7% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.42E-08 | 2.92E-08 | 8% | |
| R14a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.07E-04 | 3.71E-05 | 5% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.78E-02 | 6.18E-03 | 5% | |
| | | | PM | 24, 8760 | 9.25E-03 | 6.61E-03 | 2% | |
| | | | PM10 | 24 | 5.04E-03 | 2.40E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.33E-03 | 6.23E-04 | 3% | |
| | | | Crystalline silica | 24 | 5.18E-05 | 5.18E-05 | 1% | |
| | | | CO | 1, 8 | 1.52E-01 | 5.28E-02 | 5% | |
| | | | Benzene | 24, 8760 | 4.41E-05 | 1.53E-05 | 5% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.19E-06 | 1.46E-06 | 5% | |
| | | | Acrolein | 1, 24 | 6.49E-06 | 2.25E-06 | 4% | |
| | | | Acetaldehyde | 30 min, 24 | 4.48E-05 | 1.56E-05 | 4% | |
| | | | Formaldehyde | 24 | 8.33E-05 | 2.89E-05 | 4% | |
| | | | Benzo(a)pyrene | 24, 8760 | 5.64E-08 | 1.96E-08 | 5% | |
| R14b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.16E-04 | 4.03E-05 | 5% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.93E-02 | 6.71E-03 | 5% | |
| | | | PM | 24, 8760 | 1.00E-02 | 7.17E-03 | 2% | |
| | | | PM10 | 24 | 5.47E-03 | 2.60E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.44E-03 | 6.76E-04 | 3% | |
| | | | Crystalline silica | 24 | 5.62E-05 | 5.62E-05 | 1% | |
| | | | CO | 1, 8 | 1.65E-01 | 5.73E-02 | 6% | |
| | | | Benzene | 24, 8760 | 4.79E-05 | 1.66E-05 | 5% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.55E-06 | 1.58E-06 | 6% | |
| | | | Acrolein | 1, 24 | 7.04E-06 | 2.44E-06 | 5% | |
| | | | Acetaldehyde | 30 min, 24 | 4.86E-05 | 1.69E-05 | 5% | |
| | | | Formaldehyde | 24 | 9.04E-05 | 3.14E-05 | 4% | |
| | | | Benzo(a)pyrene | 24, 8760 | 6.12E-08 | 2.13E-08 | 5% | |
| R15a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.86E-04 | 6.46E-05 | 9% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.07E-02 | 1.07E-02 | 8% | |
| | | | PM | 24, 8760 | 1.59E-02 | 1.13E-02 | 3% | |
| | | | PM10 | 24 | 8.78E-03 | 4.15E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 2.28E-03 | 1.07E-03 | 5% | |
| | | | Crystalline silica | 24 | 8.77E-05 | 8.77E-05 | 1% | |
| | | | CO | 1, 8 | 2.62E-01 | 9.09E-02 | 9% | |
| | | | Benzene | 24, 8760 | 7.64E-05 | 2.65E-05 | 8% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.34E-06 | 2.55E-06 | 9% | |
| | | | Acrolein | 1, 24 | 1.15E-05 | 3.98E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 7.88E-05 | 2.74E-05 | 8% | |
| | | | Formaldehyde | 24 | 1.47E-04 | 5.10E-05 | 7% | |
| | | | Benzo(a)pyrene | 24, 8760 | 9.66E-08 | 3.35E-08 | 9% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R15b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.68E-05 | 2.67E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.27E-02 | 4.40E-03 | 3% | |
| | | | PM | 24, 8760 | 6.57E-03 | 4.65E-03 | 1% | |
| | | | PM10 | 24 | 3.63E-03 | 1.71E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 9.42E-04 | 4.40E-04 | 2% | |
| | | | Crystalline silica | 24 | 3.62E-05 | 3.62E-05 | 1% | |
| | | | CO | 1, 8 | 1.08E-01 | 3.75E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.15E-05 | 1.10E-05 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.03E-06 | 1.05E-06 | 4% | |
| | | | Acrolein | 1, 24 | 4.73E-06 | 1.64E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.25E-05 | 1.13E-05 | 3% | |
| | | | Formaldehyde | 24 | 6.07E-05 | 2.11E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 3.99E-08 | 1.39E-08 | 4% | |
| R16_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.34E-04 | 8.13E-05 | 11% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.36E-02 | 1.52E-02 | 12% | |
| | | | PM | 24, 8760 | 2.53E-02 | 2.05E-02 | 4% | |
| | | | PM10 | 24 | 1.08E-02 | 5.99E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 3.33E-03 | 1.72E-03 | 7% | |
| | | | Crystalline silica | 24 | 1.79E-04 | 1.79E-04 | 3% | |
| | | | CO | 1, 8 | 3.43E-01 | 1.19E-01 | 11% | |
| | | | Benzene | 24, 8760 | 9.66E-05 | 3.35E-05 | 10% | |
| | | | 1,3-Butadiene | 24, 8760 | 8.00E-06 | 2.78E-06 | 10% | |
| | | | Acrolein | 1, 24 | 1.13E-05 | 3.92E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 8.18E-05 | 2.84E-05 | 8% | |
| | | | Formaldehyde | 24 | 1.48E-04 | 5.13E-05 | 7% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.30E-07 | 4.52E-08 | 12% | |
| R17a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.07E-04 | 7.19E-05 | 10% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.47E-02 | 1.21E-02 | 9% | |
| | | | PM | 24, 8760 | 1.83E-02 | 1.31E-02 | 3% | |
| | | | PM10 | 24 | 9.99E-03 | 4.76E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 2.64E-03 | 1.24E-03 | 5% | |
| | | | Crystalline silica | 24 | 1.03E-04 | 1.03E-04 | 2% | |
| | | | CO | 1, 8 | 2.97E-01 | 1.03E-01 | 10% | |
| | | | Benzene | 24, 8760 | 8.57E-05 | 2.97E-05 | 9% | |
| | | | 1,3-Butadiene | 24, 8760 | 8.04E-06 | 2.79E-06 | 10% | |
| | | | Acrolein | 1, 24 | 1.24E-05 | 4.29E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 8.57E-05 | 2.97E-05 | 9% | |
| | | | Formaldehyde | 24 | 1.59E-04 | 5.52E-05 | 8% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.11E-07 | 3.84E-08 | 10% | |
| R17b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.14E-04 | 7.44E-05 | 10% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.60E-02 | 1.25E-02 | 10% | |
| | | | PM | 24, 8760 | 1.90E-02 | 1.36E-02 | 3% | |
| | | | PM10 | 24 | 1.04E-02 | 4.93E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 2.73E-03 | 1.28E-03 | 6% | |
| | | | Crystalline silica | 24 | 1.06E-04 | 1.06E-04 | 2% | |
| | | | CO | 1, 8 | 3.08E-01 | 1.07E-01 | 10% | |
| | | | Benzene | 24, 8760 | 8.87E-05 | 3.08E-05 | 10% | |
| | | | 1,3-Butadiene | 24, 8760 | 8.33E-06 | 2.89E-06 | 10% | |
| | | | Acrolein | 1, 24 | 1.28E-05 | 4.45E-06 | 9% | |
| | | | Acetaldehyde | 30 min, 24 | 8.87E-05 | 3.08E-05 | 9% | |
| | | | Formaldehyde | 24 | 1.65E-04 | 5.72E-05 | 8% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.15E-07 | 3.98E-08 | 10% | |
| R18_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.02E-04 | 7.01E-05 | 10% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.77E-02 | 1.31E-02 | 10% | |
| | | | PM | 24, 8760 | 2.19E-02 | 1.77E-02 | 4% | |
| | | | PM10 | 24 | 9.31E-03 | 5.17E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 2.88E-03 | 1.48E-03 | 6% | |
| | | | Crystalline silica | 24 | 1.54E-04 | 1.54E-04 | 2% | |
| | | | CO | 1, 8 | 2.96E-01 | 1.03E-01 | 10% | |
| | | | Benzene | 24, 8760 | 8.34E-05 | 2.89E-05 | 9% | |
| | | | 1,3-Butadiene | 24, 8760 | 6.91E-06 | 2.40E-06 | 9% | |
| | | | Acrolein | 1, 24 | 9.74E-06 | 3.38E-06 | 7% | |
| | | | Acetaldehyde | 30 min, 24 | 7.06E-05 | 2.45E-05 | 7% | |
| | | | Formaldehyde | 24 | 1.27E-04 | 4.42E-05 | 6% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.12E-07 | 3.90E-08 | 10% | |
| R19a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.06E-05 | 2.45E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.16E-02 | 4.01E-03 | 3% | |
| | | | PM | 24, 8760 | 5.97E-03 | 4.19E-03 | 1% | |
| | | | PM10 | 24 | 3.34E-03 | 1.57E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 8.56E-04 | 3.98E-04 | 2% | |
| | | | Crystalline silica | 24 | 3.23E-05 | 3.23E-05 | 1% | |
| | | | CO | 1, 8 | 9.82E-02 | 3.41E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.89E-05 | 1.00E-05 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.81E-06 | 9.76E-07 | 3% | |
| | | | Acrolein | 1, 24 | 4.42E-06 | 1.53E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.03E-05 | 1.05E-05 | 3% | |
| | | | Formaldehyde | 24 | 5.66E-05 | 1.97E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 3.61E-08 | 1.25E-08 | 3% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R19b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 8.99E-05 | 3.12E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.47E-02 | 5.11E-03 | 4% | |
| | | | PM | 24, 8760 | 7.60E-03 | 5.33E-03 | 1% | |
| | | | PM10 | 24 | 4.26E-03 | 1.99E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 1.09E-03 | 5.07E-04 | 2% | |
| | | | Crystalline silica | 24 | 4.11E-05 | 4.11E-05 | 1% | |
| | | | CO | 1, 8 | 1.25E-01 | 4.34E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.68E-05 | 1.28E-05 | 4% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.58E-06 | 1.24E-06 | 4% | |
| | | | Acrolein | 1, 24 | 5.63E-06 | 1.95E-06 | 4% | |
| | | | Acetaldehyde | 30 min, 24 | 3.85E-05 | 1.34E-05 | 4% | |
| | | | Formaldehyde | 24 | 7.21E-05 | 2.50E-05 | 4% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.59E-08 | 1.59E-08 | 4% | |
| R20a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.09E-04 | 7.25E-05 | 10% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.42E-02 | 1.19E-02 | 9% | |
| | | | PM | 24, 8760 | 1.77E-02 | 1.24E-02 | 3% | |
| | | | PM10 | 24 | 9.89E-03 | 4.63E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 2.53E-03 | 1.18E-03 | 5% | |
| | | | Crystalline silica | 24 | 9.56E-05 | 9.56E-05 | 2% | |
| | | | CO | 1, 8 | 2.91E-01 | 1.01E-01 | 10% | |
| | | | Benzene | 24, 8760 | 8.54E-05 | 2.97E-05 | 9% | |
| | | | 1,3-Butadiene | 24, 8760 | 8.32E-06 | 2.89E-06 | 10% | |
| | | | Acrolein | 1, 24 | 1.31E-05 | 4.54E-06 | 9% | |
| | | | Acetaldehyde | 30 min, 24 | 8.96E-05 | 3.11E-05 | 9% | |
| | | | Formaldehyde | 24 | 1.67E-04 | 5.82E-05 | 8% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.07E-07 | 3.71E-08 | 10% | |
| R20b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 9.47E-05 | 3.29E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.55E-02 | 5.38E-03 | 4% | |
| | | | PM | 24, 8760 | 1.18E-02 | 9.44E-03 | 2% | |
| | | | PM10 | 24 | 5.21E-03 | 2.83E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.33E-03 | 7.17E-04 | 3% | |
| | | | Crystalline silica | 24 | 8.14E-05 | 8.14E-05 | 1% | |
| | | | CO | 1, 8 | 1.32E-01 | 4.57E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.87E-05 | 1.34E-05 | 4% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.77E-06 | 1.31E-06 | 5% | |
| | | | Acrolein | 1, 24 | 5.93E-06 | 2.06E-06 | 4% | |
| | | | Acetaldehyde | 30 min, 24 | 4.06E-05 | 1.41E-05 | 4% | |
| | | | Formaldehyde | 24 | 7.59E-05 | 2.64E-05 | 4% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.84E-08 | 1.68E-08 | 4% | |
| R21a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 8.16E-05 | 2.83E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E-02 | 4.64E-03 | 4% | |
| | | | PM | 24, 8760 | 1.02E-02 | 8.14E-03 | 2% | |
| | | | PM10 | 24 | 4.49E-03 | 2.44E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 1.15E-03 | 6.17E-04 | 2% | |
| | | | Crystalline silica | 24 | 7.02E-05 | 7.02E-05 | 1% | |
| | | | CO | 1, 8 | 1.14E-01 | 3.94E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.34E-05 | 1.16E-05 | 4% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.25E-06 | 1.13E-06 | 4% | |
| | | | Acrolein | 1, 24 | 5.11E-06 | 1.77E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.50E-05 | 1.22E-05 | 4% | |
| | | | Formaldehyde | 24 | 6.54E-05 | 2.27E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.17E-08 | 1.45E-08 | 4% | |
| R21b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.57E-04 | 5.45E-05 | 7% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.57E-02 | 8.92E-03 | 7% | |
| | | | PM | 24, 8760 | 1.33E-02 | 9.32E-03 | 2% | |
| | | | PM10 | 24 | 7.44E-03 | 3.48E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 1.90E-03 | 8.85E-04 | 4% | |
| | | | Crystalline silica | 24 | 7.19E-05 | 7.19E-05 | 1% | |
| | | | CO | 1, 8 | 2.18E-01 | 7.59E-02 | 7% | |
| | | | Benzene | 24, 8760 | 6.42E-05 | 2.23E-05 | 7% | |
| | | | 1,3-Butadiene | 24, 8760 | 6.25E-06 | 2.17E-06 | 8% | |
| | | | Acrolein | 1, 24 | 9.83E-06 | 3.41E-06 | 7% | |
| | | | Acetaldehyde | 30 min, 24 | 6.73E-05 | 2.34E-05 | 7% | |
| | | | Formaldehyde | 24 | 1.26E-04 | 4.37E-05 | 6% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.02E-08 | 2.79E-08 | 7% | |
| R22_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.59E-04 | 5.53E-05 | 8% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.97E-02 | 1.03E-02 | 8% | |
| | | | PM | 24, 8760 | 1.72E-02 | 1.40E-02 | 3% | |
| | | | PM10 | 24 | 7.34E-03 | 4.07E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 2.27E-03 | 1.17E-03 | 5% | |
| | | | Crystalline silica | 24 | 1.22E-04 | 1.22E-04 | 2% | |
| | | | CO | 1, 8 | 2.34E-01 | 8.11E-02 | 8% | |
| | | | Benzene | 24, 8760 | 6.57E-05 | 2.28E-05 | 7% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.45E-06 | 1.89E-06 | 7% | |
| | | | Acrolein | 1, 24 | 7.68E-06 | 2.67E-06 | 5% | |
| | | | Acetaldehyde | 30 min, 24 | 5.56E-05 | 1.93E-05 | 6% | |
| | | | Formaldehyde | 24 | 1.00E-04 | 3.49E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.86E-08 | 3.08E-08 | 8% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R23a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.66E-04 | 9.23E-05 | 13% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.60E-02 | 1.60E-02 | 12% | |
| | | | PM | 24, 8760 | 2.49E-02 | 1.86E-02 | 4% | |
| | | | PM10 | 24 | 1.25E-02 | 6.26E-03 | 6% | |
| | | | PM2.5 | 24, 8760 | 3.52E-03 | 1.70E-03 | 7% | |
| | | | Crystalline silica | 24 | 1.52E-04 | 1.52E-04 | 2% | |
| | | | CO | 1, 8 | 4.05E-01 | 1.41E-01 | 14% | |
| | | | Benzene | 24, 8760 | 1.13E-04 | 3.93E-05 | 12% | |
| | | | 1,3-Butadiene | 24, 8760 | 9.90E-06 | 3.44E-06 | 12% | |
| | | | Acrolein | 1, 24 | 1.45E-05 | 5.03E-06 | 10% | |
| | | | Acetaldehyde | 30 min, 24 | 1.03E-04 | 3.57E-05 | 10% | |
| | | | Formaldehyde | 24 | 1.88E-04 | 6.53E-05 | 9% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.51E-07 | 5.25E-08 | 14% | |
| R23b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.54E-04 | 8.80E-05 | 12% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.39E-02 | 1.52E-02 | 12% | |
| | | | PM | 24, 8760 | 2.37E-02 | 1.77E-02 | 4% | |
| | | | PM10 | 24 | 1.19E-02 | 5.96E-03 | 6% | |
| | | | PM2.5 | 24, 8760 | 3.35E-03 | 1.62E-03 | 7% | |
| | | | Crystalline silica | 24 | 1.45E-04 | 1.45E-04 | 2% | |
| | | | CO | 1, 8 | 3.86E-01 | 1.34E-01 | 13% | |
| | | | Benzene | 24, 8760 | 1.08E-04 | 3.74E-05 | 12% | |
| | | | 1,3-Butadiene | 24, 8760 | 9.44E-06 | 3.28E-06 | 12% | |
| | | | Acrolein | 1, 24 | 1.38E-05 | 4.79E-06 | 9% | |
| | | | Acetaldehyde | 30 min, 24 | 9.80E-05 | 3.40E-05 | 10% | |
| | | | Formaldehyde | 24 | 1.79E-04 | 6.23E-05 | 9% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.44E-07 | 5.01E-08 | 13% | |
| R24_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.70E-04 | 5.90E-05 | 8% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.17E-02 | 1.10E-02 | 9% | |
| | | | PM | 24, 8760 | 1.84E-02 | 1.49E-02 | 3% | |
| | | | PM10 | 24 | 7.84E-03 | 4.35E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 2.42E-03 | 1.25E-03 | 5% | |
| | | | Crystalline silica | 24 | 1.30E-04 | 1.30E-04 | 2% | |
| | | | CO | 1, 8 | 2.49E-01 | 8.66E-02 | 8% | |
| | | | Benzene | 24, 8760 | 7.02E-05 | 2.44E-05 | 8% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.81E-06 | 2.02E-06 | 7% | |
| | | | Acrolein | 1, 24 | 8.20E-06 | 2.85E-06 | 6% | |
| | | | Acetaldehyde | 30 min, 24 | 5.94E-05 | 2.06E-05 | 6% | |
| | | | Formaldehyde | 24 | 1.07E-04 | 3.72E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 9.46E-08 | 3.28E-08 | 8% | |
| R25a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.55E-04 | 8.84E-05 | 12% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.30E-02 | 1.49E-02 | 12% | |
| | | | PM | 24, 8760 | 2.28E-02 | 1.64E-02 | 4% | |
| | | | PM10 | 24 | 1.23E-02 | 5.87E-03 | 6% | |
| | | | PM2.5 | 24, 8760 | 3.28E-03 | 1.54E-03 | 7% | |
| | | | Crystalline silica | 24 | 1.29E-04 | 1.29E-04 | 2% | |
| | | | CO | 1, 8 | 3.69E-01 | 1.28E-01 | 12% | |
| | | | Benzene | 24, 8760 | 1.06E-04 | 3.67E-05 | 11% | |
| | | | 1,3-Butadiene | 24, 8760 | 9.82E-06 | 3.41E-06 | 12% | |
| | | | Acrolein | 1, 24 | 1.50E-05 | 5.20E-06 | 10% | |
| | | | Acetaldehyde | 30 min, 24 | 1.04E-04 | 3.62E-05 | 10% | |
| | | | Formaldehyde | 24 | 1.93E-04 | 6.70E-05 | 10% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.38E-07 | 4.80E-08 | 12% | |
| R25b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.98E-04 | 6.89E-05 | 9% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.35E-02 | 1.16E-02 | 9% | |
| | | | PM | 24, 8760 | 1.78E-02 | 1.28E-02 | 3% | |
| | | | PM10 | 24 | 9.56E-03 | 4.58E-03 | 5% | |
| | | | PM2.5 | 24, 8760 | 2.55E-03 | 1.20E-03 | 5% | |
| | | | Crystalline silica | 24 | 1.01E-04 | 1.01E-04 | 2% | |
| | | | CO | 1, 8 | 2.88E-01 | 9.99E-02 | 10% | |
| | | | Benzene | 24, 8760 | 8.25E-05 | 2.86E-05 | 9% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.66E-06 | 2.66E-06 | 10% | |
| | | | Acrolein | 1, 24 | 1.17E-05 | 4.06E-06 | 8% | |
| | | | Acetaldehyde | 30 min, 24 | 8.13E-05 | 2.82E-05 | 8% | |
| | | | Formaldehyde | 24 | 1.50E-04 | 5.22E-05 | 7% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.08E-07 | 3.74E-08 | 10% | |
| R26a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.13E-04 | 3.94E-05 | 5% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.84E-02 | 6.40E-03 | 5% | |
| | | | PM | 24, 8760 | 1.36E-02 | 1.07E-02 | 2% | |
| | | | PM10 | 24 | 6.21E-03 | 3.29E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.57E-03 | 8.28E-04 | 3% | |
| | | | Crystalline silica | 24 | 9.08E-05 | 9.08E-05 | 1% | |
| | | | CO | 1, 8 | 1.53E-01 | 5.32E-02 | 5% | |
| | | | Benzene | 24, 8760 | 4.57E-05 | 1.59E-05 | 5% | |
| | | | 1,3-Butadiene | 24, 8760 | 4.57E-06 | 1.59E-06 | 6% | |
| | | | Acrolein | 1, 24 | 7.29E-06 | 2.53E-06 | 5% | |
| | | | Acetaldehyde | 30 min, 24 | 4.96E-05 | 1.72E-05 | 5% | |
| | | | Formaldehyde | 24 | 9.31E-05 | 3.23E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 5.72E-08 | 1.99E-08 | 5% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R26b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.40E-04 | 4.86E-05 | 7% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.28E-02 | 7.90E-03 | 6% | |
| | | | PM | 24, 8760 | 1.68E-02 | 1.32E-02 | 3% | |
| | | | PM10 | 24 | 7.67E-03 | 4.07E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 1.93E-03 | 1.02E-03 | 4% | |
| | | | Crystalline silica | 24 | 1.12E-04 | 1.12E-04 | 2% | |
| | | | CO | 1, 8 | 1.89E-01 | 6.57E-02 | 6% | |
| | | | Benzene | 24, 8760 | 5.64E-05 | 1.96E-05 | 6% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.64E-06 | 1.96E-06 | 7% | |
| | | | Acrolein | 1, 24 | 9.00E-06 | 3.13E-06 | 6% | |
| | | | Acetaldehyde | 30 min, 24 | 6.12E-05 | 2.13E-05 | 6% | |
| | | | Formaldehyde | 24 | 1.15E-04 | 3.99E-05 | 6% | |
| | | | Benzo(a)pyrene | 24, 8760 | 7.07E-08 | 2.45E-08 | 6% | |
| R27_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.47E-04 | 5.12E-05 | 7% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.75E-02 | 9.54E-03 | 7% | |
| | | | PM | 24, 8760 | 2.59E-02 | 2.29E-02 | 4% | |
| | | | PM10 | 24 | 8.70E-03 | 5.67E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 2.57E-03 | 1.56E-03 | 5% | |
| | | | Crystalline silica | 24 | 2.12E-04 | 2.12E-04 | 3% | |
| | | | CO | 1, 8 | 2.16E-01 | 7.51E-02 | 7% | |
| | | | Benzene | 24, 8760 | 6.08E-05 | 2.11E-05 | 7% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.04E-06 | 1.75E-06 | 6% | |
| | | | Acrolein | 1, 24 | 7.11E-06 | 2.47E-06 | 5% | |
| | | | Acetaldehyde | 30 min, 24 | 5.15E-05 | 1.79E-05 | 5% | |
| | | | Formaldehyde | 24 | 9.30E-05 | 3.23E-05 | 5% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.20E-08 | 2.85E-08 | 7% | |
| R28a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.09E-05 | 2.46E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.23E-02 | 4.28E-03 | 3% | |
| | | | PM | 24, 8760 | 1.06E-02 | 8.93E-03 | 2% | |
| | | | PM10 | 24 | 4.09E-03 | 2.42E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 1.13E-03 | 6.42E-04 | 2% | |
| | | | Crystalline silica | 24 | 8.01E-05 | 8.01E-05 | 1% | |
| | | | CO | 1, 8 | 1.08E-01 | 3.76E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.04E-05 | 1.05E-05 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.60E-06 | 9.03E-07 | 3% | |
| | | | Acrolein | 1, 24 | 3.74E-06 | 1.30E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 2.67E-05 | 9.28E-06 | 3% | |
| | | | Formaldehyde | 24 | 4.87E-05 | 1.69E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.02E-08 | 1.40E-08 | 4% | |
| R28b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.65E-05 | 2.65E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.33E-02 | 4.62E-03 | 4% | |
| | | | PM | 24, 8760 | 1.14E-02 | 9.64E-03 | 2% | |
| | | | PM10 | 24 | 4.41E-03 | 2.61E-03 | 2% | |
| | | | PM2.5 | 24, 8760 | 1.22E-03 | 6.93E-04 | 3% | |
| | | | Crystalline silica | 24 | 8.65E-05 | 8.65E-05 | 1% | |
| | | | CO | 1, 8 | 1.17E-01 | 4.06E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.27E-05 | 1.14E-05 | 4% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.81E-06 | 9.74E-07 | 3% | |
| | | | Acrolein | 1, 24 | 4.03E-06 | 1.40E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 2.88E-05 | 1.00E-05 | 3% | |
| | | | Formaldehyde | 24 | 5.25E-05 | 1.82E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.34E-08 | 1.51E-08 | 4% | |
| R29a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 3.05E-05 | 1.06E-05 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.85E-03 | 1.68E-03 | 1% | |
| | | | PM | 24, 8760 | 6.93E-03 | 6.14E-03 | 1% | |
| | | | PM10 | 24 | 2.31E-03 | 1.51E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 5.72E-04 | 3.77E-04 | 1% | |
| | | | Crystalline silica | 24 | 5.69E-05 | 5.69E-05 | 1% | |
| | | | CO | 1, 8 | 3.75E-02 | 1.30E-02 | 1% | |
| | | | Benzene | 24, 8760 | 1.17E-05 | 4.08E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.27E-06 | 4.40E-07 | 2% | |
| | | | Acrolein | 1, 24 | 2.11E-06 | 7.33E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 1.41E-05 | 4.89E-06 | 1% | |
| | | | Formaldehyde | 24 | 2.67E-05 | 9.28E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.48E-08 | 5.14E-09 | 1% | |
| R29b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.23E-05 | 4.27E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.96E-03 | 6.79E-04 | 1% | |
| | | | PM | 24, 8760 | 2.80E-03 | 2.48E-03 | 0% | |
| | | | PM10 | 24 | 9.32E-04 | 6.11E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 2.31E-04 | 1.52E-04 | 0% | |
| | | | Crystalline silica | 24 | 2.30E-05 | 2.30E-05 | 0% | |
| | | | CO | 1, 8 | 1.51E-02 | 5.26E-03 | 1% | |
| | | | Benzene | 24, 8760 | 4.74E-06 | 1.65E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.11E-07 | 1.78E-07 | 1% | |
| | | | Acrolein | 1, 24 | 8.52E-07 | 2.96E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 5.68E-06 | 1.97E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.08E-05 | 3.75E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 5.98E-09 | 2.08E-09 | 1% | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Simcoe Street - Bridge Replacement***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R30_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.52E-05 | 8.76E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.03E-03 | 1.40E-03 | 1% | |
| | | | PM | 24, 8760 | 2.67E-03 | 2.02E-03 | 0% | |
| | | | PM10 | 24 | 1.32E-03 | 6.66E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 3.27E-04 | 1.66E-04 | 1% | |
| | | | Crystalline silica | 24 | 1.67E-05 | 1.67E-05 | 0% | |
| | | | CO | 1, 8 | 3.17E-02 | 1.10E-02 | 1% | |
| | | | Benzene | 24, 8760 | 9.81E-06 | 3.41E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 1.04E-06 | 3.61E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.72E-06 | 5.97E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 1.15E-05 | 4.00E-06 | 1% | |
| | | | Formaldehyde | 24 | 2.18E-05 | 7.57E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.24E-08 | 4.29E-09 | 1% | |
| R31_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.47E-05 | 5.12E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.75E-03 | 9.54E-04 | 1% | |
| | | | PM | 24, 8760 | 2.59E-03 | 2.29E-03 | 0% | |
| | | | PM10 | 24 | 8.70E-04 | 5.67E-04 | 0% | |
| | | | PM2.5 | 24, 8760 | 2.57E-04 | 1.56E-04 | 1% | |
| | | | Crystalline silica | 24 | 2.12E-05 | 2.12E-05 | 0% | |
| | | | CO | 1, 8 | 2.16E-02 | 7.51E-03 | 1% | |
| | | | Benzene | 24, 8760 | 6.08E-06 | 2.11E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.04E-07 | 1.75E-07 | 1% | |
| | | | Acrolein | 1, 24 | 7.11E-07 | 2.47E-07 | 0% | |
| | | | Acetaldehyde | 30 min, 24 | 5.15E-06 | 1.79E-06 | 1% | |
| | | | Formaldehyde | 24 | 9.30E-06 | 3.23E-06 | 0% | |
| | | | Benzo(a)pyrene | 24, 8760 | 8.20E-09 | 2.85E-09 | 1% | |
| R32_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 9.15E-05 | 3.18E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.71E-02 | 5.92E-03 | 5% | |
| | | | PM | 24, 8760 | 1.61E-02 | 1.42E-02 | 3% | |
| | | | PM10 | 24 | 5.40E-03 | 3.52E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.60E-03 | 9.66E-04 | 3% | |
| | | | Crystalline silica | 24 | 1.31E-04 | 1.31E-04 | 2% | |
| | | | CO | 1, 8 | 1.34E-01 | 4.66E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.78E-05 | 1.31E-05 | 4% | |
| | | | 1,3-Butadiene | 24, 8760 | 3.13E-06 | 1.09E-06 | 4% | |
| | | | Acrolein | 1, 24 | 4.42E-06 | 1.53E-06 | 3% | |
| | | | Acetaldehyde | 30 min, 24 | 3.20E-05 | 1.11E-05 | 3% | |
| | | | Formaldehyde | 24 | 5.77E-05 | 2.00E-05 | 3% | |
| | | | Benzo(a)pyrene | 24, 8760 | 5.09E-08 | 1.77E-08 | 5% | |
| R33a_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.00E-05 | 6.96E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.28E-03 | 1.14E-03 | 1% | |
| | | | PM | 24, 8760 | 5.95E-03 | 5.44E-03 | 1% | |
| | | | PM10 | 24 | 1.76E-03 | 1.26E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 4.46E-04 | 3.16E-04 | 1% | |
| | | | Crystalline silica | 24 | 5.15E-05 | 5.15E-05 | 1% | |
| | | | CO | 1, 8 | 2.79E-02 | 9.68E-03 | 1% | |
| | | | Benzene | 24, 8760 | 8.19E-06 | 2.85E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 7.98E-07 | 2.77E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.25E-06 | 4.35E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 8.59E-06 | 2.98E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.61E-05 | 5.58E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.02E-08 | 3.55E-09 | 1% | |
| R33b_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 2.46E-05 | 8.54E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 4.02E-03 | 1.40E-03 | 1% | |
| | | | PM | 24, 8760 | 3.07E-03 | 2.45E-03 | 1% | |
| | | | PM10 | 24 | 1.35E-03 | 7.35E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 3.45E-04 | 1.86E-04 | 1% | |
| | | | Crystalline silica | 24 | 2.12E-05 | 2.12E-05 | 0% | |
| | | | CO | 1, 8 | 3.42E-02 | 1.19E-02 | 1% | |
| | | | Benzene | 24, 8760 | 1.01E-05 | 3.49E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 9.79E-07 | 3.40E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.54E-06 | 5.35E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 1.05E-05 | 3.66E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.97E-05 | 6.85E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 1.26E-08 | 4.36E-09 | 1% | |
| R34_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 6.06E-05 | 2.11E-05 | 3% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.03E-02 | 3.58E-03 | 3% | |
| | | | PM | 24, 8760 | 2.01E-02 | 1.86E-02 | 3% | |
| | | | PM10 | 24 | 5.70E-03 | 4.19E-03 | 3% | |
| | | | PM2.5 | 24, 8760 | 1.48E-03 | 1.07E-03 | 3% | |
| | | | Crystalline silica | 24 | 1.77E-04 | 1.77E-04 | 3% | |
| | | | CO | 1, 8 | 8.86E-02 | 3.08E-02 | 3% | |
| | | | Benzene | 24, 8760 | 2.53E-05 | 8.78E-06 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.32E-06 | 8.07E-07 | 3% | |
| | | | Acrolein | 1, 24 | 3.52E-06 | 1.22E-06 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 2.46E-05 | 8.53E-06 | 2% | |
| | | | Formaldehyde | 24 | 4.54E-05 | 1.58E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 3.33E-08 | 1.16E-08 | 3% | |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Simcoe Street - Bridge Replacement*
*Appendix E*
*Source Summary Table*

| Source ID | Source Description | Type of Source and Location | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling* | | | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1-hr Emission Rate (g/s) | 24-hr Emission Rate (g/s) | % of Overall Emissions | |
| R35_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 7.54E-05 | 2.62E-05 | 4% | |
| | | | $NO_x$ | 1, 24, 8760 | 1.41E-02 | 4.88E-03 | 4% | |
| | | | PM | 24, 8760 | 3.49E-02 | 3.34E-02 | 6% | |
| | | | PM10 | 24 | 8.58E-03 | 7.03E-03 | 4% | |
| | | | PM2.5 | 24, 8760 | 2.35E-03 | 1.83E-03 | 5% | |
| | | | Crystalline silica | 24 | 3.24E-04 | 3.24E-04 | 5% | |
| | | | CO | 1, 8 | 1.11E-01 | 3.84E-02 | 4% | |
| | | | Benzene | 24, 8760 | 3.11E-05 | 1.08E-05 | 3% | |
| | | | 1,3-Butadiene | 24, 8760 | 2.58E-06 | 8.96E-07 | 3% | |
| | | | Acrolein | 1, 24 | 3.64E-06 | 1.26E-06 | 2% | |
| | | | Acetaldehyde | 30 min, 24 | 2.64E-05 | 9.15E-06 | 3% | |
| | | | Formaldehyde | 24 | 4.76E-05 | 1.65E-05 | 2% | |
| | | | Benzo(a)pyrene | 24, 8760 | 4.20E-08 | 1.46E-08 | 4% | |
| R36_Q | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.64E-05 | 5.71E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 2.60E-03 | 9.03E-04 | 1% | |
| | | | PM | 24, 8760 | 3.55E-03 | 3.11E-03 | 1% | |
| | | | PM10 | 24 | 1.22E-03 | 7.81E-04 | 1% | |
| | | | PM2.5 | 24, 8760 | 2.99E-04 | 1.94E-04 | 1% | |
| | | | Crystalline silica | 24 | 2.87E-05 | 2.87E-05 | 0% | |
| | | | CO | 1, 8 | 1.98E-02 | 6.87E-03 | 1% | |
| | | | Benzene | 24, 8760 | 6.26E-06 | 2.18E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 6.88E-07 | 2.39E-07 | 1% | |
| | | | Acrolein | 1, 24 | 1.16E-06 | 4.02E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 7.69E-06 | 2.67E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.46E-05 | 5.08E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 7.92E-09 | 2.75E-09 | 1% | |
| R37_C | Construction - Tailpipe emissions and road dust from detoured vehicles | Volume - construction area | $SO_2$ | 10 min, 1, 8760 | 1.63E-05 | 5.66E-06 | 1% | |
| | | | $NO_x$ | 1, 24, 8760 | 3.04E-03 | 1.06E-03 | 1% | |
| | | | PM | 24, 8760 | 7.55E-03 | 7.21E-03 | 1% | |
| | | | PM10 | 24 | 1.86E-03 | 1.52E-03 | 1% | |
| | | | PM2.5 | 24, 8760 | 5.08E-04 | 3.95E-04 | 1% | |
| | | | Crystalline silica | 24 | 7.01E-05 | 7.01E-05 | 1% | |
| | | | CO | 1, 8 | 2.39E-02 | 8.31E-03 | 1% | |
| | | | Benzene | 24, 8760 | 6.73E-06 | 2.34E-06 | 1% | |
| | | | 1,3-Butadiene | 24, 8760 | 5.57E-07 | 1.94E-07 | 1% | |
| | | | Acrolein | 1, 24 | 7.86E-07 | 2.73E-07 | 1% | |
| | | | Acetaldehyde | 30 min, 24 | 5.70E-06 | 1.98E-06 | 1% | |
| | | | Formaldehyde | 24 | 1.03E-05 | 3.57E-06 | 1% | |
| | | | Benzo(a)pyrene | 24, 8760 | 9.07E-09 | 3.15E-09 | 1% | |

***Appendix E: Summary of Air Dispersion Modelling Inputs***
***Location: Simcoe Street - Bridge Replacement***

**Dispersion Modelling Parameters for Area Polygon Source**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | PAREA1 | | |
| No. of vertices | 4 | | |
| Area | 634 | m2 | assumed active construction area for worst-case scenario |
| Release Height | 1.0 | m | assumed release height of dust |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Initial Vertical Dimension | 1.63 | m | (Plume Height) / 2.15 |

**Dispersion Modelling Parameters for Volume Sources**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | VOL1 - VOL9 | | |
| Length of x side | 14.8 | m | truck travel on 4 lanes with each lane assumed to be 3.7 m wide |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Release Height | 3.0 | m | assumed height of exhaust for construction vehicles |
| Initial Lateral Dimension | 3.44 | m | (Length of side) / 4.3 |
| Initial Vertical Dimension | 0.81 | m | for elevated release height: (Plume Height) / 4.3 |
| Model Source ID | VOL10 - VOL11 | | |
| Length of x side | 7.4 | m | truck travel on 2 lanes with each lane assumed to be 3.7 m wide |
| Vehicle Height | 3.5 | m | assumed average construction vehicle height |
| Release Height | 3.0 | m | assumed height of exhaust for construction vehicles |
| Initial Lateral Dimension | 1.72 | m | (Length of side) / 4.3 |
| Initial Vertical Dimension | 0.81 | m | for elevated release height: (Plume Height) / 4.3 |

**Dispersion Modelling Parameters for Line Source**

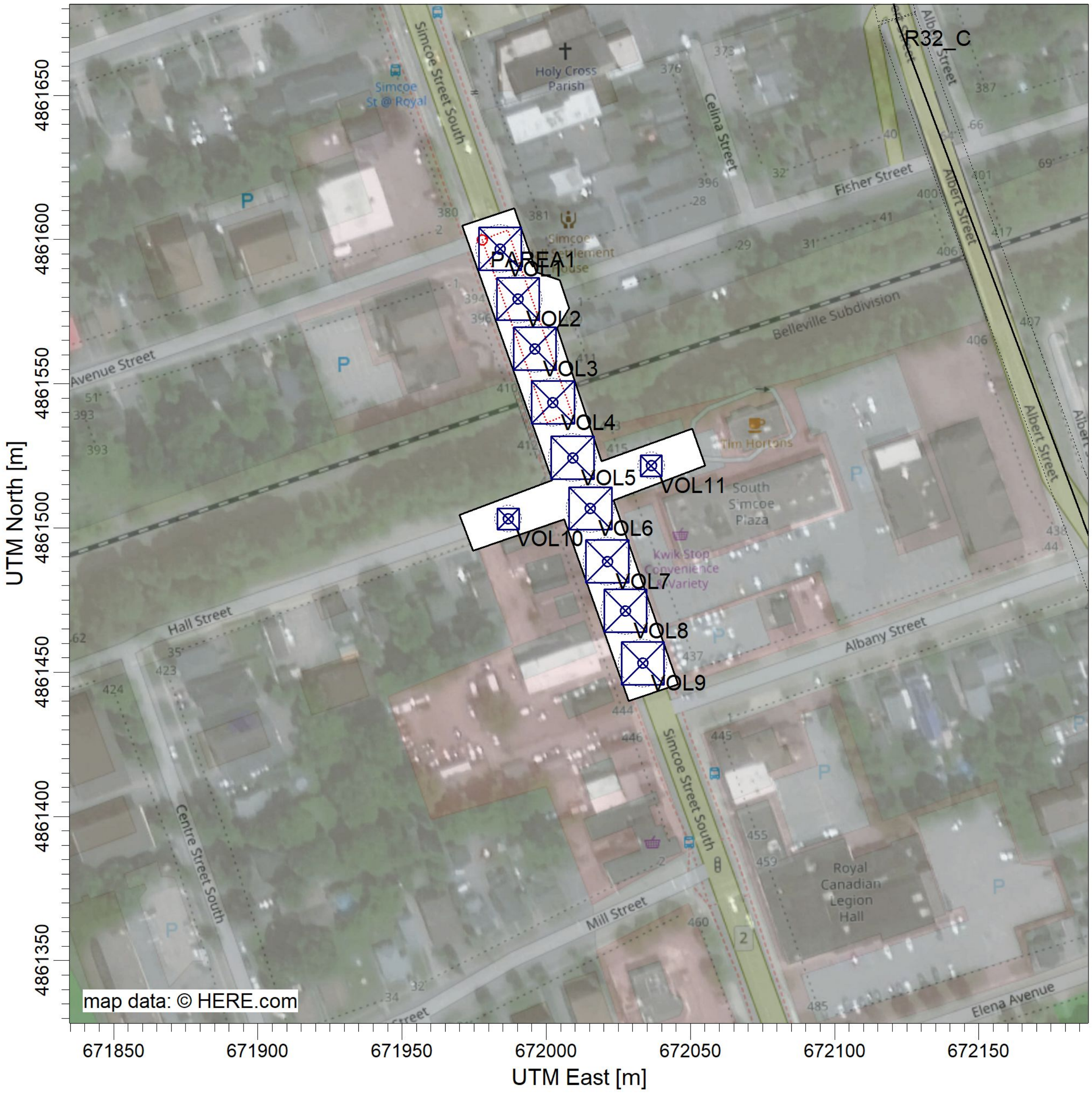
| Parameter | Values | Unit | Notes |
|---|---|---|---|
| **Construction Area** | | | |
| Model Source ID | R1 - R38 | | |
| Car Height | 1.5 | m | assumed height of a passenger car |
| Truck Height | 3 | m | assumed based on US EPA haul road memorandum 2012 |
| Release Height | 0.24 | m | assumed tailpipe release height |
| Width | variable | | assumed width of modelled roadway + 6 m |
| Initial Vertical Dimension | 0.36 | | (Plume Height) / 2.15 |

**Background Ozone concentrations used for Ozone Limiting Method in AERMOD model**

| | Background ozone concentrations (ppb) | | | |
|---|---|---|---|---|
| **Hour** | **Winter** | **Spring** | **Summer** | **Fall** |
| 1 | 34 | 38 | 33 | 26 |
| 2 | 34 | 37 | 32 | 26 |
| 3 | 34 | 36 | 30 | 26 |
| 4 | 33 | 34 | 26 | 26 |
| 5 | 32 | 34 | 24 | 25 |
| 6 | 30 | 31 | 21 | 24 |
| 7 | 29 | 31 | 21 | 22 |
| 8 | 29 | 33 | 25 | 22 |
| 9 | 31 | 36 | 30 | 22 |
| 10 | 33 | 40 | 38 | 24 |
| 11 | 34 | 44 | 45 | 27 |
| 12 | 36 | 47 | 49 | 29 |
| 13 | 37 | 50 | 53 | 30 |
| 14 | 39 | 53 | 56 | 31 |
| 15 | 39 | 55 | 55 | 32 |
| 16 | 39 | 55 | 56 | 32 |
| 17 | 39 | 54 | 55 | 31 |
| 18 | 37 | 53 | 55 | 28 |
| 19 | 35 | 51 | 51 | 27 |
| 20 | 34 | 49 | 46 | 27 |
| 21 | 33 | 44 | 40 | 27 |
| 22 | 34 | 42 | 37 | 26 |
| 23 | 33 | 40 | 35 | 27 |
| 24 | 34 | 39 | 33 | 26 |

PROJECT TITLE:

**Figure E-4: Dispersion Modelling Plan for Simcoe Street Bridge - Construction Sources**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - Project footprint | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:2,222<br>0 — 0.05 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

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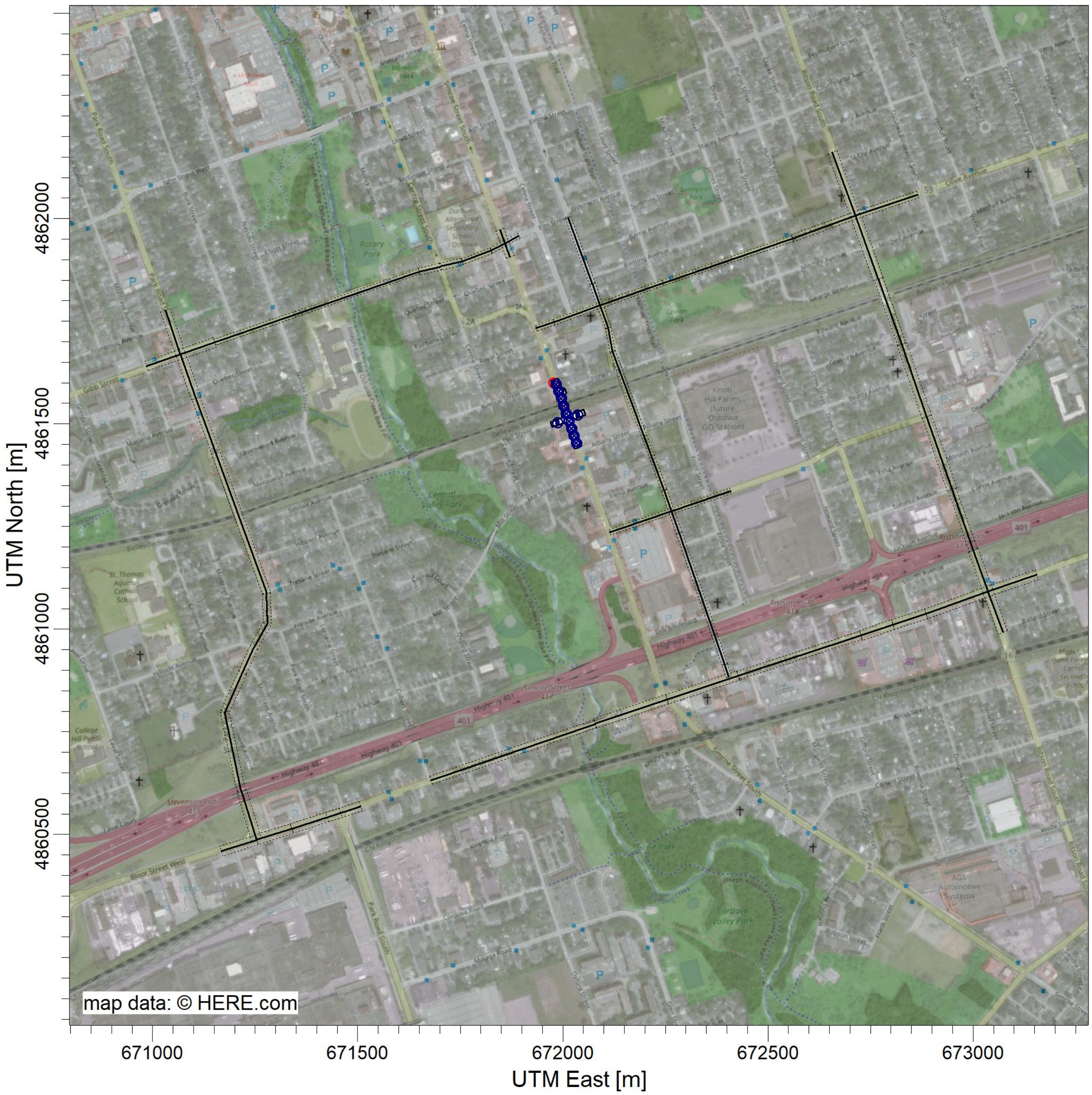
PROJECT TITLE:

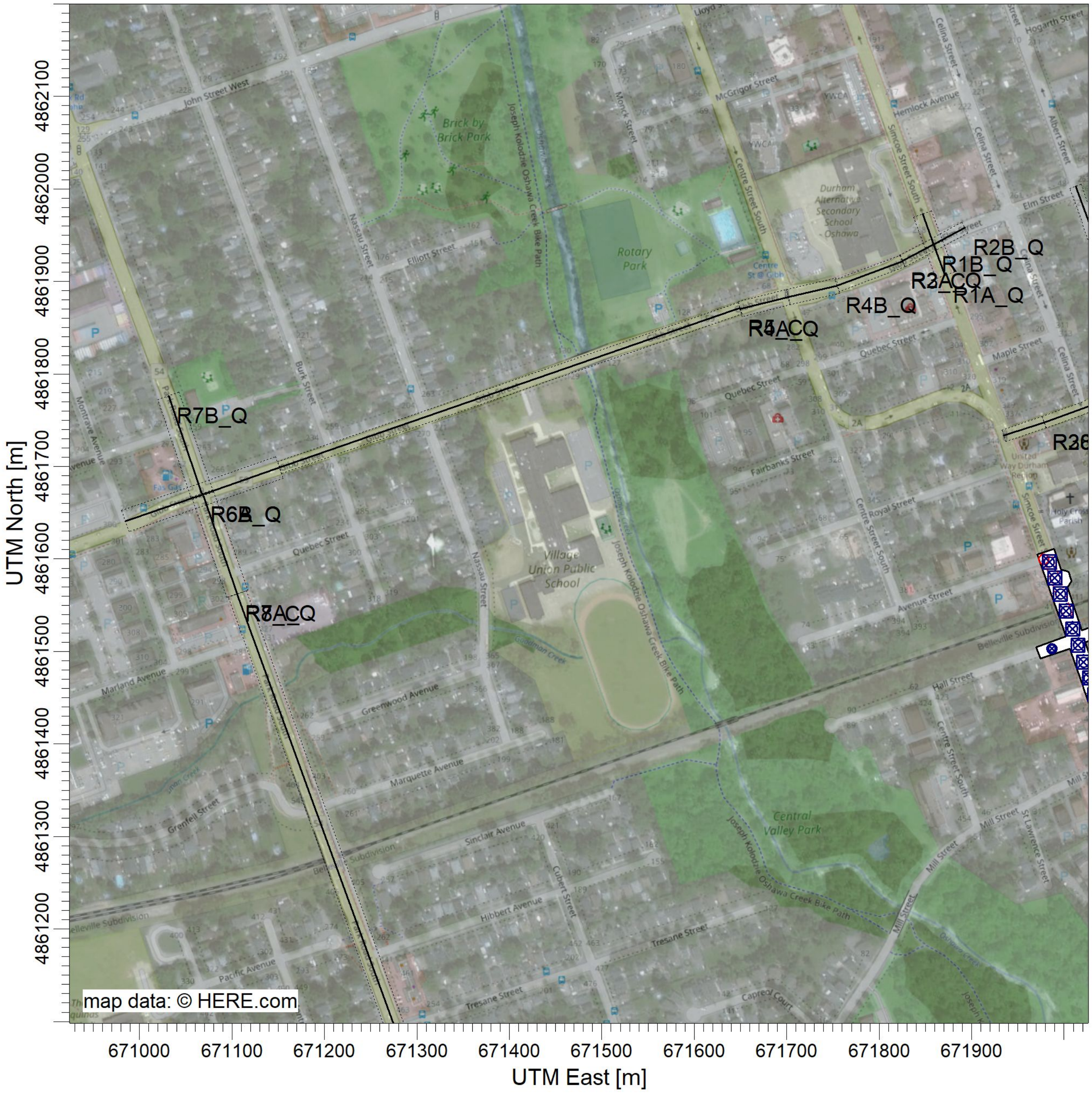
**Figure E-5: Dispersion Modelling Plan for Simcoe Street Bridge - Road Detour Sources**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - line sources | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:15,620<br>0 — 0.5 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

PROJECT TITLE:

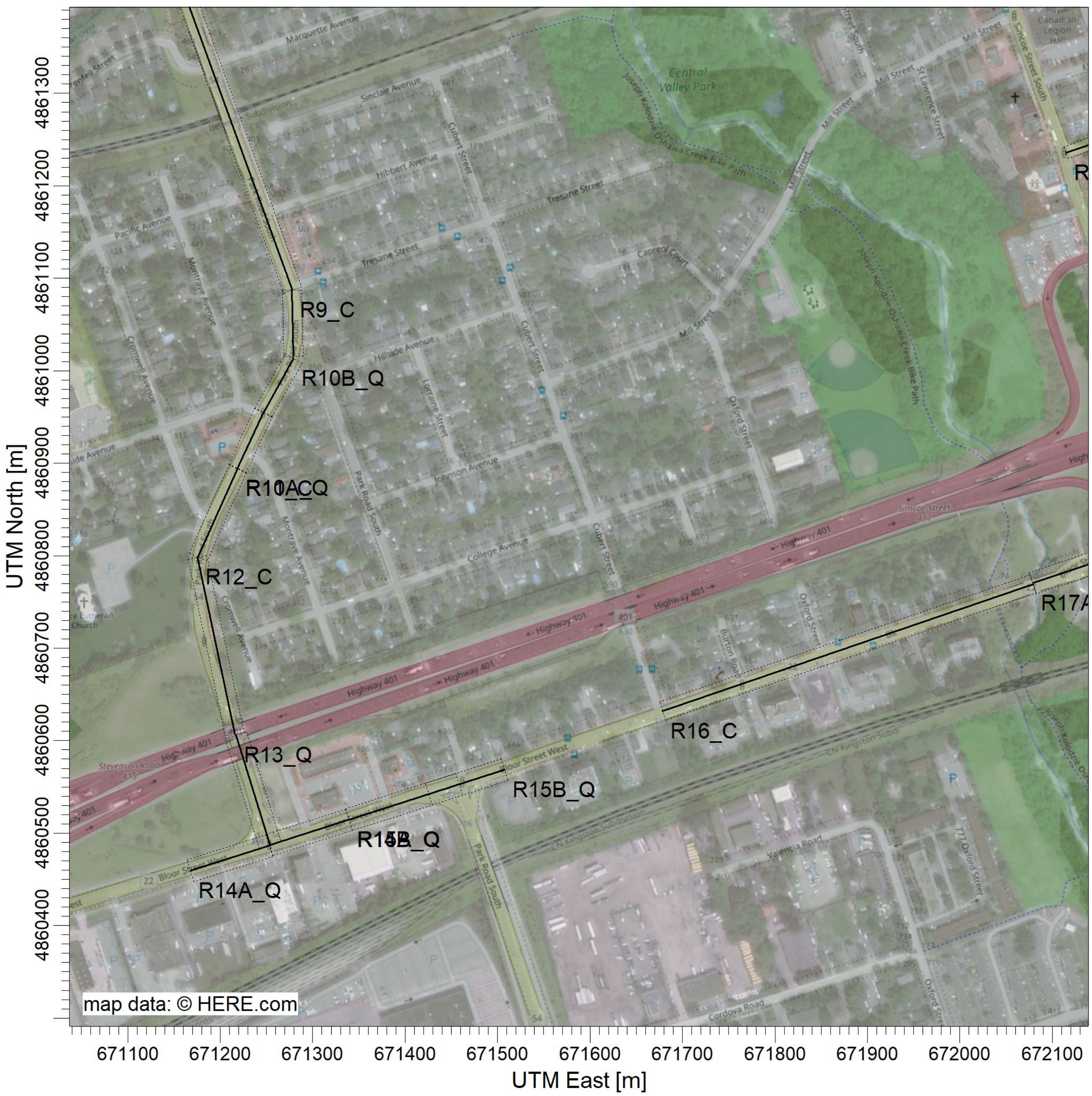
**Figure E-6: Dispersion Modelling Plan for Simcoe Street Bridge - Road Detour Sources**
**Simcoe Street / Gibb Street / Park Road**




| | | | |
|---|---|---|---|
| COMMENTS:<br>blue box - volume source<br>red line - area source<br>black line - line sources | SOURCES:<br>**67** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:6,931<br>0 — 0.2 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

PROJECT TITLE:

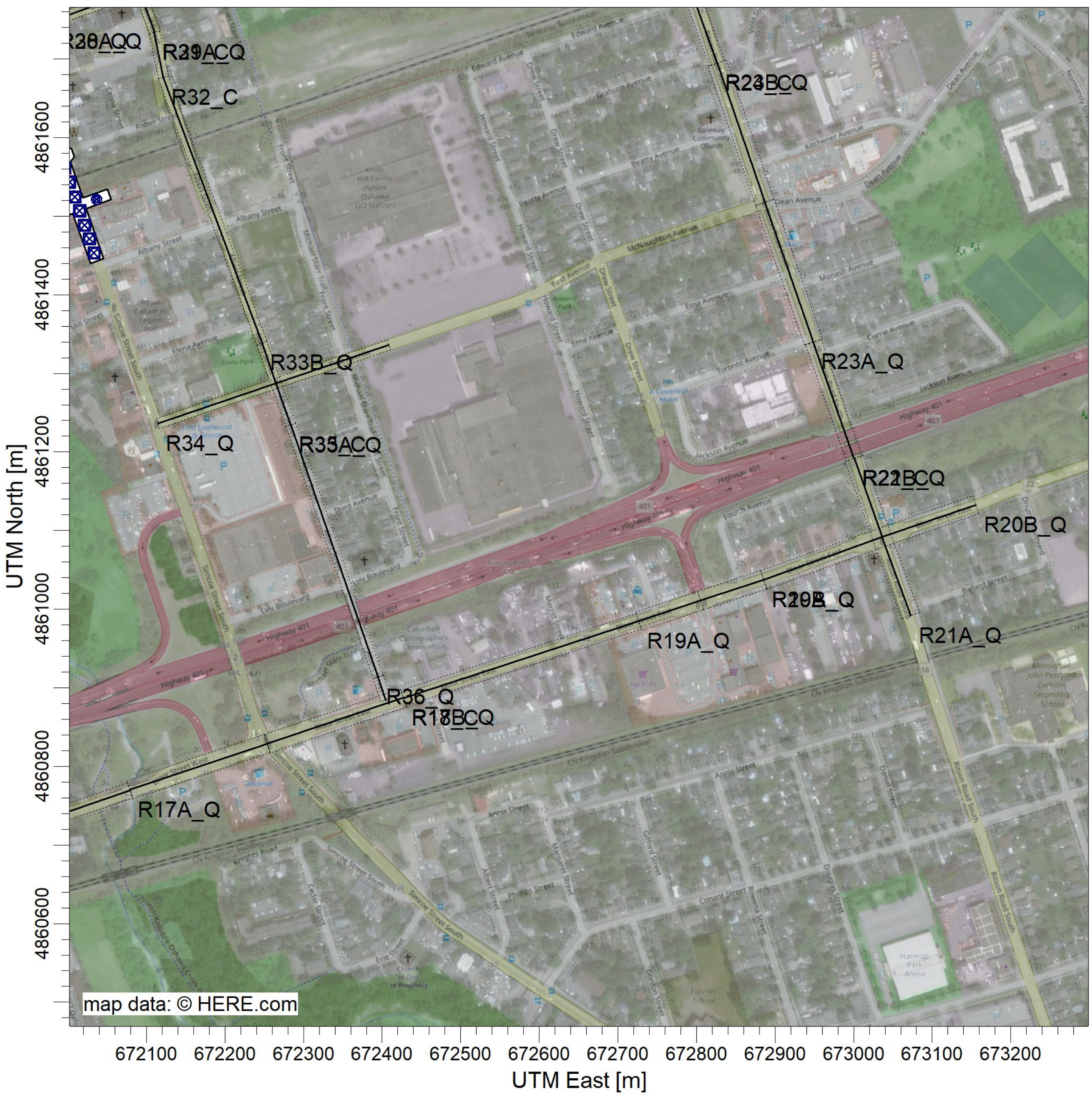
**Figure E-6: Dispersion Modelling Plan for Simcoe Street Bridge - Road Detour Sources Park Road / Bloor Street W**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - line sources | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:6,931<br>0 — 0.2 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure E-7: Dispersion Modelling Plan for Simcoe Street Bridge - Road Detour Sources**
**Bloor Street E / Ritson Road**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - line sources | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:8,154<br>0 — 0.3 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure E-8: Dispersion Modelling Plan for Simcoe Street Bridge - Road Detour Sources**
**Ritson Road / Olive Avenue**


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| blue box - volume source<br>red line - area source<br>black line - line sources | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | | SCALE: 1:8,154<br>0 — 0.3 km | |
| | | DATE:<br>**1/16/2022** | PROJECT NO.: |

*Appendix E1.2: Summary of Air Dispersion Modelling Inputs*
*Location: Project Operations Oshawa, Courtice and Bowmanville Segments*

**Dispersion Modelling Parameters for Area Sources**

| Model Source ID | Release Height | Area |
|---|---|---|
| | m | $m^2$ |
| B1_PPUDO | 0.15 | 3,964 |
| B2_LOT | 0.15 | 34,213 |
| B2_PPUDO1 | 0.15 | 2,768 |
| B2_PPUDO2 | 0.15 | 2,039 |
| B3_LOT | 0.15 | 21,417 |
| EX_LOT1 | 0.15 | 4,824 |
| B3_PPUDO | 0.15 | 4,676 |
| B4_LOT | 0.15 | 31,993 |
| B4_PPUDO | 0.15 | 1,917 |
| EX_LOT2 | 0.15 | 2,091 |

Note: Release height is assumed for a passenger car.

**Dispersion Modelling Parameters for Volume Sources**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| Model Source ID | GO_IDLEB1A, GO_IDLEB1B, GO_IDLEB2A, GO_IDLEB2B, GO_IDLEB3A, GO_IDLEB3B, GO_IDLEB4A and GO_IDLEB4B | | |
| Vertical dimension | 4.72 | m | locomotive height |
| Release Height | 2.36 | m | calculated height (= 0.5* vertical dimension) |
| Length of side | 8.20 | m | squareroot of the area of a single MP40 locomotive structure |
| Initial lateral dimension | 1.91 | m | calculated (= length of side / 4.3) |
| Initial vertical dimension | 1.10 | m | calculated (= vertical dimension / 4.3) |
| Model Source ID | EX_BUS_IDL1, EX_BUS_IDLE2, FB_BUS_IDLE | | |
| Vertical dimension | 3.5 | m | assumed bus height |
| Release Height | 1.75 | m | calculated height (= 0.5* vertical dimension) |
| Length of side | 15 | m | assumed bus idling area |
| Initial lateral dimension | 3.49 | m | calculated (= length of side / 4.3) |
| Initial vertical dimension | 0.81 | m | calculated (= vertical dimension / 4.3) |

**Dispersion Modelling Parameters for Line Volume Sources**

| Parameter | Values | Unit | Notes |
|---|---|---|---|
| Model Source ID | CP0, CP1A, CP2B, GO2B, GO3A, GO4B | | |
| Configuration | Separated | | |
| Vehicle Height | 4.72 | m | assumed locomotive height |
| Plume height | 8.02 | m | calculated height of plume (= 1.7 * vehicle height) |
| Release Height | 4.01 | m | calculated height of exhaust (= 0.5* Plume height) |
| # of Rails | Two lanes | | Google Earth Imagery and Study Area map |
| Rail Width | 7.50 | m | measured in Google Earth imagery |
| Plume width | 13.50 | m | calculated width of plume (= road width + 6m) |
| Model Source ID | GM1, GM2, CP1B, GO1, GO2A, CP2A, CP2C, GO3B, CP3, GO4A, CP4 | | |
| Configuration | Separated | | |
| Vehicle Height | 4.72 | m | assumed locomotive height |
| Plume height | 8.02 | m | calculated height of plume (= 1.7 * vehicle height) |
| Release Height | 4.01 | m | calculated height of exhaust (= 0.5* Plume height) |
| # of Rails | Single lane | | Google Earth Imagery and Study Area map |
| Rail Width | 3.24 | m | width of MP40 locomotive |
| Plume width | 9.24 | m | calculated width of plume (= road width + 6m) |
| Model Source ID | EX_BUS1, EX_BUS2, FB_BUS_B4 | | |
| Configuration | Separated | | |
| Vehicle Height | 3.5 | m | assumed bus height |
| Plume height | 5.95 | m | calculated height of plume (= 1.7 * vehicle height) |
| Release Height | 2.98 | m | calculated height of exhaust (= 0.5* Plume height) |
| Lane Type | Single lane | | assumed |
| Road Width | 3.50 | m | assumed width of travelled way |
| Plume width | 9.50 | m | calculated width of plume (= road width + 6m) |

**Background Ozone concentrations used for Ozone Limiting Method in AERMOD model**

| Hour | Background ozone concentrations (ppb) | | | |
|---|---|---|---|---|
| | Winter | Spring | Summer | Fall |
| 1 | 34 | 38 | 33 | 26 |
| 2 | 34 | 37 | 32 | 26 |
| 3 | 34 | 36 | 30 | 26 |
| 4 | 33 | 34 | 26 | 26 |
| 5 | 32 | 34 | 24 | 25 |
| 6 | 30 | 31 | 21 | 24 |
| 7 | 29 | 31 | 21 | 22 |
| 8 | 29 | 33 | 25 | 22 |
| 9 | 31 | 36 | 30 | 22 |
| 10 | 33 | 40 | 38 | 24 |
| 11 | 34 | 44 | 45 | 27 |
| 12 | 36 | 47 | 49 | 29 |
| 13 | 37 | 50 | 53 | 30 |
| 14 | 39 | 53 | 56 | 31 |
| 15 | 39 | 55 | 55 | 32 |
| 16 | 39 | 55 | 56 | 32 |
| 17 | 39 | 54 | 55 | 31 |
| 18 | 37 | 53 | 55 | 28 |
| 19 | 35 | 51 | 51 | 27 |
| 20 | 34 | 49 | 46 | 27 |
| 21 | 33 | 44 | 40 | 27 |
| 22 | 34 | 42 | 37 | 26 |
| 23 | 33 | 40 | 35 | 27 |
| 24 | 34 | 39 | 33 | 26 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| **Baseline** | | | | | | | |
| CP0 | EX/FNB/FB - GM/CP trains west of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 5.24E-04 | 9.35E-05 | 4% |
| | | | $NO_x$ | 1, 24, 8760 | 3.20E-01 | 5.72E-02 | 4% |
| | | | PM | 24, 8760 | 4.35E-03 | 7.77E-04 | 4% |
| | | | PM10 | 24 | 4.18E-03 | 7.46E-04 | 4% |
| | | | PM2.5 | 24, 8760 | 3.92E-03 | 6.99E-04 | 4% |
| | | | CO | 1, 8 | 5.36E-03 | 9.57E-04 | 3% |
| | | | Benzene | 24, 8760 | 3.96E-04 | 7.06E-05 | 4% |
| | | | 1,3-Butadiene | 24, 8760 | 1.36E-05 | 2.43E-06 | 4% |
| | | | Acrolein | 1, 24 | 1.37E-04 | 2.44E-05 | 4% |
| | | | Acetaldehyde | 0.5, 24 | 7.60E-04 | 1.36E-04 | 4% |
| | | | Formaldehyde | 24 | 2.13E-03 | 3.81E-04 | 4% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.90E-08 | 5.18E-09 | 4% |
| CP1A | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 6.55E-04 | 1.17E-04 | 5% |
| | | | $NO_x$ | 1, 24, 8760 | 4.00E-01 | 7.15E-02 | 5% |
| | | | PM | 24, 8760 | 5.44E-03 | 9.71E-04 | 5% |
| | | | PM10 | 24 | 5.22E-03 | 9.33E-04 | 5% |
| | | | PM2.5 | 24, 8760 | 4.90E-03 | 8.74E-04 | 5% |
| | | | CO | 1, 8 | 6.70E-03 | 1.20E-03 | 4% |
| | | | Benzene | 24, 8760 | 4.94E-04 | 8.83E-05 | 5% |
| | | | 1,3-Butadiene | 24, 8760 | 1.70E-05 | 3.04E-06 | 5% |
| | | | Acrolein | 1, 24 | 1.71E-04 | 3.05E-05 | 5% |
| | | | Acetaldehyde | 0.5, 24 | 9.50E-04 | 1.70E-04 | 5% |
| | | | Formaldehyde | 24 | 2.67E-03 | 4.77E-04 | 5% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.63E-08 | 6.48E-09 | 5% |
| CP1B | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 3.00E-03 | 5.35E-04 | 24% |
| | | | $NO_x$ | 1, 24, 8760 | 1.83E+00 | 3.27E-01 | 24% |
| | | | PM | 24, 8760 | 2.49E-02 | 4.45E-03 | 24% |
| | | | PM10 | 24 | 2.39E-02 | 4.27E-03 | 24% |
| | | | PM2.5 | 24, 8760 | 2.24E-02 | 4.00E-03 | 24% |
| | | | CO | 1, 8 | 3.07E-02 | 5.48E-03 | 17% |
| | | | Benzene | 24, 8760 | 2.26E-03 | 4.04E-04 | 24% |
| | | | 1,3-Butadiene | 24, 8760 | 7.78E-05 | 1.39E-05 | 23% |
| | | | Acrolein | 1, 24 | 7.82E-04 | 1.40E-04 | 24% |
| | | | Acetaldehyde | 0.5, 24 | 4.35E-03 | 7.77E-04 | 24% |
| | | | Formaldehyde | 24 | 1.22E-02 | 2.18E-03 | 24% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.66E-07 | 2.97E-08 | 21% |
| GM1 | EX/FNB - GM Trains on Existing Railway Tracks | line volume | $SO_2$ | 10-min, 1, 8760 | 1.95E-04 | 2.44E-05 | 2% |
| | | | $NO_x$ | 1, 24, 8760 | 1.20E-01 | 1.49E-02 | 2% |
| | | | PM | 24, 8760 | 1.62E-03 | 2.03E-04 | 2% |
| | | | PM10 | 24 | 1.56E-03 | 1.95E-04 | 2% |
| | | | PM2.5 | 24, 8760 | 1.46E-03 | 1.83E-04 | 2% |
| | | | CO | 1, 8 | 2.00E-03 | 2.50E-04 | 1% |
| | | | Benzene | 24, 8760 | 1.48E-04 | 1.84E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 5.07E-06 | 6.34E-07 | 1% |
| | | | Acrolein | 1, 24 | 5.10E-05 | 6.38E-06 | 2% |
| | | | Acetaldehyde | 0.5, 24 | 2.84E-04 | 3.55E-05 | 2% |
| | | | Formaldehyde | 24 | 7.97E-04 | 9.96E-05 | 2% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.08E-08 | 1.35E-09 | 1% |
| CP2A | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.83E-03 | 3.26E-04 | 15% |
| | | | $NO_x$ | 1, 24, 8760 | 1.12E+00 | 1.99E-01 | 15% |
| | | | PM | 24, 8760 | 1.52E-02 | 2.71E-03 | 14% |
| | | | PM10 | 24 | 1.46E-02 | 2.60E-03 | 15% |
| | | | PM2.5 | 24, 8760 | 1.37E-02 | 2.44E-03 | 15% |
| | | | CO | 1, 8 | 1.87E-02 | 3.34E-03 | 11% |
| | | | Benzene | 24, 8760 | 1.38E-03 | 2.46E-04 | 15% |
| | | | 1,3-Butadiene | 24, 8760 | 4.74E-05 | 8.46E-06 | 14% |
| | | | Acrolein | 1, 24 | 4.77E-04 | 8.51E-05 | 15% |
| | | | Acetaldehyde | 0.5, 24 | 2.65E-03 | 4.73E-04 | 15% |
| | | | Formaldehyde | 24 | 7.44E-03 | 1.33E-03 | 15% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.01E-07 | 1.81E-08 | 13% |
| CP2B | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.73E-03 | 3.14E-04 | 14% |
| | | | $NO_x$ | 1, 24, 8760 | 1.06E+00 | 1.92E-01 | 14% |
| | | | PM | 24, 8760 | 1.44E-02 | 2.61E-03 | 14% |
| | | | PM10 | 24 | 1.38E-02 | 2.50E-03 | 14% |
| | | | PM2.5 | 24, 8760 | 1.29E-02 | 2.35E-03 | 14% |
| | | | CO | 1, 8 | 1.77E-02 | 3.21E-03 | 10% |
| | | | Benzene | 24, 8760 | 1.30E-03 | 2.37E-04 | 14% |
| | | | 1,3-Butadiene | 24, 8760 | 4.48E-05 | 8.15E-06 | 13% |
| | | | Acrolein | 1, 24 | 4.51E-04 | 8.19E-05 | 14% |
| | | | Acetaldehyde | 0.5, 24 | 2.51E-03 | 4.55E-04 | 14% |
| | | | Formaldehyde | 24 | 7.04E-03 | 1.28E-03 | 14% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.57E-08 | 1.74E-08 | 12% |
| CP2C | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.80E-03 | 3.23E-04 | 14% |
| | | | $NO_x$ | 1, 24, 8760 | 1.10E+00 | 1.98E-01 | 14% |
| | | | PM | 24, 8760 | 1.50E-02 | 2.68E-03 | 14% |
| | | | PM10 | 24 | 1.44E-02 | 2.58E-03 | 14% |
| | | | PM2.5 | 24, 8760 | 1.35E-02 | 2.42E-03 | 14% |
| | | | CO | 1, 8 | 1.84E-02 | 3.30E-03 | 10% |
| | | | Benzene | 24, 8760 | 1.36E-03 | 2.44E-04 | 14% |
| | | | 1,3-Butadiene | 24, 8760 | 4.68E-05 | 8.39E-06 | 14% |
| | | | Acrolein | 1, 24 | 4.70E-04 | 8.43E-05 | 14% |
| | | | Acetaldehyde | 0.5, 24 | 2.62E-03 | 4.69E-04 | 14% |
| | | | Formaldehyde | 24 | 7.34E-03 | 1.32E-03 | 14% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.99E-08 | 1.79E-08 | 13% |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Location: Project Operation - Oshawa, Courtice and Bowmanville Segment*
*Appendix E*
*Source Summary Table*

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| EX_LOT1 | EX/FNB - vehicles in existing parking lot | area | $SO_2$ | 10-min, 1, 8760 | 1.25E-05 | 3.52E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E-03 | 2.59E-04 | 0% |
| | | | PM | 24, 8760 | 6.88E-04 | 2.55E-03 | 1% |
| | | | PM10 | 24 | 3.57E-04 | 5.60E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.57E-04 | 1.43E-04 | 0% |
| | | | CO | 1, 8 | 2.73E-02 | 6.97E-03 | 16% |
| | | | Benzene | 24, 8760 | 6.65E-05 | 9.47E-06 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 8.28E-06 | 1.12E-06 | 2% |
| | | | Acrolein | 1, 24 | 1.81E-06 | 2.54E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.73E-05 | 3.83E-06 | 0% |
| | | | Formaldehyde | 24 | 1.83E-05 | 2.77E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 4.53E-08 | 6.52E-09 | 6% |
| EX_BUS1 | EX/FNB - existing station bus loop (travelling buses) | line volume | $SO_2$ | 10-min, 1, 8760 | 1.85E-06 | 4.63E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 1.44E-03 | 3.61E-04 | 0% |
| | | | PM | 24, 8760 | 3.32E-04 | 1.56E-03 | 0% |
| | | | PM10 | 24 | 1.24E-04 | 3.13E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 4.80E-05 | 8.25E-05 | 0% |
| | | | CO | 1, 8 | 6.48E-04 | 1.62E-04 | 0% |
| | | | Benzene | 24, 8760 | 7.04E-07 | 1.76E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 2.51E-07 | 6.27E-08 | 0% |
| | | | Acrolein | 1, 24 | 6.13E-07 | 1.53E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 3.46E-06 | 8.66E-07 | 0% |
| | | | Formaldehyde | 24 | 7.44E-06 | 1.86E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.55E-09 | 3.87E-10 | 0% |
| EX_BUS_IDL1 | EX/FNB - existing GO buses idling at loop | volume | $SO_2$ | 10-min, 1, 8760 | 1.91E-06 | 4.77E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 2.08E-03 | 5.20E-04 | 0% |
| | | | PM | 24, 8760 | 3.60E-05 | 9.01E-06 | 0% |
| | | | PM10 | 24 | 3.60E-05 | 9.01E-06 | 0% |
| | | | PM2.5 | 24, 8760 | 3.31E-05 | 8.29E-06 | 0% |
| | | | CO | 1, 8 | 8.05E-04 | 2.01E-04 | 0% |
| | | | Benzene | 24, 8760 | 1.27E-06 | 3.19E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 4.53E-07 | 1.13E-07 | 0% |
| | | | Acrolein | 1, 24 | 1.10E-06 | 2.76E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 6.22E-06 | 1.55E-06 | 0% |
| | | | Formaldehyde | 24 | 1.34E-05 | 3.36E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.96E-09 | 4.90E-10 | 0% |
| CP3 | EX/FNB/FB - GM/CP trains along main railway corridor in Bowmanville | line volume | $SO_2$ | 10-min, 1, 8760 | 2.19E-03 | 3.91E-04 | 18% |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E+00 | 2.39E-01 | 18% |
| | | | PM | 24, 8760 | 1.82E-02 | 3.25E-03 | 17% |
| | | | PM10 | 24 | 1.75E-02 | 3.12E-03 | 18% |
| | | | PM2.5 | 24, 8760 | 1.64E-02 | 2.93E-03 | 18% |
| | | | CO | 1, 8 | 2.24E-02 | 4.00E-03 | 13% |
| | | | Benzene | 24, 8760 | 1.65E-03 | 2.95E-04 | 17% |
| | | | 1,3-Butadiene | 24, 8760 | 5.69E-05 | 1.02E-05 | 17% |
| | | | Acrolein | 1, 24 | 5.72E-04 | 1.02E-04 | 18% |
| | | | Acetaldehyde | 0.5, 24 | 3.18E-03 | 5.68E-04 | 18% |
| | | | Formaldehyde | 24 | 8.93E-03 | 1.59E-03 | 18% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.21E-07 | 2.17E-08 | 16% |
| CP4 | EX/FNB/FB - GM/CP trains east of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 4.84E-04 | 8.64E-05 | 4% |
| | | | $NO_x$ | 1, 24, 8760 | 2.96E-01 | 5.29E-02 | 4% |
| | | | PM | 24, 8760 | 4.02E-03 | 7.18E-04 | 4% |
| | | | PM10 | 24 | 3.86E-03 | 6.89E-04 | 4% |
| | | | PM2.5 | 24, 8760 | 3.62E-03 | 6.46E-04 | 4% |
| | | | CO | 1, 8 | 4.95E-03 | 8.84E-04 | 3% |
| | | | Benzene | 24, 8760 | 3.65E-04 | 6.53E-05 | 4% |
| | | | 1,3-Butadiene | 24, 8760 | 1.26E-05 | 2.24E-06 | 4% |
| | | | Acrolein | 1, 24 | 1.26E-04 | 2.26E-05 | 4% |
| | | | Acetaldehyde | 0.5, 24 | 7.03E-04 | 1.25E-04 | 4% |
| | | | Formaldehyde | 24 | 1.97E-03 | 3.52E-04 | 4% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.68E-08 | 4.79E-09 | 3% |
| EX_BUS2 | EX/FNB - existing station bus loop (travelling buses) | line volume | $SO_2$ | 10-min, 1, 8760 | 1.09E-06 | 3.19E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.54E-04 | 2.49E-04 | 0% |
| | | | PM | 24, 8760 | 3.01E-04 | 1.55E-03 | 0% |
| | | | PM10 | 24 | 9.31E-05 | 3.07E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 3.34E-05 | 7.97E-05 | 0% |
| | | | CO | 1, 8 | 3.83E-04 | 1.12E-04 | 0% |
| | | | Benzene | 24, 8760 | 4.16E-07 | 1.21E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.48E-07 | 4.32E-08 | 0% |
| | | | Acrolein | 1, 24 | 3.62E-07 | 1.06E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.05E-06 | 5.97E-07 | 0% |
| | | | Formaldehyde | 24 | 4.40E-06 | 1.28E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.14E-10 | 2.66E-10 | 0% |
| EX_BUS_IDL2 | EX/FNB - existing GO buses idling at loop | volume | $SO_2$ | 10-min, 1, 8760 | 7.63E-06 | 2.23E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.32E-03 | 2.43E-03 | 0% |
| | | | PM | 24, 8760 | 1.44E-04 | 4.20E-05 | 0% |
| | | | PM10 | 24 | 1.44E-04 | 4.20E-05 | 0% |
| | | | PM2.5 | 24, 8760 | 1.33E-04 | 3.87E-05 | 0% |
| | | | CO | 1, 8 | 3.22E-03 | 9.39E-04 | 2% |
| | | | Benzene | 24, 8760 | 5.10E-06 | 1.49E-06 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.81E-06 | 5.28E-07 | 1% |
| | | | Acrolein | 1, 24 | 4.42E-06 | 1.29E-06 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.49E-05 | 7.25E-06 | 0% |
| | | | Formaldehyde | 24 | 5.38E-05 | 1.57E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 7.85E-09 | 2.29E-09 | 1% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| EX_LOT2 | EX/FNB - existing GO vehicle parking lot | area | $SO_2$ | 10-min, 1, 8760 | 7.00E-06 | 1.28E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 9.45E-04 | 1.37E-04 | 0% |
| | | | PM | 24, 8760 | 2.20E-04 | 5.32E-04 | 0% |
| | | | PM10 | 24 | 1.52E-04 | 1.25E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.02E-04 | 3.81E-05 | 0% |
| | | | CO | 1, 8 | 1.66E-02 | 2.80E-03 | 9% |
| | | | Benzene | 24, 8760 | 5.27E-05 | 6.82E-06 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 6.65E-06 | 8.50E-07 | 2% |
| | | | Acrolein | 1, 24 | 1.45E-06 | 1.86E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.17E-05 | 2.80E-06 | 0% |
| | | | Formaldehyde | 24 | 1.43E-05 | 1.88E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.58E-08 | 4.65E-09 | 5% |
| **Future No Build** | | | | | | | |
| CP0 | EX/FNB/FB - GM/CP trains west of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 5.24E-04 | 9.35E-05 | 4% |
| | | | $NO_x$ | 1, 24, 8760 | 3.20E-01 | 5.72E-02 | 4% |
| | | | PM | 24, 8760 | 4.35E-03 | 7.77E-04 | 4% |
| | | | PM10 | 24 | 4.18E-03 | 7.46E-04 | 4% |
| | | | PM2.5 | 24, 8760 | 3.92E-03 | 6.99E-04 | 4% |
| | | | CO | 1, 8 | 5.36E-03 | 9.57E-04 | 3% |
| | | | Benzene | 24, 8760 | 3.96E-04 | 7.06E-05 | 4% |
| | | | 1,3-Butadiene | 24, 8760 | 1.36E-05 | 2.43E-06 | 4% |
| | | | Acrolein | 1, 24 | 1.37E-04 | 2.44E-05 | 4% |
| | | | Acetaldehyde | 0.5, 24 | 7.60E-04 | 1.36E-04 | 4% |
| | | | Formaldehyde | 24 | 2.13E-03 | 3.81E-04 | 4% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.90E-08 | 5.18E-09 | 4% |
| CP1A | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 6.55E-04 | 1.17E-04 | 5% |
| | | | $NO_x$ | 1, 24, 8760 | 4.00E-01 | 7.15E-02 | 5% |
| | | | PM | 24, 8760 | 5.44E-03 | 9.71E-04 | 5% |
| | | | PM10 | 24 | 5.22E-03 | 9.33E-04 | 5% |
| | | | PM2.5 | 24, 8760 | 4.90E-03 | 8.74E-04 | 5% |
| | | | CO | 1, 8 | 6.70E-03 | 1.20E-03 | 4% |
| | | | Benzene | 24, 8760 | 4.94E-04 | 8.83E-05 | 5% |
| | | | 1,3-Butadiene | 24, 8760 | 1.70E-05 | 3.04E-06 | 5% |
| | | | Acrolein | 1, 24 | 1.71E-04 | 3.05E-05 | 5% |
| | | | Acetaldehyde | 0.5, 24 | 9.50E-04 | 1.70E-04 | 5% |
| | | | Formaldehyde | 24 | 2.67E-03 | 4.77E-04 | 5% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.63E-08 | 6.48E-09 | 5% |
| CP1B | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 3.00E-03 | 5.35E-04 | 24% |
| | | | $NO_x$ | 1, 24, 8760 | 1.83E+00 | 3.27E-01 | 24% |
| | | | PM | 24, 8760 | 2.49E-02 | 4.45E-03 | 24% |
| | | | PM10 | 24 | 2.39E-02 | 4.27E-03 | 24% |
| | | | PM2.5 | 24, 8760 | 2.24E-02 | 4.00E-03 | 24% |
| | | | CO | 1, 8 | 3.07E-02 | 5.48E-03 | 17% |
| | | | Benzene | 24, 8760 | 2.26E-03 | 4.04E-04 | 24% |
| | | | 1,3-Butadiene | 24, 8760 | 7.78E-05 | 1.39E-05 | 23% |
| | | | Acrolein | 1, 24 | 7.82E-04 | 1.40E-04 | 24% |
| | | | Acetaldehyde | 0.5, 24 | 4.35E-03 | 7.77E-04 | 24% |
| | | | Formaldehyde | 24 | 1.22E-02 | 2.18E-03 | 24% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.66E-07 | 2.97E-08 | 21% |
| GM1 | EX/FNB - GM Trains on Existing Railway Tracks | line volume | $SO_2$ | 10-min, 1, 8760 | 1.95E-04 | 2.44E-05 | 2% |
| | | | $NO_x$ | 1, 24, 8760 | 1.20E-01 | 1.49E-02 | 2% |
| | | | PM | 24, 8760 | 1.62E-03 | 2.03E-04 | 2% |
| | | | PM10 | 24 | 1.56E-03 | 1.95E-04 | 2% |
| | | | PM2.5 | 24, 8760 | 1.46E-03 | 1.83E-04 | 2% |
| | | | CO | 1, 8 | 2.00E-03 | 2.50E-04 | 1% |
| | | | Benzene | 24, 8760 | 1.48E-04 | 1.84E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 5.07E-06 | 6.34E-07 | 1% |
| | | | Acrolein | 1, 24 | 5.10E-05 | 6.38E-06 | 2% |
| | | | Acetaldehyde | 0.5, 24 | 2.84E-04 | 3.55E-05 | 2% |
| | | | Formaldehyde | 24 | 7.97E-04 | 9.96E-05 | 2% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.08E-08 | 1.35E-09 | 1% |
| CP2A | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.83E-03 | 3.26E-04 | 15% |
| | | | $NO_x$ | 1, 24, 8760 | 1.12E+00 | 1.99E-01 | 15% |
| | | | PM | 24, 8760 | 1.52E-02 | 2.71E-03 | 14% |
| | | | PM10 | 24 | 1.46E-02 | 2.60E-03 | 15% |
| | | | PM2.5 | 24, 8760 | 1.37E-02 | 2.44E-03 | 15% |
| | | | CO | 1, 8 | 1.87E-02 | 3.34E-03 | 11% |
| | | | Benzene | 24, 8760 | 1.38E-03 | 2.46E-04 | 15% |
| | | | 1,3-Butadiene | 24, 8760 | 4.74E-05 | 8.46E-06 | 14% |
| | | | Acrolein | 1, 24 | 4.77E-04 | 8.51E-05 | 15% |
| | | | Acetaldehyde | 0.5, 24 | 2.65E-03 | 4.73E-04 | 15% |
| | | | Formaldehyde | 24 | 7.44E-03 | 1.33E-03 | 15% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.01E-07 | 1.81E-08 | 13% |
| CP2B | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.73E-03 | 3.14E-04 | 14% |
| | | | $NO_x$ | 1, 24, 8760 | 1.06E+00 | 1.92E-01 | 14% |
| | | | PM | 24, 8760 | 1.44E-02 | 2.61E-03 | 14% |
| | | | PM10 | 24 | 1.38E-02 | 2.50E-03 | 14% |
| | | | PM2.5 | 24, 8760 | 1.29E-02 | 2.35E-03 | 14% |
| | | | CO | 1, 8 | 1.77E-02 | 3.21E-03 | 10% |
| | | | Benzene | 24, 8760 | 1.30E-03 | 2.37E-04 | 14% |
| | | | 1,3-Butadiene | 24, 8760 | 4.48E-05 | 8.15E-06 | 13% |
| | | | Acrolein | 1, 24 | 4.51E-04 | 8.19E-05 | 14% |
| | | | Acetaldehyde | 0.5, 24 | 2.51E-03 | 4.55E-04 | 14% |
| | | | Formaldehyde | 24 | 7.04E-03 | 1.28E-03 | 14% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.57E-08 | 1.74E-08 | 12% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| CP2C | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.80E-03 | 3.23E-04 | 14% |
| | | | $NO_x$ | 1, 24, 8760 | 1.10E+00 | 1.98E-01 | 14% |
| | | | PM | 24, 8760 | 1.50E-02 | 2.68E-03 | 14% |
| | | | PM10 | 24 | 1.44E-02 | 2.58E-03 | 14% |
| | | | PM2.5 | 24, 8760 | 1.35E-02 | 2.42E-03 | 14% |
| | | | CO | 1, 8 | 1.84E-02 | 3.30E-03 | 10% |
| | | | Benzene | 24, 8760 | 1.36E-03 | 2.44E-04 | 14% |
| | | | 1,3-Butadiene | 24, 8760 | 4.68E-05 | 8.39E-06 | 14% |
| | | | Acrolein | 1, 24 | 4.70E-04 | 8.43E-05 | 14% |
| | | | Acetaldehyde | 0.5, 24 | 2.62E-03 | 4.69E-04 | 14% |
| | | | Formaldehyde | 24 | 7.34E-03 | 1.32E-03 | 14% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.99E-08 | 1.79E-08 | 13% |
| EX_LOT1 | EX/FNB - vehicles in existing parking lot | area | $SO_2$ | 10-min, 1, 8760 | 1.25E-05 | 3.52E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E-03 | 2.59E-04 | 0% |
| | | | PM | 24, 8760 | 6.88E-04 | 2.55E-03 | 1% |
| | | | PM10 | 24 | 3.57E-04 | 5.60E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.57E-04 | 1.43E-04 | 0% |
| | | | CO | 1, 8 | 2.73E-02 | 6.97E-03 | 16% |
| | | | Benzene | 24, 8760 | 6.65E-05 | 9.47E-06 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 8.28E-06 | 1.12E-06 | 2% |
| | | | Acrolein | 1, 24 | 1.81E-06 | 2.54E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.73E-05 | 3.83E-06 | 0% |
| | | | Formaldehyde | 24 | 1.83E-05 | 2.77E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 4.53E-08 | 6.52E-09 | 6% |
| EX_BUS1 | EX/FNB - existing station bus loop (travelling buses) | line volume | $SO_2$ | 10-min, 1, 8760 | 1.85E-06 | 4.63E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 1.44E-03 | 3.61E-04 | 0% |
| | | | PM | 24, 8760 | 3.32E-04 | 1.56E-03 | 0% |
| | | | PM10 | 24 | 1.24E-04 | 3.13E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 4.80E-05 | 8.25E-05 | 0% |
| | | | CO | 1, 8 | 6.48E-04 | 1.62E-04 | 0% |
| | | | Benzene | 24, 8760 | 7.04E-07 | 1.76E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 2.51E-07 | 6.27E-08 | 0% |
| | | | Acrolein | 1, 24 | 6.13E-07 | 1.53E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 3.46E-06 | 8.66E-07 | 0% |
| | | | Formaldehyde | 24 | 7.44E-06 | 1.86E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.55E-09 | 3.87E-10 | 0% |
| EX_BUS_IDL1 | EX/FNB - existing GO buses idling at loop | volume | $SO_2$ | 10-min, 1, 8760 | 1.91E-06 | 4.77E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 2.08E-03 | 5.20E-04 | 0% |
| | | | PM | 24, 8760 | 3.60E-05 | 9.01E-06 | 0% |
| | | | PM10 | 24 | 3.60E-05 | 9.01E-06 | 0% |
| | | | PM2.5 | 24, 8760 | 3.31E-05 | 8.29E-06 | 0% |
| | | | CO | 1, 8 | 8.05E-04 | 2.01E-04 | 0% |
| | | | Benzene | 24, 8760 | 1.27E-06 | 3.19E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 4.53E-07 | 1.13E-07 | 0% |
| | | | Acrolein | 1, 24 | 1.10E-06 | 2.76E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 6.22E-06 | 1.55E-06 | 0% |
| | | | Formaldehyde | 24 | 1.34E-05 | 3.36E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.96E-09 | 4.90E-10 | 0% |
| CP3 | EX/FNB/FB - GM/CP trains along main railway corridor in Bowmanville | line volume | $SO_2$ | 10-min, 1, 8760 | 2.19E-03 | 3.91E-04 | 18% |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E+00 | 2.39E-01 | 18% |
| | | | PM | 24, 8760 | 1.82E-02 | 3.25E-03 | 17% |
| | | | PM10 | 24 | 1.75E-02 | 3.12E-03 | 18% |
| | | | PM2.5 | 24, 8760 | 1.64E-02 | 2.93E-03 | 18% |
| | | | CO | 1, 8 | 2.24E-02 | 4.00E-03 | 13% |
| | | | Benzene | 24, 8760 | 1.65E-03 | 2.95E-04 | 17% |
| | | | 1,3-Butadiene | 24, 8760 | 5.69E-05 | 1.02E-05 | 17% |
| | | | Acrolein | 1, 24 | 5.72E-04 | 1.02E-04 | 18% |
| | | | Acetaldehyde | 0.5, 24 | 3.18E-03 | 5.68E-04 | 18% |
| | | | Formaldehyde | 24 | 8.93E-03 | 1.59E-03 | 18% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.21E-07 | 2.17E-08 | 16% |
| CP4 | EX/FNB/FB - GM/CP trains east of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 4.84E-04 | 8.64E-05 | 4% |
| | | | $NO_x$ | 1, 24, 8760 | 2.96E-01 | 5.29E-02 | 4% |
| | | | PM | 24, 8760 | 4.02E-03 | 7.18E-04 | 4% |
| | | | PM10 | 24 | 3.86E-03 | 6.89E-04 | 4% |
| | | | PM2.5 | 24, 8760 | 3.62E-03 | 6.46E-04 | 4% |
| | | | CO | 1, 8 | 4.95E-03 | 8.84E-04 | 3% |
| | | | Benzene | 24, 8760 | 3.65E-04 | 6.53E-05 | 4% |
| | | | 1,3-Butadiene | 24, 8760 | 1.26E-05 | 2.24E-06 | 4% |
| | | | Acrolein | 1, 24 | 1.26E-04 | 2.26E-05 | 4% |
| | | | Acetaldehyde | 0.5, 24 | 7.03E-04 | 1.25E-04 | 4% |
| | | | Formaldehyde | 24 | 1.97E-03 | 3.52E-04 | 4% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.68E-08 | 4.79E-09 | 3% |
| EX_BUS2 | EX/FNB - existing station bus loop (travelling buses) | line volume | $SO_2$ | 10-min, 1, 8760 | 1.09E-06 | 3.19E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.54E-04 | 2.49E-04 | 0% |
| | | | PM | 24, 8760 | 3.01E-04 | 1.55E-03 | 0% |
| | | | PM10 | 24 | 9.31E-05 | 3.07E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 3.34E-05 | 7.97E-05 | 0% |
| | | | CO | 1, 8 | 3.83E-04 | 1.12E-04 | 0% |
| | | | Benzene | 24, 8760 | 4.16E-07 | 1.21E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.48E-07 | 4.32E-08 | 0% |
| | | | Acrolein | 1, 24 | 3.62E-07 | 1.06E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.05E-06 | 5.97E-07 | 0% |
| | | | Formaldehyde | 24 | 4.40E-06 | 1.28E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.14E-10 | 2.66E-10 | 0% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| EX_BUS_IDL2 | EX/FNB - existing GO buses idling at loop | volume | $SO_2$ | 10-min, 1, 8760 | 7.63E-06 | 2.23E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.32E-03 | 2.43E-03 | 0% |
| | | | PM | 24, 8760 | 1.44E-04 | 4.20E-05 | 0% |
| | | | PM10 | 24 | 1.44E-04 | 4.20E-05 | 0% |
| | | | PM2.5 | 24, 8760 | 1.33E-04 | 3.87E-05 | 0% |
| | | | CO | 1, 8 | 3.22E-03 | 9.39E-04 | 2% |
| | | | Benzene | 24, 8760 | 5.10E-06 | 1.49E-06 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.81E-06 | 5.28E-07 | 1% |
| | | | Acrolein | 1, 24 | 4.42E-06 | 1.29E-06 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.49E-05 | 7.25E-06 | 0% |
| | | | Formaldehyde | 24 | 5.38E-05 | 1.57E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 7.85E-09 | 2.29E-09 | 1% |
| EX_LOT2 | EX/FNB - existing GO vehicle parking lot | area | $SO_2$ | 10-min, 1, 8760 | 7.00E-06 | 1.28E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 9.45E-04 | 1.37E-04 | 0% |
| | | | PM | 24, 8760 | 2.20E-04 | 5.32E-04 | 0% |
| | | | PM10 | 24 | 1.52E-04 | 1.25E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.02E-04 | 3.81E-05 | 0% |
| | | | CO | 1, 8 | 1.66E-02 | 2.80E-03 | 9% |
| | | | Benzene | 24, 8760 | 5.27E-05 | 6.82E-06 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 6.65E-06 | 8.50E-07 | 2% |
| | | | Acrolein | 1, 24 | 1.45E-06 | 1.86E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.17E-05 | 2.80E-06 | 0% |
| | | | Formaldehyde | 24 | 1.43E-05 | 1.88E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.58E-08 | 4.65E-09 | 5% |
| **Future Build** | | | | | | | |
| CP0 | EX/FNB/FB - GM/CP trains west of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 5.24E-04 | 9.35E-05 | 2% |
| | | | $NO_x$ | 1, 24, 8760 | 3.20E-01 | 5.72E-02 | 2% |
| | | | PM | 24, 8760 | 4.35E-03 | 7.77E-04 | 2% |
| | | | PM10 | 24 | 4.18E-03 | 7.46E-04 | 2% |
| | | | PM2.5 | 24, 8760 | 3.92E-03 | 6.99E-04 | 2% |
| | | | CO | 1, 8 | 5.36E-03 | 9.57E-04 | 0% |
| | | | Benzene | 24, 8760 | 3.96E-04 | 7.06E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 1.36E-05 | 2.43E-06 | 2% |
| | | | Acrolein | 1, 24 | 1.37E-04 | 2.44E-05 | 2% |
| | | | Acetaldehyde | 0.5, 24 | 7.60E-04 | 1.36E-04 | 2% |
| | | | Formaldehyde | 24 | 2.13E-03 | 3.81E-04 | 2% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.90E-08 | 5.18E-09 | 1% |
| CP1A | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 6.55E-04 | 1.17E-04 | 2% |
| | | | $NO_x$ | 1, 24, 8760 | 4.00E-01 | 7.15E-02 | 2% |
| | | | PM | 24, 8760 | 5.44E-03 | 9.71E-04 | 2% |
| | | | PM10 | 24 | 5.22E-03 | 9.33E-04 | 2% |
| | | | PM2.5 | 24, 8760 | 4.90E-03 | 8.74E-04 | 2% |
| | | | CO | 1, 8 | 6.70E-03 | 1.20E-03 | 0% |
| | | | Benzene | 24, 8760 | 4.94E-04 | 8.83E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 1.70E-05 | 3.04E-06 | 2% |
| | | | Acrolein | 1, 24 | 1.71E-04 | 3.05E-05 | 2% |
| | | | Acetaldehyde | 0.5, 24 | 9.50E-04 | 1.70E-04 | 2% |
| | | | Formaldehyde | 24 | 2.67E-03 | 4.77E-04 | 2% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.63E-08 | 6.48E-09 | 1% |
| CP1B | EX/FNB/FB - GM/CP Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 3.00E-03 | 5.35E-04 | 11% |
| | | | $NO_x$ | 1, 24, 8760 | 1.83E+00 | 3.27E-01 | 11% |
| | | | PM | 24, 8760 | 2.49E-02 | 4.45E-03 | 9% |
| | | | PM10 | 24 | 2.39E-02 | 4.27E-03 | 9% |
| | | | PM2.5 | 24, 8760 | 2.24E-02 | 4.00E-03 | 9% |
| | | | CO | 1, 8 | 3.07E-02 | 5.48E-03 | 2% |
| | | | Benzene | 24, 8760 | 2.26E-03 | 4.04E-04 | 10% |
| | | | 1,3-Butadiene | 24, 8760 | 7.78E-05 | 1.39E-05 | 9% |
| | | | Acrolein | 1, 24 | 7.82E-04 | 1.40E-04 | 10% |
| | | | Acetaldehyde | 0.5, 24 | 4.35E-03 | 7.77E-04 | 10% |
| | | | Formaldehyde | 24 | 1.22E-02 | 2.18E-03 | 10% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.66E-07 | 2.97E-08 | 6% |
| GM2 | FB - GM Trains on Future Build Railway Tracks | line volume | $SO_2$ | 10-min, 1, 8760 | 1.95E-04 | 2.44E-05 | 1% |
| | | | $NO_x$ | 1, 24, 8760 | 1.20E-01 | 1.49E-02 | 1% |
| | | | PM | 24, 8760 | 1.62E-03 | 2.03E-04 | 1% |
| | | | PM10 | 24 | 1.56E-03 | 1.95E-04 | 1% |
| | | | PM2.5 | 24, 8760 | 1.46E-03 | 1.83E-04 | 1% |
| | | | CO | 1, 8 | 2.00E-03 | 2.50E-04 | 0% |
| | | | Benzene | 24, 8760 | 1.48E-04 | 1.85E-05 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.08E-06 | 6.35E-07 | 1% |
| | | | Acrolein | 1, 24 | 5.10E-05 | 6.38E-06 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 2.84E-04 | 3.55E-05 | 1% |
| | | | Formaldehyde | 24 | 7.97E-04 | 9.96E-05 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.08E-08 | 1.35E-09 | 0% |
| GO1 | FB - GO Trains from Oshawa GO Station to main railway in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 2.96E-03 | 2.22E-03 | 11% |
| | | | $NO_x$ | 1, 24, 8760 | 1.83E+00 | 1.37E+00 | 11% |
| | | | PM | 24, 8760 | 2.98E-02 | 2.23E-02 | 11% |
| | | | PM10 | 24 | 2.86E-02 | 2.14E-02 | 11% |
| | | | PM2.5 | 24, 8760 | 2.68E-02 | 2.01E-02 | 11% |
| | | | CO | 1, 8 | 9.60E-02 | 7.20E-02 | 7% |
| | | | Benzene | 24, 8760 | 2.41E-03 | 1.80E-03 | 10% |
| | | | 1,3-Butadiene | 24, 8760 | 8.27E-05 | 6.20E-05 | 9% |
| | | | Acrolein | 1, 24 | 8.31E-04 | 6.23E-04 | 11% |
| | | | Acetaldehyde | 0.5, 24 | 4.62E-03 | 3.47E-03 | 11% |
| | | | Formaldehyde | 24 | 1.30E-02 | 9.74E-03 | 11% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.99E-07 | 1.49E-07 | 7% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| GO2A | FB - GO Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 1.01E-03 | 7.58E-04 | 4% |
| | | | $NO_x$ | 1, 24, 8760 | 6.23E-01 | 4.67E-01 | 4% |
| | | | PM | 24, 8760 | 1.02E-02 | 7.61E-03 | 4% |
| | | | PM10 | 24 | 9.74E-03 | 7.31E-03 | 4% |
| | | | PM2.5 | 24, 8760 | 9.14E-03 | 6.85E-03 | 4% |
| | | | CO | 1, 8 | 3.28E-02 | 2.46E-02 | 2% |
| | | | Benzene | 24, 8760 | 8.20E-04 | 6.15E-04 | 4% |
| | | | 1,3-Butadiene | 24, 8760 | 2.82E-05 | 2.11E-05 | 3% |
| | | | Acrolein | 1, 24 | 2.83E-04 | 2.13E-04 | 4% |
| | | | Acetaldehyde | 0.5, 24 | 1.58E-03 | 1.18E-03 | 4% |
| | | | Formaldehyde | 24 | 4.43E-03 | 3.32E-03 | 4% |
| | | | Benzo(a)pyrene | 24, 8760 | 6.77E-08 | 5.08E-08 | 3% |
| GO2B | FB - GO Trains along main railway corridor in Oshawa | line volume | $SO_2$ | 10-min, 1, 8760 | 2.83E-03 | 2.12E-03 | 10% |
| | | | $NO_x$ | 1, 24, 8760 | 1.74E+00 | 1.31E+00 | 10% |
| | | | PM | 24, 8760 | 2.84E-02 | 2.13E-02 | 10% |
| | | | PM10 | 24 | 2.73E-02 | 2.04E-02 | 10% |
| | | | PM2.5 | 24, 8760 | 2.56E-02 | 1.92E-02 | 11% |
| | | | CO | 1, 8 | 9.16E-02 | 6.87E-02 | 6% |
| | | | Benzene | 24, 8760 | 2.29E-03 | 1.72E-03 | 10% |
| | | | 1,3-Butadiene | 24, 8760 | 7.89E-05 | 5.92E-05 | 9% |
| | | | Acrolein | 1, 24 | 7.93E-04 | 5.95E-04 | 10% |
| | | | Acetaldehyde | 0.5, 24 | 4.41E-03 | 3.31E-03 | 10% |
| | | | Formaldehyde | 24 | 1.24E-02 | 9.29E-03 | 10% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.89E-07 | 1.42E-07 | 7% |
| GO_IDLEB1A | FB - GO train idling at B1 Station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| GO_IDLEB1B | FB - GO train idling at B1 Station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| GO_IDLEB2A | FB - GO train idling at B2 Station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| GO_IDLEB2B | FB - GO train idling at B2 Station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| B1_PPUDO | FB - B1 station passenger drop off and pick up area | area | $SO_2$ | 10-min, 1, 8760 | 6.62E-05 | 4.05E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 2.23E-04 | 1.36E-04 | 0% |
| | | | PM | 24, 8760 | 7.66E-04 | 5.59E-03 | 0% |
| | | | PM10 | 24 | 4.72E-04 | 1.27E-03 | 0% |
| | | | PM2.5 | 24, 8760 | 1.08E-04 | 3.10E-04 | 0% |
| | | | CO | 1, 8 | 5.41E-02 | 3.31E-02 | 4% |
| | | | Benzene | 24, 8760 | 1.15E-05 | 7.05E-06 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 8.83E-10 | 5.40E-10 | 0% |
| | | | Acrolein | 1, 24 | 2.17E-07 | 1.32E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 2.49E-06 | 1.52E-06 | 0% |
| | | | Formaldehyde | 24 | 4.67E-06 | 2.85E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.10E-08 | 6.74E-09 | 0% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| B2_LOT | FB - B2 station vehicles in parking lot | area | $SO_2$ | 10-min, 1, 8760 | 7.49E-05 | 1.97E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 6.54E-03 | 8.95E-04 | 0% |
| | | | PM | 24, 8760 | 3.25E-03 | 6.84E-03 | 1% |
| | | | PM10 | 24 | 2.42E-03 | 1.84E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 1.26E-03 | 5.02E-04 | 1% |
| | | | CO | 1, 8 | 1.11E-01 | 2.57E-02 | 8% |
| | | | Benzene | 24, 8760 | 3.87E-04 | 5.08E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 4.75E-05 | 5.94E-06 | 5% |
| | | | Acrolein | 1, 24 | 1.09E-05 | 1.40E-06 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 1.68E-04 | 2.15E-05 | 0% |
| | | | Formaldehyde | 24 | 8.68E-05 | 1.18E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 3.06E-07 | 4.02E-08 | 11% |
| B2_PPUDO1 | FB - GO buses idling at B4 TOC | volume | $SO_2$ | 10-min, 1, 8760 | 1.32E-04 | 1.61E-04 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 3.86E-04 | 4.72E-04 | 0% |
| | | | PM | 24, 8760 | 4.93E-04 | 2.41E-03 | 0% |
| | | | PM10 | 24 | 3.85E-04 | 8.15E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.29E-04 | 2.43E-04 | 0% |
| | | | CO | 1, 8 | 1.03E-01 | 1.26E-01 | 7% |
| | | | Benzene | 24, 8760 | 2.21E-05 | 2.71E-05 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.69E-09 | 2.07E-09 | 0% |
| | | | Acrolein | 1, 24 | 4.15E-07 | 5.07E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 4.78E-06 | 5.84E-06 | 0% |
| | | | Formaldehyde | 24 | 8.94E-06 | 1.09E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.18E-08 | 2.66E-08 | 1% |
| B2_PPUDO2 | FB - B2 station PPUDO area 2 | area | $SO_2$ | 10-min, 1, 8760 | 1.32E-04 | 1.61E-04 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 3.86E-04 | 4.72E-04 | 0% |
| | | | PM | 24, 8760 | 4.93E-04 | 2.41E-03 | 0% |
| | | | PM10 | 24 | 3.85E-04 | 8.15E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.29E-04 | 2.43E-04 | 0% |
| | | | CO | 1, 8 | 1.03E-01 | 1.26E-01 | 7% |
| | | | Benzene | 24, 8760 | 2.21E-05 | 2.71E-05 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.69E-09 | 2.07E-09 | 0% |
| | | | Acrolein | 1, 24 | 4.15E-07 | 5.07E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 4.78E-06 | 5.84E-06 | 0% |
| | | | Formaldehyde | 24 | 8.94E-06 | 1.09E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.18E-08 | 2.66E-08 | 1% |
| CP2A | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.83E-03 | 3.26E-04 | 7% |
| | | | $NO_x$ | 1, 24, 8760 | 1.12E+00 | 1.99E-01 | 7% |
| | | | PM | 24, 8760 | 1.52E-02 | 2.71E-03 | 5% |
| | | | PM10 | 24 | 1.46E-02 | 2.60E-03 | 6% |
| | | | PM2.5 | 24, 8760 | 1.37E-02 | 2.44E-03 | 6% |
| | | | CO | 1, 8 | 1.87E-02 | 3.34E-03 | 1% |
| | | | Benzene | 24, 8760 | 1.38E-03 | 2.46E-04 | 6% |
| | | | 1,3-Butadiene | 24, 8760 | 4.74E-05 | 8.46E-06 | 5% |
| | | | Acrolein | 1, 24 | 4.77E-04 | 8.51E-05 | 6% |
| | | | Acetaldehyde | 0.5, 24 | 2.65E-03 | 4.73E-04 | 6% |
| | | | Formaldehyde | 24 | 7.44E-03 | 1.33E-03 | 6% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.01E-07 | 1.81E-08 | 4% |
| CP2B | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.73E-03 | 3.14E-04 | 6% |
| | | | $NO_x$ | 1, 24, 8760 | 1.06E+00 | 1.92E-01 | 6% |
| | | | PM | 24, 8760 | 1.44E-02 | 2.61E-03 | 5% |
| | | | PM10 | 24 | 1.38E-02 | 2.50E-03 | 5% |
| | | | PM2.5 | 24, 8760 | 1.29E-02 | 2.35E-03 | 5% |
| | | | CO | 1, 8 | 1.77E-02 | 3.21E-03 | 1% |
| | | | Benzene | 24, 8760 | 1.30E-03 | 2.37E-04 | 6% |
| | | | 1,3-Butadiene | 24, 8760 | 4.48E-05 | 8.15E-06 | 5% |
| | | | Acrolein | 1, 24 | 4.51E-04 | 8.19E-05 | 6% |
| | | | Acetaldehyde | 0.5, 24 | 2.51E-03 | 4.55E-04 | 6% |
| | | | Formaldehyde | 24 | 7.04E-03 | 1.28E-03 | 6% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.57E-08 | 1.74E-08 | 4% |
| CP2C | EX/FNB/FB - GM/CP trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.80E-03 | 3.23E-04 | 6% |
| | | | $NO_x$ | 1, 24, 8760 | 1.10E+00 | 1.98E-01 | 7% |
| | | | PM | 24, 8760 | 1.50E-02 | 2.68E-03 | 5% |
| | | | PM10 | 24 | 1.44E-02 | 2.58E-03 | 5% |
| | | | PM2.5 | 24, 8760 | 1.35E-02 | 2.42E-03 | 6% |
| | | | CO | 1, 8 | 1.84E-02 | 3.30E-03 | 1% |
| | | | Benzene | 24, 8760 | 1.36E-03 | 2.44E-04 | 6% |
| | | | 1,3-Butadiene | 24, 8760 | 4.68E-05 | 8.39E-06 | 5% |
| | | | Acrolein | 1, 24 | 4.70E-04 | 8.43E-05 | 6% |
| | | | Acetaldehyde | 0.5, 24 | 2.62E-03 | 4.69E-04 | 6% |
| | | | Formaldehyde | 24 | 7.34E-03 | 1.32E-03 | 6% |
| | | | Benzo(a)pyrene | 24, 8760 | 9.99E-08 | 1.79E-08 | 4% |
| GO3A | FB - GO trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 3.11E-03 | 2.34E-03 | 11% |
| | | | $NO_x$ | 1, 24, 8760 | 1.92E+00 | 1.44E+00 | 11% |
| | | | PM | 24, 8760 | 3.13E-02 | 2.35E-02 | 11% |
| | | | PM10 | 24 | 3.00E-02 | 2.25E-02 | 11% |
| | | | PM2.5 | 24, 8760 | 2.82E-02 | 2.11E-02 | 12% |
| | | | CO | 1, 8 | 1.01E-01 | 7.57E-02 | 7% |
| | | | Benzene | 24, 8760 | 2.53E-03 | 1.90E-03 | 11% |
| | | | 1,3-Butadiene | 24, 8760 | 8.69E-05 | 6.52E-05 | 10% |
| | | | Acrolein | 1, 24 | 8.74E-04 | 6.55E-04 | 11% |
| | | | Acetaldehyde | 0.5, 24 | 4.86E-03 | 3.64E-03 | 11% |
| | | | Formaldehyde | 24 | 1.36E-02 | 1.02E-02 | 11% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.09E-07 | 1.56E-07 | 8% |

## *Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
## *Location: Project Operation - Oshawa, Courtice and Bowmanville Segment*
## *Appendix E*
*Source Summary Table*

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| GO3B | FB - GO trains along main railway corridor in Courtice | line volume | $SO_2$ | 10-min, 1, 8760 | 1.75E-03 | 1.31E-03 | 6% |
| | | | $NO_x$ | 1, 24, 8760 | 1.08E+00 | 8.07E-01 | 6% |
| | | | PM | 24, 8760 | 1.75E-02 | 1.32E-02 | 6% |
| | | | PM10 | 24 | 1.68E-02 | 1.26E-02 | 6% |
| | | | PM2.5 | 24, 8760 | 1.58E-02 | 1.18E-02 | 7% |
| | | | CO | 1, 8 | 5.66E-02 | 4.24E-02 | 4% |
| | | | Benzene | 24, 8760 | 1.42E-03 | 1.06E-03 | 6% |
| | | | 1,3-Butadiene | 24, 8760 | 4.87E-05 | 3.65E-05 | 5% |
| | | | Acrolein | 1, 24 | 4.90E-04 | 3.67E-04 | 6% |
| | | | Acetaldehyde | 0.5, 24 | 2.72E-03 | 2.04E-03 | 6% |
| | | | Formaldehyde | 24 | 7.65E-03 | 5.74E-03 | 6% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.17E-07 | 8.77E-08 | 4% |
| GO_IDLEB3A | FB - GO train idling at B3 station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| GO_IDLEB3B | FB - GO train idling at B3 station | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| B3_LOT | FB - B3 TOC vehicles in parking lot | area | $SO_2$ | 10-min, 1, 8760 | 8.04E-05 | 2.60E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 5.40E-03 | 7.94E-04 | 0% |
| | | | PM | 24, 8760 | 4.12E-03 | 1.04E-02 | 1% |
| | | | PM10 | 24 | 2.84E-03 | 2.72E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 1.16E-03 | 6.76E-04 | 0% |
| | | | CO | 1, 8 | 1.12E-01 | 3.22E-02 | 8% |
| | | | Benzene | 24, 8760 | 3.15E-04 | 4.31E-05 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 3.81E-05 | 4.77E-06 | 4% |
| | | | Acrolein | 1, 24 | 8.81E-06 | 1.17E-06 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 1.36E-04 | 1.78E-05 | 0% |
| | | | Formaldehyde | 24 | 7.15E-05 | 1.05E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.49E-07 | 3.41E-08 | 9% |
| B3_PPUDO | FB - B3 station passenger drop off and pick up area | area | $SO_2$ | 10-min, 1, 8760 | 4.69E-05 | 5.74E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 1.79E-04 | 2.19E-04 | 0% |
| | | | PM | 24, 8760 | 8.65E-04 | 1.81E-03 | 0% |
| | | | PM10 | 24 | 5.24E-04 | 7.83E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.05E-04 | 1.64E-04 | 0% |
| | | | CO | 1, 8 | 4.00E-02 | 4.89E-02 | 3% |
| | | | Benzene | 24, 8760 | 8.49E-06 | 1.04E-05 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 6.51E-10 | 7.96E-10 | 0% |
| | | | Acrolein | 1, 24 | 1.60E-07 | 1.95E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 1.84E-06 | 2.25E-06 | 0% |
| | | | Formaldehyde | 24 | 3.44E-06 | 4.21E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 7.91E-09 | 9.67E-09 | 0% |
| CP3 | EX/FNB/FB - GM/CP trains along main railway corridor in Bowmanville | line volume | $SO_2$ | 10-min, 1, 8760 | 2.19E-03 | 3.91E-04 | 8% |
| | | | $NO_x$ | 1, 24, 8760 | 1.34E+00 | 2.39E-01 | 8% |
| | | | PM | 24, 8760 | 1.82E-02 | 3.25E-03 | 7% |
| | | | PM10 | 24 | 1.75E-02 | 3.12E-03 | 7% |
| | | | PM2.5 | 24, 8760 | 1.64E-02 | 2.93E-03 | 7% |
| | | | CO | 1, 8 | 2.24E-02 | 4.00E-03 | 2% |
| | | | Benzene | 24, 8760 | 1.65E-03 | 2.95E-04 | 7% |
| | | | 1,3-Butadiene | 24, 8760 | 5.69E-05 | 1.02E-05 | 6% |
| | | | Acrolein | 1, 24 | 5.72E-04 | 1.02E-04 | 7% |
| | | | Acetaldehyde | 0.5, 24 | 3.18E-03 | 5.68E-04 | 7% |
| | | | Formaldehyde | 24 | 8.93E-03 | 1.59E-03 | 7% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.21E-07 | 2.17E-08 | 5% |
| CP4 | EX/FNB/FB - GM/CP trains east of study area | line volume | $SO_2$ | 10-min, 1, 8760 | 4.84E-04 | 8.64E-05 | 2% |
| | | | $NO_x$ | 1, 24, 8760 | 2.96E-01 | 5.29E-02 | 2% |
| | | | PM | 24, 8760 | 4.02E-03 | 7.18E-04 | 1% |
| | | | PM10 | 24 | 3.86E-03 | 6.89E-04 | 1% |
| | | | PM2.5 | 24, 8760 | 3.62E-03 | 6.46E-04 | 2% |
| | | | CO | 1, 8 | 4.95E-03 | 8.84E-04 | 0% |
| | | | Benzene | 24, 8760 | 3.65E-04 | 6.53E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 1.26E-05 | 2.24E-06 | 1% |
| | | | Acrolein | 1, 24 | 1.26E-04 | 2.26E-05 | 2% |
| | | | Acetaldehyde | 0.5, 24 | 7.03E-04 | 1.25E-04 | 2% |
| | | | Formaldehyde | 24 | 1.97E-03 | 3.52E-04 | 2% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.68E-08 | 4.79E-09 | 1% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| GO4A | FB - GO trains along main railway corridor in Bowmanville | line volume | $SO_2$ | 10-min, 1, 8760 | 2.02E-03 | 1.51E-03 | 7% |
| | | | $NO_x$ | 1, 24, 8760 | 1.25E+00 | 9.34E-01 | 7% |
| | | | PM | 24, 8760 | 2.03E-02 | 1.52E-02 | 7% |
| | | | PM10 | 24 | 1.95E-02 | 1.46E-02 | 7% |
| | | | PM2.5 | 24, 8760 | 1.83E-02 | 1.37E-02 | 8% |
| | | | CO | 1, 8 | 6.55E-02 | 4.91E-02 | 5% |
| | | | Benzene | 24, 8760 | 1.64E-03 | 1.23E-03 | 7% |
| | | | 1,3-Butadiene | 24, 8760 | 5.64E-05 | 4.23E-05 | 6% |
| | | | Acrolein | 1, 24 | 5.67E-04 | 4.25E-04 | 7% |
| | | | Acetaldehyde | 0.5, 24 | 3.15E-03 | 2.36E-03 | 7% |
| | | | Formaldehyde | 24 | 8.85E-03 | 6.64E-03 | 7% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.35E-07 | 1.02E-07 | 5% |
| GO4B | FB - GO trains along main railway corridor in Bowmanville | line volume | $SO_2$ | 10-min, 1, 8760 | 2.79E-04 | 2.09E-04 | 1% |
| | | | $NO_x$ | 1, 24, 8760 | 1.72E-01 | 1.29E-01 | 1% |
| | | | PM | 24, 8760 | 2.80E-03 | 2.10E-03 | 1% |
| | | | PM10 | 24 | 2.69E-03 | 2.02E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.52E-03 | 1.89E-03 | 1% |
| | | | CO | 1, 8 | 9.04E-03 | 6.78E-03 | 1% |
| | | | Benzene | 24, 8760 | 2.26E-04 | 1.70E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 7.79E-06 | 5.84E-06 | 1% |
| | | | Acrolein | 1, 24 | 7.83E-05 | 5.87E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 4.35E-04 | 3.26E-04 | 1% |
| | | | Formaldehyde | 24 | 1.22E-03 | 9.17E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.87E-08 | 1.40E-08 | 1% |
| GO_IDLEB4A | GO trains idling at station B4 | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| GO_IDLEB4B | GO trains idling at station B4 | volume | $SO_2$ | 10-min, 1, 8760 | 8.93E-05 | 6.70E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 8.04E-02 | 6.03E-02 | 0% |
| | | | PM | 24, 8760 | 2.37E-03 | 1.77E-03 | 1% |
| | | | PM10 | 24 | 2.27E-03 | 1.70E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 2.13E-03 | 1.60E-03 | 1% |
| | | | CO | 1, 8 | 1.44E-02 | 1.08E-02 | 1% |
| | | | Benzene | 24, 8760 | 1.70E-04 | 1.27E-04 | 1% |
| | | | 1,3-Butadiene | 24, 8760 | 5.84E-06 | 4.38E-06 | 1% |
| | | | Acrolein | 1, 24 | 5.87E-05 | 4.40E-05 | 1% |
| | | | Acetaldehyde | 0.5, 24 | 3.27E-04 | 2.45E-04 | 1% |
| | | | Formaldehyde | 24 | 9.17E-04 | 6.88E-04 | 1% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.58E-08 | 1.18E-08 | 1% |
| B4_LOT | FB - B4 vehicles in parking lot | area | $SO_2$ | 10-min, 1, 8760 | 8.28E-05 | 2.50E-05 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 6.14E-03 | 8.77E-04 | 0% |
| | | | PM | 24, 8760 | 4.02E-03 | 9.63E-03 | 1% |
| | | | PM10 | 24 | 2.84E-03 | 2.54E-03 | 1% |
| | | | PM2.5 | 24, 8760 | 1.26E-03 | 6.47E-04 | 1% |
| | | | CO | 1, 8 | 1.18E-01 | 3.15E-02 | 8% |
| | | | Benzene | 24, 8760 | 3.60E-04 | 4.85E-05 | 2% |
| | | | 1,3-Butadiene | 24, 8760 | 4.39E-05 | 5.48E-06 | 5% |
| | | | Acrolein | 1, 24 | 1.01E-05 | 1.33E-06 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 1.56E-04 | 2.02E-05 | 0% |
| | | | Formaldehyde | 24 | 8.14E-05 | 1.16E-05 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.85E-07 | 3.83E-08 | 11% |
| B4_PPUDO | FB - B4 station passenger drop off and pick up area | area | $SO_2$ | 10-min, 1, 8760 | 1.12E-04 | 1.36E-04 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 3.20E-04 | 3.91E-04 | 0% |
| | | | PM | 24, 8760 | 4.24E-04 | 2.84E-03 | 0% |
| | | | PM10 | 24 | 2.84E-04 | 7.90E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 1.05E-04 | 2.39E-04 | 0% |
| | | | CO | 1, 8 | 8.67E-02 | 1.06E-01 | 6% |
| | | | Benzene | 24, 8760 | 1.86E-05 | 2.28E-05 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 1.42E-09 | 1.74E-09 | 0% |
| | | | Acrolein | 1, 24 | 3.49E-07 | 4.26E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 4.02E-06 | 4.91E-06 | 0% |
| | | | Formaldehyde | 24 | 7.52E-06 | 9.19E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.84E-08 | 2.25E-08 | 1% |
| FB_BUS_B4 | FB - B4 station bus loop (travelling buses) | line volume | $SO_2$ | 10-min, 1, 8760 | 1.48E-06 | 7.11E-07 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 6.97E-04 | 3.34E-04 | 0% |
| | | | PM | 24, 8760 | 2.81E-04 | 2.73E-03 | 0% |
| | | | PM10 | 24 | 8.99E-05 | 5.39E-04 | 0% |
| | | | PM2.5 | 24, 8760 | 2.20E-05 | 1.35E-04 | 0% |
| | | | CO | 1, 8 | 3.89E-04 | 1.86E-04 | 0% |
| | | | Benzene | 24, 8760 | 1.23E-07 | 5.88E-08 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 4.10E-08 | 1.97E-08 | 0% |
| | | | Acrolein | 1, 24 | 1.27E-07 | 6.07E-08 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 8.48E-07 | 4.06E-07 | 0% |
| | | | Formaldehyde | 24 | 1.51E-06 | 7.21E-07 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 2.58E-10 | 1.24E-10 | 0% |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Location: Project Operation - Oshawa, Courtice and Bowmanville Segment***
***Appendix E***
***Source Summary Table***

| Source ID | Source Description | Type of Source | Contaminant | Averaging Period (hours) | Worst-case Scenario for Modelling [1] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Hourly Emission Rate (g/s) | Daily Emission Rate (g/s) | % of Overall Emissions |
| FB_BUS_IDLE | FB - GO buses idling at B4 TOC | volume | $SO_2$ | 10-min, 1, 8760 | 6.31E-06 | 3.02E-06 | 0% |
| | | | $NO_x$ | 1, 24, 8760 | 4.46E-03 | 2.14E-03 | 0% |
| | | | PM | 24, 8760 | 1.19E-04 | 5.70E-05 | 0% |
| | | | PM10 | 24 | 1.19E-04 | 5.70E-05 | 0% |
| | | | PM2.5 | 24, 8760 | 2.88E-05 | 1.38E-05 | 0% |
| | | | CO | 1, 8 | 1.83E-03 | 8.79E-04 | 0% |
| | | | Benzene | 24, 8760 | 9.86E-07 | 4.72E-07 | 0% |
| | | | 1,3-Butadiene | 24, 8760 | 3.28E-07 | 1.57E-07 | 0% |
| | | | Acrolein | 1, 24 | 1.01E-06 | 4.83E-07 | 0% |
| | | | Acetaldehyde | 0.5, 24 | 6.70E-06 | 3.21E-06 | 0% |
| | | | Formaldehyde | 24 | 1.20E-05 | 5.77E-06 | 0% |
| | | | Benzo(a)pyrene | 24, 8760 | 1.55E-09 | 7.44E-10 | 0% |

Note:
(1) % of overall emission is calculated using hourly emission rates.

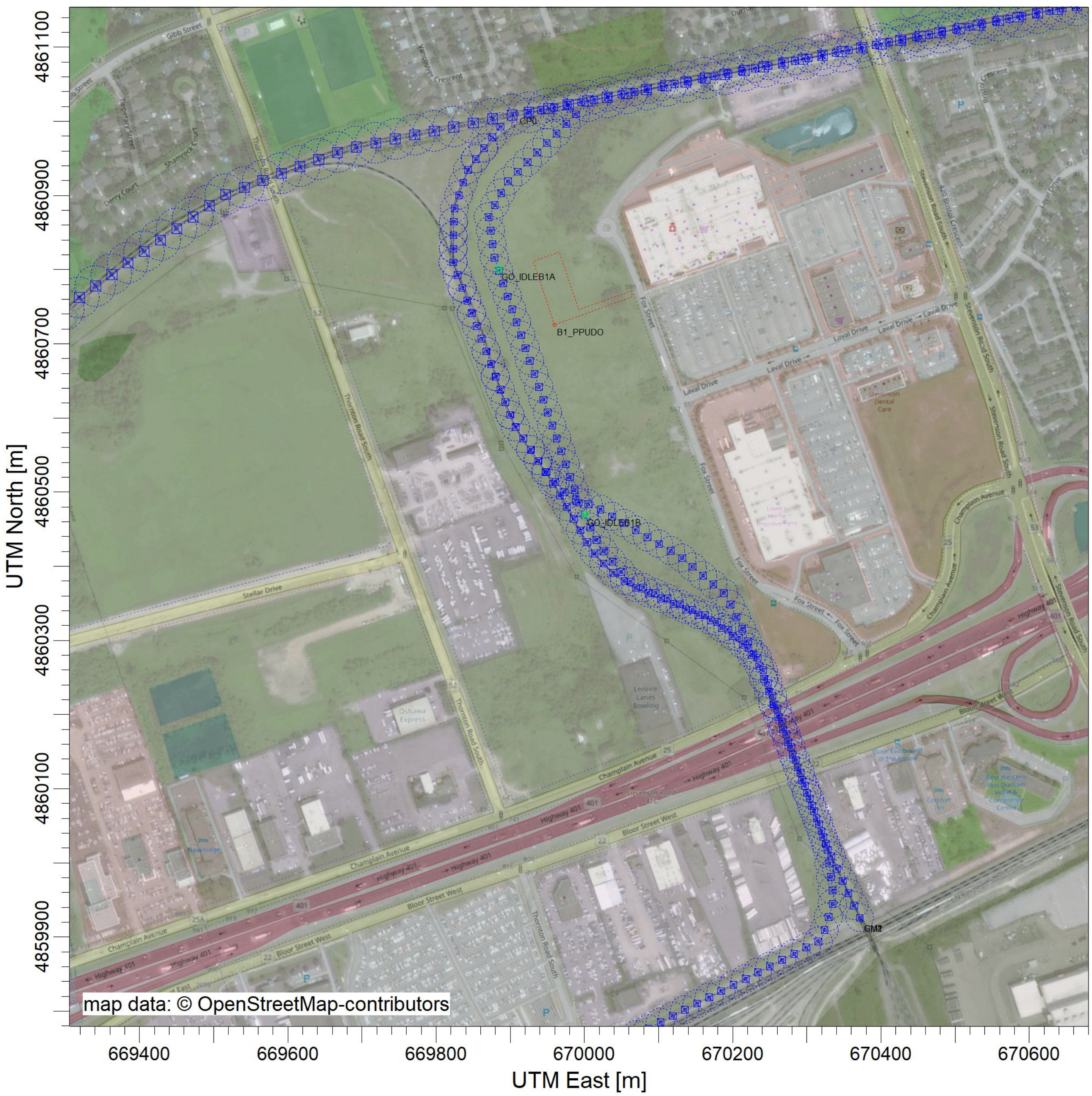
PROJECT TITLE:

**Figure E-9A: Dispersion Modelling Plan for Oshawa segment - Operation Sources**


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **16** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**171** | | |
| | | SCALE: 1:51,640<br>0 — 2 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

PROJECT TITLE:

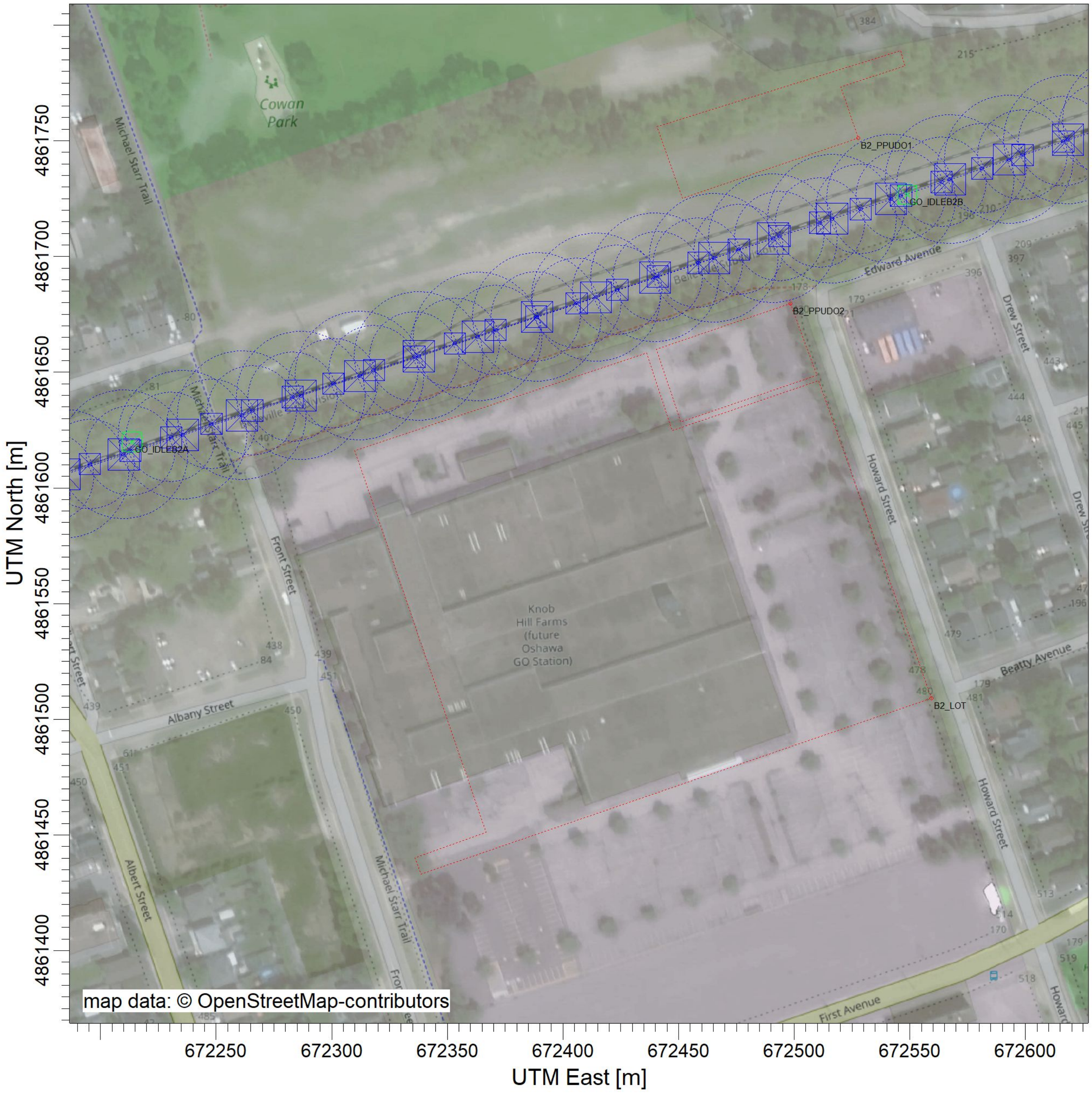
**Figure E-9B: Dispersion Modelling Plan for Oshawa segment - Operation Sources**
**Closeup of sources at B1**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **16** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**171** | | |
| | | SCALE: 1:8,642<br>0 — 0.3 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

PROJECT TITLE:

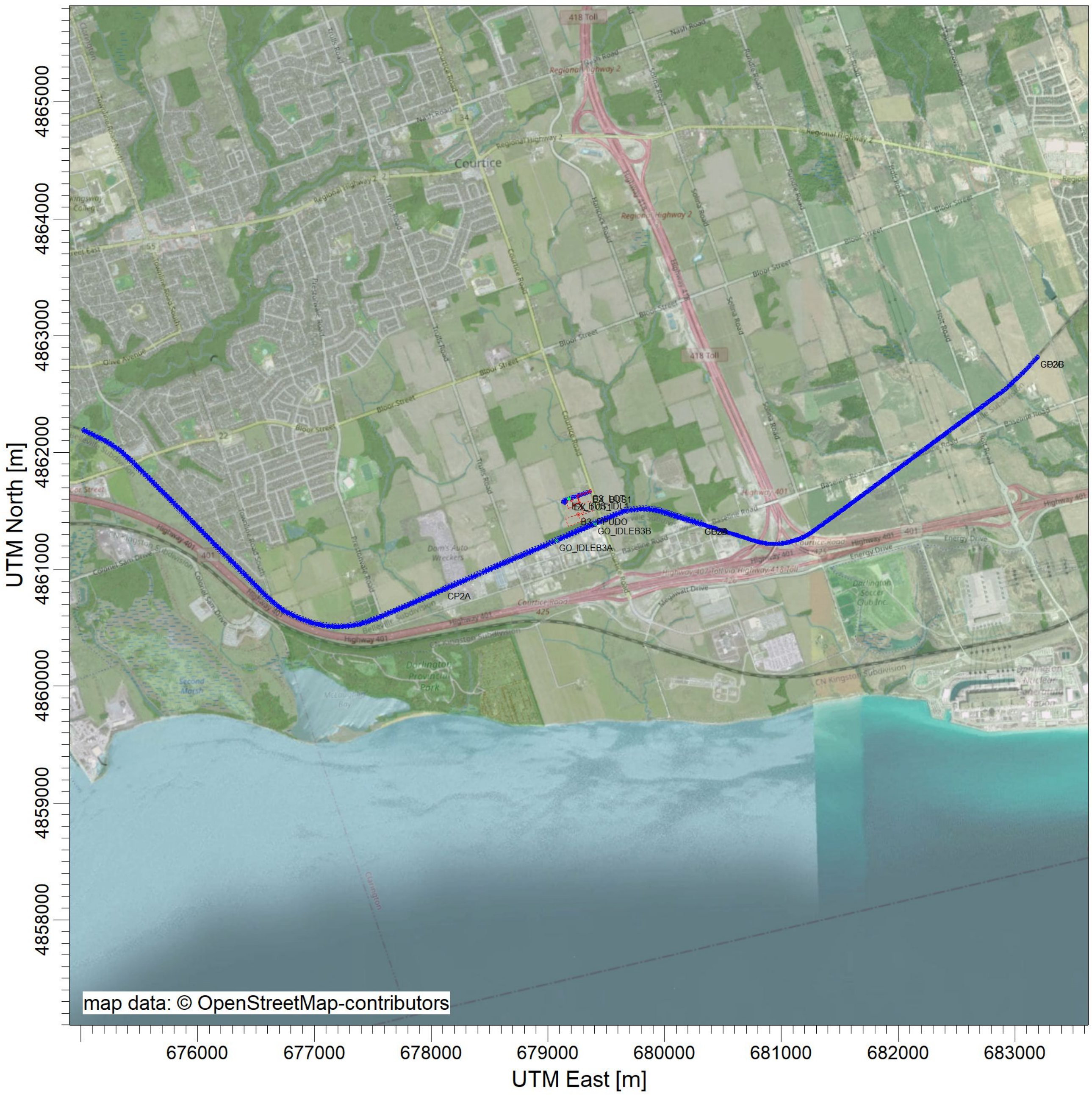
**Figure E-9C: Dispersion Modelling Plan for Oshawa segment - Operation Sources Closeup of sources at B2**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **16** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**171** | | |
| | | SCALE: 1:2,771<br>0 — 0.1 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure E-10A: Dispersion Modelling Plan for Courtice segment - Operation Sources**




COMMENTS:

green box - volume source
red line - area source
blue - line source

SOURCES:

**12**

RECEPTORS:

**5546**

COMPANY NAME:

**Stantec Consulting Ltd.**

SCALE: 1:54,882

0 2 km

DATE:

**4/18/2022**

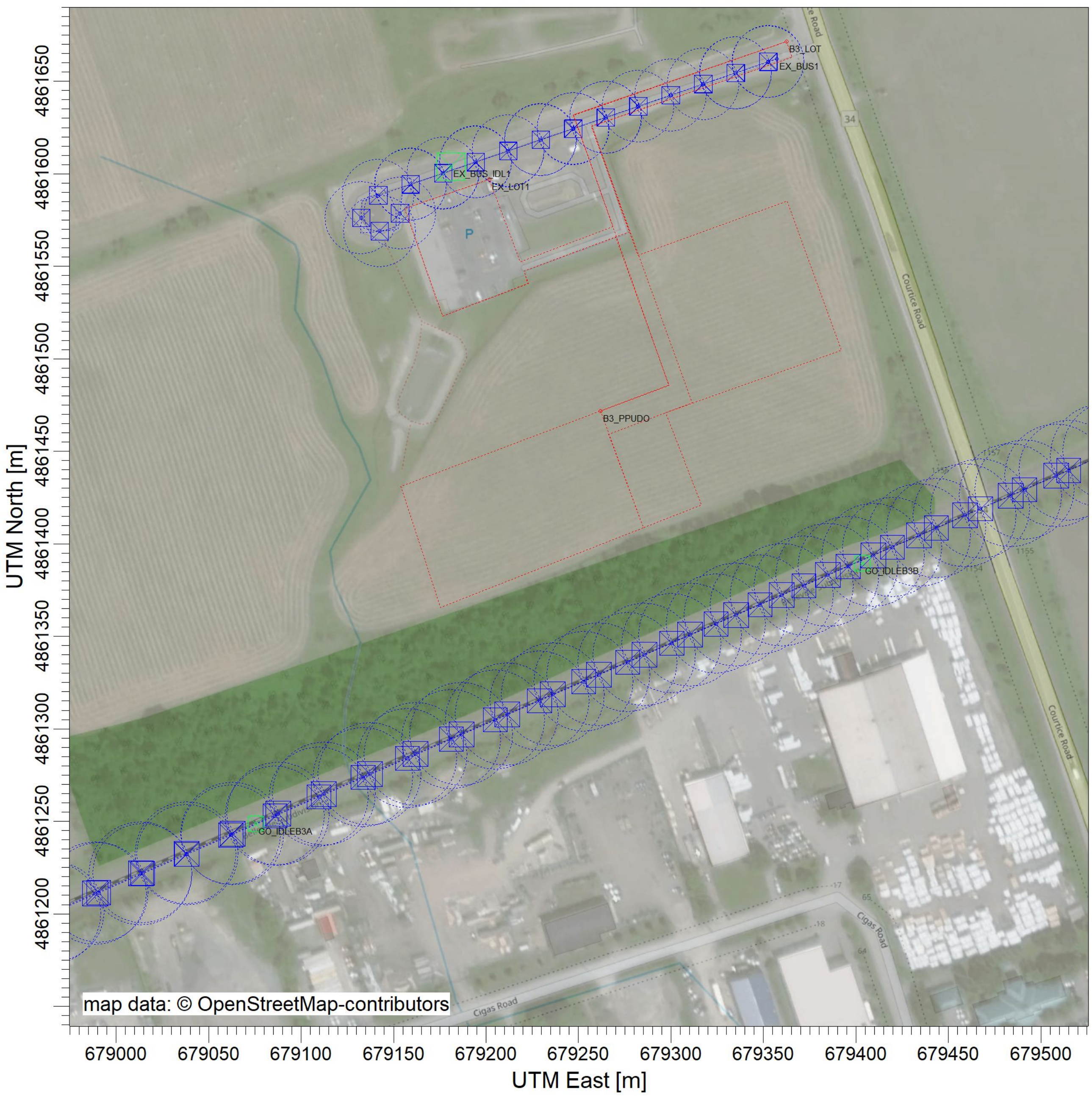
PROJECT NO.:

AERMOD View - Lakes Environmental Software

C:\Users\clim\Documents\Models\Aermod19191\Bowmanville_courtice\op_ex_courtice\op_ex_courtice.isc

PROJECT TITLE:

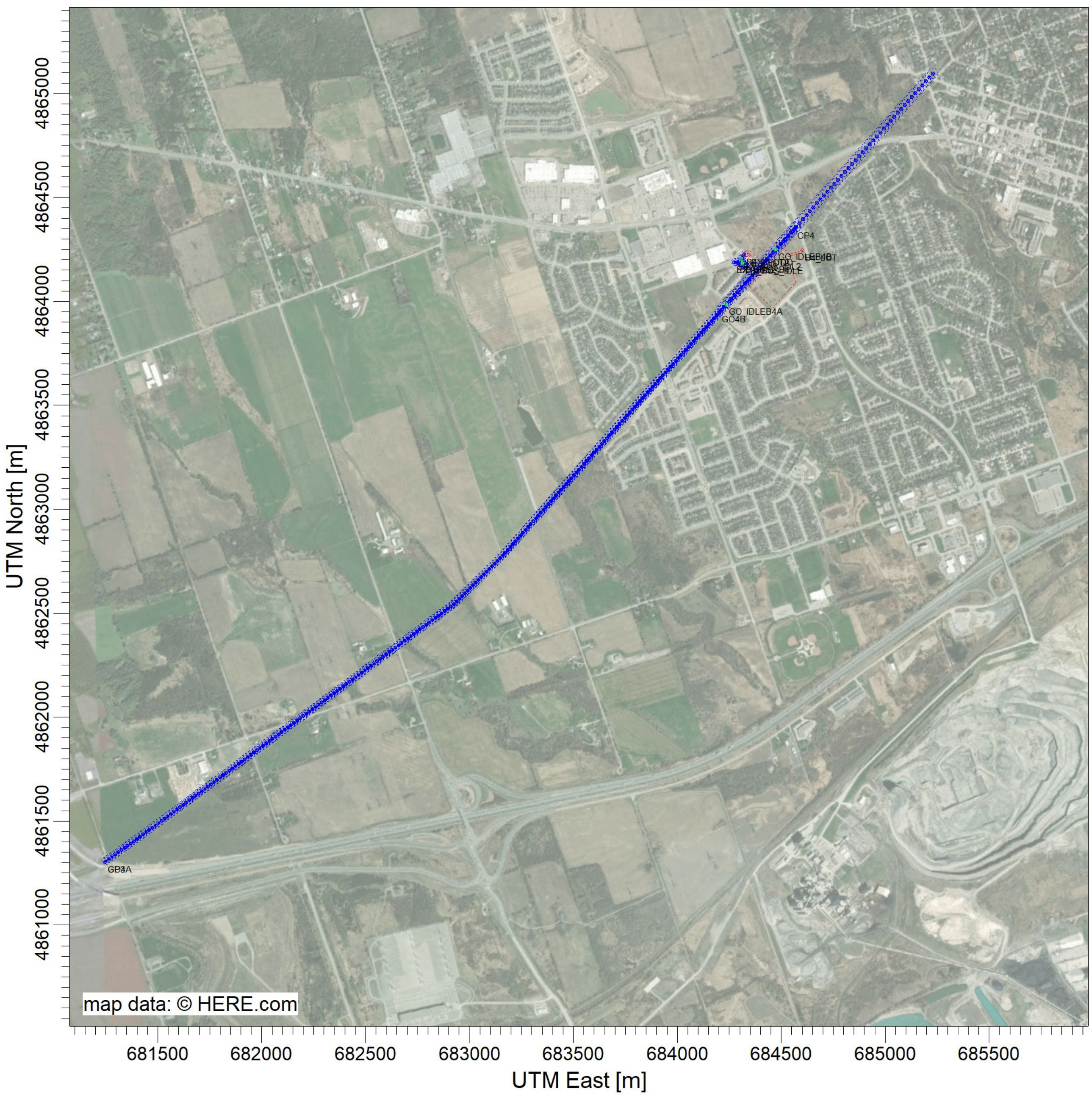
**Figure E-10B: Dispersion Modelling Plan for Courtice segment - Operation Sources**
**Closeup of sources at B3**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **12** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**5546** | | |
| | | SCALE: 1:3,464<br>0 — 0.1 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure E-11A: Dispersion Modelling Plan for Bowmanville segment - Operation Sources**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**3440** | | |
| | | SCALE: 1:30,830<br>0 ▬ 1 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

C:\Users\clim\Documents\Models\Aermod19191\Bowmanville_bowmanville\op_ex_bowmanville\op_ex_bowmanville.isc

PROJECT TITLE:

**Figure E-11B: Dispersion Modelling Plan for Bowmanville segment - Operation Sources**
**Closeup of sources at B4**

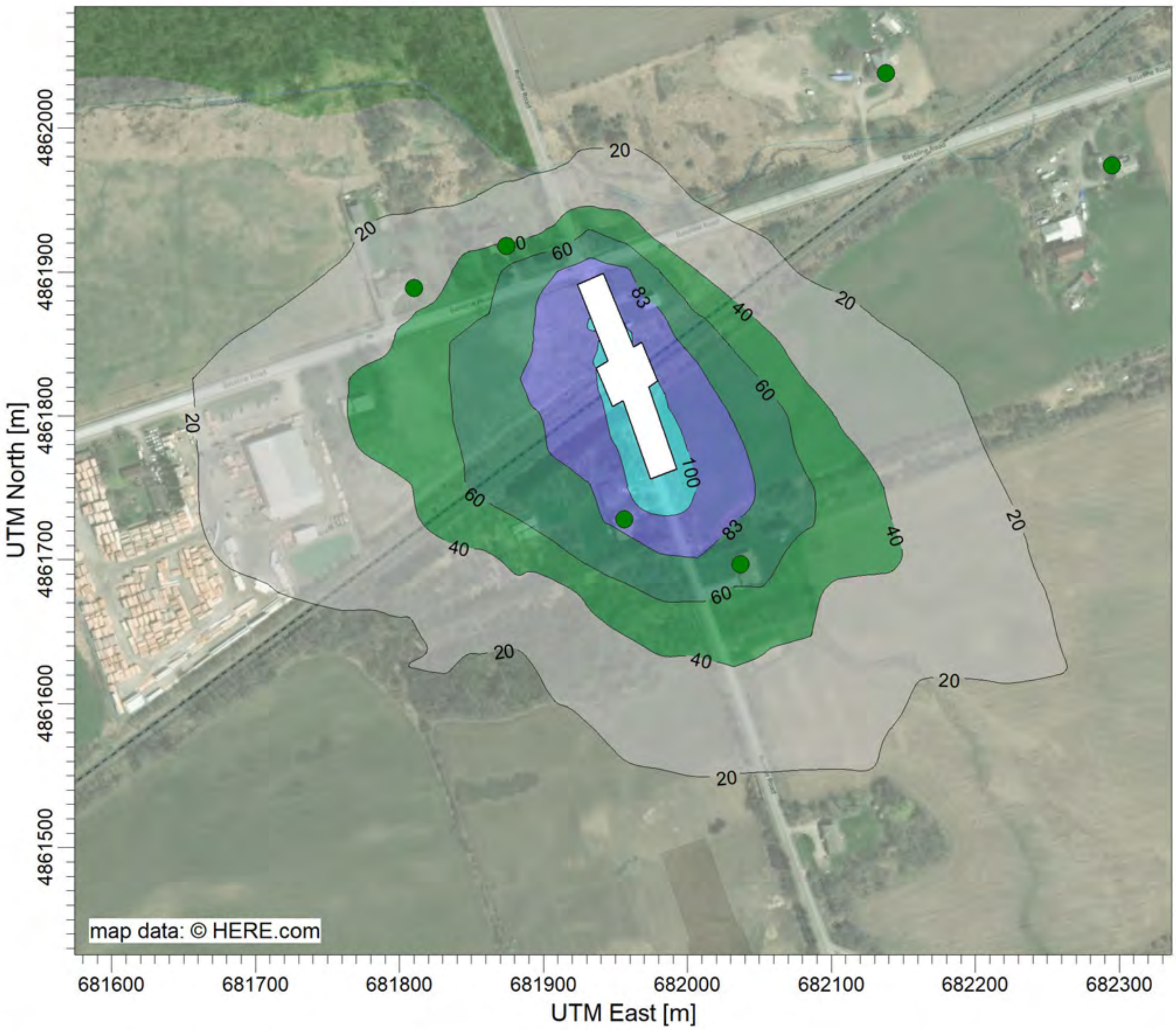

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| green box - volume source<br>red line - area source<br>blue - line source | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**3440** | | |
| | | SCALE: 1:2,693<br>0 — 0.1 km | |
| | | DATE:<br>**4/18/2022** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software C:\Users\clim\Documents\Models\Aermod19191\Bowmanville_bowmanville\op_ex_bowmanville\op_ex_bowmanville.isc

# Appendix F
## Contour Plots (Project Alone Concentrations)

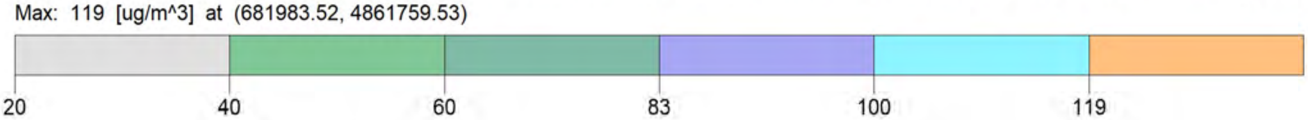
PROJECT TITLE:

**Figure F-1: Rundle Road Crossing Construction - Contour Plot for Nitrogen Dioxide Predicted 1-hour Average 98th Percentile Concentrations**




PLOT FILE OF 8TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 119 [ug/m^3] at (681983.52, 4861759.53)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 1-hour 2020 CAAQS: 119 ug/m3<br>1-hour 2025 CAAQS: 83 ug/m3<br><br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**994** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:4,792<br>0 0.1 km | |
| | MAX:<br>**119 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

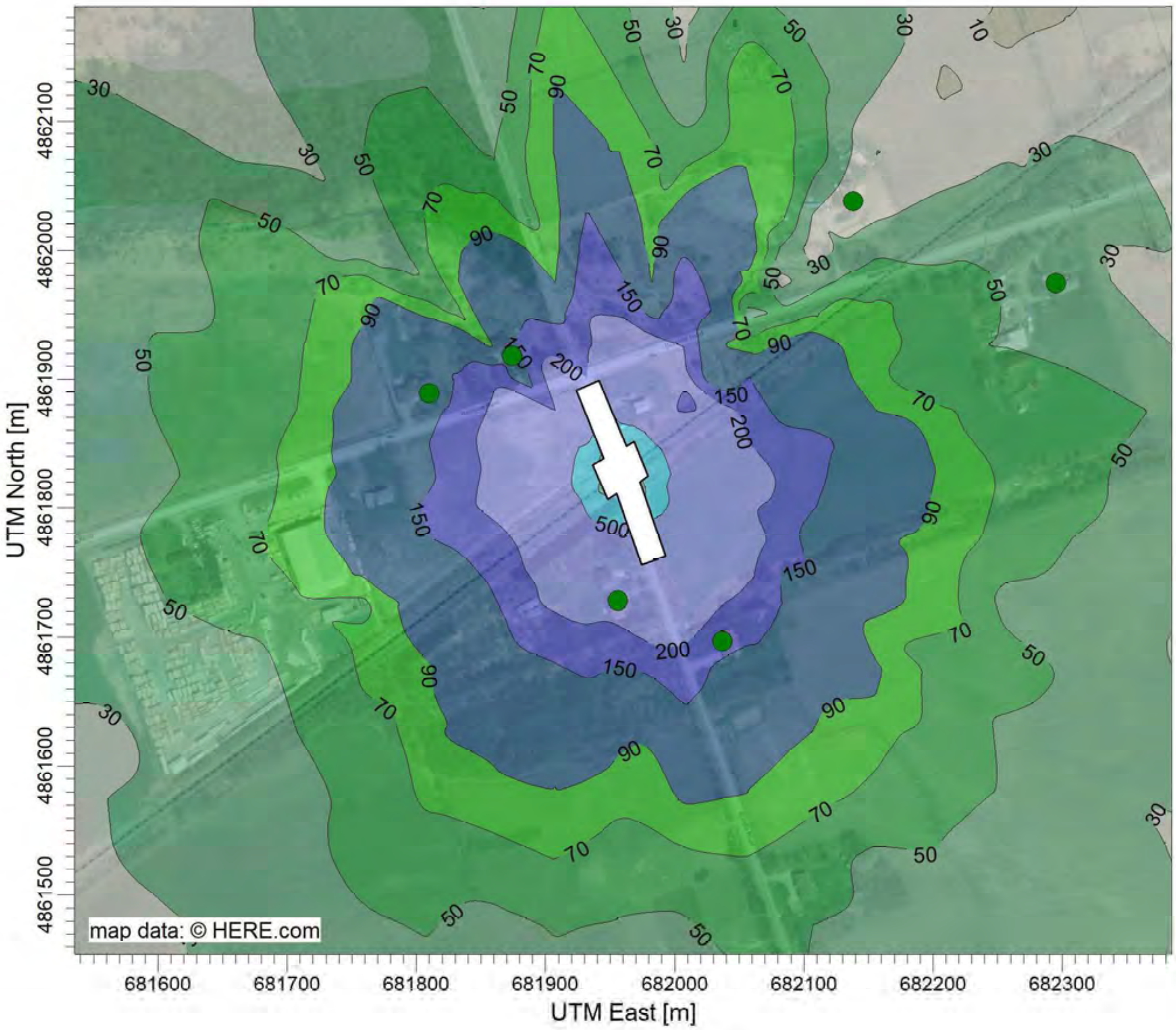
PROJECT TITLE:

**Figure F-2: Rundle Road Crossing Construction - Contour Plot for Total Suspended Particulate (TSP) Predicted 24-hour Average Concentrations**


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 24-hour AAQC: 120 ug/m3<br><br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**994** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,941<br>0 — 0.1 km | |
| | MAX:<br>**134 ug/m^3** | DATE:<br>**9/15/2021** | PROJECT NO.: |

PROJECT TITLE:

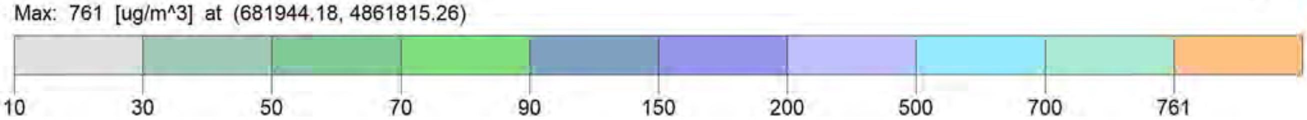
**Figure F-3: Rundle Road Crossing Construction - Contour Plot for PM10 Predicted 15-minute Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 761 [ug/m^3] at (681944.18, 4861815.26)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 150 ug/m3<br><br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**994** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:5,341<br>0 — 0.2 km | |
| | MAX:<br>**761 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-4: Rundle Road Crossing Construction - Contour Plot for PM10 Predicted 24-hour Average Concentrations**


PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 86.4 [ug/m^3] at (681944.90, 4861838.13)

10.0 | 20.0 | 40.0 | 50.0 | 60.0 | 86.4

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 24-hour AAQC: 50 ug/m3<br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS: **994** | | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:2,026<br>0 — 0.05 km | |
| | MAX: **86.4 ug/m^3** | DATE: **11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-5: Rundle Road Crossing Construction - Contour Plot for PM2.5 Predicted 15-minute Average Concentrations**


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 81 ug/m3<br><br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**994** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:3,026<br>0 — 0.1 km | |
| | MAX:<br>**86.6 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

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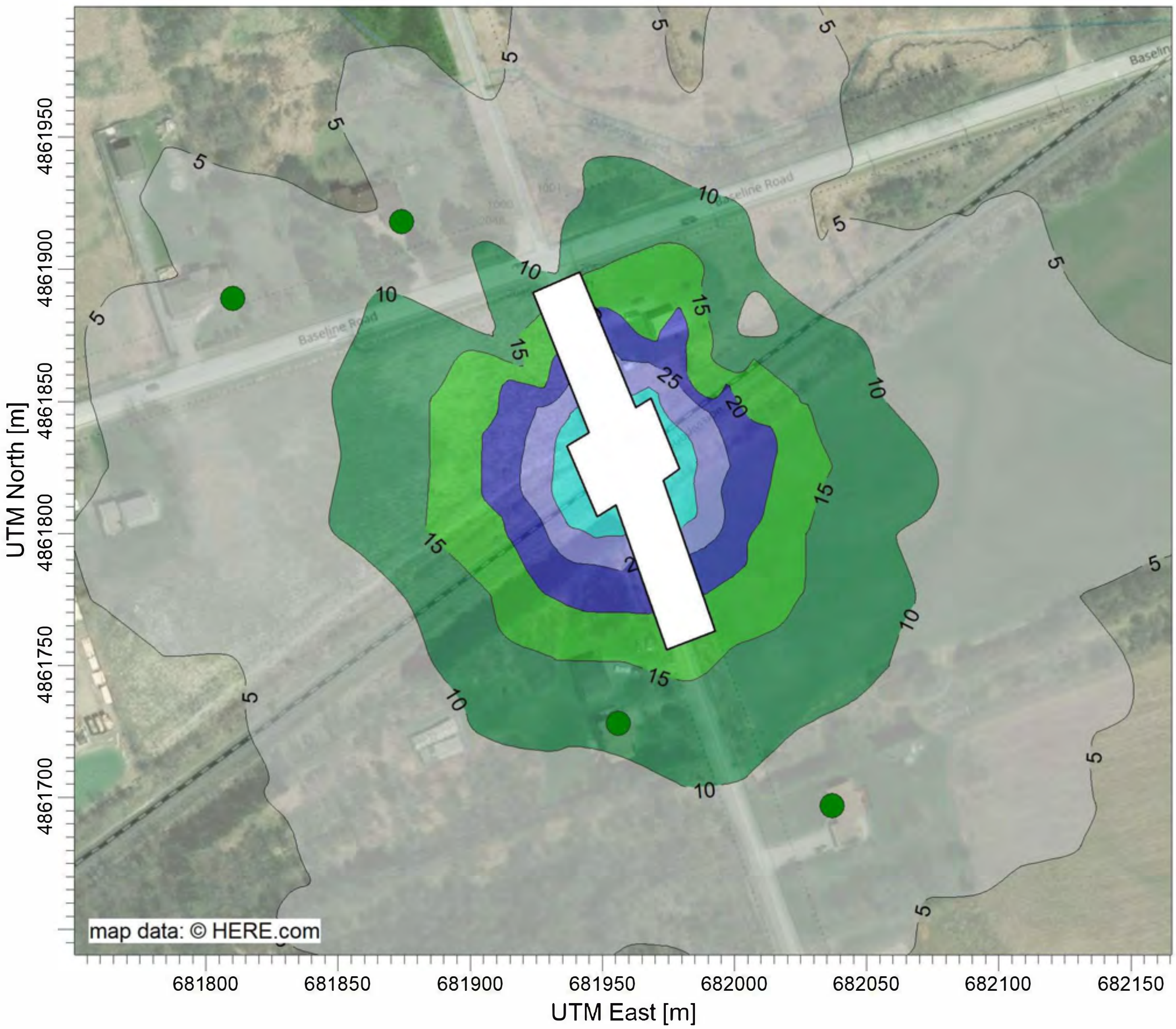
PROJECT TITLE:

**Figure F-6: Rundle Road Crossing Construction - Contour Plot for Crystalline Silica Predicted 15-minute Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

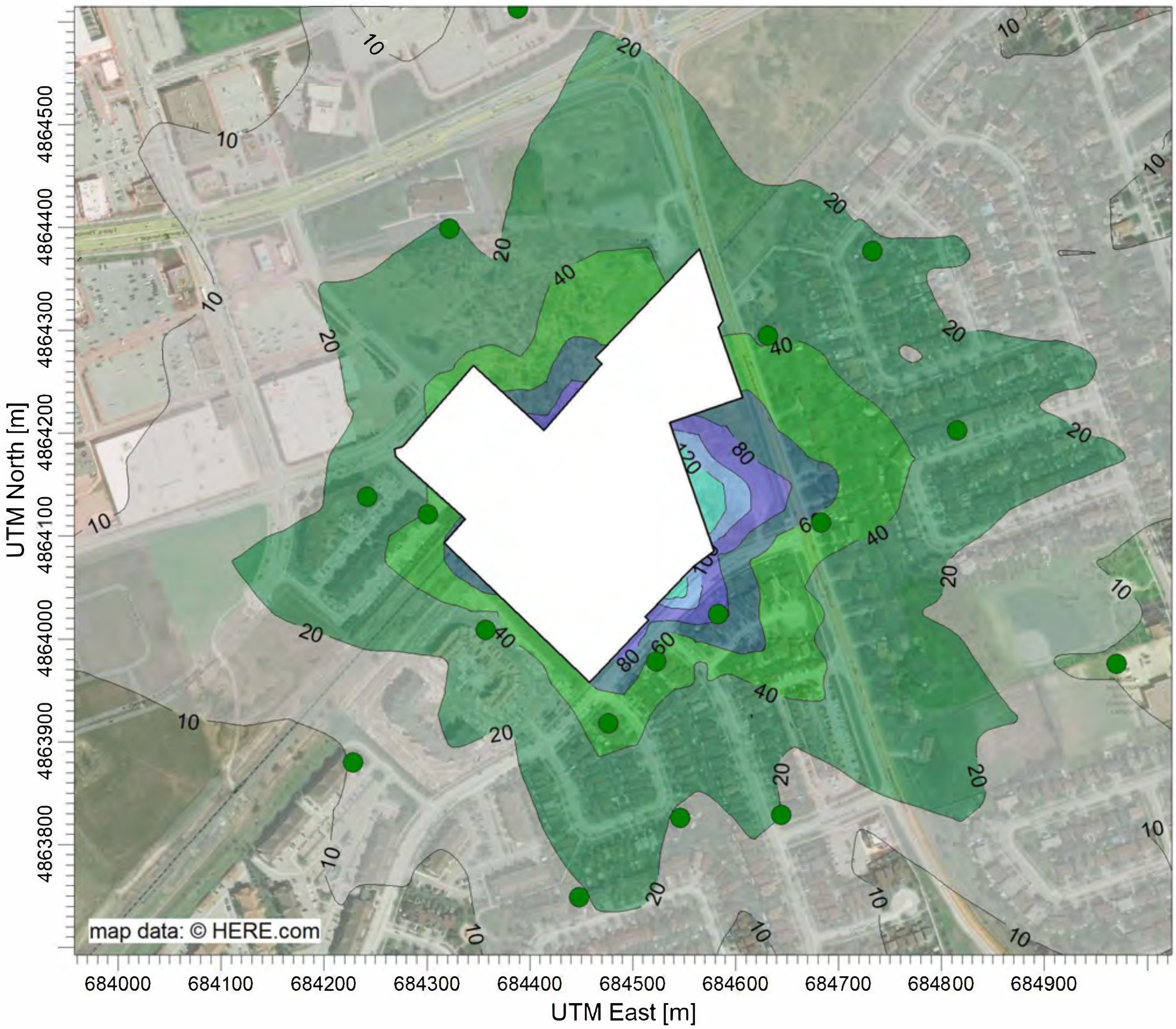
ug/m^3

Max: 39.3 [ug/m^3] at (681944.18, 4861815.26)


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 25 ug/m3<br><br>green circle indicates the location of a special receptor | **10** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**994** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,611<br>0 — 0.05 km | |
| | MAX:<br>**39.3 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

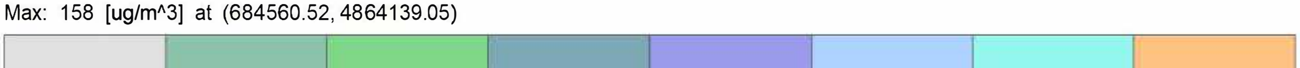
**Figure F-7: B4 Bowmanville TOC Construction - Contour Plot for Total Suspended Particulate (TSP) Predicted 24-hour Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 158 [ug/m^3] at (684560.52, 4864139.05)

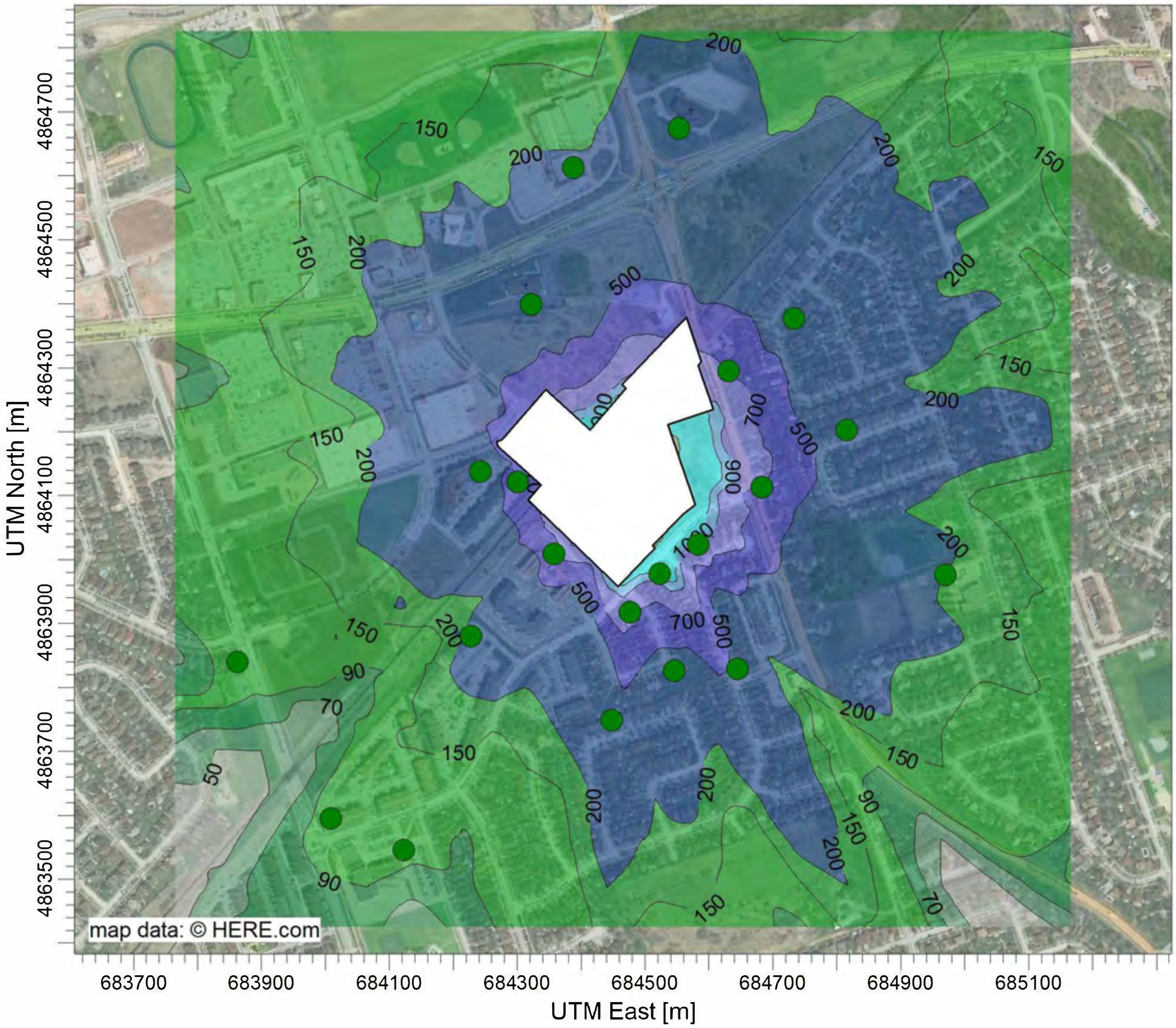


10 20 40 60 80 100 120 158

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 24-hour AAQC: 120 ug/m3<br>green circle indicates the location of a special receptor | **6** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1111** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:6,705<br>0 0.2 km | |
| | MAX:<br>**158 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-8: B4 Bowmanville TOC Construction - Contour Plot for PM10 Predicted 15-minute Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

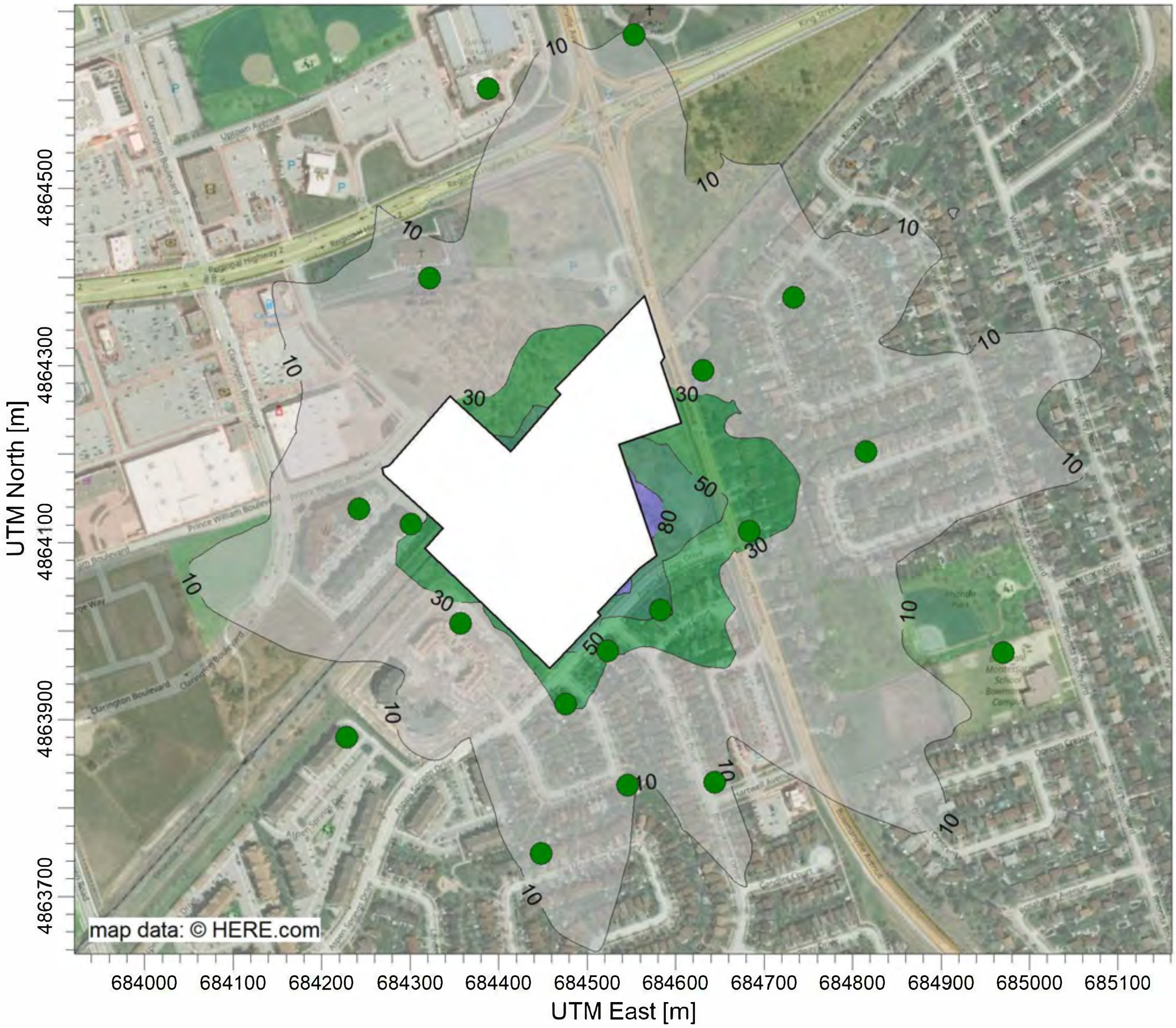
Max: 1605 [ug/m^3] at (684548.21, 4864174.82)

30 | 50 | 70 | 90 | 150 | 200 | 500 | 700 | 900 | 1000 | 1500 | 1605

| | | |
|---|---|---|
| COMMENTS:<br>15-minute Metrolinx Mitigation Threshold: 150 ug/m3<br>green circle indicates the location of a special receptor | SOURCES:<br>**6** | COMPANY NAME:<br>**Stantec Consulting Ltd.** |
| | RECEPTORS:<br>**1111** | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:10,793<br>0 — 0.4 km |
| | MAX:<br>**1605 ug/m^3** | DATE:<br>**11/9/2021** |
| | | PROJECT NO.: |

PROJECT TITLE:

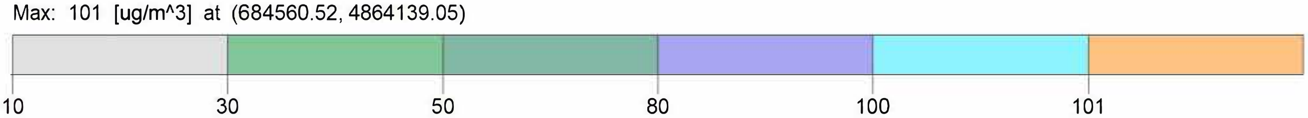
**Figure F-9: B4 Bowmanville TOC Construction - Contour Plot for PM10 Predicted 24-hour Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

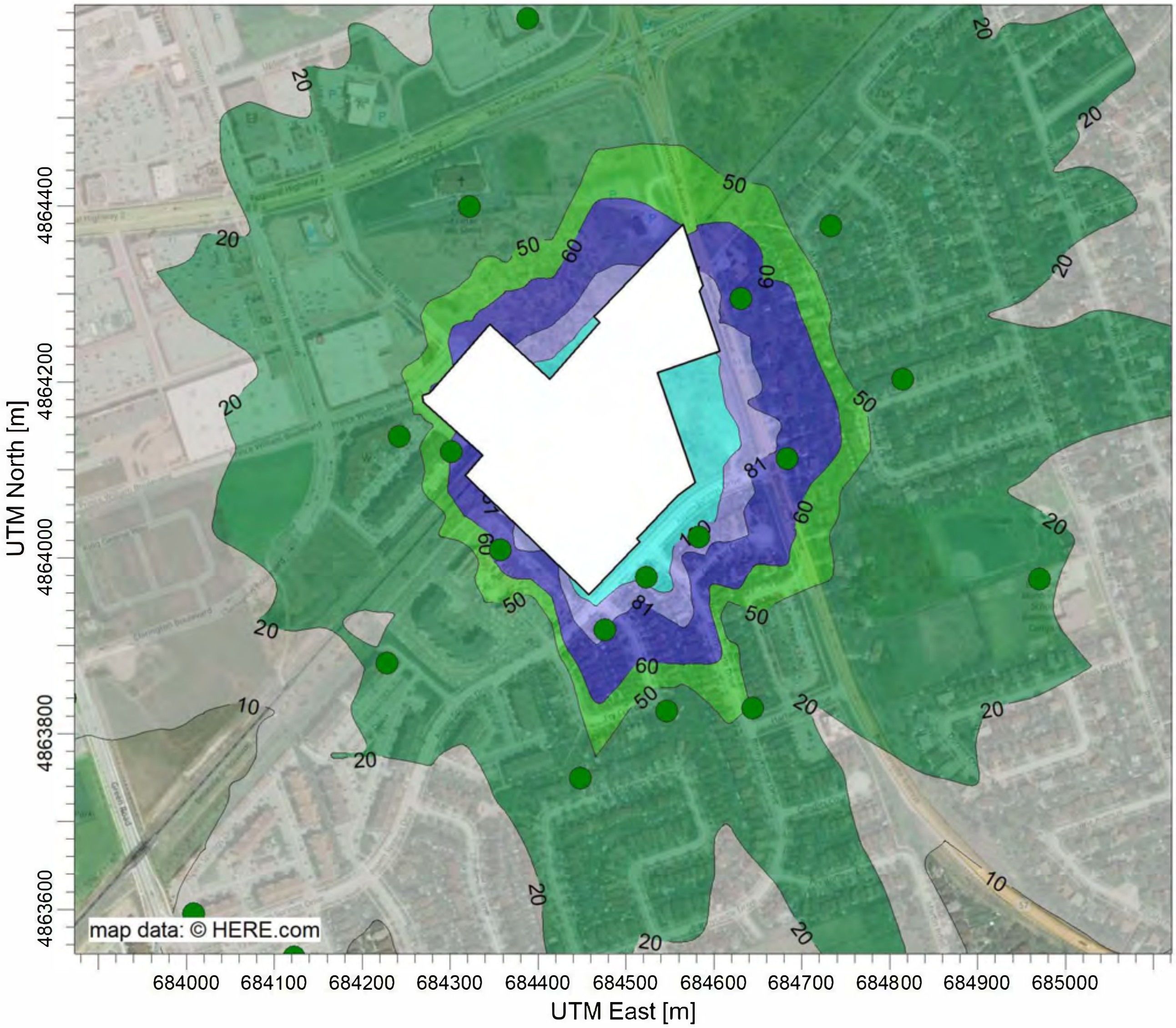
Max: 101 [ug/m^3] at (684560.52, 4864139.05)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 24-hour AAQC: 50 ug/m3<br><br>green circle indicates the location of a special receptor | **6** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1111** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:7,798<br>0 — 0.2 km | |
| | MAX:<br>**101 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-10: B4 Bowmanville TOC Construction - Contour Plot for PM2.5 Predicted 15-minute Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 163 [ug/m^3] at (684548.21, 4864174.82)


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 81 ug/m3<br><br>green circle indicates the location of a special receptor | **6** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1111** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:7,848<br>0 ─ 0.2 km | |
| | MAX:<br>**163 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-11: B4 Bowmanville TOC Construction - Contour Plots for Crystalline Silica Predicted 15-minute Average Concentrations**


PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

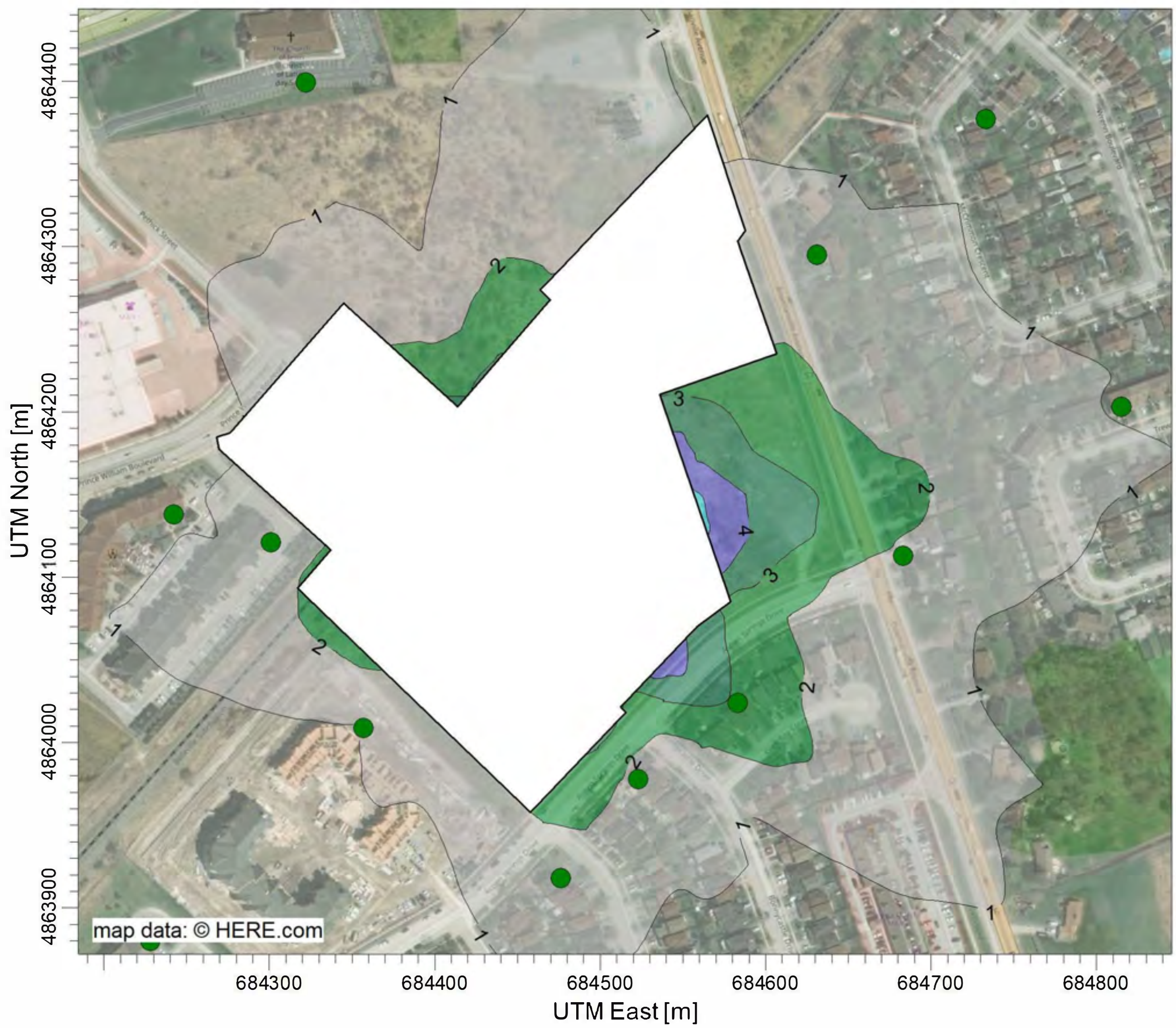
Max: 83.5 [ug/m^3] at (684548.21, 4864174.82)

10.0 25.0 40.0 50.0 60.0 80.0 83.5

| | | |
|---|---|---|
| COMMENTS: 15-minute Metrolinx Mitigation Threshold: 25 ug/m3<br>green circle indicates the location of a special receptor | SOURCES: **6** | COMPANY NAME: **Stantec Consulting Ltd.** |
| | RECEPTORS: **1111** | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:4,889<br>0 0.1 km |
| | MAX: **83.5 ug/m^3** | DATE: **11/9/2021** PROJECT NO.: |

PROJECT TITLE:

**Figure F-12: B4 Bowmanville TOC Construction - Contour Plots for Crystalline Silica Predicted 24-hour Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 5.26 [ug/m^3] at (684560.52, 4864139.05)

1.00 2.00 3.00 4.00 5.00 5.26

COMMENTS:

24-hour AAQC: 5 ug/m3

green circle indicates the location of a special receptor

SOURCES:

**6**

COMPANY NAME:

**Stantec Consulting Ltd.**

RECEPTORS:

**1111**

OUTPUT TYPE:

**Concentration**

SCALE:

1:4,156

0 0.1 km

MAX:

**5.26 ug/m^3**

DATE:

**11/9/2021**

PROJECT NO.:

PROJECT TITLE:

**Figure F-13: Track and Grading Construction (Farewell St to Harmony Rd) - Contour Plot for Nitrogen Dioxide Predicted 1-hour Average 98th Percentile Concentrations**


PLOT FILE OF 8TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: ALL ug/m^3

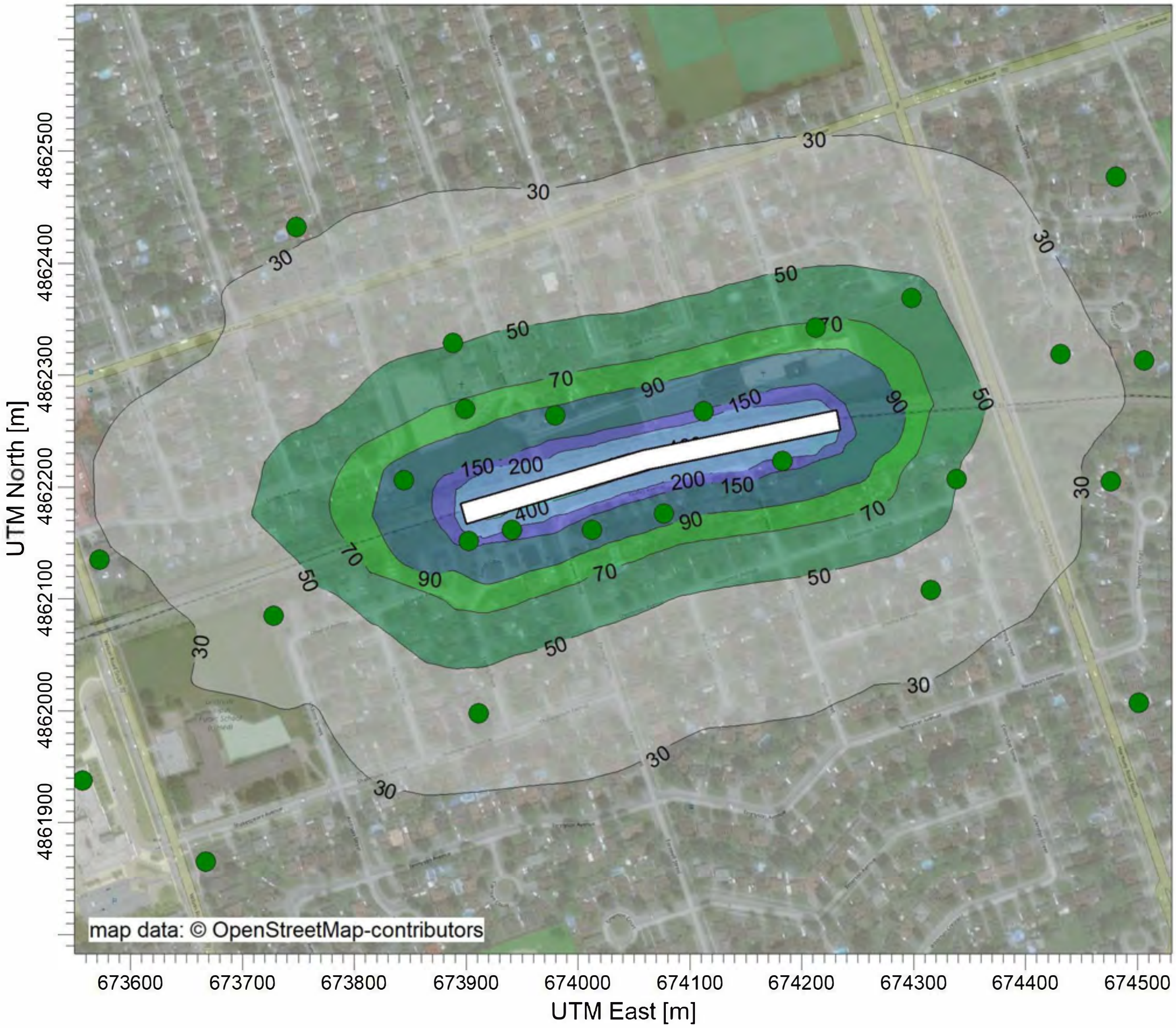
Max: 122 [ug/m^3] at (674047.92, 4862230.06)

20 | 40 | 60 | 83 | 100 | 119 | 122

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 1-hour 2020 CAAQS: 119 ug/m3<br>1-hour 2025 CAAQS: 83 ug/m3<br><br>green circle indicates the location of a special receptor | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1052** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:3,551<br>0 — 0.1 km | |
| | MAX:<br>**122 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

PROJECT TITLE:

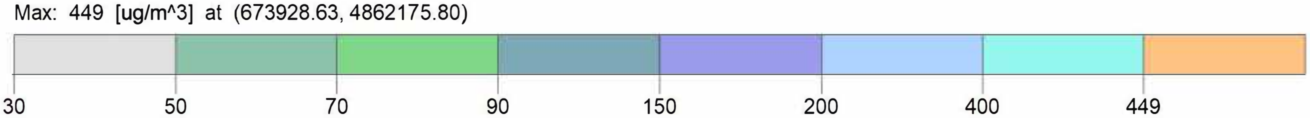
**Figure F-14: Track and Grading (Farewell Street to Harmony Road) - Contour Plot for PM10 Predicted 15-minute Average Concentrations**




PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 449 [ug/m^3] at (673928.63, 4862175.80)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 150 ug/m3 | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS: **1052** | | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:6,167 0 — 0.2 km | |
| | MAX: **449 ug/m^3** | DATE: **11/9/2021** | PROJECT NO.: |

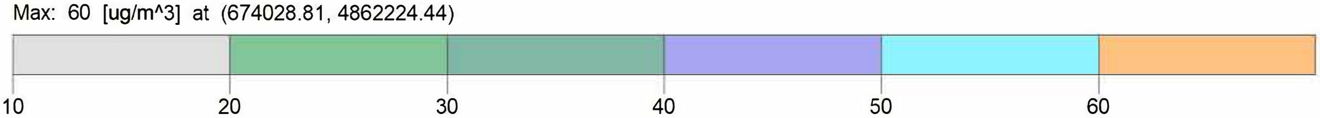
PROJECT TITLE:

**Figure F-15: Track and Grading (Farewell Street to Harmony Road) - Contour Plot for PM10 Predicted 24-hour Average Concentrations**


PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 60 [ug/m^3] at (674028.81, 4862224.44)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 15-minute Metrolinx Mitigation Threshold: 150 ug/m3 | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1052** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,736<br>0 — 0.1 km | |
| | MAX:<br>**60 ug/m^3** | DATE:<br>**11/9/2021** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

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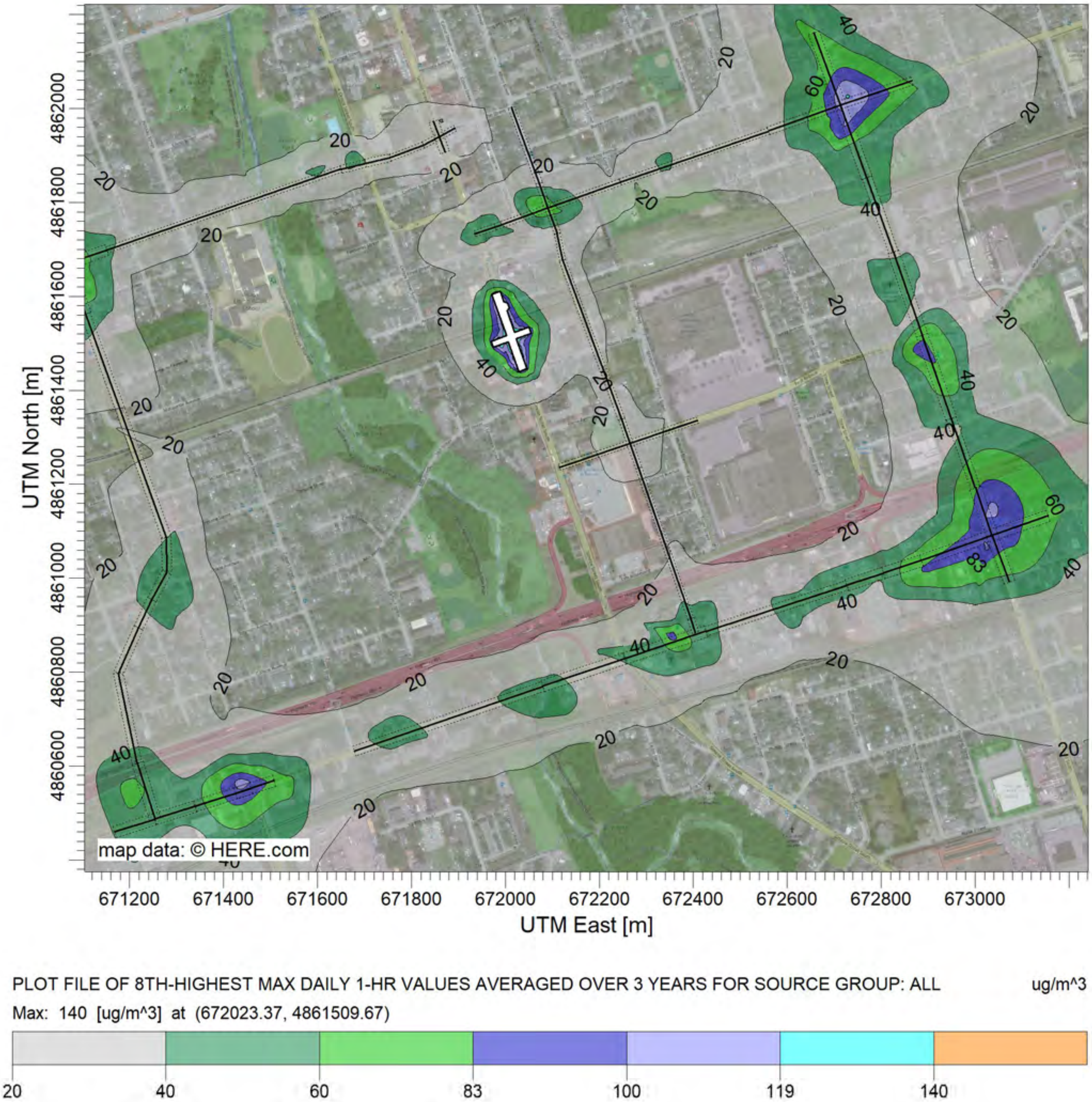
PROJECT TITLE:

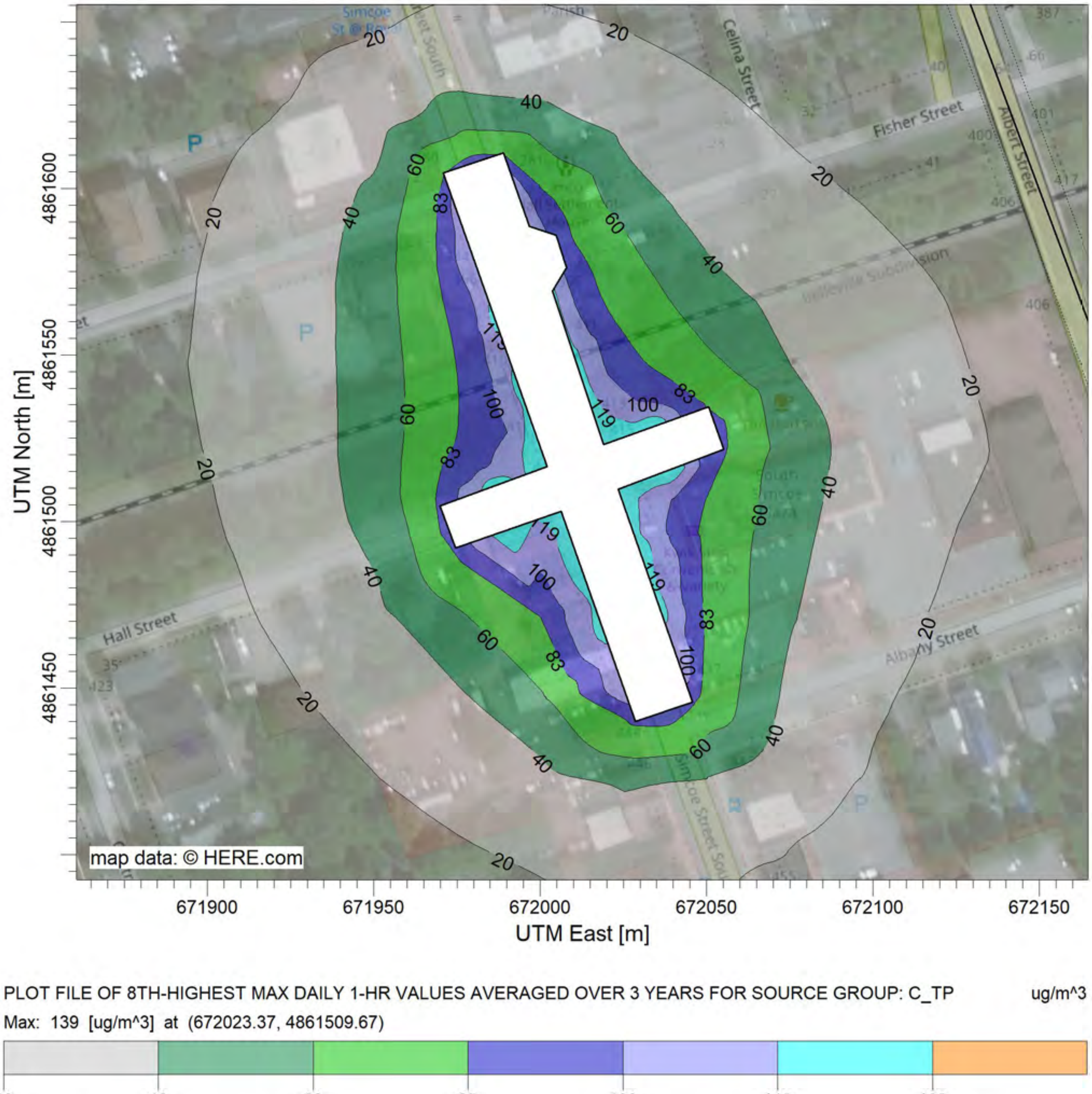
**Figure F-16: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for Nitrogen dioxide Predicted 1- hour Average 98th Percentile Concentrations for Case 1**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 1-hour 2020 CAAQS: 119 ug/m3<br>1-hour 2025 CAAQS: 83 ug/m3<br><br>Case 1 model predictions include construction tailpipe emissions and on-road vehicle emissions from detour roads. | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:13,435<br>0 — 0.5 km | |
| | MAX:<br>**140 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-17: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for Nitrogen dioxide Predicted 1- hour Average 98th Percentile Concentrations for Case 2**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 1-hour 2020 CAAQS: 119 ug/m3<br>1-hour 2025 CAAQS: 83 ug/m3<br><br>Case 2 model predictions include construction tailpipe emissions only | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:1,911<br>0 0.05 km | |
| | MAX:<br>**139 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-18: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for Nitrogen dioxide Predicted Annual Average Concentrations for Case 1**


PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: ALL

ug/m^3

Max: 26.7 [ug/m^3] at (672728.00, 4862026.00)

10.0 | 15.0 | 20.0 | 26.7

| | | | |
|---|---|---|---|
| COMMENTS:<br><br>annual 2020 CAAQS: 34 ug/m3<br>annual 2025 CAAQS: 24 ug/m3<br><br>Case 1 model predictions include construction tailpipe emissions and on-road vehicle emissions from detour roads. | SOURCES:<br>**67** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:14,749<br>0 — 0.5 km | |
| | MAX:<br>**26.7 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-19: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for Nitrogen dioxide Predicted Annual Average Concentrations for Case 2**


PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: C_TP ug/m^3

Max: 13.4 [ug/m^3] at (672023.37, 4861509.67)


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| annual 2020 CAAQS: 34 ug/m3<br>annual 2025 CAAQS: 24 ug/m3<br><br>Case 2 model predictions include construction tailpipe emissions only. | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,098<br>0 0.05 km | |
| | MAX:<br>**13.4 ug/m^3** | DATE:<br>**4/16/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-20: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for PM10 Predicted 15-minute Average Concentrations for Case 1**


PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 349 [ug/m^3] at (671992.70, 4861542.99)


COMMENTS:

15-minute Metrolinx mitigation threshold: 150 ug/m3

Scenario 1 model results include construction tailpipe emissions, construction dust and on-road vehicle travel on detour roads

SOURCES:

**67**

COMPANY NAME:

**Stantec Consulting Ltd.**

RECEPTORS:

**1870**

OUTPUT TYPE:

**Concentration**

SCALE: 1:15,524

0 0.5 km

MAX:

**349 ug/m^3**

DATE:

**1/17/2022**

PROJECT NO.:

AERMOD View - Lakes Environmental Software

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PROJECT TITLE:

**Figure F-21: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for PM10 Predicted 15-minute Average Concentration for Case 2**


PLOT FILE OF HIGH 1ST HIGH 15.0-MIN VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 344 [ug/m^3] at (671992.70, 4861542.99)

30 | 50 | 100 | 150 | 200 | 300 | 344

| | | | |
|---|---|---|---|
| COMMENTS:<br>15-minute Metrolinx mitigation threshold:150 ug/m3<br>Scenario 2 model results include construction tailpipe emissions and construction dust | SOURCES:<br>**67** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,757<br>0 — 0.1 km | |
| | MAX:<br>**344 ug/m^3** | DATE:<br>**1/17/2022** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

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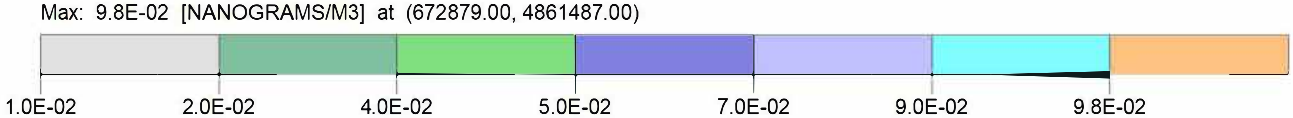
PROJECT TITLE:

**Figure F-22: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for B(a)P Predicted 24-hour Average Concentrations for Case 1**


PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL — NANOGRAMS/M3

Max: 9.8E-02 [NANOGRAMS/M3] at (672879.00, 4861487.00)




| | | | |
|---|---|---|---|
| COMMENTS:<br>24-hour AAQC: 0.05 ng/m3<br>Scenario 1 model results include construction tailpipe emissions, and on-road vehicle travel on detour roads | SOURCES:<br>**67** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:19,590<br>0 — 0.5 km | |
| | MAX:<br>**9.8E-02 NANOGRAMS/M3** | DATE:<br>**1/17/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-23: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for B(a)P Predicted 24-hour Average Concentrations for Case 2**


PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: C_TP NANOGRAMS/M3

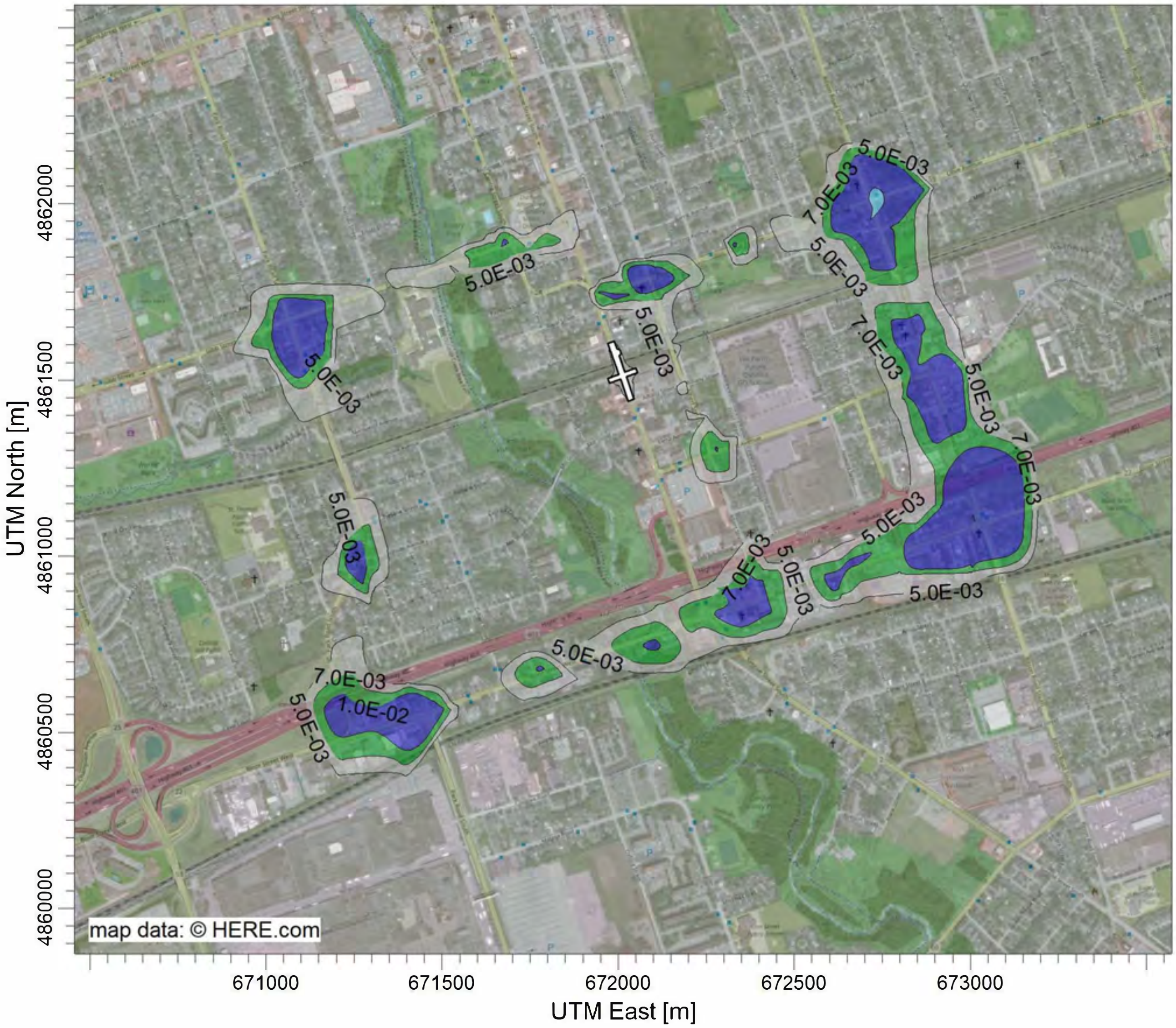
Max: 2.7E-02 [NANOGRAMS/M3] at (672023.37, 4861509.67)

1.0E-02 2.0E-02 2.7E-02

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 24-hour AAQC: 0.05 ng/m3 | **67** | **Stantec Consulting Ltd.** | |
| Scenario 2 model results include construction tailpipe emissions | RECEPTORS: **1870** | | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:2,369 (0 — 0.05 km) | |
| | MAX: **2.7E-02 NANOGRAMS/M3** | DATE: **1/17/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-24: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for B(a)P Predicted Annual Average Concentrations for Case 1**




PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: ALL NANOGRAMS/M3

Max: 3.5E-02 [NANOGRAMS/M3] at (672728.00, 4862026.00)

5.0E-03 7.0E-03 1.0E-02 3.0E-02 3.5E-02

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| annual AAQC: 0.01 ng/m3<br><br>Scenario 1 model results include construction tailpipe emissions and on-road vehicle travel on detour roads | **67** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:19,591<br>0 0.5 km | |
| | MAX:<br>**3.5E-02 NANOGRAMS/M3** | DATE:<br>**1/17/2022** | PROJECT NO.: |

AERMOD View - Lakes Environmental Software

D:\2021\Mx_BMV\Simcoe_bap_24h\Simcoe_bap_24h.isc

PROJECT TITLE:

**Figure F-25: Bridge Reconstruction Scenario (Simcoe Street Bridge) - Contour Plot for B(a)P Predicted Annual Average Concentrations for Case 2**


PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: C_TP NANOGRAMS/M3

Max: 5.2E-03 [NANOGRAMS/M3] at (672023.37, 4861509.67)

1.0E-03 3.0E-03 5.0E-03 5.2E-03

| | | | |
|---|---|---|---|
| COMMENTS:<br>annual AAQC: 0.01 ng/m3<br>Scenario 2 model results include construction tailpipe emissions | SOURCES:<br>**67** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**1870** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:2,369<br>0 0.05 km | |
| | MAX:<br>**5.2E-03 NANOGRAMS/M3** | DATE:<br>**1/17/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-26: Oshawa Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted 1-hour Average 98th Percentile Concentrations**


PLOT FILE OF 8TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: FB ug/m^3

Max: 129 [ug/m^3] at (672557.25, 4861698.68)

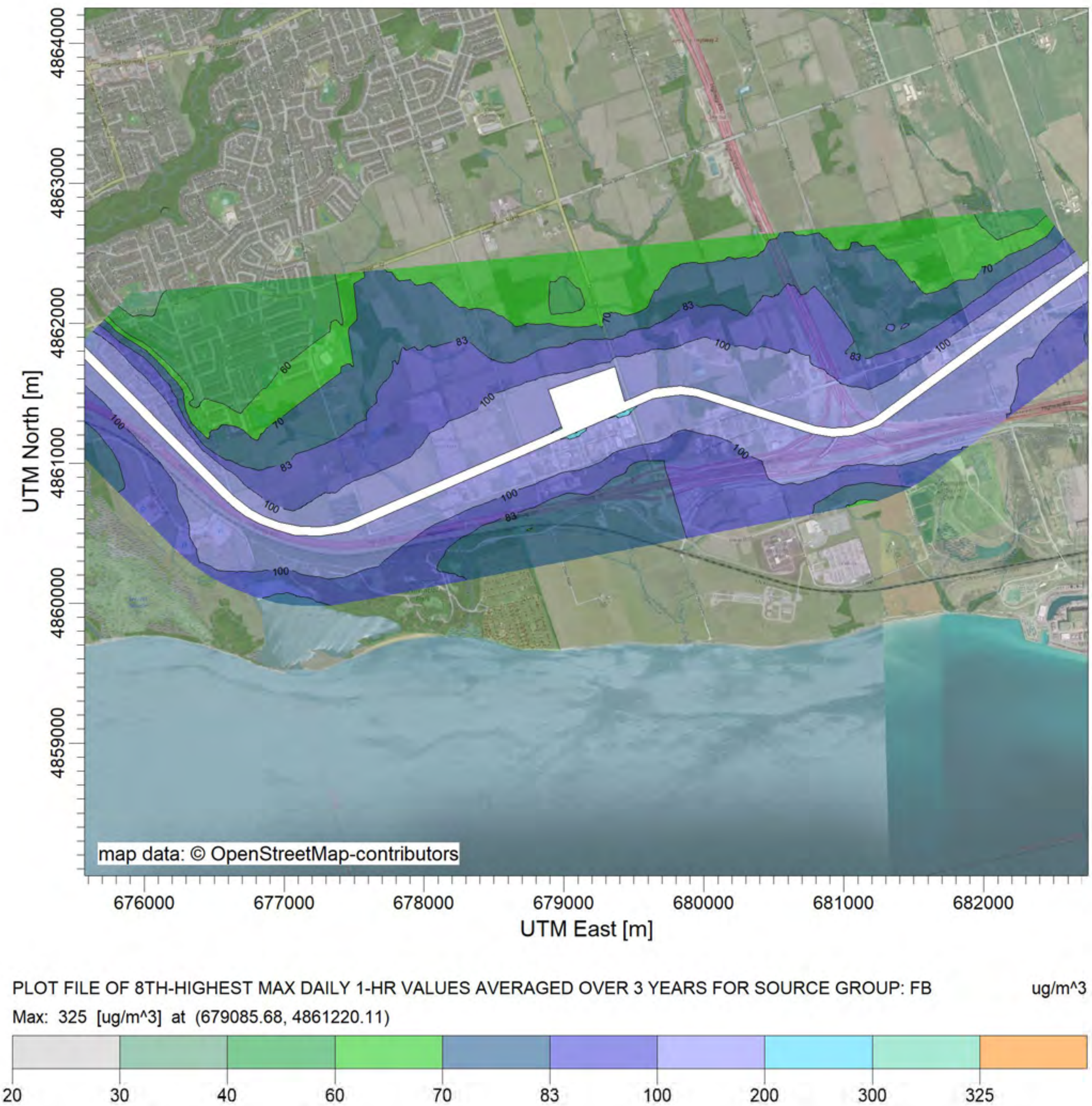
7 10 15 20 30 40 50 83 100 129

| | | |
|---|---|---|
| COMMENTS:<br>1-hour 2025 CAAQS: 83 ug/m3<br>Contour plot for meteorology data period 2018 - 2020 | SOURCES:<br>**16** | COMPANY NAME:<br>**Stantec Consulting Ltd.** |
| | RECEPTORS:<br>**7592** | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:45,238<br>0 1 km |
| | MAX:<br>**129 ug/m^3** | DATE:<br>**4/18/2022** |
| | | PROJECT NO.: |

AERMOD View - Lakes Environmental Software C:\Users\clim\Documents\Models\Aermod19191\Bowmanville_oshawa\op_Osh_caaqs3\op_Osh_caaqs3.isc

PROJECT TITLE:

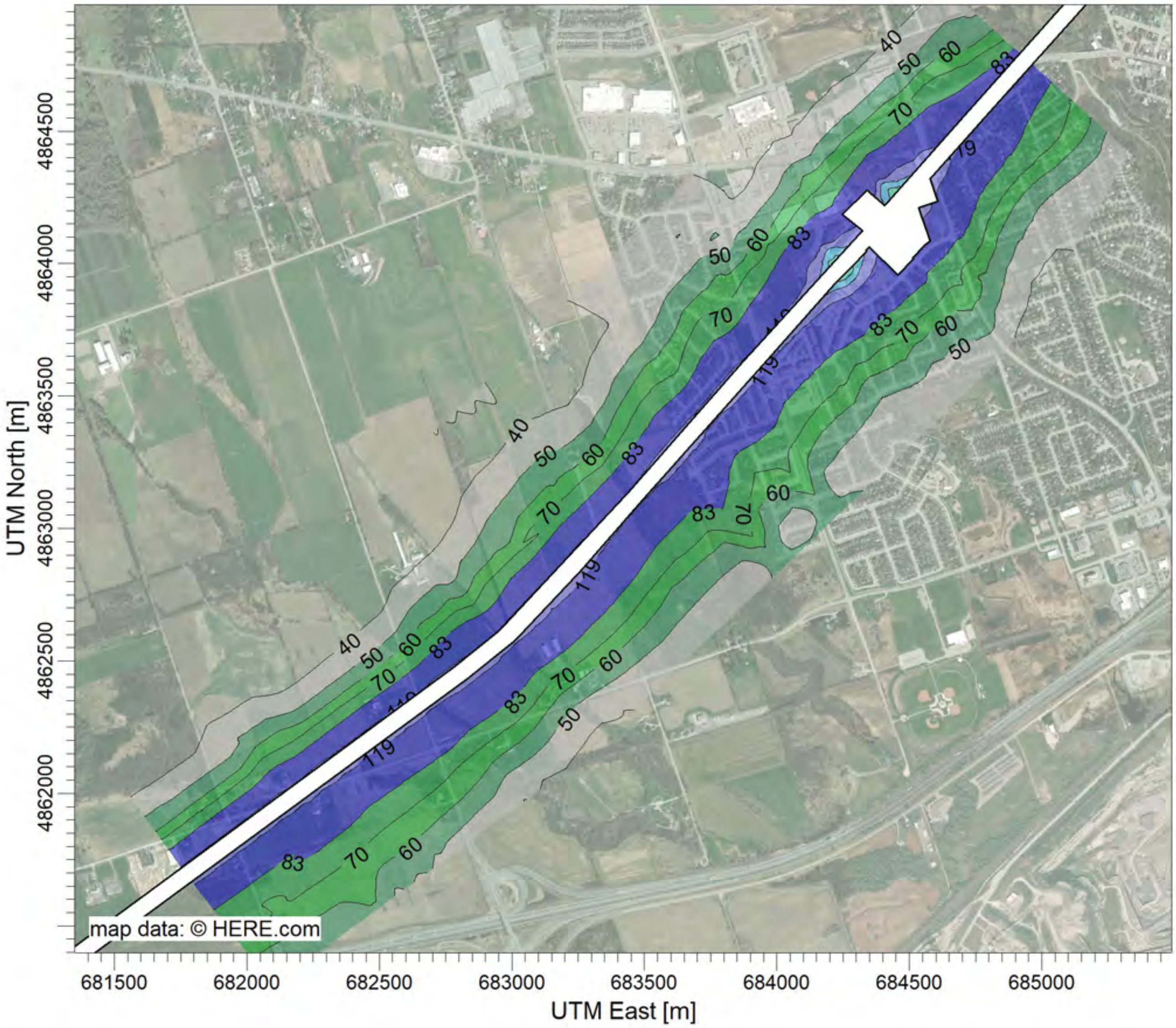
**Figure F-27: Courtice Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted 1-hour Average 98th Percentile Concentrations**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| 1-hour 2025 CAAQS:83 ug/m3<br><br>Contour plot for meteorology data period 2018 - 2020 | **12** | **Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**5432** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:45,083<br>0 1 km | |
| | MAX:<br>**325 ug/m^3** | DATE:<br>**4/19/2022** | PROJECT NO.: |

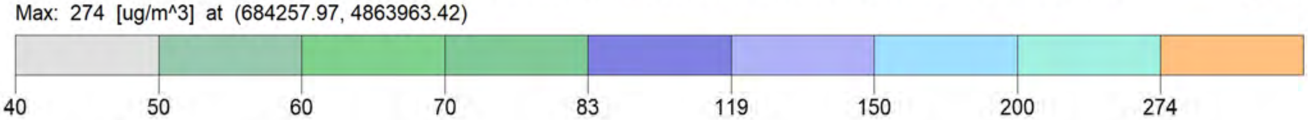
PROJECT TITLE:

**Figure F-28: Bowmanville Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted 1-hour Average 98th Percentile Concentrations**




PLOT FILE OF 8TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: FB ug/m^3

Max: 274 [ug/m^3] at (684257.97, 4863963.42)




| | | | |
|---|---|---|---|
| COMMENTS:<br>1-hour 2025 CAAQS: 83 ug/m3<br>Contour plot for meteorology data period 2017 - 2019 | SOURCES:<br>**13** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**3440** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:26,034<br>0 — 1 km | |
| | MAX:<br>**274 ug/m^3** | DATE:<br>**4/19/2022** | PROJECT NO.: |

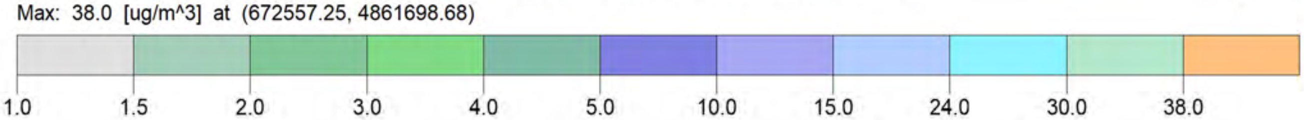
PROJECT TITLE:

**Figure F-29: Oshawa Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted Annual Average Concentrations**


PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: FB

ug/m^3

Max: 38.0 [ug/m^3] at (672557.25, 4861698.68)




| | | | |
|---|---|---|---|
| COMMENTS:<br>Annual 2025 CAAQS: 24 ug/m3 | SOURCES:<br>**16** | COMPANY NAME:<br>**Stantec Consulting Ltd.** | |
| | RECEPTORS:<br>**7592** | | |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:45,210<br>0 — 1 km | |
| | MAX:<br>**38.0 ug/m^3** | DATE:<br>**4/18/2022** | PROJECT NO.: |

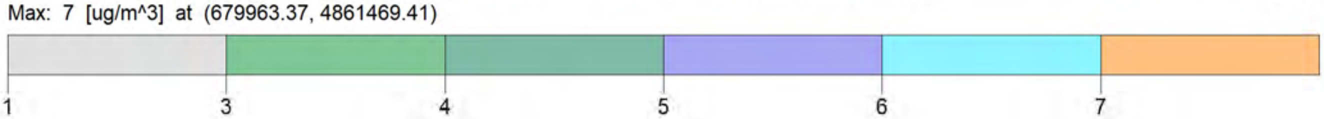
PROJECT TITLE:

**Figure F-30: Courtice Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted Annual Average Concentrations**


PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 1 YEARS FOR SOURCE GROUP: EX_FNB

ug/m^3

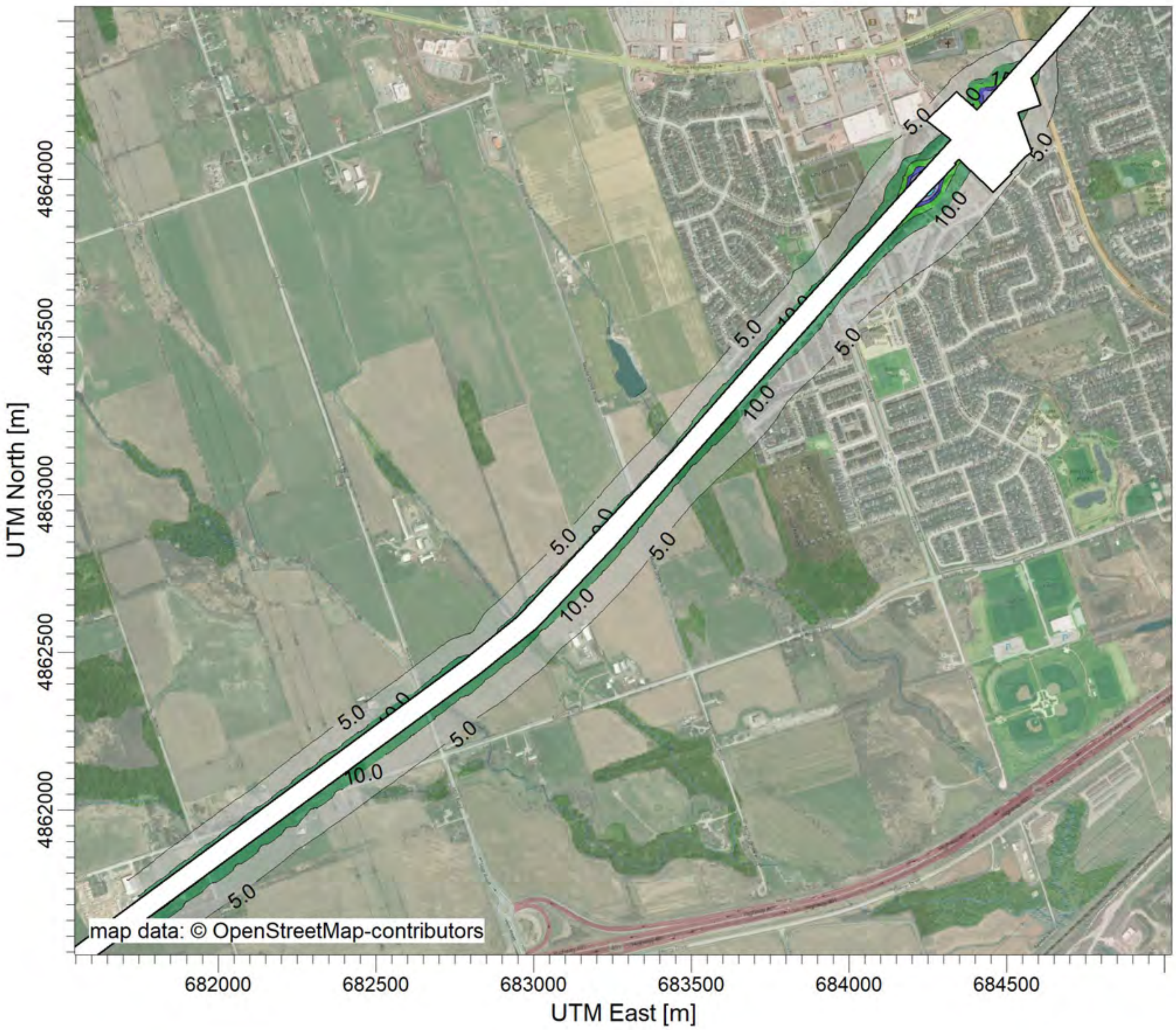
Max: 7 [ug/m^3] at (679963.37, 4861469.41)




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| Annual 2025 CAAQS: 24 ug/m3 | **12** | **Stantec Consulting Ltd.** | |
| | RECEPTORS: **5432** | | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:46,016 0 — 1 km | |
| | MAX: **7 ug/m^3** | DATE: **4/19/2022** | PROJECT NO.: |

PROJECT TITLE:

**Figure F-31: Bowmanville Segment Future Build Operation Scenario - Contour Plot for Nitrogen Dioxide Predicted Annual Average Concentrations**




PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 1 YEARS FOR SOURCE GROUP: FB — ug/m^3

Max: 37.8 [ug/m^3] at (684257.97, 4863963.42)

5.0 | 10.0 | 15.0 | 20.0 | 24.0 | 30.0 | 37.8

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| Annual 2025 CAAQS: 24 ug/m3 | **13** | **Stantec Consulting Ltd.** | |
| | RECEPTORS: **3440** | | |
| | OUTPUT TYPE: **Concentration** | SCALE: 1:21,865 (0 — 0.5 km) | |
| | MAX: **37.8 ug/m^3** | DATE: **4/19/2022** | PROJECT NO.: |

# Appendix G
## Greenhouse Gas Emission Sources and Emission Estimation

## *Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
## *Project GHG Emissions Summary*

Per the draft *"Technical Guide Related to the Strategic Assessment of Climate Change"* dated August 2021, Net GHG emissions from the Project are calculated using the following equation:

Net GHG Emissions = Direct GHG Emissions
+ Acquired Energy GHG Emissions
- Avoided Domestic GHG Emissions
- Offset measures

**Summary of Site-Wide Project GHG Emissions in kt CO2e**

| Year and Project Phase | Direct GHG emissions | Acquired energy GHG emissions | CO2 captured and stored | Avoided domestic GHG emissions | Offset credits | Net GHG emissions |
|---|---|---|---|---|---|---|
| **Construction** | | | | | | |
| 2022 | 4.0969 | 0 | 0 | 0 | 0 | 4.0969 |
| 2023 | 4.0969 | 0 | 0 | 0 | 0 | 4.0969 |
| 2024 | 4.0969 | 0 | 0 | 0 | 0 | 4.0969 |
| **Operation** | | | | | | |
| 2025 | 14.7075 | 0.3883 | 0 | 3.9971 | 0 | 11.0986 |
| 2026 | 14.7075 | 0.3883 | 0 | 4.0770 | 0 | 11.0187 |
| 2027 | 14.7075 | 0.3883 | 0 | 4.1586 | 0 | 10.9372 |
| 2028 | 14.7075 | 0.3883 | 0 | 4.2417 | 0 | 10.8540 |
| 2029 | 14.7075 | 0.3883 | 0 | 4.3266 | 0 | 10.7692 |
| 2030 | 14.7075 | 0.3883 | 0 | 4.4131 | 0 | 10.6826 |
| 2031 | 14.7075 | 0.3883 | 0 | 4.5014 | 0 | 10.5944 |
| 2032 | 14.7075 | 0.3883 | 0 | 4.5914 | 0 | 10.5043 |
| 2033 | 14.7075 | 0.3883 | 0 | 4.6832 | 0 | 10.4125 |
| 2034 | 14.7075 | 0.3883 | 0 | 4.7769 | 0 | 10.3188 |
| 2035 | 14.7075 | 0.3883 | 0 | 4.8724 | 0 | 10.2233 |
| 2036 | 14.7075 | 0.3883 | 0 | 4.9699 | 0 | 10.1259 |
| 2037 | 14.7075 | 0.3883 | 0 | 5.0693 | 0 | 10.0265 |
| 2038 | 14.7075 | 0.3883 | 0 | 5.1707 | 0 | 9.9251 |
| 2039 | 14.7075 | 0.3883 | 0 | 5.2741 | 0 | 9.8217 |
| 2040 | 14.7075 | 0.3883 | 0 | 5.3796 | 0 | 9.7162 |
| 2041 | 14.7075 | 0.3883 | 0 | 5.4871 | 0 | 9.6086 |
| 2042 | 14.7075 | 0.3883 | 0 | 5.5969 | 0 | 9.4988 |
| 2043 | 14.7075 | 0.3883 | 0 | 5.7088 | 0 | 9.3869 |
| 2044 | 14.7075 | 0.3883 | 0 | 5.8230 | 0 | 9.2727 |
| 2045 | 14.7075 | 0.3883 | 0 | 5.9395 | 0 | 9.1563 |
| 2046 | 14.7075 | 0.3883 | 0 | 6.0583 | 0 | 9.0375 |
| 2047 | 14.7075 | 0.3883 | 0 | 6.1794 | 0 | 8.9163 |
| 2048 | 14.7075 | 0.3883 | 0 | 6.3030 | 0 | 8.7927 |
| 2049 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2050 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2051 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2052 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2053 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2054 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2055 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2056 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2057 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2058 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2059 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2060 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2061 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2062 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2063 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2064 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2065 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2066 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2067 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2068 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2069 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2070 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2071 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2072 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2073 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2074 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2075 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2076 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2077 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2078 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2079 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2080 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2081 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2082 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2083 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| 2084 | 14.7075 | 0.3883 | 0 | 6.4291 | 0 | 8.6667 |
| **Decommissioning** | | | | | | |
| No data | | | | | | |

## *Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
## *Project Construction GHG Emissions Summary*

**Summary of Site-Wide GHG Emissions**

| Source Group | CO2 (kt) | CH4 (kt) | N2O (kt) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|---|---|
| **Land Use Change** | | | | |
| Land Clearing | | 0.2308 | | **0.2308** |
| **Track & Grading** | | | | |
| On-road and Off-road equipment on-site | 2.68 | 1.40E-04 | 8.19E-05 | **3.7099** |
| **Station Platforms** | | | | |
| On-road and Off-road equipment on-site | 2.44 | 1.28E-04 | 7.48E-05 | **3.5681** |
| **Bridge Expansions** | | | | |
| **modified bridges** | | | | |
| On-road and Off-road equipment on-site | 0.10 | 5.32E-06 | 3.12E-06 | **0.1897** |
| **new bridges** | | | | |
| On-road and Off-road equipment on-site | 1.43 | 7.47E-05 | 4.38E-05 | **2.0354** |
| **bridge replacements** | | | | |
| On-road and Off-road equipment on-site | 1.72 | 9.01E-05 | 5.28E-05 | **2.3981** |
| **At-Grade Crossing upgrades** | | | | |
| On-road and Off-road equipment on-site | 0.12 | 6.37E-06 | 3.73E-06 | **0.1588** |
| **Total GHG Emissions During Construction (kt CO2 eq over a 3-year period)** | | | | **12.2908** |
| **Estimated Annual GHG Emissions During Construction** | | | | **4.0969** |

Note: The original GHG assessment assumes that Albert Street Bridge will be reconstructed. Since the completion of the original GHG assessment, Albert Street Bridge will only be removed and not reconstructed. The GHG quantification has not been updated to reflect this change. The results should be conservative.

## *Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
## *Project Operation GHG Emissions Summary*

**Summary of Site-Wide GHG Emissions**

| Source Group | CO2 (kt) | CH4 (kt) | N2O (kt) | Estimated GHG Emissions (kt CO2 eq/year) |
|---|---|---|---|---|
| **Direct Emission Sources** | | | | |
| GO Trains | 12.1430 | 6.75E-04 | 4.66E-03 | **13.5490** |
| GO Buses | 1.1414 | 5.96E-05 | 3.49E-05 | **1.1533** |
| Stationary fuel combustion equipment | 0.0051 | 1.38E-07 | 4.17E-08 | **0.0051** |
| **Indirect Emission Sources** | | | | |
| Electricity consumption | | 0.3883 | | **0.3883** |
| | **Total GHG During Operation (kt CO2 eq/year)** | | | **15.0957** |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Land Use Change***

**Greenhouse Gas Emissions During Project Construction: Land Clearing**

**Description:**
Greenhouse gas (GHG) emissions generated as a result of land clearing.

**Contaminant(s) of Concern:**
Emissions of stored CO2.

| | | |
|---|---|---|
| **Land clearing area** | 121 acres | estimated vegetative area within Project footprint |
| **Type of existing vegetation in area to be cleared** | Upland mixed wood forest | worst case assumption |

Since the area to be cleared does not contain a significant amount of forested area, greenhouse gas emissions from the change in land cover is expected to be insignificant. To illustrate the impact, 121 acres of fully forested land typically has 230.8 tonnes CO2e sink potential.
Emissions from equipment used for any land clearing is included in the construction vehicles calculations.

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Track & Grading***

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during track and grading of the new corridor.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
- On-road construction
- Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
- FC = annual fuel consumed (volume/yr);
- ER = equipment rating (hp, kW, or J);
- LF = equipment load factor (fraction);
- OT = annual operating time (hr/yr);
- ETT = equipment thermal efficiency ($Btu_{input}/hp\text{-}hr_{output}$, $Btu_{input}/kW\text{-}hr_{output}$, or $J_{input}/J_{output}$).; and
- HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Grading | | | Track | | | Fuel Usage (L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Power Rating (hp/equipment) [2] | Fuel Type | Operating Load [3] | Equipment Type | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Grading | Track | Total |
| Backhoe | 120 | Diesel | 40% | Off-Road | 2 | 50% | 18 | | | 18 | 32,176 | 0 | 32,176 |
| Ballast regulator | 250 | Diesel | 50% | Off-Road | | | 18 | 2 | 50% | 6 | 0 | 27,931 | 27,931 |
| Bobcat | 115 | Diesel | 40% | Off-Road | | | 18 | 1 | 50% | 18 | 0 | 15,418 | 15,418 |
| Compactor | 100 | Diesel | 20% | Off-Road | 2 | 50% | 18 | | | 18 | 13,407 | 0 | 13,407 |
| Concrete truck | 500 | Diesel | 40% | On-Road | 4 | 10% | 18 | | | 18 | 53,627 | 0 | 53,627 |
| Crane | 270 | Diesel | 16% | Off-Road | 1 | 50% | 18 | 1 | 10% | 18 | 14,479 | 2,896 | 17,375 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 4 | 50% | 18 | 2 | 50% | 18 | 321,760 | 160,880 | 482,641 |
| Dynamic stabilizer | 475 | Diesel | 50% | Off-Road | | | 18 | 1 | 50% | 6 | 0 | 26,534 | 26,534 |
| Flatbed truck | 360 | Diesel | 40% | On-Road | 1 | 10% | 18 | 1 | 50% | 18 | 9,653 | 48,264 | 57,917 |
| Flash butt rail welder | 402 | Diesel | 40% | Off-Road | | | 18 | 1 | | 6 | 0 | 0 | 0 |
| Front end loader | 300 | Diesel | 40% | Off-Road | 2 | 50% | 18 | 1 | 50% | 18 | 80,440 | 40,220 | 120,660 |
| Grader | 200 | Diesel | 40% | Off-Road | 2 | 50% | 18 | | | 18 | 53,627 | 0 | 53,627 |
| Locomotive / rail cars | - | - | - | - | | | 18 | 1 | 0% | 18 | - | - | - |
| Pickup truck | 290 | Diesel | 40% | On-Road | 4 | 50% | 18 | 6 | 50% | 18 | 155,518 | 233,276 | 388,794 |
| Rail drill | 4 | Diesel | 20% | Off-Road | | | 18 | 1 | 10% | 18 | 0 | 54 | 54 |
| Rail grinder | 30 | Diesel | 50% | Off-Road | | | 18 | 1 | 0% | 18 | 0 | 0 | 0 |
| Rail saw | 50 | Diesel | 20% | Off-Road | | | 18 | 1 | 10% | 18 | 0 | 670 | 670 |
| Speedswing | 163 | Diesel | 50% | Off-Road | | | 18 | 1 | 50% | 18 | 0 | 27,316 | 27,316 |
| Spike machine | 140 | Diesel | 50% | Off-Road | | | 18 | 1 | 5% | 18 | 0 | 2,346 | 2,346 |
| Track liner/tamper | 270 | Diesel | 50% | Off-Road | | | 18 | 2 | 50% | 6 | 0 | 30,165 | 30,165 |
| Water truck | 285 | Diesel | 40% | On-Road | 1 | 10% | 18 | 1 | 10% | 18 | 7,642 | 7,642 | 15,284 |
| Zoomboom | 110 | Diesel | 20% | Off-Road | | | 18 | 1 | 10% | 18 | 0 | 1,475 | 1,475 |
| | | | | | | | | | | | **742,328** | **625,087** | **1,367,415** |

**Notes:**
1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.
3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.
4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of equipment is used is estimated by the Project design team.
5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 369,153 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 989,515 | kg | Calculated |
| CH4 | 26.9 | kg | Calculated |
| N2O | 53.5 | kg | Calculated |
| **Total emissions** | **1,006.1** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios:

| | |
|---|---|
| Tier 3 | 40% |
| Tier 4 | 60% |

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 998,262 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2021, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 2,675,841 | kg | Calculated |
| CH4 | 140 | kg | Calculated |
| N2O | 82 | kg | Calculated |
| **Total emissions** | **2,704** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 1.0061 | **3.7099** |
| On-road equipment on-site | 2.7037 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Stations***

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during the construction of each station.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
• On-road construction
• Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}$/hp-hr $_{output}$, $Btu_{input}$/kW-hr $_{output}$, or $J_{input}/J_{output}$); and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Clearing | | | Parking construction | | | Building/Platform construction | | | Fuel Usage (L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Power Rating (hp/equipment) [2] | Fuel Type | Operating Load [3] | Equipment Type | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Clearing | Parking construction | Building/Platform construction | Total |
| Asphalt spreader | 142 | Diesel | 50% | Off-Road | | | 1 | 1 | 10% | 9 | | | 24 | 0 | 2,380 | 0 | 2,380 |
| Backhoe | 120 | Diesel | 40% | Off-Road | 1 | 50% | 1 | 1 | 10% | 9 | 1 | 10% | 24 | 894 | 1,609 | 4,290 | 6,793 |
| Bobcat | 115 | Diesel | 40% | Off-Road | | | 1 | | | 9 | 1 | 50% | 24 | 0 | 0 | 20,557 | 20,557 |
| Caisson auger | 300 | Diesel | 20% | Off-Road | | | 1 | | | 9 | 1 | 10% | 24 | 0 | 0 | 5,363 | 5,363 |
| Compactor | 100 | Diesel | 20% | Off-Road | | | 1 | 1 | 50% | 9 | 1 | 10% | 24 | 0 | 3,352 | 1,788 | 5,139 |
| Concrete truck | 500 | Diesel | 40% | On-Road | | | 1 | 1 | 10% | 9 | 1 | 10% | 24 | 0 | 6,703 | 17,876 | 24,579 |
| Crane | 270 | Diesel | 16% | Off-Road | | | 1 | 1 | 50% | 0 | 1 | 10% | 24 | 0 | 0 | 3,861 | 3,861 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 4 | 50% | 1 | 2 | 50% | 9 | 1 | 10% | 24 | 17,876 | 80,440 | 21,451 | 119,766 |
| Earth scraper | 600 | Diesel | 40% | Off-Road | 1 | 50% | 1 | | | 9 | | | 24 | 4,469 | 0 | 0 | 4,469 |
| Flatbed truck | 360 | Diesel | 40% | On-Road | | | 1 | 1 | 10% | 9 | 1 | 50% | 24 | 0 | 4,826 | 64,352 | 69,178 |
| Front end loader | 300 | Diesel | 40% | Off-Road | | | 1 | 1 | 50% | 9 | | | 24 | 0 | 20,110 | 0 | 20,110 |
| Grader | 200 | Diesel | 40% | Off-Road | | | 1 | 1 | 50% | 9 | | | 24 | 0 | 13,407 | 0 | 13,407 |
| Paving roller | 100 | Diesel | 20% | Off-Road | | | 1 | 2 | 10% | 9 | | | 24 | 0 | 1,341 | 0 | 1,341 |
| Water truck | 285 | Diesel | 40% | On-Road | 1 | 10% | 1 | 1 | 10% | 9 | 1 | 10% | 24 | 425 | 3,821 | 10,189 | 14,435 |
| Welder | 210 | Diesel | 40% | Off-Road | | | 1 | | | 9 | 1 | 10% | 24 | 0 | 0 | 7,508 | 7,508 |
| Zoomboom | 110 | Diesel | 20% | Off-Road | | | 1 | | | 9 | 1 | 50% | 24 | 0 | 0 | 9,832 | 9,832 |
| | | | | | | | | | | | | | | **23,238** | **132,827** | **139,537** | **295,602** |

**Notes:**
1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of
5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 100,758 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 270,082 | kg | Calculated |
| CH4 | 7.4 | kg | Calculated |
| N2O | 14.6 | kg | Calculated |
| **Total emissions** | **274.6** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%
Tier 4 60%

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 227,958 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 611,042 | kg | Calculated |
| CH4 | 32 | kg | Calculated |
| N2O | 19 | kg | Calculated |
| **Total emissions** | **617** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions per Station**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 0.2746 | **0.8920** |
| On-road equipment on-site | 0.6174 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Modified Bridges***

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during the construction of a modified bridge.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
• On-road construction
• Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}/hp\text{-}hr_{output}$, $Btu_{input}/kW\text{-}hr_{output}$, or $J_{input}/J_{output}$).; and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Removals and Site Preparation | | | Abutment underpinning | | | Site clean up | | | Fuel Usage (L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Power Rating (hp/equipment) [2] | Fuel Type | Operating Load [3] | Equipment Type | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Removals and Site Preparation | Abutment underpinning | Site clean up | Total |
| Augers/Drill Rig | 260 | Diesel | 20% | Off-Road | | | 1 | 2 | 10% | 3 | | | 1 | 0 | 1,162 | 0 | 1,162 |
| Backhoe | 120 | Diesel | 40% | Off-Road | 1 | 50% | 1 | 1 | 50% | 3 | | | 1 | 894 | 2,681 | 0 | 3,575 |
| Bobcat | 115 | Diesel | 40% | Off-Road | 1 | 50% | 1 | | | 3 | 1 | 50% | 1 | 857 | 0 | 857 | 1,713 |
| Boom truck | 500 | Diesel | 50% | Off-Road | | | 1 | 1 | 10% | 3 | | | 1 | 0 | 2,793 | 0 | 2,793 |
| Concrete breaker | 68 | Diesel | 50% | Off-Road | 1 | 10% | 1 | | | 3 | | | 1 | 127 | 0 | 0 | 127 |
| Concrete pump | 100 | Diesel | 20% | Off-Road | | | 1 | 1 | 10% | 3 | | | 1 | 0 | 223 | 0 | 223 |
| Concrete saw | 50 | Diesel | 20% | Off-Road | 1 | 10% | 1 | | | 3 | | | 1 | 37 | 0 | 0 | 37 |
| Concrete truck | 500 | Diesel | 40% | On-Road | | | 1 | 2 | 10% | 3 | | | 1 | 0 | 4,469 | 0 | 4,469 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 2 | 50% | 1 | 1 | 10% | 3 | 1 | 10% | 1 | 8,938 | 2,681 | 894 | 12,513 |
| Flatbed truck | 360 | Diesel | 40% | On-Road | | | 1 | 1 | 10% | 3 | | | 1 | 0 | 1,609 | 0 | 1,609 |
| Pile Driver | 240 | Diesel | 50% | Off-Road | | | 1 | 1 | 10% | 3 | | | 1 | 0 | 1,341 | 0 | 1,341 |
| Water truck | 285 | Diesel | 40% | On-Road | | | 1 | | | 3 | 1 | 10% | 1 | 0 | 0 | 425 | 425 |
| Welder | 210 | Diesel | 40% | Off-Road | | | 1 | 1 | 50% | 3 | | | 1 | 0 | 4,692 | 0 | 4,692 |
| Zoomboom | 110 | Diesel | 20% | Off-Road | | | 1 | 1 | 10% | 3 | | | 1 | 0 | 246 | 0 | 246 |
| | | | | | | | | | | | | | **Total** | **10,852** | **21,898** | **2,175** | **34,924** |

**Notes:**
1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An “acoustical usage factor” for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of equipment is used is estimated by the Project design team.
5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 15,909 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 42,645 | kg | Calculated |
| CH4 | 1.2 | kg | Calculated |
| N2O | 2.3 | kg | Calculated |
| **Total emissions** | **43.4** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%; Tier 4 60%

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 19,015 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 50,970 | kg | Calculated |
| CH4 | 3 | kg | Calculated |
| N2O | 2 | kg | Calculated |
| **Total emissions** | **52** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions per Modified Bridge**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 0.0434 | **0.0949** |
| On-road equipment on-site | 0.0515 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: New Bridges***

## Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during the construction of a new bridge.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
• On-road construction
• Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}/hp\text{-}hr_{output}$, $Btu_{input}/kW\text{-}hr_{output}$, or $J_{input}/J_{output}$).; and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Utility relocation and road closure | | | Abutment construction | | | Span construction | | | Road reinstatement | | | Site clean up | | | Fuel Usage (L) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Power Rating (hp/equipment) [2] | Fuel Type | Operating Load [3] | Equipment Type | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Total Number of Equipment to be Used Onsite[1] | % time used [4] | Duration (months) [1,5] | Utility relocation and road closure | Abutment construction | Span construction | Road reinstatement | Site clean up | Total |
| Asphalt spreader | 142 | Diesel | 50% | Off-Road | | | 6 | | | 1 | | | 2 | 1 | 10% | 2 | | | 1 | 0 | 0 | 0 | 529 | 0 | 529 |
| Augers/Drill Rig | 260 | Diesel | 20% | Off-Road | | | 6 | 1 | 50% | 1 | | | 2 | | | 2 | | | 1 | 0 | 968 | 0 | 0 | 0 | 968 |
| Backhoe | 120 | Diesel | 40% | Off-Road | 1 | 50% | 6 | 2 | 50% | 1 | | | 2 | | | 2 | | | 1 | 5,363 | 1,788 | 0 | 0 | 0 | 7,150 |
| Bobcat | 115 | Diesel | 40% | Off-Road | 1 | 50% | 6 | | | 1 | | | 2 | | | 2 | 1 | 50% | 1 | 5,139 | 0 | 0 | 0 | 857 | 5,996 |
| Boom truck | 500 | Diesel | 50% | Off-Road | 1 | 10% | 6 | | | 1 | 1 | 10% | 2 | 1 | 50% | 2 | | | 1 | 5,586 | 0 | 1,862 | 9,310 | 0 | 16,758 |
| Compactor | 100 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 2 | 1 | 10% | 2 | | | 1 | 447 | 0 | 0 | 149 | 0 | 596 |
| Concrete breaker | 68 | Diesel | 50% | Off-Road | | | 6 | | | 1 | | 10% | 2 | | | 2 | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Concrete pump | 100 | Diesel | 20% | Off-Road | | | 6 | 1 | 10% | 1 | 1 | 10% | 2 | | | 2 | | | 1 | 0 | 74 | 149 | 0 | 0 | 223 |
| Concrete truck | 500 | Diesel | 40% | On-Road | | | 6 | 4 | 10% | 1 | 4 | 10% | 2 | | | 2 | | | 1 | 0 | 2,979 | 5,959 | 0 | 0 | 8,938 |
| Crane | 270 | Diesel | 16% | Off-Road | | | 6 | | | 1 | | | 2 | | | 2 | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 2 | 50% | 6 | 1 | 10% | 1 | | | 2 | 2 | 50% | 2 | 1 | 10% | 1 | 53,627 | 894 | 0 | 17,876 | 894 | 73,290 |
| Flatbed truck | 360 | Diesel | 40% | On-Road | | | 6 | 1 | 10% | 1 | 1 | 10% | 2 | | | 2 | | | 1 | 0 | 536 | 1,073 | 0 | 0 | 1,609 |
| Pavement saw | 50 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 2 | | | 2 | | | 1 | 223 | 0 | 0 | 0 | 0 | 223 |
| Paving roller | 100 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 2 | 1 | 10% | 2 | | | 1 | 447 | 0 | 0 | 149 | 0 | 596 |
| Pile Driver | 240 | Diesel | 50% | Off-Road | | | 6 | 1 | 50% | 1 | | | 2 | | | 2 | | | 1 | 0 | 2,234 | 0 | 0 | 0 | 2,234 |
| Water truck | 285 | Diesel | 40% | On-Road | 1 | 10% | 6 | 1 | 10% | 1 | 1 | 10% | 2 | 1 | 10% | 2 | 1 | 10% | 1 | 2,547 | 425 | 849 | 849 | 425 | 5,095 |
| Zoomboom | 110 | Diesel | 20% | Off-Road | | | 6 | | | 1 | 1 | 50% | 2 | | | 2 | | | 1 | 0 | 0 | 819 | 0 | 0 | 819 |
| | | | | | | | | | | | | | | | | | | | **Total** | **73,379** | **9,899** | **10,710** | **28,862** | **2,175** | **125,025** |

**Notes:**
1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of equipment is used is estimated by the Project design team.

5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 36,094 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 96,749 | kg | Calculated |
| CH4 | 2.6 | kg | Calculated |
| N2O | 5.2 | kg | Calculated |
| **Total emissions** | **98.4** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%
Tier 4 60%

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 88,931 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 238,380 | kg | Calculated |
| CH4 | 12 | kg | Calculated |
| N2O | 7 | kg | Calculated |
| **Total emissions** | **241** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions per New Bridge**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 0.0984 | **0.3392** |
| On-road equipment on-site | 0.2409 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Bridge Replacements***

**Source: Construction Non-Road Mobile Equipment Emissions (Various Phases)**

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during bridge replacement activities.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
• On-road construction
• Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}/hp\text{-}hr_{output}$, $Btu_{input}/kW\text{-}hr_{output}$, or $J_{input}/J_{output}$).; and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Utility relocation and road closure | | | Demolition of existing bridge | | | Abutment construction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Power Rating (hp/equipment)[2] | Fuel Type | Operating Load[3] | Equipment Type | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] |
| Asphalt spreader | 142 | Diesel | 50% | Off-Road | | | 6 | | | 1 | | | 1 |
| Augers/Drill Rig | 260 | Diesel | 20% | Off-Road | | | 6 | | | 1 | 1 | 50% | 1 |
| Backhoe | 120 | Diesel | 40% | Off-Road | 1 | 50% | 6 | 2 | 50% | 1 | 2 | 50% | 1 |
| Bobcat | 115 | Diesel | 40% | Off-Road | 1 | 50% | 6 | 1 | 50% | 1 | | | 1 |
| Boom truck | 500 | Diesel | 50% | Off-Road | 1 | 10% | 6 | | | 1 | | | 1 |
| Compactor | 100 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 1 |
| Concrete breaker | 68 | Diesel | 50% | Off-Road | | | 6 | 2 | 50% | 1 | | | 1 |
| Concrete pump | 100 | Diesel | 20% | Off-Road | | | 6 | | | 1 | 1 | 10% | 1 |
| Concrete truck | 500 | Diesel | 40% | On-Road | | | 6 | | | 1 | 4 | 10% | 1 |
| Crane | 270 | Diesel | 16% | Off-Road | | | 6 | 1 | 5% | 1 | | | 1 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 2 | 50% | 6 | 4 | 50% | 1 | 1 | 10% | 1 |
| Flatbed truck | 360 | Diesel | 40% | On-Road | | | 6 | | | 1 | 1 | 10% | 1 |
| Pavement saw | 50 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 1 |
| Paving roller | 100 | Diesel | 20% | Off-Road | 1 | 10% | 6 | | | 1 | | | 1 |
| Pile Driver | 240 | Diesel | 50% | Off-Road | | | 6 | | | 1 | 1 | 50% | 1 |
| Water truck | 285 | Diesel | 40% | On-Road | 1 | 10% | 6 | 1 | 10% | 1 | 1 | 10% | 1 |
| Zoomboom | 110 | Diesel | 20% | Off-Road | | | 6 | | | 1 | | | 1 |

| | Span construction | | | Road reinstatement | | | Site clean up | | | Fuel Usage (L) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Equipment[1] | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] | Total Number of Equipment to be Used Onsite[1] | % time used[4] | Duration (months)[1,5] | Utility relocation and road closure | Demolition of existing bridge | Abutment construction | Span construction | Road reinstatement | Site clean up | Total |
| Asphalt spreader | | | 2 | 1 | 10% | 2 | | | 1 | 0 | 0 | 0 | 0 | 529 | 0 | 529 |
| Augers/Drill Rig | | | 2 | | | 2 | | | 1 | 0 | 0 | 968 | 0 | 0 | 0 | 968 |
| Backhoe | | | 2 | | | 2 | | | 1 | 5,363 | 1,788 | 1,788 | 0 | 0 | 0 | 8,938 |
| Bobcat | | | 2 | | | 2 | 1 | 50% | 1 | 5,139 | 857 | 0 | 0 | 0 | 857 | 6,852 |
| Boom truck | 1 | 10% | 2 | 1 | 50% | 2 | | | 1 | 5,586 | 0 | 0 | 1,862 | 9,310 | 0 | 16,758 |
| Compactor | | | 2 | 1 | 10% | 2 | | | 1 | 447 | 0 | 0 | 0 | 149 | 0 | 596 |
| Concrete breaker | | 10% | 2 | | | 2 | | | 1 | 0 | 1,266 | 0 | 0 | 0 | 0 | 1,266 |
| Concrete pump | 1 | 10% | 2 | | | 2 | | | 1 | 0 | 0 | 74 | 149 | 0 | 0 | 223 |
| Concrete truck | 4 | 10% | 2 | | | 2 | | | 1 | 0 | 0 | 2,979 | 5,959 | 0 | 0 | 8,938 |
| Crane | | | 2 | | | 2 | | | 1 | 0 | 80 | 0 | 0 | 0 | 0 | 80 |
| Dump Truck | | | 2 | 2 | 50% | 2 | 1 | 10% | 1 | 53,627 | 17,876 | 894 | 0 | 17,876 | 894 | 91,165 |
| Flatbed truck | 1 | 10% | 2 | | | 2 | | | 1 | 0 | 0 | 536 | 1,073 | 0 | 0 | 1,609 |
| Pavement saw | | | 2 | | | 2 | | | 1 | 223 | 0 | 0 | 0 | 0 | 0 | 223 |
| Paving roller | | | 2 | 1 | 10% | 2 | | | 1 | 447 | 0 | 0 | 0 | 149 | 0 | 596 |
| Pile Driver | | | 2 | | | 2 | | | 1 | 0 | 0 | 2,234 | 0 | 0 | 0 | 2,234 |
| Water truck | 1 | 10% | 2 | 1 | 10% | 2 | 1 | 10% | 1 | 2,547 | 425 | 425 | 849 | 849 | 425 | 5,519 |
| Zoomboom | 1 | 50% | 2 | | | 2 | | | 1 | 0 | 0 | 0 | 819 | 0 | 0 | 819 |
| | | | | | | | | | **Total** | **73,379** | **22,291** | **9,899** | **10,710** | **28,862** | **2,175** | **147,316** |

**Notes:**
1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of equipment is used is estimated by the Project design team.

5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 40,084 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 107,446 | kg | Calculated |
| CH4 | 2.9 | kg | Calculated |
| N2O | 5.8 | kg | Calculated |
| **Total emissions** | **109.3** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios: Tier 3 40%; Tier 4 60%

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 107,231 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 287,433 | kg | Calculated |
| CH4 | 15 | kg | Calculated |
| N2O | 9 | kg | Calculated |
| **Total emissions** | **290** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions per Replacement Bridge**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 0.1093 | **0.3997** |
| On-road equipment on-site | 0.2904 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Construction Component: Widen Crossings***

## Source: Construction Non-Road Mobile Equipment Emissions

**Description:**
Greenhouse gas (GHG) emissions generated as a result of fuel combustion in the equipment used during the widening of crossings.

The fuel combustion sources will be the following equipment during construction, and expected annual GHG emissions (in CO2 equivalents) from each of these sources are estimated in this datasheet.
• On-road construction
• Off-road construction

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the onsite construction equipment. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment to be used during the construction; and
(2) estimated fuel usage for each type of equipment.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}$/hp-hr $_{output}$, $Btu_{input}$ kW-hr $_{output}$, or $J_{input}/J_{output}$) ; and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{\text{year}}\right) = \text{Fuel usage}\left(\frac{L}{\text{year}}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{\text{tonne}}{10^6 g}\right)$$

**Construction Off-Road and On-Road Mobile Equipment Emissions**
**Description:**
Off-road and On-Road equipment will be used during construction of the facility. Tailpipe emissions of GHGs due to the fuel combustion would be generated from these sources.

| Construction Phase | | | | | Removals and Reconstruction | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Equipment[1]** | **Power Rating (hp/equipment) [2]** | **Fuel Type** | **Operating Load [3]** | **Equipment Type** | **Total Number of Equipment to be Used Onsite[1]** | **% time used [4]** | **Duration (months) [1,5]** | **Fuel Usage (L)** |
| Backhoe | 120 | Diesel | 40% | Off-Road | 1 | 50% | 0.5 | 447 |
| Bobcat | 115 | Diesel | 40% | Off-Road | 1 | 50% | 0.5 | 428 |
| Boom truck | 500 | Diesel | 50% | Off-Road | 1 | 10% | 0.5 | 466 |
| Compactor | 100 | Diesel | 20% | Off-Road | 1 | 10% | 0.5 | 37 |
| Concrete Saw | 50 | Diesel | 20% | Off-Road | 1 | 10% | 0.5 | 19 |
| Concrete truck | 500 | Diesel | 40% | On-Road | 1 | 10% | 0.5 | 372 |
| Dump Truck | 600 | Diesel | 40% | On-Road | 2 | 50% | 0.5 | 4,469 |
| Pavement saw | 50 | Diesel | 20% | Off-Road | 1 | 10% | 0.5 | 19 |
| Paving roller | 100 | Diesel | 20% | Off-Road | 1 | 10% | 0.5 | 37 |
| Water truck | 285 | Diesel | 40% | On-Road | 1 | 10% | 0.5 | 212 |
| **Notes:** | | | | | | | **Total** | **6,506** |

1) Equipment that may be used onsite and duration is estimated by the project design team.
2) Detailed construction equipment is not available from the project design. The make/model of each construction equipment is selected from commonly used equipment to represent the units that may be used at the project construction.

3) Not all the equipment will be operating at their full load considering the conditions such as idling, moving, loading and non-operating time. The average operating load for the equipment during the construction period is assumed based on the following reference:
FHWA Roadway Construction Noise Model User's Guide, prepared by U.S. Department of Transportation, Federal Highway Administration.
An "acoustical usage factor" for each type of construction equipment is used to estimate the fraction of time each piece of construction equipment is operating at full power during a construction operation. The acoustical usage factor is also considered as the duty cycle / operating load usage factor of the construction equipment.

4) Construction activities will occur during 8:00 a.m. to 5:00 p.m. for an 8 hour work day (1 hour assumed for breaks), Monday to Friday. Each piece of equipment will not be operational for the entire work day. The % of time each piece of equipment is used is estimated by the Project design team.
5) Assumes 1 month has, on average, 21 working days.

**GHG emission calculation - Off-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 1,452 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 4 |
| CH4 | 0.073 | g/L | |
| N2O | 0.227 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 3,893 | kg | Calculated |
| CH4 | 0.1 | kg | Calculated |
| N2O | 0.2 | kg | Calculated |
| **Total emissions** | **4.0** | **tonne CO2eq** | Calculated |

**Note:**
It is assumed that construction equipment to be used will be either US EPA Tier 3 or Tier 4 emission compliant at the following ratios:

| | |
|---|---|
| Tier 3 | 40% |
| Tier 4 | 60% |

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 5,054 | L | Calculated |
| LDDTs Total fuel usage | 0 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| LDDTs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: LDDTs Moderate Control. |
| CH4 | 0.068 | g/L | |
| N2O | 0.21 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 13,546 | kg | Calculated |
| CH4 | 1 | kg | Calculated |
| N2O | 0 | kg | Calculated |
| **Total emissions** | **14** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions per Crossing**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Off-road equipment on-site | 0.0040 | **0.0176** |
| On-road equipment on-site | 0.0137 | |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Operation Component***

## Source: Diesel Train Emissions

**Description:**
Greenhouse gas (GHG) emissions generated as a result of locomotive fuel combustion.

| GO Train Schedule | | Reference |
|---|---|---|
| Total Number of Mx GO Train Passes per day (weekday) | 54 | two way total - Provided by Jennifer Wong @ Metrolinx via email on November 24, 2021 |
| Total Number of Mx GO Train Passes per day (weekend) | 18 | two way total - Stantec RFI # 201075-STANTEC-RFI-00019 |
| Project track length (km) | 18.6 | Provided by Project design team |
| Weekdays per year | 261 | Stantec Assumption |
| Weekends per year | 104 | Stantec Assumption |
| Annual Travel length (km) | 296,968 | Calculated |
| Train speed along corridor (km/h) | 88 | assumes a constant travel speed through rail corridor - Stantec RFI # 201075-STANTEC-RFI-00019 |
| Annual Travel Time (hrs within Project area) | 3,356 | Calculated |
| Idling Time at Each Station (minutes) | 1.5 | Stantec RFI # 201075-STANTEC-RFI-00019 |
| # of Stations within Study Area | 4 | Provided by Project design team |
| Annual Idle Time at Each Station (hrs) | 1,597 | Calculated |

| GO Train Engine Parameters | Line Haul | | HEP | Reference |
|---|---|---|---|---|
| Engine Tier Rating | Tier 2 | Tier 3 | Tier 2 | Stantec RFI # 201075-STANTEC-RFI-00017 |
| Fuel Type | Diesel | Diesel | Diesel | Stantec RFI # 201075-STANTEC-RFI-00017 |
| Engines per Train | 2 | 2 | 2 | Stantec RFI # 201075-STANTEC-RFI-00043 |
| % of Fleet | 70% | 30% | 100% | Stantec RFI # 201075-STANTEC-RFI-00017 |
| Fuel Use (88 km/h or Notch 6) - L/hr | 528.52 | 431.78 | - | Stantec RFI # 201075-STANTEC-RFI-00017 |
| Fuel Use (Idling) - L/hr | 19.82 | 20.01 | - | Stantec RFI # 201075-STANTEC-RFI-00017 |
| Fuel Use @ 50% load | - | - | 112.50 | constant operating load of 50% as per the draft Metrolinx AQ Guide dated November 2019. |

**Contaminant(s) of Concern:**
Emissions of $CO_2$, $CH_4$ and $N_2O$ in the form of $CO_2e$

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the trains. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment; and
(2) estimated fuel usage.

**GHG Emission Calculations:**

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{\text{year}}\right) = \text{Fuel usage}\left(\frac{L}{\text{year}}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{\text{tonne}}{10^6 g}\right)$$

**GO Train Emissions (Travelling @ 55mph)**

| Engine Type | Engines per Train | L/hr per Engine | % of Fleet | Annual Travel Time (hr) | Fuel Usage (L) |
|---|---|---|---|---|---|
| Line Haul Tier 2 | 2 | 528.52 | 70% | 3,356 | 2,483,018 |
| Line Haul Tier 3 | 2 | 431.78 | 30% | 3,356 | 869,369 |
| HEP Tier 2 | 2 | 112.50 | 100% | 3,356 | 755,045 |

**GO Train Emissions (Idling)**

| Engine Type | Engines per Train | L/hr per Engine | % of Fleet | Annual Idle Time (hr) | Fuel Usage (L) |
|---|---|---|---|---|---|
| Line Haul Tier 2 | 2 | 19.82 | 70% | 1,597 | 44,302 |
| Line Haul Tier 3 | 2 | 20.01 | 30% | 1,597 | 19,169 |
| HEP Tier 2 | 2 | 112.50 | 100% | 1,597 | 359,235 |

**GHG emission calculation - Railway Diesel Train:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Total fuel usage Diesel | 4,530,138 | L | Calculated |
| Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Railways: Diesel Train |
| CH4 | 0.149 | g/L | |
| N2O | 1.029 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 12,143,034 | kg | Calculated |
| CH4 | 675.0 | kg | Calculated |
| N2O | 4,661.5 | kg | Calculated |
| **Total emissions** | **13,549.0** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Diesel Train Emissions**

| Source Group | Estimated GHG Emissions (kt CO2 eq) | Total GHG Emissions (kt CO2 eq) |
|---|---|---|
| Diesel Trains | 13.5 | **13.5** |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Operation***

## Source: GO Bus Fuel Combustion

**Description:**
GO Bus service will increase at B4 TOC in the future build scenario.
Greenhouse gas (GHG) emissions are generated as a result of diesel fuel combustion from operating additional GO Buses.

**Bus Volumes:**
GO Bus service is currently provided at the proposed B4 TOC at Clarington Blvd. @ Durham Hwy. 2 (Bowmanville) Park & Ride. This stop is located just north of the existing CP rail tracks.
The current bus count was derived from the GO Bus schedule for Route 88 Peterborough/Oshawa. Specifically, GO Buses travel between Trent University and Oshawa GO Station.
The Project will not provide GO Bus service to B1, B2 or B3 TOC. Therefore, it is assumed that the current Go Bus 88 travel route will not change in the future build scenario.
Future bus counts for B4 TOC were provided by Metrolinx (RFI 201075-STANTEC-RFI-00019).

| | Current GO Bus Counts | | | Future Bus Counts | | | Difference |
|---|---|---|---|---|---|---|---|
| **Bus Schedule** | Southbound (SB) | Northbound (NB) | Total | Southbound (SB) | Northbound (NB) | Total | Future Total - Current Total |
| Weekday | 14 | 14 | 28 | 18 | 18 | 36 | 8 |
| Weekend | 10 | 10 | 20 | 13 | 13 | 26 | 6 |

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2021 NIR 1990-2019 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**Methodology:** Emission Factor (EF)
Diesel is the primary fuel that will be used in the GO Buses. Emissions are estimated based on
(1) GHG emission factors from published resources relevant to the fuel combustion equipment; and
(2) estimated fuel usage.

**GHG Emission Calculations:**

Constants for Calculations

| | | | | | |
|---|---|---|---|---|---|
| **Diesel HHV** | 38.50 | GJ/kL | 36,490,955 | Btu/m3 | Ontario GHG Guideline 2019, Table 20-1a |
| **Thermal efficiency (diesel engine)** | 8089 | Btu/hp-hr | | | API Compendium (2009), Table 4-2 |
| **Conversion factor** | 1000 | L in 1 m3 | | | |
| **Conversion factor** | 0.1589873 | m3 in 1 bbl | | | |
| **Conversion factor** | 947817 | Btu/m3 in 1 Gj/kl | | | |

The calculations for fuel usage are following the equation presented in API (2009); Equation 4-5

$$FC = ER \times LF \times OT \times ETT \times \frac{1}{HV} \qquad \text{(Equation 4-5)}$$

where
FC = annual fuel consumed (volume/yr);
ER = equipment rating (hp, kW, or J);
LF = equipment load factor (fraction);
OT = annual operating time (hr/yr);
ETT = equipment thermal efficiency ($Btu_{input}/hp\text{-}hr_{output}$, $Btu_{input}/kW\text{-}hr_{output}$, or $J_{input}/J_{output}$).; and
HV = fuel heating value (energy/volume).

The calculations for GHG emissions follow the equation:

$$\text{Emissions}\left(\frac{t}{year}\right) = \text{Fuel usage}\left(\frac{L}{year}\right) \times \text{Emission Factor}\left(\frac{g}{L}\right) \times \text{Conversion}\left(\frac{tonne}{10^6 g}\right)$$

**On-Road Emissions:**

| Equipment | Power Rating (hp) [1] | Fuel Type | Operating Load [2] | Equipment Type | Additional GO Buses per Day [3] | Travel Time (hrs) [4] | Days Per Year | Annual Operating Time (hrs) [5] | Fuel Usage (L) |
|---|---|---|---|---|---|---|---|---|---|
| Transit Bus - Weekday | 425 | Diesel | 100% | On-Road | 8 | 1.67 | 261 | 3480 | 327,852 |
| Transit Bus - Weekend | 425 | Diesel | 100% | On-Road | 6 | 1.67 | 104 | 1040 | 97,979 |
| **Notes:** | | | | | | | | **Total** | **425,831** |

1) Highest standard transit bus hp rating listed in Table 13 of the Metrolinx *Draft Environmental Guide: Recommended Approach for Assessing and Mitigating Air Quality Impacts and Greenhouse Gas Emissions of Metrolinx Public Transit Projects* dated November 2019.
2) Conservative Stantec assumption since operating time considers actual bus travel time.
3) The difference between future GO bus volumes with the Project minus current (2021) volumes.
4) Approximate GO Bus travel time from Trent University to Oshawa GO Station - derived from the GO Bus schedule for Route 88 Peterborough/Oshawa.
5) Annual operating time (hrs) = Additional GO Buses per Day x Travel Time (hrs) x Days per Year

**GHG emission calculation - On-road Diesel Equipment:**

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| HDDVs Total fuel usage | 425,831 | L | Calculated |
| HDDVs Emission Factors: | | | |
| CO2 | 2680.5 | g/L | Environment Canada 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Road Transport: Diesel: HDDVs Moderate Control. |
| CH4 | 0.14 | g/L | |
| N2O | 0.082 | g/L | |
| Emissions Diesel: | | | |
| CO2 | 1,141,439 | kg | Calculated |
| CH4 | 60 | kg | Calculated |
| N2O | 35 | kg | Calculated |
| **Total emissions** | **1,153** | **tonne CO2eq** | Calculated |

**Summary of Site-Wide GHG Emissions from GO Buses**

| Source Group | Estimated GHG Emissions (kt CO2 eq) |
|---|---|
| On-road equipment on-site | 1.2 |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Operation***

## Source: Stationary Fuel Combustion at B1, B2, B3 and B4 TOC

**Description:**

Greenhouse gas (GHG) emissions generated during Project Operations as a result of using the following equipment at each TOC:
- 1 diesel fired standby generator
- mobile maintenance equipment is not stored or dedicated to each station. Indoor maintenance equipment are all 120V with minimal power draws and trickle chargers are used. Emissions from mobile equipment is therefore expected to be insignificant.

**Contaminant(s) of Concern:**

Emissions of $CO_2$, $CH_4$ and $N_2O$ in the form of $CO_2e$

**Methodology:** Emission Factor (EF)

Emissions estimated based on:
(1) Maximum annual fuel consumption of the generator based on the equipment specification sheet
(2) Assumed operating time; and
(3) ON Guideline for Quantification, Reporting and Verification for GHG Emissions February 2020 Version (ON Guidance, 2020) which references Canada's Greenhouse Gas Quantification Requirements, December 2019 Version 3.0 (GGQR, 2019).

**Global Warming Potentials (GWPs):**

| GHG | GWP |
|---|---|
| CO2 | 1 |
| CH4 | 25 |
| N2O | 298 |

Source: ECCC 2020 NIR 1990-2018 Part 1., these values are from the IPCC Fourth Assessment Report (IPCC, 2012).

**GHG Emission Calculations: 1 Standby Diesel Generator**

Constants for Calculation

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| **Total # of Units** | 4 | | Stantec assumes 1 unit per TOC |
| **Standby Power Rating** | 600 | kW | Based on similar units installed at existing GO stations 201075-STANTEC-GENRFI-00040 |
| **Fuel Type** | diesel | | |
| **Operating Time** | 0.5 | hour/month | Stantec assumption - 30 minute testing per month |
| **Fuel consumption** | 79.0 | L/hr | Based on unit specification @ 50% load |
| **Fuel consumption** | 1,896 | L/year | Calculated |

| Data | Value | Unit | Reference / Note |
|---|---|---|---|
| Diesel Emission Factors: | | | |
| CO2 | 2680.5 | g/L | ECCC 2022, NIR 1990-2020, Annex 6, Table A6.1-14 Off-road: Off-road Diesel >=19kW, Tier 1-3 |
| CH4 | 0.073 | g/L | |
| N2O | 0.022 | g/L | |
| Diesel Emissions: | | | |
| CO2 | 5.08 | tonnes/year | Calculated |
| CH4 | 0.0001384 | tonnes/year | Calculated |
| N2O | 0.0000417 | tonnes/year | Calculated |
| **Total emissions** | **0.0051** | **kt CO2eq/year** | Calculated |

***Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility***
***Project Operation***

**Source: Electricity Consumption at B1, B2, B3 and B4 Stations**

**Description:**
Greenhouse gas (GHG) emissions generated as a result of electricity consumed from the grid during operation for B1, B2, B3 and B4 Stations.
There will also be Wayside power to plug in two diesel
locomotives a day

**Contaminant(s) of Concern:**
Emissions of $CO_2$, $CH_4$ and $N_2O$ in the form of $CO_2e$

**Methodology:** Emission Factor (EF)
Emissions estimated based on
(1) GHG electricity consumption intensity emission factors for Ontario in 2019 from ECCC 2021 NIR Part 3;
(2) Estimated station power requirements based on an existing similar station

**GHG Emission Calculation:**

Constants for Station Power Calculations:

| | Parameter | Reference |
|---|---|---|
| **# of Stations** | 4 | B1, B2, B3 and B4 |
| **Power Load Requirement for each station** | 62.4 | kW (based on a similar operating GO station 201075-STANTEC-GENRFI-00040 - for simplicity, Stantec assumes an identical power |
| **Electricity Use** | 2,186,496 | kWh per year (calculated) = # of stations * power load rating (kW) * 8760 hours |
| **Consumption Intensity** | 28 | g CO2 eq/kWh for Ontario (ECCC 2020 NIR) |
| **Conversion factor** | 1,000,000 | gram to tonne |
| **Conversion factor** | 1,000 | tonne to kilotonne |
| **Indirect Emissions** | 0.06 | kt CO2 eq per year |

Constants for Wayside Power at B4 station only calculations:

| | Parameter | Reference |
|---|---|---|
| **# of Units** | 2 | two units at B4 station as per 01075-STANTEC GEN-RFI-00045 |
| **Power Load Requirement wayside power unit** | 1,000 | kW per unit as per 01075-STANTEC GEN-RFI-00045 |
| **Electricity Use** | 11,680,000 | kWh per year (calculated) = # of units * power load rating (kW) * 5840 hours |
| **Consumption Intensity** | 28 | g CO2 eq/kWh for Ontario (ECCC 2020 NIR) |
| **Conversion factor** | 1,000,000 | gram to tonne |
| **Conversion factor** | 1,000 | tonne to kilotonne |
| **Indirect Emissions** | 0.33 | kt CO2 eq per year |

Sample Calculation: Station Power

Worst Case Peak Indirect Emissions = Electricity Consumed (kW) x Operating Time (hours) x Consumption Intensity (g $CO_2$ eq/kWh) x 1 t/$10^6$ g x 1kt/$10^3$ t
= 4 stations x 62.4 kW x 8760 hours x 30 (g $CO_2$ eq/kWh) x 1 t/$10^6$ g x 1kt/$10^3$ t
= 0.06 kt $CO_2$ eq per year

**Summary of Site-Wide GHG Emissions**

| Source Group | Estimated GHG | Total GHG Emissions (kt CO2 eq / year) |
|---|---|---|
| Electric on-site | 0.39 | **0.39** |

*Emission Inventory - Metrolinx Oshawa to Bowmanville Rail Service Extension and Rail Maintenance Facility*
*Project Operation*

## Greenhouse Gas Emissions Reduction During Project Operation: Reduced Automobile Vehicle Kilometres Travelled

**Description:**
Greenhouse gas (GHG) emissions reductions as a result of reduced automobile kilometres travelled due to the implementation of the Project.

**Contaminant(s) of Concern:**
Emissions of CO2, CH4 and N2O in the form of CO2e

**Methodology:** Emission Factor (EF)
Emissions estimated based on:
(1) Total reduction in vehicle kilometres travelled for the 60-year evaluation period of the project, 201075-STANTEC-GENRFI-00040;
(2) 2017 Canada specific vehicle emission factor from IEA (2019), Fuel Economy in Major Car Markets, IEA, Paris https://www.iea.org/reports/fuel-economy-in-major-car-markets

**GHG Emission Calculation:**

Constants for Calculations:

| | Parameter | Reference |
|---|---|---|
| **Vehicle Kilometres Reduced** | 1,713,811,574 | km (the 60-year evaluation period of the project) |
| **Emission Factor** | 206 | g CO2 eq/km (IEA 2019) |
| **Conversion factor** | 1,000,000 | gram to tonne |
| **Conversion factor** | 1,000 | tonne to kilotonne |
| **60-Year Emissions Reduction** | 353 | kt CO2 eq |

Sample Calculation:

Emissions Reduction (kt CO2 eq) = Vehicle Kilometres Reduced (km) x Emission Factor (g CO2 eq/km) x 1 t/$10^6$ g x 1kt/$10^3$ tonne
= (1,713,811,574 km x 206 g CO2 eq/km x 1 kt/$10^6$ g x 1kt/$10^3$ tonne
= 353.0

**Year by Year Emissions Reduction**

| Year | Vehicle Kilometers Reduced | Annual Emission Reduction |
|---|---|---|
| 2025 | 19,403,338 | 4.00 |
| 2026 | 19,791,405 | 4.08 |
| 2027 | 20,187,233 | 4.16 |
| 2028 | 20,590,978 | 4.24 |
| 2029 | 21,002,798 | 4.33 |
| 2030 | 21,422,853 | 4.41 |
| 2031 | 21,851,311 | 4.50 |
| 2032 | 22,288,337 | 4.59 |
| 2033 | 22,734,103 | 4.68 |
| 2034 | 23,188,786 | 4.78 |
| 2035 | 23,652,561 | 4.87 |
| 2036 | 24,125,612 | 4.97 |
| 2037 | 24,608,125 | 5.07 |
| 2038 | 25,100,287 | 5.17 |
| 2039 | 25,602,293 | 5.27 |
| 2040 | 26,114,339 | 5.38 |
| 2041 | 26,636,626 | 5.49 |
| 2042 | 27,169,358 | 5.60 |
| 2043 | 27,712,745 | 5.71 |
| 2044 | 28,267,000 | 5.82 |
| 2045 | 28,832,340 | 5.94 |
| 2046 | 29,408,987 | 6.06 |
| 2047 | 29,997,167 | 6.18 |
| 2048 | 30,597,110 | 6.30 |
| 2049 | 31,209,052 | 6.43 |
| 2050 | 31,209,052 | 6.43 |
| 2051 | 31,209,052 | 6.43 |
| 2052 | 31,209,052 | 6.43 |
| 2053 | 31,209,052 | 6.43 |
| 2054 | 31,209,052 | 6.43 |
| 2055 | 31,209,052 | 6.43 |
| 2056 | 31,209,052 | 6.43 |
| 2057 | 31,209,052 | 6.43 |
| 2058 | 31,209,052 | 6.43 |
| 2059 | 31,209,052 | 6.43 |
| 2060 | 31,209,052 | 6.43 |
| 2061 | 31,209,052 | 6.43 |
| 2062 | 31,209,052 | 6.43 |
| 2063 | 31,209,052 | 6.43 |
| 2064 | 31,209,052 | 6.43 |
| 2065 | 31,209,052 | 6.43 |
| 2066 | 31,209,052 | 6.43 |
| 2067 | 31,209,052 | 6.43 |
| 2068 | 31,209,052 | 6.43 |
| 2069 | 31,209,052 | 6.43 |
| 2070 | 31,209,052 | 6.43 |
| 2071 | 31,209,052 | 6.43 |
| 2072 | 31,209,052 | 6.43 |
| 2073 | 31,209,052 | 6.43 |
| 2074 | 31,209,052 | 6.43 |
| 2075 | 31,209,052 | 6.43 |
| 2076 | 31,209,052 | 6.43 |
| 2077 | 31,209,052 | 6.43 |
| 2078 | 31,209,052 | 6.43 |
| 2079 | 31,209,052 | 6.43 |
| 2080 | 31,209,052 | 6.43 |
| 2081 | 31,209,052 | 6.43 |
| 2082 | 31,209,052 | 6.43 |
| 2083 | 31,209,052 | 6.43 |
| 2084 | 31,209,052 | 6.43 |
| **Total** | **1,713,811,574** | **353** |

**Summary of Site-Wide GHG Emissions**

| Source Group | Total Estimated GHG Emissions (kt CO2 eq for a 60 year period) |
|---|---|
| On-Road | 353 |