New Track and Facilities Transit Project Assessment Process

Final Environmental Project Report – Chapter 6

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This submission was completed and reviewed in accordance with the Quality Assurance Process for this project.

Table of Contents

Tables

Figures

Appendices

6 Operations and Maintenance Impacts

6.1 Noise & Vibration

6.1.1 Background – GO Rail Network Electrification TPAP (2017)

Metrolinx and Hydro One (as co-proponents) jointly completed the GO Rail Network Electrification TPAP (Transit Project Assessment Process) in 2017 to convert six Metrolinx-owned rail corridors from diesel to electric propulsion. The Richmond Hill rail corridor was not one of the six assessed at this time. The 2017 EPR (Environmental Project Report) assessed the environmental effects associated with:

- The increase in rail traffic associated with the conversion from diesel to electric propulsion;
- Infrastructure improvements; and
- Installation of proposed traction power supply and power distribution components.

Since 2017, Metrolinx has developed a more advanced design for how increased passenger service will be delivered through GO Expansion, which involves further infrastructure and rail traffic changes. These changes necessitate a reassessment of potential impacts. Specifically, the 2017 plans did not anticipate certain service expansions and realignments, new stations and layover sites that are part of Metrolinx's future plans. These proposed changes require a reassessment of potential noise and vibration effects, which are being captured as a component of an addendum to the 2017 GO Rail Electrification Environmental Project Report (EPR).

The electrification of a portion of the Richmond Hill rail corridor is included within the scope of the New Track and Facilities TPAP, as it was not assessed in 2017, and therefore the assessment of potential noise and vibration impacts is a component of it (and separate from the addendum to the 2017 GO Rail Electrification EPR). An assessment of potential noise and vibration impacts was completed along a portion of the Richmond Hill rail corridor from the limits of the Union Station rail corridor to Mile Marker 4.38, where the rail line intersects with Pottery Road in the City of Toronto. This corresponds to the limits of proposed electrification within the New Track and Facilities TPAP. Other rail corridors were evaluated in separate Noise and Vibration Study reports as part of the GO Rail Electrification EPR Addendum.

6.1.2 Study Area

The study area for the noise and vibration assessment begins west of the Don River where the Richmond Hill corridor diverges north from Union Station corridor and ends at Mile Marker 4.38, where the rail line intersects with Pottery Road in the City of Toronto. The Study Area is approximately 4 km in length. The Study Area for the operational noise and vibration assessment is shown in Figure 6-1.

FIGURE 6-1 RICHMOND HILL RAIL CORRIDOR OPERATIONAL NOISE & VIBRATION ASSESSMENT STUDY AREA

6.1.3 Noise & Vibration Assessment Methodology

The methodology for noise and vibration studies for Metrolinx rail infrastructure projects as part of a TPAP follows guidance provided in the "Protocol for Noise and Vibration Assessment" (the "MOEE/GO Protocol"). For the work associated with the New Track & Facilities TPAP, Metrolinx developed a draft internal document entitled, "Work Plan: Noise and Vibration Impact Assessment for the GO Expansion OnCorr Project" (Metrolinx Work Plan). This document describes in detail the methodology expected to be followed for the current work and provides information that compliments the approach of the MOEE/GO Protocol. Notably, the Metrolinx Work Plan describes a detailed methodology for assessing proposed noise barriers according to administrative, operational, economic and technical criteria, which the MOEE/GO Protocol refers to but does not define in detail.

Overall, the methodology used in the assessment of sound and vibration effects related to this project is based on numerical modelling and the comparison of sound and vibration levels between an existing scenario (or baseline) and a future scenario after implementation of the project and associated increases in rail traffic. Measurements of sound and vibration levels can be used to inform the modelling, (e.g., to confirm sound and vibration emissions from train wheels impacting a rail switch), but the assessment itself is based on a comparison of sound and vibration levels predicted by modelling both existing and future scenarios (i.e., a consistent model-to-model comparison).

Following the MOEE/GO Protocol, the assessments of sound and vibration effects are based on the difference in predicted levels from existing to future scenarios. When defined thresholds are met or exceeded, this triggers the investigation of possible mitigation. For sound levels this threshold is a predicted 5 dB increase in average sound levels at nearby points of reception (i.e., residences) as a result of the project. For vibration, the threshold is when future predicted levels are 25% or more above existing vibration levels at a point of vibration assessment. Any proposed mitigation for both sound and vibration effects must meet administrative, operational, economic and technical criteria.

Noise mitigation typically involves proposing walls or barriers to block receptors (i.e., homes) from the sound of trains, but can also involve reducing sound levels at the source (e.g., quieter trains) or at the receptor location (e.g., more sound-proof windows). Vibration mitigation typically involves installing technologies such as ballast mats under the rails, which absorb vibration energy and reduce the effects on nearby receptors.

Vibration effects were predicted in accordance with the methods of the United States Department of Transportation - Federal Transit Administration (FTA, 2018). Vibration levels were assessed in terms of root-mean-square (RMS) velocity in the vertical direction, which is the dominant axis for vibration generated from mobile sources such as trains and most closely correlated with human annoyance and perceptibility.

To simplify the vibration assessment, a methodology was developed that evaluated the area of influence around trackwork (e.g., switches).

The FTA vibration calculations account for:

- Vehicle speed;
- Track type and track conditions;
- Special trackwork (i.e., switches);
- Type of locomotive power;
- Condition of wheels (i.e., wheel wear);
- Proximity of rail to receptors; and

- Soil conditions (i.e., shallow bedrock).

The FTA vibration level predictions were compared to measured existing vibration levels at a selection of locations in the vicinity of the GO Rail Network. The measurements resulted in a modification to the special trackwork adjustment that was approximately 50% higher than the default FTA adjustment for special trackwork.

The MOEE/GO Protocol evaluates the change in vibration between the Pre-project and Post-project scenarios. Modelling is used to estimate both the Pre-project and Post-project vibration levels. Measurements are not used for Pre-project vibration levels since a direct comparison cannot be made to modelled Post-project levels. However, measurements may be used to adjust modelled factors, such as the special trackwork adjustment noted above. At the detailed design stage, verification measurements will be conducted at key receptors to validate the Post-project vibration levels.

Adjusted curves were established for passenger trains and freight trains. The modelling assumed that generic FTA soil conditions are representative in the corridor and did not account for sub-surface features, such as shallow bedrock, that could enhance vibration propagation locally. This assumption was applied to both the Pre-project and Post-project modelling. As vibration effects are evaluated based on the change between Pre-project and Post-project vibration levels, it is not expected to impact the conclusions. Additionally, as part of the detailed design, verification measurements may be conducted at key receptors. These measurements would validate the FTA vibration calculations and the generic soil conditions assumption.

6.1.4 Key Assumptions

Metrolinx provided pertinent information, such as existing and future train volumes, trip log data including throttle and speed profiles, and track diagrams, for incorporation within this assessment. Where information was not available, assumptions were documented for approval by Metrolinx.

The information provided was used to assess a credible worst-case scenario, which includes a description of rail traffic, types of locomotives (e.g., diesel, electric), size of consists (e.g., one locomotive and six rail cars, two locomotives with twelve rail cars), etc. The intention was to capture the range of actual scenarios that may be implemented in the future to deliver required service levels. The credible worst-case scenario is based on the minimum infrastructure requirements to achieve a service goal. Regulations and policies based on operational and safety considerations limit the service levels that can be achieved for a given infrastructure design.

6.1.5 Noise Model Selection

The MOEE/GO Protocol stipulates the use of a model known as Sound from Trains Environmental Analysis Method (STEAM) for predicting rail traffic sound levels. STEAM was developed by the MECP (MOE, 1990). As a result of consultations with Metrolinx, the noise modelling for the 2017 GO Rail Electrification EPR and for the current assessment deviated from this guidance in that rail traffic sound levels were modelled using the “Federal Noise and Vibration Impact Assessment” (the “FTA Protocol”; FTA, 2018) and the “Federal Railroad Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment” (the “FRA Protocol”; FRA, 2012).

The FTA and FRA algorithms are included in Cadna/A, a software package used in the assessment. Cadna/A also includes the stationary source algorithms in ISO 9613 (ISO 1994, ISO 1996) used in the assessment.

Details regarding the implications of using of FTA/FRA in lieu of STEAM are outlined in the GO Rail Network Electrification EPR (Metrolinx, 2017).

6.1.6 Noise Receptors

Receptors for this assessment include the following sensitive land uses:

- Residences;
- Hotels, motels and campgrounds;
- Schools, universities, libraries and daycare centres;
- Hospitals and clinics, nursing/retirement homes;
- Churches and places of worship;
- Planned residential developments with approved building permits from the City of Toronto; and
- Vacant lots that are currently zoned for residential use.

Receptors within the operational noise study area are mainly residential homes located adjacent to the Richmond Hill rail corridor. In general, areas of receptors were identified using publicly available address point databases or through visual identification using publicly available satellite aerial images. All vacant lots that are zoned for residential use (with or without building permits) were included in the assessment. Data was provided by the City of Toronto on approved building permits for new residential uses and zoning information. This information was reviewed and included in the assessment, and all vacant lots within the Study Area were considered.

Representative receptors were chosen to simplify the presentation of results for a much larger number of receptors assessed. The representative receptors are summarized in Table 6-1 and shown in detail in Figure 6-2. To capture the full extent of receptors, sound level contours (isopleths of equal sound level) were also generated and included within **Appendix M1**.

The MOEE/GO Protocol considers both daytime and nighttime receptors. Daytime receptors were placed in the front yard or backyard of a residential property, whichever is most exposed to rail operations. Nighttime receptors were placed at the plane of the bedroom window that is most exposed to rail operations. Residences are mainly located in an urban area where front and backyards have small surface areas. For simplicity, the daytime and nighttime receptors were collocated at a single horizontal position, at the most exposed façade of the dwelling. Generally, this approach should give representative results for the most exposed outdoor area for each receptor. Exceptions would be for very deep lots where the building façade is well-removed from the property line closest to the rail corridor.

The receptor height used differed between daytime and nighttime. Daytime sound levels were assessed at a height of 1.5 m above local grade. Nighttime sound levels were assessed at the bedroom window height, assumed to be 4.5 m above ground (i.e., the second storey bedroom window). This approach is consistent with MECP guidelines.

TABLE 6-1 RECEPTOR LOCATIONS AND DESCRIPTIONS – UNION STATION TO POTTERY ROAD

Receptor ID	Description	Receptor Distance from Nearest Track (m)	Track Section
R01	Condominium Building	100	Union Station to Mile 4.38 (Pottery Road)
R02	Condominium Building	60	
R03	Townhouse	70	
R04	Single Detached Residence	140	
R05	Single Detached Residence	200	
R06	Single Detached Residence	165	
R07	Single Detached Residence	90	
R08	Single Detached Residence	200	

FIGURE 6-2 REPRESENTATIVE NOISE & VIBRATION RECEPTORS FOR THE RICHMOND HILL RAIL CORRIDOR

6.1.7 Noise Impacts of Operations

The Pre-project, and Post-project sound levels were modelled for the portions of the Richmond Hill rail corridor where electrification is proposed. Results at each discrete receptor were used to establish the Adjusted Noise Impact.

The predicted Adjusted Noise Impacts for the project are summarised in Table 6-2 and outlined in detail in **Appendix M1**. Sound level contours generated for the entirety of the corridor for Pre-project sound, Post-project sound, and Adjusted Noise Impact are also included in **Appendix M1**.

Impact ratings for the evaluated 8 representative receptors listed in the table can be summarised as follows. Note that a day and night impact rating was assigned to each receptor:

- 1 daytime Adjusted Noise Impact was classified as noticeable (i.e., between 3 and 4.99 dB);
- 7 daytime Adjusted Noise Impacts were classified as insignificant (i.e., less than 2.99 dB); and
- 8 nighttime Adjusted Noise Impacts were classified as insignificant (i.e., less than 2.99 dB).

There are no Adjusted Noise Impacts that were classified as significant (i.e., between a 5 and 9.99 dB increase) or very significant (i.e., greater than a 10 dB increase).

As all Adjusted Noise Impacts were predicted to less than 5 dB, investigation of noise mitigation is not required.

TABLE 6-2 SUMMARY OF ADJUSTED NOISE IMPACTS RESULTING FROM OPERATIONS ON THE RICHMOND HILL RAIL CORRIDOR

Receptor ID	Time Period [1]	Adjusted Impact Rating [2]	Objective [3]	Adjusted Noise Impact (dB)	Investigate Mitigation? [4]
R01	Day	Insignificant	55.0	0.8	No
	Night	Insignificant	50.0	-5.2	No
R02	Day	Insignificant	55.0	1.5	No
	Night	Insignificant	50.0	-5.3	No
R03	Day	Noticeable	55.0	3.5	No
	Night	Insignificant	50.3	-4.9	No
R04	Day	Insignificant	55.0	-2.1	No
	Night	Insignificant	50.0	-9.4	No
R05	Day	Insignificant	55.0	-7.5	No
	Night	Insignificant	50.0	-13.6	No
R06	Day	Insignificant	55.0	-3.6	No
	Night	Insignificant	50.0	-9.3	No
R07	Day	Insignificant	55.0	-11.4	No
	Night	Insignificant	50.0	-20.2	No
R08	Day	Insignificant	55.0	-5.0	No
	Night	Insignificant	50.0	-14.5	No

Notes:
[1] Day is a 16-hour period (i.e., from 0700h to 2300h) and Night is an 8-hour period (i.e., from 2300h to 0700h).

[2] Ratings are quantified as: Insignificant – Less than 3 dB, Noticeable – 3 dB to 4.99 dB, Significant – 5 to 9.99 dB.

[3] The objective is the higher of either the Pre-project sound level or the 55 / 50 dBA default day/night sound levels.

[4] The potential to mitigate is considered when a significant (or greater) impact is predicted. This is equivalent to an increase of 5 dB or greater, relative to the objective level, as per the MOEE/GO Protocol. An adjusted noise impact greater than 5 dB requires the investigation of mitigation.

6.1.8 Vibration Impacts of Operations

The desirable objective of the MOEE/GO Protocol is that the root mean square (RMS) velocity of vibration produced by the future GO Transit operations at a receptor should not exceed:

- 0.14 mm/s; or
- The existing vibration levels where existing operations already produce vibration that exceeds 0.14 mm/s.

Furthermore, the MOEE/GO Protocol stipulates that the requirement to evaluate mitigation is triggered when the RMS velocity exceeds the objective by 25% or more (i.e., the greater of 0.175 mm/s, or a 25% increase over existing levels).

6.1.9 Vibration Receptors and Results

The proximity of all receptors within the Richmond Hill rail corridor to changes in track alignment or special trackwork was assessed. The three (3) proposed switches along the corridor were identified as areas of investigation for operational vibration. New trackwork is planned in approximately the same location as existing trackwork or further away from nearby receptors, and therefore was not considered as part of this assessment. The point of evaluation is defined as 5 to 10 m from the building foundation in a direction parallel to the tracks (i.e., with equivalent setback distance between foundation and rail).

Areas where operational vibration levels are expected to exceed the MOEE/GO Protocol vibration limits at receptors were not found in the Study Area. Where sensitive receptors fall within these areas, mitigation would be recommended. Of the three (3) switches included in this assessment, none triggered assessment of mitigation.

6.1.10 Operational Noise & Vibration Mitigation

Table 6-3 provides a discussion of general approaches that could be taken into consideration in the development of mitigation options to reduce noise and vibration impacts related to operations on the Richmond Hill Corridor. The following table provides a summary of the key project components/activities, potential effects, mitigation measures, and proposed monitoring activities/commitments to future work associated with the New Track & Facilities TPAP Undertaking.

TABLE 6-3 SUMMARY OF POTENTIAL EFFECTS, MITIGATION MEASURES & MONITORING COMMITMENTS – OPERATIONAL NOISE & VIBRATION[1]

Project Component	Project Activities	Potential Effect	Mitigation Measure(s)	Monitoring
Richmond Hill Corridor	• Operational Noise (Trains)	Environmental noise may cause annoyance, disturb sleep and other activities, and affect human health. If operations are projected to cause a 5-dB increase or greater in the average energy equivalent noise (referred to as "L_{EQ}") relative to the existing noise level or the MECP objective of 55 dBA for daytime and 50 dBA for nighttime, whichever is higher, then mitigation is required.	Mitigation per TPAP Study Report (Noise Barriers): • Deploy the noise barriers defined in the *Noise and Vibration Study Reports GO Rail Network Electrification Project, 2020* (RWDI). • Maintain noise barriers so as to ensure their continued effectiveness in noise reduction. • If deviating from the assessments made in the *Noise and Vibration Study Reports GO Rail Network Electrification Project, 2020* (RWDI), comply with the noise impact and assessment criteria in the Metrolinx *Guide for Noise and Vibration Assessment* (2020). Mitigation at the Source: • Deploy vehicle and track technology and related maintenance measures to maintain compliance with the noise and vibration exposure criteria defined below. Mitigation Criteria: • Meet the following long-term daytime/ nighttime maximum noise exposure objectives at all noise sensitive receptors across the system, where background noise levels allow their realization: ○ 10-year objective: 70/60 dBA ○ 20-year objective: 60/50 dBA ○ 25-year objective: 55/50 dBA • Meet the airborne noise exposure criteria in the 1995 MOEE/GO Transit Draft Noise and Vibration Protocol. • Meet the ground-borne (vibration induced) noise exposure criteria in the 1995 MOEE/GO Transit Draft Noise and Vibration Protocol. • Meet any additional future criteria or guidance developed by regulatory agencies, as applicable.	• Measure and document the Leq (16-hour) and Leq (8-hour) noise levels, under predictable worst-case conditions, at locations where new noise mitigation barriers have been provided per the 2020 noise and vibration studies and per the Metrolinx Enhanced Mitigation Program. Outdoor measurements will be carried out in accordance with MECP requirements and US FTA Report No. 0123, *Transit Noise and Vibration Impact Assessment Manual* (2018). The primary purpose of these measurements is to ascertain the effectiveness of the implemented mitigation measure(s). • Assess the condition and performance of locomotives, coaches, DMUs and EMUs with respect to noise emissions as part of maintenance to ensure continued compliance with manufacturer specifications. • Assess the condition and performance of the rail tracks and switches with respect to noise as part of maintenance to ensure continued compliance with manufacturer specifications.
	• Operational Vibration (Trains)	Vibration can cause annoyance, interfere with human activity and affect human health. It may also cause building damage. A change in vibration levels may occur where there are changes in track alignment, addition of new track, and changes to or addition of special track work. Vibration levels may also change with changes in rail vehicle specifications and operating conditions.	Mitigation per TPAP Study Report: • Deploy mitigation recommended in the *OnCorr Noise and Vibration Study Report* (RWDI). Review and update the vibration assessment during the design of new infrastructure at representative receptor locations to ensure compliance with the vibration exposure criteria in the MOEE/GO Transit *Draft Protocol for Noise and Vibration Assessment* (1994). Mitigation at the Source: • Deploy vehicle and track technology and related maintenance measures to maintain compliance with the noise and vibration exposure criteria defined below. Mitigation Criteria: • Meet the ground-borne vibration criteria in the 1995 MOEE/GO Transit Noise and Vibration Protocol.	• Measure and document the vibration impacts, under predictable worst-case conditions, of each distinct type of GO Transit train consist operating in the corridor of interest at locations where the 2020 noise and vibration studies recommends mitigation of vibration impacts. Measurements will be carried out at or near representative vibration sensitive receptors in accordance with MECP requirements and US FTA Report No. 0123, *Transit Noise and Vibration Impact Assessment Manual* (2018). The primary purpose of these measurements is to ascertain the effectiveness of the implemented mitigation measure(s). • Assess the condition and performance of locomotives, coaches, DMUs and EMUs with respect to vibration levels as part of maintenance to ensure continued compliance with manufacturer specifications. • Assess the condition and performance of the rail tracks and switches with respect to vibration levels as part of maintenance to ensure continued compliance with manufacturer specifications.

[1] Notes: Regulations, standards and guidance documents referenced herein are current as of the time of writing and may be amended from time to time. If clarification is required regarding regulatory requirements, consult with the appropriate regulatory agencies.

6.2 Air Quality

6.2.1 Background – GO Rail Network Electrification TPAP (2017)

Metrolinx and Hydro One (as co-proponents) jointly completed the GO Rail Network Electrification TPAP in 2017 to convert six Metrolinx-owned rail corridors from diesel to electric propulsion. The Richmond Hill rail corridor was not one of the six assessed at this time. The 2017 EPR assessed the environmental effects associated with:

- The increase in rail traffic associated with the conversion from diesel to electric propulsion;
- Infrastructure improvements; and
- Installation of proposed traction power supply and power distribution components.

Since 2017, Metrolinx has developed a more advanced design for how increased passenger service will be delivered through GO Expansion, which involves further infrastructure and rail traffic changes. These changes necessitate a reassessment of potential impacts. Specifically, the 2017 plans did not anticipate certain service expansions and realignments, new stations and layover sites that are part of Metrolinx's future plans. These proposed changes require a reassessment of potential operational air quality effects, which are being captured as a component of an addendum to the 2017 GO Rail Electrification EPR.

The electrification of a portion of the Richmond Hill rail corridor is included within the scope of the New Track and Facilities TPAP, as it was not assessed in 2017, and therefore the assessment of potential operational air quality impacts is a component of it. An assessment of potential operational air quality impacts was completed along a portion of the Richmond Hill rail corridor from the Union Station rail corridor to Mile Marker 4.38, where the rail line intersects with Pottery Road in the City of Toronto. This corresponds to the limits of proposed electrification within the New Track and Facilities TPAP. Other rail corridors were evaluated in separate Air Quality reports as part of the GO Rail Electrification EPR Addendum.

6.2.2 Study Area

The Richmond Hill air quality study area begins west of the Don River where the Richmond Hill corridor diverges north from the Union Station rail corridor and continues for 3.2 km to the north. The Richmond Hill Operational Air Quality Study Area is shown in Figure 6-3.

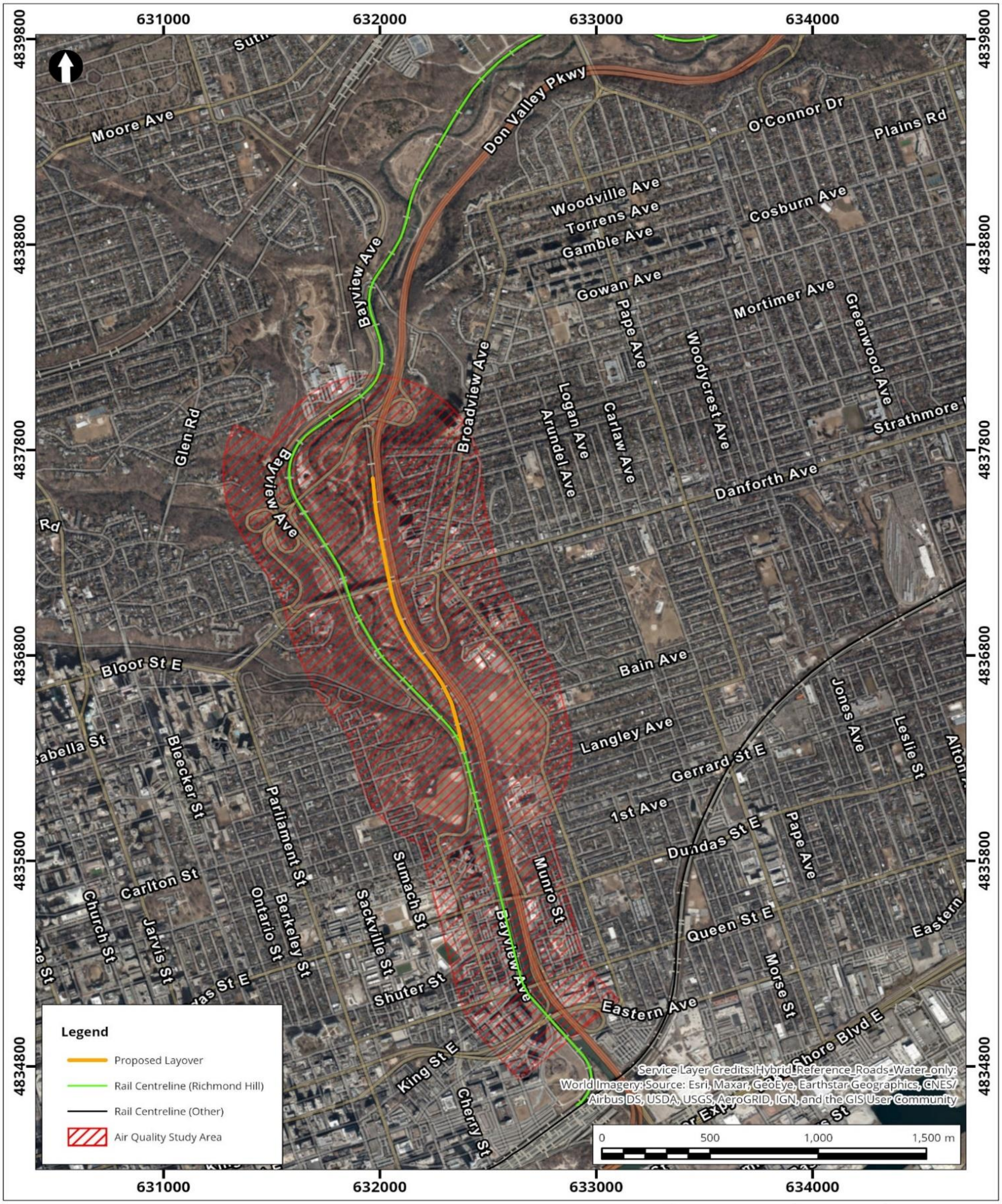


FIGURE 6-3 RICHMOND HILL OPERATIONAL AIR QUALITY STUDY AREA

6.2.3 Local Air Quality Assessment Methodology

In general, the methodology of the operational air quality assessment followed what has been described in detail in the Metrolinx document: “ON Corridor Air Quality and Greenhouse Gas Emissions Study” (DRAFT #3, September 5, 2019) (Work Plan). Where appropriate, details of the assessment also took into consideration elements of methodologies outlined in the following guidelines:

- Ministry of Transportation Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Project (October 2019); and
- PM Hot-spot Analyses: Guidance (US EPA-420-B-15-084, November 2015).

Metrolinx provided pertinent information, such as baseline and future train volumes, trip log data including throttle and speed profiles, and track diagrams for incorporation within this assessment. Where information was not available, assumptions were documented for approval by Metrolinx.

The air contaminants considered in the local air quality assessment are as follows:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Respirable Particulate Matter ($PM_{2.5}$);
- Inhalable Particulate Matter (PM_{10});
- Benzene (C_6H_6);
- Benzo(a)pyrene ($C_{20}H_{12}$);
- 1,3-Butadiene (C_4H_6);
- Formaldehyde (CH_2O);
- Acetaldehyde (CH_3CHO); and
- Acrolein (C_3H_4O).

These are the key air contaminants associated with diesel combustion and are those included within this study.

The local air quality assessment involves predicting maximum and average concentrations of these contaminants and comparing the concentrations to objectives that have been established either provincially or nationally. The relevant objectives are the Ontario Ambient Air Quality Criteria (AAQC) and the Canadian Ambient Air Quality Standards (CAAQS). Table 6-4 shows the applicable AAQC and CAAQS objectives.

TABLE 6-4 AIR QUALITY OBJECTIVES

Contaminant	Averaging Period	Objective (µg/m^3)
AAQC		
CO	1 hour	36,200
	8 hours	15,700
NO_2	1 hour	400
	24 hours	200

Contaminant	Averaging Period	Objective (µg/m^3)
PM_{10}	24 hours	50
Benzene	24 hours	2.3
	Annual	0.45
Benzo(a)pyrene	24 hours	5.0E-05
	Annual	1.0E-05
1,3-Butadiene	24 hours	10
	Annual	2
Formaldehyde	24 hours	65
Acetaldehyde	24 hours	500
Acrolein	1 hour	4.5
	24 hours	0.4
CAAQS		
NO_2 (2020)	1-hour [1]	119
	Annual [2]	34
NO_2 (2025)	1-hour [1]	83
	Annual [2]	24
$PM_{2.5}$ (2020)	24 hours [3]	27
	Annual [4]	8.8

6.2.4 Background Air Quality

Background concentrations of air contaminants were estimated and added to the model-predicted concentrations produced by rail operations. This provided a prediction of cumulative concentrations of air contaminants.

Background air quality concentrations were estimated using historical air quality monitoring data from provincial and federal air quality monitoring stations that best represent the study area. The monitoring stations used to determine background air quality concentrations for the air quality study area can be seen in **Appendix M2**.

For NO_2 and $PM_{2.5}$, the available monitoring data consisted of continuous hourly values. The data allowed for estimating background concentration by hour of day. As background concentrations vary widely from day to day, a 90th percentile concentration was calculated for each hour of the day using 5 years of hourly monitoring data. The resulting background concentrations represented the highest background conditions likely to coincide with maximum predicted concentrations from rail operations. They were used when predicting maximum 1-hour and/or 24-hour cumulative concentrations of NO_2 and $PM_{2.5}$.

For other contaminants, the background monitoring data consisted of intermittent 24-hour samples. The data did not allow for estimating background concentrations by hour of day. Instead, a 90th percentile 24-hour concentration was calculated from 5 years of monitoring data and was used to represent background conditions when predicting maximum 24-hour cumulative concentrations.

When predicting annual average cumulative concentrations, annual average concentrations from the monitoring data was used to represent background conditions.

Table 6-5 and Table 6-6 present background concentrations for all contaminants and relevant averaging times. The 90th percentile 24-hour concentrations for NO_2 and $PM_{2.5}$ was determined using data from the Toronto Downtown monitoring station for the years 2013 to 2017. Detailed information on the background air quality data for each contaminant and the corresponding monitoring stations has been provided in **Appendix M2**.

TABLE 6-5 SUMMARY OF BACKGROUND CONCENTRATION LEVELS

Contaminant	Averaging Time	Background Concentrations (µg/m^3)
CO	1 hour	219
	8 hours [2]	1189
NO_2	Annual	28
$PM_{2.5}$	Annual	8.04
PM_{10} [1]	24 hours	26
Benzene	24 hours	0.80
	Annual	0.52
Benzo(a)pyrene	24 hours	9.5E-05
	Annual	5.5E-05
1,3-Butadiene	24 hours	0.07
	Annual	0.04
Formaldehyde	24 hours	3.5
Acetaldehyde	24 hours	1.7
Acrolein	1 hour [3]	0.12
	24 hours	0.07

[1] Ambient Background Level estimated from $PM_{2.5}$ levels using published emission factors (Lall et al., 2004)
[2] 90th percentile 8-hour ambient CO data was not available; the maximum 8-hour concentration from NAPS Station 60430 – Toronto West was used
[3] 1-hr average ambient acrolein data was not available; the maximum 24-hr concentration from NAPS Station 62601- Experimental Farm, Simcoe, ON was used.

TABLE 6-6 90TH PERCENTILE BACKGROUND NO_2 AND $PM_{2.5}$ CONCENTRATIONS BY HOUR OF DAY

Hour of Day	NO_2 (ppb)	$PM_{2.5}$ (µg/m^3)
1	26	16
2	26	16
3	26	16
4	26	16
5	26	16
6	27	17
7	30	16
8	32	16
9	31	16

Hour of Day	NO_2 (ppb)	$PM_{2.5}$ (µg/m^3)
10	27	16
11	23	16
12	20	16
13	19	16
14	18	14
15	18	14
16	18	14
17	19	14
18	20	14
19	21	15
20	23	15
21	24	15
22	25	15
23	26	16
24	26	15

A comparison of background concentrations to the applicable AAQCs and CAAQS show that background concentrations generally meet air quality objectives, with the exception of Benzo(a)pyrene and annual average Benzene concentrations. This situation with the latter two air contaminants is not unique to the study area and is widespread across Southern Ontario.

6.2.5 Receptors

Receptors for the operational air quality assessment included the following sensitive land uses:

- Residences;
- Schools, universities, libraries and daycare centres;
- Hospitals and clinics, nursing/retirement homes; and
- Churches and places of worship.

Receptors were included within 300 m of the rail line, and within 500 m of fixed infrastructure, including train stations and layover/storage facilities. In general, receptors were identified using publicly available address point databases or through visual identification using publicly available satellite aerial images. During the review of aerial images, if construction was visible that was thought to potentially for a sensitive use building, it was included in the assessment.

For residential buildings up to two storeys in height, receptors were included at a height of 1.5 m above the ground. Buildings greater than two storeys include receptors at every 3 m along the building façade. Within 150 m of the rail corridor, all buildings with sensitive land use were included as receptors in the assessment. Beyond 150 m from the rail line, receptors were placed in a 100 m grid within the study area, up to 300 or 500 m. Figure 6-4 shows the receptor locations in the study area.

FIGURE 6-4 RECEPTOR LOCATIONS IN THE RICHMOND HILL AIR QUALITY STUDY AREA

6.2.6 Local Air Quality Impacts of Train Operations

The highest predicted concentrations at the worst-case receptors, under the worst-case meteorological conditions, are summarized in Table 6-7 (baseline scenario) and Table 6-8 (future scenario). The general trend among all contaminants and averaging periods is decreased concentrations at the worst-case receptor in the Future Scenario, relative to the Baseline Scenario. This is due to a projected decrease in emission factors for highway traffic on the Don Valley Parkway (DVP) between the Baseline horizon year (2015) and the Future horizon year (2025) and is unrelated to the Project. The DVP is the dominant source of air contaminant emissions in the study area and dwarfs any effect of the Project. Emissions from the DVP constitute more than 90% of the maximum impacts on the worst affected receptors in the baseline scenario, and generally, more than 80% percent in the future scenario.

The results indicate that maximum concentrations of contaminants remain within the air quality objectives at all receptors, except in the following cases: (i) 24-hour and annual average B(a)P, and annual average Benzene, which exceed their applicable provincial AAQCs at the worst-affected receptors in both the baseline and future scenarios; and (ii) 1-hour NO_2, annual NO_2, and annual $PM_{2.5}$ which exceed the federal CAAQS at the worst-affected receptors in the baseline and future scenarios.

In the case of Benzene, the predicted exceedances of the objectives are due to background air quality conditions. The contribution from railway operations in the study area is small in relation to background levels and is not significant.

For Benzo(a)pyrene, the majority of the impact on the most affected receptor is the result of emissions from highway traffic on the DVP. The contribution from rail operations is small in comparison.

In the case of NO_2, the predicted concentrations meet the provincial 1-hour and 24-hour concentrations in both the baseline and future scenario. However, the maximum predicted NO_2 concentrations do not meet the 1-hour or annual CAAQS in both scenarios, as these objectives are more stringent than the AAQC. $PM_{2.5}$ does not meet the annual CAAQS threshold in the baseline and future scenarios. Similar to the Benzene impacts, contribution of $PM_{2.5}$ from railway operations in the study area is small compared to background levels.

6.2.7 Operational Air Quality Mitigation

Table 6-9 provides a discussion of general approaches that could be taken into consideration in the development of mitigation options to reduce air quality impacts related to construction of the Don Valley Layover. The table provides a summary of the key project components/activities, potential effects, mitigation measures, and proposed monitoring activities/commitments to future work associated with the New Track & Facilities TPAP undertaking.

TABLE 6-7 MAXIMUM MODELED SCENARIO FOR BASELINE SCENARIO

Pollutant	Averaging Time	Modelled Impact (µg/m³)	DVP Impact (µg/m³)	Ambient Background Level (µg/m³)	Maximum Cumulative Concentration (µg/m³)	Objective (µg/m³)	Percentage of Criterion, Total Concentration
NO_2	1 hour	201	201	41	242	400	60%
	24 hours	108	108	45	153	200	77%
Acrolein	1 hour	0.40	0.38	0.15	0.55	4.50	12%
	24 hours	0.100	0.10	0.07	0.17	0.4	41%
CO	1 hour	1593	1588	219	1812	36200	5.0%
	8-hr	549	548	1189	1738	15700	11%
PM_{10}	24 hours	17.49	17.44	26	43	50	87%
Benzene	24 hours	0.678	0.672	0.80	1.5	2.3	64%
	Annual	0.191	0.189	0.52	0.72	0.45	159%
B(a)pyrene	24 hours	1.83E-03	1.83E-03	9.5E-05	1.9E-03	5.0E-05	3848%
	Annual	5.10E-04	5.10E-04	5.5E-05	5.6E-04	1.0E-05	5646%
Formaldehyde	24 hours	1.30	1.26	3.5	4.8	65	7.4%
Acetaldehyde	24 hours	0.63	0.62	1.7	2.4	500	0.5%
1,3-Butadiene	24 hours	0.0930	0.0927	0.07	0.16	10	1.6%
	Annual	0.0261	0.0261	0.039	0.065	2	3.3%
NO_2	1 hour (2020)	158	156	44	201	119	169%
	1 hour (2025)	158	156	44	201	83	242%
	Annual (2020)	53	52	28	81	34	240%
	Annual (2025)	53	52	28	81	24	340%
$PM_{2.5}$	24 hours	8.4	8.3	15	24	27	88%
	Annual	3.65	3.64	8	12	8.8	133%

[1] Background levels based on difference between receptor concentration with and without background concentrations in model.
[2] Results averaged based on CAAQS averaging periods described in Table 1 above.

TABLE 6-8 AVERAGE MODELLED CONCENTRATIONS FOR FUTURE SCENARIO

Pollutant	Averaging Time	Modelled Impact ($\mu g/m^3$)	DVP Impact ($\mu g/m^3$)	Ambient Background Level ($\mu g/m^3$)	Maximum Cumulative Concentration ($\mu g/m^3$)	Objective ($\mu g/m^3$)	Percentage of Criterion, Total Concentration
NO_2	1 hour	137	135	37	174	400	44%
	24 hours	79	76	45	124	200	62%
Acrolein	1 hour	1.05	0.17	0.15	1.20	4.50	27%
	24 hours	0.054	0.04	0.07	0.12	0.4	30%
CO	1 hour	772	758	219	991	36200	2.7%
	8-hr	271	268	1189	1460	15700	9.3%
PM_{10}	24 hours	8.88	8.66	26	35	50	70%
Benzene	24 hours	0.235	0.208	0.80	1.0	2.3	45%
	Annual	0.066	0.059	0.52	0.59	0.45	131%
B(a)pyrene	24 hours	5.82E-04	5.80E-04	9.5E-05	6.8E-04	5.0E-05	1353%
	Annual	1.62E-04	1.62E-04	5.5E-05	2.2E-04	1.0E-05	2170%
Formaldehyde	24 hours	0.75	0.59	3.5	4.3	65	6.5%
Acetaldehyde	24 hours	0.31	0.25	1.7	2.1	500	0.4%
1,3-Butadiene	24 hours	0.0208	0.0198	0.07	0.09	10	0.9%
	Annual	0.0058	0.0056	0.039	0.045	2	2.2%
NO_2	1 hour (2020)	119	112	39	158	119	133%
	1 hour (2025)	119	112	39	158	83	190%
	Annual (2020)	31	30	28	59	34	177%
	Annual (2025)	31	30	28	59	24	250%
$PM_{2.5}$	24 hours	3.4	3.2	15	19	27	70%
	Annual	1.46	1.41	8	10	8.8	108%

TABLE 6-9 SUMMARY OF POTENTIAL EFFECTS, MITIGATION MEASURES AND MONITORING COMMITMENTS – AIR QUALITY[2]

Project Component	Project Activities	Potential Effect	Mitigation Measures	Monitoring
Richmond Hill Corridor	• Operations and maintenance	• Exhaust emissions of diesel-powered trains contribute to local and regional air pollution	Mitigation Measures: • A detailed Operations Air Quality Management Plan will be developed and implemented to limit the generation and dispersion of airborne particulate matter, NO_X and other air contaminants associated with project operations. • New traction engines or propulsion systems and new auxiliary engines and power units will meet higher emission standards (i.e., Tier 4 diesels rather than lower tier diesels). • Engines and their emission control equipment will be maintained to manufacturers' specifications. • Rebuilt diesel engines will meet Tier 4 emission standards at the time of major engine rebuilds. • Unnecessary train/engine/propulsion system idling will be minimized through technical and operational measures. • Unnecessary non-revenue equipment runs will be minimized through design and planning. Mitigation Criteria: • Diesel engines used for traction and auxiliary power in locomotives and DMUs are subject to corresponding US EPA and Transport Canada heavy-duty diesel engine exhaust emission standards for CO, PM, NOx and HC.	• On-site inspections will be undertaken to confirm the implementation of the mitigation measures and identify corrective actions if required. • Annually, test train propulsion and auxiliary power units, which produces exhaust emissions and ensure that they remain in compliance with applicable Transport Canada heavy-duty diesel engine exhaust emission standards for CO, PM, NOx and HC. Engine testing will include: ○ Testing at no load ○ Testing at 50% load ○ Testing at 100% load • Test rebuilt traction and auxiliary power diesel engines, before being placed into service, to the exhaust emission standards they are rebuilt to meet. • Develop an Air Sampling and Monitoring Plan and submit an annual report summarizing all sampling and monitoring results accumulated over the preceding year.

[2] Notes: Regulations, standards and guidance documents referenced herein are current as of the time of writing and may be amended from time to time. If clarification is required regarding regulatory requirements, consult with the appropriate regulatory agencies.

6.3 Traffic Impact Assessment Methodology

Numerous traffic models provide estimates of capacity and level of service of roadways. These models are generally used to test the potential impacts of new developments. This is usually done by taking existing or projected "background" traffic and adding the estimated trips from new development. Background traffic is often the current traffic counts plus additional traffic expected from the natural growth of a community or preapproved development projects.

Traffic Impact Assessments were completed for each of the three (3) proposed layover/storage facilities as part of the New Track and Facilities TPAP. The methodology for these studies began with a review of documents relevant to understanding existing and future transportation conditions in the vicinity of each layover/storage facility. Nearby roads with the potential to be impacted by the proposed works were identified, and existing traffic counts were obtained. This information was used to generalize the existing capacity of surrounding roadways, based on broad assumptions of typical operations in Canada and the United States that were borrowed from standard capacities considered to be acceptable professional practice. Specifically, a maximum practical traffic figure of 1,000 was used based on studies that show residents' level of dissatisfaction with traffic rises when the traffic is over 1,000 trips per day (see: Residential Street Standards & Neighborhood Traffic Control: A Survey of Cities' Practices and Public Officials' Attitudes - Eran Ben-Joseph, Institute of Urban and Regional Planning, University of California at Berkeley).

In the case of two of the three layover/storage facilities, all except for the proposed Walkers Line Layover, nearby intersections were then analyzed using a method known as Critical Movement Analysis (CMA) to obtain a high-level sense of their capacity and operational performance. This methodology also determined which of the intersections requires more in-depth analysis. The results of the CMA were applied to data provided by Metrolinx for the anticipated number of employees, visitors, and truck deliveries to each layover/storage site, based on an 8-hour shift, to identify the required number of parking spaces and peak travel patters, subject to the following assumptions:

- Typically, employees will arrive within 30 minutes before the beginning of a shift and leave within 30 minutes after the end of the shift;
- This study presumed that 25% of the total anticipated visitors will arrive within the peak hour and the remainder will arrive over the next seven hours; and
- Delivery truck arrivals should be uniformly distributed throughout the 8-hour shifts.

Finally, proposed driveway spacing was reviewed based on the guidelines of the 2017 Geometric Design Guide for Canadian Roads published by the Transportation Association of Canada (TAC), and recommendations were identified to improve pedestrian and vehicular circulation, loading and delivery operations, and overall traffic circulation in the vicinity of each site.

In the case of the Walkers Line Layover, a Synchro analysis for three (3) traffic concept scenarios was completed to identify macro levels of service at critical intersections in the vicinity of the layover. Synchro is designed to evaluate the performance of urban streets, signalized intersections, and unsignalized intersections (two-way stop, all-way stop, and single-lane roundabouts). It calculates not only capacity, but also delay and other useful operational statistics. Synchro does not provide performance data for freeways, multilane highways, or two-lane rural roads. See Section 6.5.2 below for further details on the results of this analysis.

The inclusion of the Walkers Line Layover Facility within the scope of the New Track and Facilities TPAP was made relatively late in the Pre-planning phase of the TPAP and following the assessment of the original layover facilities, which utilized CMA as described above. Metrolinx opted to complete a Synchro analysis at Walkers Line following receipt of comments from local municipalities that requested a form of analysis they are more accustomed to within the Greater Toronto and Hamilton Area.

It should be noted that both forms of traffic analysis seek to assess the potential effects of traffic caused by a proposed development on regional and local roadways, and to identify the required roadway and access improvements needed to ensure that the roadway system will operate at an acceptable level upon completion of the proposed development. In all cases and regardless of the methodology applied, all Traffic Impact Assessments completed in support of the New Track and Facilities TPAP achieved the following:

- Providing decision makers with a basis on which to assess transportation implications of proposed development applications;
- Providing a rational basis on which to evaluate if the scale of development is appropriate for a particular site and what improvements may be necessary, on and off the site, to provide safe and efficient access and traffic flow;
- Providing a basis for assessing existing or future localized transportation system deficiencies that should be improved; and
- Addressing transportation-related issues associated with development proposals that may be of concern to neighbouring residents, businesses and property owners.

6.4 Climate Change Methodology

As part of the TPAP, Metrolinx's climate change goals will be reviewed based on their overall effectiveness in reducing the Project's impact on climate change (climate change mitigation); and ability to increase the Project's and local ecosystem's resilience to climate change (climate change adaptation), as per the MECP guide for considering climate change in environmental assessments.

The discussion/assessment of the climate change strategy considers the use of third-party guiding principles/evaluation frameworks, where appropriate, such as:

- American Public Transportation Association (APTA) recognition;
- PIEVC climate change adaptation protocol; and
- Rotary International (RI) Sustainability Index.

The TPAP starts with a selected transit project. *O. Reg. 231/08 Transit Projects and Metrolinx Undertakings* does not require proponents to evaluate planning/design alternatives as part of the EA process. The climate change assessment contained in this EPR therefore focuses on the various design and mitigation measures that will support climate change mitigation and adaptation during construction and operation of the Project.

Since infrastructure proposed as part of the Project have lifespans with the potential to face significant climatic changes based on conservative climate projections, it will likely be affected by future climate change-related events such as droughts or intense precipitation. As a result, the proposed infrastructure needs to be designed and operated with these future events in mind. The Project will continue to take climate change considerations into account as the design progresses beyond the EA phase.

6.5 Operation/Maintenance - New Layover/Storage Yard Facilities

6.5.1 Noise, Vibration & Air Quality

The Operational Noise, Vibration and Air Quality Impacts of the Don Valley layover facility been captured within the Richmond Hill Corridor Operational Noise & Vibration Assessment (see **Appendix M1**) and the Richmond Hill Corridor Operational Air Quality Assessment (see **Appendix M2**).

Operational/maintenance-related noise, vibration and air quality impacts for the remaining layover/storage yard facilities assessed within the New Track and facilities TPAP have been documented in the separate Noise/Vibration and Air Quality study reports prepared as part of the GO Rail Electrification Environmental Project Report (EPR) Addendum.

6.5.2 Walkers Line Layover – Lakeshore West Corridor

6.5.2.1 Traffic

Site Trip Generation and Distribution

To determine the site peak hour volumes for the proposed layover facility, the *Trip Generation Manual 10th Edition* published by the Institute of Transportation Engineers (ITE) was reviewed, but no similar land use was found. Using the number of employees, expected visitors, and Metrolinx deliveries, the number of trips was estimated.

The projected employee, visitor, and truck delivery trips were developed on an 8-hour shift basis. From this data shown in Table 6-10 the morning peak hour traffic was estimated, corresponding to Shift 1. Most of the morning peak hour traffic will be produced by Shift 1 employees leaving and Shift 2 employees arriving. Metrolinx provided information on the number of employees, visitors, and deliveries for assessment purposes.

This study used the following assumptions to estimate the site peak-hour traffic volumes.

- Typically, employees will arrive within 30 minutes before starting a shift and leave within 30 minutes after the shift change.
- Even though visitors and delivery trips were included in the study, Metrolinx projects these types of trips to be much less frequent than shown in Table 6-10.

TABLE 6-10 PROJECTED SITE TRIPS PER SHIFT

Peak Hour	**Shift 1**	**Shift 2**	**Shift 3**
	11:00 PM - 07:00 AM	**07:00 AM - 03:00 PM**	**03:00 PM - 11:00 PM**
Regular and On-call Employees Including Management Staff	10	2	10
Anticipated Visitors	1	3	2
Total Delivery Trucks, One-Way Trips	3	2	2
Total Trips Per Shift	***14***	***7***	***14***

To estimate the trips to and from the site, the following assumptions were made based on the proposed shift timing below. This proposition is a near "worst case" scenario having all trips being made during the facility peak hours. This is seen in Figure 6-5.

Trips inbound 6:30 to 7:00

Trips outbound 7:00 to 7:30

Type of Trips	Shift 1 11:00 PM - 07:00 AM	Shift 2 07:00 AM - 03:00 PM	Shift 3 3:00 PM - 11:00 PM
Regular and On-call Employees Including Management Staff	10	2	10
Anticipated Visitors	1	3	2
Total Delivery Trucks, One-Way Trips	3	2	2
Total Trips Per Shift	***14***	***7***	***14***

FIGURE 6-5 EXAMPLE CALCULATION FOR SHIFT CHANGE TRAFFIC 06:30 – 07:20

Table 6-11 indicates that none of the peak hours of the traffic to/from the proposed site will overlap with the peak hours of traffic on the adjacent main roadways. Where some of the Shift 2 employees arrive late at the facility, some overlap of these movements and those occurring within the morning peak hour of the adjacent roadways may be possible.

To assign the site traffic volumes to the adjacent road network, trip distribution and direction of approach were derived from the existing traffic's turning movements.

TABLE 6-11 ADJACENT MAJOR ROADWAY AND PROPOSED SITE PEAK HOUR COMPARISON

Peak Hour	Roadway Peak Hour Times	Proposed Site Peak Hour
Weekday AM Peak Hour	08:00 AM to 09:00 AM	06:30 AM - 07:30 AM
Weekday PM Peak Hour	04:45 PM -05:45 PM	02:30 PM -03:30 PM

Opening Year Background and Total Future Intersection Volumes Forecast

The 2024 (assumed opening date of the Walkers Line Layover Facility) future total volumes for the intersections were developed by adding the traffic volumes shown projected in the study.

The Reference Concept Design presents two driveways (although only one will be constructed). Therefore, multiple traffic circulation scenarios were analyzed within the proposed layover to provide the greatest amount of flexibility during future design stages. Specifically, three (3) feasible traffic circulation concepts have been identified, as discussed within the sections below.

See the *Walkers Line Layover – Traffic Impact Study* (Gannett Fleming, 2020) in **Appendix I** for the traffic movement details used in this Synchro analysis.

Concept 1 – Two Driveways Each Allowing All Turning Movements (Buses at Driveway #2)

There are two driveways in this scenario. It is assumed that the western driveway access (Driveway #1) to the layover facility will be all-movements-allowed. The eastern driveway (Driveway #2) will also be all movements allowed. The layover traffic in this scenario is mixed with the outbound traffic from the School Bus Dispatch Centre. See Table 6-12 for the summary of Levels of Service for the Concept 1 Scenario.

TABLE 6-12 TRAFFIC SUMMARY OF CONCEPT 1 – TWO DRIVEWAYS EACH ALLOWING ALL TURNING MOVEMENTS

Intersection and Control		**Critical Hour**	**Level of Service 2020**	**Level of Service (2024 No Facility)**	**Level of Service in 2024 (With Facility)**	**2024 Problem Lane Groups** **(Bolded Lane Groups may be Impacted by Traffic from the Layover Facility)**
Walkers Line at Harvester Road	Signal	AM	F	F	F	Possible Hot Spots **Southbound left-turn is most problematic lane group** Layover adds 4 trips to the left turn lane group in the AM peak hour
Walkers Line at Fraser Drive	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 10 trips westbound through and 6 trips eastbound through in the AM peak hour
Western Driveway Driveway #1 to Layover Facility	No Signal	AM	N/A	A	A	This scenario should have minimal impact on the public roads. No layover left inbound trip happens in the AM Peak. Northbound lefts will experience approximately 30 seconds' delay
Eastern Driveway Driveway # 2 to the Layover Facility All directions allowed	No Signal	AM	Not Known	A	A	Possible issues with mixing the layover facility traffic with many school buses in the morning peak hour. Northbound Lefts will experience approximately 60 seconds' delay Most of this delay is due to buses
Walkers Line at South Service Road	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 1 trip westbound through and 3 trips eastbound through in the AM peak hour
Walkers Line at Appleby Line	Signal	AM	C	C	C	Possible Hot Spots **None** Layover adds 3 trips to westbound left turn lane and 1 trip southbound right turn lane in the AM peak hour

Intersection and Control		Critical Hour	Level of Service 2020	Level of Service (2024 No Facility)	Level of Service in 2024 (With Facility)	2024 Problem Lane Groups (Bolded Lane Groups may be Impacted by Traffic from the Layover Facility)
Walkers Line at QEW South Ramp Set	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 4 trips to the loop on-ramp to QEW westbound and 2 trips to off-ramp turning left
Walkers Line at QEW at North Ramp Set	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 2 trips to the off-ramp then turning left and adding 4 trips to the QEW on-ramp westbound
Walkers Line at Harvester Road	Signal	AM	F	F	F	Possible Hot Spots **Southbound** left-turn is most problematic lane group Layover adds 4 trips to the left turn lane group in the AM peak hour
Walkers Line at Fraser Drive	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 10 trips westbound through and 6 trips eastbound through in the AM peak hour
Western Driveway # 1 to Layover Facility	No Signal	AM	N/A	A	A	This scenario should have minimal impact on the public roads. Only 1 extra left inbound trip happens in the AM Peak
Eastern Driveway to the Layover Facility (Outbound Trips Only)	No Signal	AM	Not Known	A	A	Possible issues with mixing the layover facility traffic with many school buses in the morning peak hour.
Walkers Line at South Service Road	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 1 trip westbound through and 3 trips eastbound through in the AM peak hour
Walkers Line at Appleby Line	Signal	AM	C	C	C	Possible Hot Spots **None** Layover adds 3 trips to westbound left turn lane and 1 trip southbound right turn lane in the AM peak hour

Intersection and Control		Critical Hour	Level of Service 2020	Level of Service (2024 No Facility)	Level of Service in 2024 (With Facility)	2024 Problem Lane Groups (Bolded Lane Groups may be Impacted by Traffic from the Layover Facility)
Walkers Line at QEW South Ramp Set	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 4 trips to the loop on-ramp to QEW westbound and 2 trips to off-ramp turning left
Walkers Line at QEW at North Ramp Set	Signal	AM	B	B	B	Possible Hot Spots **None** Layover adds 2 trips to the off-ramp, then turning left and adding 4 trips to the QEW on-ramp westbound

Concept 2 – Two Driveways with the Eastern Driveway as Out-Only Trips

There are two driveways in this scenario, and it is assumed that the western driveway access (Driveway #1) will be all-movements-allowed. The eastern driveway (Driveway #2) will be outbound only. The layover traffic in this scenario is mixed with the outbound traffic from the School Bus Dispatch Centre. See Table 6-13 for the summary of Levels of Service for the two driveway scenario.

The only changes in this concept scenario is at the driveways serving the layover and the School Bus Dispatch Centre. Therefore, the following table only addresses those driveways.

TABLE 6-13 PROJECTED 2024 BACKGROUND TRAFFIC AND SITE TRAFFIC CONDITIONS

Intersection and Control		Critical Hour	Level of Service 2020	Level of Service (2024 No Facility)	Level of Service in 2024 (With Facility)	2024 Problem Lane Groups Bolded Lane Groups may be Impacted by Traffic from the Layover Facility
Western Driveway Driveway # 1 to Layover Facility	No Signal	AM	N/A	A	A	This scenario should have minimal impact on the public roads.
Eastern Driveway Driveway 2 to the Layover Facility (Outbound Trips Only)	No Signal	AM	Not Known	A	A	Possible issues with mixing the layover facility traffic with many school buses in the morning peak hour causing left turn delays from the driveway

Concept 3 – Western Driveway Only (All Movements Allowed)

In this scenario, none of the facility traffic would use the outbound only driveway currently used by the School Bus Dispatch Centre. One of the reasons the scenario was evaluated is the possible complications of sharing the outbound driveway. If the layover facility used the Bus Dispatch Centre, that outbound driveway would need to be redesigned to handle traffic from the dispatch center and the layover facility. See Table 6-14 for the summary of Levels of Service for the one driveway scenario.

Since the change of the access points to the layover is localized, there is no impact on the public road system when all of the Walkers Line traffic uses one driveway. The only difference would be at the access points to the layover. This is shown in the table below. The Walkers Line scenario using one driveway rather than two only impacts two of the existing intersections on both sides of the proposed driveway. They are the intersections of Harvester Road and Fraser Drive, and Harvester Road and Morris Drive.

TABLE 6-14 LEVEL OF SERVICE ANALYSIS FOR THE ONE DRIVEWAY (WESTERN) SCENARIO

Intersection and Control		**Critical Hour**	**Level of Service 2020**	**Concept Two Driveways 2024 Level of Service**	**Option Concept One Driveway 2024 Level of Service**
Western Driveway Driveway #1 to Layover Facility	No signal	AM	N/A	A	B
Eastern Driveway Driveway #2 to the Layover Facility (Outbound Trips Only)	No signal	AM	N/A	N/A	A

This portion of the analysis shows that the layover site's traffic can be easily handled with only one driveway.

Conclusions and Recommended Mitigation

The potential traffic effects associated with the Walkers Line Layover Facility are documented in the *New Track & Facilities TPAP – Walkers Line Layover – Traffic Impact Study* (Gannett Fleming, 2020) (see **Appendix I**).

This traffic impact study estimates that the 24-hour trip generation for the layover facility will be approximately 35 trips. The layover facility peak hour is 06:30 AM to 07:30 AM. During this time, the layover should produce approximately 14 outbound directional trips and 7 inbound trips. Considering that the peak hour operation of the layover facility occurs before the regular community morning peak hour, the traffic impacts of this facility should be minimal.

Even though the Level of Service analysis both with and without the driveway #2 (outbound only) can operate at a reasonable Level of Service, there are a number of considerations leading us to recommend only using one driveway. This is due to the potential conflicts with the existing dispatch center as well as conflicts with other driveways along Harvester Road.

Traffic operations staff from the City of Burlington recommended a design of the driveway and gate area. In some cases, automatic gates are too close to the roadway and the gate is slow in reacting to incoming traffic. When that is the case, a vehicle queue could occur in the through lanes on the main roadway. This current design keeps the gate approximately 200 m away from Harvester Road and will alleviate any potential conflict and queuing problems. See Figure 6-6 below.

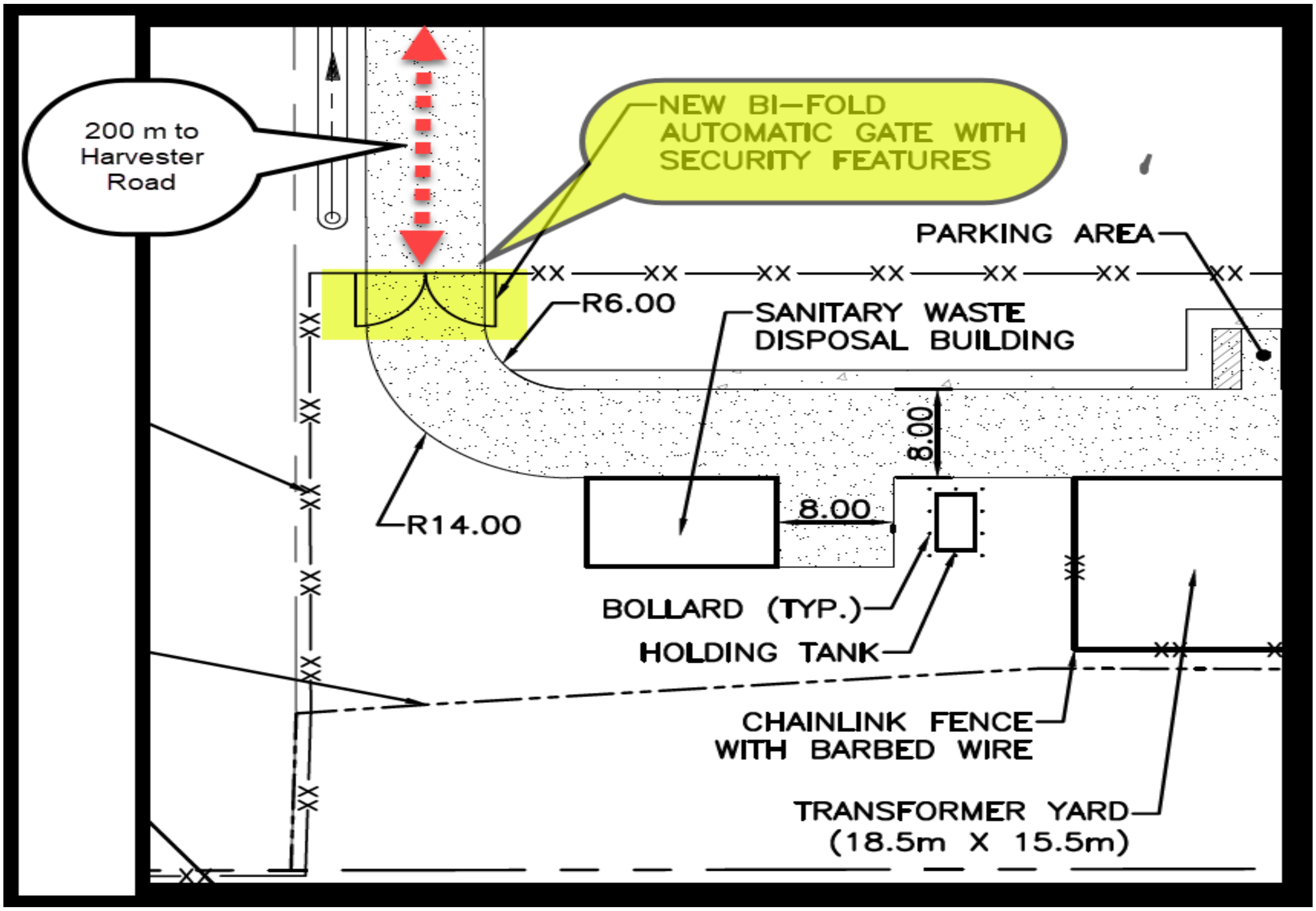


FIGURE 6-6 ENTRANCE GATE SHOULD PREVENT BACKUP ON HARVETER ROAD

6.5.3 Unionville Storage Yard Facility – Stouffville Corridor

6.5.3.1 Traffic

Site Trip Generation and Distribution

To determine the site peak hour volumes for the proposed storage facility, the *Trip Generation Manual 10th Edition* published by the Institute of Transportation Engineers (ITE) was reviewed, but no similar land use was found. Using the number of employees, expected visitors and deliveries as provided by Metrolinx, the number of trips was estimated.

The projected employee, visitor, and truck delivery trips developed on an 8-hour shift basis from this data are shown in Table 6-15.

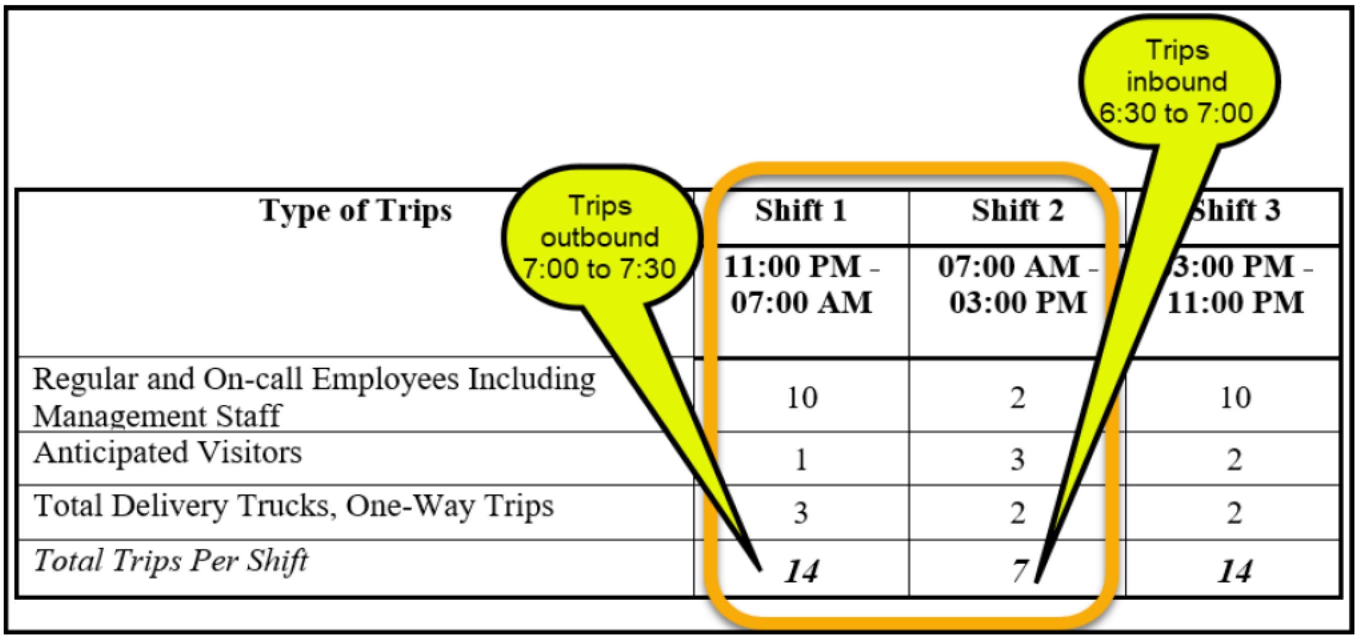
This study used the following assumptions to estimate the site peak-hour traffic volumes.

- Typically, employees will arrive within 30 minutes before the beginning of a shift and leave within 30 minutes after the end of the shift change.
- Even though visitors and delivery trips were included in the study, Metrolinx projects these types of trips to be much less frequent than shown in Table 6-15. This due to the fact this is not a typical layover facility but instead a storage facility for Metrolinx rail cars.

TABLE 6-15 PROJECTED SITE TRIPS PER SHIFT

Type of Trips	Shift 1	Shift 2	Shift 3
	11:00 PM - 07:00 AM	**07:00 AM - 03:00 PM**	**03:00 PM - 11:00 PM**
Regular and On-call Employees Including Management Staff	10	2	10
Anticipated Visitors	1	3	2
Total Delivery Trucks, One-Way Trips	3	2	2
Total Trips Per Shift	***14***	***7***	***14***

To estimate the trips to and from the site, the following assumptions were made based on the proposed shift timing below. This proposition is a near "worst case" scenario having all trips being made during the facility peak hours. This is seen in Figure 6-7.



Type of Trips	Shift 1	Shift 2	Shift 3
	11:00 PM - 07:00 AM	07:00 AM - 03:00 PM	3:00 PM - 11:00 PM
Regular and On-call Employees Including Management Staff	10	2	10
Anticipated Visitors	1	3	2
Total Delivery Trucks, One-Way Trips	3	2	2
Total Trips Per Shift	***14***	*7*	***14***

FIGURE 6-7 EXAMPLE CALCULATION FOR SHIFT CHANGE TRAFFIC 06:30 – 07:20

It should be noted that continuing the worst-case scenario analysis has included visitors and deliveries even though there will probably not be visitors nor deliveries to this facility. Unionville is a "Storage" facility and not a typical "Layover" facility. A layover facility usually has facilities for servicing rolling stock, as well as staff office space. Since this is a storage facility, it should only store Metrolinx cars for the next needed shift.

Table 6-16 indicates that none of the peak hours of the traffic to/from the proposed site will overlap with the peak hours of traffic on the adjacent main roadways. In the case where some of the Shift 2 employees arrive late at the facility, some overlap of these movements and those occurring within the morning peak hour of the adjacent roadways may be possible.

To assign the site traffic volumes to the adjacent road network, trip distribution and direction of approach was derived from the turning movements of the existing traffic morning and afternoon traffic volumes.

TABLE 6-16 ADJACENT MAJOR ROADWAY AND PROPOSED SITE PEAK HOUR COMPARISON

Peak Hour	Roadway Peak Hour Times	Proposed Site Peak Hour
Weekday AM Peak Hour	08:00 AM to 09:00 AM	06:30 AM - 07:30 AM
Weekday PM Peak Hour	04:45 PM -05:45 PM	02:30 PM -03:30 PM

Opening Year Background and Total Future Intersection Volumes Forecast

The 2023 (assumed opening date of the Unionville Storage Facility) future total volumes for the intersections were developed by adding the traffic volumes shown projected in the study.

TABLE 6-17 2020 PLANNING LEVEL VIEW OF CAPACITY

Roadway in Relation to the Proposed Site	Description	Daily Traffic 2020
Enterprise Boulevard, between the proposed facility access and 170 m to the Southwest towards Birchmount Road	**4-lane roadway** with center turn lane, sidewalks and bike lanes on both sides of the roadway ***This is the portion where the facility access meets the public roadway system***	**16,400** *(Under generalized daily capacity guidelines of 32,400)* **Note:** 15,600 counted in 2018 and adjusted upwards 1% per year for five years to account for when the original traffic counts were taken
Enterprise Boulevard, between Birchmount Road and Rivis Road	**4-lane roadway** with a portion of center turn lane near the proposed facility access. The remaining portion has restrictive medians. Sidewalks are on both sides of the roadway	**16,400** *(Under generalized daily capacity guidelines of 32,400)* **Note:** 15,600 counted in 2018 and adjusted upwards 1% per year for five years to account for when the original traffic counts were taken
Enterprise Boulevard between Rivis Road and Bill Crothers Drive towards the east	**4-lane roadway** with a painted median with a small portion of concrete near the left turn lanes. Extensive left turn serving both sides of the road without the use of two-way left-turn lanes Sidewalks on both sides of the roadway	**15,900** *(Under generalized daily capacity guidelines of 32,400)* **Note:** 15,600 counted in 2015 and adjusted upwards 1% per year for eight years to account for when the original traffic counts were taken
Birchmount Road	**4- lane roadway** with restrictive medians and exclusive turn lanes at the intersection with Enterprise Boulevard Sidewalks and bike lanes on both sides of the roadway	Daily traffic not available
Rivis Road	**4- lane undivided roadway** with exclusive turn lanes at the Intersection with Enterprise Boulevard Bike lanes and sidewalks on both sides of the roadway	Daily traffic not available

It has been determined that not all intersections are sensitive to changes from the additional traffic of the proposed storage facility. The capacity analysis is only done for the intersections identified to be most susceptible to additional traffic from the proposed storage facility. It is only those intersections that are summarized in Table 6-18. These conclusions were based on the use of Critical Movement Analysis. Specifically, nearby Enterprise Boulevard intersections with Birchmount Road and Rivis Roads will be near capacity at the storage facility's presumed opening year. However, even the conservative, 'worst-case' scenario of potential storage facility traffic will only have a minimal impact on the overall capacity. The details of the Critical Movement Analysis are found in **Appendix I**.

TABLE 6-18 PROJECTED 2023 BACKGROUND TRAFFIC AND SITE TRAFFIC CONDITIONS

Intersection and Control		**Critical Hour**	**Critical Movement Capacity in 2020**	**Critical Movement Capacity in 2023 (No Facility)**	**Critical Movement Capacity in 2023 (With Facility)**	**Possible Problem Lane Groups** **Bolded Lane Groups may be Impacted by Traffic from the Storage Facility**
Enterprise Boulevard and Birchmount Road	Signal	AM	0.85 Under Capacity	0.89 Near Capacity	0.90 Near Capacity	Possible Hot Spots **EB through Westbound left** **NB left**
Enterprise Boulevard and Rivis Road	Signal	AM	0.92 Near Capacity	0.94 Near Capacity	0.95 Near Capacity	Possible Hot Spots **WB through NB left**

A concern that was investigated was the potential impact of the future access to the planned parking area for the York University Markham Campus development. Using the latest (2018) traffic study provided by the City of Markham, it was concluded that there would be no significant adverse impact on safety or traffic operations, even if the two access points were close together. This conclusion was reached by comparing the AM peak (the critical peak for the Unionville facility) with the projected driveway activity from the York University Markham parking lot.

<u>Conclusions and Recommended Mitigation</u>

The potential traffic effects associated with the Unionville Storage Yard Facility are documented in the *New Track & Facilities TPAP – Unionville Storage Yard – Traffic Impact Study* (Gannett Fleming, 2020) (see **Appendix I**).

The traffic impact study estimated that the 24-hour trip generation for the storage yard will be approximately 35 trips. The facility's peak hour is 06:30 AM to 07:30 AM. During this time, about 14 peak directional trips outbound and seven trips inbound are anticipated. Considering that the peak hour operation of the layover facility occurs before the regular community morning peak hour, the traffic impacts of this facility should be minimal.

To have the storage facility access operate most safely, it is advisable to consider the construction of a restrictive median with an opening that prohibits left-turns-out from the proposed access. Even though this directional median opening will prevent left-turns-out, it will serve the left-turn-into the property. The position of this opening and turning left into the access will provide the best site distance for the left-turn-in vehicles.

Figure 6-8 shows a proposed design that would channelize left-turn movements to prevent left-turns out of the access but allow left turns into the facility. The left turns in would be less impacted by sight distance issues. It should be noted that any modifications to the local road network, including the proposed enhancements discussed within this EPR, must be further considered during future project phases and in coordination with the appropriate authorities having jurisdiction.

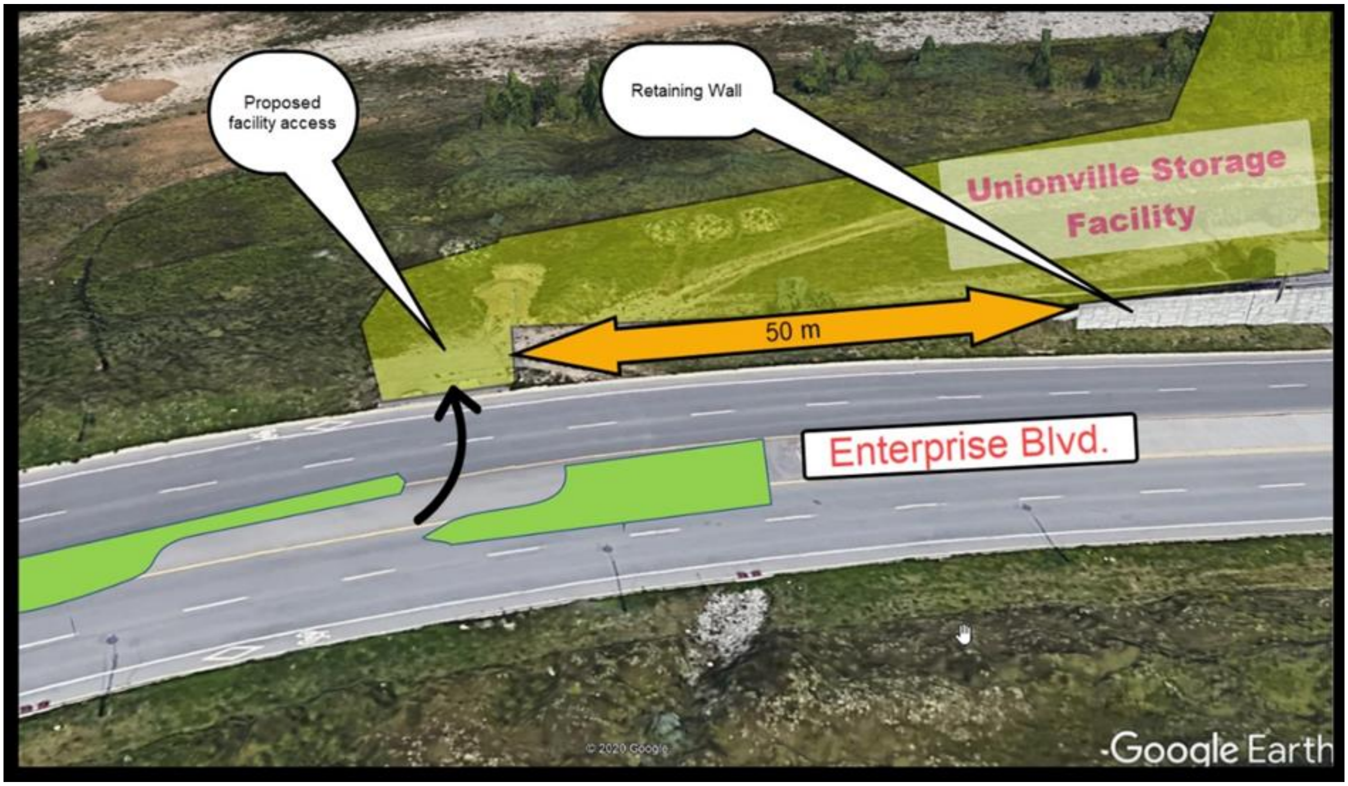


FIGURE 6-8 PROPOSED DIRECTIONAL MEDIAN OPENING SERVING THE UNIONVILLE FACILITY

The planned expansion of York University provides an opportunity to improve the vehicular access and pedestrian activities near the Unionville Storage Yard. The university is proposing a satellite parking lot adjacent to the Unionville facility. When the York University satellite parking lot is constructed, further consideration should be given to closing the driveway to the Unionville facility. At that time, all Unionville facility traffic has the potential to use the access to the satellite parking lot.

6.5.4 Don Valley Layover Facility – Richmond Hill Corridor

6.5.4.1 Traffic

Site Trip Generation and Distribution

To determine the site peak hour volumes for the proposed layover facility, the Trip Generation Manual 10th Edition published by the Institute of Transportation Engineers (ITE) was reviewed, but no similar land use was found. A first principle methodology was instead used to estimate the layover facility peak hour traffic by using the Metrolinx-provided number of employees, visitors, and truck deliveries. See Table 6-19 for the projected employee, visitor, and truck delivery trips developed on an 8-hour shift basis.

This study used the following assumptions to estimate the facility peak-hour traffic volumes:

1. Typically, employees will arrive within 30 minutes before the beginning of a shift and leave within 30 minutes after the end of the shift change; and
2. This study presumed that 100% of visitors and deliveries would occur within the study peak hour.

The total projected site traffic volumes for each shift change were converted into peak hour volumes based on these assumptions. The estimated site peak hour volumes are shown in Table 6-19**.**

TABLE 6-19 WORKSHEET FOR ESTIMATED TOTAL SITE PEAK HOUR VOLUMES PER SHIFT (DON VALLEY LAYOVER)

Type of Trips	Shift 1	Shift 2	Shift 3	Total
	11:00 PM - 07:00 AM	07:00 AM - 03:00 PM	03:00 PM - 11:00 PM	24 Hours
Regular and On-call Employees Including Management Staff	10	2	10	22
Anticipated Visitors	1	3	2	6
Total Delivery Trucks, One-Way Trips	3	2	2	7
Total Trips Per Shift	***14***	***7***	***14***	***35***

Peak hour traffic movements for the Don Valley layover facility were examined using shift change information. Using Figure 6-10 it would be expected that from 6:30 AM to 7:00 AM, traffic from Shift Number 2, would be entering the facility site. People leaving from Shift Number 1 would be going outbound from 7:00 AM to 7:30 AM. This would create the most significant number of trips to occur during the "waking day hours."

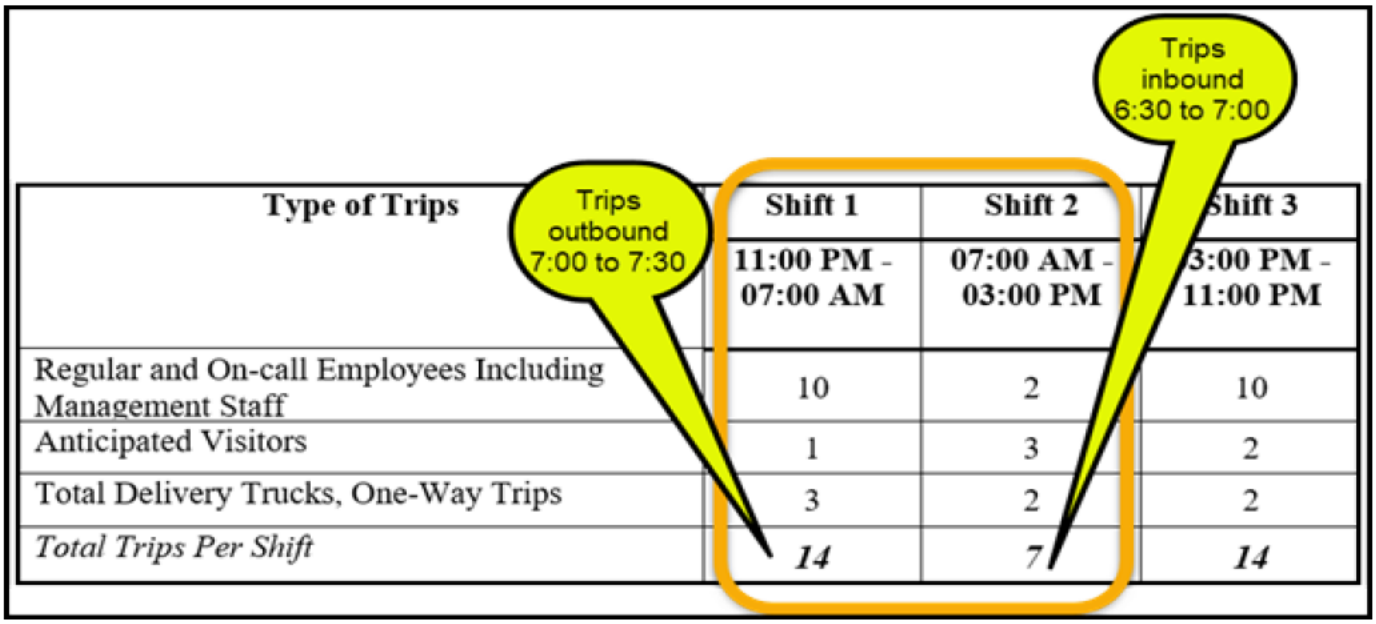


FIGURE 6-9 EXAMPLE CALCULATION FOR SHIFT CHANGE TRAFFIC 06:30 – 07:30

Table 6-20 compares peak hours for both the morning and evening. In both cases, the critical study hour would be between at least 30 minutes before the typical roadway morning peak hour.

TABLE 6-20 ADJACENT MAJOR ROADWAY AND PROPOSED SITE PEAK HOUR COMPARISON

Peak Hour	Typical Roadway Peak Hour Times within the Vicinity	Layover Facility Peak Hour
Weekday AM Peak Hour	08:00 AM to 09:00 AM	06:30 AM - 07:30 AM
Weekday PM Peak Hour	05:00 PM -06:00 PM	02:30 PM -03:30 PM

Opening Year Background and Total Future Intersection Volumes Forecast

The 2023 (assumed opening year of the Don Valley Layover Facility) future total volumes for the intersections were developed by adding the traffic volumes shown projected in the study.

A level of service analysis review was done for the existing conditions using the Planning Methods in the Highway Capacity Manual (HCM), using 4% heavy vehicles, a base saturation flow rate for 2,400 vehicles (for expressway lanes), and a PHF of 1.0. The conditions on Don Valley Parkway proper are known to be very congested with daily volumes near or over 100,000. An extra 14 vehicles added in one direction before the facility peak would be inconsequential.

Table 6-21 has the details for the future (2023) operations/capacity of the surrounding highway system.

TABLE 6-21 SURROUNDING ROADWAYS AND ESTIMATED HOURLY DIRECTIONAL CAPACITIES

Roadway in Relation to the Proposed Site	Description
Don Valley Parkway Connector The connection from Bayview Avenue to Don Valley Parkway proper	4-lane divided expressway *This is the portion where traffic from the layover facility meets the public roadway system* ***Approximate hourly directional maximum LOS D service volume = 3,890*** ***Existing AM Directional Traffic: 2,759 during the AM Peak Southbound, Currently LOS C***
Don Valley Parkway	6-lane divided expressway ***Approximate hourly directional maximum LOS D=5,780***
Bayview Avenue	4-lane undivided arterial ***Approximate hourly directional capacity at LOS D =2,000***

Conclusions and Recommended Mitigation

The potential traffic effects associated with the Don Valley Layover Facility are documented in the *New Track & Facilities TPAP – Don Valley Layover – Traffic Impact Study* (Gannett Fleming, 2020) (see **Appendix I**).

The proposed layover facility will consist of the following features (see Figure 6-10):

- Two access points connecting to the Don Valley Parkway Connector;
- A right in and out at the northeast approach to the Don Valley Parkway;
- A right out only at the southwest approach to Bayview Avenue; and
- A formalized access road to replace the current, unpaved road that Hydro One uses to access its substation, and that the City of Toronto uses to maintain the Prince Edward Viaduct and Lower Don River Trail.

Because the two access points to the Don Valley layover are along the high-speed Don River Parkway Connector (linking the main Don Valley Parkway to Danforth Avenue and Bayview Avenue), the existing access lanes should be repaved and redesigned to include deceleration and acceleration lanes (see Figure 6-11). These design changes should improve the safety of the access lanes. Additional safety measures include a highly visible traffic gate, highway signs and markings to prevent the unintentional use of these access points by the public.

The Don Valley layover is facility projected to have a minimal effect on local traffic, as:

- The facility will generate a limited amount of traffic on the Don River Parkway Connector; and,
- Most of the nearby ramps and roadways already operate at or below capacity, so traffic generated by the layover facility is projected to dissipate quickly during peak hours.

FIGURE 6-10 DON VALLEY LAYOVER CONNECTION TO THE MUNICIPAL ROAD NETWORK

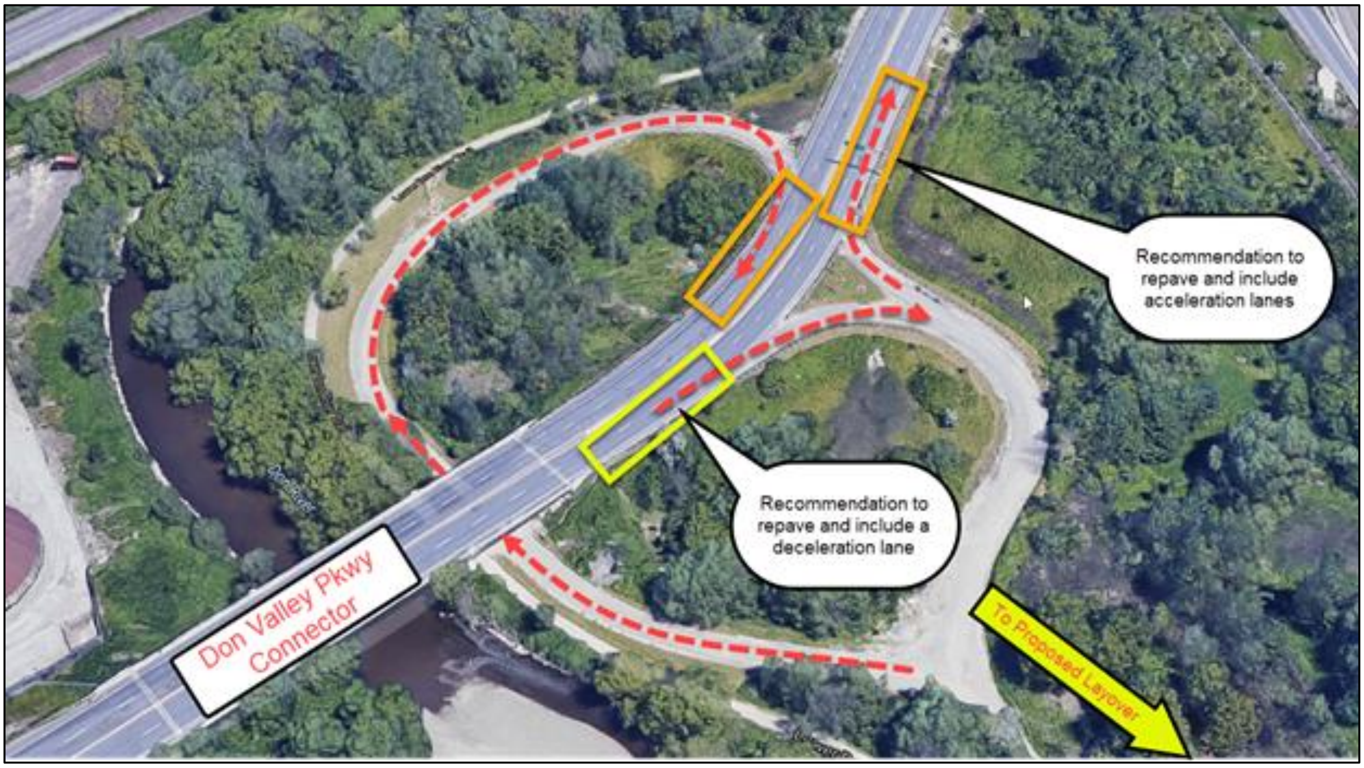


FIGURE 6-11 SUGGESTED IMPROVEMENTS FOR THE PRIMARY ACCESS TO THE DON VALLEY LAYOVER

6.6 Operation/Maintenance - Electrified Infrastructure (Richmond Hill Corridor)

The operational effects related to noise/vibration and air quality are addressed in Sections 6.1 and 6.2 above.

6.6.1 Cultural Heritage Evaluation Report (CHER) – Richmond Hill Rail Corridor Bridges, City of Toronto

The electrification of the Richmond Hill Corridor will result in direct impacts to three bridges; the Queen Street East Bridge, the Dundas Street East Bridge, and the Gerrard Street East Bridge in the City of Toronto (referred to as 'the subject bridges'). The Cultural Heritage Assessment Report identified the subject bridges as potential built heritage resources (BHRs) (see **Appendix F2** for more information). Potential impacts to the subject bridges were identified as electrification of the corridor requires wire attachments to the structures, and the addition/modification of bridge protection barriers. Therefore, a Cultural Heritage Evaluation has been undertaken to determine if the potential BHRs contain cultural heritage value or interest. Further details pertaining to the evaluation of the subject bridges is presented below (see **Appendix F3** for more information).

6.6.1.1 Queen Street East Bridge

The Queen Street East Bridge connects the Riverside and Corktown neighbourhoods of the City of Toronto in a mixed commercial and residential context between River Street on the west and Davies Avenue on the east. The Queen Street East Bridge is a nine-span structure with eight steel deck-plate girder spans and one Pratt through truss span and was built in 1911. The subject bridge carries Queen Street East over the Bayview Avenue Extension, the Richmond Hill rail corridor at Mile 1.98, the Lower

Don River Trail, the Don River, and the Don Valley Parkway including an offramp to Eastern Avenue. The subject bridge is jointly owned by the City of Toronto (70%) and Metrolinx (30%) (see Figure 6-12).

FIGURE 6-12 QUEEN STREET EAST BRIDGE, CITY OF TORONTO

Cultural Heritage Value or Interest

The Queen Street East Bridge retains historical or associative value due to its association with Queen Street East, the Don River Valley, and the railway history of the City of Toronto in the early twentieth century. The bridge was constructed in 1911, replacing earlier bridges on this location. The construction of this bridge was important in continuing the historical transportation and settlement patterns in the City of Toronto and would have been instrumental in supporting the early growth and development of the commercial and industrial sectors of the City, and the residential and commercial establishment of the Corktown and Riverside neighbourhoods.

The Queen Street East Bridge retains contextual value as an important crossing that is significant to defining, maintaining and supporting the historical character of the mixed residential and commercial surroundings. The Queen Street East Bridge is also physically, functionally, and historically linked to the Don River Valley and the rail corridor within the City of Toronto, and is the site of one of the earliest crossings of the Don River in the downtown core of the City beginning c. 1803 with a wooden bridge. Finally, the subject bridge is highly visible and significant views are available to motorists, public transit users, and pedestrians on Queen Street East and to users of the Lower Don Recreational Trail, the Don

River, and the Don Valley Parkway. Significant views of the Don Valley and the City of Toronto are also available from the bridge. As such, the subject bridge is considered a landmark

Heritage Attributes

Key heritage attributes that embody the heritage value of the subject bridge in the local context include:

- Main Pratt through truss span over the Don River constructed in 1911;
- Riveted plate girder main structural elements and rolled steel girder secondary support element in the truss span;
- Riveted connections in the truss span;
- Cantilevered concrete pedestrian sidewalks with metal lattice railing at deck level;
- Historical plaques commemorating the history of the crossing and local area on the bridge deck;
- All substructure elements that support the main Pratt truss span;
- Deck plate girders and structural elements on the 1911 western approach spans;
- Substructure supporting 1911 western approach spans; and
- Location as an early bridging point over the Don River in the City of Toronto.

6.6.1.2 Dundas Street East Bridge

The Dundas Street East Bridge connects the Riverside and Regent Park neighbourhoods of the City of Toronto in a mixed commercial and residential context between River Street on the west and Carrol Street on the west. The Dundas Street East Bridge is a four-span structure and features three steel deck plate girder spans and one open spandrel column steel plate girder arch span and was built in 1911. The subject bridge carries Dundas Street East over the Bayview Avenue Extension, the Richmond Hill rail corridor at Mile 2.26, the Lower Don River Trail, the Don River, and the Don Valley Parkway. The subject bridge is 100% owned by the City of Toronto (see Figure 6-13).

FIGURE 6-13 DUNDAS STREET EAST BRIDGE, CITY OF TORONTO

Cultural Heritage Value or Interest

The Dundas Street East Bridge retains historical or associative value due to its association with Dundas Street East, the Don River Valley, and the railway history of the City of Toronto in the early twentieth century. The bridge was constructed in 1911 and is an original structure at this location. The construction of this bridge was important in continuing the historical transportation and settlement patterns in the City of Toronto, and would have been instrumental in supporting the early growth and development of the commercial and industrial sectors of the City and the residential and commercial establishment of the Corktown and Riverside neighbourhoods.

The Dundas Street East Bridge retains contextual value as an important crossing that is significant to defining, maintaining and supporting the historical character of the mixed residential and commercial surroundings. The Dundas Street East Bridge is also physically, functionally, and historically linked to the Don River Valley and the rail corridor within the City of Toronto. Finally, the subject bridge is highly visible and significant views are available to users of the Lower Don Recreational Trail, the Don River, and the Don Valley Parkway. Significant views of the Don Valley and the City of Toronto are also available from the bridge. As such, the subject bridge is considered a landmark.

Heritage Attributes

Key heritage attributes that embody the heritage value of the subject bridge in the local context include:

- Main open spandrel steel plate girder arch span over the Don River;
- Riveted plate girder main structural elements and rolled steel girder secondary support element in the open spandrel arch span;
- Riveted connections in the arch span;
- Metal lattice railings at deck level;
- Decorative concrete piers with arched columns that support the main open spandrel arch span;
- Deck plate girders and structural elements on the 1911 western approach spans;
- Substructure supporting 1911 western approach spans; and
- Location as an early bridging point over the Don River in the City of Toronto.

6.6.1.3 Gerrard Street East Bridge

The Gerrard Street East Bridge is immediately southeast of the Cabbagetown neighbourhood of the City of Toronto in a mixed commercial and residential context between River Street on the west and St. Matthews Road on the east. The Gerrard Street East Bridge is a three-span open spandrel steel plate girder arch structure that was built in 1922. The subject bridge carries Gerrard Street East over the Bayview Avenue Extension, the Richmond Hill rail corridor at Mile 2.45, the Lower Don River Trail, the Don River, and the Don Valley Parkway. The subject bridge is 100% owned by the City of Toronto (see Figure 6-14).

FIGURE 6-14 GERRARD STREET EAST BRUDGE, CITY OF TORONTO

Cultural Heritage Value or Interest

The Gerrard Street East Bridge retains historical or associative value due to its association with Gerrard Street East, the Don River Valley, and the railway history of the City of Toronto in the early twentieth century. The bridge was constructed in 1923 to replace an earlier structure at this location. The construction of this bridge was important in continuing the historical transportation and settlement patterns in the City of Toronto and would have been instrumental in supporting the early growth and development of the commercial and industrial sectors of the City and the residential and commercial establishment of the Cabbagetown and Riverside neighbourhoods.

The Gerrard Street East Bridge retains contextual value as an important crossing that is significant to defining, maintaining and supporting the historical character of the mixed residential and commercial surroundings. The Gerrard Street East Bridge is also physically, functionally, and historically linked to the Don River Valley and the rail corridor within the City of Toronto. Finally, the subject bridge is highly visible and significant views are available to users of the Lower Don Recreational Trail, the Don River, and the Don Valley Parkway. Significant views of the Don Valley and the City of Toronto are also available from the bridge. As such, the subject bridge is considered a landmark.

Heritage Attributes

Key heritage attributes that embody the heritage value of the subject bridge in the local context include:

- Three open spandrel steel plate girder arch spans over the Don River;
- Riveted plate girder main structural elements and rolled steel girder secondary support element in the open spandrel arch span;
- Riveted connections in the arch spans;
- Original decorative steel railing on deck level of bridge approach spans;
- Decorative concrete piers with arched columns that support the open spandrel arch spans;
- Cast-in-place concrete abutments; and
- Location as an early bridging point over the Don River in the City of Toronto.

6.7 Vegetation Management - Electrification of Richmond Hill Corridor

Vegetation management will consist of a vegetation/tree trimming/removal program that will consist of two parts. The first phase will cut back/remove trees and other vegetation within the vegetation clearance zone to a maximum of seven (7) meters from the center of the outer most track. The second phase will be a reoccurring maintenance phase that will involve trimming branches or removing vegetation that may grow back into the vegetation clearance zone over time. The frequency between vegetation trimming/removal activities will depend on the rate that the vegetation grows back and the allowable space within Metrolinx ROW. Vegetation trimming/removal is accomplished using trucks and equipment such as wood chippers that will work from within the track area. This approach to vegetation management is consistent with the Metrolinx Vegetation Compensation Protocol and applies to all affected corridors GO Transit operates on.

For additional information regarding potential impacts and mitigation, refer to EPR Chapter 5, Section 5.20.1 and Table 5-101. For further information related to Metrolinx's Vegetation Guideline, refer to Chapter 9.

6.8 Climate Change

This section outlines how climate change considerations were taken into account in the environmental assessment and design of the proposed infrastructure associated with the New Track and Facilities Project. Specifically, this section describes how the Transit Project Assessment Process (TPAP) for new tracks and facilities incorporates the Ministry of the Environment, Conservation, and Parks (MECP) guidance for considering climate change in environmental assessments, with a focus on climate change mitigation and adaptation.

The requirements and recommendations included in this section must be applied with the consideration that the proposed layover/storage yards are industrial facilities and will not serve GO customers. Therefore, some of Metrolinx's climate change requirements may not apply to the design and construction of the proposed infrastructure under this project. The three proposed facilities (Don Valley Layover, Walkers Line Layover and Unionville Storage Yard) are infrastructure components that are critical to the Metrolinx GO Rail Network and the GO Expansion Program and efforts will be made to ensure that climate change mitigation is applied to the maximum extent possible. Metrolinx is continuing to refine its climate change requirements/approach, and additional measures specific to GO Expansion infrastructure may be incorporated at a future date.

The Intergovernmental Panel on Climate Change (IPPC) defines climate change as:

> *"…a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use." (Intergovernmental Panel on Climate Change, 2014)*

The term "climate change" can apply to any major variation in temperature, wind patterns or precipitation that occurs over time. Changes in the composition of the atmosphere are resulting in processes that alter global temperature, precipitation, and are affecting local weather patterns. These processes are leading to increased occurrence of extreme weather events such as floods, droughts, ice storms and heat waves across the Greater Toronto and Hamilton Area (Metrolinx, 2017).

To mitigate climate change and its effects on the natural and built environments, government agencies at all levels have developed strategies and guidelines to reduce greenhouse gas (GHG) emissions into the atmosphere. Government agencies are also implementing measures that promote resiliency to a changing climate. Consistent with these strategies and guidelines, the planning and design of this Project will consider both climate change *mitigation* (i.e., minimizing effects of a project on climate change) and *adaptation* (i.e., resilience of a project to future climatic conditions).

Section 6.8.1 outlines the policy context which guides how climate change has been considered in the planning of this Project. Sections 6.8.2 (mitigation) and 6.8.3 (adaptation) describe how these considerations are being implemented in project planning and design. Given the relatively small effects of the transit project on climate change, and Metrolinx's extensive existing guidance on how to build and operate the infrastructure considering future extreme weather events, reference to existing climate change strategies and policies was judged to be sufficient in considering climate change in the TPAP.

6.8.1 Policy Context

6.8.1.1 Government of Ontario

The Government of Ontario has committed to reducing GHG emissions to 30% below the 2005 levels by 2030 (i.e., 143 megatonnes of carbon dioxide equivalent (CO_2e) by 2030) (Government of Ontario 2018).

The *Infrastructure for Jobs and Prosperity Act*, *2015* (Province of Ontario, 2015) indicates that infrastructure should be planned to mitigate effects on climate change and be designed to consider climate change adaptation. Specifically, Section 3.11 of this Act states that:

> *"Infrastructure planning and investment should minimize the impact of infrastructure on the environment and respect and help maintain ecological and biological diversity, and infrastructure should be designed to be resilient to the effects of climate change."*

The 2020 Provincial Policy Statement (PPS) (Ministry of Municipal Affairs and Housing, 2020) issued under the *Planning Act* advises on the need to consider reducing GHG emissions and reducing the potential risk of climate change-related events like droughts or intense precipitation. It encourages green infrastructure and strengthened stormwater management requirements; energy conservation and efficiency; reduced GHG emissions; climate change adaptation (e.g., tree cover for shade and for carbon sequestration); and consideration of the increased risk associated with natural hazards (e.g., flooding due to severe weather).

Applicability to the Project

Improving the public transit network can reduce traffic congestion and reduce the need for new road infrastructure, as well as reduce carbon emissions and air quality concerns associated with automobile use, contributing to reductions in GHG emission and helping to achieve provincial targets. Metrolinx is working in alignment with the intent of the *Infrastructure for Jobs and Prosperity Act*, *2015* in the planning and design of the project.

Since infrastructure proposed by the project have lifespans that have the potential to face significant climatic changes based on conservative climate projections, there is a need to consider both the operational impacts to climate change, as well as how the Project will be affected by future climate change-related events such as droughts or intense precipitation. This includes consideration of most of the aspects highlighted in the PPS, including green infrastructure; stormwater management; energy conservation and efficiency; GHG emissions; vegetation/carbon sequestration; and resiliency to natural hazards such as flooding. Specific measures related to these aspects are further discussed in Sections 6.8.2 and 6.8.3.

6.8.1.2 Ministry of the Environment, Conservation and Parks (MECP)

The MECP has prepared a guide titled *Considering Climate Change in the Environmental Assessment Process* (The Ministry of Environment , Conservation, and Parks, 2017), to describe how environmental assessment processes shall incorporate consideration of climate change impacts, including:

- The effects of a project on climate change;
- The effects of climate change on a project; and
- Various means of identifying and minimizing negative effects during project design.

Considering climate change in accordance with the guide is meant to result in a project that is more resilient to future changes in climate and helps maintain the ecological integrity of the local environment in the face of a changing climate.

The guide states that proponents should take into account climate change mitigation and adaptation during both the assessment of alternatives to the undertaking and alternative methods of implementing the undertaking. Specific to transit projects assessed under the TPAP, the guide advises that the consideration of climate change should be scaled to the significance of the project's potential environmental effects, and that evaluation can be qualitative and/or quantitative.

Applicability to the Project

The TPAP starts with a selected transit project. *O. Reg. 231/08* does not require proponents to look at the rationale and planning alternatives or alternative solutions to public transit or the rationale and planning alternatives or alternative solutions to the particular transit project (MECP 2014). The climate change assessment contained in this EPR focuses on the various design and mitigation measures that will support climate change mitigation and adaptation during operations of the Project.

Since the Project will be operational for the foreseeable future, it will likely be affected by future climate change-related events such as droughts or intense precipitation. As a result, designs, construction and operations should consider the potential for these future events. The Project will continue to take climate change considerations into account as the design progresses beyond the TPAP as the project advances from its current conceptual level of design in future project phases.

Table 6-22 outlines how climate change was considered in this Project. Each of the areas considered is described in greater detail in Sections 6.8.2 and 6.8.3.

TABLE 6-22 CONSIDERATION OF CLIMATE CHANGE IN THE PRE-TPAP AND TPAP PHASES

Consideration	Project Phase	Areas considered	Type of Evaluation
Effects of the Project on climate change (mitigation)	Pre-TPAP, detailed design, construction, operations	• Planning for transit	• Qualitative
		• GHG emissions	• Quantitative
		• Vegetation removal and compensation	• Qualitative
		• Energy consumption and emissions	• Qualitative
		• Environmental Management System	• Qualitative
Effects of climate change on the Project (adaptation)	Detailed design, construction, operations	• Air temperature (building materials, solar infiltration, shade, urban heat island effect)	• Qualitative
		• Precipitation (stormwater management, low impact development, erosion and sediment control)	• Qualitative
		• Drought (water reuse/reduction, vegetation)	• Qualitative

Further, Table 6-23 outlines how the primary expectations for proponents when considering climate change according to the MECP's guide (as indicated by "should" statements in the guide) have been addressed in the EPR.

TABLE 6-23 CONSIDERATION OF CLIMATE CHANGE IN THE EPR

Recommendation	Section(s)
The ministry expects proponents to take into account: • The project's expected production of greenhouse gas emissions and effects on carbon sinks (climate change mitigation) • Resilience or vulnerability of the undertaking to changing climatic conditions (climate change adaptation)	• See Section 6.8.2 (greenhouse gas emissions) • See Section 6.8.2 (effects on carbon sinks) • See Section 6.8.3 (climate change adaptation)
The proponent should also include a discrete statement in their study report detailing how climate change was considered in the environmental assessment.	See Section 6.8.
Proponents of natural resource related projects should consult Appendix B of the MECP's Guide to Environmental Assessment Requirements for Transit Projects, 2014 for treatment of carbon stocks as sinks versus sources.	The transit project is not natural resource related, therefore this is not applicable.
Proponents should include evaluation criteria, such as greenhouse gas emissions and effects on carbon sinks, in the assessment of alternatives and alternative methods	*O. Reg. 231/08 Transit Projects and Metrolinx Undertakings* does not require proponents to evaluate planning/design alternatives or methods as part of the EA process, therefore this is not applicable.
In concluding an environmental assessment study, the proponent should also include a statement in their study report about how climate change was considered in the environmental assessment and how the preferred alternative (project) is expected to perform with climate change considered	See Section 6.8.
Proponents should include evaluation criteria such as extreme weather events in their screening of alternatives, and alternative methods	*O. Reg. 231/08 Transit Projects and Metrolinx Undertakings* does not require proponents to evaluate planning/design alternatives or methods as part of the EA process, therefore this is not applicable.

Recommendation	Section(s)
Proponents should also include in their study report, a statement about how climate change was considered in the environmental assessment, specifically in relation to the preferred alternative (project).	*O. Reg. 231/08 Transit Projects and Metrolinx Undertakings* does not require proponents to evaluate planning/design alternatives or methods as part of the EA process, therefore this is not applicable.
All climate parameters with potential to interact with a project should be defined and considered at a screening level to fully understand which interactions pose higher risk.	See Section 6.8.
Proponents should also document any uncertainty related to either downscaling climate change projections to specific sites, or expected effects to the environment or project, within the environmental assessment.	Metrolinx is moving towards using downscaling projections as described in its *Planning for Resiliency* report (Metrolinx, 2017) to inform decisions regarding planning, construction and operations of infrastructure. This considers adaptation to climate change across all infrastructure assets.
Considering climate change in the terms of reference for an environmental assessment should commit the proponent to considering climate change effects in related project studies prepared in support of the environmental assessment report.	The TPAP does not include a terms of reference, therefore this is not applicable.
Considering climate change in an environmental assessment should result in the proponent refining and documenting measures for dealing with climate change effects as the undertaking moves toward implementation stage. Examples could include adapted design or maintenance schedules, additional studies, and revised operating procedures.	See Sections 6.8.2 and 6.8.3.
Considering climate change in streamlined environmental assessment processes and studies could result in the inclusion of a commitment on how the proponent will implement climate change adaptation and mitigation measures during the detailed design phase of any given project.	See Sections 6.8.2 and 6.8.3.
Proponents should consider whether making reference to existing climate change strategies or policies alone is sufficient as a consideration of climate change, or whether a more detailed consideration of climate change should be carried out when conducting project-specific environmental assessment studies. Documentation of the results of this consideration should be included as part of project reporting.	See Section 6.8.

6.8.1.3 Metrolinx

Metrolinx's Regional Transportation Plan (RTP) 2041 (Metrolinx, 2018) outlines the long-term projects, plans, and activities Metrolinx will deliver to support reduction of Ontario's overall GHG emissions by promoting a shift from single occupant vehicles to more energy-efficient options such as public transit, walking, cycling, carpooling, and teleworking.

Metrolinx is committed to ensuring that the existing transit network and new layover and storage facilities will have a low-carbon footprint[3] and contribute to a clean and healthy environment for future generations (Metrolinx, 2016). Metrolinx has outlined key climate change goals in its Sustainability Strategy (2015 –

[3] A carbon footprint is the total greenhouse gas emissions attributed to a body (e.g., person, facility, or event) expressed as carbon dioxide equivalent (CO_2e). CO_2e is a standard unit for measuring carbon footprints, as a way to express the impact of each different greenhouse gas in terms of the amount of CO_2 that would create the same amount of warming.

2020) (Metrolinx, 2016). The Sustainability Strategy addresses climate change through five goals, which are:

- **Goal 1:** Become Climate Resilient – Accelerate and intensify our efforts to implement a climate adaptation and resilience program to manage and mitigate climate change risks.
- **Goal 2:** Reduce Energy Use and Emissions – Adopt processes, programs and technologies that allow us to effectively track, monitor and reduce our energy consumption, and carbon and air emissions.
- **Goal 3:** Integrate Sustainability in our Supply Chain – Minimize the impact associated with the use, extraction, processing, transport, maintenance, and disposal of materials and integrate sustainability criteria into our vendor management decisions. This goal extends to consideration of embodied carbon (i.e., the carbon dioxide emitted during the manufacture, transport and construction of materials, together with end of life emissions).
- **Goal 4:** Minimize Impacts on Ecosystems – Consider the impact of infrastructure and services on ecosystems and ecosystem services and make best efforts to manage, preserve and protect. This includes the consideration of infrastructure projects within the broader context of ecosystems and ecological values, including watershed/stormwater management considerations.
- **Goal 5:** Enhance Community Responsibility – Leverage our significant investment in the region to create a lasting legacy for our communities and work closely with communities to create economic and social value.

For GO stations, terminals, and facilities, including this Project, Metrolinx generally requires that contractors adhere to the *GO Design Requirements Manual* (DRM) (Metrolinx, 2020) and other applicable Metrolinx design standards, including the Metrolinx Sustainable Design Standard. The DRM outlines the Guiding Principles and technical details for designing and building GO station infrastructure. The DRM covers a number of areas directly and indirectly related to climate change adaptation and mitigation, including stormwater management, energy consumption and emissions, and vegetation. Effort will be made to apply DRM requirements to new layover and storage facilities and associated infrastructure components to the maximum extent possible. The Metrolinx Sustainable Design Standard outlines specific design requirements and reporting direction for designing and building projects with capital costs over $100 million or otherwise required by Metrolinx. The Sustainable Design Standard covers a number of areas related to climate vulnerability and risk assessments and stormwater management. Effort will be made to apply Sustainable Design Standard requirements to new layover and storage facilities and associated infrastructure components to the maximum extent possible.

Applicability to the Transit Project

Of the goals identified above, Goals 1, 2 and 4 align most directly with climate change adaptation and mitigation as described in the MECP's guide. Goal 1 is focused on adaptation and has been considered in various aspects of new facilities design. Goal 2 relates to minimizing emissions during operations (mitigation), while Goal 4 focuses on minimizing impacts to ecosystems both during construction and operations (adaptation and mitigation). The following sections outline how project planning and design have been undertaken with regard to climate change mitigation and adaptation.

Goals 3 and 5 more broadly speak to how the construction and operations of the Project can minimize environmental impacts as well as maximize social value. These goals are discussed in throughout this section.

6.8.2 Considering the Effects of the Project on Climate Change (Climate Change Mitigation)

As indicated in

Table 6-22, the effects of the Project on climate change (mitigation) have been evaluated both quantitatively (for GHG emissions) and qualitatively (for transit planning, vegetation compensation/revegetation, energy consumption/emissions and environmental management systems).

Planning for Transit

Public transportation is a beneficial service that can reduce traffic congestion, the need for new road infrastructure, and carbon emissions and air quality concerns associated with automobile use. Improvements to transit will decrease average transit trip times in the GTHA, even with an increasing population, leading to more people using public transportation and fewer vehicle-kilometres travelled in congested conditions. This reduction in congestion, when combined with expected improvements in automobile fuel efficiency, will result in a decrease in per capita GHG emissions from automobile trips (Metrolinx, 2018).

The Project has been identified for implementation through a comprehensive, iterative planning process for new infrastructure in the GTHA. Business case analysis for the GO Expansion Program has indicated that benefits (travel time savings for new customers, auto usage decrease, increased service) outweigh impacts (delays to upstream passengers, auto usage increase). Further information about the business cases is provided in Chapter 1. It is anticipated that the introduction of these new tracks and facilities will assist in implementing the planned service increases and thus increasing the use of public transportation, thereby decreasing congestion and improving per capita GHG emissions.

Greenhouse Gas Emissions

Metrolinx will establish a baseline of GHG emissions for the Project once operational and monitor energy use of all forms for future opportunities for reduction (this should be done using a three-year baseline in order to establish a normalization of energy data). An accurate picture of energy savings can be developed in accordance with the new Metrolinx GHG Corporate Reporting process and standards.

Greenhouse gas emissions were not included in the construction air quality investigation as a detailed Construction Air Quality Management Plan will be prepared that will include specific air quality objectives as outlined in the Metrolinx Environmental Guide of Air Quality and Greenhouse Gas Emissions Assessment (Metrolinx 2019a).

Vegetation Removal and Compensation

As noted in the Natural Environment Impact Assessment (see **Appendix B2** and Chapter 7 of this EPR), the construction of the new facilities will require the removal of trees and vegetation, which will result in a temporary loss of an existing carbon sink within the local environment.

Metrolinx is establishing a Vegetation Removal and Compensation Protocol for GO Expansion projects that will be applied to the Project, and vegetation or trees that are removed will be compensated for in accordance with the provisions of this protocol, as follows:

- **For Municipal/Private Trees:** Metrolinx will work with each municipality to develop a municipality-wide streamlined tree permitting / compensation approach for municipal and private trees. The goal is to reduce administrative permitting burden for trees along long stretches of rail corridor.
- **For Trees Within Metrolinx Property:** Metrolinx is developing a methodology to compensate for trees located within Metrolinx's property. This will involve categorizing trees community types / ecological value and establishing the appropriate level of compensation. Metrolinx will be looking to partner with Conservation Authorities and municipalities to develop the final compensation plan.

- **Conservation Authorities:** For vegetation removals within Conservation Authority regulated areas where required, applicable removal and restoration requirements will be followed.
- **Federal lands:** For vegetation removals within Federally owned lands where required, applicable removal and restoration requirements will be followed.
- **Tree End Use:** Options for the end use of trees removed from Metrolinx property (e.g., reuse/recycling options) will be developed.

Compensation of disturbed areas will take place as soon as possible. Post-planting monitoring of restoration areas will occur for one year after installation. One site visit will be conducted during the subsequent growing season to confirm survival of plantings and/or seed mix. Should the plantings and/or seed mix not survive, additional seeding and/or plantings will be undertaken one year thereafter with one additional monitoring visit in the following growing season.

Additionally, the Metrolinx DRM requires that plant materials suitable to the growing environment at project sites be selected for vegetation/revegetation, and that species (native or non-native) must be hardy, drought and salt-tolerant, and resistant to the stresses of compacted soils and weather exposure.

Energy Consumption and Emissions

To lower the energy consumption and carbon footprint of the proposed layover facilities and storage yard, Metrolinx will explore (sequentially) the following groups of methods for applicability and feasibility: energy efficiency, energy conservation and recovery, and energy harvesting. Examples include:

- **Energy efficiency** – use premium efficiency motors or other equipment; applying passive means of reducing energy where it does not conflict with other operational design requirements, including the use of building materials with high-insulation/energy efficiency value where possible.
- **Energy conservation and recovery** – employ regenerative braking systems to capture energy from braking vehicles (already proposed for the GO Rail Network Electrification (2017)); and
- **Energy harvesting** – consider incorporating solar thermal systems, passive solar systems and/or ground source heat pump systems to replace or augment fuel-based systems

These and other considerations will be developed into an Energy and Emissions Management Plan that will include targets and programs to promote continuous reduction of energy and emissions (both GHG and criteria air contaminant [CAC]).

Environmental Management System

Metrolinx has developed an Environmental Management System (Env.MS), which outlines an organization-wide framework for pursuing environmental compliance and continuous environmental improvements. The Env.MS, which follows the ISO 14001 standard[4], is currently expanding from its operational focus to encompass additional environmental responsibility and stewardship considerations. The overall objectives of the Metrolinx Sustainability Strategy are reflected in the Env.MS with respect to climate change mitigation, energy use reduction, and air emissions (i.e., GHG) management. Both the construction and operation of the Project will be subject to Metrolinx's Env.MS.

[4] ISO 14001 is an international standard that outlines specific requirements for an effective environmental management system. The standard provides a framework suitable for use by an organization, and covers topics such as: Context of the organization, Leadership, Planning, Support, Operation, Performance evaluation, and Improvement.

The Env.MS includes:

- Environmental standards for managing chemicals, solid waste, regulated waste, bulk storage and fuel handling, water use and disposal, energy use, air emissions, ozone-depleting substances, designated substances and hazardous materials, snow and ice, and wildlife and vegetation;
- Compliance audits and corrective action planning;
- Environmental reporting metrics;
- Monitoring of environmental impacts; and
- Monitoring of energy use and air emissions.

Through the use of standards, audits, and reporting, the Env.MS will promote ongoing compliance with regulatory and corporate environmental requirements throughout construction and operations of the Project. Additionally, monitoring of impacts will support ecosystem resilience, consistent with overall Metrolinx sustainability objectives.

Additionally, a Sustainability Plan for the Project will be developed by the successful Project consortium and will be aligned with the Env.MS. Once developed, this Sustainability Plan will be incorporated into the Env.MS to help ensure that the Project maintains environmental compliance and continuous environmental improvement.

6.8.3 Considering Potential Effects of Climate Change on the Project (Climate Change Adaptation)

It is recognized that climate change is already underway and can be anticipated to affect the construction and operations of the Project. There is general agreement that the Great Lakes Basin will see increases in temperature, precipitation, drought, wind gust events, and freezing rain by the end of this century; however, the level of confidence and quality of supporting evidence for these projections vary considerably (Metrolinx, 2017). Table 6-24 shows changing climate parameters and predictions for climate change.

TABLE 6-24 METROLINX CLIMATE PARAMETERS LIST: PROBABILITY AND SCORES

Climate Parameter	Threshold	Annual Probability		Prob. of Occurrence for Study Period (2015-2050)	PIEVC Scoring		
		Historical	2050s		Annual: Historical	Annual: 2050s	Study Period (35 year)
Extreme Temperatures	40°C	~0.01 per year	1-7 days per year	~100%	**1**	**7**	**7**
	32°C	6.5 days per year	27.5 days per year	100%	**7**	**7**	**7**
	-30°C	0.05 days per year[1]	<0.01 days per year	<70%	**2**	**0-1[2]**	**5-6[3]**
	-23°C	1.1 days per year	0.1 days per year	100%	**7**	**3**	**7**
Temperatures Range	60°C in one year	0.1 days per year	<0.01 events per year	<90%	**3**	**0-1**	**6**
Reduced Visibility *(e.g., fog, blowing snow)*	400 m (or ¼ mile)	49 hours per year, 15.1 days per year	**strong trend ↓, stable recent period**	100%	**7**	**6-7**	**7**
	200 m	33 hours per year, 11.9 days per year	**strong trend ↓, stable recent period**	100%	**7**	**6-7**	**7**
Frost Penetration	1.2 m or below	0.17[4] per year	**Trend ↓ but some conflicting factors**	>90%	**4**	**3**	**6-7**
High Winds (Gusts)	90 km/h	2 per year	>2.5 per year	100%	**7**	**7**	**7**
	120 km/h	0.05 days per year	**Likely ↑**	~85% or higher	**2**	**2**	**6-7**
Tornadoes	EF1 +	1-in-6,000	**Unknown[5]**	~0.6%	**0**	**0**	**0-1**
Overland Flood/Heavy Rainfall	≥25 mm in 2 hour	~ 0.8 events per year	**Very likely ↑**	100%	**6**	**6**	**7**
	≥60 mm in 2 hours	≤ 0.03 events or less per year	**Very likely ↑**	~70%	**1-2**	**2[6]**	**6**
Freezing Rain	≥ 10 mm	~0.2 days per year	~0.3 days per year	~100%	**4**	**4-5**	**7**
	≥ 25 mm	0.06 days per year	>0.09 days per year	>95%	**2**	**3**	**7**
Snow	Blowing snow	7.8 days per year	**Trends not significant to scoring**	100%	**7**	**7**	**7**
	≥ 20 cm in one day	0.1 days per year	**Conflicting trends, likely remaining similar**	>95%	**3**	**3**	**6-7**
	Design Loads (snow-water-equivalent)	184 mm (Willowbrook/ Port Credit[7])	**No observed trend, some factors indicate ↑**	~20%	**1**	**1-2**	**4**
		153 mm (Streetsville[8])		~40%	**1**	**1-2**	**5**
		133 mm (Oakville[9])		~40%	**1**	**1-2**	**5**
Hail *(Mississauga Area example)*	"Golf ball" / 45 mm or larger	0.07 per year	**Unknown**	>90%	**2-3**	**Unknown**	**6**
Horizontal Rain	Gusting 50 km/h + >25 mm rain	1.8 days per year	**Slight trend ↑**	100%	**7**	**7**	**7**
Lightning	Direct strikes	~0.3% per year	**Likely ↑**	>99%	1	**Unknown**	**3**

To focus the consideration of effects of climate change on the Project, only those themes where there is high or medium agreement on data are addressed in the sections below, for both the construction and operations phases of the Project.

Air Temperature

Recognizing increasing summer temperatures, the DRM considers reducing effects of extreme heat on all Metrolinx assets. It should be noted that DRM requirements may not be applicable for all of the proposed layover facilities and storage yard as they will consist of different infrastructure components. The DRM indicates that new GO infrastructure designs will:

- Consider building material selection to limit absorption of solar radiation;

- Automate building systems to reduce solar infiltration (i.e. automatic window blinds) or provide manual alternatives;
- Maximize shade along pedestrian routes and in parking areas; and
- Mitigate the urban heat island effect through plantings, selection of building materials and proactive shade management.

Precipitation

Precipitation, whether it is rainfall, snowfall, or other forms of frozen/liquid water, is the key climate and weather-related variable of concern in stormwater management (SWM). As a result of climate change, storm events are predicted to become more intense in the GTHA, which can result in larger volumes of precipitation at one time.

The SWM design for the Project will consider the drainage and SWM objectives of the MECP Stormwater Management Planning and Design Manual (2003), MTO Drainage Management Manual (2008), TRCA Stormwater Management Criteria (2012), Low Impact Development Guidelines for Storm Water Management Design (2010), and the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering (2017). This will be supplemented by current guidance such as the runoff volume control targets for Ontario recommended to MECP (Aquafor Beech Ltd. and Earthfx Inc., 2016) from local municipalities and Conservation Authorities.

Stormceptors[5] and stormwater management features must be sized appropriately to manage predicted future scenario flows and sediment loading (i.e. winter and spring).

Intensity-Duration-Frequency Curves

A detailed SWM Plan will be developed prior to the construction phase of the Project so that runoff from rainfall is controlled based on predicted future scenarios, to promote climate resilience. These scenarios will be identified by using the most up-to-date precipitation intensity-duration-frequency (IDF) curves available.

IDF curves are graphical representations of the amount of water that falls within a given period of time in catchment areas and are used by decision makers to plan and design infrastructure to withstand severe weather impacts (Office of the Auditor General of Canada, 2016). Current SWM practices include the use of IDF data and design storm distributions (e.g., Chicago Storm, Hurricane Hazel), as well as 2-year through to 100-year[6] storm events.

Designing the SWM systems for the Project based on up-to-date IDF curves will lead to:

- Reduced ongoing operation and maintenance requirements; and,
- Minimized impacts on surrounding ecosystems, since SWM systems will be designed to ensure that runoff from rainfall is controlled mostly on-site.

Low-Impact Development

The SWM designs for the Project will consider implementation of Low Impact Development (LID) measures. LID is a SWM strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible (i.e., in the vicinity of the proposed

[5] A stormceptor is an oil grit separator/hydrodynamic separator, designed to protect waterways from hazardous material spills and stormwater pollution.
[6] Storm even frequency is used to simplify the definition of a rainfall event that statistically has a chance of occurring once within the given time period (e.g., a 100-year storm has a 1 in 100 (1%) probability of occurring in any given year.

infrastructure). Compared to conventional design, LID measures allow for increased infiltration of stormwater through built infrastructure, which would be beneficial for managing stormwater should storms increase in intensity. LID design strategies include measures that can effectively remove nutrients, pathogens and metals from runoff, and reduce the volume and intensity of stormwater flows (Sustainable Technologies Evaluation Program (STEP), 2019).

The design of the LID measures will consider the guidance provided in the *Low Impact Development Stormwater Management Planning And Design Guide* (Sustainable Technologies Evaluation Program (STEP), 2019). Over the long-term operation of the Project, SWM facilities including LID measures will be monitored to ensure that these features are maintained appropriately and repaired where and when required.

Erosion and Sediment Control Measures

An increase in storm intensity, which is projected as a result of climate change (see Table 6-24), can make erosion and sedimentation more likely, especially during construction. Erosion and Sediment Control (ESC) measures as described in **Appendix H** of the EPR, including the development of an ESC Plan, will be implemented during the construction phase of the Project to ensure stormwater runoff is controlled and sediment is prevented from entering sewers and watercourses. The ESC Plan will include consideration of the' Erosion and Sediment Control Guide for Urban Construction (Toronto and Region Conservation Authority, 2019) and OPSS 805 (Erosion and Sediment Control Measures). Installation and monitoring of appropriate ESC measures will help mitigate potential effects of climate change on the Project.

Drought

As summarized in Table 6-24, the Great Lakes Basin is projected to see increases in frequency and extent of drought. Facilities design will include consideration of water conservation measures to reduce effects of drought on the Project, such as:

- Metering indoor and outdoor water use to better track and manage the impacts of extended droughts on operations and landscape plantings;
- Using collected rainwater for plant irrigation;
- Using water conserving systems to reduce consumption; and
- Planting drought resistant vegetation.