Appendix A6-2B Noise and Vibration Study Lakeshore East Corridor, GO Rail Network Electrification Project

Executive Summary under Operational Noise Assessment

For electric traction power facilities, at the Durham switching station (SWS) and WMRF traction power substation (TPS) the predicted noise levels at nearby receptors were below the limits. Therefore, noise mitigation for electric traction power facilities was not required. For the Scarborough SWS the predicted sound levels were above the applicable sound level limits. At the detailed design stage, more accurate sound levels for the transformers will be assessed. If expected sound levels of the transformers exceed those assumed in this report, their impacts will be re-examined and, if necessary, mitigation measures such as low noise fans or barriers will be investigated.

3.5.6 Rail Traffic Movements

All rail traffic on the track infrastructure used by GO Transit is considered in the Pre-project and Post-project assessments. Rail traffic along the LSE Rail Corridor includes GO Transit, other passenger trains (VIA Rail) and freight activity. In the Pre-project scenario, a typical section of the corridor expects 96 GO trains, 35 VIA trains, and 2 CN freight switcher per day. In the Post-project scenario, a typical section of the corridor expects up to 259 GO trains, 35 VIA trains, 2 CN freight switchers, and no new service providers operating along the tracks, per day. Detailed rail traffic volumes are summarized in Appendix D, trains included in ~~Tables~~ the Pre-project scenario are listed in Table D2.1, and the Post-project in Table D2.2.

3.5.7.5 Crossovers and Switches (applicable to all trains)

Additional details of the measurements and sensitivity analysis are included in Appendix F.

~~Switch heaters operate intermittently and have low sound levels with respect to rail activity. As sound is evaluated over a 16-hour and 8-hour time period, the intermittent and irregular operation results in insignificant impacts from these sources.~~

Switch heaters for all new switches were assessed under NPC-300 Section B7.4, to a L_{EQ} (1-hr) limit of 55 dBA. The switch heaters were assessed as stationary sources assumed to operate continuously for any given hour. The predicted levels due to the switch heaters were less than 48 dBA, and therefore compliant with NPC-300 in all cases. No further assessment of switch heaters was completed.

3.5.8 Electric Traction Power Facility (applicable to electric trains only)

Three electric traction power facilities are required along the LSE Corridor as follows:

- Whitby Rail Maintenance Facility (WRMF) Traction Power Substation (TPS) and tap;
- Durham Station (SWS); and
- Scarborough SWS.

There are no other electric traction facilities proposed along the LSE corridor.

The locations of the electric traction power facilities are shown broadly in Figure 1, and in more detail in Appendix D Figures D.1.4, D.1.9 and D.1.12.

3.5.9 Layover Sites (applicable to all trains)

The distribution of train consist types at the layovers are as follows:

- Henry Layover site: 3 x E2L12
- Oshawa Layover site: 2 x D2L12
- WRMF Layover site: 7 x D2L12 and 5 x E2L12
- Midland Layover site: 5 x E2L12

There are no other layover sites along the LSE corridor.

4.3 Methodology and Key Inputs

Additionally, as part of the detailed design, verification measurements will be conducted at key receptors to validate the calculations and assumptions. Metrolinx will complete vibration measurements of the existing conditions at the detailed design stage in areas where vibration mitigation is recommended.

Note under Table 7

Note. [1] Mitigation can include ballast mats, under sleeper pads, or resilient fixation

5.1 Applicable Criteria

For historical buildings, a criterion of 5 mm/s was used. This criterion is below the lowest of the building damage criteria of 8 mm/s provided in Table 10 and is in line with Category III structures (Non-engineered timber and masonry buildings) noted in Table 7-5 of the FTA Protocol, which is expected to be representative of the most susceptible buildings along the LSE corridor. Given its relatively modern construction, Category III structures as per FTA, are representative. The threshold for FTA Category III is comparable to the City of Toronto Zone of Influence for construction vibration impacts.

Table 11, Operational Noise (Trains) under Monitoring

- ~~Monitor air-borne and air-borne noise as part of an annual "Noise and Vibration Survey" at representative receptors across the corridor to confirm compliance with Operation Noise and Vibration requirements of the Ministry of Environment, Conservation and Parks, other provincial and federal requirements, and Metrolinx requirements. Representative receptors will be selected per the following criteria:~~

  - ~~Location subject to highest rail related noise and vibration~~
  - ~~Location representative of a significant number of receptors~~
  - ~~Location housing highly noise and/or vibration sensitive activity or equipment~~
  - ~~Locations approximately equally distributed along the length of the corridor~~

- Measure and document the L_{EQ} (16-hour) and L_{EQ} (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).

Table 11, Construction and Maintenance-related Noise under Mitigation Measures

- Prior to commencement of construction, ~~the Constructor will~~ develop and submit a detailed Construction Noise Management Plan ~~to Metrolinx for review and approval.~~
- The Construction Noise Management Plan shall:
  - Document and commit to all measures to be taken for meeting the noise exposure limits documented in the Metrolinx *Guide for Noise and Vibration*

Assessment (2020) at every directly exposed sensitive receptor and throughout the entire project.

- Determine the Zone of Influence ~~(ZOI)~~ for construction related noise based on the noise exposure limits outlined in the Metrolinx *Guide for Noise and Vibration Assessment* (2020) and taking into consideration the construction site, staging and laydown sites and hauling routes, each stage of the construction (including demolition), the overall construction schedule along with the schedule of each major component and associated major construction processes and equipment usage.

- Identify all sensitive receptors that fall within the ~~ZOI~~ Zone of Influence for construction related noise. Mitigation measures will be proposed for these sensitive receptors, and the effects of the proposed mitigation measures will then be evaluated using noise modelling. If results of the modelling indicate that any sensitive receptors still remain within the ~~ZOI~~ Zone of Influence for construction related noise, then the following shall apply:

    - Additional mitigation is proposed and subsequently modelled until the sensitive receptor does not fall within the ~~ZOI~~ Zone of Influence; or

    - If mitigation strategies are ~~deemed by Metrolinx to be~~ not viable, receptor based mitigation will be proposed.

- The Construction Noise Management Plan will include the temporary/permanent noise barriers indicated in the applicable noise and vibration construction impact assessment report (2020). Where additional work sites are identified which were not assessed as part of the applicable noise and vibration construction impact assessment report (2020), or where construction activities at any given site differ from those considered in this report, ~~the Constructor will~~ conduct modelling to evaluate the need for additional noise barriers ~~and submit results and recommendations~~ as part of the Construction Noise Management Plan.

Table 11, Construction and Maintenance-related Noise under Monitoring

- The Construction Noise Management Plan will incorporate the following requirements related to monitoring of noise and noise related complaints:

- ~~The Constructor will monitor~~ Monitor noise where the Construction Noise Management Plan indicates that noise exposure limits may be exceeded. At these locations, ~~the Constructor will~~ monitor noise continuously at each geographically distinct, active construction site with one monitor located strategically to capture the highest exposure level based on planned construction activities and the number,

geographic distribution and proximity of noise sensitive receptors. ~~The Constructor will submit~~ Develop weekly reports ~~to Metrolinx~~ describing the monitoring conducted and summarizing the data collected for the reporting period. The reports will include but not be limited to the number and duration of any incident during which any of the noise exposure limits documented in the Metrolinx *Guide for Noise and Vibration Assessment* (2020) were exceeded, the probable cause of each exceedance, the incident-specific measure(s) implemented, the resulting mitigated noise levels and the complaints investigation procedure.

- Establish a Communications Protocol and a Complaints Protocol ~~in accordance with the Project Agreement.~~to respond to issues that develop during construction.

Table 11, Operational Vibration (Trains) under Monitoring

- ~~Monitor air-borne and air-borne noise as part of an annual "Noise and Vibration Survey" at representative receptors across the corridor to confirm compliance with Operation Noise and Vibration requirements of the Ministry of Environment, Conservation and Parks, other provincial and federal requirements, and Metrolinx requirements. Representative receptors will be selected per the following criteria:~~

  - ~~Location subject to highest rail related noise and vibration~~

  - ~~Location representative of a significant number of receptors~~

  - ~~Location housing highly noise and/or vibration sensitive activity or equipment~~

  - ~~Locations approximately equally distributed along the length of the corridor~~

- Measure and document the vibration impacts, under predictable worst-case conditions, of each distinct type of GO Transit train consistently 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 ~~noise emissions~~ 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 ~~noise~~ vibration levels as part of maintenance to ensure continued compliance with manufacturer specifications.

Table 11, Construction and Maintenance-related Vibration under Mitigation Measures

- Adhere to the following vibration exposure limits:
  - Vibration, as a human irritant, is assessed in terms of its average level. Vibration velocity should not exceed 0.14 mm/s or current conditions (whichever is higher) by more than 25%.
  - As a threat to buildings, vibration is assessed in terms of its peak value. The ~~ZOI~~ Zone Of Influence for vibration shall be the area where structures are expected to experience vibration peak particle velocities that exceed 5 mm/s. Vibration velocity should be limited to 8-22 mm/s, depending on vibration frequency. These limits are prescribed by the ~~City of Toronto *By-Law No. 514-2008*~~most current versions of the *Toronto Municipal Code Chapter 591, Noise* (2020) and *Chapter 363, Vibration* (2019) for typical structures (not building with special needs).
- Adhere to the ground-borne (vibration induced) noise exposure criteria in the US FTA Report No. 0123, Transit Noise and Vibration Impact Assessment Manual (2018).
- Develop and implement a detailed Construction Vibration Management Plan for Metrolinx review and approval with minimum requirements outlined below:
  - Complete a detailed construction related vibration assessment prior to the commencement of construction that includes assessment of the vibration ~~ZOI. The ZOI~~ Zone Of Influence. The Zone Of Influence for vibration shall be established by using the methodology and input data provided in Section 7.2 of the US FTA Report No. 0123 (2018), *Transit Noise and Vibration Impact Assessment Manual* (2018).
  - Complete pre-construction condition surveys for properties within the vibration ~~ZOI~~ Zone Of Influence of the planned work to establish their condition and establish a baseline prior to any work beginning.
  - Identify any heritage structures and other sensitive structures, buildings or infrastructure vulnerable to vibration damage, assess requirements and, if necessary, develop mitigation measures.
  - Identify buildings, where vibration sensitive activities such as sound recording or medical image processing take place, assess requirements and, if necessary, develop mitigation measures.

  - Establish a 15-metre setback distance between the construction vibration source and nearby buildings, where possible, to minimize impacts. If this is not possible, then monitor the vibration levels associated with the activity.

  - Select construction/maintenance methods and equipment with the least vibration impacts.

- In the presence of persistent complaints and subject to the results of a field investigation, identify alternative vibration control measures, where reasonably available.

Table 11, Construction and Maintenance-related Vibration under Monitoring

The Construction Vibration Management Plan will incorporate the following requirements related to monitoring of vibration and vibration related complaints:

- ~~The Constructor is to monitor~~ Monitor vibration continuously at structures where the Construction Vibration Management Plan indicates that structures are deemed to be within the ~~ZOI~~ Zone Of Influence for construction related vibration or at additional structures as requested by Metrolinx.

- The type of Vibration Monitoring Program that is established is based on the vibration ~~ZOI~~ Zone Of Influence, the project location, duration, presence of night-time activity, and receptor proximity. The monitoring types include:

    - ✓ Type 1: Monitoring continuously throughout the project (for receptors within the ~~ZOI~~ Zone Of Influence).
    - ✓ Type 2: Monitoring during most impactful phases of the project only (for receptors outside of the ~~ZOI~~ Zone Of Influence but within 50 m of the boundary of the construction site).
    - ✓ Type 3: Monitoring in response to complaints only (for receptors outside of the ~~ZOI~~ Zone Of Influence and beyond 50 m of the boundary of the construction site).

Establish a Communications Protocol and a Complaints Protocol ~~in accordance with the Project Agreement.~~to respond to issues that develop during construction.

Table 11 Note

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, the Constructor is encouraged to consult with the appropriate regulatory agencies.~~ If clarification is required regarding regulatory requirements, consult with the appropriate regulatory agencies.

Appendix C - Added Notes

The design drawings included here were used to guide the locations of equipment and infrastructure, such as modeled noise sources, new track alignment, and switches. Any ‘hatched areas’ or ‘impact areas’ are not pertinent to the noise and vibration impact study presented in this report.

Appendix A6-3A Noise and Vibration Study Stouffville Corridor, GO Rail Network Electrification Project – RWDI Confirmation Letter

[PDF of RWDI Letter to be inserted in Errata PDF]

2.2 Proposed Changes

The Noise & Vibration impacts due changes in rail operations as a result of the Scarborough Junction Grade Separation Project are considered in this assessment. ~~The Scarborough Rail-Rail Grade Separation Project is not included in the evaluation of operational noise or vibration. Noise and vibration associated with the construction of this project is evaluated by others and referenced in this report in Section 5.2.~~

As part of the electrification of the GO Rail Network electric traction power facilities (TPF) are required on the SV Corridor. In the 2017 EPR, three TPF locations were assessed:

- Lincolnville Paralleling Station (PS);
- Unionville Paralleling Station (PS); and
- Scarborough Traction Power Substation (TPS).

The Lincolnville Paralleling Station was ~~relocated~~ shifted slightly to the south to accommodate the Lincolnville Layover expansion. All other TPFs are unchanged from the 2017 EPR, and there are no other TPFs (either existing or current) located on this corridor. The locations of the traction power facilities are shown broadly in Figure 2, and in more detail in Appendix D Figures D.1.1, D.1.4 and D.1.7.

Current layover sites include the Lincolnville Layover. The Lincolnville Layover site will be moved to the south approximately 800 m. The Unionville Storage Yard Facility will be built approximately 500 m north of the Unionville GO Station to support the increase in rail traffic volumes. There are no other layover sites (either existing or current) located on the corridor. The locations of these layover sites are shown in broadly in Figure 2, and in more detail in Appendix D Figures D.1.4, and D.1.7.

3.2 Receptors

Added: The MOEE-GO Protocol defines sensitive land uses to include "Committed uses such as: existing development, approved site plans, approved condominium plans or draft approved plans of subdivision." This assessment included the assessment of committed noise-sensitive institutional and commercial uses where known. It further goes beyond the protocol and considers vacant residential lots not yet “committed”.

3.5.6 Rail Traffic Movements

All rail traffic on the track infrastructure used by GO Transit is considered in the Pre-project and Post-project assessments. Rail traffic along the SV Rail Corridor includes GO Transit, and freight activity. In the Pre-project scenario, a typical section of the corridor expects 16 GO trains, and 1 CN freight switcher per day. In the Post-project scenario, a typical section of the corridor expects up to 111 GO trains, 0 CN freight switchers, and no new service providers operating along the tracks, per day. Detailed rail traffic volumes are summarized in Appendix D, trains included in ~~Tables~~ the Pre-project scenario are listed in Table D.2.1, and the Post-project in Table D.2.2.

3.5.7.5 Crossovers and Switches (applicable to all trains)

Additional details of the measurements and sensitivity analysis are included in Appendix F.

~~Switch heaters operate intermittently and have low sound levels with respect to rail activity. As sound is evaluated over a 16-hour and 8-hour time period, the intermittent and irregular operation results in insignificant impacts from these sources.~~

Switch heaters for all new switches were assessed under NPC-300 Section B7.4, to a limit of 55 dBA. The resulting levels due to the switch heaters were less than 50 dBA, and therefore compliant with NPC-300 in all cases. No further discussion on the assessment of switch heaters was completed.

4 Operational Vibration Assessment

The MOEE/GO Protocol outlines desired objectives for vibration levels from GO Transit Projects. The requirement to investigate vibration mitigation focuses on the change between the existing vibration levels and the future vibration levels. A change in vibration levels may occur under the following circumstances: change in track alignment or addition of track (e.g., where train operations will be closer to residential receptors), and addition of special track work (such as switches).

Vibration effects are a function of the intensity of the vibrational energy reaching a receptor, not on how often vibration from trains passing can occur. Since vibration is evaluated on a pass-by basis (i.e., the effect of a single train passing by), results are associated with the characteristics of individual trains (especially the weight of the locomotive). Vibration effects are therefore not related to the increased rail traffic associated with the Ultimate Capacity service levels.

4.1 Applicable Vibration Criteria

The desirable objective of the MOEE/GO Protocol is that the 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).

4.2 Receptors

The proximity of all receptors within the SV Corridor to changes in track alignment or special trackwork was assessed. The following areas were identified as areas of investigation for operational vibration:

- 1.2 km of new track at Unionville GO Station;

- 1.2 km of new track at Mount Joy GO Station; and

- 16 new switches along the SV Corridor.

Receptors for vibration include the same sensitive land uses as described in Section 3.2.1. However, future development locations that did not have approval for residential uses were not included since they would need to be designed to achieve appropriate vibration levels with the future rail infrastructure in place. The point of evaluation is defined as 5 to 10 m from the building foundation in a direction parallel to the tracks.

4.3 Methodology and Key Input

From 4.1 moved to 4.3 Methodology and Key Inputs

Text under Figure 6:

Additionally, as part of the detailed design, verification measurements will be conducted at key receptors to validate the calculations and assumptions. Metrolinx will complete vibration measurements of the existing conditions at the detailed design stage in areas where vibration mitigation is recommended.

4.4 Results

From 4.2 moved to 4.4 Results

5.1 Applicable Criteria

For historical buildings, a criterion of 5 mm/s was used. This criterion is below the lowest of the building damage criteria of 8 mm/s provided in Table 11 and is in line with Category III structures (Non-engineered timber and masonry buildings) noted in Table 7-5 of the FTA Protocol, which is expected to be representative of the most susceptible buildings along the SV corridor. Given its relatively modern construction, Category III structures as per FTA, are representative. The threshold for FTA Category III is comparable to the City of Toronto Zone of Influence for construction vibration impacts. Fragile, or buildings extremely susceptible to vibration damage (Category IV) are not expected along the corridor. If fragile buildings do occur along the corridor, they should be reviewed to ensure the criteria are appropriate for them. Chapter 7 of the California Department of Transportation “Transportation and Construction Vibration Guidance Manual”, a widely accepted document, notes that for “historic and some old buildings” a maximum PPV of 0.25 in/sec (6.35 mm/s) shall be used for continuous/frequent and intermittent sources, which is higher than the 5 mm/s criterion.

5.4 Recommendation for Construction Noise Mitigation

Although no receptors are identified within the Zones of Influence, recommendations for implementing a number of mitigation measures and monitoring are outlined in ~~Section 6~~ Table 12, and should be implemented for the receptors located marginally outside of the Zones of Influence.

6.0 Recommendations for Noise and Vibration Mitigation

This section provides a discussion of general approaches that could be taken into consideration in the development of mitigation options to reduce noise and vibration impacts on the SV Corridor. Table 12 provides a summary of the key project components/activities, potential effects, mitigation measures, and proposed monitoring activities~~/commitments to~~ for future work associated with the GO Rail Network Electrification Project.

Table 12 Under Operational Noise (*Trains)* , Monitoring Bullet 1

~~• Monitor air-borne and air-borne noise as part of an annual ”Noise and Vibration Survey” at representative receptors across the corridor to confirm compliance with Operation Noise and Vibration requirements of the Ministry of Environment, Conservation and Parks, other provincial and federal requirements, and Metrolinx requirements. Representative receptors will be selected per the following criteria:~~

~~○ Location subject to highest rail related noise and vibration~~
~~○ Location representative of a significant number of receptors~~

- ~~Location housing highly noise and/or vibration sensitive activity or equipment~~
- ~~Locations approximately equally distributed along the length of the corridor~~

- 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).

Table 12, Under Construction and Maintenance-related Noise, Monitoring

The Construction Noise Management Plan will incorporate the following requirements related to monitoring of noise and noise related complaints:

- ~~The Constructor will monitor~~ Monitor noise where the Construction Noise Management Plan indicates that noise exposure limits may be exceeded. At these locations, ~~the Constructor~~ will monitor noise continuously at each geographically distinct, active construction site with one monitor located strategically to capture the highest exposure level based on planned construction activities and the number, geographic distribution and proximity of noise sensitive receptors. ~~The Constructor will submit~~ Develop weekly reports ~~to Metrolinx~~ describing the monitoring conducted and summarizing the data collected for the reporting period. The reports will include but not be limited to the number and duration of any incident during which any of the noise exposure limits documented in the Metrolinx *Guide for Noise and Vibration Assessment* (2020) were exceeded, the probable cause of each exceedance, the incident-specific measure(s) implemented, the resulting mitigated noise levels and the complaints investigation procedure.

Establish a Communications Protocol and a Complaints Protocol in accordance with the Project Agreement to respond to issues that develop during construction.

Table 12 Under Operational Vibration (*Trains),* under Monitoring first bullet

- ~~Monitor air-borne and air-borne noise as part of an annual "Noise and Vibration Survey" at representative receptors across the corridor to confirm compliance with Operation Noise and Vibration requirements of the Ministry of Environment, Conservation and Parks, other provincial and federal requirements, and Metrolinx requirements. Representative receptors will be selected per the following criteria:~~
  - ~~Location subject to highest rail related noise and vibration~~
  - ~~Location representative of a significant number of receptors~~

  - ~~Location housing highly noise and/or vibration sensitive activity or equipment~~
  - ~~Locations approximately equally distributed along the length of the corridor~~
- Measure and document the vibration impacts, under predictable worst-case conditions, of each distinct type of GO Transit train consistently 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).

Table 12 Under Construction and Maintenance-related Vibration, under Mitigation Measures first bullet

- Adhere to the following vibration exposure limits:
  - Vibration, as a human irritant, is assessed in terms of its average level. Vibration velocity should not exceed 0.14 mm/s or current conditions (whichever is higher) by more than 25%.
  - As a threat to buildings, vibration is assessed in terms of its peak value. The ZOI for vibration shall be the area where structures are expected to experience vibration peak particle velocities that exceed 5 mm/s. Vibration velocity should be limited to 8-22 mm/s, depending on vibration frequency. These limits are prescribed by the ~~City~~ most current version of the Toronto ~~*By-Law No. 514-2008*~~ *Municipal Code Chapter 591, Noise* (2020) and *Chapter 363, Vibration* (2019)for typical structures (not building with special needs).

Table 12 Under Construction and Maintenance-related Vibration, under Monitoring 3rd bullet

Establish a Communications Protocol and a Complaints Protocol ~~in accordance with the Project Agreement~~ to respond to issues that develop during construction.

2.1 Scope

- develop, calibrate and validate a mesoscopic model for the study area existing conditions. The 2011 EMME model subarea traversal demand matrices were used as the initial demand matrices for AM and PM peak hours and were adjusted using the updated traffic counts in the study area. The main target of conducting the OD adjustment process was to update the macro model demand based on the latest traffic count volumes in the study area; ~~using the traversal origin-destination demand matrices extracted from the regional Emme model and adjusted based on the observed traffic volumes and travel times in the study area;~~

Table 5.1: Comparison of Performance Indicators

Performance Indicator	Baseline (2025)	Alternative 1	Alternative 2		Alternative 3
			Stage 1	Stage 2	
Average Network Speed (km/h)	**31.5**	**28.9**	**31.5**	**31.4**	**31.1**
Change in Network Speed[13]		- 8.3%	0.0%	-0.3%	- 1.3%
Vehicle Hours of Travel (hrs)	**814**	**1016**	**823**	**828**	**848**
Change in Total Travel Time[34]		+ 24.8%	+1.1%	+1.7%	+ 4.2%
Total Travel Time for Three-Month Period (hrs)[45]	53,724	58,168	54,483		54846
Change in Three Months Total Travel Time[36]		+8.3%	+1.4%		+2.1%
Total Travelled Distance (km)	**24,490**	**26,784**	**24,797**	**24,812**	**25,260**
Change in Total Distance Travelled[37]		+ 9.4%	+ 1.3%	+ 1.3%	+ 3.1%

[3] Change is calculated compared to Future Baseline conditions
[4] See Note 1
[45] This is not a direct modelling output. This value is provided to take into consideration the different construction periods for each alternative. A period of three-months was selected based on the longest alternative construction time (Alternative 2). The calculations are based on assuming 22 weekdays per month. For Alternatives 1 and 3 with construction times less than three months, the extra days were calculated based on the Baseline scenario value.
[6] See Note 1
[7] See Note 1

8.2.2 Multimodal Level of Service Analysis

[Note to Reader: This is a new section. Subsequent section and table references were updated accordingly.]

A multi-modal level of service (MMLOS) analysis was carried out to evaluate the baseline and post construction conditions for automobiles, transit, bicycles, and pedestrians at the intersection of Midland Avenue and Danforth Road. The findings of the MMLOS analysis will be determine the improvements at the intersection for all modes of transportation. The intention of MMLOS analysis is to recognize and assess the level of service of pedestrian, cyclist, transit and truck modes, based on the

methods that have been introduced through the methodology adopted from the City of Ottawa Multi-Modal Level of Service (MMLOS) Guidelines (Ottawa, 2015).

The MMLOS analysis is summarised in Table 0-1. Results confirm that the proposed removal of right turn channels at this intersection will improve the experienced level of service for pedestrians in post construction layout. Detailed MMLOS analysis results are provided in Appendix B for reference.

Table 0-1 Multimodal Level of Service Analysis

Mode	Scenario	Pre Construction				Post Construction			
	Crossing Side	North	South	East	West	North	South	East	West
Pedestrian	Exposure to Traffic LOS	E	D	E	D	E	D	E	D
	Pedestrian Delay LOS	F	F	F	F	E	D	E	D
	PLOS	F	F	F	F	E	D	E	D
		F				E			
Bicycle	Through Movement	-	-	D	D	-	-	-	-
	Cyclist Left Turning	D	F	D	D	D	F	D	D
	BLOS	D	F	D	D	D	F	D	D
		F				F			
Transit	Average Signal Delay	E	E	E	C	D	D	E	C
	TLOS	E				E			
Truck	TkLOS	D	D	D	D	D	D	D	D
		D				D			
Auto[5]	ALOS	D				C			

[5] The results from HCM analysis used for intersection analysis. Details for movements, approach and intersection based for AM and PM peak hours can be found in this report.

Appendix B Synchro Summary Reports

Multi-Modal Level of Service - Intersections Form was added to Appendix B.

Observation

A total of ~~358~~360 trees have been included in the inventory. The inventory included the following tree species:

No memorial trees were identified within the portion of the Project Footprint at Corvette Park.

4.1 Trees Recommended for Preservation

There are ~~172~~187 trees identified in the inventory that will be retained within the Project Footprint. The trees with opportunity for preservation have been identified for protection or retention as identified below. These are identified in Table A in Appendix B under 'Action' for each tree.

- ***Protect - Hoarding***: Trees are recommended to be preserved, and hoarding will be installed at the limits of construction or the TPZ, whichever is greater. A total of ~~172~~187 trees are within this preservation category.

4.2 Trees Identified for Removal or Injury

A total of ~~186~~173 trees are recommended for removal for the Project. There are ~~40~~39 City trees (Category 5 trees) recommended for removal and will require City removal permits. Forty-~~four (~~three (43) private trees above 30 cm DBH are recommended for removal and will require a private tree removal permit. Twenty-~~two (22~~one (21) park trees are also recommended for removal and will require a permit. Six (6) additional City trees are dead and will not require a permit for removal. Another ~~74~~64 private trees below the DBH of 30cm DBH are also recommended for removal, however a permit is not required for them as they do not qualify for the private tree by law 'Toronto Municipal Code Chapter 813, Trees, Article III'.

Tree impacts:

- Removals for Construction with Permit = ~~106~~103
- Removal for Construction without Permit = ~~74~~64
- Removal of Dead Trees = 6
- Total Removals = ~~186~~173

4.3 Pruning

There are ~~2~~14 trees that have been identified for pruning in Table A in Appendix B. Tree pruning has been recommended in order to facilitate construction of the storm sewer upgrades.

4.4.1 Permits

CITY PARK REMOVAL PERMITS = ~~20~~21

4.4.2 Compensation

The compensation numbers for ~~all Metrolinx trees~~ are based on the City of Toronto's City Street Tree Bylaw (Article II of Chapter 813), the Private Tree Bylaw (Article III of Chapter 813), and the Parks Bylaw (Article VII of Chapter 608), as applicable. ~~according to the new Metrolinx guidelines 'Metrolinx Vegetation Guideline, 2020'. The compensation numbers for all other trees are based on 'Tree Bylaws – Compensation Planting Ratios – City of Toronto'.~~

The compensation requirements for the ~~site~~Project are as below. ~~Incase,~~ If due to lack of space compensation plantings are not possible, cash in lieu will be provided to the City of Toronto for the remaining trees at $583/tree.

1. Compensation for City Tree Removal at 3 to 1 replacement for 39 trees = 117
~~4~~2. Compensation for Park Tree Removal at 3 to 1 replacement for ~~20~~21 trees = ~~60~~63
~~5. Compensation for Private Tree Removal at 1 to 1 replacement for 0 trees = 0~~
~~4~~3. Compensation for Private Tree Removal at 3 to 1 replacement for 43 trees = 129

Total Compensation Trees Required = ~~306~~309 Trees

6.0 Conclusion

Trees are a critical part of the community and all efforts should be made to protect them through the proposed work. A total of ~~358~~360 trees have been inventoried for this site. One hundred ~~seventy-two (172~~eighty-seven (187) trees have been recommended to be retained and protected using a Tree Protection Fence. ~~Forty (40~~Thirty-nine (39) street trees and ~~22~~21 park trees were recommended for removal and will require street and park tree removal permits. Forty~~-four (44~~three (43) private trees were recommended for removal, these will require private tree removal permits. ~~Seventy~~ Sixty-four (~~74~~64) private trees below the DBH of 30 cm are also recommended for removal, however a permit is not required. Six dead (6) trees were recommended for removal that will not require a permit. There were ~~2~~14 trees that have been identified for pruning, and as such a contract agreement with the City must be completed prior to construction. Tree Protection Fence shall be installed prior to the start of excavation or any construction works. The Project Arborist shall be contacted if there are concerns with trees during construction.

Appendix A Scarborough Junction Tree Management Plan L-900 to L-907

Drawings were adjusted to indicate:

- avoidance of trees within Corvette Park
- addition of two trees
- addition of tree protection fencing

Appendix B Scarborough Junction - Detailed Tree Inventory

The Inventory was adjusted based on the modifications to the drawings outlined above.