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Pre-Feasibility Noise and Vibration Study

Burlington Mobility Hubs
Burlington, ON
Project #TPB178008 Brook McIlroy Inc.

Prepared for:

Brook McIlroy Inc.

161 Spadina Avenue, 2nd Floor, Toronto, ON M5V 2L6

August 2021

Revision Log

Rev	Description	Revised By	Reviewed By	Date Issued (M/D/Y)
0	DRAFT for BrookMcIlroy and the City of Burlington Review	S. Sagar	B. Ledger	06/08/2018
1	Issued as Final at the request of BrookMcIlroy and the City of Burlington	S. Sagar	B. Ledger	08/18/2021

August 18, 2021

Tneshia Pages Innocente
Associate & Planner
BrookMcIlroy
161 Spadina Avenue
2nd Floor
Toronto, ON M5V 2L6

Dear Ms. Innocente,

As requested, please find enclosed one (1) electronic copy, in PDF format, of our Pre-Feasibility Noise and Vibration Study in final for the Burlington Mobility Hubs project. Since issuance of the draft report, no technical and modelling updates to the report have been made except for the corrections to Table 5.3-3, further to our email correspondence from December 18th, 2018.

We greatly appreciate the opportunity to be of service to BrookMcIlroy and the City of Burlington. Should you have any questions regarding this study, please do not hesitate to contact us.

Sincerely,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

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August 2021

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1.0 Introduction

Wood Environment & Infrastructure Solutions, a Division of Wood Canda Limited ("Wood") was retained by Brook McIlroy Inc. (Brook McIlroy), on behalf of the City of Burlington ("the City") to complete a Pre-Feasibility Noise and Vibration Study for the proposed Burlington, Aldershot and Appleby Mobility Hub areas.

The overall City of Burlington Mobility Hub Planning Study has been divided into three stages: Preliminary Studies and Land Use Scenarios; Area Specific Plan (ASP) Development; and Implementation, as identified in the Terms of Reference (TOR) (The Corporation of the City of Burlington, 2016).

The objective of this Pre-Feasibility Noise and Vibration Study was to satisfy the following requirements as outlined in the TOR for noise and vibration:

Stage 1: Preliminary Studies and Land Use Scenarios

- To understand existing conditions within the study area in terms of potential land use compatibility matters for sensitive land uses (including noise, vibration, air quality etc.) from sources both within and external to the study area;
- Undertake Pre-Feasibility Noise/Vibration Studies for the Aldershot, Burlington and Appleby Mobility Hub study areas to identify the feasibility of introducing new sensitive land uses in proximity to existing stationary and transportation noise sources (such as industrial uses, rail lines and rail yards, among others) which exist within or outside the applicable Mobility Hub study area.

Stage 2: Area Specific Plan Development

- Policy directions regarding the following:
  - Land use compatibility (dust, noise, vibration, odour etc.) and appropriate mitigation measures.

A glossary of commonly used noise and vibration terminology can be found in Appendix A.

2.0 Project Background

The City of Burlington is in the next phase of city-building as it approaches full build-out of the urban area. The purpose of the encompassing project is to develop an ASP for each Mobility Hub: Burlington, Aldershot, Appleby and Downtown. The Downtown site is excluded from the Pre-Feasibility Noise and Vibration Study Report as per the instructions provided in Section 3 – 5.0 of the TOR.

The Burlington Mobility Hub is the smallest of all the proposed hubs, centralized around Burlington GO Station, with an approximate area of 97 hectares (Brook McIlroy Incorporated, 2017). The hub spans from the Queen Elizabeth Way (QEW) to Graham's Lane and Drury Lane to the Hydro Corridor. The area is comprised mostly of mixed-use spaces, with two employment use areas adjacent to the QEW. The employment areas are omitted from this study as it is focused on noise-sensitive land-uses, such as mixed-use areas which can contain residences. One of the key goals with respect to land use at this hub is to focus on mixed-use development along key transit corridors (City of Burlington). The majority of the proposed buildings are classified as either midrise (4-11 storeys) and high-rise (12-20+ storeys) (Brook

McIlroy Incorporated, 2017). A copy of the preferred land use concept for the Burlington Mobility Hub is included in Appendix B.

The Aldershot Mobility Hub is centralized around Aldershot GO Station, with an approximate area of 129 hectares (Brook McIlroy Incorporated, 2017). The hub spans from Highway 403 to Gallagher Road and Plains Road to Daryl Drive. The area is to be comprised entirely of mixed-use spaces and parks. The majority of the proposed buildings are classified as either midrise (4-11 storeys) and high-rise or tall (12-20+ storeys) (Brook McIlroy Incorporated, 2017). A copy of the preferred land use concept for the Aldershot Mobility Hub is included in Appendix B.

The Appleby Mobility Hub is the largest of all of the proposed hubs, centralized around Appleby GO Station, with an approximate area of 207 hectares (Brook McIlroy Incorporated). The hub spans from the QEW/Highway 403 on the north end, and the Centennial Bikeway on the south end. The hub is mainly comprised of employment areas north of the rail line, and mixed-use areas to the south. The proposed buildings include a mix of low-rise (1-3 storeys), midrise and tall buildings (Brook McIlroy Incorporated). A copy of the preferred land use concept for the Appleby Mobility Hub is included in Appendix B.

The Mobility Hubs are generally surrounded by lands zoned under mixed use, residential, general employment and commercial. The current plan focuses on keeping existing large residential areas and instead developing mixed use areas for residential, office and commercial spaces. Small to medium scale industrial facilities also exist throughout the Mobility Hub areas and can potentially remain operational adjacent to development areas of interest. Due to the close proximity of mixed-use areas to major roads and rail lines, the following noise and vibration concerns with the introduction of new sensitive land uses have been identified:

- Road traffic noise impacts, predominantly from major streets with large traffic volumes;
- Rail noise impacts from trains operated by GO Transit, Canadian National (CN) and VIA Rail;
- Ground-borne vibration impacts from trains operated by GO Transit, CN and VIA Rail; and
- Environmental noise impacts from the surrounding industrial facilities.

3.0 Applicable Guidelines

The guidelines applicable to the project are discussed under this section.

3.1 MECP NPC-300

The NPC-300 guideline "Environmental Noise Guideline: Stationary and Transportation Sources – Approval and Planning" Publication NPC-300 (Ontario Ministry of The Envrionment, Conservation and Parks, 2013) (hereafter simply "NPC-300") was published by the Ontario Ministry of the Environment, Conservation and Parks (MECP) and provides specific guidance on noise impact studies including sound level limits, sound level metrics, etc., for different types of noise sources in the context of Approvals and Planning.

"Planning" is addressed in Part C of NPC-300 and refers to the land-use planning process as well as approvals and permits granted by local planning authorities using their authority as delegated by the Ministry of Municipal Affairs (MAH) under the Ontario Planning Act (PA).

Part C of NPC-300 covers the assessment of both transportation (road, rail and air traffic) and stationary sources of noise on new noise sensitive developments. Generally, noise studies are completed at this level of detail when a specific site concept for the noise sensitive development is available and at the zoning by-law amendment of site plan approval phase of planning.

The guideline states under section C3.2 (Road Traffic Noise) and C3.3 (Rail Traffic Noise) that the A-weighted 16-hour equivalent sound level, $L_{Aeq-16h}$, shall not be greater than 55 dBA in the outdoor living area (OLA) during daytime (07:00-23:00) and the 8-hour equivalent sound level, L_{Aeq-8h}, shall not exceed 50 dBA during nighttime (23:00-07:00) for road and rail noise sources.

3.2 Railway Proximity

The "Guidelines for New Development in Proximity to Railway Operations" (hereafter simply "Proximity Guidelines") published by The Railway Association of Canada/The Federation of Canadian Municipalities (RAC/FCM) (The Federation of Canadian Municipalities and the Railway Association of Canada, 2013) discusses both vibration and noise generated by railway operations.

The vibration limit presented in the Proximity Guidelines is 0.14 mm/sec between 4 Hz and 200 Hz when measured using a 1-second root mean square (RMS) averaging time constant. This criterion is also consistent with that provided in the documents, "Draft Protocol for Noise and Vibration Assessment" from the Ministry of Environment and Energy (MOEE) and GO Transit; and, "Principal Main Line Requirements" from Canadian National Railways (GO Transit and the Ministry of Enviornment and Energy (MOEE), 1995; Canadian National, 2008).

Although the Proximity Guidelines discuss noise requirements, they are essentially similar and adapted from LU-131 (the predecessor guideline to NPC-300). Typically, in Ontario, NPC-300 is regarded as the primary reference and guideline for noise assessment.

3.3 MECP Guideline D-6

The MECP Guideline D-6 "Compatibility Between Industrial Facilities and Sensitive Land Uses" (hereafter simply "D-6 Guideline") presents tools and principles for early stage land-use planning with respect to compatibility. The D-6 Guideline is used to assess risk related to land-use compatibility when the details regarding the source and/or receiving development are not known with enough specificity to complete meaningful detailed noise impact studies. The guideline provides the minimum separation distances between noise-sensitive land uses and industrial facilities based on the classification of the industries (e.g., heavy, medium and light industries). As per the D-6 Guideline, the industrial classifications and the recommended minimum setback distances and potential influence areas are given below (Guideline D-6 Comptability Between Industrial Facilities and Sensitive Land Uses, 1995):

Class I
NOISE: Sound not audible off property.
DUST and/or ODOUR: Infrequent and not intense.
VIBRATION: No ground borne vibration on plant property.
Recommended minimum separation distance: 20 m
Potential area of influence: 70 m.

Class II
NOISE: Sound occasionally audible off property.
DUST and/or ODOUR: Frequent and occasionally intense.
VIBRATION: Possible ground-borne vibration, but cannot be perceived off property.
Recommended minimum separation distance: 70 m
Potential area of influence: 300 m.

Class III
NOISE: Sound frequently audible off property.
DUST and/or ODOUR: Persistent and/or intense.
VIBRATION: Ground-borne vibration can frequently be perceived off property.
Recommended minimum separation distance: 300 m
Potential area of influence: 1000 m.

Regardless of the recommended minimum separation distances per the D-6 Guideline, the developments are permitted if the noise, vibration, dust and odour guideline limits are met.

4.0 Assessment Methodology

4.1 Road and Rail Traffic Noise

There are several significant roads that potentially impact the road traffic noise levels within the hubs. GO Transit, CN and VIA Rail traffic can also significantly impact all three mobility hubs. Road and rail noise impact assessments were completed for the study areas to predict noise levels at the proposed land uses. The predicted noise levels from road/rail were predicted using STAMSON and assessed in accordance with the NPC-300 noise criteria. For this Pre-Feasibility Study, the noise receptor locations considered are at the mixed-use areas (which include residential uses).

Speed limits and traffic data for local and regional roads were provided by the City in the form of a 2016 AADT map. Traffic data for provincial highways in the study areas were retrieved from the most recent1 publicly available 2013 AADT data from the Ministry of Transportation Ontario (Ministry of Transportation Ontario, 2013).

CN operates freight trains in all three mobility hub areas. The rail traffic data provided by CN stated that 20-30 trains per day are expected. The following assumptions were made with respect to CN rail traffic:

- CN daily rail traffic volume of 30 trains per day;
- Daytime (07:00 - 23:00) volume is two thirds the total daily volume;
- Nighttime (23:00 - 07:00) volume is one third of total daily volume;
- Trains operate at an average speed of 60km/h; and
- Trains consist of two locomotives and 100 cars.

Since the rail tracks are split at the Burlington Hub, an assumed allocation of each train type was also made. There is a rounded segment of the rail line east of Brant St. which does not appear to intersect with

[1] Refers to the time of assessment.

the GO station waiting area, so it was assumed that 90% of CN's total traffic in the area travels on that line. South of that, there is another line where a 100% GO / 100% VIA / 10% CN allocation was assumed. Finally, the two lines meet west of Brant St. where a 100% volume of each train type results.

GO Transit operates in all three areas at Burlington GO Station, Aldershot GO Station, and Appleby GO Station. GO trains were assumed to operate with a single locomotive carrying 12 cars at a speed of 80km/h (Metrolinx). VIA Rail trains only stop at Aldershot station and were assumed to operate with one locomotive and 10 cars, at an operational speed of 120 km/h, unless otherwise noted.

VIA traffic was still included in the rail noise calculations for Burlington and Appleby Hub, as an inspection done through Google Maps confirms they pass through the area on the same line GO Transit utilizes. Volumes were calculated from their respective websites' trip schedules.

Traffic counts for both road and rail were forecasted to the horizon year of 2041 (as advised by the project team) at an annual growth rate of 2%.

4.2 Rail Vibration

A rail vibration impact assessment was completed for the study areas by predicting the root mean square (RMS) vibration levels at the proposed land-uses. Predicted vibration levels were calculated using the Federal Transit Administration (FTA) guidance manual, "Transit Noise and Vibration Impact Assessment," and assessed in accordance with the applicable limit of 0.14 mm/s outlined in the RAC/FCM's Proximity Guidelines — summarized in Section 3.2 of this report.

4.3 Stationary Noise

A detailed assessment of stationary noise sources is not included in the current study. The D-6 Guideline applies for early land use planning purposes when noise sensitive land uses are being proposed in the vicinity of existing or proposed industrial land uses.

The D-6 Guideline states*: "in the absence of site specific studies, this guideline should be utilized when sensitive land use encroaches on an existing industrial facility. In these situations, the appropriate criteria are the potential influence area and recommended minimum separation distance as set out in the guideline.* (Guideline D-6 Comptability Between Industrial Facilities and Sensitive Land Uses, 1995)*"* The minimum separation distances based on the industry classification are calculated and assessed for the industries surrounding and within the mobility hubs.

Industrial sites were reviewed using publicly available aerial imagery and setback distances in accordance with the D-6 Guideline were recommended.

5.0 Assessment Results

5.1 Burlington Hub

5.1.1 Road and Rail Traffic Noise

The calculated noise levels represent the point from the middle of the nearest right of way road/rail segment to the façade of the potential building, assumed to be at the land use area's edge closest to the

road. The street outlined in **bold** represents the road that the actual traffic is travelling on. The approximate addresses can be used in addition to the intersection to identify the specific land use area evaluated.

The predicted noise levels from road and rail traffic within the Burlington Hub are presented in Table 5.1-1.

Table 5.1-1: Predicted Road and Rail Noise Levels – Burlington Hub

Nearest Intersection [1] / Rail Traffic Assessed	Approximate Location [2]	Daytime (0700-2300) L_{eq-16h} (dBA)	Nighttime (2300-0700) L_{eq-8h} (dBA)
Fairview St. & Brant St.	855 Brant St. (Mid Rise)	72	65
Brant St. & Fairview St.	853 Brant St. (Mid Rise)	71	64
Brant St. & Fairview St.	853 Brant St. (High Rise)	71	65
Brant St. & Graham's Lane	813 Brant St. (High Rise)	73	66
Fairview St. & Drury Ln.	2263 Fairview St. (Mid Rise)	68	61
Fairview St. & Drury Ln.	2263 Fairview St. (High Rise)	70	63
Fairview St. & Burlington GO Station	2187 Fairview St. (High Rise)	70	64
Fairview St. & Brant St.	2071 Fairview St. (High Rise)	70	63
GO/VIA/CN	596630.95 m E, 4799454.63 m N (High Rise)	74	73
GO/VIA/CN	596877.80 m E, 4799679.26 m N (Mid Rise)	76	74
CN	596087.60 m E, 4799282.39 m N (Mid Rise)	71	71
CN	596000.80 m E, 4799081.28 m N (High Rise)	76	76
GO/VIA/CN	595847.80 m E, 4798836.19 m N (High Rise)	77	77
GO/VIA/CN	596021.46 m E, 4798868.11 m N (High Rise)	70	69

Notes:
[1] Where both streets are bolded, traffic from both streets were assessed in a cumulative manner.
[2] Where coordinates are provided, UTM Zone 17T is referenced.

5.1.2 Rail Vibration

The predicted RMS vibration levels from CN rail traffic within the Burlington Hub is presented in Table 5.1-2. Only values representing CN trains are presented as they are likely to produce the largest levels of vibration.

Table 5.1-2: Rail Vibration Impact Levels – Burlington Hub

Location (UTM Zone 17T)	Distance from Rail Line (m)	RMS Vibration Level (mm/s)
Nearest Mixed Use Lot (596759.84 m E, 4799570.69 m N)	15	1.01

5.1.3 Stationary Noise

The industrial businesses located within the Burlington Hub and just outside, which are predicted to cause noticeable off-site noise levels are identified in Table 5.1-3.

Table 5.1-3: Industrial Sites with Possible Noise Impacts – Burlington Hub

Business Name	Address	Recommended Minimum Separation Distance (m)
Solenis Canada	942 Brant St	70
Nalco Canada Co.	1055 Truman St.	70

5.2 Aldershot Hub

5.2.1 Road and rail Traffic Noise

The calculated noise levels represent the point from the middle of the nearest right of way road/rail segment to the façade of the potential building, assumed to be at the land use area's edge closest to the road. The street outlined in **bold** represents the road that the actual traffic is travelling on. The approximate addresses can be used in addition to the intersection to identify the specific land use area evaluated.

The predicted noise levels from road and rail traffic within the Aldershot Hub are presented in Table 5.2-1.

Table 5.2-1: Predicted Road and Rail Noise Levels – Aldershot Hub

Nearest Intersection / Rail Traffic Assessed	Approximate Location [1]	Daytime (0700-2300) L_{eq-16h} (dBA)	Nighttime (2300-0700) L_{eq-8h} (dBA)
Plains Rd. W. & Draryl Dr.	152 Plains Rd. W.	71	65
Waterdown Rd. & Masonry Ct.	1080 Waterdown Rd. (East)	66	59
Waterdown Rd. & Masonry Ct.	1080 Waterdown Rd. (West)	60	53
Waterdown Rd. & Masonry Ct.	1060 Waterdown Rd. (East)	69	63
Waterdown Rd. & Masonry Ct.	1060 Waterdown Rd. (West)	65	58
Waterdown Rd. & Plains Rd.	1030 Waterdown Rd. (East)	68	61
Waterdown Rd. & Plains Rd.	1030 Waterdown Rd. (West)	65	59
Plains Rd. & Emery Ave.	37 Plains Rd. W.	72	66
Plains Rd. & Cooke Blvd.	29 Plains Rd. W.	72	66

Nearest Intersection / Rail Traffic Assessed	Approximate Location [1]	Daytime (0700-2300) L_{eq-16h} (dBA)	Nighttime (2300-0700) L_{eq-8h} (dBA)
Plains Rd. & St. Matthews Ave.	126 Plains Rd. E	71	64
E of **403** & Waterdown Rd.	592793.69 m E, 4796507.67 m N	83	83
GO/CN/VIA	592829.12 m E, 4796152.99 m N (High Rise)[2]	74	73
GO/CN/VIA	592547.62 m E, 4795900.94 m N (High Rise)[2]	79	78

Notes:
[1] Where coordinates are provided, UTM Zone 17T is referenced.
[2] Includes road noise contribution from Waterdown Rd. and Highway 403.

5.2.2 Rail Vibration

The predicted RMS vibration levels from CN rail traffic for all three hubs is presented in Table 5.2-2. Only values representing CN trains are presented as they are likely to produce the largest levels of vibration.

Table 5.2-2: Rail Vibration Impact Levels – Aldershot Hub

Location (UTM Zone 17T)	Distance from Rail Line (m)	RMS Vibration Level (mm/s)
Nearest Mixed Use Lot (592753.10 m E, 4796085.92 m N)	38	0.38

5.2.3 Stationary Noise

The industrial businesses located within the Aldershot Hub which are predicted to cause noticeable off-site noise levels are identified in Table 5.2-3.

Table 5.2-3: Industrial Sites with Possible Noise Impacts – Aldershot Hub

Business Name	Address	Recommended Minimum Separation Distance (m)
St Marys Cement Inc (Canada)	1035 Howard Rd.	70
KPM Industries Ltd	1077 Howard Rd.	70
2033940 Ontario Inc.	1070 Waterdown Rd.	70
Ann Elizabeth Henderson	1140 Waterdown Rd.	20
1704300 Ontario Inc	1160 Waterdown Rd.	20

5.2.3.1 Shunting Noise

CN Rail operates a rail yard east of Waterdown Road/Highway 403, where shunting activities are assumed to be undertaken. This is assessed as a stationary noise source, as opposed to a transportation noise

source as required by Section B6 of NPC-300. The criteria limits from NPC-300 for a predictable worst-case hour from a stationary noise source is an L_{eq-1h} of 50 dBA during the daytime, and an L_{eq-1h} of 45 dBA during the nighttime2. The predicted noise levels for a sample shunting operation are presented in Table 5.2-4.

Table 5.2-4: Predicted Noise Levels from Shunting Operations – Aldershot Hub

Receptor Location (UTM Zone 17T)	Operation	Noise Level Leq-1h (dBA/dBAI) [1]
593302.96 m N, 4796584.45 m E (Low Rise)	Shunting	53
	Train Pass-by	73
593159.08 m N, 4796451.68 m E (Mid Rise)	Shunting	52
	Train Pass-by	74
592945.49 m N, 4796407.11 m E (High Rise)	Shunting	43
	Train Pass-by	71
592924.03 m N, 4796239.33 m E (Low Rise)	Shunting	39
	Train Pass-by	65

Notes:
[1]Shunting noise has units of dBAI, and train pass-by noise has units of dBA.

Shunting noise alone is considered impulsive, which generally has higher limits than steady stationary noise. In this case, since the number of impulses in a one-hour period was assumed to be 9 or more, the daytime and nighttime limits at a plane of window remain the same as the limit for steady sources mentioned above.

5.3 Appleby Hub

5.3.1 Road and Rail Traffic Noise

The calculated noise levels represent the point from the middle of the nearest right of way road/rail segment to the façade of the potential building, assumed to be at the land use area's edge closest to the road. The street outlined in bold represents the road that the actual traffic is travelling on. The approximate addresses can be used in addition to the intersection to identify the specific land use area evaluated.

The predicted noise levels from road and rail traffic within the Appleby Hub are presented in Table 5.3-1.

[2] Assuming a Class 1 area.

Table 5.3-1: Predicted Road and Rail Noise Levels – Appleby Hub

Nearest Intersection [1] / Rail Traffic Assessed	Approximate Location [2]	Daytime (0700-2300) L_{eq-16h} (dBA)	Nighttime (2300-0700) L_{eq-8h} (dBA)
Fairview St. & Appleby Line	5027 Fairview St. (High Rise)	70	64
Fairview St. & Oval Crt.	5130 Fairview St. (Low Rise)	64	57
Fairview St. & Appleby Line	685 Appleby Line (Mid Rise)	74	67
Appleby Line & Fairview St.	661 Appleby Line (Mid Rise)	70	63
Appleby Line & Fairview St.	764 Appleby Line (High Rise)	73	67
Fairview St. & Appleby Line	4460 Fairview St. (Mid Rise)	70	63
Fairview St. & Appleby Line	4480 Fairview St. (High Rise)	71	64
Fairview St. & Angela Crt.	4356 Fairview St. (Mid Rise)	69	63
CN/GO/VIA	4803369.25 m N, 600128.23 m E (High Rise)[3]	80	79
CN/GO/VIA	599735.11 m E, 4802896.13 m N (Low Rise)	76	76
CN/GO/VIA	596877.00 m E, 4799679.00 m N (High Rise)	79	79

Notes:
[1] Where both streets are bolded, traffic from both streets were assessed in a cumulative manner.
[2] Where coordinates are provided, UTM Zone 17T is referenced.
[3] Includes road noise contribution from Appleby Line.

5.3.2 Rail Vibration

The predicted RMS vibration levels from CN rail traffic for all three hubs is presented in Table 5.3-2. Only values representing CN trains are presented as they are likely to produce the largest levels of vibration.

Table 5.3-2: Rail Vibration Impact Levels – Appleby Hub

Location (UTM Zone 17T)	Distance from Rail Line (m)	RMS Vibration Level (mm/s)
Nearest Mixed Use Lot (600125.82 m E, 4803366.58 m N)	10	1.27

5.3.3 Stationary Noise

The industrial businesses located within the mobility hubs, or just outside, which are predicted to cause noticeable noise levels off-site are identified in Table 5.3-3.

Table 5.3-3: Industrial Sites with Possible Noise Impacts – Appleby Hub

Business Name	Address	Recommended Minimum Separation Distance (m)
Aldaho Holdings Inc. – Dominion Nickel Alloys Ltd.	834 Appleby Line	300
Lafarge Construction Materials - A Division of Lafarge	800 Appleby Line	70
Fearmans Pork - Sofina Foods Inc.	821 Appleby Line	300
Maple Leaf Pork/Division of Maple Leaf Meats	821 Appleby Line	300
Fisher and Ludlow Ltd. – Nucor Grating	750 Appleby Line	300

6.0 Discussion

6.1 Burlington Hub

The predicted noise levels from road and rail traffic at the Burlington Hub are predicted to exceed the applicable NPC-300 limits at all the assessed locations. The levels exceed the daytime limit (L_{eq-16h} of 55 dBA) by 13-21 dB, and exceed the nighttime limit (L_{eq-8h} of 50 dBA) by 11-26 dB. The results presented herein represent worst-case sound levels on the building façade adjacent to the road. Careful planning should be undertaken with respect to building orientation. Noise barriers may be required for OLAs which are exposed to adjacent major roads and/or railway lines. Alternatively, OLAs can be located such that the building provides acoustical shielding from the adjacent roads and/or railway lines. Upgraded building façade components such as walls and windows may also be required due to high sound levels.

Traffic noise from the QEW is likely not to be of concern within the Burlington Hub as the proposed land adjacent to the highway is designated for employment use, which does not classify as a sensitive land-use as per NPC-300.

Ground-borne vibration levels (RMS) from train pass-bys were determined based on the characteristics of freight trains and predictions were completed based on the FTA method (Federal Transit Administration (FTA), May 2006). For freight trains, worn wheels were considered in the assessment, which lead to high vibration levels being predicted. The predicted RMS vibration levels exceed the criteria limit of 0.14 mm/s and are expected to be as high as 1.01 mm/s at the nearest proposed land-use area. Sensitive land uses should be setback at greater distances from active rail lines to reduce vibration levels and/or, where necessary, the implementation of building isolation is recommended. The vibration transmission into the new structure depends on the design of the building foundation. Re-radiated vibration can also cause structure-borne noise within the building and this should be considered in the design.

A Class 4 designation may be helpful for addressing stationary noise impacts from the industrial facilities, which offsets the NPC-300 criteria limits by 10 dB. Regardless of the recommended minimum separation distances as in the D-6 Guideline, the developments are permitted if the noise, vibration, dust and odour guideline limits are met.

6.2 Aldershot Hub

The predicted noise levels from road and rail traffic at the Aldershot Hub are predicted to exceed the applicable NPC-300 limits at all the assessed locations. The levels exceed the daytime limit (L_{eq-16h} of 55 dBA) by 5-28 dB, and exceed the nighttime limit (L_{eq-8h} of 50 dBA) by 3-33 dB. The intersection of Highway 403 and Waterdown Road is expected to be the largest contributor to road traffic noise as the 403 carries large amounts of traffic, and will have a cumulative effect with Waterdown Road.

The predicted RMS vibration levels at the Aldershot hub exceed the criteria limit of 0.14 mm/s and are expected to be as high as 0.38 mm/s at the nearest proposed land use area, the lowest vibration level from all three hubs. The lowest predicted vibration level out of all three hubs relates to it's largest setback distance from the rail line.

The predicted noise levels due to shunting operations are expected to exceed the applicable NPC-300 criteria limits by 2-24 dB in the daytime, and by 7-29 dB in the nighttime. Possible mitigation options are similar to those recommended for road/rail traffic noise; a noise barrier at the right of way of the rail line, and upgraded building components/glazing at building facades. Additionally, designation of a Class 4 area will also aid in achieving compliance, as the designation would increase the limits by 5-10 dB. However, it is important to note that a minimum setback distance of 300m for dwellings are required for railway yards, which would extend past the study area boundary when measured perpendicular to the yard.

6.3 Appleby Hub

The predicted noise levels from road and rail traffic at the Appleby Hub are predicted to exceed the applicable NPC-300 limits at all the assessed locations. The levels exceed the daytime limit (L_{eq-16h} of 55 dBA) by 9-25 dB, and exceed the nighttime limit (L_{eq-8h} of 50 dBA) by 7-29 dB. Similar to the Burlington Hub, the road noise from the QEW is likely not to be a concern. The QEW is adjacent to employment lands, which does not classify as a sensitive land use as per NPC-300. However, the rail line in close proximity to the mixed use lands causes the predicted noise levels to be high.

The predicted RMS vibration levels at the Aldershot hub exceed the criteria limit of 0.14 mm/s and is expected to be 1.27 mm/s at the nearest proposed land use lot; the highest vibration level of all three hubs. The highest predicted level out of all three hubs relates to it's close proximity to the rail line.

The minimum separation distances for stationary noise represent the distance setback from the existing industrial business's property line to a proposed sensitive receptor. Aldaho Holdings Inc. (Dominion Nickel Alloys Ltd), Fearmans Pork, Lafarge Canada Inc. and Maple Leaf Pork are four facilities identified within the Appleby Hub are in proposed employment areas. Noise impacts within these areas are likely not to be of concern; however, their separation distances overlap with proposed mixed-use areas. Nucor Grating is a medium to large scale facility which is located within a mixed-use area, so it's separation distance can naturally intersect with any proposed sensitive areas. Due to the vast number of noise sources an industrial site can hold, an individual assessment for each site would be required to accurately predict impacts on nearby sensitive land uses. Detailed acoustic assessments should be undertaken/reviewed to determine any potential impacts, both from the standalone facilities and if any cumulative effects from the rail line exists (especially a possibility within Appleby Hub). The Burlington, Aldershot and Appleby GO stations should also be reviewed, as placing sensitive receptors nearby may require an amendment to their Environmental Compliance Approvals.

7.0 Policy Recommendations

Based on this noise and vibration pre-feasibility study, the following policy recommendation is made for the Project:

- Detailed noise and vibration studies should be conducted for each noise-sensitive land-use as part of the land-use planning and approvals process for specific development applications. The studies should address both transportation and stationary noise and vibration impacts. The studies should be conducted in accordance with the requirements of the NPC-300 guidelines and should consider Class 4 designations, upgraded building components and strategic OLA placement.

8.0 Closing

A noise and vibration pre-feasibility study for the Burlington, Aldershot and Appleby study areas was completed for the Burlington Mobility Hubs project by Wood for the sole benefit of the City of Burlington or its representative. The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in Wood's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this document. This report is intended to be used by the City of Burlington only, and its nominated representatives, subject to the terms and conditions of its contract with Wood. Any other use of, or reliance on, this report by any third party is at that party's sole risk. This report has been prepared in accordance with generally accepted industry-standard. No other warranty, expressed or implied, is made.

If you have any questions regarding this report or require further information, please contact the undersigned at (905) 568-2929. Thank you for the opportunity to be of service to Brook McIlroy and the City of Burlington.

Sincerely,

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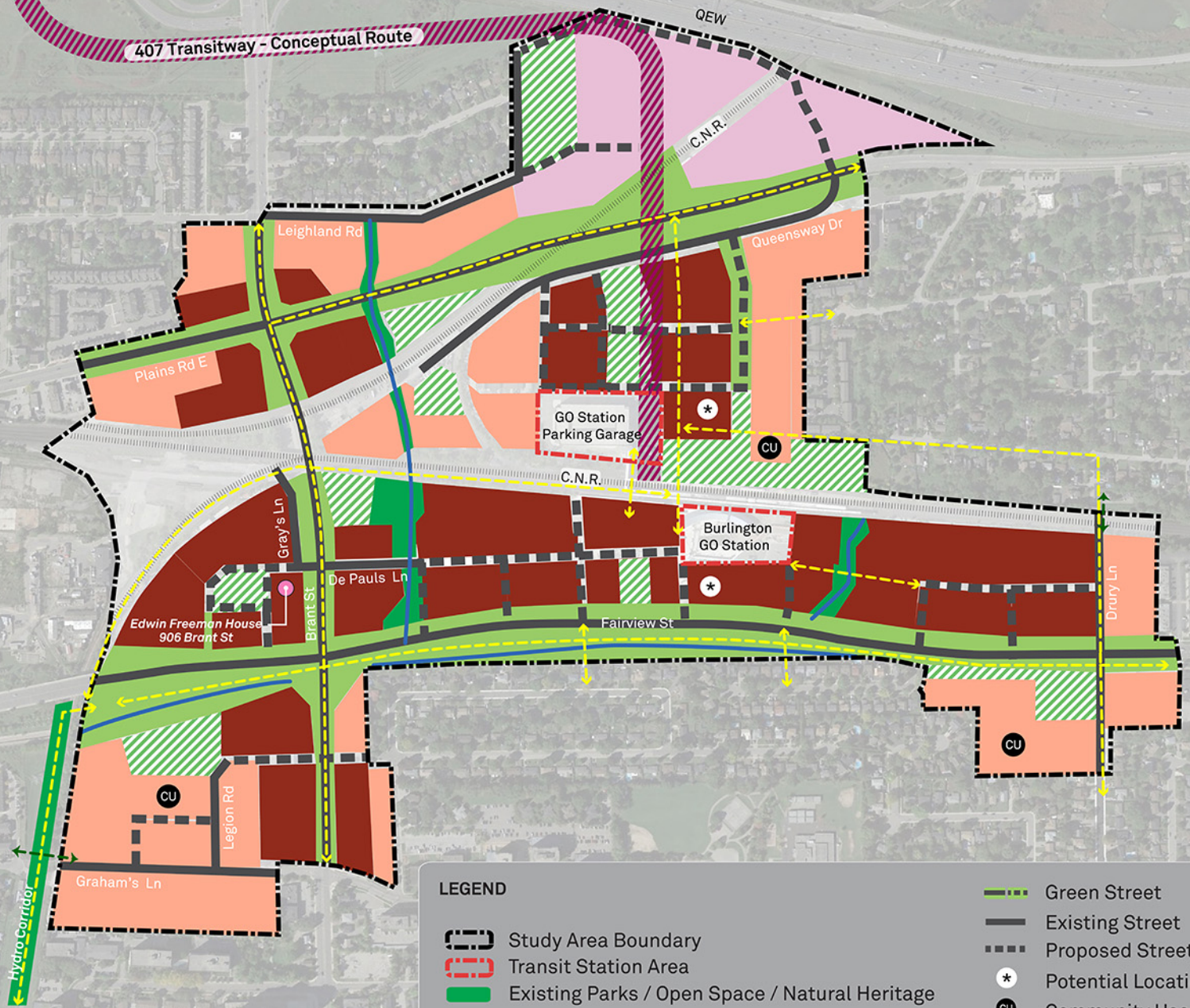
Appendix A

Preferred Concepts

BURLINGTON GO MOBILITY HUB
PREFERRED CONCEPT: LAND USE



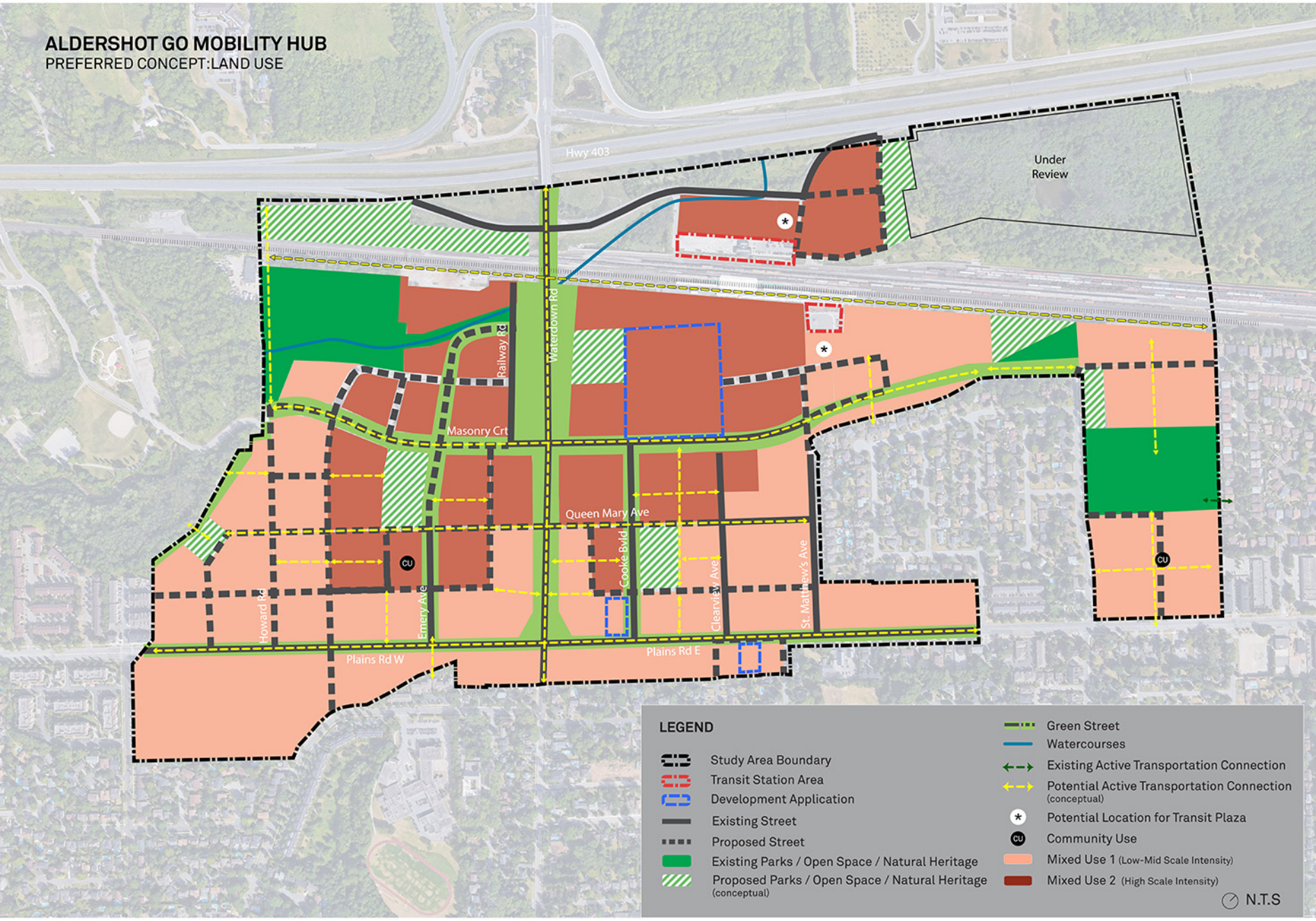
LEGEND

- Study Area Boundary
- Transit Station Area
- Existing Parks / Open Space / Natural Heritage
- Proposed Parks / Open Space / Natural Heritage (conceptual)
- Watercourse
- Existing Active Transportation Connection
- Potential Active Transportation Connection (conceptual)
- Green Street
- Existing Street
- Proposed Street
- Potential Location for Transit Plaza
- CU Community Use
- Listed Heritage Property
- Employment Use
- Mixed Use 1 (Low Mid Scale Intensity)
- Mixed Use 2 (Mid High Scale Intensity)

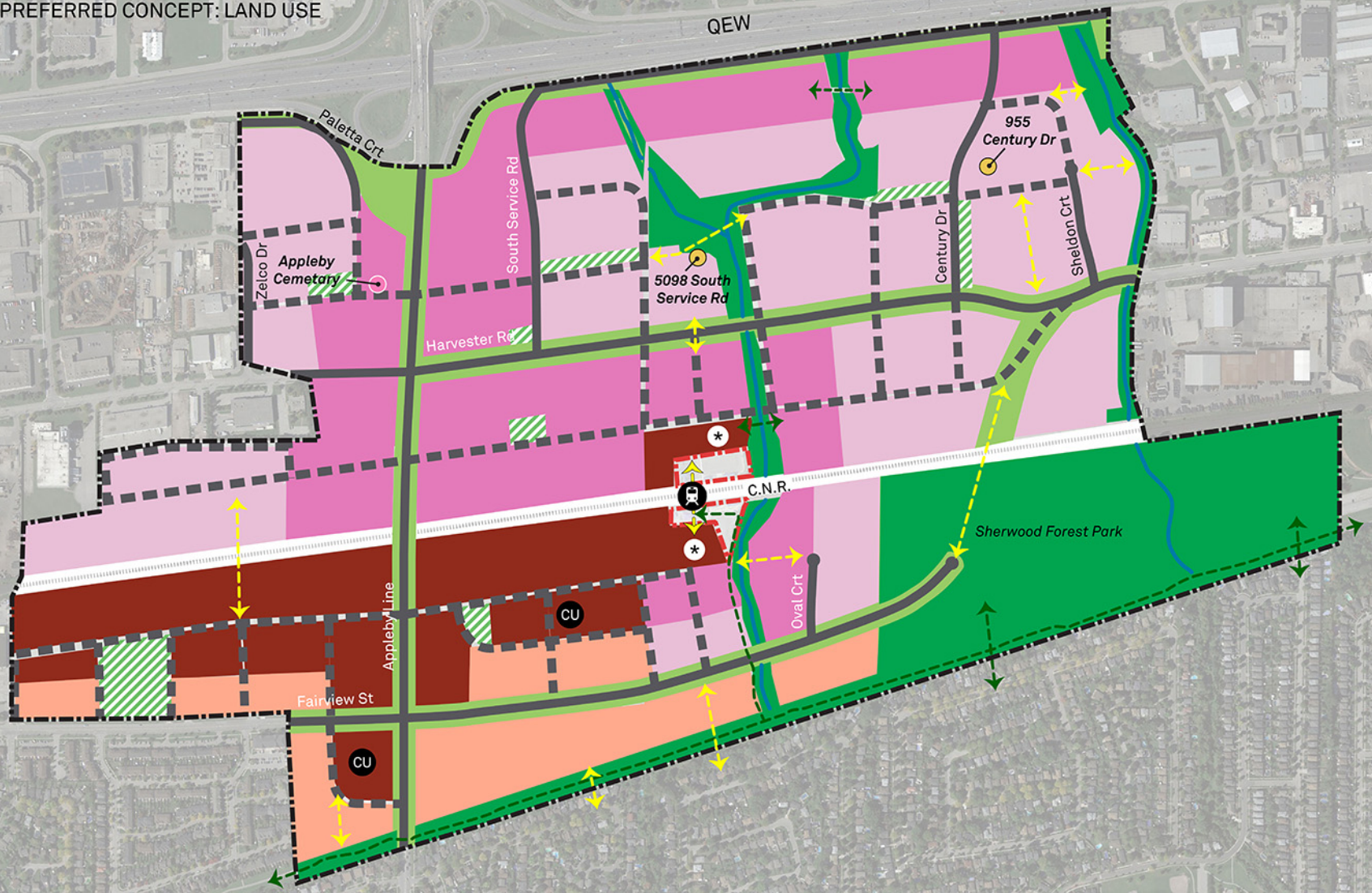
N.T.S N

ALDERSHOT GO MOBILITY HUB

PREFERRED CONCEPT:LAND USE



APPLEBY GO MOBILITY HUB
PREFERRED CONCEPT: LAND USE



LEGEND

- Study Area Boundary
- Transit Station Area
- Existing Street
- Proposed Street
- Existing Parks / Open Space / Natural Heritage
- Proposed Parks / Open Space / Natural Heritage (conceptual)
- CU Community Use
- * Potential Location for Transit Plaza
- Designated Heritage Property
- Listed Heritage Property
- Existing Active Transportation Connection
- Potential Active Transportation Connection (conceptual)
- Green Street
- Watercourses
- Employment 1 (Low Scale Intensity)
- Employment 2 (Mid-High Scale Intensity)
- Mixed Use 1 (Low-Mid Scale Intensity)
- Mixed Use 2 (High Scale Intensity)

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Appendix B

Glossary of Commonly Used Noise and Vibration Terminology

Glossary of Commonly Used Noise and Vibration Terminology

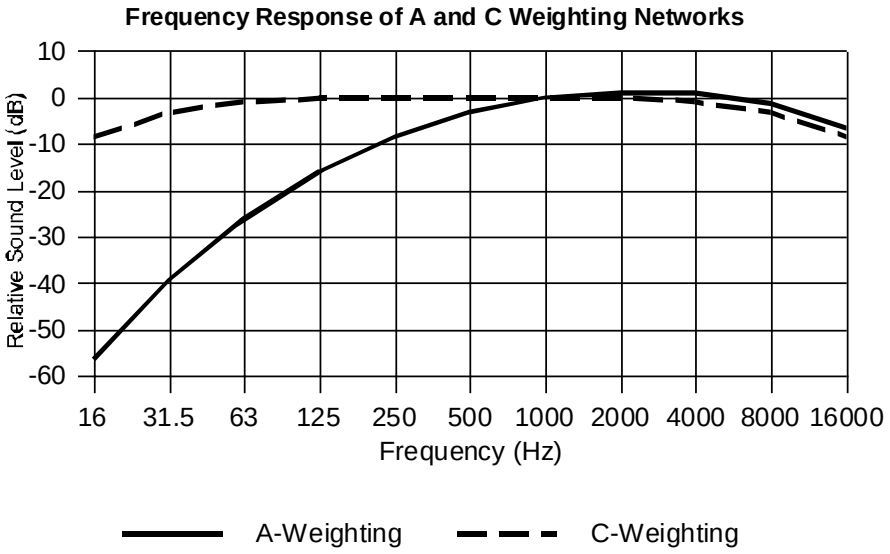
NOISE

Ambient or Background Noise: The ambient noise from all sources other than the sound of interest (i.e. sound other than that being measured). Under most MOE guidelines, aircraft overflights and train noise, due to their transient nature, are normally excluded from measurements of background noise.

Attenuation: The reduction of sound intensity by various means (e.g., air, humidity, porous materials, etc.).

dB - Decibel: The logarithmic units associated with sound pressure level, sound power level, or acceleration level. See sound pressure level, for example.

dBA - Decibel, A-Weighted: The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to quiet sound levels. The resultant sound pressure level is therefore representative of the subjective response of the human ear. A-weighted sound pressure levels are denoted by the suffix 'A' (ie. dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).



dBC - Decibel, C-Weighted: The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to loud sound levels. C-weighted sound pressure levels are denoted by the suffix 'C' (ie. dBC). C-weighted levels are often used in low-frequency noise analysis, as the filtering effect is nearly flat at lower frequencies.

dBL or dBLin - Decibel, Linear: The logarithmic units associated with a sound pressure level, where the sound pressure signal is unfiltered, and represents the full spectrum of incoming noise.

Calibrator (Acoustical): A device which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to standard specifications.

Directivity Factor (Q) (also, **Directional** or **Directionality Factor):** A factor mathematically related to Directivity Index, used in calculating propagated sound levels to account for the effect of reflecting surfaces near to the source. For example, for a source in free space where the sound is radiating spherically, Q = 1. For a source located on or very near to a surface (such as the ground, a wall, rooftop, etc.), where the sound is radiating hemispherically, Q = 2. This accounts for the additional sound energy reflecting off the surface, and translates into a +3 dB add.

Energy Equivalent Sound Level (L_{eq}): An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (e.g., $L_{eq}(24)$ for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. An L_{eq} value expressed in dBA is a good, single value descriptor of the annoyance of noise.

Exceedance Noise Level (L_N): The noise level exceeded N% of the time. It is a statistical measure of the noise level. For highly varying sounds, the L_{90} represents the background noise level, L_{50} represents the median or typical noise level, and L_{10} represents the short term peak noise levels, such as those due to occasional traffic or a barking dog.

Far Field: Describes a region in free space where the sound pressure level from a source obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). Also, in this region the sound particle velocity is in phase with the sound pressure. Closer to the source where these two conditions do not hold constitutes the "near field" region.

Free Sound Field (Free Field): A sound field in which the effects of obstacles or boundaries on sound propagated in that field are negligible.

Frequency: The number of times per second that the sine wave of sound or of a vibrating object repeats itself, now expressed in hertz (Hz), formerly in cycles per second (cps).

Hertz (Hz): Unit of measurement of frequency, numerically equal to cycles per second.

Human Perception of Sound: The human perception of noise impact is an important consideration in qualifying the noise effects caused by projects. The following table presents a general guideline.

Increase in Noise Level (dB)	Perception
3 or less	insignificant due to imperceptibility
4 to 5	just-noticeable difference
6 to 9	marginally significant
10 or more	significant, perceived as a doubling of sound exposure

Impact Sound: The sound produced by the collision of two solid objects, e.g., footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building. Typical industrial sources include punch presses, forging hammers, etc.

Impulsive Noise: a) Single or multiple sound pressure peak(s) (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 500 millisecond pauses, b) A sharp sound pressure peak occurring in a short interval of time.

Infrasonic: Sounds of a frequency lower than 20 hertz.

Insertion Loss (IL): The arithmetic difference between the sound level from a source before and after the installation of a noise mitigation measure, at the same location. Insertion loss is typically presented as a positive number, i.e., the post-mitigation sound level is lower than the pre-mitigation level. Insertion loss is expressed in dB and is usually specified per 1/1 octave band, per 1/3 octave band, or overall.

Low Frequency Noise (LFN): Noise in the low frequency range, from infrasonic sounds (<20 Hz) up to 250 Hz.

Masking: a) The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound, or b) The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound.

Near Field: The sound field very near to a source, where sound pressure does not obey the inverse-square law and the particle velocity is not in phase with the sound pressure.

Noise: Unwanted sound.

Noise Level: Same as Sound Level, except applied to unwanted sounds.

Peak Sound Pressure Level: Same as Sound Pressure Level except that peak (not peak-to-peak) sound pressure values are used in place of RMS pressures.

Quasi-Steady Impulsive Noise: Noise composed of a series of short, discrete events, characterized by rapid rise times, but with less than 0.5 seconds elapsing between events.

RMS Sound Pressure: The square-root of the mean-squared pressure of a sound (usually the result of an RMS detector on a microphone signal).

Reverberant Field: The region in a room where the reflected sound dominates, as opposed to the region close to the noise source where the direct sound dominates.

Sound: a dynamic (fluctuating) pressure.

Sound Exposure Level (SEL): An L_{eq} referenced to a one second duration. Also known as the Single Event Level. It is a measure of the cumulative noise exposure for a single event. It provides a measure of the accumulation of sound energy over the duration of the event.

Sound Intensity: The sound energy flow through a unit area in a unit time.

Sound Level Meter: An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

Sound Pressure Level (SPL): The logarithmic ratio of the RMS sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by equation (1) where P is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-5} Pascals.

(1) $SPL\ (dB) = 20 \log(P_{RMS}/P_0)$

Sound Power Level (PWL): The logarithmic ratio of the instantaneous sound power (energy) of a noise source to that of an international standard reference power. The sound power level is defined by equation (2) where W is the sound power of the source in watts, and W_0 is the reference power of 10^{-12} watts.

(2) $PWL\ (dB) = 10 \log(W/W_0)$

Interrelationships between sound pressure level (SPL) and sound power level (PWL) depend on the location and type of source.

Spectrum: The description of a sound wave's resolution into its components of frequency and amplitude.

Speed (Velocity) of Sound in Air: 344 m/s (1128 ft/s) at 70°F (21°C) in air at sea level.

Threshold of Audibility (Threshold of Detectability): The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of trials.

VIBRATION

Acceleration: Acceleration is rate of change of velocity with time (denoted as dv/dt or d^2x/dt^2), usually along a specified axis, usually expressed in g or gravitational units. It may refer to angular motion.

Accelerometer: A sensor or transducer or pickup for converting acceleration to an electrical signal.

Ambient vibration: Ambient vibration is the all-encompassing vibration associated with a given environment, being usually a composite of vibration from many sources, near and far.

Amplitude: The magnitude of variation (in a changing quantity) from its zero value. Always modify it with an adjective such as peak, RMS, average, etc. It may refer to displacement, velocity, acceleration, voltage, current force of pressure.

Angular Frequency: (Also known as circular frequency.) ⋅ is the torsional vibration frequency in radians per second. Or divide by 2 ⋅ and express in hertz (Hz) or cycles per second (cps).

Average: Refer to a textbook on electrical engineering. In the exclusive case of a pure sine wave, the average value is 0.636 x peak value.

Averaging: Summing and suitably dividing several like measurements to improve accuracy or to lessen any asynchronous components.

Background Noise: Background noise is the total of all sources of interference in a system used for the production, detection, measurement, or recording of a signal, independent of the presence of the signal.

Calibration: (as applied to vibration sensors) An orderly procedure for determining sensitivity as a function of frequency, temperature, altitude, etc.

Circular Frequency: (See angular frequency).

Comparison: A term applied to calibration (e.g. of an accelerometer) in which sensitivity is tested against a standard.

Complex Vibration: Complex vibration is vibration whose components are sinusoids not harmonically related to one another. (See harmonic).

Crest Factor. The crest factor is the ratio of the peak value to the root-mean-squared value.

Critical Frequency: A particular resonant frequency (see resonance) at which damage or degradation in performance is likely.

Cycle: The complete sequence of instantaneous values of a periodic event, during one period.

Damper: A damper is a device used to reduce the magnitude of a shock or vibration by one or more energy dissipation methods.

Damping: Damping is the dissipation of energy with time or distance.

Deterministic Vibration: A vibration whose instantaneous value at any future time can be predicted by an exact mathematical expression. Sinusoidal vibration is the classic example. Complex vibration is less simple (two or more sinusoids).

Displacement: Specified change of position, or distance, usually measured from mean position or position of rest. Usually applies to uniaxial, less often to angular motion.

Displacement Pickup: Displacement pickup is a transducer that converts an input displacement to an output that is proportional to the input displacement.

Forced Vibration: It is the vibratory motion of a system caused by some mechanical excitation. If the excitation is periodic and continuous, the response motion eventually becomes steady-state.

Forcing Frequency: In sinusoidal vibration testing or resonance searching, the frequency at which a shaker vibrates. The frequency at which forced vibration occurs is called forcing frequency.

Free Vibration: Free vibration occurs without forcing, as after a reed is plucked, or after a heel drop on a floor.

Frequency: The reciprocal of the period T in seconds (or a periodic function; $1/T_0$). Usually given in Hertz (Hz), meaning cycles per second (cps).

Frequency Spectrum: A description of the resolution of any electrical signal into its frequency components, giving the amplitude (sometimes also phase) of each component.

Fundamental Mode of Vibration: That mode having the lowest natural frequency.

Harmonic: A sinusoidal quantity having a frequency that is an integral multiple (x2, x3, etc.) of a fundamental (x1) frequency.

Impact: An impact is a single collision of one mass in motion with a second mass which may be either in motion or at rest.

Isolation: A reduction of motion severity, usually by resilient support. A shock mount or isolator attenuates shock. A vibration mount or isolator attenuates steady-state vibration.

Magnetic Recorder: A magnetic recorder is equipment incorporating an electromagnetic transducer and means for moving a ferromagnetic recording medium relative to the transducer for recording electric signals as magnetic variations in the medium.

Mass: A physical property, dynamically computed as acceleration divided by force. Statistically computes as W (which can be measured on a butcher scale) divided by the acceleration due to gravity. Ordinary structures are not pure masses as they contain reactive elements (i.e. springs and damping).

Maximum Value: The maximum value is the value of a function when any small change in the independent variable causes a decrease in the value of the function.

Mode: A characteristic pattern in a vibrating system. All points reach their maximum displacements at the same instant.

Natural Environments: Conditions occurring in nature, not caused by any equipment; effects are observed whether an equipment or activity is at rest or in operation.

Natural Frequency: The frequency of an undamped system's free vibration; also, the frequency of any of the normal modes of vibration. Natural frequency drops when damping is present.

Natural Mode of Vibration: The natural mode of vibration is a mode of vibration assumed by a system when vibrate freely.

Noise: The total of all interferences in measurement system, independent of the presence of signal.

Oscillation: Variation with time of a quantity such as force, stress, pressure, displacement, velocity, acceleration or jerk. Usually implies some regularity (as in sinusoidal or complex vibration).

Peak: Extreme value of a varying quantity, measured from the zero or mean value. Also, a maximum spectral value.

Peak-to-Peak Value: The algebraic difference between extreme values (as D = 2X).

Period: The interval of time over which a cyclic vibration repeats itself.

Periodic Vibration: (See also Deterministic Vibration.) Periodic vibration is an oscillation whose waveform regularly repeats. Compare with probabilistic vibration.

Pickup: (See transducer).

Pseudo-Steady State: A sequence of impulses emitted from the same source with a short time period between impulses.

Recording Channel: The term recording channel refers to one of a number of independent recorders in a recording system or to independent recording tracks on a recording medium.

Recording System: A recording system is a combination of transducers and associated equipment suitable for storing signals in a form capable of subsequent reproduction.

Response: The vibratory motion or force that results from some mechanical input.
Response Signal: The signal from a "response sensor" measuring the mechanical response of a mechanical system to an input vibration or shock.

Resonance: Forced vibration of a true single degree of freedom system causes resonance when the forcing frequency equals the natural frequency, when any forcing frequency change decreases system response.

Resonance Frequency: Resonance frequency is a frequency at which resonance exists.

RMS or Root-Mean-Square Value: The square root of the time-averaged squares of a series of measurements. Refer to a textbook on electrical engineering. In the exclusive case of sine wave, •, the RMS value is 0.707 x the peak value.

Seismic Pickup or Seismic Transducer: A seismic pickup or transducer is a device consisting of a seismic system in which the differential movement between the mass and the base of the system produces a measurable indication of such movement.

Sensitivity: Of a mechanical-to-electrical sensor or pickup, the ratio between electrical signal (output) and mechanical quantity (input).

Shock Pulse: A transmission of kinetic energy into a system in a relatively short interval compared with the system's natural period. A natural decay of oscillatory motion follows; usually displayed as time history, as on an oscilloscope.

Signal Conditioner: An amplifier following a sensor, which prepares the signal for succeeding amplifiers, transmitters, readout instruments, etc. It may also supply sensor power.

Simple Harmonic Motion: Periodic vibration that is a sinusoidal function of time.

Spectrum: See frequency spectrum.

Steady-State Vibration: Periodic vibration for which the statistical measurement properties (such as the peak, average, RMS and mean values) are constant.

Stiffness: Stiffness is the ratio of change of force (or torque) to the corresponding change on translational or rotational deflection of an elastic element.

Transducer (Pickup): A transducer is a device which converts shock or vibratory motion into an optical, mechanical, or most commonly to an electrical signal that is proportional to a parameter of the experienced motion.

Transient Vibration: Short-term vibration of a mechanical system.

Transmissibility: In steady-state vibration, transmissibility is the non-dimensional ratio of response motion/input motion.

Transmission Loss: Transmission loss is the reduction in the magnitude of some characteristic of a signal, between two stated points in a transmission system.

Velocity: Rate of change of displacement with time, usually along a specified axis; it may refer to angular motion as well as to uniaxial motion.

Velocity Pickup: A velocity pickup is a transducer that converts an input velocity to an output (usually electrical) that is proportional to the input velocity.

Vibration: Mechanical oscillation or motion about a reference point of equilibrium.

Vibration Isolator: A vibration isolator is a resilient support that tends to isolate a system from steady-state excitation.

Vibration Meter: An apparatus (usually an electronic amplifier, detector and readout meter) for measuring electrical signals from vibration sensors. It may display displacement, velocity and/or acceleration.

Weight: That property of an object that can be weighted, as on a scale; the gravitational force on an object.

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Limitations

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