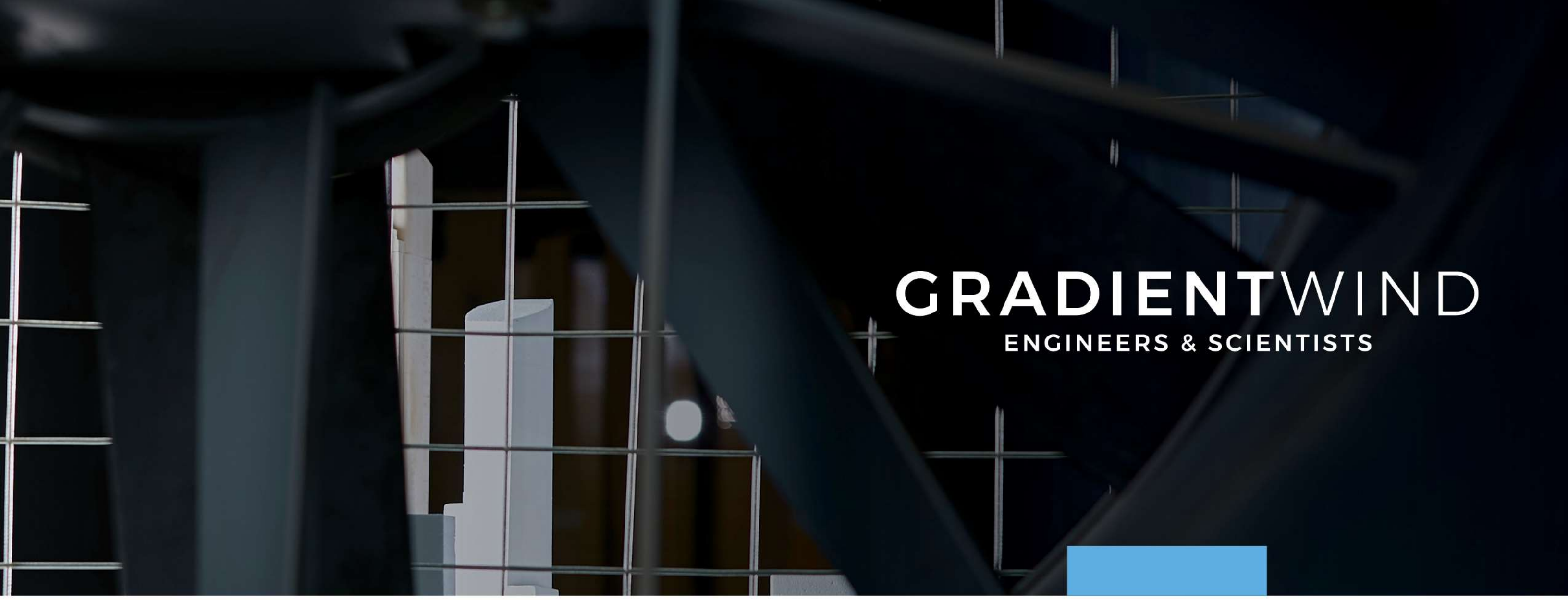
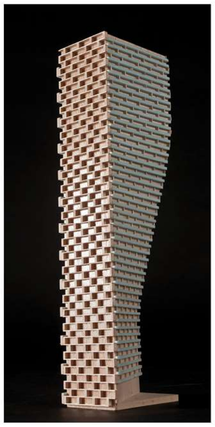
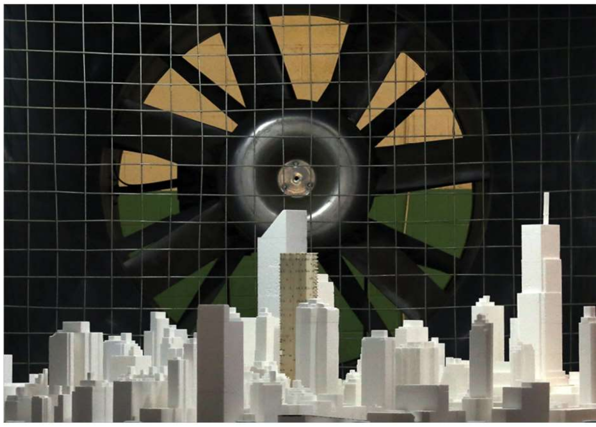


ENVIRONMENTAL NOISE & VIBRATION FEASIBILITY ASSESSMENT

41-43 Essa Road and 259 Innisfil Street
Barrie, Ontario

REPORT: GW21-138-Noise & Vibration





September 21, 2021

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EXECUTIVE SUMMARY

This report describes an environmental noise and vibration assessment in support of a Zoning By-Law Amendment (ZBA) application for the proposed mixed-use development located at 41-43 Essa Road and 259 Innisfil Street in Barrie, Ontario. The development comprises four residential buildings referred to as Building 1 (29-Storeys), Building 2 (35-Storeys), Building 3 (37-Storeys), and Building 4 (20-Storeys) linked by a mixed-use 6-storey podium. An Outdoor Living Area (OLA) is located on the podium rooftop. Balconies extending less than 4 metres from the building façade do not require consideration as OLAs in this study. The major sources of traffic noise are Essa Road, Innisfil Street, Tiffin Street, Burton Avenue, and the Barrie Collingwood Railway (BCRY) corridor to the north, which is a source of both noise and vibration. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) requirements; (ii) future vehicular traffic volumes based on projected roadway traffic counts and train information obtained from GHD Group and the City of Barrie, respectively; and (iii) architectural drawings received from Architecture Unfolded in September 2021.

The results of the current analysis indicate that transportation noise levels will range between 52 and 61 dBA at the Plane of Window during the daytime period (07:00-23:00) and between 45 and 54 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 61 dBA) occur along the northeast façade of the podium, which is nearest and most exposed to Essa Road. Noise levels at the Outdoor Living Area atop the podium are expected to approach 45 dBA daytime period.

The noise levels predicted due to roadway and railway traffic are below the criteria listed in Section 4.2 for upgraded building components. Therefore, standard building components in conformance with the Ontario Building Code (OBC) will provide sufficient noise attenuation. As noise levels at the Plane of Window exceed 55 dBA at multiple points of reception, the development should consider the need for occupants to keep windows and doors closed. Therefore, the building should be designed with provisions for the installation of central air conditioning at the occupant's discretion. A Type C Warning Clause will also be required on all Lease, Purchase and Sale Agreements, as summarized in section 6. Noise levels at the Outdoor Living Area are expected to fall below the NPC-300 limits of 55 dBA, thus mitigation will not be required for this area.

An assessment of stationary noise impacts from the surroundings on the development was conducted. The following sources of stationary noise were identified and analyzed: GO Bus Terminal operations approximately 90 metres northeast of the development, HVAC equipment on rooftops of surrounding buildings, garage doors and idling vehicles associated with nearby automotive repair garages. Results indicate that stationary noise impacts from the surroundings on the development do not exceed the NPC-300 criteria, thus mitigation is not required.

The development's own mechanical equipment has the potential to generate noise off-site at surrounding noise-sensitive (residential) developments. Any potential impacts can be minimized by judicious selection of the mechanical equipment and its location. It is preferable to locate large pieces of equipment, such as cooling towers and make up air units, on the roof of the towers or in mechanical penthouses. Once the mechanical design of the building has developed sufficiently, it should be reviewed by a qualified acoustical engineer to ensure compliance with NPC-300 sound level limits.

Estimated vibration levels at the nearest edge of the property line to the BCRY corridor are expected to be 0.135 mm/s RMS (74.5 dBV), based on the FTA protocol and a conservative offset distance of 9 metres to the nearest railway track centerline. Details of the calculation are provided in Appendix A. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the property line, vibration mitigation will not be required. As vibration levels are acceptable, correspondingly regenerated noise levels are also expected to be acceptable.

GRADIENTWIND
ENGINEERS & SCIENTISTS

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Tonlu Holdings Ltd. to undertake an environmental noise and vibration assessment in support of a Zoning By-Law Amendment (ZBA) application for the proposed four-tower, mixed-use development located at 41-43 Essa Road and 259 Innisfil Street in Barrie, Ontario. This report summarizes the methodology, results, and recommendations related to an environmental noise and ground vibration assessment investigating exterior noise levels generated by stationary and transportation noise sources, as well as ground vibrations generated by local railway traffic.

The assessment was performed based on theoretical noise calculation methods conforming to the Ministry of the Environment, Conservation and Parks (MECP) NPC-300 guidelines. Noise calculations were based on architectural drawings received from Architecture Unfolded in September 2021, with future traffic volumes corresponding to roadway traffic counts and train information obtained from GHD Group and the City of Barrie, respectively.

2. TERMS OF REFERENCE

The focus of this environmental noise and vibration assessment is the proposed four-tower, mixed-use development located at 41-43 Essa Road and 259 Innisfil Street in Barrie, Ontario. The study site is situated on an irregular parcel of land bordering Innisfil Street to the west, Essa Road to the east, and the Barrie Collingwood Railway (BCRY) to the north.

The development comprises four residential buildings referred to as Building 1 (29-Storeys), Building 2 (35-Storeys), Building 3 (37-Storeys), and Building 4 (20-Storeys) linked by a mixed-use 6-storey podium. Floors 1 and 2 of the podium will comprise a mix of retail units on the northeast corner, residential units along the west façade, and vehicle parking throughout the rest of the floor. Floors 3-6 of the podium will comprise residential units on the northeast corner and along the west façade, with vehicle parking throughout the rest of the floor. Level 6 is expected to comprise an Outdoor Living Area (OLA) atop the podium, and a mix of residential units and indoor amenity space at the base of each tower. The remaining floors above will comprise entirely of residential space.

The site is surrounded by low-rise commercial buildings to the east and west, the Barrie Collingwood Railway (BCRY) to the north, and low-rise residential neighbourhoods to the south. Primary sources of transportation noise are Innisfil Street to the west, Tiffin Street to the north, Essa Road to the east, Burton Avenue to the east, and the Barrie Collingwood Railway (BCRY) to the north. The BCRY is also a source of ground vibrations. Figure 1 illustrates a site plan with surrounding context.

3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the study buildings produced by local transportation and stationary sources, and (ii) determine whether exterior noise and vibration levels exceed the allowable limits specified by the MECP Noise Control Guidelines – NPC-300 as outlined in Section 4 of this report.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Transportation Noise

4.2.1 Criteria for Transportation Noise

For vehicle traffic, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00)/8-hour (L_{eq8}) nighttime

(23:00-07:00) split to assess its impact on residential buildings. The NPC-300 guidelines specify that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for retail space, residence living rooms and sleeping quarters respectively, as listed in Table 1. However, to account for deficiencies in building construction and to control peak noise, these levels should be targeted toward 47, 42 and 37 dBA. Indoor noise levels due to railway traffic are 5 dB lower.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [1]

Type of Space	Time Period	Leq (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50	45
Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45	40
Sleeping quarters of hotels/motels	23:00 – 07:00	45	40
Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40	35

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise while a standard closed window is capable of providing a minimum 20 dBA noise reduction[2]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning (or similar systems). Where noise levels exceed 65 dBA daytime and 60 dBA nighttime building components will require higher levels of sound attenuation[3].

[1] Adapted from Table C-2, Part C, Section 3.2.3 of NPC-300
[2] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[3] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

For designated Outdoor Living Areas (OLAs), the sound level limit is 55 dBA during the daytime period. An excess above the limit is acceptable only in cases were the required noise control measures are not feasible for technical, economic or administrative reasons.

4.2.2 Roadway and Railway Traffic Volumes

NPC-300 dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes have been considered for the mature state of development based on traffic counts obtained from GHD Group and train information obtained from the City of Barrie. Counts are then projected to 10 years in the future from the year of the project (2021) using a growth factor of 2% per year. Table 2 (below) summarizes the Annual Average Daily Traffic (AADT) values used for each roadway and railway line included in this assessment.

TABLE 2: ROADWAY AND RAILWAY TRAFFIC DATA

Segment	Roadway/Transit Class	Speed Limit (km/h)	Existing AADT Count	Year of Count	Projected 2031 ADT Count
Essa Road	2-UAU	50	12,930	2017	**17,060**
Tiffin Street	2-UAU	50	11,050	2017	**14,580**
Innisfil Street	2-UCU	50	5,150	2021	**6,278**
Burton Avenue	2-UCU	50	8,910	2017	**11,757**
BCRY	Railway	16	1/0*	-	**-**

* Daytime/nighttime volumes

4.2.3 Theoretical Transportation Noise Predictions

The impact of transportation noise sources on the development was determined by computer modelling. Transportation noise source modelling is based on the software program *Predictor-Lima* which can represent three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The calculation method used for this section of the study is based on the United States Federal Highway Administration's Traffic Noise Model (TNM) to represent roadway line sources. A set of comparative calculations were performed in the free field environment for comparisons to the current Ontario traffic noise prediction model STAMSON. The STAMSON model is however older and requires each receptor to be calculated separately. STAMSON also does not accurately account for building reflections and multiple screening elements, and curved road geometry. Noise levels were found to be within an imperceptible level of 0-3 dBA of those predicted in Predictor. A total of 20 receptor locations were identified around the site, as illustrated in Figure 2.

Roadway and railway noise calculations were performed by treating each transportation segment as separate line sources of noise, and by using existing building locations as noise barriers. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 1% heavy trucks and 2% medium trucks, based on averages derived from traffic count data.
- The daytime/nighttime traffic volume split was taken as 90% daytime and 10% nighttime.
- Reflective intermediate ground surfaces were assumed.
- Receptor heights were placed at 85.5 metres for façades of Building 1; 103.5 m for façades of Building 2; 109.5 m for façades of Building 3; 58.5 for façades of Building 4; 16.5 m for façades of the podium; and 19.5 m for the podium rooftop OLA.
- Surrounding buildings were considered as noise barriers.
- The study site was treated as having gently sloping topography.
- Noise receptors were strategically placed at 20 locations around the study area (Figure 2).
- For the BCRY, one locomotive was modelled per train, with six cars per train.
- Railway tracks were assumed to be welded.

The noise generated from both on-road and railway traffic were combined for the 20 receptor locations identified in Figure 2. The combined outdoor noise levels from both road and rail were compared to the appropriate NPC-300 criteria stipulated in Table C1 of the “Land Use Planning Requirements” guideline.

4.3 Stationary Noise

Stationary sources are defined in NPC-300 as: “a source of sound or combination of sources of sound that are included and normally operated within the property lines of a facility and includes the premises of a person as one stationary source, unless the dominant source of sound on those premises is construction"[4]. Common stationary sources of noise include HVAC equipment, emergency generators, cooling towers and exhaust fans, which are often found on industrial and commercial facilities. As stationary noise can cause an adverse effect, it is important to examine (i) the impact of existing stationary sources on the development, and (ii) impact of study building sources on the surrounding residences.

4.3.1 Criteria for Stationary Noise

Noise criteria taken from the NPC-300 apply to all points of reception (POR). A POR is defined under NPC-300 as "any location on a noise sensitive land use where noise from a stationary source is received"[5]. A POR can be located on an existing or zoned for future use premises of permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, camp grounds, and noise sensitive buildings such as schools and places of worship. The recommended maximum noise levels for a Class 1 area in a urban environment adjacent to arterial roadways at a POR are outlined in Table 3 below. The study site is considered to be in a Class 1 area because it is located on a parcel of land bounded by arterial roadways. This condition indicates that the sound field is dominated by manmade sources.

TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 1 AREA

Time of Day	Outdoor Points of Reception	Plane of Window
07:00 – 19:00	50	50
19:00 – 23:00	50	50
23:00 – 07:00	N/A	45

The sound level limit for stationary noise is the higher of the exclusion limit value given in Table 3, or the background sound level caused by transportation noise sources. A review of satellite imagery identified the following stationary noise sources impacting the development:

- GO Bus Terminal approximately 90 metres northeast of the development
- HVAC equipment on rooftops of surrounding buildings
- Garage doors and idling vehicles associated with nearby automotive repair garages

[4] NPC – 300, page 16
[5] NPC – 300, page 14

4.3.2 Determination of Noise Source Power Levels

Mechanical information for the surrounding stationary noise sources impacting the development has been based on Gradient Wind's experience. Table 4 summarizes the sound power of each source used in the analysis. Figure 3 Illustrates the location of each stationary noise source used in the analysis. The following assumptions have been made in the analysis:

(i) The locations, quantity and tonnage of rooftop units has been assumed based on recent satellite imagery and Gradient Wind's experience with similar developments.

(ii) Rooftop mechanical units are assumed to operate continuously over a 1-hour period during the daytime period (07:00-23:00) and at 50% operation during the nighttime period (23:00-07:00).

(iii) Rooftop mechanical units of commercial developments are assumed to operate at 75% over a 1-hour period during the daytime period, and at 30% during the nighttime period.

(iv) The automotive repair garage doors operate for 30 minutes per hour during the daytime period and do not operate during the nighttime period.

(v) Three vehicles are assumed to be idling in the parking lot of each automotive repair shop.

(vi) Frequency of bus movements (arrivals/departures) to the GO Bus Terminal are based on the GO Transit schedule. Thirty-one (31) bus movements are scheduled during the daytime period, and five (5) during the nighttime. One (1) bus is assumed to Idle at the station for 30 minutes per hour.

TABLE 4: EQUIPMENT SOUND POWER LEVELS (dBA)

Source ID	Description	Height Above Grade (m)	Frequency (Hz)								
			63	125	250	500	1000	2000	4000	8000	Total
S1 - S24	Rooftop Air-Handling Unit	1.0	61	69	75	79	80	77	73	66	85
S25	Bus Idling	2	65	72	76	85	90	89	83	74	94
S26	Bus Movement	2	65	72	76	85	90	89	83	74	94
S27 - S32	Automotive Shop Idling Cars	1.5	-	-	-	-	82	-	-	-	82
S33 - S34	Automotive Shop Garage Doors	3.0	-	-	-	-	86	-	-	-	86

4.3.3 Stationary Noise Source Predictions

The impact of stationary noise sources on nearby residential areas was determined by computer modelling using the software program Predictor-Lima. The calculation method used for this section of the study was developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. The methodology has been used on numerous assignments and has been accepted by the Ministry of the Environment, Conservation and Parks (MECP) as part of Environmental Compliance Approval applications.

A total of 20 receptor locations were chosen around the site, corresponding to the locations chosen in section 4.2.3. This enables measurement and comparison of stationary noise and transportation noise impacts. Figure 2 illustrates the location of all PORs used in this study. In the predictor model, all sources of stationary noise were modelled as point sources, with the exception of bus movements to the GO station modelled as a moving source. Table 5 below contains Predictor-Lima calculation settings. These are typical settings that have been based on ISO 9613 standards and guidance from the MECP.

Ground absorption over the study area was determined based on topographical features (such as water, concrete, grassland, etc.). An absorption value of 0 is representative of hard ground, while a value of 1 represents grass and similar soft surface conditions. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. A Predictor-Lima sample output and further modelling data is available upon request.

TABLE 5: CALCULATION SETTINGS

Parameter	Setting
Meteorological correction method	Single value for C0
Value C0	2.0
Default ground attenuation factor	0
Ground attenuation factor for roadways and paved areas	0
Temperature (K)	283.15
Pressure (kPa)	101.33
Air humidity (%)	70

4.3.4 Impacts on Surroundings

The development's own mechanical equipment has the potential to generate noise off-site at surrounding noise sensitive (residential) developments. Any potential impacts can be minimized by judicious selection of mechanical equipment and its location. It is preferable to locate large pieces of equipment, such as cooling towers and make up air units, on the roof of the towers or in mechanical penthouses. Once the mechanical design of the building has developed sufficiently, it should be reviewed by a qualified acoustical engineer to ensure compliance with NPC-300 sound level limits.

4.4 Ground Vibration & Ground-borne Noise

4.4.1 Background on Vibrations

Transit systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through a medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata.

Similar to sound waves in air, ground vibrations also produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, such as from a train. The repetitive motion of steel wheels on the track or rubber tires passing over an uneven surface causes vibrations to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a noise signature that is unique to that structure and soil combination.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical measurement units of ground vibration are millimeters per second (mm/s) or inches per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is 0.5 mm/s RMS (or 85 dBV), five times higher than the perception threshold, whereas the threshold for significant structural damage is 10 mm/s RMS (or 112 dBV), at least one hundred times higher than the perception threshold level.

4.4.2 Ground Vibration Criteria

The Canadian Railway Association and Canadian Association of Municipalities have set standards for new sensitive land developments within 300 metres of a railway right-of-way, as published in their document *Guidelines for New Development in Proximity to Railway Operations*[6], which indicate that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one second time-period at the first floor and above of the proposed building.

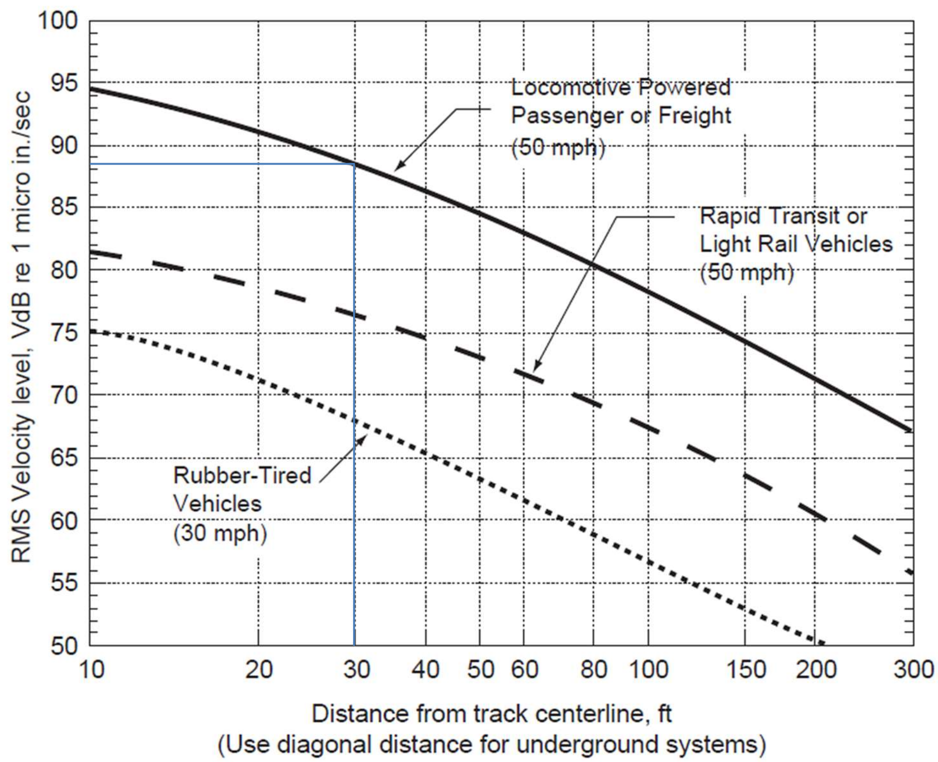
4.4.3 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) Transit Noise and Vibration Impact Assessment[7] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure on the following page, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as operating speed of vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. The vibration impact on the building was determined using a set of curves for Locomotive Powered Passenger of Freight at a speed of 50 mph. Adjustment factors were considered based on the following information:

[6] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Associated of Canada, May 2013

[7] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

- The operating speed of the trains near the study site is 16 km/h (10 mph)
- The distance between the property line of the development and the closest track is 9 metres
- The vehicles are assumed to have soft primary suspensions
- Tracks are welded, and in good condition
- Soil conditions do not efficiently propagate vibrations
- The building's foundation is large masonry on piles



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the transportation noise calculations are summarized in Table 6 below.

TABLE 6: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Location	Roadway Noise Level (dBA)		Railway Noise Level (dBA)		Total Noise Level (dBA)	
		Day	Night	Day	Night	Day	Night
Building 1							
1	POW - North Façade	53	47	37	N/A*	**53**	**47**
2	POW - East Façade	54	47	33	N/A*	**54**	**47**
3	POW - South Façade	56	50	20	N/A*	**56**	**50**
4	POW - West Façade	58	51	36	N/A*	**58**	**51**
Building 2							
5	POW - North Façade	56	49	40	N/A*	**56**	**49**
6	POW - East Façade	52	45	36	N/A*	**52**	**45**
7	POW - South Façade	54	47	31	N/A*	**54**	**47**
8	POW - West Façade	58	52	38	N/A*	**58**	**52**
Building 3							
9	POW - North Façade	54	48	40	N/A*	**54**	**48**
10	POW - East Façade	54	48	37	N/A*	**54**	**48**
11	POW - South Façade	53	46	30	N/A*	**53**	**46**
12	POW - West Façade	52	46	37	N/A*	**52**	**46**
Building 4							
13	POW - North Façade	56	50	42	N/A*	**56**	**50**
14	POW - East Façade	60	54	38	N/A*	**60**	**54**
15	POW - South Façade	55	49	36	N/A*	**55**	**49**
16	POW - West Façade	53	47	41	N/A*	**53**	**47**

TABLE 6 (CONTINUED): EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Receptor Location	Roadway Noise Level (dBA)		Railway Noise Level (dBA)		Total Noise Level (dBA)	
		Day	Night	Day	Night	Day	Night
Podium							
17	POW - Northeast Façade	58	51	45	N/A*	**58**	**51**
18	POW - Southeast Façade	61	54	40	N/A*	**61**	**54**
19	POW - West Façade	59	53	39	N/A*	**59**	**53**
20	OLA - Podium Rooftop	45	N/A**	26	N/A*	**45**	**N/A****

* Train passes are not expected to occur during the nighttime period (23:00 - 07:00)
** Nighttime noise levels are not considered for OLA receptors, as per NPC-300 guidelines

The results of the current analysis indicate that transportation noise levels will range between 52 and 61 dBA at the Plane of Window during the daytime period (07:00-23:00) and between 45 and 54 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 61 dBA) occur along the northeast façade of the podium, which is nearest and most exposed to Essa Road. Noise levels at the Outdoor Living Area atop the podium are expected to approach 45 dBA daytime period. Roadway traffic noise contours at 30 metres above grade for daytime and nighttime periods can be seen in Figures 4 and 5 respectively.

5.2 Stationary Noise Levels

The sound levels listed in Table 7 are based on the assumptions outlined in Section 2.1.

TABLE 7: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Receptor Location	Noise Level (dBA)		Sound Level Limits		Meets NPC-300 Class 1 Criteria	
		Day	Night	Day	Night	Day	Night
Building 1							
1	POW - North Façade	44	40	50	45	**YES**	**YES**
2	POW - East Façade	45	42	50	45	**YES**	**YES**
3	POW - South Façade	44	39	50	45	**YES**	**YES**
4	POW - West Façade	44	36	50	45	**YES**	**YES**

TABLE 7 (CONTINUED): NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Receptor Location	Noise Level (dBA)		Sound Level Limits		Meets NPC-300 Class 1 Criteria	
		Day	Night	Day	Night	Day	Night
	Building 2						
5	POW - North Façade	39	36	50	45	**YES**	**YES**
6	POW - East Façade	43	40	50	45	**YES**	**YES**
7	POW - South Façade	44	40	50	45	**YES**	**YES**
8	POW - West Façade	42	36	50	45	**YES**	**YES**
	Building 3						
9	POW - North Façade	41	38	50	45	**YES**	**YES**
10	POW - East Façade	44	41	50	45	**YES**	**YES**
11	POW - South Façade	44	40	50	45	**YES**	**YES**
12	POW - West Façade	40	36	50	45	**YES**	**YES**
	Building 4						
13	POW - North Façade	47	43	50	45	**YES**	**YES**
14	POW - East Façade	45	41	50	45	**YES**	**YES**
15	POW - South Façade	46	43	50	45	**YES**	**YES**
16	POW - West Façade	40	36	50	45	**YES**	**YES**
	Podium						
17	POW - Northeast Façade	50	45	50	45	**YES**	**YES**
18	POW - Southeast Façade	47	43	50	45	**YES**	**YES**
19	POW - West Façade	49	45	50	45	**YES**	**YES**
20	OPOR - Podium Rooftop	41	37	50	N/A*	**YES**	**N/A***

*Nighttime noise levels not considered at OPOR receptors as per NPC-300

Noise levels from stationary sources meet NPC-300 Class 1 criteria at all points of reception. Stationary noise contours at 30 metres above grade can be seen in Figures 6 and 7 for daytime and nighttime periods respectively.

5.3 Ground Vibrations & Ground-Borne Noise Levels

Estimated vibration levels at the nearest edge of the property line to the BCRY corridor are expected to be 0.135 mm/s RMS (74.5 dBV), based on the FTA protocol and a conservative offset distance of 9 metres to the nearest railway track centerline. Details of the calculation are provided in Appendix A. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the property line, vibration mitigation will not be required. Further justification considers the expected offset distance to the building foundation (22 metres) and the coupling to the building foundation (large masonry on piles) which will result in attenuated vibration levels within the building compared to those predicted at the property line. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that transportation noise levels will range between 52 and 61 dBA at the Plane of Window during the daytime period (07:00-23:00) and between 45 and 54 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 61 dBA) occur along the northeast façade of the podium, which is nearest and most exposed to Essa Road. Noise levels at the Outdoor Living Area atop the podium are expected to approach 45 dBA daytime period.

The noise levels predicted due to roadway and railway traffic are below the criteria listed in Section 4.2 for upgraded building components. Therefore, standard building components in conformance with the Ontario Building Code (OBC) will provide sufficient noise attenuation. Noise levels at the Outdoor Living Area are expected to fall below the NPC-300 limits of 55 dBA, thus mitigation will not be required for this area. As noise levels at the Plane of Window exceed 55 dBA at multiple points of reception, the development should consider the need for occupants to keep windows and doors closed. Therefore, the building should be designed with provisions for the installation of central air conditioning at the occupant's discretion. A Type C Warning Clause[8] will also be required on all Lease, Purchase and Sale Agreements, as follows:

[8] MECP, Environmental Noise Guidelines, NPC 300 – Section 8.1

"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."

An assessment of stationary noise impacts from the surroundings on the development was conducted. The following sources of stationary noise were identified and analyzed: GO Bus Terminal operations approximately 90 metres northeast of the development, HVAC equipment on rooftops of surrounding buildings, garage doors and idling vehicles associated with nearby automotive repair garages. Results indicate that stationary noise impacts from the surroundings on the development do not exceed the NPC-300 criteria, thus mitigation is not required.

The development's own mechanical equipment has the potential to generate noise off-site at surrounding noise-sensitive (residential) developments. Any potential impacts can be minimized by judicious selection of the mechanical equipment and its location. It is preferable to locate large pieces of equipment, such as cooling towers and make up air units, on the roof of the towers or in mechanical penthouses. Once the mechanical design of the building has developed sufficiently, it should be reviewed by a qualified acoustical engineer to ensure compliance with NPC-300 sound level limits.

Estimated vibration levels at the nearest edge of the property line to the BCRY corridor are expected to be 0.135 mm/s RMS (74.5 dBV), based on the FTA protocol and a conservative offset distance of 9 metres to the nearest railway track centerline. Details of the calculation are provided in Appendix A. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the property line, vibration mitigation will not be required. As vibration levels are acceptable, correspondingly regenerated noise levels are also expected to be acceptable.

This concludes our assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

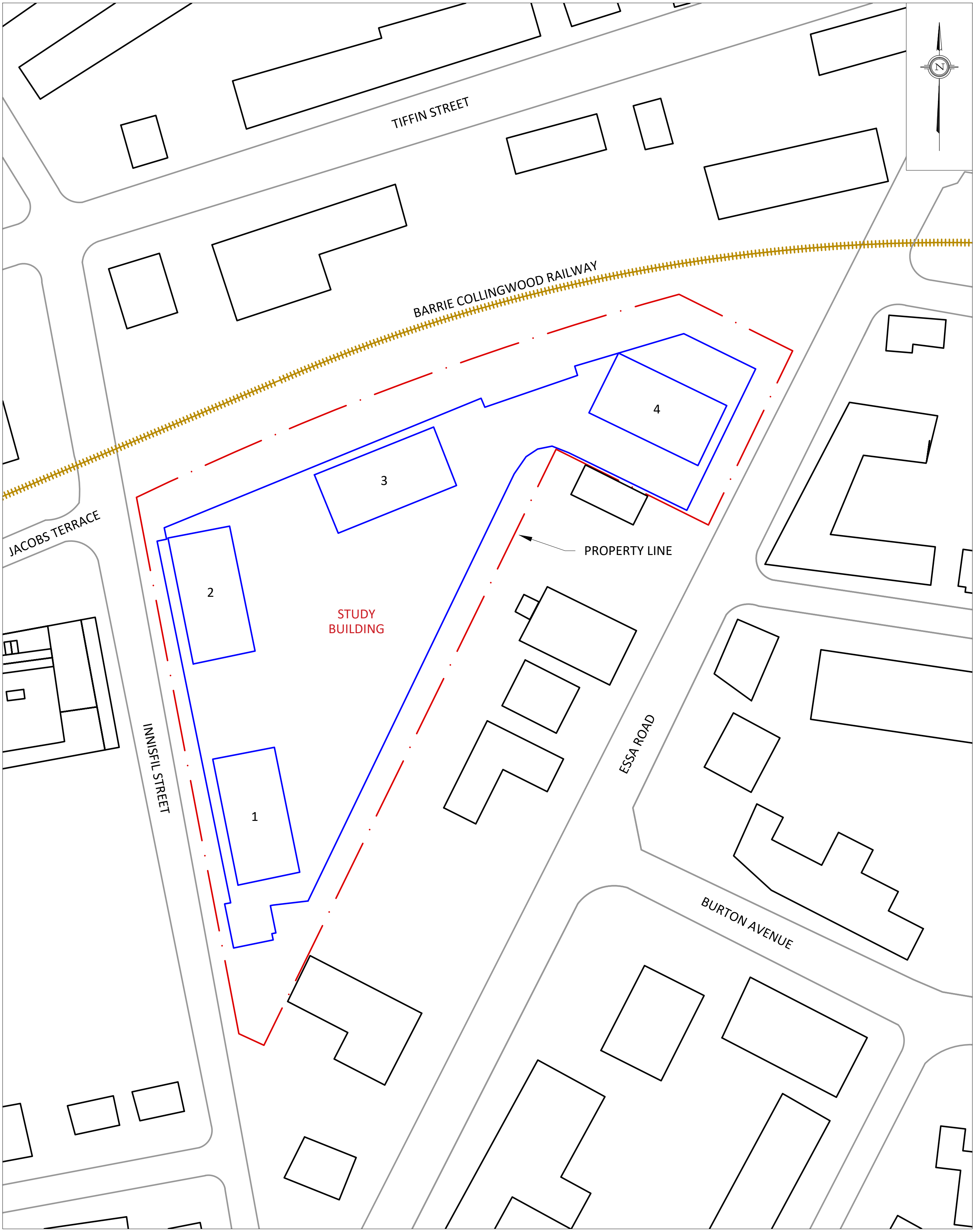
Sincerely,

Gradient Wind Engineering Inc.

Tanyon Matheson-Fitchett, B.Eng.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

GW21-138



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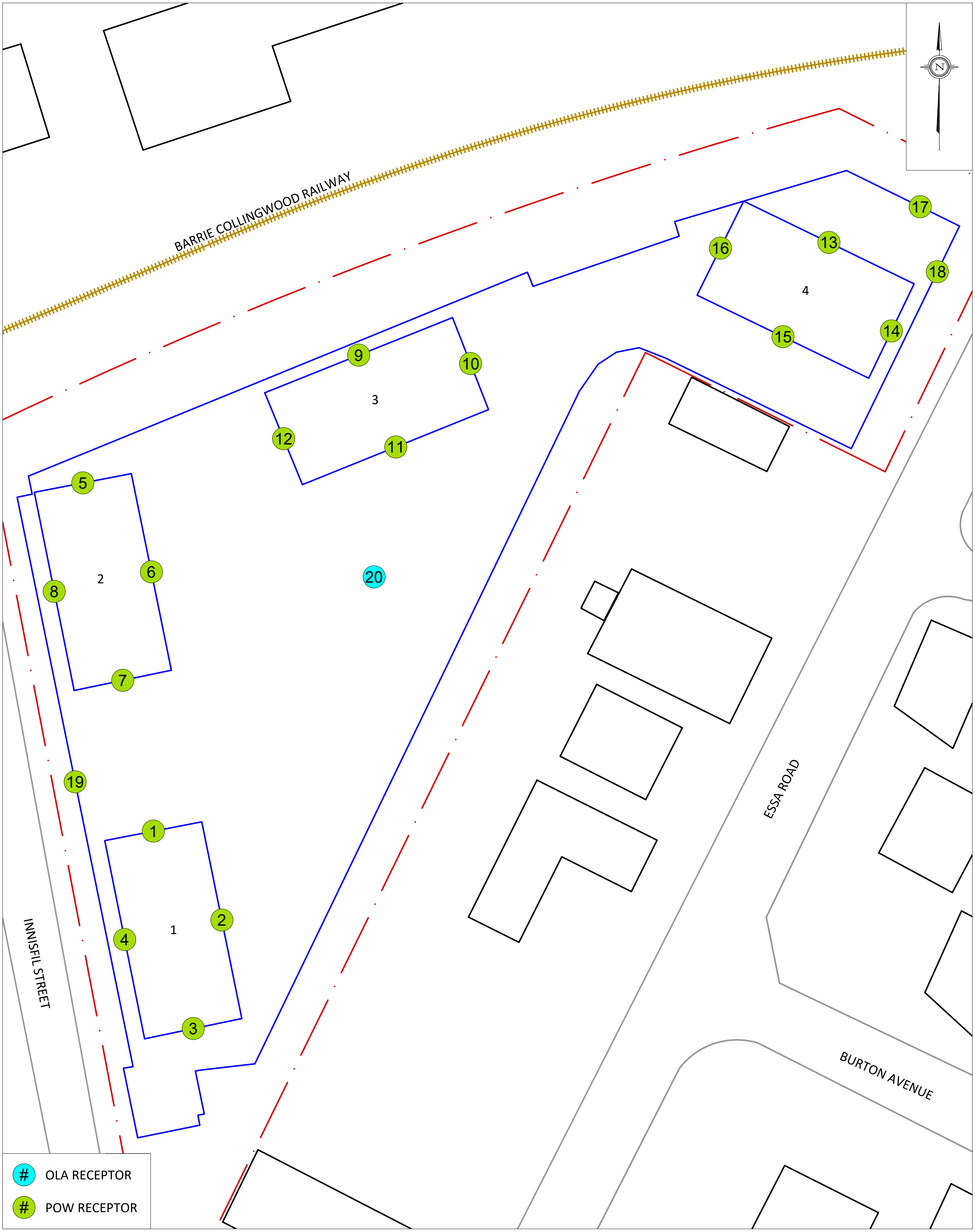
PROJECT	41-43 ESSA RD. & 259 INNISFIL ST. - BARRIE, ON ENVIRONMENTAL NOISE FEASIBILITY ASSESSMENT		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GW21-138-1
DATE	JULY 20, 2021	DRAWN BY	T.M.F.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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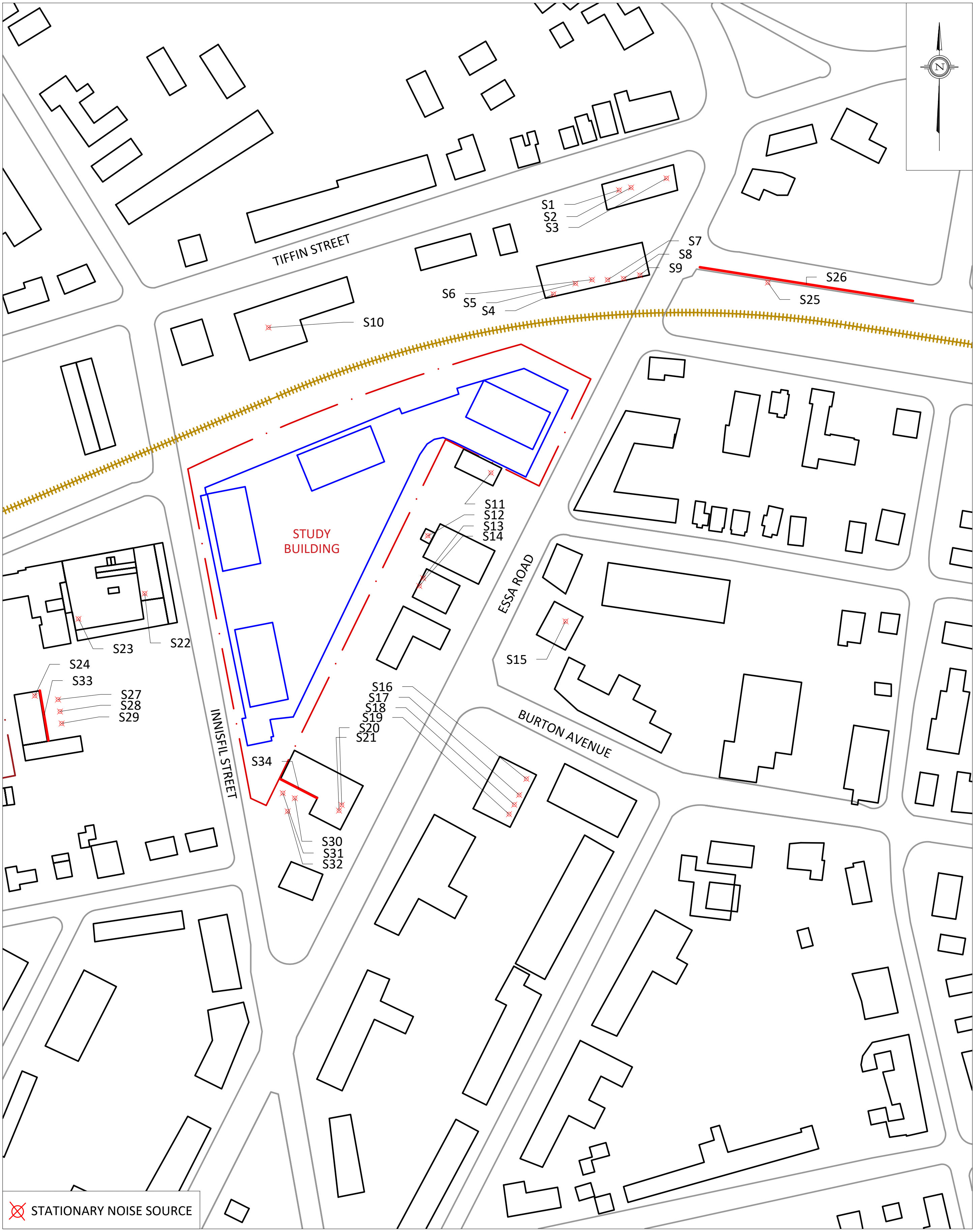
PROJECT 41-43 ESSA RD. & 259 INNISFIL ST. - BARRIE, ON ENVIRONMENTAL NOISE FEASIBILITY ASSESSMENT		DESCRIPTION FIGURE 2: RECEPTOR LOCATIONS
SCALE 1:1000 (APPROX.)	DRAWING NO. GW21-138-2	
DATE JULY 20, 2021	DRAWN BY T.M.F.	



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PROJECT	41-43 ESSA RD. & 259 INNISFIL ST. - BARRIE, ON ENVIRONMENTAL NOISE FEASIBILITY ASSESSMENT
SCALE	1:2500 (APPROX.)
DRAWING NO.	GW21-138-3
DATE	JULY 26, 2021
DRAWN BY	T.M.F.
DESCRIPTION	FIGURE 3: STATIONARY NOISE SOURCE LOCATIONS

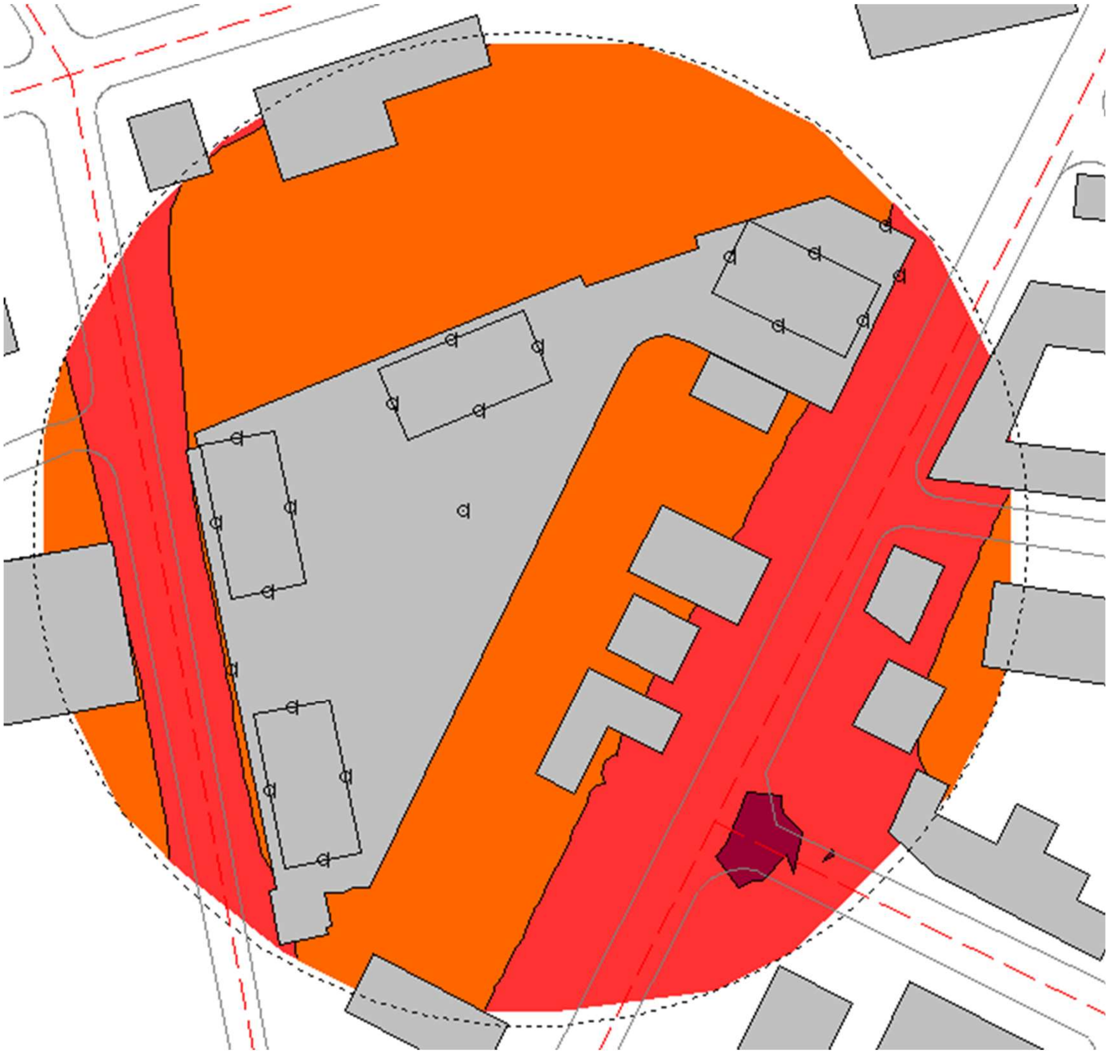


FIGURE 4: DAYTIME ROADWAY TRAFFIC NOISE CONTOURS (30 METERS ABOVE GRADE)

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB

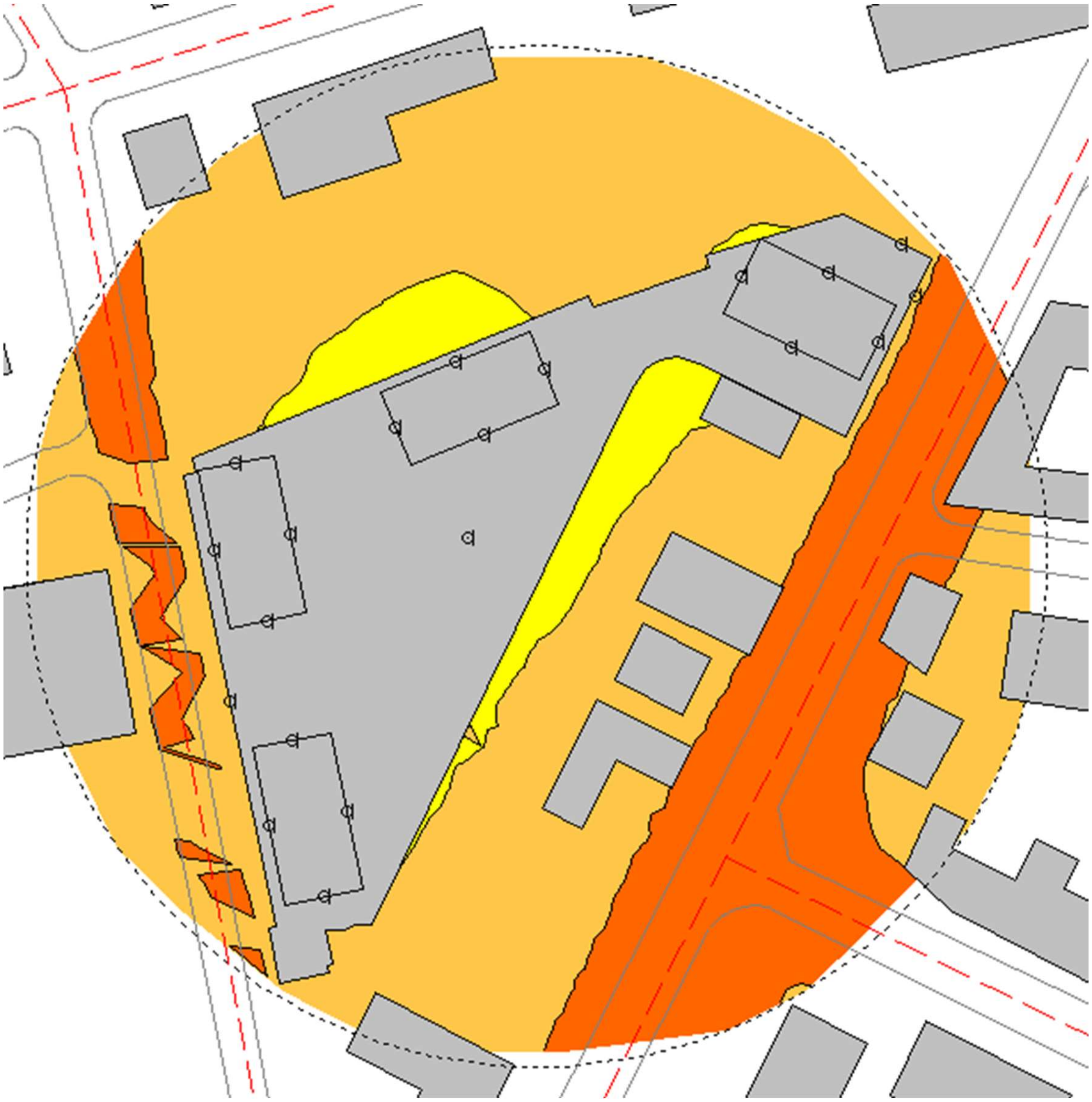


FIGURE 5: NIGHTTIME ROADWAY TRAFFIC NOISE CONTOURS (30 METERS ABOVE GRADE)

	80 – 85 dB
	75 – 80 dB
	70 – 75 dB
	65 – 70 dB
	60 – 65 dB
	55 – 60 dB
	50 – 55 dB
	45 – 50 dB
	40 – 45 dB
	35 – 40 dB
	0 – 35 dB

FIGURE 6: DAYTIME STATIONARY NOISE CONTOURS (30 METERS ABOVE GRADE)

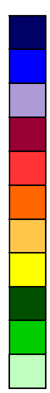
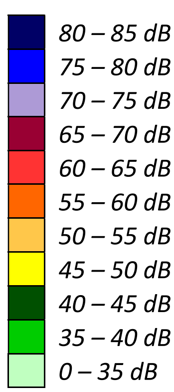
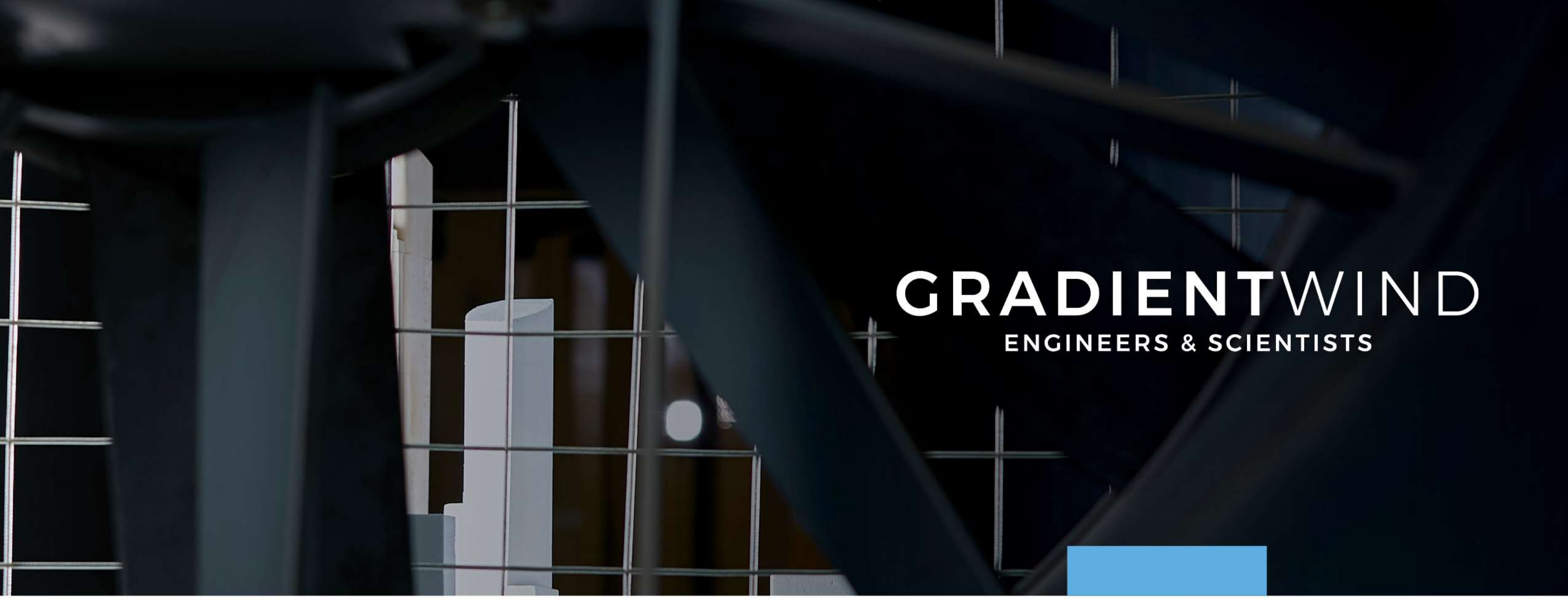
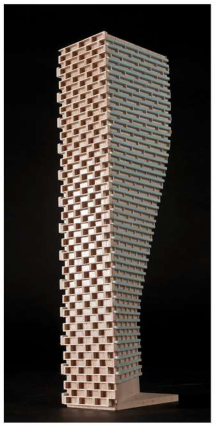
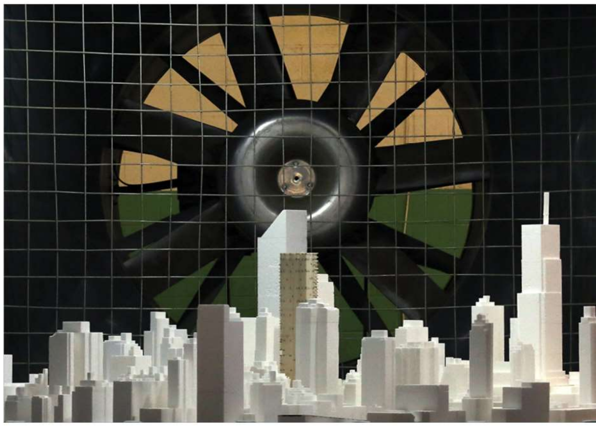


FIGURE 7: NIGHTTIME STATIONARY NOISE CONTOURS (30 METERS ABOVE GRADE)









APPENDIX A

FTA VIBRATION CALCULATIONS

GW21-138 27-Jul-21

Possible Vibration Impacts on 41-43 Essa Rd. & 259 Innisfil St.
Predicted using FTA General Assesment

Train Speed 16 km/h 10 mph

	Distance	
	(m)	(ft)
BCRY	9.0	29.5

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from tra	88.5	dBV re 1 micro in/sec	

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	-14	16 km/h (10 mph)	
Vehicle Parameters	0	Assume Soft primary suspension,	
Track Condition	0	None	Wheels run true
Track Treatments	0	None	
Type of Transit Structure	0	None	
Efficient vibration Propagation	0	None	
Vibration Levels at Ppty Line	75		0.135

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise				
Factors Affecting Vibration Source				
Source Factor	**Adjustment to Propagation Curve**			**Comment**
		Reference Speed		
Speed	Vehicle Speed	50 mph	30 mph	Vibration level is approximately proportional to 20*log(speed/speed$_{ref}$). Sometimes the variation with speed has been observed to be as low as 10 to 15 log(speed/speed$_{ref}$).
	60 mph	+1.6 dB	+6.0 dB	
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time.
Special Trackwork	+10 dB			Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track.
Jointed Track or Uneven Road Surfaces	+5 dB			Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
Track Treatments (not additive, apply greatest value only)				
Floating Slab Trackbed	-15 dB			The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration.
Ballast Mats	-10 dB			Actual reduction is strongly dependent on frequency of vibration.
High-Resilience Fasteners	-5 dB			Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz.

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise

Factors Affecting Vibration Source				
Source Factor	**Adjustment to Propagation Curve**			**Comment**
		Reference Speed		
Speed	Vehicle Speed	50 mph	30 mph	Vibration level is approximately proportional to $20*\log(speed/speed_{ref})$. Sometimes the variation with speed has been observed to be as low as 10 to 15 $\log(speed/speed_{ref})$.
	60 mph	+1.6 dB	+6.0 dB	
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time.
Special Trackwork	+10 dB			Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track.
Jointed Track or Uneven Road Surfaces	+5 dB			Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
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