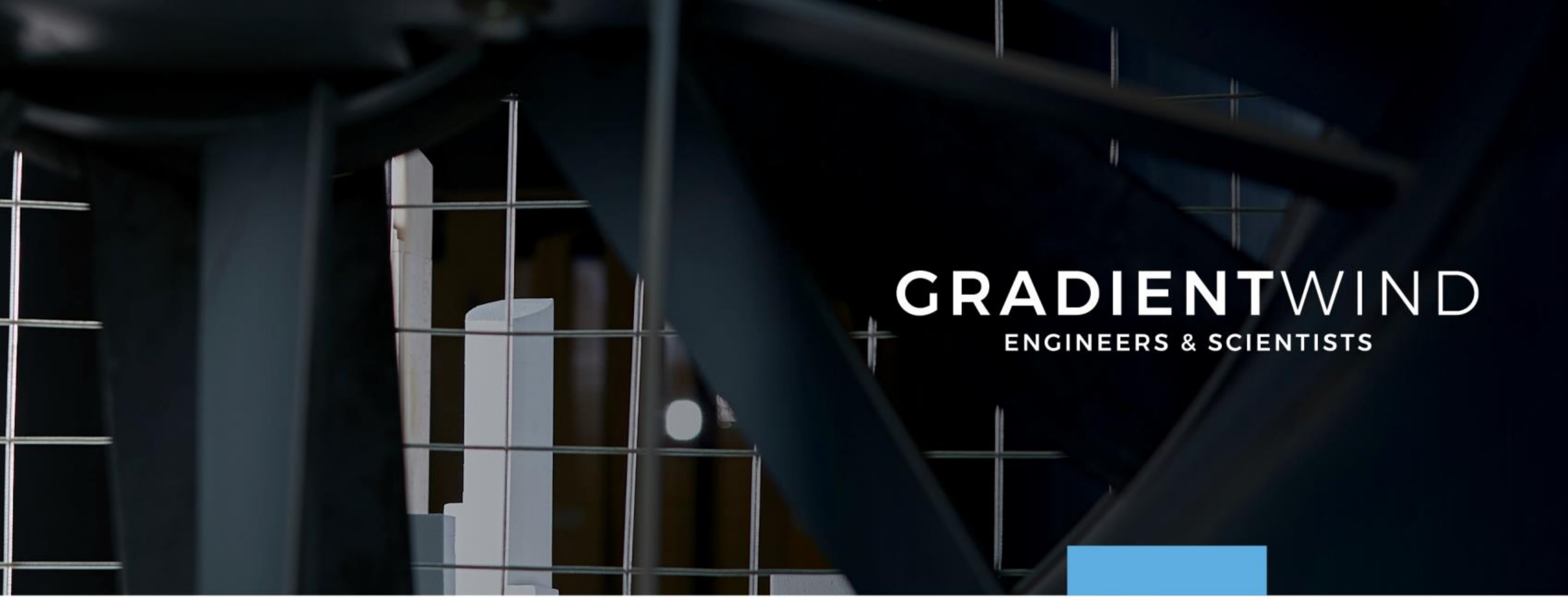
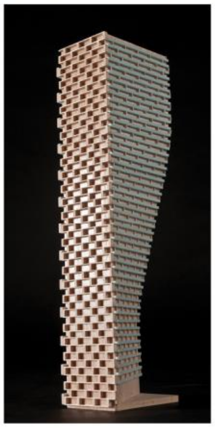
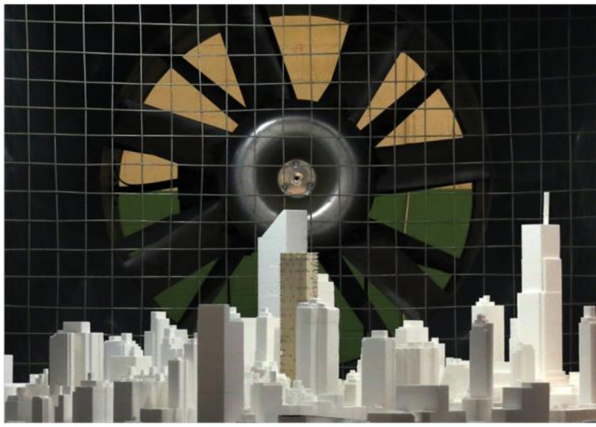


TRANSPORTATION NOISE & VIBRATION FEASIBILITY ASSESSMENT

299 Lynden Road
Brantford, Ontario

REPORT: 22-304 – Transportation Noise & Vibration Feasibility R1





October 10, 2023

PREPARED FOR
Welton & Innes GP Inc.
3700 Steeles Avenue West, Suite 800
Vaughan, Ontario
L4L 8MP

PREPARED BY
Essraa Alqassab, BASc, Junior Environmental Scientist
Joshua Foster, P.Eng., Lead Engineer

GRADIENTWIND
ENGINEERS & SCIENTISTS

EXECUTIVE SUMMARY

This document describes a transportation noise feasibility assessment performed in support of a Block Plan Application for a proposed residential subdivision development located at 299 Lynden Road in Brantford, Ontario. The study site is situated north of Lynden Road and west of the CN (Dundas subdivision) railway line. The assessment analyzes transportation noise impacts on the development to ensure that future occupants are afforded comfortable use of the outdoor and indoor living spaces, as directed by the Ministry of the Environment Conservation and Parks (MECP) NPC-300 guidelines.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP); (ii) noise level criteria as specified by the NPC-300; (iii) future vehicular traffic volumes based on the City of Brantford's Official Plan (OP) roadway classifications; and (iv) a detailed concept plan drawing provided by Sorbara Group of Companies, dated August 21, 2023. As the site plan may be subject to change, the approach undertaken in this feasibility study is to establish noise contours around the site without the consideration of site massing. The contours were then used to determine what level of noise control would be required for various areas on site.

The results of the current study indicate that noise levels due to roadway traffic and the CN rail corridor over the site will range between approximately 54 and 73 dBA during the daytime period (07:00-23:00) and between 51 and 71 dBA during the nighttime period (23:00-07:00). The highest noise levels will occur at the southeast corner of the site, at lots that are nearest and most exposed to the CN rail corridor. Upgraded building components with higher Sound Transmission Class (STC) rating will be required where noise levels exceed 60 dBA due to the railway source and 65 dBA due to the roadway source.

The results also indicate that dwellings on lots that experience noise levels above 60 dBA will require air conditioning, or a similar mechanical system, to ensure the comfort of occupants. Dwellings on lots that experience noise levels between 55-60 dBA will require forced air heating with provision for air conditioning. Finally, lots that experience noise levels that fall below 55 dBA do not require any noise mitigation.

Results of the transportation noise calculations indicate that rear yards backing onto the rail line and Lynden Road may require noise control measures. Mitigation measures are described in Section 5.2, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible.

Estimated vibration levels at the foundation nearest to the railway corridor are expected to be 0.14 mm/s RMS (75 dBV), based on the FTA protocol and an offset distance of 45 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, no vibration mitigation is required. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

A detailed transportation noise and vibration study will be required at the time of subdivision registration to determine specific noise control measures for the development.

GRADIENTWIND
ENGINEERS & SCIENTISTS

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Welton & Innes GP Inc. to undertake a transportation noise and vibration feasibility assessment of a proposed residential subdivision located at 299 Lynden Road in Brantford, Ontario. This report summarizes the methodology, results and recommendations related to transportation noise and was prepared in consideration of the client's Block Plan submission. Gradient Wind's scope of work involved assessing exterior noise levels throughout the site, generated by local roadway and railway traffic.

The report also addresses any potential noise impact mitigation measures. The assessment was performed on the basis of theoretical noise calculation methods conforming to the Ministry of the Environment, Conservation and Parks[1] (MECP) guidelines. Noise calculations were based on a detailed concept plan drawing provided by Sorbara Group of Companies in August 2023, with future traffic volumes corresponding to the City of Brantford's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this transportation noise feasibility assessment is a proposed subdivision located at 299 Lynden Road in Brantford Ontario. The site is bordered by Lynden Road to the south, CN rail corridor to the east, residential development to the west, and vacant land to the north. The development will comprise of single-family homes, townhomes, and a neighborhood park. Due to the current state of the development, the final site configuration is uncertain and may be subject to change. Therefore, the approach undertaken in this feasibility assessment was to establish noise contours around the site as per the current plans, however site massing was not considered.

The major sources of transportation noise affecting the development is Lynden Road, identified as a minor arterial in the City of Brantford's Transportation Master Plan, and the CN Dundas Subdivision. Figure 1 illustrates the site location with surrounding context.

---

[1] Ontario Ministry of the Environment and Climate Change – Publication NPC-300

3. OBJECTIVES

The principal objective of this work is to calculate the future noise levels on the study site produced by local roadway traffic and explore potential for noise mitigation where required. Noise calculations were based on a Block Plan Concept Plan provided by Welton & Innes GP Inc.Group of Companies, with future traffic volumes corresponding to the City of Brantford's OP roadway classifications.

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 dwellings. As the dominant source of noise for this development is the rail line, the NPC-300 guidelines specify that the recommended indoor noise limit range is 40 and 35 dBA for 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 35 and 32 dBA.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD/RAIL)

Type of Space	Time Period	Road Leq (dBA)	Rail Leq (dBA)
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]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[3]. 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. Where noise levels exceed 60 dBA daytime and 55 dBA nighttime, building components will require higher levels of sound attenuation[4].

Noise barriers are recommended where noise levels at the Outdoor Living Areas (OLA) exceed 55 dBA, which applies during the daytime period only (07:00 to 23:00). In all cases, noise levels shall not exceed 60 dBA, where technically and administratively feasible.

[2] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[3] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[4] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Roadway Noise Predictions

To provide a general sense of roadway traffic noise across the site, the employed software program used was *Predictor-Lima (TNM calculation)*, which incorporates the United States Federal Highway Administration's (FHWA) Transportation Noise Model (TNM) 2.5. This computer program is capable of representing three-dimensional surface and first reflections of sound waves over a suitable spectrum for human hearing. A receptor grid with 5 × 5 m spacing was placed across the study site, along with a number of discrete receptors at key sensitive areas.

Roadway noise calculations were performed by treating each road segment as separate line sources of noise. Theoretical roadway noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks.
- The day/night split was taken to be 90% / 10% respectively for all streets.
- Reflective ground (pavement) surface between sources and receivers.
- The study site was treated as having flat or gently sloping topography.
- No massing considered as potential noise screening elements.
- Twelve receptors were strategically placed throughout the study area.
- Topography modelled as provided in the grading plan.

4.2.3 Theoretical Railway Traffic Noise Predictions

When an area is influenced by road and rail traffic, the criteria requires the outdoor noise impact from each source to be examined for comparison to respective criterion. Calculations were performed for receptors in close proximity to the railway with the assistance of Predictor-Lima which utilizes ISO 9613: Parts 1 and 2 Noise Model to represent the railway line sources. The impact from railway noise is then combined with roadway predictions using a logarithmic addition at each point of reception and compared to the relevant criteria.

Similar to the roadway traffic noise calculations, the railway line was treated as a single line source of noise. Theoretical noise predictions were based on the following parameters:

- Freight trains comprise four diesel locomotives and 140 cars per train, with a speed of 60 km/h.

- Way Freight trains comprise four diesel locomotives and of 10 cars per train, with a speed of 60 km/h.
- Passenger trains comprise 2 locomotives and 10 cars per train, with a speed of 80 km/h.
- Whistle events were not considered because there are no level crossings in the area.
- Rail lines are assumed to be welded along the corridor next to the study site.
- The rail line was modelled to be in a 3m deep depression below grade.

The noise generated from both on-road and railway traffic were combined for the 12 receptor locations identified in Figure 2. The results were then confirmed by performing discrete noise calculations with the MECP computerized noise assessment program, STAMSON 5.04, at key receptor locations coinciding with receptor locations in Predictor as shown in Figure 2.

4.2.4 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 are based on the roadway classifications outlined in the City of Brantford Transportation Master Plan (TMP), which provides additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on theoretical capacities for each roadway classification. Table 2 (below) summarizes the AADT values used for the roadway included in this assessment. Railway traffic volumes are based on the best available information obtained from the rail authority, projected at 2.5% annual growth to 2032 to account for future growth.

TABLE 1: TRANSPORTATION TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Lynden Road	4-Lane Minor Arterial	60	**12,000**
CN Dundas Subdivision	Freight	60	**19/6***
	Way Freight	60	**8/4***
	Passenger	80	**12/1***

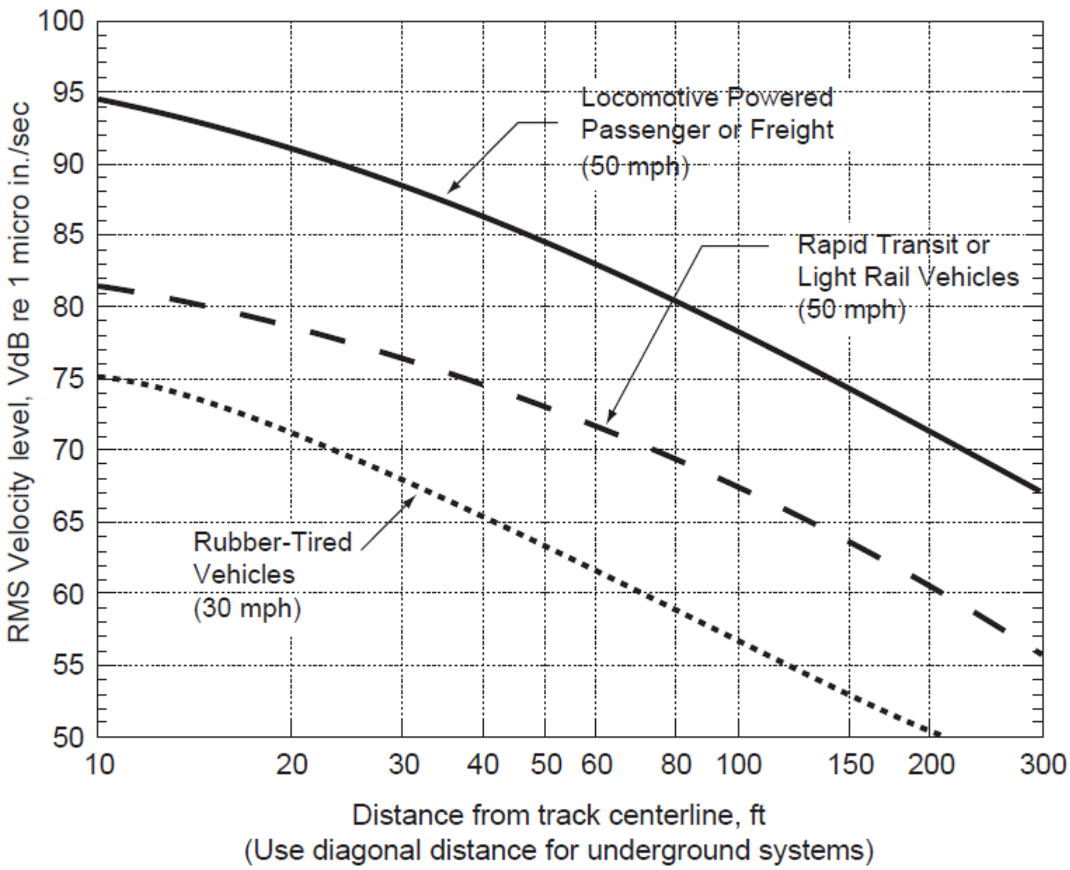
4.3 Ground Vibration Criteria

In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by the MECP. For main line railways, a document titled *Guidelines for New Development in Proximity to Railway Operations*[5], indicates 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 dwelling. The Federal Transportation Authority (FTA) criterion was adopted as the appropriate standard for this study.

4.4 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*[6] 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/Freight at a speed of 50 mph. Adjustment factors were considered based on the following information:

- The maximum operating speed of the rail line is 80 km/h (50 mph).
- The conservative offset distance between the development and the closest track is 45 m. This is based on a 30m offset distance between the first row of dwellings closest to the property line, and a 15m distance between the property line and the track centerline.
- The vehicles are assumed to have soft primary suspensions.
- Tracks are welded and in good condition.
- Soil conditions do not efficiently propagate vibrations.
- Type of transit structure is Cut.
- The building's foundation coupling is Wood Frame houses.



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 for the daytime and nighttime periods, covering the entire study site, are shown below in Table 2 with noise contours illustrated in Figures 3, 4, and 5. Discrete receptors were placed 4.5 m above ground level at key locations throughout the site. Receptors 1-3 are placed at the southwest corner, 4-5 at the northwest corner, 8-9,11 and 12 are located near the southeast corner, and receptor 10 at the northeast corner. Results indicate that noise level will vary between 73 and 54 dBA during the daytime and between 51 and 71 dBA during the nighttime periods.

TABLE 2: EXTERIOR NOISE LEVELS (PREDICTOR-LIMA)

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Roadway Noise Level (dBA)		Railway Noise Level (dBA)		Total Noise Level (dBA)	
			Day	Night	Day	Night	Day	Night
1	4.5	POW – Southwest corner	64	58	57	55	65	60
2	4.5	POW –Southwest corner	49	43	57	54	58	54
3	4.5	POW –Southwest corner	48	42	57	54	58	54
4	4.5	POW –Northwest corner	38	31	54	51	54	51
5	4.5	POW –Northwest corner	37	31	57	54	57	54
6	4.5	POW –Northwest corner	39	33	57	55	57	55
7	4.5	POW –Southeast corner	40	34	58	56	58	56
8	4.5	POW –Southeast corner	40	34	61	58	61	58
9	4.5	POW –Southeast corner	41	34	62	60	62	60
10	4.5	POW –Northeast corner	38	31	61	58	61	58
11	4.5	POW –Southeast corner	36	29	67	65	67	65
12	4.5	POW –Southeast corner	34	28	73	71	73	71

Table 3 shows a comparison in results between Predictor-Lima and STAMSON 5.04. Noise levels calculated in STAMSON were found to have a good correlation with Predictor-Lima and variability between the two programs was within an acceptable limit of ±0-3 dBA. Sample calculations are presented in Appendix A.

TABLE 3: COMPARISON BETWEEN PREDICTOR-LIMA AND STAMSON 5.04 RESULTS

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	PREDICTOR LIMA-Total Noise Level (dBA)		STAMSON 5.04-Total Noise Level (dBA)	
			Day	Night	Day	Night
11	4.5	POW –Southeast corner	67	65	67	65
12	4.5	POW –Southeast corner	73	71	72	70

5.2 Noise Control Measures

As noise levels exceed the 60 dBA noise criterion due to railway noise, the lots situated along the east boundary of the development will require upgraded building components with higher Sound Transmission Class (STC) Rating. Furthermore, lots/blocks that experience noise levels above 60 (dark and light red in Figure 3) will require air conditioning, or a similar mechanical system, to ensure the comfort of occupants. Dwellings on lots that experience noise levels between 55-60 dBA (dark orange in Figure 3) will require forced air heating with provision for air conditioning. Finally, lots that experience noise levels that fall below 55 dBA (light orange and yellow in Figure 3) will not have ventilation requirements for noise mitigation purposes. Ventilation and Warning Clause requirements are shown in Figure 6.

The OLA noise levels predicted due to roadway traffic, at a number of receptors, exceed the criteria listed in the NPC-300 for outdoor living areas, as discussed in Section 4.2. Therefore, noise control measures as described below will be required to reduce the L_{eq} to 55 dBA:

- Distance setback with soft ground
- Insertion of noise insensitive land uses between the source and sensitive points of reception
- Orientation of buildings to provide sheltered zones in rear yards
- Shared outdoor amenity areas
- Earth berms (sound barriers)

- Acoustic barriers

Examining the noise control measures listed above, these conclusions consider the possibility that not all of the proposed buildings will be oriented to provide screening elements for their OLA against roadway or railway sources. Distance setback, insertion of non-noise sensitive land uses, and building orientation to provide sheltered zones in rear yards may not be feasible due to the requirements of the Community Development Plan. It is also not feasible to have shared outdoor amenity areas for this development with respect to rear yards, as this would have a significant impact on marketability. Therefore, the most feasible measures are insertion of earth berms or acoustic wall barriers between the sensitive rear yards and sources of noise, as mentioned in Section 5.1. Potential noise barrier locations are noted in Figure 7.

5.3 Ground Vibrations and Ground-Borne Noise Levels

Estimated vibration levels at the foundation nearest to the CN Dundas Subdivision are expected to be 0.14 mm/s RMS (75 dBV), based on the FTA protocol and an offset distance of 45 m to the nearest 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 foundation, concerns due to vibration impacts on the site are not expected. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels due to roadway traffic and the CN rail corridor over the site will range between approximately 54 and 73 dBA during the daytime period (07:00-23:00) and between 51 and 71 dBA during the nighttime period (23:00-07:00). The highest noise levels will occur along the east of the development, nearest and most exposed to the CN Dundas Subdivision. Noise contours 4.5m above grade are shown in Figures 3 and 4 for the daytime/nighttime periods, respectively. Noise contours at ground level during the daytime are shown in Figure 5. Upgraded building components with higher Sound Transmission Class (STC) rating will be required where noise levels exceed 60 dBA due to the rail source and 65 dBA due to the roadway traffic.

Results also indicate that developments experiencing noise levels above 60 (dark and light red in Figure 3) will require air conditioning, or a similar mechanical system, to ensure the comfort of occupants.

Dwellings on lots that experience noise levels between 55-60 dBA (dark orange in Figure 3) will require forced air heating with provision for air conditioning. Finally, lots that experience noise levels that fall below 55dBA (light orange and yellow in Figure 3) will not have ventilation requirements for noise mitigation purposes. Ventilation and Warning Clause requirements can be found in Figure 6.

According to Table 2, the lots orientated south and east of the site will likely require noise barriers along the edge of the rear yards, which are closest and most exposed to either Lynden Road or the CN Dundas Subdivision. The potential locations of the noise barriers for the affected lots/blocks are presented in Figure 7. Massing elements (houses / townhomes) along the edge of the site are expected block direct line of sight of the roadway and the rail line at a majority of OLAs and act as noise barriers, reducing the sound experienced at the lots situated further away.

Estimated vibration levels at the foundation nearest to the railway corridor are expected to be 0.14 mm/s RMS (75 dBV), based on the FTA protocol and an offset distance of 45 m to the nearest track centerline. Details of the calculation are provided in Appendix B. Since predicted vibration levels do not exceed the criterion of 0.14 mm/s RMS at the foundation, no vibration mitigation is required. As vibration levels are acceptable, correspondingly, regenerated noise levels are also expected to be acceptable.

A detailed transportation noise study will be required at the time of subdivision registration to determine specific noise control measures for the development.

This concludes our transportation noise feasibility 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,

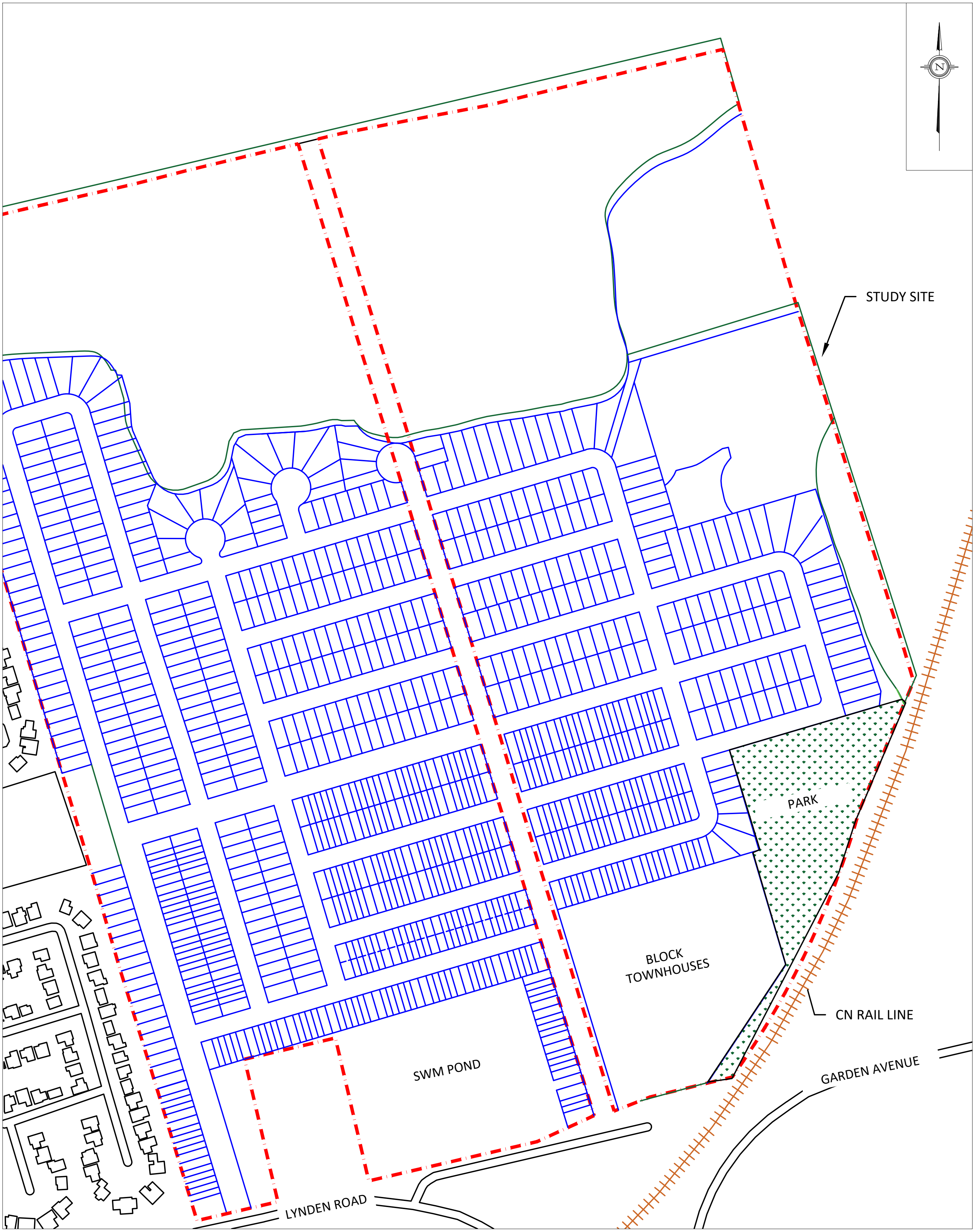
Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Oct 10, 2023
PROVINCE OF ONTARIO

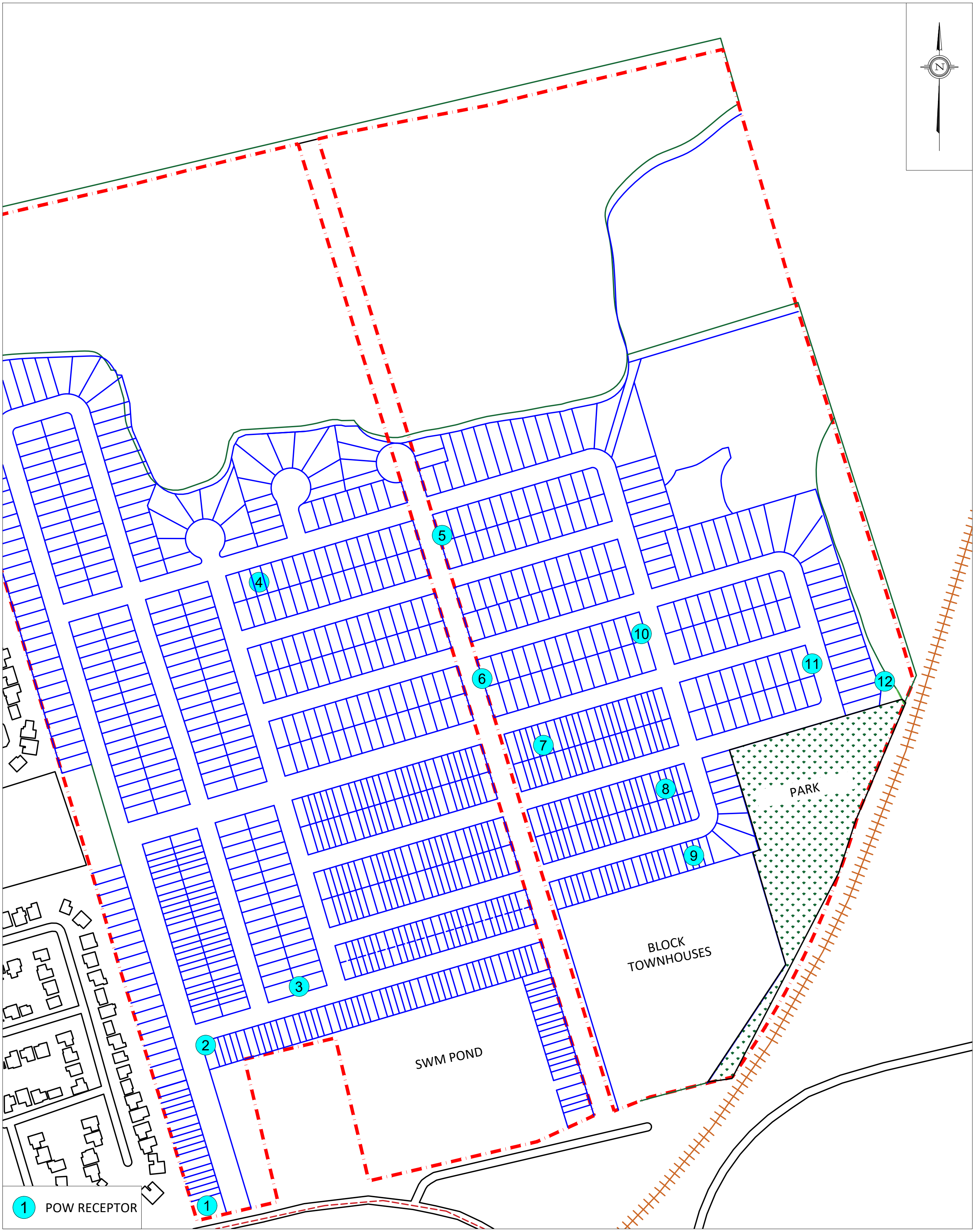
Essraa Alqassab, BASc
Junior Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #22-304 – Transportation Noise & Vibration Feasibility



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 299 LYNDEN ROAD, BRANTFORD TRANSPORTATION NOISE FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
	SCALE: 1:5000 (APPROX.)	DRAWING NO.: GW22-304-1	
	DATE: SEPTEMBER 26, 2023	DRAWN BY: E.A.	



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 299 LYNDEN ROAD, BRANTFORD TRANSPORTATION NOISE FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 2: RECEPTOR LOCATIONS
	SCALE: 1:5000 (APPROX.)	DRAWING NO.: GW22-304-2	
	DATE: SEPTEMBER 26, 2023	DRAWN BY: E.A.	

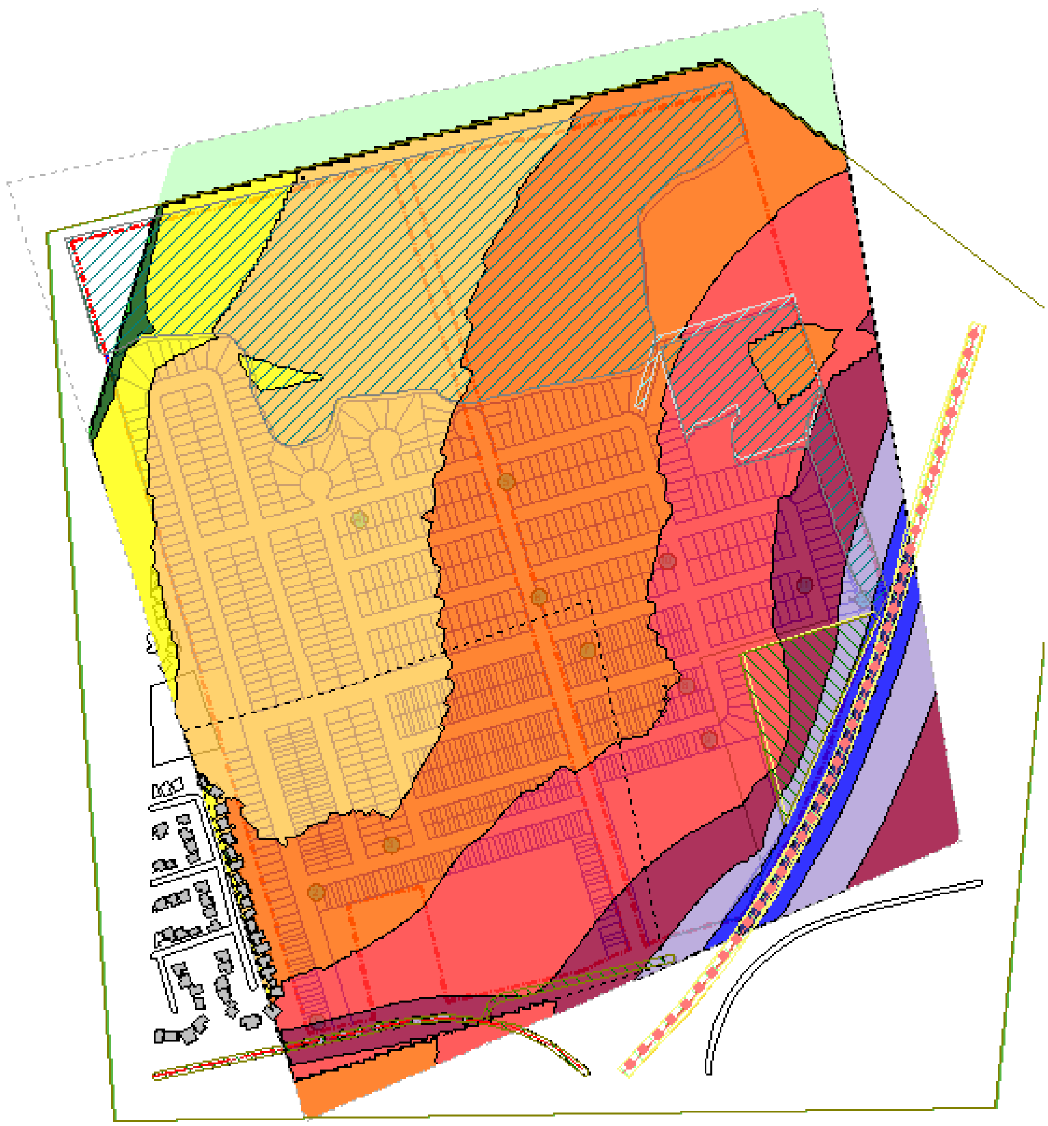
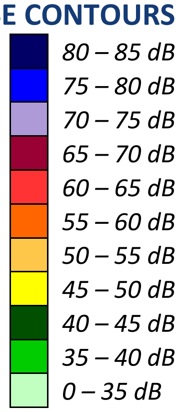


FIGURE 3: 4.5M HIGH NOISE CONTOURS FOR THE SITE (DAYTIME PERIOD)



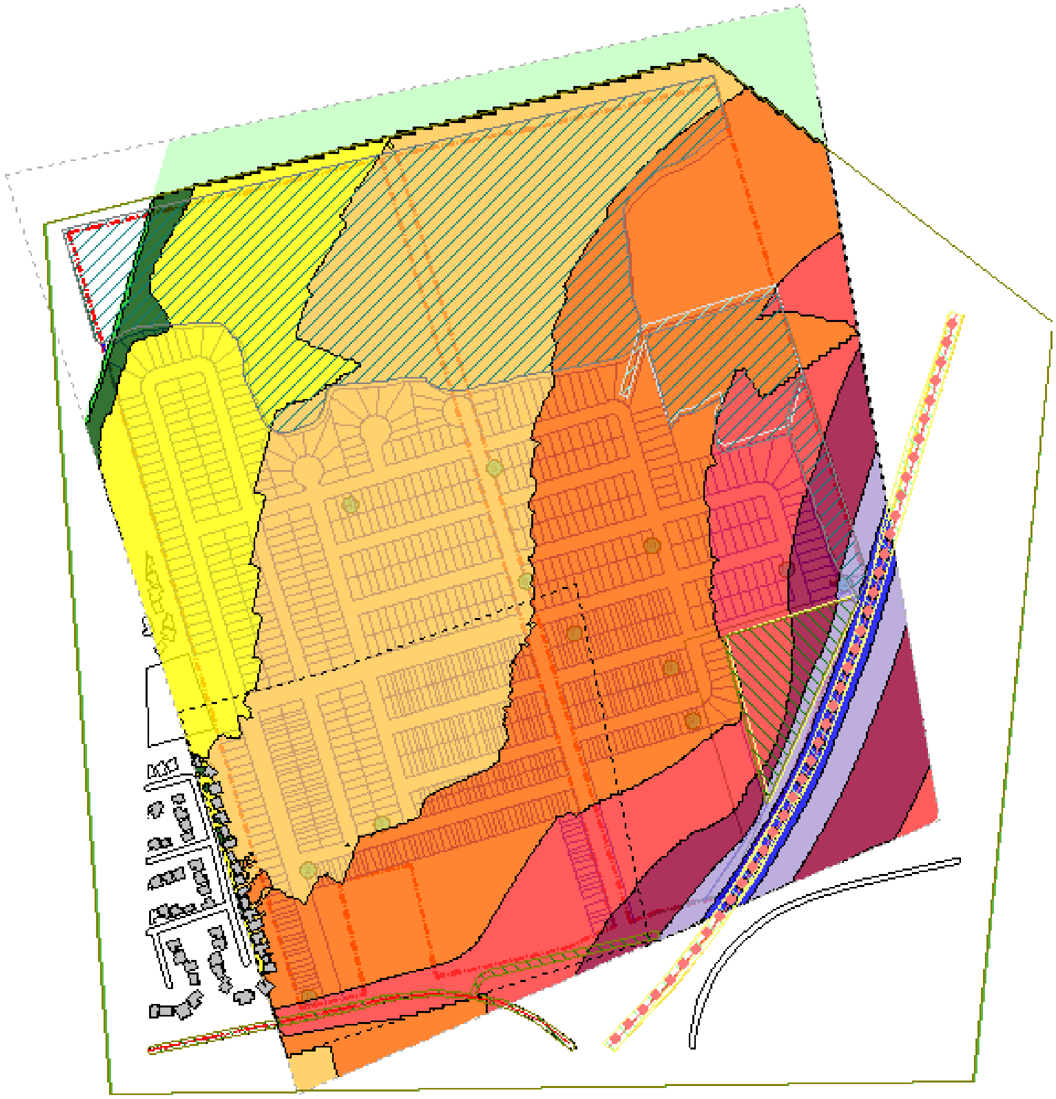
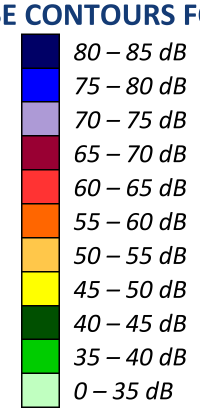


FIGURE 4: 4.5 M HIGH NOISE CONTOURS FOR THE SITE (NIGHTTIME PERIOD)



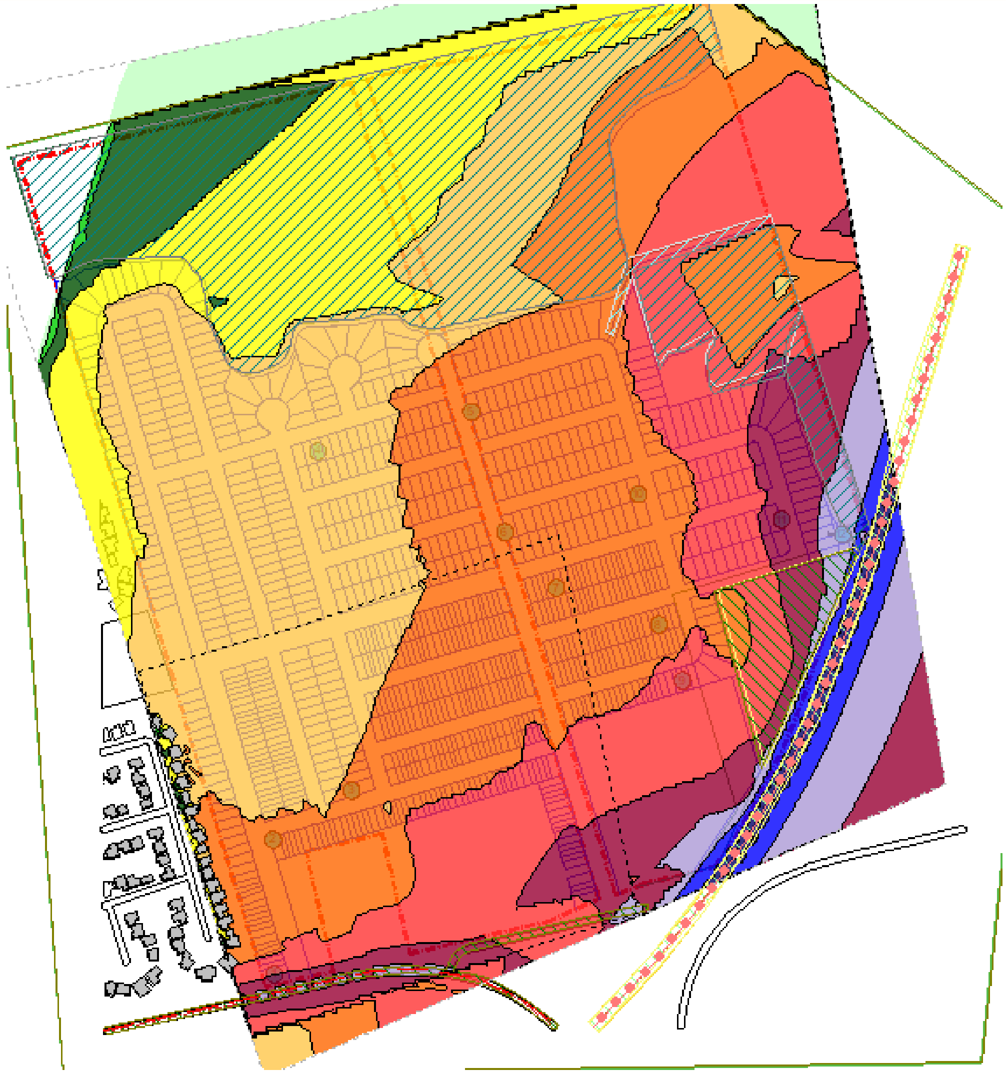
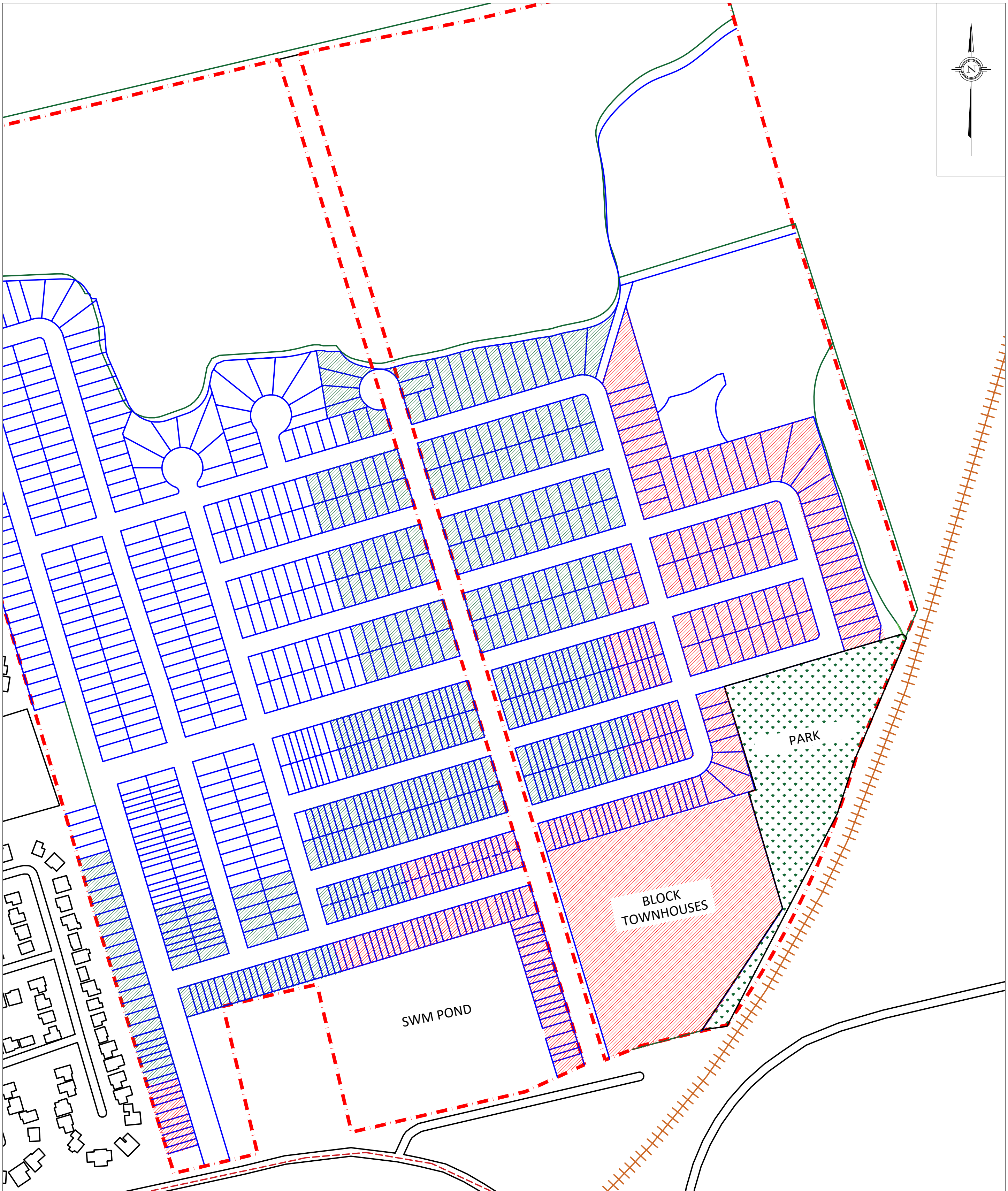


FIGURE 5: GROUND LEVEL NOISE CONTOURS FOR THE SITE (DAYTIME PERIOD)

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



AIR CONDITIONING AND WARNING CLAUSE TYPE D

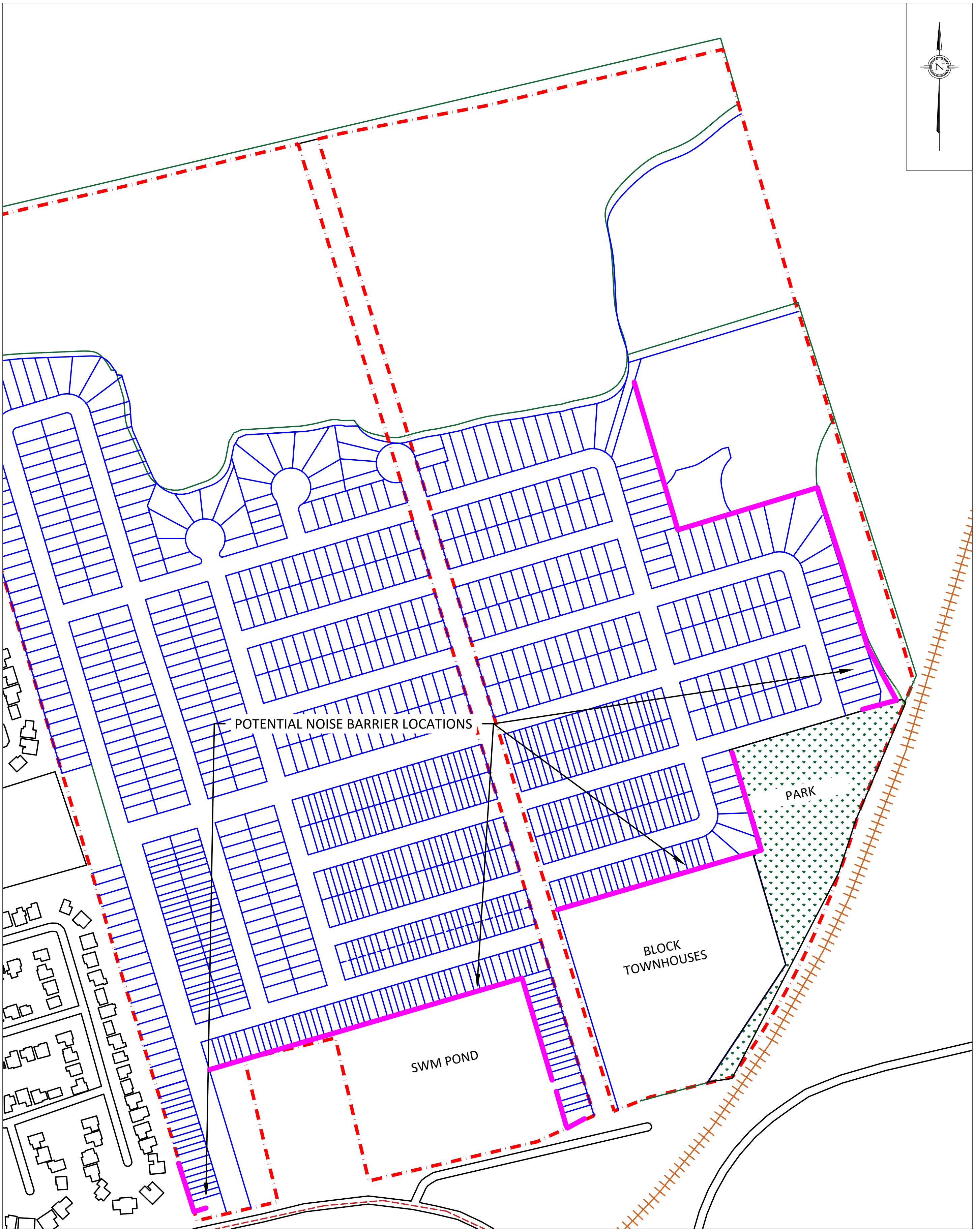
FORCED AIR HEATING WITH PROVISIONS AND WARNING CLAUSE TYPE C

GRADIENTWIND
ENGINEERS & SCIENTISTS
127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	299 LYNDEN ROAD, BRANTFORD TRANSPORTATION NOISE FEASIBILITY ASSESSMENT		
SCALE	1:5000 (APPROX.)	DRAWING NO.	GW22-304-6
DATE	SEPTEMBER 26, 2023	DRAWN BY	E.A.

DESCRIPTION

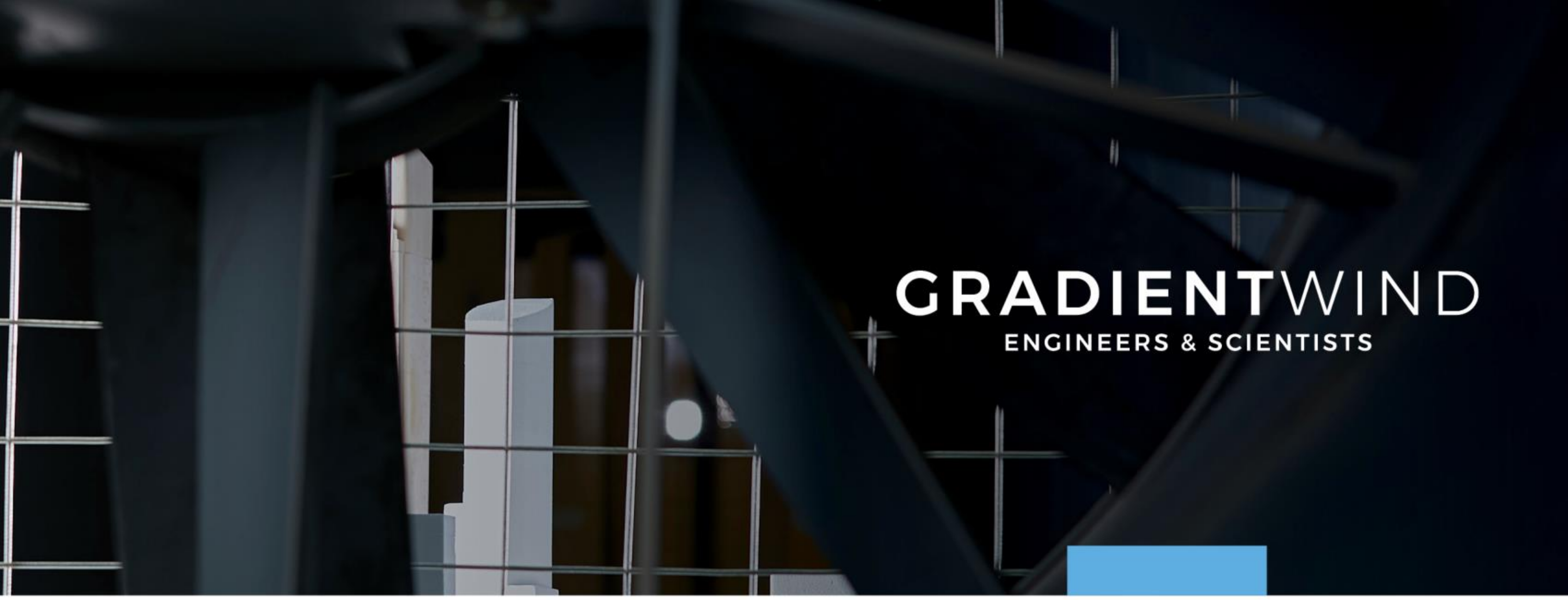
FIGURE 6:
VENTILATION/WARNING CLAUSE REQUIREMENTS

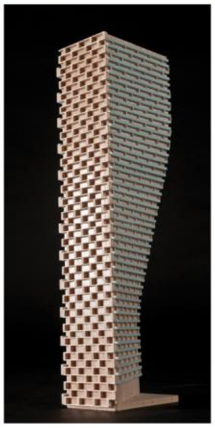


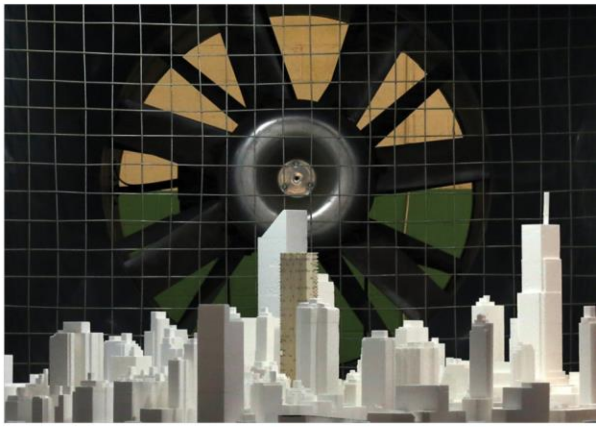
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	299 LYNDEN ROAD, BRANTFORD TRANSPORTATION NOISE FEASIBILITY ASSESSMENT			DESCRIPTION
SCALE	1:5000 (APPROX.)	DRAWING NO.	GW22-304-7	FIGURE 7: POTENTIAL NOISE BARRIER LOCATIONS
DATE	SEPTEMBER 26, 2023	DRAWN BY	E.A.	







APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

```
STAMSON 5.0        NORMAL REPORT        Date: 26-09-2023 15:38:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11.te                Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: Rail (day/night)
----------------------------------------
Train            ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type             !              !(km/h) !/Train!/Train! type !weld
-----------------+--------------+-------+------+------+------+----
  1. Freight     !  19.0/6.0    !  60.0 !  4.0 !140.0 !Diesel! Yes
  2. Way Freight !   8.0/4.0    !  60.0 !  4.0 ! 25.0 !Diesel! Yes
  3. Passenger   !  12.0/1.0    !  80.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 1: Rail (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 112.50 / 112.50 m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00


Results segment # 1: Rail (day)
-------------------------------

LOCOMOTIVE (0.00 + 66.48 + 0.00) = 66.48 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  75.23  -8.75   0.00   0.00   0.00   0.00  66.48
----------------------------------------------------------------------

WHEEL (0.00 + 59.07 + 0.00) = 59.07 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  67.82  -8.75   0.00   0.00   0.00   0.00  59.07
----------------------------------------------------------------------

Segment Leq : 67.20 dBA

Total Leq All Segments: 67.20 dBA


Results segment # 1: Rail (night)
---------------------------------
```

```
LOCOMOTIVE (0.00 + 64.39 + 0.00) = 64.39 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  73.14  -8.75   0.00   0.00   0.00   0.00  64.39
----------------------------------------------------------------------

WHEEL (0.00 + 57.03 + 0.00) = 57.03 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  65.78  -8.75   0.00   0.00   0.00   0.00  57.03
----------------------------------------------------------------------

Segment Leq : 65.12 dBA

Total Leq All Segments: 65.12 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.20
                         (NIGHT): 65.12
```

```
STAMSON 5.0        NORMAL REPORT        Date: 26-09-2023 14:36:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12.te              Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: Rail (day/night)
----------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. Freight     !  19.0/6.0   !  60.0 !  4.0 !140.0 !Diesel! Yes
  2. Way Freight !   8.0/4.0   !  60.0 !  4.0 ! 25.0 !Diesel! Yes
  3. Passenger   !  12.0/1.0   !  80.0 !  2.0 ! 10.0 !Diesel! Yes

Data for Segment # 1: Rail (day/night)
--------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  39.00 / 39.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00


Results segment # 1: Rail (day)
-------------------------------

LOCOMOTIVE (0.00 + 71.08 + 0.00) = 71.08 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  75.23  -4.15   0.00   0.00   0.00   0.00  71.08
----------------------------------------------------------------------

WHEEL (0.00 + 63.67 + 0.00) = 63.67 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  67.82  -4.15   0.00   0.00   0.00   0.00  63.67
----------------------------------------------------------------------

Segment Leq : 71.80 dBA

Total Leq All Segments: 71.80 dBA


Results segment # 1: Rail (night)
---------------------------------
```

```
LOCOMOTIVE (0.00 + 68.99 + 0.00) = 68.99 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  73.14  -4.15   0.00   0.00   0.00   0.00  68.99
----------------------------------------------------------------------

WHEEL (0.00 + 61.63 + 0.00) = 61.63 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  65.78  -4.15   0.00   0.00   0.00   0.00  61.63
----------------------------------------------------------------------

Segment Leq : 69.72 dBA

Total Leq All Segments: 69.72 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 71.80
                         (NIGHT): 69.72
```

APPENDIX B

FTA VIBRATION CALCULATIONS

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

GWE22-304 21-Oct-22

Possible Vibration Impacts on 299 Lynden Road
Perdicted using FTA General Assesment

Train Speed 80 km/h 50 mph

	Distance from C/L	
	(m)	(ft)
Rail	45.0	147.6

Vibration

From FTA Manual Fig 10-1

Vibration Levels at distance from track	74	dBV re 1 micro in/sec

Adjustment Factors FTA Table 10-1

Speed reference 50 mph	0	Operating speed 43 mph	
Vehicle Parameters	0	Assume Soft primary suspension, Weels run true	
Track Condition	0	None	
Track Treatments	0	None	
Type of Transit Structure	0	Open Cut	
Efficient vibration Propagation	0	Propogation through rock	
Vibration Levels at Fdn	74		0.127
Coupling to Building Foundation	-5	Wood frame houses	
Floor to Floor Attenuation	0.0	Ground Floor occupied	
Amplification of Floor and Walls	6		
Total Vibration Level	75	dBV or	0.143 mm/s
Noise Level in dBA	40	dBA	

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 (Continued)		
Factors Affecting Vibration Path		
Path Factor	**Adjustment to Propagation Curve**	**Comment**
Resiliently Supported Ties	-10 dB	Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Configuration (not additive, apply greatest value only)		
Type of Transit Structure	Relative to at-grade tie & ballast: Elevated structure -10 dB Open cut 0 dB	The general rule is the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration.
	Relative to bored subway tunnel in soil: Station -5 dB Cut and cover -3 dB Rock-based - 15 dB	
Ground-borne Propagation Effects		
Geologic conditions that promote efficient vibration propagation	Efficient propagation in soil +10 dB	Refer to the text for guidance on identifying areas where efficient propagation is possible.
	Propagation in rock layer — **Dist.** / **Adjust.** 50 ft +2 dB 100 ft +4 dB 150 ft +6 dB 200 ft +9 dB	The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source.
Coupling to building foundation	Wood Frame Houses -5 dB 1-2 Story Masonry -7 dB 3-4 Story Masonry -10 dB Large Masonry on Piles -10 dB Large Masonry on Spread Footings -13 dB Foundation in Rock 0 dB	The general rule is the heavier the building construction, the greater the coupling loss.
Factors Affecting Vibration Receiver		
Receiver Factor	**Adjustment to Propagation Curve**	**Comment**
Floor-to-floor attenuation	1 to 5 floors above grade: -2 dB/floor 5 to 10 floors above grade: -1 dB/floor	This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building.
Amplification due to resonances of floors, walls, and ceilings	+6 dB	The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections.
Conversion to Ground-borne Noise		
Noise Level in dBA	Peak frequency of ground vibration: Low frequency (<30 Hz): -50 dB Typical (peak 30 to 60 Hz): -35 dB High frequency (>60 Hz): -20 dB	Use these adjustments to estimate the A-weighted sound level given the average vibration velocity level of the room surfaces. See text for guidelines for selecting low, typical or high frequency characteristics. Use the high-frequency adjustment for subway tunnels in rock or if the dominant frequencies of the vibration spectrum are known to be 60 Hz or greater.