HGC ENGINEERING

Howe Gastmeier Chapnik Limited
2000 Argentia Road, Plaza One, Suite 203
Mississauga, Ontario, Canada L5N 1P7
t: 905.826.4044

Noise and Vibration Feasibility Study
Proposed Residential Development
1335 – 1355 Plains Road East
Burlington, Ontario

Prepared for:

DVLP Property Group Inc.
1 Kawana Rd
Brampton, Ontario, L6Y 0N1



Prepared by

Victor Garcia, PEng

Reviewed by

Sheeba Paul, MEng, PEng

November 30, 2017

Table of Contents

1 Introduction and Summary 1

2 Site Description and Sources of Sound 2

3 Criteria for Acceptable Sound Levels 2

3.1 Ground-borne Vibration from Rail Traffic 4

4 Traffic Sound Level Assessment 4

4.1 Road Traffic Data 4

4.2 Rail Traffic Data 5

4.3 Road and Rail Traffic Noise Predictions 6

5 Traffic Noise Recommendations 7

5.1 Outdoor Living Areas 7

5.2 Indoor Living Areas 7

5.3 Building Façade Constructions 8

5.4 Rail Vibration Impact 9

5.5 Warning Clauses 10

6 Summary and Recommendations 11

6.1 Implementation 13

Figure 1: Key Plan
Figure 2: Proposed Site Plan Showing Prediction Locations
Figure 3: Proposed Site Plan Showing Ventilation and Brick Exterior Façade Requirements
Figure 4-9a: Pass-bys: Measured Vibratory Velocity Level
Figure 4-9b: Pass-bys: Acceleration Spectrum @ Peak Level (1 sec. Duration)

Appendix A: CN Principal Main Line Requirements
Appendix B: Road Traffic Data
Appendix C: Rail Traffic Data
Appendix D: Sample STAMSON 5.04 Output

1 Introduction and Summary

HGC Engineering was retained by DVLP Property Group Inc. to conduct a noise and vibration feasibility study for their proposed residential development to be located at 1335 – 1355 Plains Road East in Burlington, Ontario. The development will include three 3-storey townhouse blocks along with associated roadways. The study is required by the municipality as part of their planning and approvals process, specifically for rezoning of the lands.

The primary sources of noise in the area are rail traffic on the Canadian National (CN) railway to the south and road traffic data on Plains Road East. Road traffic data on the Queen Elizabeth Way (QEW) is a secondary source of noise. Rail traffic data for the CN railway was obtained from CN railway and Metrolinx personnel. Road traffic data for Plains Road East and the QEW were obtained from the City of Burlington and the Ministry of Transportation (MTO) respectively. The data was used to predict future traffic sound levels at various locations of the development. The predicted sound levels were compared to the guidelines of the Ministry of Environment and Climate Change (MOECC), Region of Halton and the City of Burlington.

The sound level predictions indicate that the future road and rail traffic sound levels will exceed MOECC guidelines in the proposed development. A 2.5 m high acoustic barrier is required for the common amenity space. Central air conditioning is required for all of the dwellings in the proposed development. Brick exterior construction is required for the façades of the proposed dwellings with exposure to the railway. Upgraded glazing constructions are required for all of the dwellings in the proposed development. The MOECC guidelines recommend that warning clauses be used to inform future residents of the traffic noise, the presence of nearby commercial facilities and to address sound level excesses.

2 Site Description and Sources of Sound

Figure 1 is a key plan showing the location of the proposed development. The development is located at 1335 – 1355 Plains Road East in Burlington, Ontario. Figure 2 is a proposed site plan prepared by Chamberlain Architect Services Limited last revised November 28, 2017. The proposed development will consist of three blocks of 3-storey townhouses along with associated roadways.

A site visit was made by HGC Engineering personnel on October 12, 2017, to make observations of the acoustical environment and to perform ground-borne vibration measurements. During the site visit, it was observed that the CN railway to the south and Plains Road East are primary sources of noise. The QEW is located approximately 700 m to the northwest and is a secondary source of noise which may impact the third floors. Lands to the north and west are existing residential. To the east and the south of the site are commercial lands including, Riz Tires & Lube Centre, City Tire Burlington, B&G Roofing and GEM Autos. Further to the east are other automotive repair facilities. On the south side of the railway are industrially zoned lands. There are existing residential dwellings closer to these lands than the subject site. Sounds from these sources were not audible at the site during the site visit due to significant traffic sounds from Plains Road East, however a warning clause is included in Section 5.6 to inform the occupants of the presence of the nearby commercial facilities.

3 Criteria for Acceptable Sound Levels

Guidelines for acceptable levels of road and rail traffic noise impacting residential developments are given in the MOECC publication NPC-300, “Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning”, Part C release date October 21, 2013 and are listed in Table 1 below. The values in Table 1 are energy equivalent (average) sound levels [L_{EQ}] in units of A weighted decibels [dBA].

Table 1: Road and Rail Traffic Noise Criteria

Space	Daytime $L_{EQ(16\ hour)}$ Road / Rail	Nighttime $L_{EQ(8\ hour)}$ Road / Rail
Outdoor Living Areas	55 dBA	--
Inside Living/Dining Rooms	45 dBA / 40 dBA	45 dBA / 40 dBA
Inside Bedrooms	45 dBA / 40 dBA	40 dBA / 35 dBA

Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00. The term "Outdoor Living Area" (OLA) is used in reference to an outdoor patio, a backyard, a terrace or other area where passive recreation is expected to occur. Balconies that are less than 4 m in depth are not considered to be outdoor living areas under MOECC guidelines.

The guidelines in the MOECC publication allow the sound level in an OLA to be exceeded by up to 5 dBA, without mitigation, if warning clauses are placed in the purchase and rental agreements to the property. Where OLA sound levels exceed 60 dBA, physical mitigation is required to reduce the OLA sound level to below 60 dBA and as close to 55 dBA as technically, economically and administratively feasible.

Indoor guidelines are 5 dBA more stringent for rail noise than for road noise, to account for the low frequency (rumbling) character of locomotive sound, and its greater potential to transmit through exterior wall/window assemblies.

A central air conditioning system as an alternative means of ventilation to open windows is required for dwellings where nighttime sound levels outside bedroom windows exceed 60 dBA or daytime sound levels outside living room windows exceed 65 dBA. Forced-air ventilation with ducts sized to accommodate the future installation of air conditioning is required when nighttime sound levels at bedroom windows are in the range of 51 to 60 dBA or when daytime sound levels at living/dining room/bedroom windows are in the range of 56 to 65 dBA.

Building components such as walls, windows and doors must be designed to achieve indoor sound level criteria when the plane of bedroom window sound level is greater than 60 dBA or the daytime sound level is greater than 65 dBA due to road traffic noise and greater than 55 dBA due to nighttime or greater than 60 dBA during the daytime hours due to rail traffic noise.

Railway guidelines recommend brick exterior walls from foundation to rafters as a minimum construction for any dwellings with a 24 hour L_{EQ} that is greater than 60 dBA, and which are within 100 m of the right of way of the railway.

The railways also provide minimum requirements for safety as well as sound and vibration for proposed residential developments located adjacent to their rights-of-way. These refer to minimum required setbacks, berms, fencing and warning clauses. The reader is referred to a copy of CN requirements for a new development adjacent to a principal main rail line, which is located in Appendix A.

3.1 Ground-borne Vibration from Rail Traffic

MOECC and CN guidelines require measurements of ground-borne vibration when dwelling units are to be located within 75 metres of a principal mainline such as the CN Oakville Subdivision. Vibration is typically measured in terms of oscillatory velocity or acceleration. The CN vibration guidelines are given in terms of ground-borne velocity. In this report, vibration levels are quoted in terms of RMS velocity levels (L_V) in units of decibels [dB] relative to 1 mm/s (i.e., 1 mm/s = 0 dB). The CN guideline limit is 0.14 mm/s, which is equivalent to -17 dB re 1 mm/s. For ease of reference, in this report the CN limit of -17 dB re 1 mm/s is identified on velocity plots in this report. These plots are provided in Figures 4 to 9.

4 Traffic Sound Level Assessment

4.1 Road Traffic Data

Road traffic data for Plains Road East was obtained from the City of Burlington. The data is provided as annual average daily traffic (AADT) and is provided in Appendix B. A commercial vehicle percentage for Plains Road East of 5.6% was provided and split into 4.6% medium trucks and 1.0% heavy trucks. A day/night split of 90%/10% was used in the analysis. A speed limit of 60 km/h was used for Plains Road East.

Road traffic data for the QEW was obtained from the MTO in the form of average daily traffic (AADT) and is provided in Appendix B. A daytime commercial vehicle percentage of 13% was split into 5.0% medium trucks and 8.0% heavy trucks, was used in the analysis. A day/night split of

67%/13% and a posted speed limit of 100 km/h were used in the analysis. Table 2 provides the projected road traffic data to the year 2027 was used in the analysis.

Table 2: Road Traffic Data Projected to 2027

Road Name		Cars	Medium Trucks	Heavy Trucks	Total
Plains Road East	Daytime	29 426	1 434	312	31 172
	Nighttime	3 270	160	34	3 464
	Total	**32 696**	**1 594**	**346**	**34 636**
Queen Elizabeth Way	Daytime	135 694	7 798	12 478	155 970
	Nighttime	67 838	3 898	6 238	77 974
	Total	**203 532**	**11 696**	**18 716**	**233 944**

4.2 Rail Traffic Data

Rail traffic data for typical operations of the CN Oakville Subdivision was obtained from CN Railway personnel and is included in Appendix C. The Oakville Subdivision is used for way freight and passenger operations and is a principal mainline. Freight trains were not indicated on the traffic data received from CN, however during the site visit, four freight train pass-bys with more than 100 cars were noted. As such, four freight trains during the day and one during the night were included as part of the analysis. The maximum train speed of 129 kph (50 mph) for freight, way freight and passenger operations; and 153 kph for GO passenger trains was used in the analysis. The maximum allowable speed in STAMSON is 150 kph and was therefore used for GO passenger trains. In conformance with CN assessment requirements, these maximum speeds, number of cars and maximum locomotives per train were used in the traffic noise analysis to yield a worst case estimate of train noise. The data was projected to the year 2027 using a 2.5% per year growth rate. Table 3 summarises the rail traffic data used in the analysis.

Table 3: Rail Traffic Data Projected to the Year 2027

Type of Train	Number of Trains Day/ Night	Number of locomotives	Number of cars	Max Speed (KPH)
Freight	5.1 / 1.3	4	140	129
Way Freight	5.1 / 2.6	4	25	129
Passenger	17.9 / 0.0	2	10	129
Passenger (GO)	189.0 / 33.0	1	12	153*

Note: The maximum allowable speed in STAMSON is 150 kph

4.3 Road and Rail Traffic Noise Predictions

To assess the levels of road and rail traffic noise which will impact the site in the future, predictions were made using STAMSON version 5.04, a computer algorithm developed by the MOECC. Sample STAMSON output is included in Appendix D.

Predictions of the traffic sound levels were made at various locations around the development. The results of these predictions are summarized in Tables 4 and 5. The acoustic requirements may be subject to modifications if the site plan is changed significantly.

Sound levels were predicted in the plane of the third floor windows during daytime and nighttime hours to investigate ventilation and building façade construction requirements.

Table 4: Future Daytime Traffic Sound Levels, Without Mitigation [dBA]

Prediction Location	Description	Daytime – at Façade ($L_{EQ-16hr}$)		Daytime – at Façade Total ($L_{EQ-16hr}$)
		Road	Rail	
[A]	Units 18 – 27, 38, back to back townhouses	67	75	76
[B]	Units 10 and 37, back to back townhouse	63	71	72
[C]	Unit 1, townhouse	58	68	69
[D]	Common amenity area	--	--	63

Note: *Back to back dwelling units have no rear yards.

Table 5: Future Nighttime Traffic Sound Levels, Without Mitigation [dBA]

Prediction Location	Description	Nighttime – at Façade (L_{EQ-8hr})		Nighttime – at Façade Total (L_{EQ-8hr})
		Road	Rail	
[A]	Units 33 – 38, back to back townhouses	61	71	71
[B]	Unit 27, back to back townhouse	56	67	68
[C]	Unit 9, townhouse	52	64	64

5 Traffic Noise Recommendations

The predictions indicate that the future road and rail traffic sound levels will exceed MOECC guidelines in the proposed development. Recommendations to address these excesses are discussed below.

5.1 Outdoor Living Areas

Back to back units do not include rear yards and physical mitigation is not required. Ground level patios are provided for units 1 to 9 that are less than 4 m in depth. Balconies and patios that are less than 4 m in depth and are not considered to be OLAs.

Common amenity area is located to the east of unit 9. The predicted sound level in the amenity area is 63 dBA, 8 dBA in excess of the MOECC limit of 55 dBA. An acoustic barrier is 2.5 m in height will reduce sound levels to 59 dBA. The 4 dBA sound level excess is acceptable to the MOECC if it is acceptable to the municipality with the use of a noise warning clause.

5.2 Indoor Living Areas

Air Conditioning

The predicted nighttime sound levels outside the third storey bedroom windows of the future dwellings will be greater than 60 dBA and greater than 65 dBA during the daytime hours. To address these excesses, the MOECC guidelines recommend that these dwellings be equipped with central air conditioning systems, so that the windows can be closed. These units are shown in Figure 3. Window or through-the-wall air conditioning units are not recommended because of the noise they produce and because the units penetrate through the exterior wall which degrades the overall sound insulating

properties of the envelope. The location, installation and sound ratings of the outdoor air conditioning devices should minimize noise impacts and comply with criteria of MOECC publication NPC-300, as applicable.

5.3 Building Façade Constructions

Future road traffic sound levels in the proposed development will exceed 60 dBA at night and 65 dBA during the daytime. MOECC guidelines recommend that the windows, walls and doors be designed so that the indoor sound levels comply with MOECC noise criteria.

The required building components are selected based on the AIF value for road and rail traffic. To do so, calculations were performed to determine the acoustical insulation factors to maintain indoor sound levels within MOECC guidelines. The calculation methods were developed by the National Research Council (NRC). They are based on the predicted future sound levels at the building facades, and the anticipated area ratios of the facade components (walls, windows and doors) and the floor area of the adjacent room.

a) Future Dwellings with direct exposure to railway

Exterior Wall Construction

CN guidelines recommend brick exterior walls from foundation to rafters as a minimum construction for any dwellings that are in the first row of dwellings with exposure to the CN rail line. Façades requiring brick exterior construction are shown in Figure 3.

Glazing Construction

The minimum necessary specification for the building envelope is Acoustical Insulation Factor, AIF-38 for bedrooms and AIF-37 for living/dining/family rooms, based on the possibility of sound entering the buildings through the windows only, since the first row of dwelling units from the railway must be constructed of brick from foundation to rafters. As a general guideline, a glazing construction with two panes of 3 mm glass and a 13 mm airspace will be sufficient for the dwelling units with exposure to the rail line as long as the window to floor area ratio does not exceed 4% for bedrooms and does not exceed 5% for living/dining/family rooms. If patio doors are to be used in the dwellings, they must be included in the window area.

b) Future Dwellings in second row from railway

The minimum necessary specification for the building envelope is Acoustical Insulation Factor, AIF-30 for living/dining/family rooms and AIF-31 for bedrooms, based on the possibility of sound entering the buildings through the windows and walls for dwellings with some exposure to the railway. As a general guideline, a glazing construction with two panes of 3 mm glass and a 13 mm airspace will be sufficient for the dwelling units with exposure to Plains Road East and the railway as long as the window to floor area ratio does not exceed 25% for living/dining/family rooms and does not exceed 20% for bedrooms. If patio doors are to be used in the dwellings, they must be included in the window area.

c) Further Review

When the detailed floor plans and elevations of the dwellings with some exposure to the railway are available, an acoustical consultant should provide revised acoustical recommendations and verify brick exterior wall construction.

5.4 Rail Vibration Impact

Measurements were performed on the site at grade, at approximately 70 m from the railway right-of-way. The results of the measurements are presented in Figures 4 to 9. Table 6 shows the maximum vibration level measurements during each of the train pass-bys.

Table 6: Maximum RMS Vibration Velocity Measurements of Train Pass-bys at 70 m from Right-of-Way

Train Pass-by	Type of Train	Measured Level (mm/s)	Criteria (mm/s)
1	Freight	0.03	0.14
2	Freight	0.02	0.14
3	Via	0.02	0.14
4	GO	0.01	0.14
5	Freight	0.02	0.14
6	Freight	0.03	0.14

The results indicate that the vibration levels are below criteria. Vibration mitigation measures are not recommended for the development.

5.5 Warning Clauses

The MOECC guidelines recommend that warning clauses be included in the property and tenancy agreements and offers of purchase and sale for all units/lots/blocks with anticipated traffic sound level excesses. Examples are provided below.

Suggested wording for buildings with sound level excesses the MOECC criteria is given below:

Type A:

> Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road and rail traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the noise criteria of the Municipality and the Ministry of the Environment and Climate Change.

Suitable wording for future dwellings requiring central air conditioning systems is given below.

Type B:

> This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels

> are within the noise criteria of the Municipality and the Ministry of the Environment and Climate Change.

Suitable wording for dwellings for lots near commercial facilities is given below.

Type C:

> Purchasers are advised that due to the proximity of the adjacent commercial facilities, sound levels from these facilities may at times be audible.

These sample clauses are provided by the MOECC as examples and can be modified by the Municipality as required.

CN requires a standard warning clause as this development is located near a principal mainline. The following sample clause is typical of those included in agreements of purchase and sale or lease on the Lands for all lots in the development.

Type D:

> Warning: Purchasers or tenants are to be advised that Canadian National Railway or its successors or assigns, have an operating right-of-way within 300 metres from the land subject hereof and there may be alterations to the right-of-way including the possibility that the Railway may expand its operations, which expansion may affect the living environment of the residents notwithstanding the inclusion of any noise and vibration attenuating measures in the design of the subdivision and individual units, and that the Railway will not be responsible for complaints or claims arising from use of its facilities and/or operations.

6 Summary and Recommendations

The results of the study indicate that the proposed residential development is feasible. Future road and rail traffic sound levels will exceed MOECC and CN guidelines, but feasible means exist to reduce the impact to within acceptable limits.

The following list, Table 7 and Figure 3 summarize the recommendations made in this report.

1. A 2.5 m high acoustic barrier is required for the common amenity area to reduce sound levels to below 60 dBA.

2. Central air conditioning is required for all of the future dwellings.

3. Brick exterior wall construction is required for façades of the proposed dwellings with exposure to the railway as shown in Figure 3. Upgraded building and glazing constructions are required for the dwellings with exposure to the CN railway. When the floor plans and elevations of the dwellings with some exposure to the railway are available, an acoustical consultant should provide revised acoustical recommendations and verify brick exterior wall construction.

4. Noise warning clauses are required for dwellings in the proposed development with noise excesses and/or within 300 m from the railway line.

5. A detailed noise study should be performed when grading information, detailed floor plans and building elevations for the dwelling units.

Table 8: Summary of Noise Control Requirements and Warning Clauses

Lot/Blk No.	Acoustic Barrier	Ventilation Requirements	Type of Warning Clause	Acoustical Insulation Factor	Brick Exterior Façade*
1	--	Central A/C	A, B, C, D	LRDR:AIF-30 BR: AIF-31	✓
2 – 9, 11 – 17, 29 – 32	--	Central A/C	A, B, C, D	LRDR:AIF-30 BR: AIF-31	--
10, 18 – 28, 38	--	Central A/C	A, B, C, D	LRDR:AIF-37 BR: AIF-38	✓
33 – 37	--	Central A/C	A, B, C, D	LRDR:AIF-33 BR: AIF-29	✓
Common amenity area	✓	--	--	--	--

Notes:
-- no specific requirement
The location, installation and sound rating of the air conditioning condensers must be compliant with MOECC Guideline NPC-300, as applicable.
Windows, walls and doors to be specified to meet these minimum AIF requirements.
LRDR – Living Room/Dining Room
BR – Bedroom
OBC – Ontario Building Code
* See Figure 3 for façades requiring brick

The reader is referred to previous sections of this report where the recommendations are discussed in more detail.

6.1 Implementation

To ensure that the noise control recommendations outlined above are fully implemented, it is recommended that:

1) A detailed noise study is required for the entire site when grading, floor plans and building elevations are available.

2) Prior to an application for a building permit, the Municipality's Building Department or a Professional Engineer qualified to provide acoustical engineering services in Ontario shall review the unit plans (floor plans and building elevations) for future dwellings on lots directly to ensure that the windows and building constructions are adequately designed to ensure acceptable indoor noise levels.

3) Prior to assumption for this development, the Municipality's building inspector or a Professional Engineer qualified to provide acoustical engineering services in the Province of Ontario to shall certify that the noise control measures for the dwellings units have been properly installed and constructed.

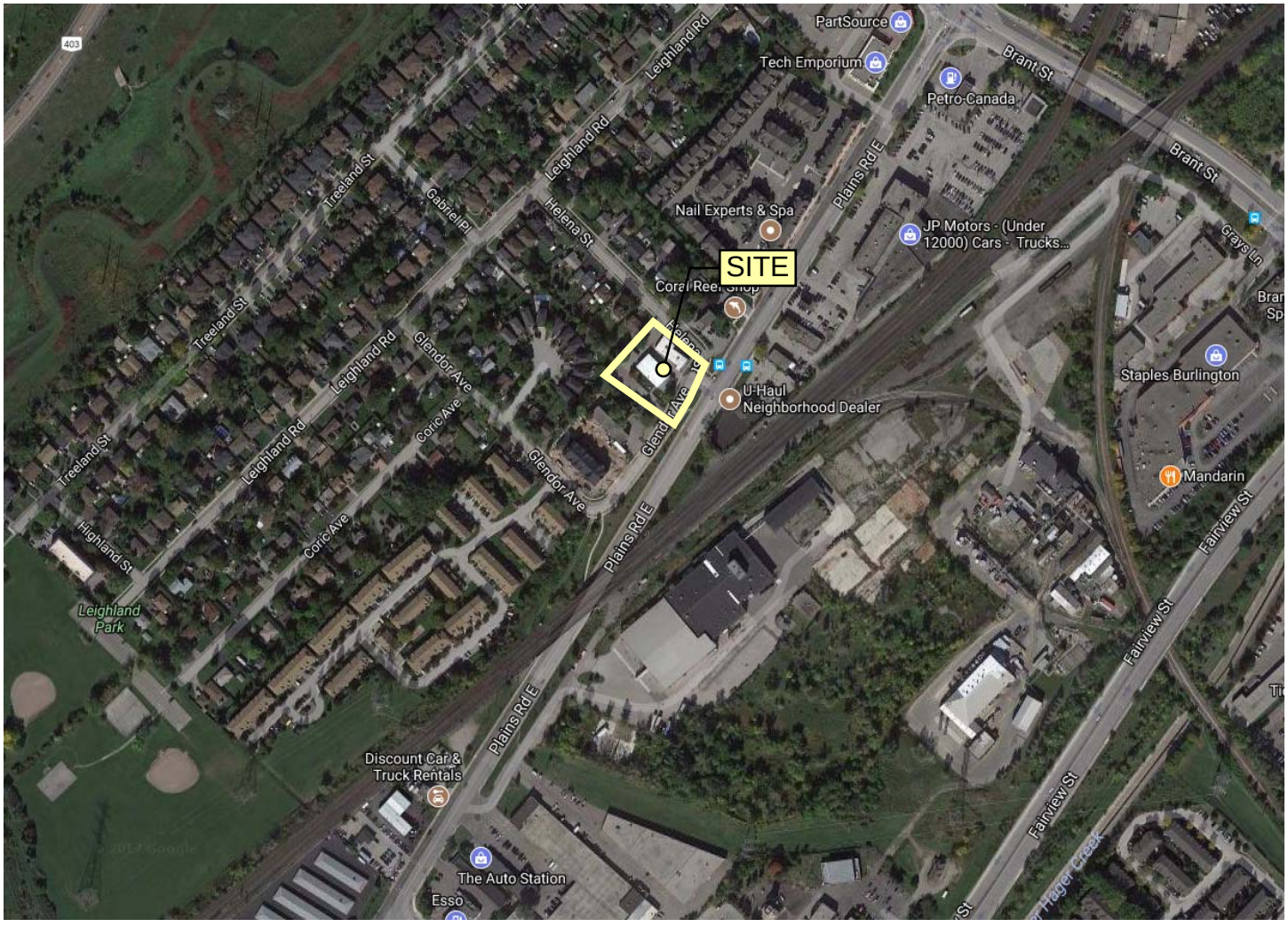


Figure 1 - Key Plan

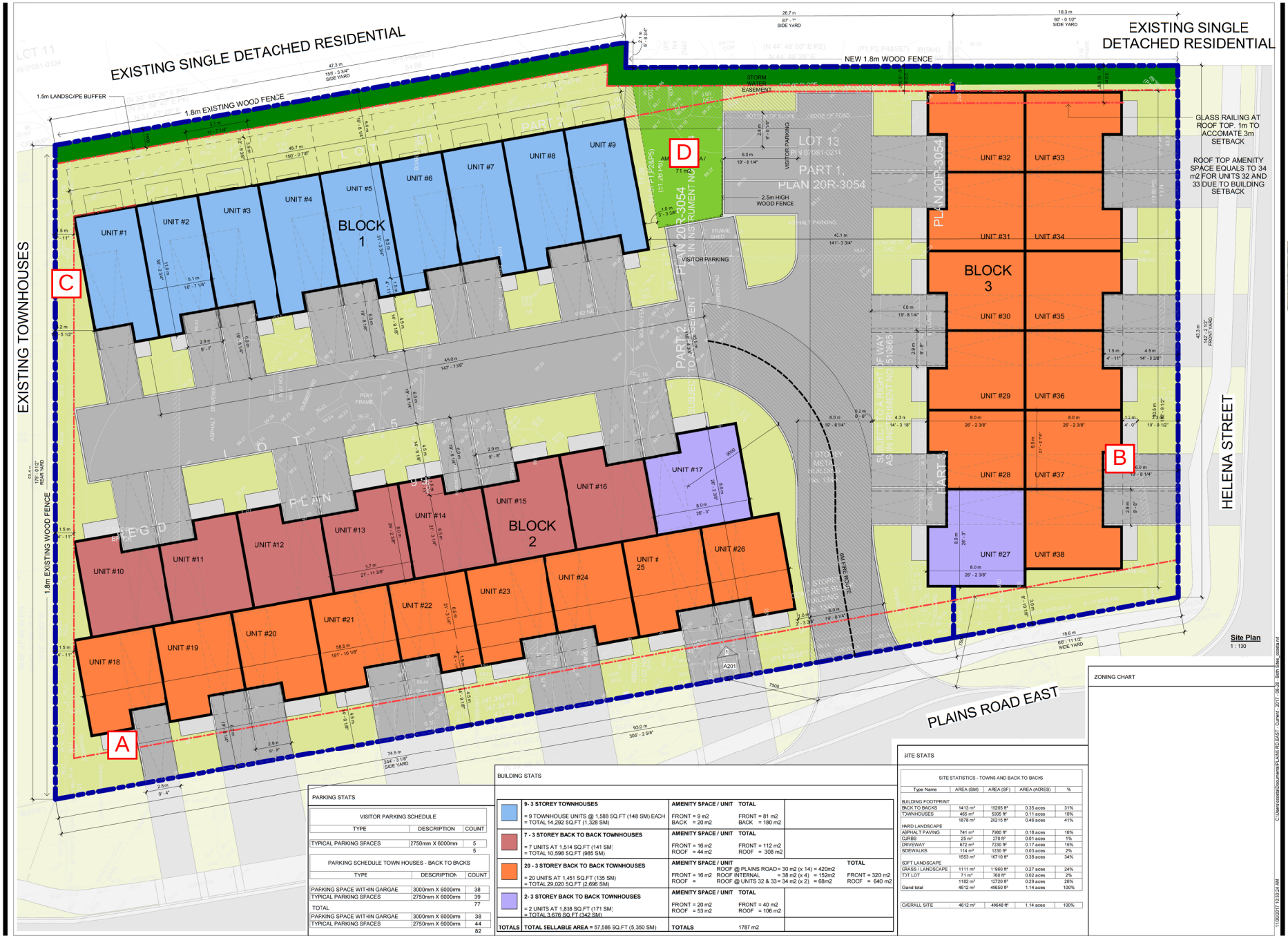


Figure 2 - Proposed Site Plan Showing Prediction Locations

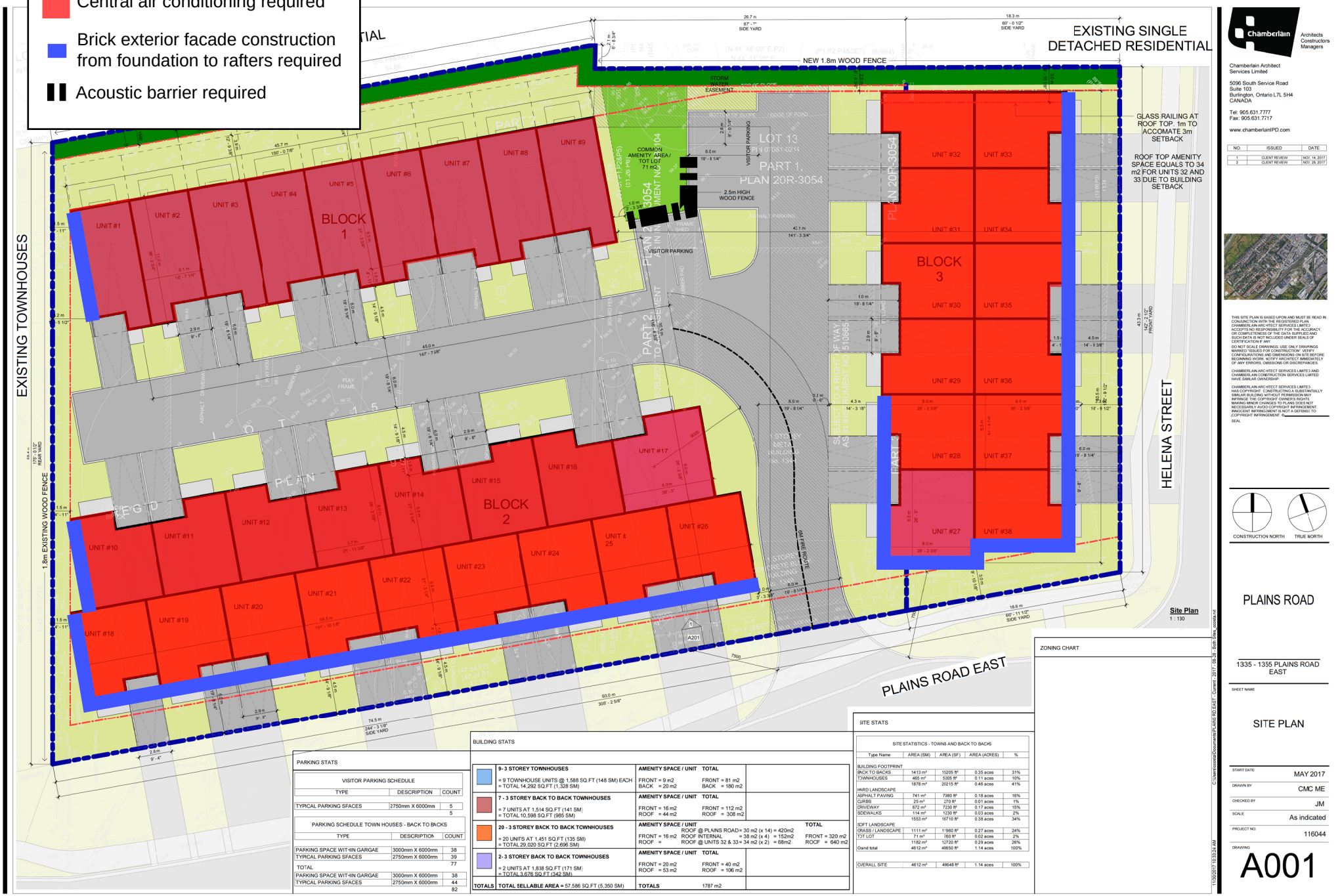


Figure 3 - Proposed Site Plan Showing Barrier, Ventilation and Brick Exterior Facade Requirements

Figure 4a: Pass-by 1
Measured Vibratory Velocity Level

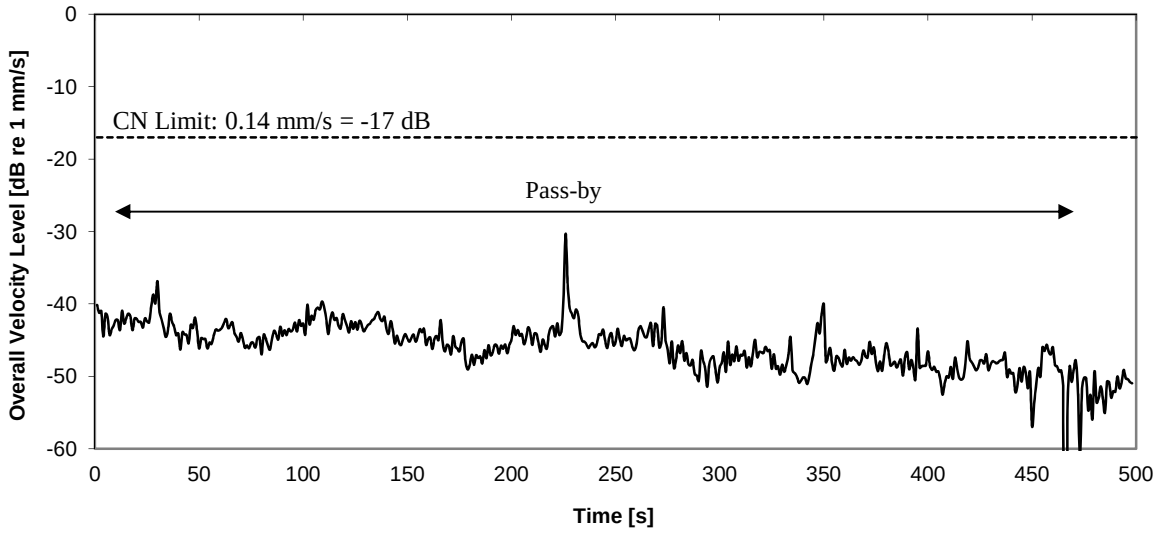


Figure 4b: Pass-by 1
Acceleration Spectrum @ Peak Level (1 sec. Duration)

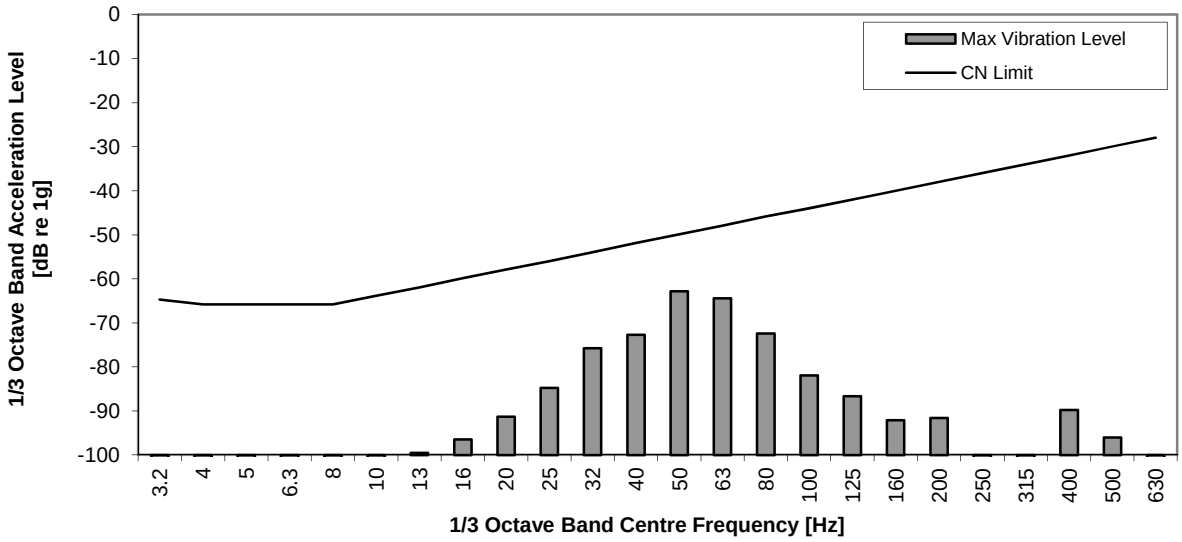


Figure 5a: Pass-by 2
Measured Vibratory Velocity Level

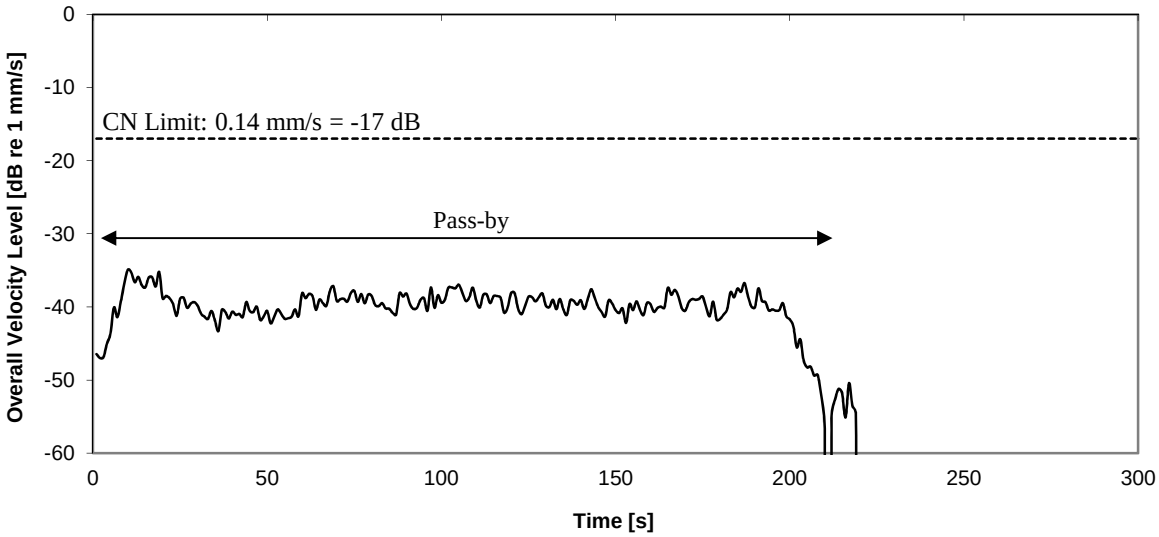


Figure 5b: Pass-by 2
Acceleration Spectrum @ Peak Level (1 sec. Duration)

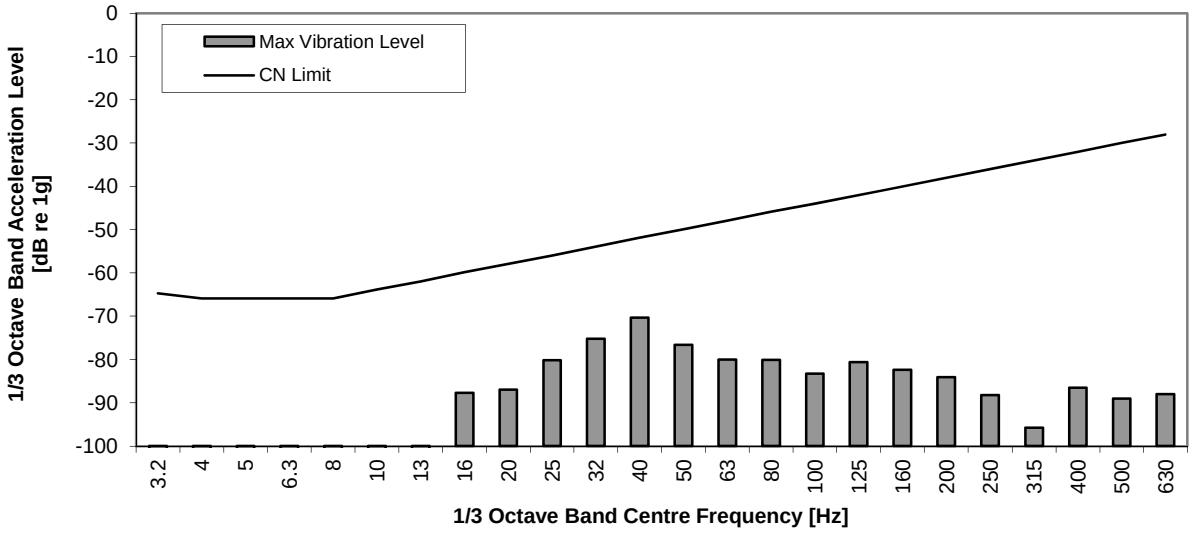


Figure 6a: Pass-by 3
Measured Vibratory Velocity Level

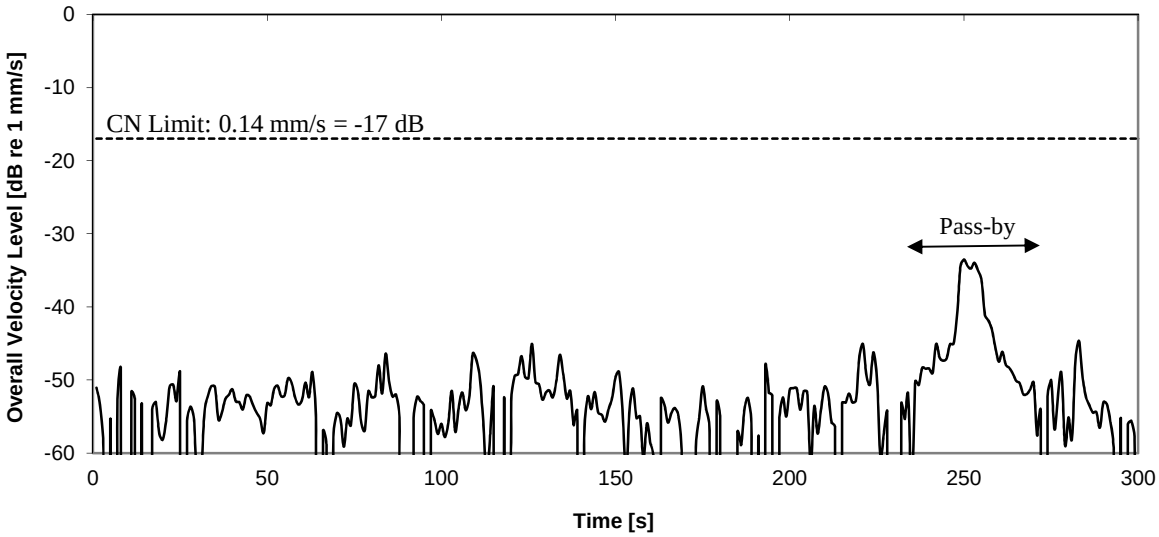


Figure 6b: Pass-by 3
Acceleration Spectrum @ Peak Level (1 sec. Duration)

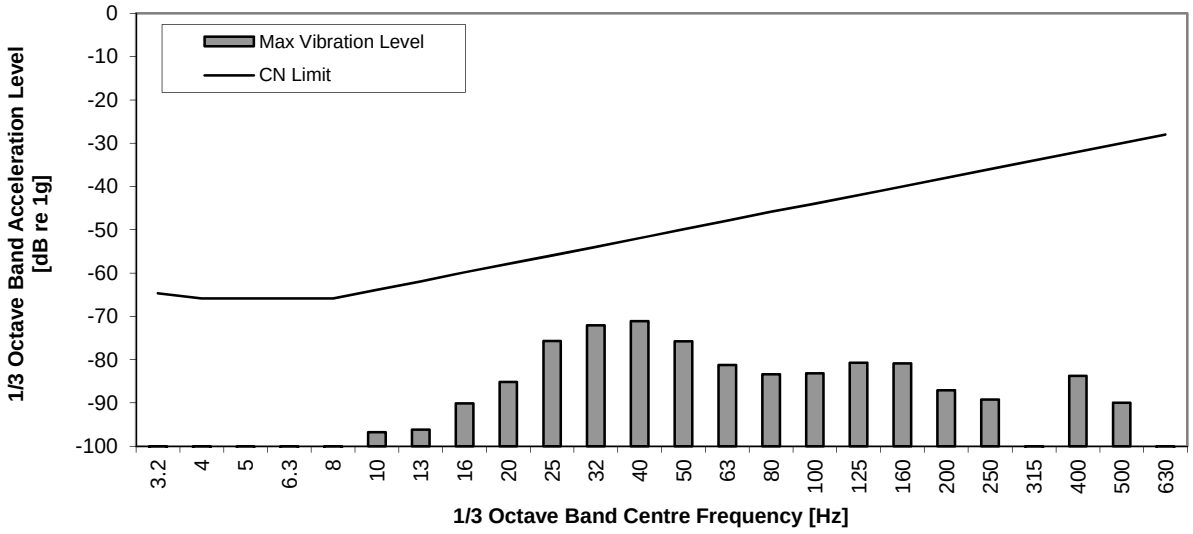


Figure 7a: Pass-by 4
Measured Vibratory Velocity Level

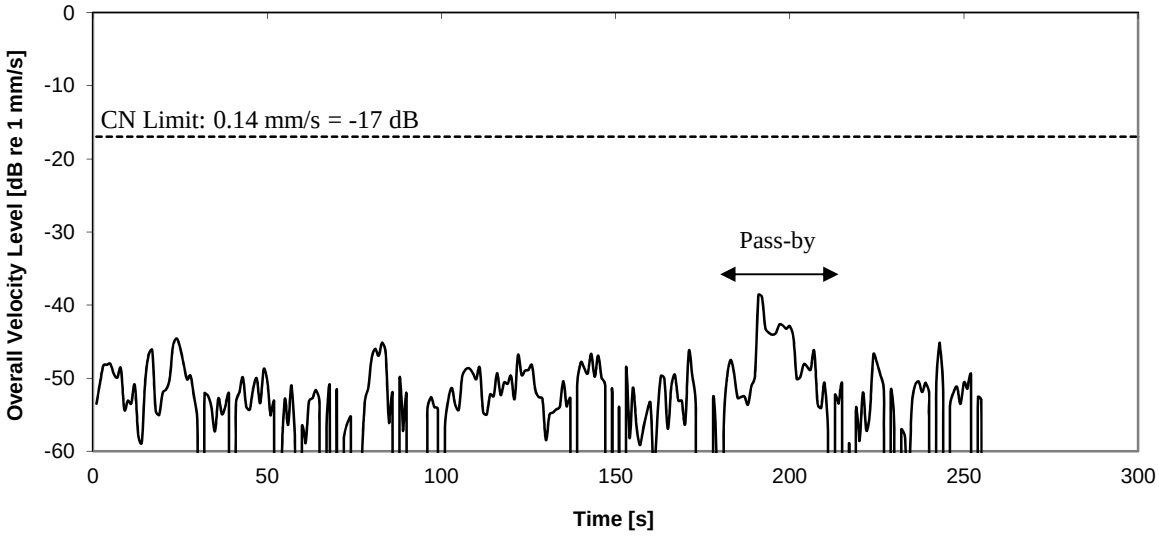


Figure 7b: Pass-by 4
Acceleration Spectrum @ Peak Level (1 sec. Duration)

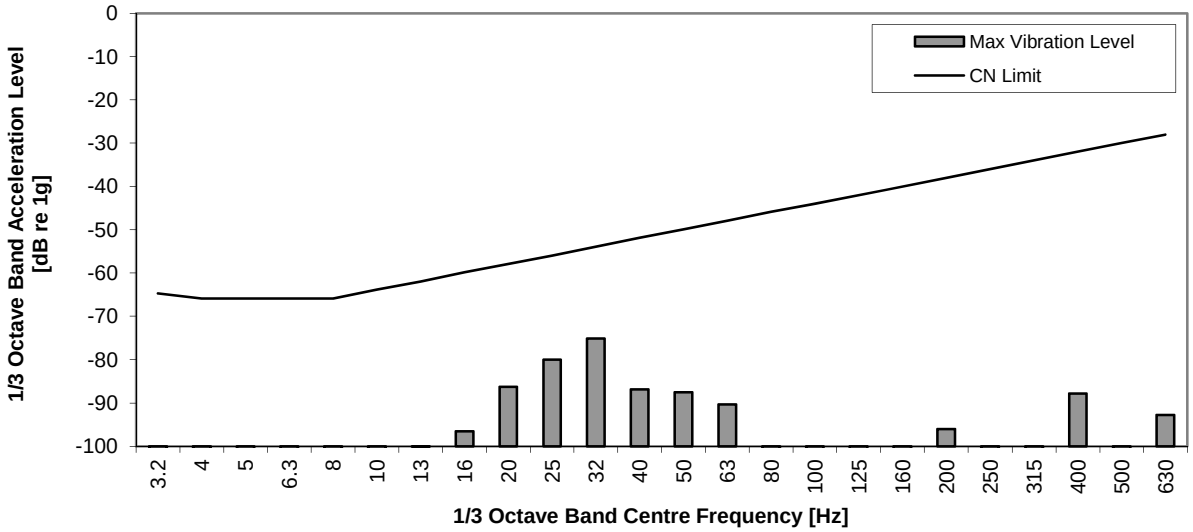


Figure 8a: Pass-by 5
Measured Vibratory Velocity Level

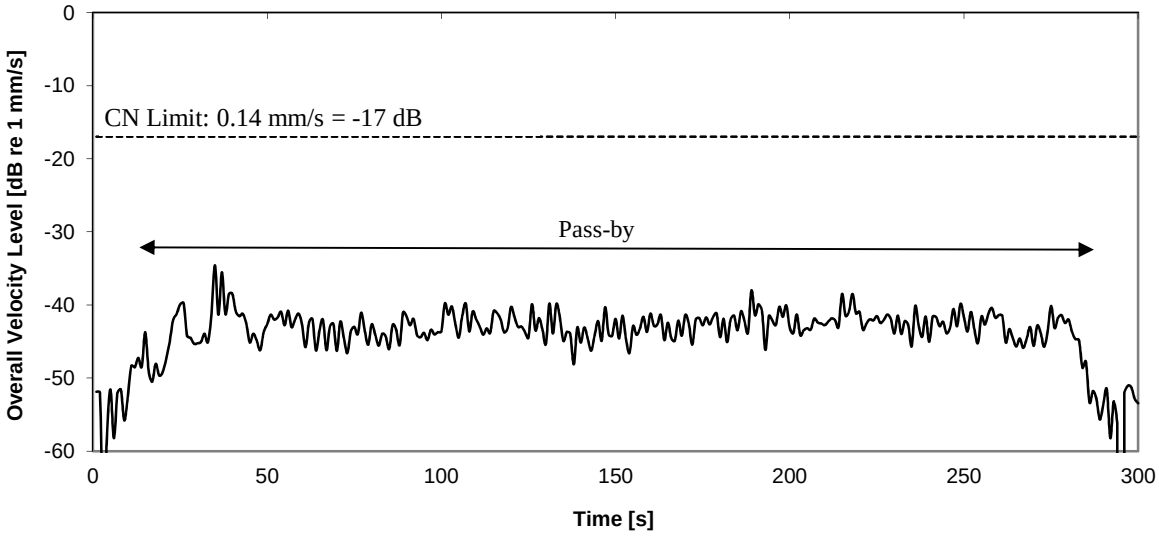


Figure 8b: Pass-by 5
Acceleration Spectrum @ Peak Level (1 sec. Duration)

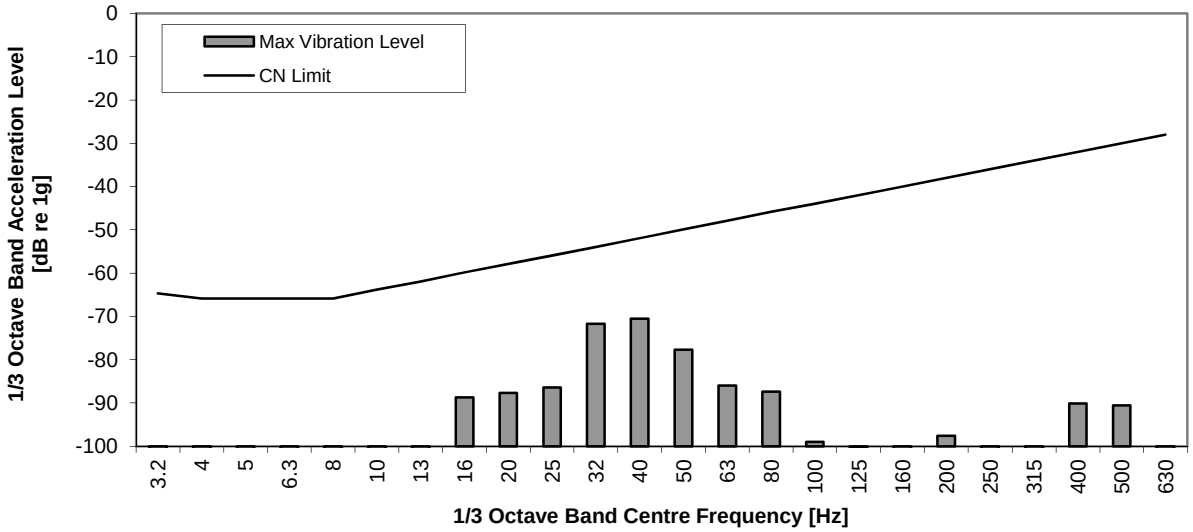


Figure 9a: Pass-by 6
Measured Vibratory Velocity Level

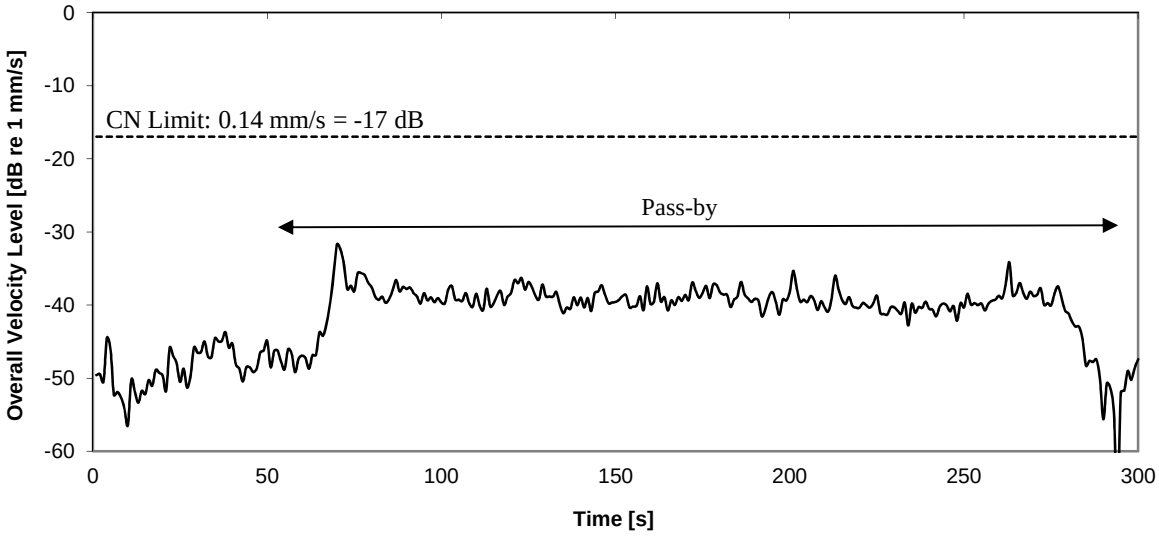
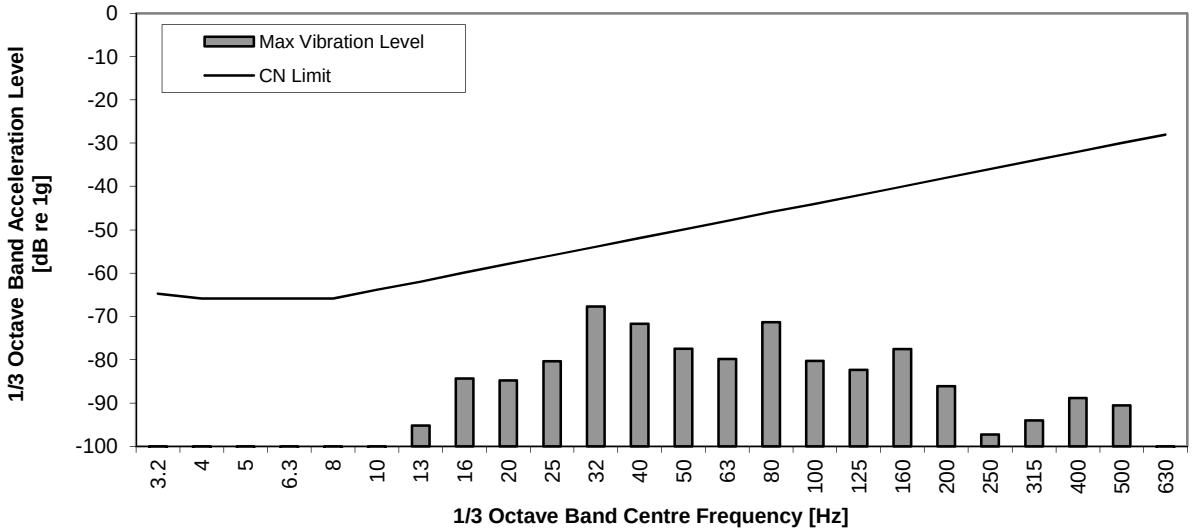


Figure 9b: Pass-by 6
Acceleration Spectrum @ Peak Level (1 sec. Duration)



APPENDIX A

CN Principal Main Line Requirements

Canadian National Railway Properties Inc.
Propriétés ferroviaires du Canadien National Inc.

277 Front Street West
Floor 8
Toronto, Ontario
M5V 2X7

Telephone: (416) 217-6961
Facsimile: (416) 217-6743

277, rue Front ouest
8e étage
Toronto (Ontario)
M5V 2X7

Téléphone: (416) 217-6961
Télécopieur: (416) 217-6743

PRINCIPAL MAIN LINE REQUIREMENTS

A. Safety setback of dwellings from the railway rights-of-way to be a minimum of 30 metres in conjunction with a safety berm. The safety berm shall be adjoining and parallel to the railway rights-of-way with returns at the ends, 2.5 metres above grade at the property line, with side slopes not steeper than 2.5 to 1.

B. The Owner shall engage a consultant to undertake an analysis of noise. At a minimum, a noise attenuation barrier shall be adjoining and parallel to the railway rights-of-way, having returns at the ends, and a minimum total height of 5.5 metres above top-of-rail. Acoustic fence to be constructed without openings and of a durable material weighing not less than 20 kg. per square metre of surface area. Subject to the review of the noise report, the Railway may consider other measures recommended by an approved Noise Consultant.

C. Ground-borne vibration transmission to be evaluated in a report through site testing to determine if dwellings within 75 metres of the railway rights-of-way will be impacted by vibration conditions in excess of 0.14 mm/sec RMS between 4 Hz and 200 Hz. The monitoring system should be capable of measuring frequencies between 4 Hz and 200 Hz, ±3 dB with an RMS averaging time constant of 1 second. If in excess, isolation measures will be required to ensure living areas do not exceed 0.14 mm/sec RMS on and above the first floor of the dwelling.

D. The Owner shall install and maintain a chain link fence of minimum 1.83 metre height along the mutual property line.

E. The following clause should be inserted in all development agreements, offers to purchase, and agreements of Purchase and Sale or Lease of each dwelling unit within 300m of the railway right-of-way: "Warning: Canadian National Railway Company or its assigns or successors in interest has or have a rights-of-way within 300 metres from the land the subject hereof. There may be alterations to or expansions of the railway facilities on such rights-of-way in the future including the possibility that the railway or its assigns or successors as aforesaid may expand its operations, which expansion may affect the living environment of the residents in the vicinity, notwithstanding the inclusion of any noise and vibration attenuating measures in the design of the development and individual dwelling(s). CNR will not be responsible for any complaints or claims arising from use of such facilities and/or operations on, over or under the aforesaid rights-of-way."

F. Any proposed alterations to the existing drainage pattern affecting railway property must receive prior concurrence from the Railway and be substantiated by a drainage report to the satisfaction of the Railway.

G. The Owner shall through restrictive covenants to be registered on title and all agreements of purchase and sale or lease provide notice to the public that the safety berm, fencing and vibration isolation measures implemented are not to be tampered with or altered and further that the Owner shall have sole responsibility for and shall maintain these measures to the satisfaction of CN.

H. The Owner enter into an Agreement stipulating how CN's concerns will be resolved and will pay CN's reasonable costs in preparing and negotiating the agreement.

I. The Owner may be required to grant CN an environmental easement for operational noise and vibration emissions, registered against the subject property in favour of CN.

A wholly owned subsidiary of Canadian National Railway Company / Une filiale en propriété exclusive de la Compagnie des chemins de fer nationaux du Canada

APPENDIX B

Road Traffic Data

Nu-Metrics Traffic Analyzer Study
Computer Generated Summary Report
City: City of Burlington
Street: Plains Rd - EB
Location: 219750

A study of vehicle traffic was conducted with HI-STAR unit number 1438. The study was done in the EB lane on Plains Rd - EB in City of Burlington, ON in from Brant St to Helena St county. The study began on 2013-08-13 at 12:00 AM and concluded on 2013-08-16 at 12:00 AM, lasting a total of 72 hours. Data was recorded in 60 minute time periods. The total recorded volume of traffic showed 32,523 vehicles passed through the location with a peak volume of 790 on 2013-08-13 at 07:00 AM and a minimum volume of 10 on 2013-08-13 at 02:00 AM. The AADT Count for this study was 10,841.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin.

Chart 1

0 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to 80	81 to 85	86 to 90	91 to 99	100 >
389	375	1005	2649	5672	8379	7292	4675	1253	431	150	51	26	28	0

At least half of the vehicles were traveling in the 51 - 55 km/h range or a lower speed. The average speed for all classified vehicles was 54 km/h with 42.9 percent exceeding the posted speed of 60 km/h. The mode speed for this traffic study was 51 km/h and the 85th percentile was 62.88 km/h.

CLASSIFICATION

Chart 2 lists the values of the eight classification bins and the total traffic volume accumulated for each bin.

Chart 2

0.0 to 4.5	5.0 to 8.0	8.5 to 9.5	10.0 to 12.5	13.0 to 15.5	16.0 to 18.5	19.0 to 22.0	22.5 >
24328	7163	238	517	52	37	34	6

Most of the vehicles classified during the study were Passenger Cars. The number of Passenger Cars in the study was 31,491 which represents 97.30 percent of the total classified vehicles. The number of Small Trucks in the study was 238 which represents 0.70 percent of the total classified vehicles. The number of Trucks/Busses in the study was 517 which represents 1.60 percent of the total classified vehicles. The number of Tractor Trailers in the study was 129 which represents 0.40 percent of the total classified vehicles.

HEADWAY

During the peak time period, on 2013-08-13 at 07:00 AM the average headway between the vehicles was 4.55 seconds. The slowest traffic period was on 2013-08-13 at 02:00 AM. During this slowest period, the average headway was 327.27 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 1 and 30 degrees Celsius. The HI-STAR determined that the roadway surface was Dry 0.00 percent of the time.

Nu-Metrics Traffic Analyzer Study
Computer Generated Summary Report
City: City of Burlington
Street: Plains Rd - WB
Location: 219750

A study of vehicle traffic was conducted with HI-STAR unit number 9B2. The study was done in the WB lane on Plains Rd - WB in City of Burlington, ON in from Brant St to Helena St county. The study began on 2013-08-13 at 12:00 AM and concluded on 2013-08-16 at 12:00 AM, lasting a total of 72 hours. Data was recorded in 60 minute time periods. The total recorded volume of traffic showed 41,013 vehicles passed through the location with a peak volume of 1,529 on 2013-08-15 at 05:00 PM and a minimum volume of 17 on 2013-08-13 at 03:00 AM. The AADT Count for this study was 13,671.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin.

Chart 1

0 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to 80	81 to 85	86 to 90	91 to 99	100 >
316	546	1161	2738	6178	10676	10322	6397	1422	533	207	95	47	68	0

At least half of the vehicles were traveling in the 51 - 55 km/h range or a lower speed. The average speed for all classified vehicles was 55 km/h with 46.9 percent exceeding the posted speed of 60 km/h. The mode speed for this traffic study was 51 km/h and the 85th percentile was 63.08 km/h.

CLASSIFICATION

Chart 2 lists the values of the eight classification bins and the total traffic volume accumulated for each bin.

Chart 2

0.0 to 4.5	5.0 to 8.0	8.5 to 9.5	10.0 to 12.5	13.0 to 15.5	16.0 to 18.5	19.0 to 22.0	22.5 >
24639	14883	375	562	122	67	44	14

Most of the vehicles classified during the study were Passenger Cars. The number of Passenger Cars in the study was 39,522 which represents 97.10 percent of the total classified vehicles. The number of Small Trucks in the study was 375 which represents 0.90 percent of the total classified vehicles. The number of Trucks/Busses in the study was 562 which represents 1.40 percent of the total classified vehicles. The number of Tractor Trailers in the study was 247 which represents 0.60 percent of the total classified vehicles.

HEADWAY

During the peak time period, on 2013-08-15 at 05:00 PM the average headway between the vehicles was 2.35 seconds. The slowest traffic period was on 2013-08-13 at 03:00 AM. During this slowest period, the average headway was 200.0 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 1 and 29 degrees Celsius. The HI-STAR determined that the roadway surface was Dry 0.00 percent of the time.

Highway	Location Description	Dist. (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT	AR
			1989	C	93,800	104,100	105,000	84,400	1.8
			1990	C	96,700	107,300	107,300	87,000	1.8
			1991	C	99,700	109,700	110,700	90,700	1.6
			1992	C	102,600	110,800	113,900	94,400	1.7
			1993	C	105,600	114,000	117,200	98,200	2.1
			1994	C	108,500	118,300	121,500	97,700	2.6
			1995	C	111,500	120,400	124,900	102,600	0.9
			1996	C	114,400	128,700	130,400	103,100	1.7
			1997	C	117,400	132,100	133,800	105,800	1.0
			1998	C	120,300	135,300	135,800	108,400	0.7
			1999	C	123,300	139,300	139,200	111,100	0.9
			2000	C	126,200	142,000	142,500	113,700	1.1
			2001	C	129,200	146,000	146,000	116,300	0.8
			2002	C	132,100	147,900	149,100	118,900	0.7
			2003	C	135,000	151,300	152,700	121,600	1.0
			2004	C	136,000	154,100	155,200	124,600	1.0
			2005	C	137,000	157,000	158,300	126,600	1.1
			2006	C	138,000	159,900	161,100	129,500	0.7
			2007	C	139,000	163,200	165,500	132,000	0.9
			2008	C	147,000	165,300	163,000	134,400	0.9
			2009	C	148,000	168,600	170,300	137,500	0.6
			2010	C	149,000	171,600	173,100	140,200	0.7
			2011	C	150,000	165,000	166,500	135,000	N/A
			2012	C	154,500	170,000	166,900	139,100	N/A
			2013	C	157,000	172,700	171,100	141,300	N/A
			2014	C	159,400	175,400	170,600	143,500	N/A
			2015	C	161,900	178,100	173,200	145,700	N/A
			2016	C	164,300	180,800	175,800	147,900	N/A
QEW	BRANT ST IC 101	1.8	1989	C	93,000	103,200	104,200	83,700	2.1
			1990	C	96,200	106,800	106,800	86,600	2.1
			1991	C	99,000	108,900	109,900	90,100	1.4
			1992	C	101,900	110,100	113,100	93,700	1.1
			1993	C	104,700	113,100	116,200	97,400	1.0

Highway	Location Description	Dist. (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT	AR
			1994	C	107,600	117,300	120,500	96,800	1.0
			1995	C	110,400	119,200	123,600	101,600	1.0
			1996	C	113,300	127,500	129,200	102,100	1.0
			1997	C	116,100	130,600	132,400	104,600	1.0
			1998	C	118,900	133,800	134,200	107,100	1.0
			1999	C	121,300	165,000	164,800	131,500	1.1
			2000	C	123,600	167,600	168,200	134,200	0.9
			2001	C	126,000	171,800	171,800	136,800	0.5
			2002	C	128,300	173,600	174,900	139,500	0.5
			2003	C	130,700	177,000	178,500	142,200	0.6
			2004	C	133,000	188,600	189,800	152,400	0.6
			2005	C	135,400	195,300	196,900	157,500	0.6
			2006	C	137,700	202,200	203,800	163,800	0.4
			2007	C	140,100	209,600	212,500	169,500	0.5
			2008	C	142,400	215,300	212,400	175,000	0.6
			2009	C	144,800	222,600	224,800	181,500	0.5
			2010	C	147,100	229,600	231,600	187,500	0.8
			2011	C	150,000	165,000	166,500	135,000	N/A
			2012	C	152,400	167,600	164,500	137,100	N/A
			2013	C	154,800	170,300	168,700	139,300	N/A
			2014	C	157,200	173,000	168,200	141,500	N/A
			2015	C	159,700	175,700	170,900	143,700	N/A
			2016	C	162,100	178,300	173,400	145,900	N/A
QEW	GUELPH LINE IC-102	2.0	1988	C	91,600	101,700	101,700	82,400	0.7
			1989	C	95,300	105,700	106,700	85,700	1.1
			1990	C	99,100	110,000	110,000	89,100	0.8
			1991	C	101,800	111,900	112,900	92,600	0.8
			1992	C	103,300	111,500	114,600	96,000	0.6
			1993	C	110,500	119,300	122,600	101,600	0.9
			1994	C	108,800	118,600	121,900	97,900	1.0
			1995	C	111,500	120,400	124,900	102,600	0.8
			1996	C	114,200	128,500	130,200	102,900	0.7
			1997	C	117,000	131,600	133,400	105,400	1.0

APPENDIX C

Rail Traffic Data

Victor Garcia

From: Brandon Gaffoor <Brandon.Gaffoor@metrolinx.com>
Sent: October-12-17 1:38 PM
To: Victor Garcia
Cc: Adam Snow
Subject: RE: Rail Traffic Data - Burlington

Hi Victor - Further to your request below dated October 12, 2017, the subject site is located at 1335 Plains Road East in the City of Burlington and is within 300 metres of GO Transit's Lakeshore West rail corridor.

It's anticipated that GO Service along this corridor will be comprised of a mix of diesel and electric trains within (at least) a 10 year time horizon. The preliminary midterm weekday train volume forecast at this location, including both revenue and equipment trips is in the order of 222 trains (diesel 45 day, 9 night; electric 144 day, 24 night). Trains will be comprised of a single locomotive and up to 12 passenger cars.

The current maximum design speed on this corridor is 95 mph (153 km/h).

With respect to future electrified rail service, it should be noted that Metrolinx has not made a final decision regarding the electric train technology or technologies to be deployed. Similarly, we are only beginning to understand potential noise and vibration implications associated with electrification. We can, however, provide the following interim information which may be helpful

1. At lower speeds, train noise is dominated by the powertrain. At higher speeds, train noise is dominated by the wheel- track interaction. Hence, at higher speeds, the noise level and spectrum of electric trains is expected to be very similar, if not identical, to those of equivalent diesel trains.

2. Along with electrification, Metrolinx will intensify service levels along all of its corridors to deliver the promised Regional Express Rail (RER) service. Everything else being equal, this will likely result in an overall increase in train noise emissions.

Given the above considerations, it would be prudent, for the purposes of acoustical analyses, to either use established model pre-sets for electrified trains or conservatively assume that the acoustical characteristics of electrified and diesel trains are equivalent. We anticipate that additional information regarding specific operational parameters for electrified trains will become available in the near future.

Operational information is subject to change and may be influenced by, among other factors, service planning priorities, operational considerations, funding availability and passenger
demand.

It should be noted that CN owns the rail corridor at this location. It would be prudent to contact CN directly for rail traffic information and track type. It should be also noted that VIA operates trains in this area and it would be prudent to contact them directly for rail traffic information.

I trust that this information is useful. Please feel free to contact me should you have any additional questions.

Brandon Gaffoor, B.E.S.
Intern | Rail Corridor Management Office | Rail Corridor Infrastructure | GO Transit
METROLINX I 335 Judson Street I Toronto I Ontario I M8Z 1B2
T. 416.202.7294 M. 647.289.1958



From: Victor Garcia [mailto:vgarcia@hgcengineering.com]
Sent: October-12-17 12:22 PM

Date: 2017/10/30 Project Number: OAK – 32.30 – Plains Road E, Burlington, ON

Dear Victor Garcia:

Re: Train Traffic Data – CN Oakville Subdivision near Plains Road E in Burlington, ON

The following is provided in response to Victor Garcia's 2017/10/12 request for information regarding rail traffic in the vicinity of Plains Road E in Burlington, ON at approximately Mile 32.30 on CN's Oakville Subdivision.

Typical daily traffic volumes are recorded below. However, traffic volumes may fluctuate due to overall economic conditions, varying traffic demands, weather conditions, track maintenance programs, statutory holidays and traffic detours that when required may be heavy although temporary. For the purpose of noise and vibration reports, train volumes must be escalated by 2.5% per annum for a 10-year period.

Typical daily traffic volumes at this site location are as follows:

***Maximum train speed is given in Miles per Hour**

	0700-2300			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	0	140	80	4
Way Freight	4	25	80	4
Passenger	14	10	80	2

	2300-0700			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	0	140	80	4
Way Freight	2	25	80	4
Passenger	0	10	80	2

The volumes recorded reflect westbound and eastbound freight and passenger operations on CN's Oakville Subdivision.

Except where anti-whistling bylaws are in effect, engine-warning whistles and bells are normally sounded at all at-grade crossings. There are no at-grade crossing in the immediate vicinity of the study area at Mile 32.30 (Plains Road E). Anti-whistling bylaws are in effect at this crossing. Please note that engine warning whistles may be sounded in cases of emergency, as a safety and or warning precaution at station locations and pedestrian crossings and occasionally for operating requirements.

With respect to equipment restrictions, the gross weight of the heaviest permissible car is 286,000 lbs.

The double mainline track is considered to be continuously welded rail throughout the study area. The presence of 8 (Eight) switches located at Mile 32.48, 32.40, 32.38, 3

(three) at 32.25, 32.17 and 32.14 may exacerbate the noise and vibration caused by train movements.

The Canadian National Railway continues to be strongly opposed to locating developments near railway facilities and rights-of-way due to potential safety and environmental conflicts. Development adjacent to the Railway Right-of-Way is not appropriate without sound impact mitigation measures to reduce the incompatibility. For confirmation of the applicable rail noise, vibration and safety standards, Adjacent Development, Canadian National Railway Properties at Proximity@cn.ca should be contacted directly.

I trust the above information will satisfy your current request.

Sincerely,

Michael Vallins P.Eng
Manager of Public Works
public_works_gld@cn.ca

APPENDIX D

Sample STAMSON 5.04 Output

STAMSON 5.0 NORMAL REPORT Date: 30-11-2017 12:58:01
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Description: Units 18 - 27, back to back townhouses

Rail data, segment # 1: CN (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 1: CN (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	78.00 / 78.00	m
Receiver height	7.50 / 7.50	m
Topography	1	(Flat/gentle slope; no barrier)
No Whistle		
Reference angle	0.00	

Results segment # 1: CN (day)

LOCOMOTIVE (0.00 + 74.17 + 0.00) = 74.17 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	81.33	-7.16	0.00	0.00	0.00	0.00	74.17

WHEEL (0.00 + 67.08 + 0.00) = 67.08 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	74.24	-7.16	0.00	0.00	0.00	0.00	67.08

Segment Leq : 74.95 dBA

Total Leq All Segments: 74.95 dBA

Results segment # 1: CN (night)

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

LOCOMOTIVE (0.00 + 69.92 + 0.00) = 69.92 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	77.08	-7.16	0.00	0.00	0.00	0.00	69.92

WHEEL (0.00 + 62.91 + 0.00) = 62.91 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	70.07	-7.16	0.00	0.00	0.00	0.00	62.91

Segment Leq : 70.71 dBA

Total Leq All Segments: 70.71 dBA

Road data, segment # 1: QEW (day/night)

```
Car traffic volume  : 67847/33919 veh/TimePeriod  *
Medium truck volume :  3899/1949  veh/TimePeriod  *
Heavy truck volume  :  6239/3119  veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

* Refers to calculated road volumes based on the following input:

```
    24 hr Traffic Volume (AADT or SADT):  89150
    Percentage of Annual Growth        :   2.50
    Number of Years of Growth          :  11.00
    Medium Truck % of Total Volume     :   5.00
    Heavy Truck  % of Total Volume     :   8.00
    Day (16 hrs) % of Total Volume     :  66.67
```

Data for Segment # 1: QEW (day/night)

```
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      7 / 7
House density             :     90 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 500.00 / 500.00 m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 2: QEW (day/night)

```
Car traffic volume  : 67847/33919 veh/TimePeriod  *
Medium truck volume :  3899/1949  veh/TimePeriod  *
Heavy truck volume  :  6239/3119  veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)
```

* Refers to calculated road volumes based on the following input:

```
    24 hr Traffic Volume (AADT or SADT):  89150
    Percentage of Annual Growth        :   2.50
    Number of Years of Growth          :  11.00
    Medium Truck % of Total Volume     :   5.00
    Heavy Truck  % of Total Volume     :   8.00
    Day (16 hrs) % of Total Volume     :  66.67
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
Data for Segment # 2: QEW (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      7 / 7
House density             :     90 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 500.00 / 500.00 m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 3: Plains (day/night)
------------------------------------------
Car traffic volume  : 14713/1635  veh/TimePeriod  *
Medium truck volume :   717/80    veh/TimePeriod  *
Heavy truck volume  :   156/17    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  12256
    Percentage of Annual Growth        :   2.50
    Number of Years of Growth          :  14.00
    Medium Truck % of Total Volume     :   4.60
    Heavy Truck  % of Total Volume     :   1.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 3: Plains (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  :  32.00 / 32.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 4: Plains (day/night)
------------------------------------------
Car traffic volume  : 14713/1635  veh/TimePeriod  *
Medium truck volume :   717/80    veh/TimePeriod  *
Heavy truck volume  :   156/17    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  12256
    Percentage of Annual Growth        :   2.50
    Number of Years of Growth          :  14.00
    Medium Truck % of Total Volume     :   4.60
    Heavy Truck  % of Total Volume     :   1.00
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 4: Plains (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   :  41.00 / 41.00  m
Receiver height            :   7.50 / 7.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

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

Source height = 1.68 m

ROAD (0.00 + 52.40 + 0.00) = 52.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  82.73   0.00 -15.23   0.00   0.00 -15.10   0.00  52.40
-------------------------------------------------------------------------------

Segment Leq : 52.40 dBA

Results segment # 2: QEW (day)
------------------------------

Source height = 1.68 m

ROAD (0.00 + 52.40 + 0.00) = 52.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  82.73   0.00 -15.23   0.00   0.00 -15.10   0.00  52.40
-------------------------------------------------------------------------------

Segment Leq : 52.40 dBA

Results segment # 3: Plains (day)
---------------------------------

Source height = 1.00 m

ROAD (0.00 + 64.31 + 0.00) = 64.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  67.60   0.00  -3.29   0.00   0.00   0.00   0.00  64.31
-------------------------------------------------------------------------------

Segment Leq : 64.31 dBA

Results segment # 4: Plains (day)
---------------------------------

Source height = 1.00 m

ROAD (0.00 + 63.23 + 0.00) = 63.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  67.60   0.00  -4.37   0.00   0.00   0.00   0.00  63.23
-------------------------------------------------------------------------------

Segment Leq : 63.23 dBA

Total Leq All Segments: 67.12 dBA

Results segment # 1: QEW (night)
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
--------------------------------

Source height = 1.68 m

ROAD (0.00 + 52.40 + 0.00) = 52.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  82.73   0.00 -15.23   0.00   0.00 -15.10   0.00  52.40
-------------------------------------------------------------------------------

Segment Leq : 52.40 dBA

Results segment # 2: QEW (night)
--------------------------------

Source height = 1.68 m

ROAD (0.00 + 52.40 + 0.00) = 52.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  82.73   0.00 -15.23   0.00   0.00 -15.10   0.00  52.40
-------------------------------------------------------------------------------

Segment Leq : 52.40 dBA

Results segment # 3: Plains (night)
-----------------------------------

Source height = 1.00 m

ROAD (0.00 + 57.76 + 0.00) = 57.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  61.05   0.00  -3.29   0.00   0.00   0.00   0.00  57.76
-------------------------------------------------------------------------------

Segment Leq : 57.76 dBA

Results segment # 4: Plains (night)
-----------------------------------

Source height = 1.00 m

ROAD (0.00 + 56.68 + 0.00) = 56.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  61.05   0.00  -4.37   0.00   0.00   0.00   0.00  56.68
-------------------------------------------------------------------------------

Segment Leq : 56.68 dBA

Total Leq All Segments: 61.49 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 75.61 dBA
                           (NIGHT): 71.20 dBA
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

STAMSON 5.0 NORMAL REPORT Date: 30-11-2017 13:00:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Description: Units 10 and 37, back to back townhouses

Rail data, segment # 1: CN (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld	
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes	
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes	
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes	
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes	

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 1: CN (day/night)

Angle1 Angle2	0.00 deg	90.00 deg
Wood depth	0	(No woods.)
No of house rows	0 / 0	
Surface	2	(Reflective ground surface)
Receiver source distance	88.00 / 88.00	m
Receiver height	7.50 / 7.50	m
Topography	1	(Flat/gentle slope; no barrier)
No Whistle		
Reference angle	0.00	

Results segment # 1: CN (day)

LOCOMOTIVE (0.00 + 70.63 + 0.00) = 70.63 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	81.33	-7.68	-3.01	0.00	0.00	0.00	70.63

WHEEL (0.00 + 63.55 + 0.00) = 63.55 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	74.24	-7.68	-3.01	0.00	0.00	0.00	63.55

Segment Leq : 71.41 dBA

Total Leq All Segments: 71.41 dBA

Results segment # 1: CN (night)

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

LOCOMOTIVE (0.00 + 66.39 + 0.00) = 66.39 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	77.08	-7.68	-3.01	0.00	0.00	0.00	66.39

WHEEL (0.00 + 59.38 + 0.00) = 59.38 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	70.07	-7.68	-3.01	0.00	0.00	0.00	59.38

Segment Leq : 67.18 dBA

Total Leq All Segments: 67.18 dBA

Road data, segment # 1: Plains (day/night)

Car traffic volume	: 14713/1635	veh/TimePeriod *
Medium truck volume	: 717/80	veh/TimePeriod *
Heavy truck volume	: 156/17	veh/TimePeriod *
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT)	: 12256
Percentage of Annual Growth	: 2.50
Number of Years of Growth	: 14.00
Medium Truck % of Total Volume	: 4.60
Heavy Truck % of Total Volume	: 1.00
Day (16 hrs) % of Total Volume	: 90.00

Data for Segment # 1: Plains (day/night)

Angle1 Angle2	: 0.00 deg	90.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 42.00 / 42.00	m
Receiver height	: 7.50 / 7.50	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

Road data, segment # 2: Plains (day/night)

Car traffic volume	: 14713/1635	veh/TimePeriod *
Medium truck volume	: 717/80	veh/TimePeriod *
Heavy truck volume	: 156/17	veh/TimePeriod *
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT)	: 12256
Percentage of Annual Growth	: 2.50
Number of Years of Growth	: 14.00
Medium Truck % of Total Volume	: 4.60
Heavy Truck % of Total Volume	: 1.00
Day (16 hrs) % of Total Volume	: 90.00

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

Data for Segment # 2: Plains (day/night)

```
--------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  51.00 / 51.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: Plains (day)

```
---------------------------------
```

Source height = 1.00 m

ROAD (0.00 + 60.12 + 0.00) = 60.12 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	67.60	0.00	-4.47	-3.01	0.00	0.00	0.00	60.12

Segment Leq : 60.12 dBA

Results segment # 2: Plains (day)

```
---------------------------------
```

Source height = 1.00 m

ROAD (0.00 + 59.27 + 0.00) = 59.27 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	67.60	0.00	-5.31	-3.01	0.00	0.00	0.00	59.27

Segment Leq : 59.27 dBA

Total Leq All Segments: 62.73 dBA

Results segment # 1: Plains (night)

```
---------------------------------
```

Source height = 1.00 m

ROAD (0.00 + 53.57 + 0.00) = 53.57 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	61.05	0.00	-4.47	-3.01	0.00	0.00	0.00	53.57

Segment Leq : 53.57 dBA

Results segment # 2: Plains (night)

```
---------------------------------
```

Source height = 1.00 m

ROAD (0.00 + 52.72 + 0.00) = 52.72 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	61.05	0.00	-5.31	-3.01	0.00	0.00	0.00	52.72

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

Segment Leq : 52.72 dBA

Total Leq All Segments: 56.18 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.96 dBA
(NIGHT): 67.51 dBA

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

STAMSON 5.0 NORMAL REPORT Date: 30-11-2017 13:02:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Description: Unit 1, townhouse

Rail data, segment # 1: CN (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld	
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes	
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes	
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes	
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes	

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 1: CN (day/night)

Angle1 Angle2	:	0.00 deg 90.00 deg
Wood depth	:	0 (No woods.)
No of house rows	:	1 / 1
House density	:	50 %
Surface	:	2 (Reflective ground surface)
Receiver source distance	:	99.00 / 99.00 m
Receiver height	:	7.50 / 7.50 m
Topography	:	1 (Flat/gentle slope; no barrier)
No Whistle		
Reference angle	:	0.00

Results segment # 1: CN (day)

LOCOMOTIVE (0.00 + 67.49 + 0.00) = 67.49 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	81.33	-8.20	-3.01	0.00	-2.63	0.00	67.49

WHEEL (0.00 + 60.40 + 0.00) = 60.40 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	74.24	-8.20	-3.01	0.00	-2.63	0.00	60.40

Segment Leq : 68.27 dBA

Total Leq All Segments: 68.27 dBA

Results segment # 1: CN (night)

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

LOCOMOTIVE (0.00 + 63.24 + 0.00) = 63.24 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	77.08	-8.20	-3.01	0.00	-2.63	0.00	63.24

WHEEL (0.00 + 56.23 + 0.00) = 56.23 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	70.07	-8.20	-3.01	0.00	-2.63	0.00	56.23

Segment Leq : 64.03 dBA

Total Leq All Segments: 64.03 dBA

Road data, segment # 1: Plains (day/night)

Car traffic volume	: 14713/1635	veh/TimePeriod *
Medium truck volume	: 717/80	veh/TimePeriod *
Heavy truck volume	: 156/17	veh/TimePeriod *
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT)	: 12256
Percentage of Annual Growth	: 2.50
Number of Years of Growth	: 14.00
Medium Truck % of Total Volume	: 4.60
Heavy Truck % of Total Volume	: 1.00
Day (16 hrs) % of Total Volume	: 90.00

Data for Segment # 1: Plains (day/night)

Angle1 Angle2	: 0.00 deg	90.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 1 / 1	
House density	: 50 %	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 64.00 / 64.00	m
Receiver height	: 7.50 / 7.50	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

Road data, segment # 2: Plains (day/night)

Car traffic volume	: 14713/1635	veh/TimePeriod *
Medium truck volume	: 717/80	veh/TimePeriod *
Heavy truck volume	: 156/17	veh/TimePeriod *
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT)	: 12256
Percentage of Annual Growth	: 2.50
Number of Years of Growth	: 14.00
Medium Truck % of Total Volume	: 4.60
Heavy Truck % of Total Volume	: 1.00
Day (16 hrs) % of Total Volume	: 90.00

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
Data for Segment # 2: Plains (day/night)
--------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  73.00 / 73.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.00 m

ROAD (0.00 + 55.60 + 0.00) = 55.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  67.60   0.00  -6.30  -3.01   0.00  -2.69   0.00  55.60
-------------------------------------------------------------------------------

Segment Leq : 55.60 dBA

Results segment # 2: Plains (day)
---------------------------------

Source height = 1.00 m

ROAD (0.00 + 55.04 + 0.00) = 55.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  67.60   0.00  -6.87  -3.01   0.00  -2.68   0.00  55.04
-------------------------------------------------------------------------------

Segment Leq : 55.04 dBA

Total Leq All Segments: 58.34 dBA

Results segment # 1: Plains (night)
-----------------------------------

Source height = 1.00 m

ROAD (0.00 + 49.05 + 0.00) = 49.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  61.05   0.00  -6.30  -3.01   0.00  -2.69   0.00  49.05
-------------------------------------------------------------------------------

Segment Leq : 49.05 dBA

Results segment # 2: Plains (night)
-----------------------------------

Source height = 1.00 m

ROAD (0.00 + 48.49 + 0.00) = 48.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  61.05   0.00  -6.87  -3.01   0.00  -2.68   0.00  48.49
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

Segment Leq : 48.49 dBA

Total Leq All Segments: 51.79 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 68.69 dBA
(NIGHT): 64.28 dBA

STAMSON 5.0 NORMAL REPORT Date: 30-11-2017 13:11:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: dbar.te Time Period: 16 hours

Description: Common amenity are with 2.5 m barrier

Rail data, segment # 1: CN

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 1: CN

Angle1 Angle2	: -90.00 deg	-20.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 1	
House density	: 80 %	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 115.50 m	
Receiver height	: 1.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)
No Whistle		
Barrier angle1	: -90.00 deg	Angle2 : -20.00 deg
Barrier height	: 9.00 m	
Barrier receiver distance	: 22.63 m	
Source elevation	: 0.00 m	
Receiver elevation	: 0.00 m	
Barrier elevation	: 0.00 m	
Reference angle	: 0.00	

Rail data, segment # 2: CN

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

1. Freight	4.0/1.0	2.50	10.00
2. Way Freight	4.0/2.0	2.50	10.00
3. Passenger	14.0/0.0	2.50	10.00
4. GO	189.0/33.0	0.00	0.00

Data for Segment # 2: CN

Angle1 Angle2	: -20.00 deg	-10.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 115.50 m	
Receiver height	: 1.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)
No Whistle		
Barrier angle1	: -20.00 deg	Angle2 : -10.00 deg
Barrier height	: 2.50 m	
Barrier receiver distance	: 4.00 m	
Source elevation	: 0.00 m	
Receiver elevation	: 0.00 m	
Barrier elevation	: 0.00 m	
Reference angle	: 0.00	

Rail data, segment # 3: CN

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

No	Train type: Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 3: CN

Angle1 Angle2	: -10.00 deg	45.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 115.50 m	
Receiver height	: 1.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)
No Whistle		
Barrier angle1	: -10.00 deg	Angle2 : 45.00 deg
Barrier height	: 9.00 m	
Barrier receiver distance	: 21.00 m	
Source elevation	: 0.00 m	
Receiver elevation	: 0.00 m	
Barrier elevation	: 0.00 m	
Reference angle	: 0.00	

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

Rail data, segment # 4: CN

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1. Freight	5.1/1.3	129.0	4.0	140.0	Diesel	Yes
* 2. Way Freight	5.1/2.6	129.0	4.0	25.0	Diesel	Yes
* 3. Passenger	17.9/0.0	129.0	2.0	10.0	Diesel	Yes
* 4. GO	189.0/33.0	150.0	1.0	12.0	Diesel	Yes

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.	Freight	4.0/1.0	2.50	10.00
2.	Way Freight	4.0/2.0	2.50	10.00
3.	Passenger	14.0/0.0	2.50	10.00
4.	GO	189.0/33.0	0.00	0.00

Data for Segment # 4: CN

Angle1	Angle2	: 45.00 deg	90.00 deg
Wood depth		: 0	(No woods.)
No of house rows		: 0	
Surface		: 2	(Reflective ground surface)
Receiver source distance		: 115.50 m	
Receiver height		: 1.50 m	
Topography		: 2	(Flat/gentle slope; with barrier)
No Whistle			
Barrier angle1		: 45.00 deg	Angle2 : 90.00 deg
Barrier height		: 9.00 m	
Barrier receiver distance		: 4.30 m	
Source elevation		: 0.00 m	
Receiver elevation		: 0.00 m	
Barrier elevation		: 0.00 m	
Reference angle		: 0.00	

Results segment # 1: CN

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	1.99	1.99
0.50	1.50	1.30	1.30

LOCOMOTIVE (0.00 + 54.61 + 0.00) = 54.61 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-20	0.00	81.33	-8.86	-4.10	0.00	-5.62	0.00	62.74
-90	-20	0.00	81.33	-8.86	-4.10	0.00	0.00	-13.75	54.61

WHEEL (0.00 + 46.90 + 0.00) = 46.90 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-20	0.00	74.24	-8.86	-4.10	0.00	-5.62	0.00	55.65
-90	-20	0.00	74.24	-8.86	-4.10	0.00	0.00	-14.37	46.90

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

Segment Leq : 55.29 dBA

Results segment # 2: CN

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	1.59	1.59
0.50	1.50	1.47	1.47

LOCOMOTIVE (0.00 + 51.06 + 0.00) = 51.06 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-20	-10	0.00	81.33	-8.86	-12.55	0.00	0.00	-8.86	51.06

WHEEL (0.00 + 43.22 + 0.00) = 43.22 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-20	-10	0.00	74.24	-8.86	-12.55	0.00	0.00	-9.61	43.22

Segment Leq : 51.72 dBA

Results segment # 3: CN

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	1.95	1.95
0.50	1.50	1.32	1.32

LOCOMOTIVE (0.00 + 48.63 + 0.00) = 48.63 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-10	45	0.00	81.33	-8.86	-5.15	0.00	0.00	-18.69	48.63

WHEEL (0.00 + 40.77 + 0.00) = 40.77 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-10	45	0.00	74.24	-8.86	-5.15	0.00	0.00	-19.45	40.77

Segment Leq : 49.29 dBA

Results segment # 4: CN

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
4.00	1.50	1.59	1.59
0.50	1.50	1.46	1.46

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

LOCOMOTIVE (0.00 + 50.30 + 0.00) = 50.30 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
45	90	0.00	81.33	-8.86	-6.02	0.00	0.00	-16.14	50.30

WHEEL (0.00 + 43.08 + 0.00) = 43.08 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
45	90	0.00	74.24	-8.86	-6.02	0.00	0.00	-16.28	43.08

Segment Leq : 51.05 dBA

Total Leq All Segments: 58.44 dBA

Road data, segment # 1: Plains

Car traffic volume	: 14713 veh/TimePeriod	*
Medium truck volume	: 717 veh/TimePeriod	*
Heavy truck volume	: 156 veh/TimePeriod	*
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

Data for Segment # 1: Plains

Angle1 Angle2	: -90.00 deg	-20.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 1	
House density	: 80 %	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 69.50 m	
Receiver height	: 1.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)
Barrier angle1	: -90.00 deg	Angle2 : -20.00 deg
Barrier height	: 9.00 m	
Barrier receiver distance	: 22.63 m	
Source elevation	: 0.00 m	
Receiver elevation	: 0.00 m	
Barrier elevation	: 0.00 m	
Reference angle	: 0.00	

Road data, segment # 2: Plains

Car traffic volume	: 14713 veh/TimePeriod	*
Medium truck volume	: 717 veh/TimePeriod	*
Heavy truck volume	: 156 veh/TimePeriod	*
Posted speed limit	: 60 km/h	
Road gradient	: 4 %	
Road pavement	: 1 (Typical asphalt or concrete)	

Data for Segment # 2: Plains

Angle1 Angle2	: -90.00 deg	-20.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 1	
House density	: 80 %	
Surface	: 2	(Reflective ground surface)
Receiver source distance	: 78.50 m	
Receiver height	: 1.50 m	
Topography	: 2	(Flat/gentle slope; with barrier)

ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
Barrier angle1            : -90.00 deg   Angle2 : -20.00 deg
Barrier height            :   9.00 m
Barrier receiver distance :  22.63 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 3: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 3: Plains
------------------------------
Angle1   Angle2           : -20.00 deg   -10.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  69.50 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -20.00 deg   Angle2 : -10.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :   4.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 4: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 4: Plains
------------------------------
Angle1   Angle2           : -20.00 deg   -10.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  78.50 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -20.00 deg   Angle2 : -10.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :   4.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 5: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 5: Plains
-----------------------------
Angle1   Angle2           : -10.00 deg   45.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  69.50 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -10.00 deg   Angle2 : 45.00 deg
Barrier height            :   9.00 m
Barrier receiver distance :  21.70 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 6: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 6: Plains
-----------------------------
Angle1   Angle2           : -10.00 deg   45.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  78.50 m
Receiver height           :   1.50 m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -10.00 deg   Angle2 : 45.00 deg
Barrier height            :   9.00 m
Barrier receiver distance :  21.70 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 7: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 7: Plains
-----------------------------
Angle1   Angle2           :  45.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
```

```
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  69.50 m
Receiver height            :   1.50 m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             :  45.00 deg   Angle2 : 90.00 deg
Barrier height             :   9.00 m
Barrier receiver distance  :   4.30 m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Road data, segment # 8: Plains
------------------------------
Car traffic volume  : 14713 veh/TimePeriod  *
Medium truck volume :   717 veh/TimePeriod  *
Heavy truck volume  :   156 veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     4 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 8: Plains
------------------------------
Angle1   Angle2            :  45.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  78.50 m
Receiver height            :   1.50 m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             :  45.00 deg   Angle2 : 90.00 deg
Barrier height             :   9.00 m
Barrier receiver distance  :   4.30 m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00

Results segment # 1: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.34 !         1.34

ROAD (0.00 + 41.91 + 0.00) = 41.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -20   0.00  67.60   0.00  -6.66  -4.10   0.00  -5.85   0.00  50.99
   -90    -20   0.00  67.60   0.00  -6.66  -4.10   0.00   0.00 -14.93  41.91
-------------------------------------------------------------------------------

Segment Leq : 41.91 dBA

Results segment # 2: Plains
---------------------------

Source height = 1.00 m
```

```
Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.36 !         1.36

ROAD (0.00 + 41.57 + 0.00) = 41.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -20   0.00  67.60   0.00  -7.19  -4.10   0.00  -5.81   0.00  50.50
   -90    -20   0.00  67.60   0.00  -7.19  -4.10   0.00   0.00 -14.74  41.57
-------------------------------------------------------------------------------

Segment Leq : 41.57 dBA

Results segment # 3: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.47 !         1.47

ROAD (0.00 + 38.74 + 0.00) = 38.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -20    -10   0.00  67.60   0.00  -6.66 -12.55   0.00   0.00  -9.65  38.74
-------------------------------------------------------------------------------

Segment Leq : 38.74 dBA

Results segment # 4: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.47 !         1.47

ROAD (0.00 + 38.26 + 0.00) = 38.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -20    -10   0.00  67.60   0.00  -7.19 -12.55   0.00   0.00  -9.60  38.26
-------------------------------------------------------------------------------

Segment Leq : 38.26 dBA

Results segment # 5: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.34 !         1.34

ROAD (0.00 + 35.96 + 0.00) = 35.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -10     45   0.00  67.60   0.00  -6.66  -5.15   0.00   0.00 -19.83  35.96
-------------------------------------------------------------------------------

Segment Leq : 35.96 dBA

Results segment # 6: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.36 !         1.36

ROAD (0.00 + 35.54 + 0.00) = 35.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -10     45   0.00  67.60   0.00  -7.19  -5.15   0.00   0.00 -19.73  35.54
-------------------------------------------------------------------------------

Segment Leq : 35.54 dBA

Results segment # 7: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.47 !         1.47

ROAD (0.00 + 38.56 + 0.00) = 38.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    45     90   0.00  67.60   0.00  -6.66  -6.02   0.00   0.00 -16.36  38.56
-------------------------------------------------------------------------------

Segment Leq : 38.56 dBA

Results segment # 8: Plains
---------------------------

Source height = 1.00 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
```


ACOUSTICS NOISE VIBRATION www.hgcengineering.com

```
------------+-------------+-------------+--------------
       1.00 !        1.50 !        1.47 !         1.47

ROAD (0.00 + 38.06 + 0.00) = 38.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    45     90   0.00  67.60   0.00  -7.19  -6.02   0.00   0.00 -16.33  38.06
-------------------------------------------------------------------------------

Segment Leq : 38.06 dBA

Total Leq All Segments: 48.14 dBA

TOTAL Leq FROM ALL SOURCES: 58.83 dBA
```