SS WILSON ASSOCIATES
Consulting Engineers

REPORT NO. WA22-002

NOISE & VIBRATION CONTROL FEASIBILITY STUDY
PROPOSED RESIDENTIAL TOWNHOUSE DEVELOPMENT
2248 CENTRE STREET
THOROLD, ON

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JANUARY 16, 2023

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1.0 INTRODUCTION

1.1 The services of SS Wilson Associates (SSWA) were retained by John Lally of Lally Homes to prepare a Noise and Vibration Control Feasibility Study for the proposed residential townhouse development to be located at 2248 Centre Street, in the community of Allanburg in Thorold, ON.

The objective of this report is to support an application for Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) for the subject development site.

1.2 The site is bounded by the following land uses:
- to the north by a hydro corridor and further by residential dwellings;
- to the south by an existing residential dwelling;
- to the east by a rail line referred to as the CN Stamford Subdivision;
- to the west by Centre Street and the Welland Canal.

The location of the site is shown in Figure 1.

1.3 As indicated in the Pre-Consultation Meeting Notes from the meeting between the City of Thorold and the proponent which took place November 5, 2020, the city requested the developer to update the noise and vibration study to determine the noise and vibration impacts from surrounding sources to ensure the subject site is compatible for a noise-sensitive residential land use.

1.4 Major features of the development are defined by the Concept Plan drawings prepared by Vallee Consulting Engineers, Architects & Planners, Project No. 21-248, Drawing Nos. 1 & 2, dated November 15, 2021. The alternative concept plans describe essentially the same site layout, which comprises between 8 and 15 residential townhomes organized in townhouse blocks in an east-west orientation. The site is accessed from Centre Street to the west, and includes an area to the south that is conceived to be a landscaped outdoor area for use by the townhouse residents.

Figure 2 illustrates the general layout of the proposed development based on concept plan 2, which shows up to 15 townhouse units in 4 blocks. Alternative site plans include fewer units at approximately similar distance setbacks from the sources of noise/vibration.

The following is a summary of the project features for consideration and noise assessment purposes:
- Dwelling facades that are exposed to potential sources of noise stated below.
- Individual/private rooftop terrace Outdoor Living Areas (OLAs) to serve individual dwellings.
- Ground-based common amenity area to serve the proposed development.

1.5 Major surface transportation noise sources (current and future) of concern to the development are:

1. Vehicle traffic upon Centre Street to the west
2. Rail traffic upon the CN Stamford Subdivision line to the east

1.6 There are no nearby stationary noise sources of concern for the proposed development.

1.7 The proposed development is located outside the 25 NEF/NEP contour lines prepared by Transport Canada; therefore, aircraft noise is not considered a problem.

1.8 The subject development is located contiguous or adjacent to a railway line. The project Planner and/or the Architect should take into consideration the technical requirements of the railway company pertaining to minimum distance setback for safety as well as relevant requirements in the Guidelines for New Development in Proximity to Railway Operations.

1.9 The subject development is also located within the influence zone of ground-borne vibration due to the railway of concern. The potential impact due to ground-borne railway vibration is also addressed in this report.

2.0 SUMMARY AND RECOMMENDATIONS

2.1 SUMMARY

Based on the analysis conducted in this investigation it is concluded that:

1. All dwellings on the development will have acceptable outdoor sound levels in their OLAs (backyards and rooftop terraces) and, therefore, no outdoor noise control measures need be considered. The common area to the south side of the site may at times experience sound levels in excess of the applicable criteria; however, since other outdoor living areas are provided for the individual dwellings, no outdoor noise controls need to be implemented.

2. The unattenuated sound levels at the outside walls of some of the dwellings will exceed the recommended objective sound levels. Indoor noise controls are required for these dwellings along with relevant warning clauses. All other dwellings on the development will have acceptable indoor sound levels. Therefore, noise control measures are not required.

3. Although the projected sound levels are predicted to be above the sound level criteria outlined in Section 3, it is feasible to control sound levels within the outdoor and indoor areas of the proposed development to meet the stated criteria.

4. There are no sources of stationary noise which affect the proposed development, therefore no assessment or mitigation for stationary noise sources is required.

5. Due to the proximity of the proposed development to the CN Stamford Subdivision rail line, vibration mitigation measures are recommended to be implemented in the foundations of building facades exposed to rail noise, along with suitable acoustic insulation in the form of brick veneer or acoustically equivalent construction.

2.2 RECOMMENDATIONS

A summary of the minimum noise attenuation requirements is presented in Table 1. Detailed description is as follows:

1. Provision for Air Conditioning

- **Units: All Units**

The above noted properties should be equipped with a ducted forced air heating system: furnace/fan, supply air plenum, and duct work. The components are to be appropriately situated and sized to accommodate future

installation of central air conditioning systems. The provision for future air conditioning should also include the installation of the necessary rough-in work such as a floor drain for the condensate, appropriate electrical power supply, thermostat control wiring and a capped sleeve in the exterior wall for future refrigeration tubing in an approved location (Installation cost of the air conditioning system is an option to the developer/builder as they see fit).

Where the air conditioning units are bracket-mounted on walls or come in direct contact with the building structure, they should be mounted on neoprene/rubber isolation supports or pads that are rated to provide minimum 0.2" static deflection.

If the purchaser/occupant does not take the central air conditioning option, the following clause should be registered in all Development Agreement(s) and Offers of Sale and Purchase or Lease of these properties:

"*This dwelling unit has been fitted with provisions, which include a fan forced heating system, suitably sized ducts, plenum, electrical power wiring, thermostatic control wiring, a nearby floor drain, etc. sized to accommodate the future addition of central air conditioning by the occupant at their expense and discretion. Installation of central air conditioning by the occupant will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment*, Conservation and Parks*. Future installation of the air conditioning system should meet the Ministry of the Environment*, Conservation and Parks *criteria in Publication NPC-216 (a maximum sound level* L_{AS} *of 50 dBA at the neighbour's closest point(s) of reception, i.e., at their ground-based outdoor areas as well as at the closest window on any floor level) and other applicable levels specified by the municipality*."

2. Warning Clauses[1]

- **Units: All Units**

The following warning clause should be registered in all Development Agreement(s) and Offers of Sale and Purchase or Lease of these properties:

"*Purchasers/tenants are advised that despite the inclusion of noise control features within this development area and within the dwellings, sound levels from increasing road and rail traffic may continue to be of concern, occasionally interfering with some activities of the dwelling occupants as the sound level exceeds the Municipality's and the Ministry of the Environment, Conservation and Parks noise criteria."*

"*Purchasers/tenants are advised that the projected outdoor sound levels in the*

*1 Reference should be made to Bulletin No. 91003, Environmental Warnings/Restrictions, Ontario Ministry of Consumer and Commercial Relations.

outdoor landscaped area due to existing and future rail traffic on the nearby rail line may exceed the provincial noise standards for outdoor living areas, and that such noise may at times interfere with outdoor activities should the owners/occupants desire to use such areas."

- **All Units Containing Balconies (if present)**

The following Warning Clause should be registered in all Development Agreements and Offers of Sale and Purchase or Lease of the properties having a balcony, if any:

"*Purchasers/tenants are advised that despite the inclusion of noise control features within this development and within the dwellings, sound levels from increasing road and rail traffic will continue to be of concern as the levels in the balcony exceed the Ministry of the Environment, Conservation and Parks criteria*".

3. Railway Vibration Mitigation

Due to the proximity of the proposed development to the noted railway tracks, it is recommended to implement vibration mitigation measures in the building foundation on the east side facing the rail line. The details of the building vibration isolation shall be prepared during the detailed building design stage to be incorporated into the foundation structural plans.

The following clause should be included in all offers of purchase Agreement(s) of sale and purchase or lease and in the title deed or lease of each dwelling:

"*Warning: The CN Stamford Subdivision (operated by CN) and its assigns and successors in interest has or have right-of-way within 300 m from the subject land hereof. There may be alterations to or expansions of the rail facilities on such right-of-way in the future, including the possibility that they or any railway company entering into an agreement with this railway company to use the right-of-way or their assigns or successors as aforesaid may expand their operations. The 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). CN will not be responsible for any complaints or claims arising from the use of such facilities and/or operations on, over or under the aforesaid right-of-way*."

4. Building Acoustic Insulation

All exterior building components (walls, windows and doors) should meet the minimum Acoustic Insulation Factors (AIF) shown in Tables 3 and 4. All windows should be well fitted and weather-stripped.

It is also the responsibility of the developer/builder responsible for final design and construction of the subject dwellings to ensure that the correct windows,

walls and doors acoustic specifications are secured from the Acoustical Engineer prior to planning and construction of the noted dwellings.

Typical Acoustic Insulation Factors (AIF) are shown in Tables 3 and 4.

The Detailed Noise Control Study should provide complete and specific tabulations of AIF's for all properties affected.

It is also the responsibility of the developer/builder responsible for final design and construction of the subject dwellings to ensure that the correct windows, walls and doors acoustic specifications are secured from the Acoustical Engineer prior to planning and construction of the noted dwellings.

The exterior walls of the dwelling units should be of the **brick** veneer or acoustically equivalent **masonry** wall construction[2] from the ground to the underside of the roof rafters (i.e., on all sides and all floor levels facing the railway line):

5. Implementation Procedures

The following is a summary of the generally recommended procedures for implementation as per the MECP requirements:

a) Prior to final approval of this development for Building Permit, a Detailed Noise Control Study, or an upgraded noise study should be required to take into consideration the following:
   - The proposed detailed grading plans
   - Final lot layout, lot/block numbers, etc.
   - Possible proposed building locations
   - The exact distances to all sources of concern
   - Final/approved sound barrier locations as well as barrier height-sound level alternatives
   - Other relevant conditions to noise in the Development Agreement

b) The necessary Development Agreement(s) should include the details of all the necessary noise control measures and procedures as outlined herein this noise study to the satisfaction of all concerned parties.

c) Prior submission of the project plans for Building Permit, the Builder's plans, with respect to the units requiring noise control measures as referred to earlier, should be certified by an Acoustical Engineer as being in conformance with the recommendations of the Detailed Noise Control Study as approved and/or amended by the authorities having jurisdiction.

   The barrier certification should include approval of the sound barrier shop drawings (showing the barrier material/wood species, construction details,

[2] An acoustically equivalent wall construction must provide minimum sound Transmission Loss (TL) values of 35+dB from 63Hz and upward as designed by an Acoustic Engineer.

support details, arrangements of the panels and exact locations on a development plan, height, and material composition) if applicable.

d) Prior to their final inspection and release for occupancy, these dwellings should be certified by an Acoustical Engineer as being in compliance with the recommendations of the Detailed Noise Control Study.

In view of the fact that municipal implementation procedures of the noise control measures recommended herein may differ, it is the responsibility of the developer/builder responsible for final design and construction of the subject structures/dwellings to ensure that the correct details related to the noise control measures referred in this report, such as sound barriers, building shell component specifications (windows, walls, doors, and others), air conditioning noise control technical requirements, etc. are secured from the Acoustical Engineer prior to planning and construction of the noted building(s).

3.0 SOUND AND VIBRATION LEVEL CRITERIA

3.1 SURFACE TRANSPORTATION CRITERIA[3]

The surface transportation noise is based on the objective sound levels recommended by the Ministry of the Environment, Conservation and Parks (Ref: MECP Publication NPC-300 "Environmental Noise Guideline, Noise Assessment Criteria for Stationary Sources and for Land Use Planning, 2013") and applicable Regional/Municipal sound level standards and procedures for different land uses and spaces.

The following is a summary of the applicable sound level criteria for surface transportation sources for the shown time periods (day=d & night=n):

Sound Level Limits for Outdoor Living Areas (OLAs)

AREA & TIME PERIOD	$L_{Aeq(day)}$ ROAD AND RAIL (dBA)
Designated (Individual or common) Outdoor Living Areas (16 hr day, 07:00 - 23:00)	$L_{Aeq(day)}$ 55

Indoor Sound Level Limits

Type of Space	L_{Aeq} (Time Period) (dBA)	
	Road	Rail
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc. (Time period-day: 16 hr, 07:00 - 23:00)	$L_{Aeq(day)}$ 45	$L_{Aeq(day)}$ 40
Living/dining, den areas of residences, hospitals. nursing homes, etc. (except schools or daycare centres) (Time period-night: 8 hr, 23:00 - 07:00)	$L_{Aeq(night)}$ 45	$L_{Aeq(night)}$ 40
Sleeping quarters (Time period-day: 16 hr, 07:00 - 23:00)	$L_{Aeq(day)}$ 45	$L_{Aeq(day)}$ 40
Sleeping quarters (Time period-night: 8 hr, 23:00 - 07:00)	$L_{Aeq(night)}$ 40	$L_{Aeq(night)}$ 35

[3] Road, rail and rolling stock traffic.

Additional Supplementary (Best Management Practices) Sound Level Criteria Recommended for Other Uses

Type of Space	L_{Aeq} (Time Period) (dBA)	
	Road	Rail
General offices, reception areas, retail stores, etc. (Time period-day: 16 hr, 07:00 - 23:00)	$L_{Aeq(day)}$ 50	$L_{Aeq(day)}$ 45
Living/dining areas of residences, hospitals, schools, nursing/retirement homes, daycare centres, theatres, places of worship, libraries, individual or semiprivate offices, conference rooms, reading rooms, etc. (Time period-day: 16 hr, 23:00 - 07:00)	$L_{Aeq(day)}$ 45	$L_{Aeq(day)}$ 40
Sleeping quarters of hotels/motels (Time period-night: 8 hr, 23:00 - 07:00)	$L_{Aeq(night)}$ 45	$L_{Aeq(night)}$ 40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc. (Time period-night: 8 hr, 23:00 - 07:00)	$L_{Aeq(night)}$ 40	$L_{Aeq(night)}$ 35

The criteria for acceptable outdoor and indoor sound levels are based on "free-field" predicted and/or measured sound levels at the applicable receiver locations, thus the effects of sound reflections and reverberant sound fields are not considered.

If the sound level is less than or equal to the sound level criteria, no control measures will be required.

The outdoor sound levels ***may*** exceed the outdoor sound level criterion by up to 5 decibels, provided that it can be demonstrated that it is not technically, economically or administratively feasible to achieve the criterion and that the occupants are informed of a potential disturbance due to the excess noise by means of a warning clause or cautionary note to be registered in all Development Agreement(s) and Offers of Sale and Purchase or Lease.

Central air conditioning is required when the daytime sound level at the outside wall of any habitable room containing windows exceeds an $L_{Aeq(day)}$ 16 hrs of 65 dBA or when the nighttime sound level at the outside wall of any habitable room containing windows exceeds an $L_{Aeq(night)}$ 8hrs of 60 dBA.

Forced air ventilation (with provision for future installation of a central air conditioning system) is required when the daytime sound level at the outside wall of any habitable room containing windows an exceeds $L_{Aeq(day)}$ 16 hrs of 55 dBA but is less than or equal to 65 dBA or when the nighttime sound level at the outside wall of any habitable room containing windows exceeds an $L_{Aeq(night)}$ 8hrs of 50 dBA

but is less than or equal to 60 dBA.

Application of Criteria

The following table summarizes the requirements for noise control measures for the various sound level range

SOURCE OF NOISE	DAYTIME SOUND LEVEL $L_{Aeq(day)}$	NIGHTTIME SOUND LEVEL $L_{Aeq(night)}$	AIR CONDITIONING	FORCED AIR VENTILATION WITH PROVISION FOR FUTURE AIR COND.	WARNING CLAUSE	ACOUSTIC INSULATION
ROAD	<=55	<=50	-	-	-	-
	>55 & <=65	>50 & <=60	-	Yes	Yes "Type C"	-
	>65	>60	Yes	-	Yes "Type D"	Yes
RAIL	<=55	<=50	-	-	-	-
	>55 & <=60	>50 & <=55	-	Yes	Yes "Type C"	-
	>60 & <=65	>55 & <=60	-	Yes	Yes "Type C"	Yes
	>65	>60	Yes	-	Yes "Type D"	Yes

3.2 GENERAL VIBRATION CRITERIA

The criteria for the assessment of the ground-borne railway vibration is based on the MECP/GO Draft Protocol which specifies a maximum Root-Mean-Square (RMS) velocity of 0.14 millimeters per second (mm/s) at any sensitive receptor.

This is the same criteria recommended by the railway companies in the 2013 Guidelines for New Development in Proximity to Railway Operations, prepared for the Federation of Canadian Municipalities and the Railway Association of Canada.

If measured vibration levels are above this criterion, vibration isolation measures will be implemented to ensure suitable indoor vibration levels.

4.0 ANALYSIS – ENVIRONMENTAL NOISE

4.1 TRANSPORTATION SOURCES OF NOISE

Road Traffic Data

The relevant road and rail traffic data were obtained from the City of Thorold and CN respectively, and are summarized below:

- Centre Street Road Traffic

Current No. of Lanes	2
Future No. of Lanes	2
Posted Speed Limit	50 km/hr.
Future Speed Limit	50 km/hr.
Assumed Speed for Calculation (85th Percentile)	85 km/hr.
AADT (Year 2020)	682 vpd
Future/Ultimate AADT (Year 2032) – Annual Growth Rate (assumed) – Number of Years of Growth (assumed)	917 vpd 2.5% 12
Total Truck Percentage – Medium Truck Split – Heavy Truck Split	7% 5% 2%
Day(16 hrs.)/Night(8 hrs.) Split	90%/10%
Directional Traffic Split (NB/SB)	46%/54%
Road Gradient (assumed)	2%

Appendix A contains the relevant road traffic data used in this study.

Rail Traffic Data (CN "Stamford Subdivision")

The rail traffic data utilized for this study was received from CN for traffic movements within the Thorold Wye, which is a rail turnaround interchange located approximately 500m to the south of the subject site. The wye is used for trains to reorient and turn around for arrivals and departures on the three connecting lines. This data was supplied by CN for another project by SS Wilson Associates, and CN was approached to confirm that the data is still valid. CN did not have any traffic to provide on the specific rail section adjacent to the subject site.

Onsite measurements were taken to assess rail vibration impacts as part of this report. Based on the onsite measurements of the actual train pass-bys, the data from CN appears to significantly overestimate the daytime traffic, and does not account for observed nighttime traffic:

- There were zero daytime trains observed between the hours of 0700 and 2300 at any time during the 7 days of vibration monitoring, as confirmed by continuous camera footage of the rail.
- This is significant, as daytime periods are the only time in which trains are reported by CN for the subject track. In the absence of daytime rail traffic,

there will be no concerns whatsoever for outdoor sound levels in the various outdoor living areas within the subject development, including the outdoor landscaped area.

- While not reported by CN in their traffic data, 2 nighttime train movements were observed (1 small train was observed to pass by in a northerly direction, and shortly returned in the southerly direction).
- This is also significant, as nighttime train movements can cause significant noise impacts upon sleep activities, and were not reported by CN in their data.
- The train that was observed during nighttime hours was moving very slowly, and did not appear to have many cars attached (and therefore is assumed to be a way freight movement).

Based on the observed nighttime trains, the traffic data used in the analysis was adjusted to account for additional way freight trains during the nighttime period. The tables below summarize the rail traffic data used for the subject analysis, based on the received traffic data and the observed nighttime train. Please note that the values below are very conservative; in reality, it appears that there is significantly less rail traffic during the day than reported, and the nighttime trains do not appear to be as large as even the values below show, and also occur infrequently.

DAYTIME (0700-2300)

TYPE OF TRAIN	MAX. NO. OF TRAINS	MAX. NO. OF CARS	MAX. OPER SPEED (KM/H)	MAX. NO. OF LOCOMOTIVES
Freight	4	140	25	4
Way Freight	4	25	25	4

NIGHTTIME (2300-0700)

TYPE OF TRAIN	MAX. NO. OF TRAINS	MAX. NO. OF CARS	MAX. OPER SPEED (KM/H)	MAX. NO. OF LOCOMOTIVES
Way Freight	2	25	25	4

ADDITIONAL COMMENTS

1. The above traffic is for present day conditions. To allow for future increases in rail traffic volumes we have increased the above data by 2.5% per year for 10 years.
2. The measures recommended in this report are strictly related to environmental noise due to train pass-bys. Reference to other measures for safety including distance setbacks, berming, and specific warning clauses can be found in the relevant policies published by the railway company.

Appendix A contains the relevant rail traffic data used in this study.

4.2 OUTDOOR NOISE ENVIRONMENT

Sound level predictions were carried out based on MECP's ORNAMENT and STEAM sound level prediction modeling procedures[4] (Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, 1989 and STEAM, Sound from Trains Environmental Analysis Method, 1990).

Representative receptor locations were selected based on the proposed site plan, and included the building facades of the subject townhouses, their associated backyard areas, potential rooftop terraces, and a ground-based common area that may be used by residents for outdoor activities.

Overall sound levels at the OLAs of the selected representative receptor locations are shown in Table 2. Sample sound level calculations at representative receptor locations are presented in Appendix B.

For the above-noted outdoor living areas, the unattenuated daytime sound levels in the OLAs are predicted to be in the range of L_{Aeq} 55dBA to 60dBA, therefore per MECP guidelines, outdoor noise controls should be recommended. The conventional approach by which excess noise in the rear yard OLAs may be mitigated is through construction of acoustical barriers.

However, based on the analysis conducted herein, outdoor noise controls to protect backyard or common OLAs are not considered necessary for the following reasons:

- Rooftop terraces are planned to be provided for residents, which are predicted to experience sound levels of up to 56dBA from both road and rail noise, which is practically in compliance with the MECP's objective sound level of 55 dBA.
- Therefore, a quiet rooftop outdoor living area is achieved with the simple use of a standard 1.1m high parapet (required by the OBC for safety purposes), and this provides the residents with a suitably quiet outdoor area; therefore, the backyard areas may be subjected to higher sound levels, less than 60 dBA, with the inclusion of a warning clause.
- Backyards of the individual townhouses will be between up to 59 dBA, from all sources of road and rail traffic. However, as observed during the onsite measurements, daytime rail movements are significantly rarer than as indicated by CN, and will produce very infrequent impacts in the backyards which will normally be much quieter; in the absence of rail noise, sound levels in the backyard OLAs due to road sources are predicted to be less than 56 dBA, which are considered to be very low and acceptable.
- Similarly, the ground-floor common OLA at the south end of the proposed

[4] The MECP's noise prediction models ORNAMENT and STEAM have a limitation as to the minimum AADT value for 24-hour traffic volume (calculated for the daytime and nighttime hourly volume). When the AADT value is less than 40 vph, there is a neutral mathematical manipulation that can be used as long as the hourly traffic volume is not very low. The manipulation is implemented by multiplying the traffic volume by any reasonable factor (for example a factor of 10) and then by deducting 10 x log "factor" from the results (in this case, 10 x log 10=10).

site plan may experience sound levels up to 63 dBA, which is above the Ministry's maximum objective sound levels; however, suitably quiet outdoor environments have been provided in the form of backyards and rooftop terraces for individual use by the residents.

The detailed architectural design of the townhouses has not yet taken place, and it is not yet known if the townhouses will contain balconies for use by the occupants. Provided they are less than 4m in depth, the balconies for the proposed development are not considered as OLAs due per MECP guidelines.

Therefore, no physical mitigation measures are required and warning clauses registered in the Development Agreement(s) will suffice.

4.3 INDOOR NOISE ENVIRONMENT

The criteria for indoor L_{Aeq} sound levels are based on projected L_{Aeq} levels at the outside face of the dwellings with appropriate assumptions for the differences between the outdoor and indoor sound levels. If the outside L_{Aeq} levels do not exceed the recommended objective sound levels, then the indoor L_{Aeq} levels will not be exceeded, assuming standard building construction and operable windows.

Overall daytime sound levels at the building facades are shown in Table 3, and the overall nighttime sound levels at the building facades are shown in Table 4.

In consideration of the estimated sound levels and by comparison to the acceptable indoor sound level criteria (Section 3) the following is concluded:

- The daytime/nighttime noise environment at the outside walls of all of the townhouse blocks (within any habitable room on any floor) is predicted to be in the range of $L_{Aeq\ day}$ 56-65 dBA and/or $L_{Aeq\ night}$ 51-60 dBA. Forced-air heating system with provision for central air conditioning is therefore required.

Typical Acoustic Insulation Factors (A.I.F.) are summarized in Tables 3 and 4.

For roadway noise, since the projected highest L_{Aeq} (day) sound level will be lower than or equal to 65 dBA and/or the projected highest L_{Aeq} (night) sound level will be lower than or equal to 60 dBA, the levels will not be of concern to warrant the use of special glazing or building components[5] on the west building facade.

Due to predicted sound levels on the east building facade in excess of 60 dBA due to railway traffic, special glazing and building components may be required (depending on the interior layout) to achieve the recommended indoor levels. The values presented herein are for information purposes, and the specific AIF factors for building construction and window glazing will be provided during the detailed design stage based on the specific room layouts and window sizes.

[5] Therefore, the highest daytime AIF will be equal to or lower than 32 and the highest nighttime AIF will be equal to or lower than 27 assuming 3 components.

4.4 TYPICAL WINDOW / WALL CONSTRUCTION

As the detailed architectural plans for Building Permit submission are not available at this time, it is not possible to specify the window and wall details to meet the AIF requirements presented in Tables 3 and 4. Further detailed analysis should be undertaken based on the data presented in this Report to take into consideration the final room location, floor area, window type (operable or fixed), window size and orientation, etc. Such analysis is required by the MECP and the municipality prior to submission for building permits as part of their Certification process.

It must be pointed out that there are several factors affecting the final glass selection including:

1. Size of window.
2. Room dimensions.
3. Floor level and direction room faces.
4. Fixed or operable glass.
5. The number of building components.
6. Type of wall to be used.
7. Projected sound levels outside the window
8. The choice of “laminated” window glazing in one or two of the window panes.

For the calculation of type of windows required for each dwelling, a detailed description of each unit is required.

As an example, for a typical unit with daytime outdoor sound level of 62 dBA, the AIF value for the Living Room will be 29 assuming 3 components. If the window to floor ratio is 32%, then the window requirements in terms of glass thickness, mm (air space thickness, mm) glass thickness, mm are any of the following:

Double Glazed: 3mm (13mm) 3mm; 4mm (6mm) 4mm

As an example, for a typical unit with nighttime outdoor sound level of 56 dBA, the AIF value for the bedrooms will be 29 assuming 3 components. If the window to floor ratio is 20%, then the window requirements in terms of glass thickness, mm (air space thickness, mm) glass thickness, mm are any of the following:

Double Glazed: 3mm (6mm) 3mm

The above window glazing construction is typical examples only. It is recommended that prior to the submission of the building plans for Building Permit that the detailed architectural drawings of the units requiring noise control measures, as referred to earlier, be examined by an Acoustical Engineer in order to advise the design consultant on the ***specific*** building components for noise control to suite the actual window construction details.

IMPORTANT NOTES TO THE WINDOW SUPPLIER/CONTRACTOR:

The Contractor should use the window glazing dimensions specified in this report. If the Contractor chooses to use, instead the minimum specified STC values herein in this report, then the Contractor MUST observe the following rules:

(1) The **specific** windows MUST be tested by an "accredited" acoustic laboratory that is "NVLAP" accredited, and
(2) The full STC test results shall be submitted to SS Wilson Associates for prior approval before installation.

4.5 CONTROL OF AIR CONDITIONING UNITS NOISE

To control the environmental noise emitted by air conditioning or heat pump units it is essential that the following procedures and specifications be considered to by the parties responsible for the selection, design and installation of the air conditioning systems:

1. Control of air conditioning noise is governed by Provincial and/or municipal standards which specify acceptable sound emission levels for the air conditioning devices and/or acceptable sound levels at the point(s) of reception.

   The Ministry of the Environment, Conservation and Parks criteria for control of air conditioning noise is outlined in several technical publications including publications NPC-300 and NPC-216 (a maximum sound level of 50 dBA[6] at the neighbour's closest point(s) of reception, i.e. at their outdoor areas as well as at the closest window on any floor level). The applicable sound level criteria for new residential development where air conditioning is a mandatory requirement for noise control inside habitable rooms are: 1) a maximum ARI* Sound Rating to suit the site specific installation for the air conditioning device, and 2) hourly L_{Aeq} sound level limits of 50 dBA at the point(s) of reception (or the prevailing hourly L_{Aeq} due to vehicular traffic ambient noise if higher than 50 dBA).

   Municipal standards for air conditioning noise may also include specific or maximum Sound Rating numbers (in bels) and/or point-of-reception sound level limits in reference to specific municipal By-Laws and/or standards as applicable.

   Therefore, it is essential that the final selection, location, design, and specifications of the air conditioning devices ensure compliance with the applicable sound level criteria prior to making any commitment.

   The following are examples of the preferred approach when dealing with the issue of air conditioning noise.

[6] Or the lowest hourly ambient Leq due to road traffic projected at the receptor location(s)
* When tested in accordance with ARI Standard 270-84

a) If the A/C condensing unit is to be installed in backyards in urban areas, then units having lower bels rating will likely be required. The use of units with lower sound rating of 6.8bel (equivalent to 68 dBA sound power) or lower may give the builder the flexibility of locating the unit as close as 3 metres from the joint property lines without exceeding the MECP 50 dBA standard for houses in urban areas.
b) If the unit is to be located in the front or in the side yard areas (closer to the front and provided that there are no windows to habitable rooms on the side walls), then units having less stringent sound level rating requirements may result in complying with sound criteria.
c) Through the building permit process of the specific properties, additional calculations must be performed to optimize the unit sound ratings depending on the house model and the installation location.

2. The resulting sound levels due to residential air conditioners at the nearest points-of-reception must not exceed the levels in MECP Publication NPC-216 (a maximum sound level of 50 dBA[7] at the neighbour's closest point(s) of reception, i.e. at their outdoor areas as well as at the closest window on any floor level).

3. The siting of the split-system central air conditioning units and other systems should follow good planning principles.

4. Should location of the outdoor air conditioner unit be in the back or side yard areas where noise is likely to interfere with the outdoor and indoor activities of any occupant and/or neighbor, then it is necessary to design and install noise control measures. Noise control measures include any or a combination of the following:

   a. Distance setback away from the receptor(s).
   b. Sound barrier wall(s) or ultimately an acoustic enclosure.
   c. Sealing selected windows, i.e. installation of non-operable windows.
   d. Deleting selected windows.

   It is also **important** that the necessary detailed technical analysis be performed prior to submitting an application for Building Permit to optimize the required air conditioning unit Sound Rating number in order to meet the Provincial sound level standards at the closest receptors after taking into consideration the specific property design and proposed A/C unit location. Other A/C noise control measures, where required to meet the sound level criteria at the point(s) of reception, should also be identified and shown on the applicable permit drawings/specifications.

[7] Or the lowest hourly ambient Leq due to road traffic projected at the receptor location(s)

4.6 Important Notes for the Residential Builder Regarding Windows

The results in this report provide information on the calculated Acoustic Insulation Factors (AIF) for windows based on typical assumed window and room dimensions.

To assist the Builder in appreciating the fact of whether the results presented herein require typical commercially available residential type windows, or special type windows, the following table[8] provides reasonably accurate information on whether such window(s) are standard industry window or not:

Acoustic Insulation Factor (AIF) in this report	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**
Window to room floor area percentage NOT to be exceeded	**10%**	**13%**	**16%**	**20%**	**25%**	**32%**	**40%**	**50%**	**63%**	**80%**

If the above ratios are exceeded, several options are available to the builder including one or more of: reducing the size of the window, increasing the inter-pane air spacing, the use of thicker glazing, the use of "laminated" glazing (1 or 2 panes), etc.

WORKED EXAMPLE 1:

- AIF shown in this study: 31
- Actual room floor area: 250 sq.ft.
- You selected a window area of: 45 sq.ft
- Your window/floor ratio: (45 divided by 250, then times 100) =18%
- Your result is less than above table value 25%; i.e. standard glazing unit

WORKED EXAMPLE 2:

- AIF shown in this study: 34
- Actual room floor area: 200 sq.ft.
- You selected a window area of: 50 sq.ft
- Your window/floor ratio: (50 divided by 200, then times 100) =25%
- Your result is more than above table value 13%; i.e. Non-standard (special) glazing unit

4.7 Abbreviations

Basic Descriptor	**Measurement Weighting**	**Time Weighting Characteristics**
		F(Fast)**. S**(Slow)**. I**(Impulse)**.**
L_p Sound pressure level	A-Weighted sound pressure level	L_{AF}, L_{AS}, L_{AI}
	C-Weighted sound pressure level	L_{CF}, L_{CS}, L_{CI}
	Z-Weighted sound pressure level(Flat)	L_{ZF}, L_{ZS}, L_{ZI}
L_{eq} Equivalent continuous sound level	Equivalent continuous A-weighted sound level	L_{Aeq}, L_{AIeq}
	Equivalent continuous C-weighted sound level	L_{Ceq}, L_{CIeq}
	Equivalent continuous Z-weighted(Flat) sound level	L_{Zeq}, L_{ZIeq}
L_E Sound Exposure Level	A-Weighted sound exposure Level	L_{AE}, L_{AIE}

[8] Based on a typical commercially available glazing: 3mm inside pane, 16mm inter-pane air space & 3mm exterior pane.

	C-Weighted sound exposure Level	L_{CE}, L_{CIE}
	Z-Weighted sound exposure Level(Flat)	L_{ZE}, L_{ZIE}
L_{max}, L_{min}	Maximum A-weighted sound level	L_{AFmax}, L_{ASmax}, L_{AImax}
Maximum Sound Level	Maximum C-weighted sound level	L_{CFmax}, L_{CSmax}, L_{CImax}
	Maximum Z- weighted sound level(Flat)	L_{ZFmax}, L_{ZSmax}, L_{ZImax}
L_N Percentile Sound Level	Percentile A-weighted sound level	L_{AFNn}, L_{ASN}, L_{AIN}
	Percentile C-weighted sound level	L_{CFNn}, L_{CSN}, L_{CIN}
	Percentile Z-weighted sound level(Flat)	L_{ZFNn}, L_{ZSN}, L_{ZIN}
L_{peak}	A-Weighted peak sound level	L_{Apeak}
Peak Sound Level	C-Weighted peak sound level	L_{Cpeak}
	Z-Weighted peak sound level(Flat)	L_{Zpeak}

5.0 ANALYSIS – GROUND-BORNE VIBRATION

5.1 Vibration Assessment Criteria

As briefly mentioned previously, the criteria for vibration assessment are based on the vibration criteria recommended by the MECP, ISO, and the railway companies themselves, which all target vibration levels below a Root-Mean-Square (RMS) velocity of 0.14 mm/s or less.

5.2 Vibration Measurements

In order to collect information on the ambient vibration levels and impacts from rail pass-bys, long-term monitoring was conducted for a period of 7 days from March 16, 2022, to March 22, 2022, inclusive.

The location of the vibration measurement was selected to be representative of the proposed location for the nearest building façade of the future development (Townhouse Unit 15). The location of the measurement is illustrated in Figure 3.

The vibration probe was securely mounted upon an aluminum spike driven into the ground, which was weather proofed and connected to a battery backup for power supply. The real time analyzer was set up to record the vibration levels on a second-by-second basis.

The following instrumentation was used for the measurements:

- NTi XL2 Acoustic Analyzer precision sound level/vibration meter and acoustic analyzer, Serial A2A-18488-E0
- PCB (ICP) accelerometer Scantek Model PV-57A
- Bruel & Kjaer calibration exciter Type 4294

Figure 4 shows a typical field instrumentation setup and equipment used for measurements in native ground.

5.3 Vibration Results

As stated in Section 4.1 discussing rail traffic data, only 1 train (2 movements) was observed during the entire measurement period, taking place around 1:00AM on March 17, 2022. When the vibration measurement data was examined at this specific time period, there is no measurement signal that clearly rises above the ambient vibration levels at other times. This indicates that the vibration impact from the subject train pass-by is unlikely to have any impact on the proposed development.

However, from the camera footage of the train pass-by, this train appears to be traveling at very low speeds and made up of only 1 locomotive and 1 or 2 rail cars. This is not representative of the worst-case trains indicated by CN traffic, which indicates that some trains may have up to 140 rail cars, and 4 locomotives, which

are the most significant source of rail vibrations. Furthermore, trains could be traveling at higher speeds than the train that was observed. Therefore, it was not possible to determine the worst-case vibration impact from the singular train pass-by during the measurement period. In order to capture the worst-case rail pass-by condition, it would be necessary to monitor for significant time periods in the hope of capturing a longer train, which may not happen on a regular, predictable basis.

Therefore, it is recommended to implement vibration isolation measures as a preventative measure to avoid adverse vibration impacts from significantly larger trains with more power/locomotive cars, which have a much greater potential to produce noticeable vibration at the subject dwelling.

The vibration isolation features shall be designed during the detailed structural design stage prior to application for building permit, to be incorporated into the foundation design on the east side facing the rail tracks. Vibration control measures may include:

- The use of special backfilling materials on the exposed facades;
- Treatments to the external face of the foundation walls (wraps, foam insulation, or other dampening materials);
- The use of vibration isolation pads or “pucks” on top of the building structural foundations below the framed construction of the upper levels.

TABLES

TABLE 1

SUMMARY OF MINIMUM REQUIRED NOISE CONTROL MEASURES

RECEPTOR	SOUND BARRIER	CENTRAL AIR CONDITIONING	PROVISION FOR CENTRAL AIR CONDITIONING	WARNING CLAUSE	**Brick** veneer or acoustically equivalent **masonry** wall construction[9] (FOR RAILWAY NOISE)
All Dwelling Units	No	No	Yes	Yes	Yes

[9] An acoustically equivalent wall construction must provide minimum sound Transmission Loss (TL) values of 35+dB from 63Hz and upward as designed by an Acoustic Engineer.

N6 Leq-AIF Master-January 2007 Proceed

SS WILSON ASSOCIATES

2022-05-05 11:32

Leq- AIF CALCULATIONS AND TYPICAL WINDOW GLAZING REQUIREMENTS (Using NRC/MOE Pocedure

File Number : WA22-002

Project Name : 2248 Centre Street

OUTDOORS

Table 2

Description : Thorold, ON

Description : Townhouse Blocks

Any Heavy Rail Line ? Yes

Appropriate adjustment will be applied to the Acoustic Insulation Factor to account for their

Record Number	1	2	3	4	5	6	7	8	9	10	11	12
Consider Record	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N
RECEPTOR	UNIT 1	UNIT 1	UNIT 8	UNIT 8	UNIT 9	UNIT 9	UNIT 15	UNIT 15				
FACE/DIRECTION	North/West	North/West	North/East	North/East	South/West	South/West	South/East	South/East				
LOCATION	Backyard	Rooftop	Backyard	Rooftop	Backyard	Rooftop	Backyard	Rooftop				
Source 1: Centre Street	Road Traffic		OUTDOOR DAYTIME LEVELS		OUTDOOR DAYTIME LEVELS				OUTDOOR DAYTIME LEVELS			
Leq Outdoors	56.00	48.00	45.00		56.00	48.00	44.00					
Partial angle of exposure, degrees	180	180	180	180	180	180	180	180				
Partial exposure adjust., dB												
Barrier Adjustment, dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA	56.00	48.00	45.00		56.00	48.00	44.00					
Source 2: Rail Line (Stamford)	Rail Traffic		OUTDOOR DAYTIME LEVELS		OUTDOOR DAYTIME LEVELS				OUTDOOR DAYTIME LEVELS			
Leq Daytime	52.00		56.00	56.00	53.00		59.00	56.00				
Partial angle of exposure, degrees	180	180	180	180	180	180	180	180				
Partial exposure adjust., dB												
Barrierl Adjustment, dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA	52.00		56.00	56.00	53.00		59.00	56.00				
Source 3:	Road Traffic		OUTDOOR DAYTIME LEVELS		OUTDOOR DAYTIME LEVELS				OUTDOOR DAYTIME LEVELS			
Leq Daytime												
Partial angle of exposure, degrees	180	180	180	180	180	180	180	180				
Partial exposure adjust., dB												
Additional Adjustment, dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Source 4:	Road Traffic		OUTDOOR DAYTIME LEVELS		OUTDOOR DAYTIME LEVELS				OUTDOOR DAYTIME LEVELS			
Leq Daytime												
Partial angle of exposure, degrees	180	180	180	180	180	180	180	180				
Partial exposure adjust., dB												
Additional Adjustment, dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Sub-Tot. 4 Sources Leq, dBA	**57.46**	**48.00**	**56.33**	**56.00**	**57.76**	**48.00**	**59.14**	**56.00**				
Aircraft noise NEF/NEP												
Adjust.1												
Adjust.2												
Adjusted NEF/NEP												
Approx. Overall Combined Leq	*57*	*48*	*56*	*56*	*58*	*48*	*59*	*56*				
Overall Road and/or Rail and/or Stationary Sources, Leq (dBA)	***57***	***48***	***56***	***56***	***58***	***48***	***59***	***56***				
Aircraft Noise Only, NEF												
NOTES												

N6 Leq-AIF Master-January 2007 Proceed

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2022-05-05 11:38

Leq- AIF CALCULATIONS AND TYPICAL WINDOW GLAZING REQUIREMENTS

File Number : WA22-002

Project Name : 2248 Centre Street

Description : Thorold, ON

DAYTIME

Table 3

(Using NRC/MOE Pocedures)

Description : Townhouse Block

Caution: , the AIF Reported for heavy Rail Noise is the Higher of day and night

Record Number	1	2	3	4	5	6	7	8	9	10	11	12
Consider Record	Y	Y	Y	Y	N	N	N	N	N	N	N	N
RECEPTOR	Unit 1	Unit 8	Unit 9	Unit 15								
FACE/ DIRECTION	WEST	EAST	WEST	EAST								
LOCATION	BUILDING FACADE	BUILDING FACADE	BUILDING FACADE	BUILDING FACADE								
ROOM CLASSIFICATION	Living /Dining	Living /Dining	Living /Dining	Living /Dining								
Adjustm. to Criterion, dBA												
MOE Transportation Sources Daytime Leq Indoor Criteria, dBA	45	45	45	45								
Aircraft Indoor Criteria, NEF	5	5	5	5								
Source 1: Centre Street	Road Traffic		DAYTIME LEVELS			DAYTIME LEVELS			DAYTIME LEVELS			
Leq Daytime	58.00		58.00									
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA	58.00		58.00									
Angular range of incidence (0,1,2,3)												
Adjusted AIF	20	-38	20	-38	-38	-38	29	18	9	-38	-38	-38
Source 2: Rail Line (Stamford)	Rail Traffic		DAYTIME LEVELS			DAYTIME LEVELS			DAYTIME LEVELS			
Leq Daytime		61.00		62.00								
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA		61.00		62.00								
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-28	28	-28	29	-28	-28	-28	-28	-28	-28	-28	-28
Source 3:	Road Traffic		DAYTIME LEVELS			DAYTIME LEVELS			DAYTIME LEVELS			
Leq Daytime												
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38
Source 4:	Road Traffic		DAYTIME LEVELS			DAYTIME LEVELS			DAYTIME LEVELS			
Leq Daytime												
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38	-38
Sub-Tot. 4 Sources Leq, dBA	**58.00**	**61.00**	**58.00**	**62.00**								
Aircraft noise NEF/NEP												
Adjust.1												
Adjust.2												
Adjusted NEF/NEP												
Approx. Overall Combined Leq	*58*	*61*	*58*	*62*								
Assumed Window/ Floor Area %	32.0	32.0	32.0	32.0								
Assumed Total # of Components (Road, Rail, and Other Sources)	3	3	3	3								
Assumed Total # of Components Aircraft ONLY	3	3	3	3								
AIF of 4 Sources	*20*	*28*	*20*	*29*								
Aircraft AIF												
Combined AIF	20	28	20	29								
Openable or Fixed windows ?	Openable	Openable	Openable	Openable								
Regular or Laminated Glass	Regular	Regular	Regular	Regular								
Other Adjustment												
Final Adjusted AIF	20	28	20	29								
Minimum STC (Approx)	*21*	*29*	*21*	*30*								
Typical Minimum Double Glazing Alternatives	3(6)3	3(6)3	3(6)3	3(13)3 4(6)4								
NOTES	Provision for A/C	Provision for A/C	Provision for A/C	Provision for A/C								

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SUMMARY TABLE OF **Leq- AIF CALCULATIONS AND TYPICAL WINDOW GLAZING REQUIREMENTS**

WA22-002
2248 Centre Street
Thorold, ON
Townhouse Block

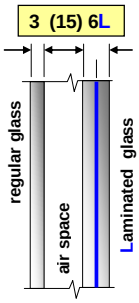
DAYTIME
Table 3

- Windows must be well-fitted weatherstripped units. - The interpane spacing shown in the tables are the minimum acceptable.
- Larger spacing for a given glazing thickness normally improves the performance.

RECEPTOR	FACE/DIRECTION	ROOM CLASSIFICATION	LOCATION	Openable or Fixed Window	Regular Strength or Laminated Glass	Combined AIF	Approx. Overall Combined Leq	Double Glazing Alternatives , mm / Triple Glazing Alternatives , mm	*Minimum STC (Approx)*
Unit 1	WEST	Living /Dining	BUILDING FA	Openable	Regular	20	58	3(6)3	*21*
Unit 8	EAST	Living /Dining	BUILDING FA	Openable	Regular	28	61	3(6)3	*29*
Unit 9	WEST	Living /Dining	BUILDING FA	Openable	Regular	20	58	3(6)3	*21*
Unit 15	EAST	Living /Dining	BUILDING FA	Openable	Regular	29	62	3(13)3 4(6)4	*30*

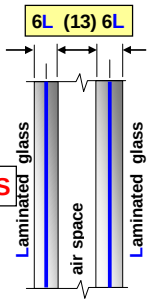
ABBREVIATIONS SPECIFIC TO THIS PROJECT : FF(Front Face), RF(Rear Face), RS(Right Side face), LS(Left Side face)

Double Glazing- regular glass

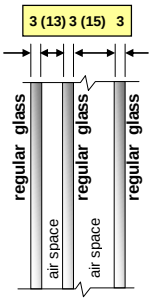


Double Glazing- *single laminated glass*

EXAMPLES



Double Glazing- *double laminated glass*



Triple Glazing- regular glass

N6 Leq-AIF Master-January 2007 Proceed **SS WILSON ASSOCIATES**

2022-05-05 11:38 **Leq- AIF CALCULATIONS AND TYPICAL WINDOW GLAZING REQUIREMENTS** (Using NRC/MOE Poc

File Number : WA22-002

Project Name : 2248 Centre Street

Description : Thorold, ON

NIGHT TIME

Table 4

Description : Townhouse Block

Caution: , the AIF Reported for heavy Rail Noise is the Higher of day and night

Record Number	1	2	3	4	5	6	7	8	9	10	11	12
Consider Record	Y	Y	Y	Y	N	N	N	N	N	N	N	N
TOWNHOUSE/ UNIT NO.	Unit 1	Unit 8	Unit 9	Unit 15								
FACE/ DIRECTION	WEST	EAST	WEST	EAST								
LOCATION	BUILDING FACADE	BUILDING FACADE	BUILDING FACADE	BUILDING FACADE								
ROOM CLASSIFICATION	Bedroom	Bedroom	Bedroom	Bedroom								
Adjustm. to Criterion, dBA												
MOE Transportation Sources Night Leq Indoor Criteria, dBA	40	40	40	40								
Aircraft Indoor Criteria, NEF												
Source 1: Centre Street	Road Traffic		**NIGHT TIME LEVELS**			NIGHT TIME LEVELS			NIGHT TIME LEVELS			
Leq Night Time	52.00		52.00									
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA	52.00		52.00									
Angular range of incidence (0,1,2,3)												
Adjusted AIF	19	-33	19	-33	25	13	26	15	6	-33	-33	-33
Source 2: Rail Line (Stamford)	Rail Traffic		**NIGHT TIME LEVELS**			NIGHT TIME LEVELS			NIGHT TIME LEVELS			
Leq Night Time		56.00		56.00								
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA		56.00		56.00								
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-28	28	-28	29	-28	-28	-28	-28	-28	-28	-28	-28
Source 3:	Road Traffic		**NIGHT TIME LEVELS**			NIGHT TIME LEVELS			NIGHT TIME LEVELS			
Leq Night Time												
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33
Source 4:	Road Traffic		**NIGHT TIME LEVELS**			NIGHT TIME LEVELS			NIGHT TIME LEVELS			
Leq Night Time												
Partial angle of exposure, degrees	180	180	180	180								
Partial exposure adjust., dB												
Additional Adjustment, dB												
Sub-Total Leq, dBA												
Angular range of incidence (0,1,2,3)												
Adjusted AIF	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33	-33
Sub-Tot. 4 Sources Leq, dBA	**52.00**	**56.00**	**52.00**	**56.00**								
Aircraft noise NEF/NEP												
Adjust.1												
Adjust.2												
Adjusted NEF/NEP												
Approx. Overall Combined Leq	*52*	*56*	*52*	*56*								
Assumed Window/ Floor Area %	20.0	20.0	20.0	20.0								
Assumed Total # of Components (Road, Rail, and Other Sources)	3	3	3	3								
Assumed Total # of Components Aircraft ONLY	3	3	3	3								
AIF of 4 Sources	*19*	*28*	*19*	*29*								
Aircraft AIF												
Combined AIF	19	28	19	29								
Openable or Fixed windows ?	Openable	Openable	Openable	Openable								
Regular or Laminated Glass	Regular	Regular	Regular	Regular								
Other Adjustment												
Final Adjusted AIF	19	28	19	29								
Minimum STC (Approx)	*18*	*27*	*18*	*28*								
Typical Minimum Double Glazing Alternatives	3(6)3	3(6)3	3(6)3	3(6)3								
NOTES	Provision for A/C	Provision for A/C	Provision for A/C	Provision for A/C								

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SUMMARY TABLE OF **Leq- AIF CALCULATIONS AND TYPICAL WINDOW GLAZING REQUIREMENTS**

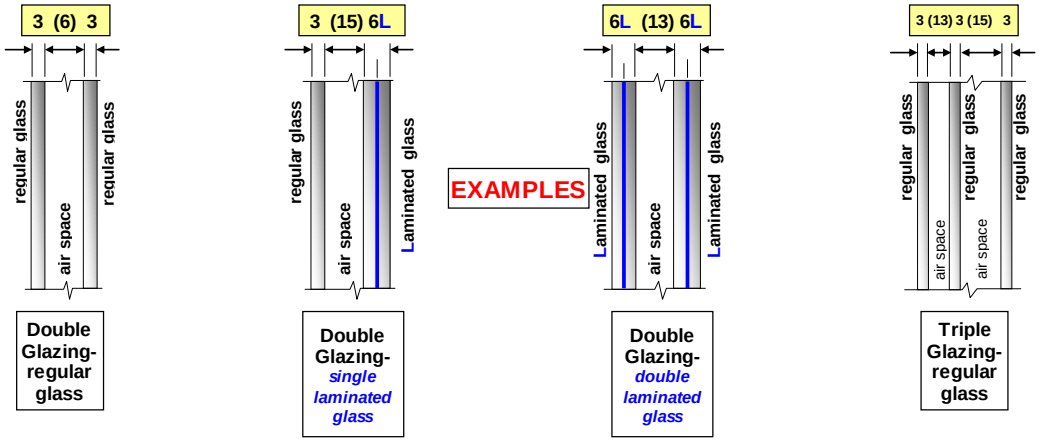
WA22-002
2248 Centre Street
Thorold, ON
Townhouse Block

NIGHT TIME
Table 4

- Windows must be well-fitted weatherstripped units. - The interpane spacing shown in the tables are the minimum acceptable.
- Larger spacing for a given glazing thickness normally improves the performance.

TOWNHOUSE/UNIT NO.	FACE/DIRECTION	ROOM CLASSIFICATION	LOCATION	Openable or Fixed Window	Regular Strength or Laminated Glass	Combined AIF	Approx. Overall Combined Leq	Double Glazing Alternatives , mm	Triple Glazing Alternatives , mm	*Minimum STC (Approx)*
Unit 1	WEST	Bedroom	BUILDING FA	Openable	Regular	19	52	3(6)3		*18*
Unit 8	EAST	Bedroom	BUILDING FA	Openable	Regular	28	56	3(6)3		*27*
Unit 9	WEST	Bedroom	BUILDING FA	Openable	Regular	19	52	3(6)3		*18*
Unit 15	EAST	Bedroom	BUILDING FA	Openable	Regular	29	56	3(6)3		*28*

ABBREVIATIONS SPECIFIC TO THIS PROJECT : FF(Front Face), RF(Rear Face), RS(Right Side face), LS(Left Side face)



FIGURES

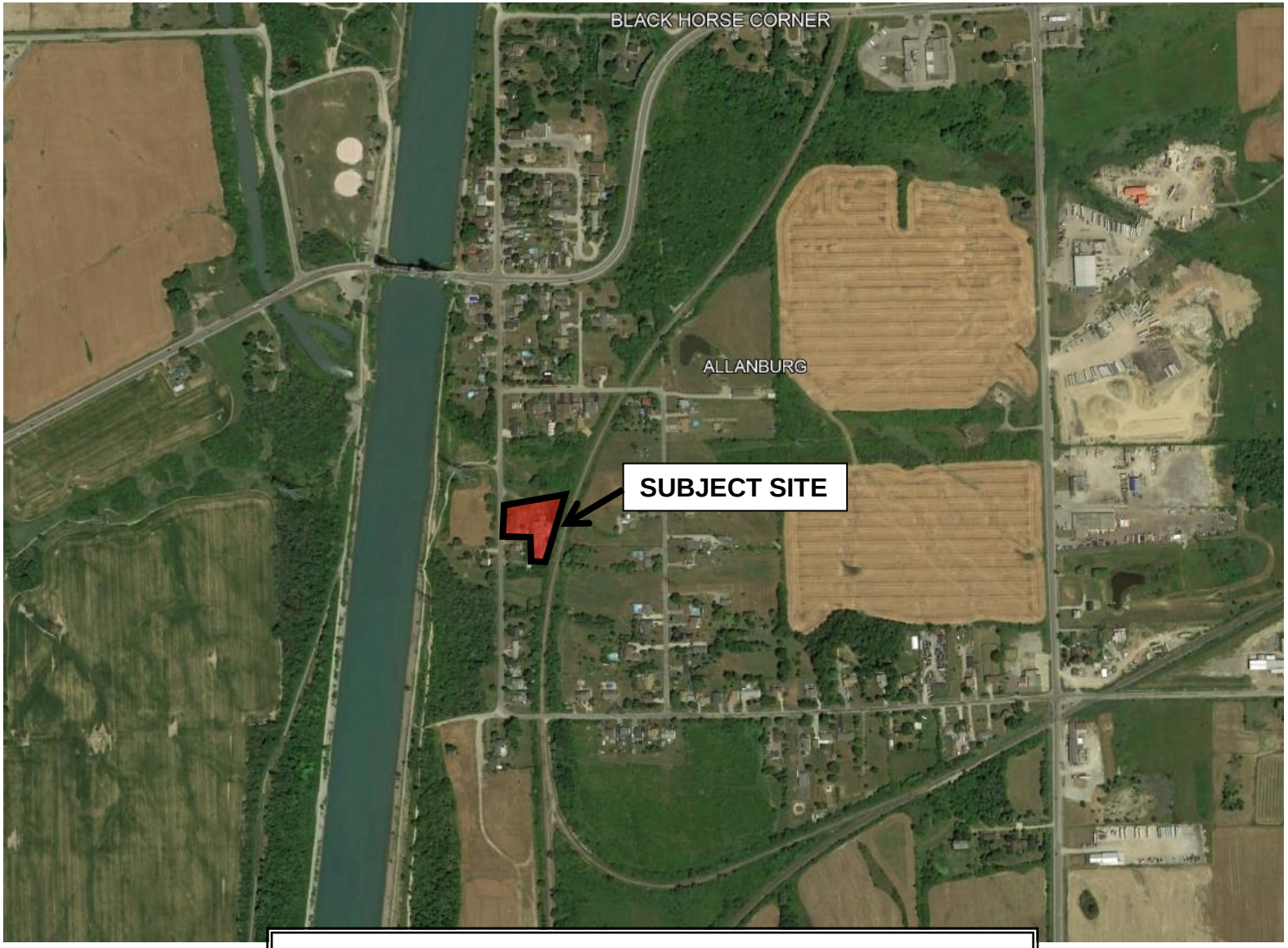


FIGURE 1
KEY PLAN

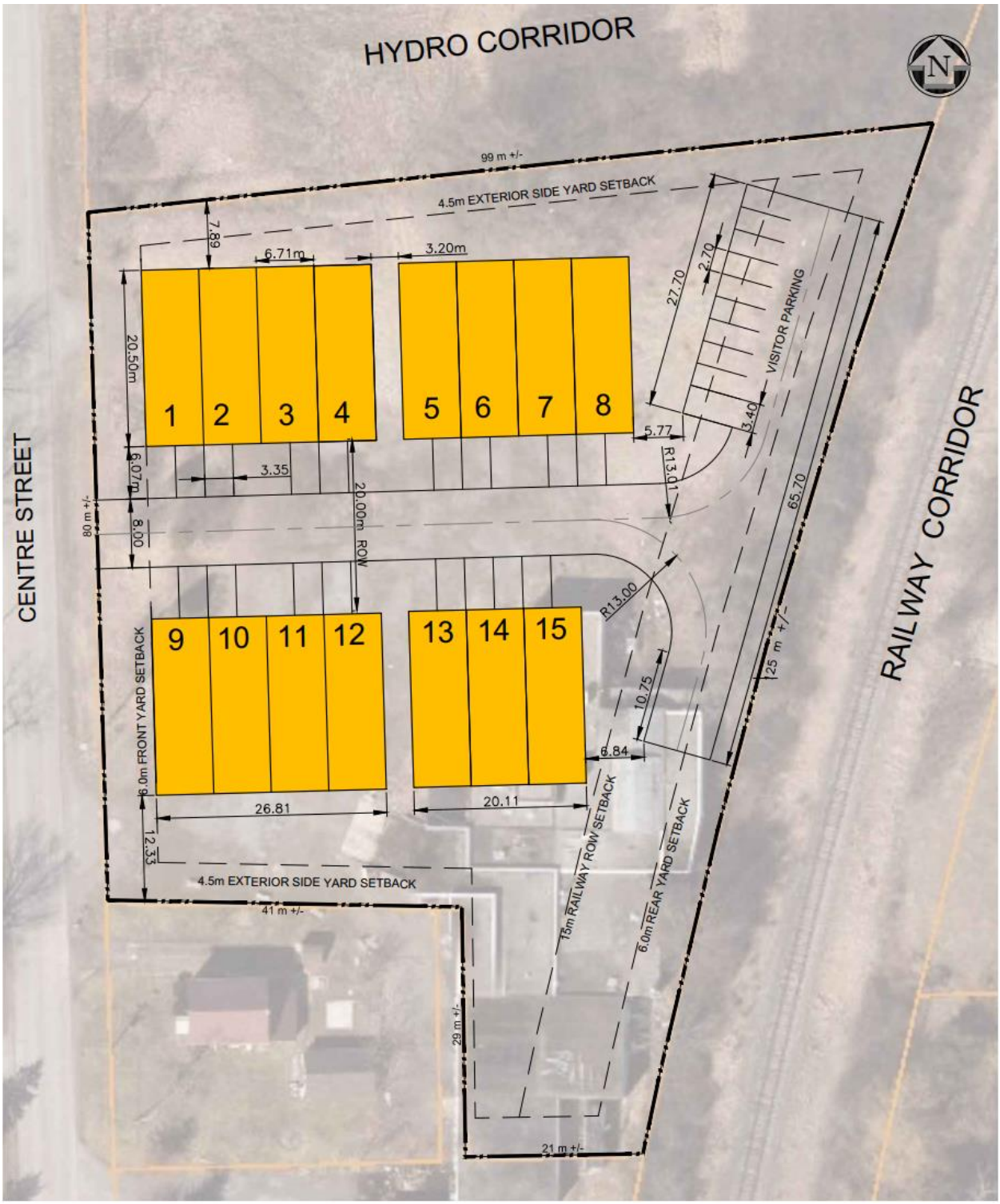


FIGURE 2
PROPOSED SITE PLAN (CONCEPT 2)

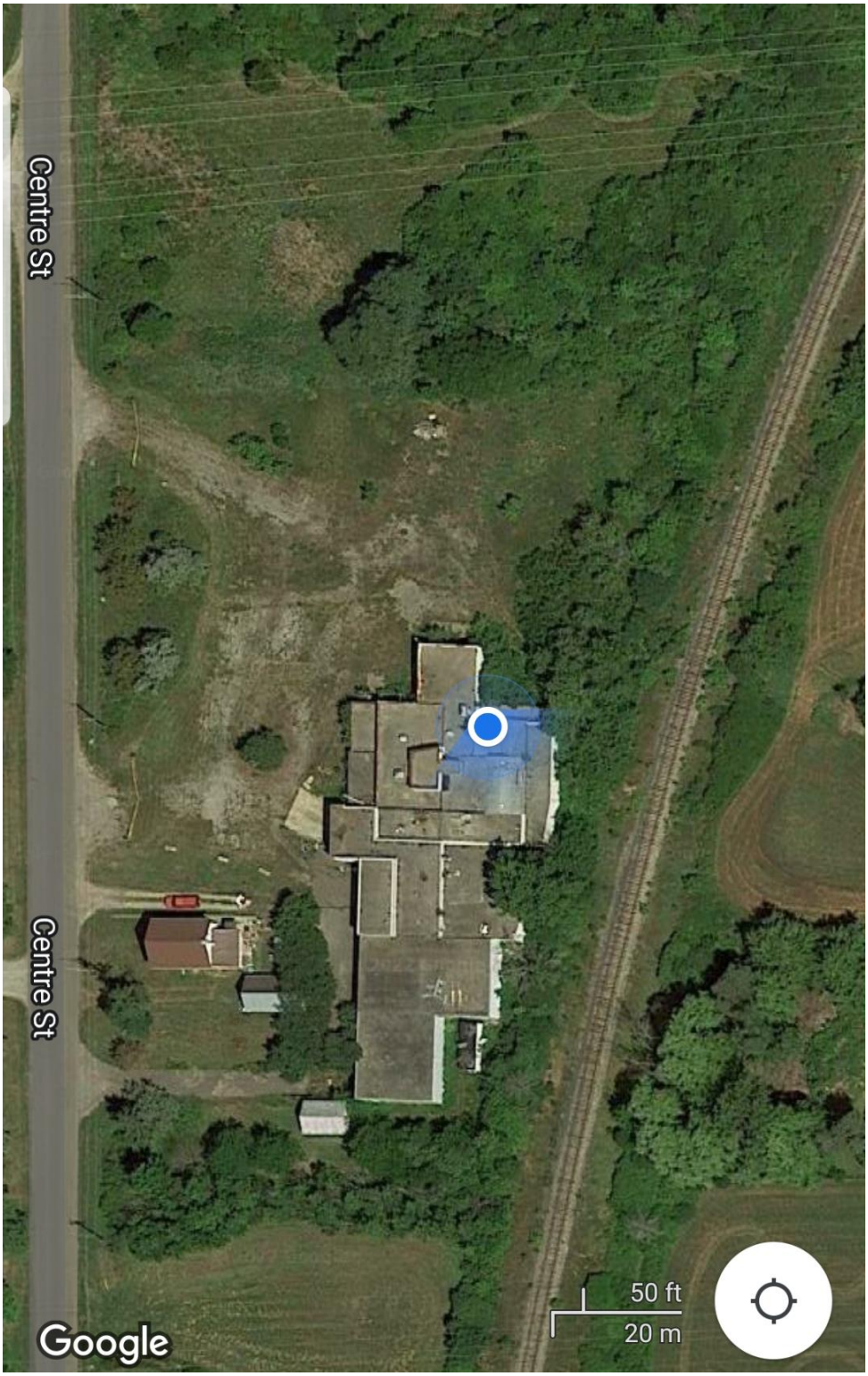


FIGURE 3
PROBE LOCATION FOR VIBRATION MEASUREMENTS

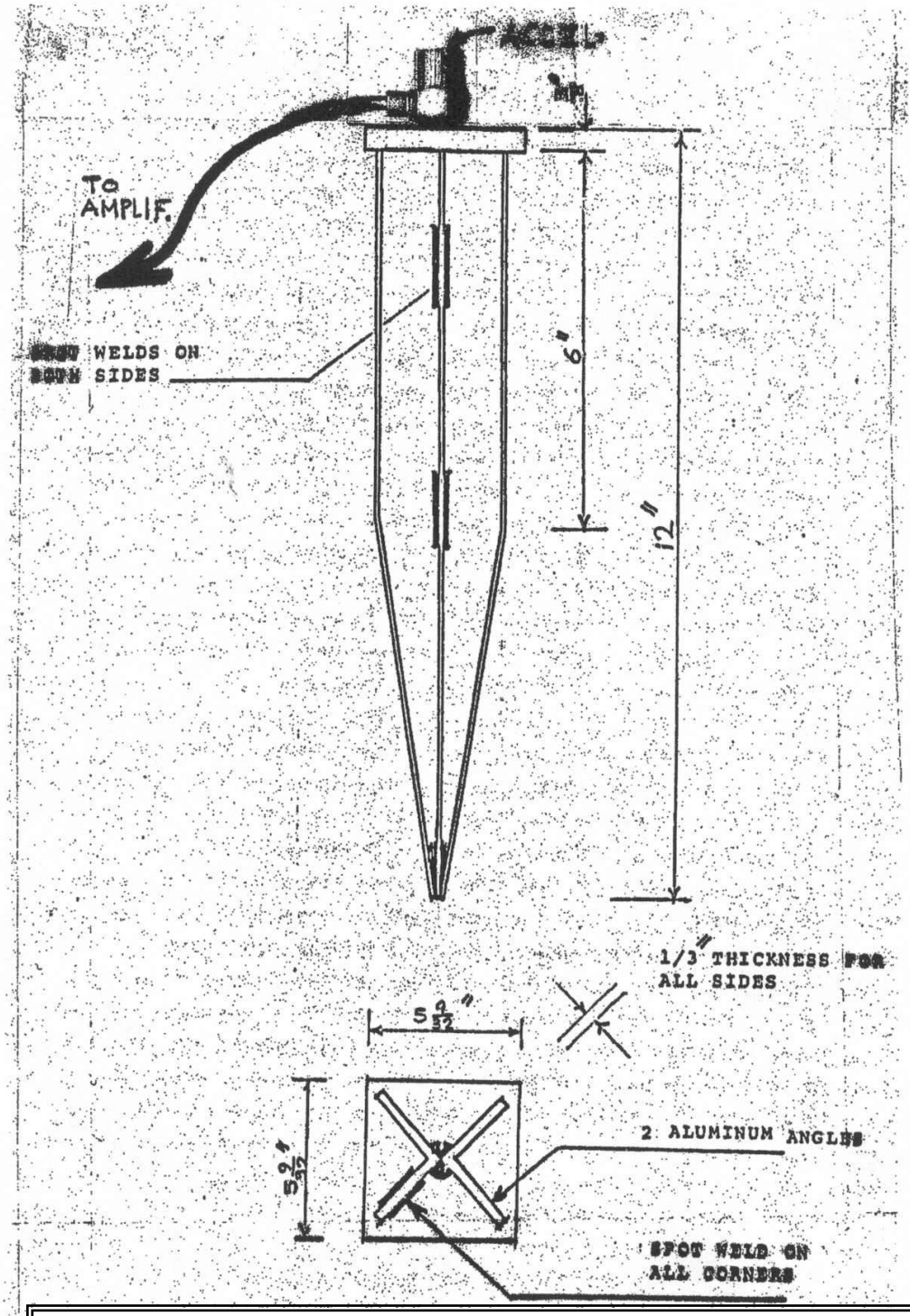


FIGURE 4
GROUND SPIKE DETAILS FOR MOUNTING THE ACCELEROMETER BELOW THE GROUND

APPENDIX A

ROAD AND RAIL TRAFFIC DATA

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: City of Thorold
Street: 2239 Centre St - NB
Location: 1

A study of vehicle traffic was conducted with the device having serial number 403588. The study was done in the NB lane at 2239 Centre St - NB in City of Thorold, ON in county. The study began on 2020-09-30 at 12:00 AM and concluded on 2020-10-02 at 12:00 AM, lasting a total of 48.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 631 vehicles passed through the location with a peak volume of 13 on 2020-09-30 at [02:45 PM-03:00 PM] and a minimum volume of 0 on 2020-09-30 at [08:30 PM-08:45 PM]. The AADT count for this study was 316.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 70 KM/H range or lower. The average speed for all classifed vehicles was 70 KM/H with 96.12% vehicles exceeding the posted speed of 50 KM/H. 21.49% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 85.80 KM/H.

< to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	100 to 109	110 to 119	120 to 129	130 to 139	140 to >
0	3	0	7	14	119	187	156	69	48	16	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 577 which represents 93 percent of the total classified vehicles. The number of Small Trucks in the study was 21 which represents 3 percent of the total classified vehicles. The number of Trucks/Buses in the study was 10 which represents 2 percent of the total classified vehicles. The number of Tractor Trailers in the study was 11 which represents 2 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
150	427	21	10	5	3	2	1							

CHART 2

HEADWAY

During the peak traffic period, on 2020-09-30 at [02:45 PM-03:00 PM] the average headway between vehicles was 64.286 seconds. During the slowest traffic period, on 2020-09-30 at [08:30 PM-08:45 PM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 13.00 and 28.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: City of Thorold
Street: 2239 Centre St - SB
Location: 1

A study of vehicle traffic was conducted with the device having serial number 405079. The study was done in the SB lane at 2239 Centre St - SB in City of Thorold, ON in county. The study began on 2020-09-30 at 12:00 AM and concluded on 2020-10-02 at 12:00 AM, lasting a total of 48.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 731 vehicles passed through the location with a peak volume of 23 on 2020-09-30 at [03:45 PM-04:00 PM] and a minimum volume of 0 on 2020-09-30 at [08:30 PM-08:45 PM]. The AADT count for this study was 366.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 70 KM/H range or lower. The average speed for all classifed vehicles was 69 KM/H with 95.98% vehicles exceeding the posted speed of 50 KM/H. 18.70% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 82.55 KM/H.

< to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	100 to 109	110 to 119	120 to 129	130 to 139	140 to >
0	1	0	7	21	151	205	202	102	26	7	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 681 which represents 94 percent of the total classified vehicles. The number of Small Trucks in the study was 14 which represents 2 percent of the total classified vehicles. The number of Trucks/Buses in the study was 17 which represents 2 percent of the total classified vehicles. The number of Tractor Trailers in the study was 10 which represents 1 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
218	463	14	17	8	1	1	0							

CHART 2

HEADWAY

During the peak traffic period, on 2020-09-30 at [03:45 PM-04:00 PM] the average headway between vehicles was 37.5 seconds. During the slowest traffic period, on 2020-09-30 at [08:30 PM-08:45 PM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 12.00 and 31.00 degrees C.

Date: 2017/06/01 Project Number: SFD – 23.90 – Thorold Wye, Thorold, ON

Dear Cheryl:

Re: Train Traffic Data – CN Stamford Subdivision near Thorold Wye in Thorold, ON

The following is provided in response to Seema Nagaraj 2017/06/22 request for information regarding rail traffic in the vicinity of Thorold Wye in Thorold, Ontario at approximately Mile 27.60 on CN's Stamford 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	4	140	15	4
Way Freight	4	25	15	4
Passenger	0	10	15	2

	2300-0700			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	0	140	15	4
Way Freight	0	25	15	4
Passenger	0	10	15	2

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

Except where anti-whistling bylaws are in effect, engine-warning whistles and bells are normally sounded at all at-grade crossings. There are three at-grade crossing in the immediate vicinity of the study area at Mile 23.38, 24.05, and 24.10 (Private Crossing, Allanport Road, and Barron Road). 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 single mainline track is considered to be continuously welded rail throughout the study area. The presence of one switche located at Mile 23.95 may exacerbate the noise and vibration caused by train movements.

APPENDIX B

SAMPLE SOUND LEVEL CALCULATIONS

SS WILSON ASSOCIATES - TRAFFIC NOISE PREDICTION MODEL

Consulting Engineers, Richmond Hill, Ontario. *v8 December 4, 2018*

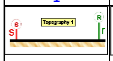
2248 Centre Street, Thorold

Lally Holdings

Source(s) of Road Traffic Noise: **Centre Street**

Receptor Name: **West Building Façade (future)**

SSWA Project Number WA22-002

Record Number	*1*	*2*	*3*	*4*
Include the following Segments in the calculations? (0 or 1)	1 Yes	1 Yes	0 No	0 No
Road Name & Direction	Centre Street	Centre Street	Text	Text
Segment Detail	Northbound	Southbound		Text
Section/Segment Number	S1	S2	S2	S2
MOE Topographic Case (1-11)-See Instructions	1  S and R on flat ground	1 S and R on flat ground		
Traffic Data Input Method	24 hour Data	24 hour Data	24 hour Data	24 hour Data
Alpha (α) Input; Manual or Auto?	Automatic	Manual		
Notes on your choice of α	As per MOE Procedures	Carefully Select α below		
Manual Alpha		0.33		
Intermediate Surface; Absorptive or Reflective	Absorptive	entry below has NO effect Absorptive		
Pavement Type	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete
Include Effect of Dense Woods?	No	No		
Measured Angle Case Number	1	1	3	3
Angle description	-θ1 Left & +θ2 Right	-θ1 Left & +θ2 Right	+θ1 & +θ2 Both on the Right	+θ1 & +θ2 Both on the Right
Angle Theta 1	-90	-90	-90	-90
Angle Theta 2	90	90	90	90
Angle Theta Error Detection Flag				
Subtended Angle (Angle of Exposure), °	180	180	180	180
% increase / year	2.50%	2.50%	0.00%	0.00%
Number of years	12	12	0	0
24 Hour Traffic Data	3160	3660	9999	9999
Medium Truck %	5.00%	4.00%	0.00%	0.00%
Heavy Truck %	2.00%	1.00%	0.00%	0.00%
Daytime Traffic Split	90.00%	90.00%	90.00%	90.00%
Daytime Hours	16	16	16	16
Posted Speed (Km/Hr) [S]	86	83	70	70
Road Gradient (%) [Gradient]	2.00%	2.00%	0.00%	0.00%
Wood Depth (m)	0	0	0	0
Number of Rows of Houses	0	0	0	0
Night time Number of Rows of Houses	0	0	0	0
Percentage of Row Occupied by Houses	80%	80%	80%	80%
Height of Row of House [HH]	7	7	7	
Receiver Height (m) [RH]	7.5	7.5	1.5	1.5
Night time Reciever Height (m) [NRH]	7.5	7.5	1.5	1.5
Source-Receiver Distance [SRD]	12	15.5	200	200
Night time Source-Receiver Distance [NSRD]	12	15.5	200	200
Barrier Height (m) [BH]	0	0	0	0
Barrier-Receiver Distance (m)	12	12	12	12
Ground Elevation Difference (m) [E]	0	0	0	0
Source Ground Elevation (m)	0	0	0	0
Receiver Ground Elevation (m)	0	0	0	0
Barrier Ground Elevation (m)	0	0	0	0
Source Height Input [Manual or Auto]	Automatic	Automatic	Automatic	Automatic
Manual Source Height (m) [MSH]			1.00	1.00
Dominant Octave Frequency Band (Hz) [F]	500	500		
x10 Volume Adjustment (-10dB)	-10	-10		
Additionl dBA Correction Factor 2- Specify	0	0		
RESULTS FOR SEGMENTS				
24 Hour Daily Segment Leq	55.04	52.98	-50.00	-50.00
Day Time [16 hours] Segment Leq	56.35	54.28	-50.00	-50.00
Night Time [8 hours] Segment Leq	49.81	47.75	-50.00	-50.00

FINAL/OVERALL	24 Hour Daily Leq	Day Time Leq	Night Time Leq
	57	58	52

SS WILSON ASSOCIATES - TRAFFIC NOISE PREDICTION MODEL

Consulting Engineers, Richmond Hill, Ontario. *v8 December 4, 2018*

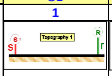
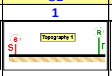
2248 Centre Street, Thorold

Lally Holdings

Source(s) of Road Traffic Noise: **Centre Street**

Receptor Name: **Ground Floor Backyard OLA (Unit 1) - Future**

SSWA Project Number WA22-002

Record Number	*1*	*2*	*3*	*4*
Include the following Segments in the calculations? (0 or 1)	1 Yes	1 Yes	0 No	0 No
Road Name & Direction	Centre Street	Centre Street	Text	Text
Segment Detail	Northbound	Southbound		Text
Section/Segment Number	S1	S2	S2	S2
MOE Topographic Case (1-11)-See Instructions	1  S and R on flat ground	1  S and R on flat ground		
Traffic Data Input Method	24 hour Data	24 hour Data	24 hour Data	24 hour Data
Alpha (α) Input; Manual or Auto?	Automatic	Manual		
Notes on your choice of α	As per MOE Procedures	Carefully Select α below		
Manual Alpha		0.33		
Intermediate Surface; Absorptive or Reflective	Absorptive	entry below has NO effect Absorptive		
Pavement Type	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete
Include Effect of Dense Woods?	No	No		
Measured Angle Case Number	1	1	3	3
Angle description	-θ1 Left & +θ2 Right	-θ1 Left & +θ2 Right	+θ1 & +θ2 Both on the Right	+θ1 & +θ2 Both on the Right
Angle Theta 1	-45	-45	-90	-90
Angle Theta 2	90	90	90	90
Angle Theta Error Detection Flag				
Subtended Angle (Angle of Exposure), °	135	135	180	180
% increase / year	2.50%	2.50%	0.00%	0.00%
Number of years	12	12	0	0
24 Hour Traffic Data	3160	3660	9999	9999
Medium Truck %	5.00%	4.00%	0.00%	0.00%
Heavy Truck %	2.00%	1.00%	0.00%	0.00%
Daytime Traffic Split	90.00%	90.00%	90.00%	90.00%
Daytime Hours	16	16	16	16
Posted Speed (Km/Hr) [S]	86	83	70	70
Road Gradient (%) [Gradient]	2.00%	2.00%	0.00%	0.00%
Wood Depth (m)	0	0	0	0
Number of Rows of Houses	0	0	0	0
Night time Number of Rows of Houses	0	0	0	0
Percentage of Row Occupied by Houses	80%	80%	80%	80%
Height of Row of House [HH]	7	7	7	
Receiver Height (m) [RH]	1.5	1.5	1.5	1.5
Night time Reciever Height (m) [NRH]	1.5	1.5	1.5	1.5
Source-Receiver Distance [SRD]	15	18.5	200	200
Night time Source-Receiver Distance [NSRD]	15	18.5	200	200
Barrier Height (m) [BH]	0	0	0	0
Barrier-Receiver Distance (m)	3	3	12	12
Ground Elevation Difference (m) [e]	0	0	0	0
Source Ground Elevation (m)	0	0	0	0
Receiver Ground Elevation (m)	0	0	0	0
Barrier Ground Elevation (m)	0	0	0	0
Source Height Input [Manual or Auto]	Automatic	Automatic	Automatic	Automatic
Manual Source Height (m) [MSH]			1.00	1.00
Dominant Octave Frequency Band (Hz) [F]	500	500		
x10 Volume Adjustment (-10dB)	-10	-10		
Additionl dBA Correction Factor 2- Specify	0	0		
RESULTS FOR SEGMENTS				
24 Hour Daily Segment Leq	52.47	50.95	-50.00	-50.00
Day Time [16 hours] Segment Leq	53.77	52.25	-50.00	-50.00
Night Time [8 hours] Segment Leq	47.24	45.72	-50.00	-50.00

FINAL/OVERALL	24 Hour Daily Leq	Day Time Leq	Night Time Leq
	55	56	50

SS WILSON ASSOCIATES - TRAFFIC NOISE PREDICTION MODEL

Consulting Engineers, Richmond Hill, Ontario. *v8 December 4, 2018*

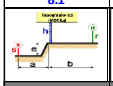
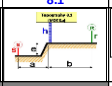
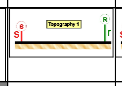
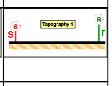
2248 Centre Street, Thorold

Lally Holdings

Source(s) of Road Traffic Noise: **Centre Street**

Receptor Name: **West Side Rooftop Amenities (Units 1/9)**

SSWA Project Number WA22-002

Record Number	*1*	*2*	*3*	*4*
Include the following Segments in the calculations? (0 or 1)	1 Yes	1 Yes	0 No	0 No
Road Name & Direction	Centre Street	Centre Street	Text	Text
Segment Detail	Northbound	Southbound		Text
Section/Segment Number	S1	S2	S2	S2
MOE Topographic Case (1-11)-See Instructions	8.1  S below R with abrupt change in elevation (e) + Barrier	8.1  S below R with abrupt change in elevation (e) + Barrier		
Traffic Data Input Method	24 hour Data	24 hour Data	24 hour Data	24 hour Data
Alpha (α) Input; Manual or Auto?	Automatic	Manual		
Notes on your choice of α	As per MOE Procedures	Carefully Select α below		
Manual Alpha		0.33		
Intermediate Surface; Absorptive or Reflective	Absorptive	entry below has NO effect Absorptive		
Pavement Type	Asphalt-Concret	Asphalt-Concret	Asphalt-Concret	Asphalt-Concret
Include Effect of Dense Woods?	No	No		
Measured Angle Case Number	1	1	3	3
Angle description	-θ1 Left & +θ2 Right	-θ1 Left & +θ2 Right	+θ1 & +θ2 Both on the Right	+θ1 & +θ2 Both on the Right
Angle Theta 1	-90	-90	-90	-90
Angle Theta 2	90	90	90	90
Angle Theta Error Detection Flag				
Subtended Angle (Angle of Exposure), °	180	180	180	180
% increase / year	2.50%	2.50%	0.00%	0.00%
Number of years	12	12	0	0
24 Hour Traffic Data	3160	3660	9999	9999
Medium Truck %	5.00%	4.00%	0.00%	0.00%
Heavy Truck %	2.00%	1.00%	0.00%	0.00%
Daytime Traffic Split	90.00%	90.00%	90.00%	90.00%
Daytime Hours	16	16	16	16
Posted Speed (Km/Hr) [S]	86	83	70	70
Road Gradient (%) [Gradient]	2.00%	2.00%	0.00%	0.00%
Wood Depth (m)	0	0	0	0
Number of Rows of Houses	0	0	0	0
Night time Number of Rows of Houses	0	0	0	0
Percentage of Row Occupied by Houses	80%	80%	80%	80%
Height of Row of House [HH]	7	7	7	
Receiver Height (m) [RH]	1.5	1.5	1.5	1.5
Night time Reciever Height (m) [NRH]	1.5	1.5	1.5	1.5
Source-Receiver Distance [SRD]	15	18.5	200	200
Night time Source-Receiver Distance [NSRD]	15	18.5	200	200
Barrier Height (m) [BH]	1	1	0	0
Barrier-Receiver Distance (m)	3	3	12	12
Ground Elevation Difference (m) [e]	10	10	0	0
Source Ground Elevation (m)	0	0	0	0
Receiver Ground Elevation (m)	10	10	0	0
Barrier Ground Elevation (m)	10	10	0	0
Source Height Input [Manual or Auto]	Automatic	Automatic	Automatic	Automatic
Manual Source Height (m) [MSH]			1.00	1.00
Dominant Octave Frequency Band (Hz) [F]	500	500		
x10 Volume Adjustment (-10dB)	-10	-10		
Additionl dBA Correction Factor 2- Specify	0	0		
RESULTS FOR SEGMENTS				
24 Hour Daily Segment Leq	43.70	42.90	-50.00	-50.00
Day Time [16 hours] Segment Leq	45.01	44.20	-50.00	-50.00
Night Time [8 hours] Segment Leq	38.48	37.67	-50.00	-50.00

FINAL/OVERALL	24 Hour Daily Leq	Day Time Leq	Night Time Leq
	46	48	41

SS WILSON ASSOCIATES -*Consulting Engineers*, Richmond Hill, Ontario Revised June

RAIL TRAFFIC NOISE PREDICTION MODEL

BASED ON MOE STEAM/ORNAMENT

2248 Centre Street, Thorold

Townhouse Blocks

Name(s) of Rail Lines:	**CN Stamford Subdivision**	
Receptor Name:	**Unit 15 Building Façade**	
SSWA Project Number:	**WA22-002**	**Comments** Text
Purpose of Calculation	**Bldg.Facade**	**Whistle Noise??**

DO NOT COPY AND PASTE CELLS UNLESS YOU PASTE "VALUES" ONLY

Include the following Segments ? (No=0 or Yes=1)	1			1		
Rail Name & Direction	CN Stamford Subdivision			CN Stamford Subdivision		
Rail/Segment Number or Other Data	Freight			Way Freight		
Segment Source of Noise	Locomo	Whistle	Wheels	Locomo	Whistle	Wheels
Whistle Noise??	Yes	No	Yes	Yes	No	Yes
MOE Topographic Case (1-11)-See Instructions	1			1		
	S and R on flat ground			S and R on flat ground		
Traffic Data Calculation Period *(24Hrs or 16/8 d/n or 1 Hr)*	Day/Night			Day/Night		
Intermediate Surface; Absorptive or Reflective	Absorptive			Absorptive		
Absorptive Alpha Override; Manual or Auto	Manual			Manual		
Manual Alpha (if Cell is Blank, do not change, otherwise, input your choice for α)	Input Alpha α from 0.0 to 0.66 0.33			Input Alpha α from 0.0 to 0.66 0.33		
Measured Angle Case Number	1			1		
Angle description	-Θ1 Left & +Θ2 Right			-Θ1 Left & +Θ2 Right		
Angle Theta θ1	-90			-90		
Angle Theta θ2	80			80		
Angle Theta Error Detection Flag						
Subtended Angle (Angle of Exposure), °	170			170		
Number of Locomotives per train	4			4		
Number of cars per train	140			25		
Number of Trains in 24 Hrs.						
Hourly Number of Trains in 1 Hour						
Number of Daytime Trains 07:00 to 23:00.	4			4		
Number of Night Trains 23:00 to 07:00	0			2		
% increase / year	2.50%			2.50%		
Number of years	10			10		
Future Number of Trains in 24 Hrs.						
Future Hourly Number of Trains in 1 Hour						
Future Number of Daytime Trains 07:00 to 23:0	5			5		
Future Number of Nighttime Trains 23:00 to 07:	0			3		
Posted Speed (Km/Hr) [S]	25			25		
Wood Depth (m)	0			0		
Day time Receiver Height,m [RH] (For 24 Hrs. & Hourly also)	7.5			7.5		
Nighttime Reciever Height (m) [NRH]	7.5			7.5		
Source-Receiver Distance [SRD]	29			29		
Nighttime Source-Receiver Distance [NSRD]	29			29		
Barrier Height (m) [BH]	0			0		
Barrier-Receiver Distance (m)	1			1		
Barrier Receiver Distance Error Flag						
Ground Elevation Difference (m) [e]	0			0		
Source Ground Elevation (m)	0			0		
Receiver Ground Elevation (m)	0			0		
Barrier Ground Elevation (m)	0			0		
Include Effect of Dense Woods?	No			No		
Number of Rows of Houses	0			0		
Nighttime Number of Rows of Houses	0			0		
Percentage of Row Occupied by Houses (??%)	80%			80%		
Height of Row of House [HH]	7			7		
Do you want to change the model frequency?	N			N		
Input your Choice of frequency						
Dominant Octave Frequency Band (Hz) [F]	500	500	500	500	500	500

For Wheel noise ONLY: Enter a factor of -5 dB for Continously Welded Rail (CWR) and +5 dB for Trestles as applicable

Day Time [16 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
Night Time [8 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text

RESULTS FOR SEGMENTS

Daytime [16 hours] Segment Leq_{16}	**61.1**	**56.5**
Nighttime [8 hours] Segment Leq_{8}	**0.0**	**56.5**
24 Hour Daily Segment Leq_{24}	57.2	62.5
1 Hour Segment Leq_{1}	67.2	62.5

Note: The predicted values may slightly differe than the MOE values

Day Time Leq (16 Hrs.)	**62**
Night Time Leq (8 Hrs.)	**56**
24 Hour Daily Leq	
1 Hour Leq	

SS WILSON ASSOCIATES -*Consulting Engineers*, Richmond Hill, Ontario Revised June

RAIL TRAFFIC NOISE PREDICTION MODEL

BASED ON MOE STEAM/ORNAMENT

2248 Centre Street, Thorold

Townhouse Blocks

Name(s) of Rail Lines:	**CN Stamford Subdivision**	
Receptor Name:	**Unit 8 Backyard**	
SSWA Project Number:	**WA22-002**	**Comments** Text
Purpose of Calculation	**Bldg.Facade**	**Whistle Noise??**

DO NOT COPY AND PASTE CELLS UNLESS YOU PASTE "VALUES" ONLY

Include the following Segments ? (No=0 or Yes=1)	1			1		
Rail Name & Direction	CN Stamford Subdivision			CN Stamford Subdivision		
Rail/Segment Number or Other Data	Freight			Way Freight		
Segment Source of Noise	Locomo	Whistle	Wheels	Locomo	Whistle	Wheels
Whistle Noise??	Yes	No	Yes	Yes	No	Yes
MOE Topographic Case (1-11)-See Instructions	1			1		
	S and R on flat ground			S and R on flat ground		
Traffic Data Calculation Period *(24Hrs or 16/8 d/n or 1 Hr)*	Day/Night			Day/Night		
Intermediate Surface; Absorptive or Reflective	Absorptive			Absorptive		
Absorptive Alpha Override; Manual or Auto	Manual			Manual		
Manual Alpha (if Cell is Blank, do not change, otherwise, input your choice for α)	Input Alpha α from 0.0 to 0.66 0.33			Input Alpha α from 0.0 to 0.66 0.33		
Measured Angle Case Number	1			1		
Angle description	-01 Left & +02 Right			-01 Left & +02 Right		
Angle Theta θ1	-90			-90		
Angle Theta θ2	-10			-10		
Angle Theta Error Detection Flag						
Subtended Angle (Angle of Exposure), °	80			80		
Number of Locomotives per train	4			4		
Number of cars per train	140			25		
Number of Trains in 24 Hrs.						
Hourly Number of Trains in 1 Hour						
Number of Daytime Trains 07:00 to 23:00.	4			4		
Number of Night Trains 23:00 to 07:00	0			2		
% increase / year	2.50%			2.50%		
Number of years	10			10		
Future Number of Trains in 24 Hrs.						
Future Hourly Number of Trains in 1 Hour						
Future Number of Daytime Trains 07:00 to 23:0	5			5		
Future Number of Nighttime Trains 23:00 to 07:	0			3		
Posted Speed (Km/Hr) [S]	25			25		
Wood Depth (m)	0			0		
Day time Receiver Height,m [RH] (For 24 Hrs. & Hourly also)	1.5			1.5		
Nighttime Reciever Height (m) [NRH]	1.5			1.5		
Source-Receiver Distance [SRD]	44.5			44.5		
Nighttime Source-Receiver Distance [NSRD]	44.5			44.5		
Barrier Height (m) [BH]	0			0		
Barrier-Receiver Distance (m)	3			3		
Barrier Receiver Distance Error Flag						
Ground Elevation Difference (m) [e]	0			0		
Source Ground Elevation (m)	0			0		
Receiver Ground Elevation (m)	0			0		
Barrier Ground Elevation (m)	0			0		
Include Effect of Dense Woods?	No			No		
Number of Rows of Houses	0			0		
Nighttime Number of Rows of Houses	0			0		
Percentage of Row Occupied by Houses (??%)	80%			80%		
Height of Row of House [HH]	7			7		
Do you want to change the model frequency?	N			N		
Input your Choice of frequency						
Dominant Octave Frequency Band (Hz) [F]	500	500	500	500	500	500

For Wheel noise ONLY: Enter a factor of -5 dB for Continously Welded Rail (CWR) and +5 dB for Trestles as applicable

Day Time [16 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
Night Time [8 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text

RESULTS FOR SEGMENTS

Daytime [16 hours] Segment Leq_{16}	**55.2**	**50.5**
Nighttime [8 hours] Segment Leq_{8}	**0.0**	**50.5**
24 Hour Daily Segment Leq_{24}	51.2	56.5
1 Hour Segment Leq_{1}	61.2	56.5

Note: The predicted values may slightly differe than the MOE values

Day Time Leq (16 Hrs.)	**56**
Night Time Leq (8 Hrs.)	**50**
24 Hour Daily Leq	
1 Hour Leq	

SS WILSON ASSOCIATES -*Consulting Engineers*, Richmond Hill, Ontario Revised June

RAIL TRAFFIC NOISE PREDICTION MODEL

BASED ON MOE STEAM/ORNAMENT

2248 Centre Street, Thorold

Townhouse Blocks

Name(s) of Rail Lines:	**CN Stamford Subdivision**	
Receptor Name:	**Unit 15 Rooftop OLA**	
SSWA Project Number:	**WA22-002**	**Comments** Text
Purpose of Calculation	**Bldg.Facade**	**Whistle Noise??**

DO NOT COPY AND PASTE CELLS UNLESS YOU PASTE "VALUES" ONLY

Include the following Segments ? (No=0 or Yes=1)	1			1			
Rail Name & Direction	CN Stamford Subdivision			CN Stamford Subdivision			
Rail/Segment Number or Other Data	Freight			Way Freight			
Segment Source of Noise	Locomo	Whistle	Wheels	Locomo	Whistle	Wheels	
Whistle Noise??	Yes	No	Yes	Yes	No	Yes	
MOE Topographic Case (1-11)-See Instructions	8.1			8.1			
	S below R with abrupt change in elevation (e) + Barrier			S below R with abrupt change in elevation (e) + Barrier			
Traffic Data Calculation Period *(24Hrs or 16/8 d/n or 1 Hr)*	Day/Night			Day/Night			
Intermediate Surface; Absorptive or Reflective	Absorptive			Absorptive			
Absorptive Alpha Override; Manual or Auto	Manual			Manual			
Manual Alpha (if Cell is Blank, do not change, otherwise, input your choice for α)	Input Alpha α from 0.0 to 0.66 0.33			Input Alpha α from 0.0 to 0.66 0.33			
Measured Angle Case Number	1			1			
Angle description	-01 Left & +02 Right			-01 Left & +02 Right			
Angle Theta θ1	-90			-90			
Angle Theta θ2	90			90			
Angle Theta Error Detection Flag							
Subtended Angle (Angle of Exposure), °	180			180			
Number of Locomotives per train	4			4			
Number of cars per train	140			25			
Number of Trains in 24 Hrs.							
Hourly Number of Trains in 1 Hour							
Number of Daytime Trains 07:00 to 23:00.	4			4			
Number of Night Trains 23:00 to 07:00	0			2			
% increase / year	2.50%			2.50%			
Number of years	10			10			
Future Number of Trains in 24 Hrs.							
Future Hourly Number of Trains in 1 Hour							
Future Number of Daytime Trains 07:00 to 23:0	5			5			
Future Number of Nighttime Trains 23:00 to 07:	0			3			
Posted Speed (Km/Hr) [S]	25			25			
Wood Depth (m)	0			0			
Day time Receiver Height,m [RH] (For 24 Hrs. & Hourly also)	1.5			1.5			
Nighttime Reciever Height (m) [NRH]	1.5			1.5			
Source-Receiver Distance [SRD]	32			32			
Nighttime Source-Receiver Distance [NSRD]	32			32			
Barrier Height (m) [BH]	1.1			1.1			
Barrier-Receiver Distance (m)	3			3			
Barrier Receiver Distance Error Flag							
Ground Elevation Difference (m) [e]	10			10			
Source Ground Elevation (m)	0			0			
Receiver Ground Elevation (m)	10			10			
Barrier Ground Elevation (m)	10			10			
Include Effect of Dense Woods?	No			No			
Number of Rows of Houses	0			0			
Nighttime Number of Rows of Houses	0			0			
Percentage of Row Occupied by Houses (??%)	80%			80%			
Height of Row of House [HH]	7			7			
Do you want to change the model frequency?	N			N			
Input your Choice of frequency							
Dominant Octave Frequency Band (Hz) [F]	500	500	500	500	500	500	

For Wheel noise ONLY: Enter a factor of -5 dB for Continously Welded Rail (CWR) and +5 dB for Trestles as applicable

Day Time [16 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
Night Time [8 hours] Additional dBA Correction Factor- Specify	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text
N/A	0 Text	0 Text	0 Text	0 Text	0 Text	0 Text

RESULTS FOR SEGMENTS

Daytime [16 hours] Segment Leq_{16}	**55.0**	**50.4**
Nighttime [8 hours] Segment Leq_{8}	**0.0**	**50.4**
24 Hour Daily Segment Leq_{24}	**51.0**	**56.4**
1 Hour Segment Leq_{1}	**61.0**	**56.4**

Note: The predicted values may slightly differe than the MOE values

Day Time Leq (16 Hrs.)	**56**
Night Time Leq (8 Hrs.)	**50**
24 Hour Daily Leq	
1 Hour Leq	