Noise and Vibration Feasibility Study
Proposed Residential Development
Station Meadows West Subdivision
Township of West Lincoln, Ontario

Prepared for:
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1 Introduction and Summary

HGC Engineering was retained by The Odan/Detech Group Inc. to perform a noise and vibration feasibility study for a proposed residential development located east of South Grimsby Road 5 and north of the Canadian Pacific (CP) railway in West Lincoln, Ontario. The proposed development will consist of single-family dwellings and townhouse blocks. The analysis includes an assessment of rail traffic noise and ground-borne vibration on the proposed residential dwellings in accordance with Ministry of the Environment, Conservation and Parks (MECP) and CP railway guidelines. The study is required by the municipality as part of the planning and approvals process.

Rail traffic data for the railway was obtained from CP personnel. Road traffic data was obtained from the Township of West Lincoln and was determined to be a low volume roadway. Traffic data was used to predict future traffic sound levels at the façades of the proposed residential dwellings and in rear yard outdoor living areas. The predicted sound levels were compared to the guidelines of the MECP and CP.

Sound levels are predicted to be above the MECP limits at the proposed development. Central air conditioning is required for dwellings closest to the railway. Forced air ventilation with ducts sized for the future installation of air conditioning by the occupant is required for dwellings further from the railway. Brick exterior wall construction is required for dwellings in the first row from the railway. Upgraded building and window glazing requirements are required for dwellings with some exposure to the railway. Warning clauses are required to inform the future residents of the sound level excesses. Ground-borne vibration levels from the rail pass-bys were measured at a distance of 30 m from the railway right-of-way. Measured vibration levels were found to be at or below CP criteria for the train pass-bys. A reflection analysis was also completed and indicates that sound levels at the existing dwellings to the south are not expected to significantly increase if a noise barrier is included between the railway and the subject site. A detailed noise study is required when detailed floor plans and building elevations, to refine the acoustic recommendations glazing construction requirements based on actual window to floor area ratios and to verify the exterior wall construction.
2 Site Description and Sources of Sound

Figure 1 shows a key plan which identifies the location of the proposed residential development. The development is located to the east of South Grimsby Road 5 and north of the CP railway in West Lincoln, Ontario. The proposed development will consist of single-family dwellings and townhouse blocks. A proposed draft plan prepared by Odan/Detech Group Inc, last revised June 10, 2020, is provided in Figure 2, which also shows the sound level prediction locations.

HGC Engineering visited the site on September 30th and October 1st, 2019 to perform ground-borne vibration measurements and observe the acoustical environment. Rail traffic noise is the primary source of noise at the site. South Grimsby Road 5 is a low volume roadway and as such has not been considered further in this report. The railway is used for freight operations only and is classified as a principal main line. Lands to the north and west of the site are existing agricultural lands. To the east and south of the CP railway are existing residential lands. There are no significant sources of stationary noise within 500 m of the subject site.

3 Criteria for Acceptable Sound Levels

3.1 Rail Traffic Noise Criteria

Guidelines for acceptable levels of rail traffic noise impacting residential developments are given in the MECP 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

<table>
<thead>
<tr>
<th></th>
<th>Daytime $L_{\text{EQ}}$ (16 hour)</th>
<th>Nighttime $L_{\text{EQ}}$ (8 hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Living Areas</td>
<td>55 dBA</td>
<td>--</td>
</tr>
<tr>
<td>Inside Living/Dining Rooms</td>
<td>40 dBA</td>
<td>40 dBA</td>
</tr>
<tr>
<td>Inside Bedrooms</td>
<td>40 dBA</td>
<td>35 dBA</td>
</tr>
</tbody>
</table>

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 MECP guidelines.

The guidelines in the MECP 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 living/dining room/bedroom windows exceed 60 dBA or daytime sound levels outside living/dining room and bedroom 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 living/dining room/bedroom windows are in the range of 51 to 60 dBA or when daytime sound levels 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/living/dining room window sound level is greater than 55 dBA due to nighttime or greater than 60 dBA during the daytime hours due to rail traffic noise.
MECP and CP policies stipulate that brick veneer or masonry equivalent construction is required for the first row of dwellings within 100 m of the railway right-of-way.

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 CP requirements for a new development adjacent to a principal main rail line, which is provided in Appendix A.

3.2 **Ground-borne Vibration from Rail Traffic**

MECP and CP guidelines require measurements of ground-borne vibration when residential dwelling units are to be located within 75 metres of a principal mainline such as the CP Hamilton Subdivision.

Vibration is typically measured in terms of oscillatory velocity or acceleration. The CP vibration guidelines are given in terms of ground-borne velocity. In this report, vibration levels are quoted in terms of RMS velocity levels (Lv) in mm/s. The CP guideline limit is 0.14 mm/s. Where excesses are noted, a review of acceleration versus frequency band was performed to determine if vibration mitigation is suitable for the proposed dwellings. These criteria are included on the plots of the measured vibration levels.

4 **Traffic Sound Level Assessment**

4.1 **Rail Traffic Data**

Rail traffic data for the CP Hamilton Subdivision was obtained from CP personnel as is included in Appendix B. This CP line is used for freight operations only and is classified as a principal main line. The maximum permissible train speed in the area of the site is 80 kph (50 mph) for the freight trains along the mainline and 16 kph (10 mph) for freight trains along the siding line. In conformance with CP assessment requirements, the maximum speeds, maximum number of cars and 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 2030 using a 2.5% per year growth rate. Table 2 summarises the CP rail traffic data used in the analysis.
Table 2: Rail Traffic Data Projected to Year 2030

<table>
<thead>
<tr>
<th>Type of Train</th>
<th>Number of Trains Day/ Night</th>
<th>Number of locomotives</th>
<th>Number of cars</th>
<th>Max Speed (KPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight</td>
<td>3.9 / 7.9</td>
<td>4</td>
<td>129</td>
<td>80</td>
</tr>
</tbody>
</table>

4.2 Traffic Noise Predictions

Future traffic sound levels were predicted using STAMSON version 5.04, a computer algorithm developed by the MECP. Sample STAMSON output is included in Appendix C.

Sound levels were predicted at the plane of windows during the daytime and nighttime hours to investigate ventilation requirements. Sound levels were predicted in the rear yard outdoor living areas to investigate the need for acoustic barriers. Train whistle noise for the crossing at South Grimsby Road 5 has been included in the analysis. The results of these predictions, without mitigation, are summarized in Table 4 below.
Table 3: Predicted Rail Traffic Sound Levels [dBA]

<table>
<thead>
<tr>
<th>Prediction Location</th>
<th>Description</th>
<th>Daytime in the OLA Total $L_{EQ-16\text{ hr}}$</th>
<th>Daytime at Façade Total $L_{EQ-16\text{ hr}}$</th>
<th>Nighttime at Façade Total $L_{EQ-8\text{ hr}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>[A]</td>
<td>South façade of 3-storey residential building</td>
<td>--</td>
<td>62</td>
<td>68</td>
</tr>
<tr>
<td>[B]</td>
<td>East façade of 3-storey residential building</td>
<td>--</td>
<td>&lt;55</td>
<td>53</td>
</tr>
<tr>
<td>[C]</td>
<td>Townhouses fronting onto single loaded road with exposure to the railway</td>
<td>&lt;55</td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td>[D]</td>
<td>Townhouses fronting onto single loaded road with exposure to the railway</td>
<td>&lt;55</td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td>[E]</td>
<td>Lot 40 with flanking exposure to the railway</td>
<td>59</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td>[F]</td>
<td>Lot 25 with some exposure to the railway</td>
<td>&lt;55</td>
<td>&lt;55</td>
<td>55</td>
</tr>
<tr>
<td>[G]</td>
<td>Townhouses in second row from railway</td>
<td>&lt;55</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>[H]</td>
<td>Townhouses in second row from the railway</td>
<td>&lt;55</td>
<td>55</td>
<td>60</td>
</tr>
<tr>
<td>[I]</td>
<td>Lot 35 with some exposure to the railway</td>
<td>&lt;55</td>
<td>55</td>
<td>60</td>
</tr>
</tbody>
</table>

5 Traffic Noise Recommendations

The predictions indicate that the future traffic sound levels will exceed MECP guidelines at the proposed residential development. Recommendations to address these excesses are discussed below.

5.1 Outdoor Living Areas

As a general recommendation for residential developments adjacent to a principal mainline, CP recommends a minimum 5.5 m barrier (2.5 m berm and 3.0 m acoustic wall on top) above the elevation of the railway tracks as indicated in Appendix A. Since the amenity areas do not require mitigation with regards to noise, the railway should be contacted for clarification regarding the berm requirements along the railway line.
5.2 **Indoor Living Areas**

**Air Conditioning**

The predicted nighttime sound levels outside the second storey windows for dwellings closest to the railway (prediction locations [A], and [C] – [E]) will be greater than 60 dBA during the night. To address these excesses, the MECP guidelines recommend that the dwellings be equipped with central air conditioning systems, so that the windows can remain closed.

**Provision for the Future Installation of Air Conditioning**

The predicted sound levels at the plane of the bedroom windows of the future dwellings further from the CP railway will be between 51 and 60 dBA during the nighttime hours and between 56 to 65 dBA during the daytime hours (prediction locations [B], and [F] to [I]). To address these excesses, the MECP guidelines recommend that these dwelling units be equipped with a forced air ventilation system with ducts sized to accommodate the future installation of air conditioning by the occupant.

Window or through-the-wall air conditioning units are not recommended for any residential units because of the noise they produce and because the units penetrate through the exterior wall which degrades the overall noise insulating properties of the envelope. Acceptable units are those that are housed in their own closet with an access door for maintenance. The location, installation and sound ratings of the outdoor air conditioning devices should minimize noise impacts and comply with criteria of MECP publication NPC-300, as applicable.

5.3 **Building Façade Construction**

Future rail traffic sound levels in the proposed development will exceed 55 dBA at night and 60 dBA during the daytime, due to rail noise. MECP guidelines recommend that the windows, walls and doors be designed so that the indoor sound levels comply with MECP noise criteria.

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

**Exterior Wall Construction**

CP guidelines recommend brick or masonry 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 CP rail line. This applies to the dwellings closest to the railway in the first row.

**Glazing Construction**

Detailed floor plans and building elevations were not available at the time of this report, and window to floor area ratios of 50% (40% fixed, 10% operable) for living/dining rooms and 40% (30% fixed, 10% operable) for bedrooms were assumed. The results are summarized in Table 6 below.

<table>
<thead>
<tr>
<th>Prediction Location</th>
<th>Space</th>
<th>#Minimum STC Requirement for Glazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>[A]</td>
<td>Living/Dining Rooms</td>
<td>*OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[B]</td>
<td>Living/Dining Rooms</td>
<td>*OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[C]</td>
<td>Living/Dining Rooms</td>
<td>*STC-29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[D]</td>
<td>Living/Dining Rooms</td>
<td>*STC-29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[E]</td>
<td>Living/Dining Rooms</td>
<td>*OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[F]</td>
<td>Living/Dining Rooms</td>
<td>+OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[G]</td>
<td>Living/Dining Rooms</td>
<td>+OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[H]</td>
<td>Living/Dining Rooms</td>
<td>+OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
<tr>
<td>[I]</td>
<td>Living/Dining Rooms</td>
<td>+OBC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bedrooms</td>
</tr>
</tbody>
</table>

Note: *Sound through windows only since the exterior wall is required to be brick.
+Sound through windows and walls
#When detailed floor plans and building elevations are available, the glazing requirements should be refined.
Operable sections, including doors and operable windows, must be well-fitted and weather-stripped in order to achieve the upper range of target STC values. Note that window glazing and frame constructions can achieve these ratings, but vendor submittals with test data for the specific units proposed will be required to verify acceptable glazing products.

**Further Review**

When the detailed floor plans and elevations of the dwellings are available, an acoustical consultant should provide revised acoustical recommendations for the glazing constructions based on actual window to floor area ratios and should verify brick exterior wall construction.

### 5.4 Rail Vibration Impact

Measurements were performed on the site at grade, at approximately 30 m from the railway right-of-way as indicated by [M1] on Figure 2. Unattended vibration measurements using a Svantek 977 Sound Level Meter with a Wilcoxon Research type 793V velocity transducer was left at the site from September 30th to October 1st, 2019. Sample plots of the measurements are presented in Figures 6 to 9. Table 7 shows the maximum vibration level measurements during each of the train pass-bys.

**Table 7: Maximum RMS Vibration Velocity Measurements of Train Pass-bys at 30 m from Right-of-Way**

<table>
<thead>
<tr>
<th>Train Pass-by</th>
<th>Measured Level (mm/s)</th>
<th>Criteria (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05</td>
<td>0.14</td>
</tr>
<tr>
<td>2</td>
<td>0.04</td>
<td>0.14</td>
</tr>
<tr>
<td>3</td>
<td>0.06</td>
<td>0.14</td>
</tr>
<tr>
<td>4</td>
<td>0.05</td>
<td>0.14</td>
</tr>
</tbody>
</table>

The results indicate that vibration levels are below the CP criteria of 0.14 mm/s and vibration mitigation measures are not required for this proposed development.
5.5 **Warning Clauses**

Suggested wording for buildings with sound level excesses the MECP 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 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, Conservation and Parks.

Suggested wording for future dwellings requiring forced air ventilation systems is given below.

**Type B:**

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

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

**Type C:**

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, Conservation and Parks.

CP’s standard warning clause which is required for all residential developments located within 300 m of their mainline is given below.

**Type D:**

Warning: Canadian Pacific Railways Company or its assigns or successors in interest has or have a right-of-way within 300 metres from the land subject hereof. There may be alteration 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 dwellings. CPR 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.

5.6 **Reflection Analysis**

A reflection analysis has also been conducted to assess the potential effects of rail traffic noise reflections from an acoustic barrier associated with the proposed development on the existing residences to the south of the railway.

To assess the impact that the development will have on background sound levels, rail traffic predictions were made using a 3-D numerical computer modelling package [*Cadna-A Version 2020 MR 2 (build: 177.5010)*]. The model is based on the methods from ISO Standard 9613-2.2, “*Acoustics – Attenuation of Sound During Propagation Outdoors*”, which accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures. For the purposes of the analysis, the façades of the proposed dwellings were conservatively assumed to be 100% reflective (i.e., no sound absorption). The railway noise source was included in the model based on traffic volumes obtained from CP personnel.

Predictions using the conservative model indicate that the proposed residential development and associated acoustic barrier will result in a minor increase (up to 1 dB). Figures 4 and 5 indicate the sound levels predicted in the acoustic model with and without the required acoustic barrier. Thus, it is concluded that reflections from the proposed development will not significantly affect the traffic noise levels at the existing homes on the south side of the railway.
6 Summary and Recommendations

The following recommendations are provided in regard to noise mitigation.

1. Central air conditioning is required for dwellings closest to the railway. Forced air ventilation with ducts sized for the future installation of air conditioning is required for dwellings further from the railway.

2. Brick or masonry exterior wall constructions are required for all of the dwellings in the first row from the railway.

3. Upgraded window glazing constructions are required for dwellings with exposure to the railway.

4. Warning clauses are required to be included in all offers of purchase and sale and property and tenancy agreements to inform future occupants of the sound level excesses.

5. Reflections from a potential acoustic barrier associated with the proposed development will not significantly affect the traffic sound levels at the existing homes to the south of the railway.

6. When detailed floor plans and building elevations are available for the future dwelling units, a detailed noise study should be performed to specify window glazing requirements with sufficient acoustical insulation for the dwelling units based on actual window to floor area ratios and to verify the exterior wall construction.

The reader is referred to the previous sections of this report where these recommendations are discussed in more detail.
Table 8: Summary of Noise Control Requirements and Noise Warning Clauses

<table>
<thead>
<tr>
<th>Prediction Location</th>
<th>Acoustic Barrier</th>
<th>Ventilation Requirements*</th>
<th>Type of Warning Clause</th>
<th>^Window Glazing Requirements</th>
<th>Brick Exterior Constructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>[A], [B]</td>
<td>--</td>
<td>Central A/C</td>
<td>A, C, D</td>
<td>1LRDR: OBC</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1BR: STC-38</td>
<td></td>
</tr>
<tr>
<td>[C]</td>
<td>--</td>
<td>Central A/C</td>
<td>A, C, D</td>
<td>1LRDR: STC-29</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1BR: STC-39</td>
<td></td>
</tr>
<tr>
<td>[D]</td>
<td>--</td>
<td>Central A/C</td>
<td>A, C, D</td>
<td>1LRDR: STC-29</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1BR: STC-39</td>
<td></td>
</tr>
<tr>
<td>[E]</td>
<td>--</td>
<td>Central A/C</td>
<td>A, C, D</td>
<td>1LRDR: OBC</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1BR: STC-39</td>
<td></td>
</tr>
<tr>
<td>[F]</td>
<td>--</td>
<td>Forced Air</td>
<td>A, B, D</td>
<td>2LRDR: OBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2BR: STC-33</td>
<td></td>
</tr>
<tr>
<td>[G]</td>
<td>--</td>
<td>Forced Air</td>
<td>A, B, D</td>
<td>2LRDR: OBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2BR: STC-33</td>
<td></td>
</tr>
<tr>
<td>[H]</td>
<td>--</td>
<td>Forced Air</td>
<td>A, B, D</td>
<td>2LRDR: OBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2BR: STC-33</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>--</td>
<td>Forced Air</td>
<td>A, B, D</td>
<td>2LRDR: OBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2BR: STC-33</td>
<td></td>
</tr>
<tr>
<td>Remaining dwellings within 300 m of railway right-of-way</td>
<td>--</td>
<td>--</td>
<td>D</td>
<td>2OBC</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes: -- no specific requirement
* The location, installation and sound rating of the air conditioning condensers must be compliant with MECP Guideline NPC-300, as applicable
1 Assuming sound through windows only since exterior façades are required to be brick
2 Assuming sound through windows and walls
^ When detailed floor plans and building elevations are available, window glazing requirements should be refined based on actual window to floor area ratios
LRDR – Living Room/Dining Room
BR – Bedroom
6.1 Implementation

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

1. Prior to the issuance of building permits for this development, the Municipality’s building inspector or a Professional Engineer qualified to perform acoustical engineering services in the Province of Ontario should certify that the noise control measures have been properly incorporated.

2. Prior to assumption of the subdivision, the Municipality’s building inspector or a Professional Engineer qualified to perform acoustical engineering services in the Province of Ontario should certify that the noise control measures have been properly installed and constructed.
Figure 2 - Proposed Site Plan Showing Prediction Locations
LEGEND

- Central air conditioning is required
- Forced air ventilation with ducts sized for the future installation of air conditioning by the occupant is required
- Brick exterior facade required

Figure 3 - Proposed Site Plan Showing Ventilation and Brick Exterior Requirements
Figure 4: Predicted Overall A-weighted Nighttime Rail Traffic Sound Levels with Proposed Residential Development, No Acoustic Barrier
Figure 5: Predicted Overall A-weighted Nighttime Rail Traffic Sound Levels with Proposed Residential Development and Acoustic Barrier
Figure 6a: Pass-by 1 at 30 m from ROW
Measured Vibratory Velocity Level

Figure 6b: Pass-by 1
Acceleration Spectrum @ Peak Level (1 sec. Duration)
Figure 8a: Pass-by 3 at 30 m from ROW
Measured Vibratory Velocity Level

Figure 8b: Pass-by 3
Acceleration Spectrum @ Peak Level (1 sec. Duration)
**Figure 9a: Pass-by 4 at 30 m from ROW**
Measured Vibratory Velocity Level

![Graph showing measured vibratory velocity level with CN limit of 0.14 mm/s.](image)

**Figure 9b: Pass-by 4**
Acceleration Spectrum @ Peak Level (1 sec. Duration)

![Graph showing 1/3 octave band acceleration level with CN limit.](image)
APPENDIX A

CP Railway Guidelines
PRINCIPAL MAIN LINE REQUIREMENTS

A. Safety setback of habitable buildings 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 shall enter into an Agreement with CN stipulating how CN's concerns will be resolved and will pay CN's reasonable costs in preparing and negotiating the agreement.

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

Rail Traffic Data
September 10, 2019

Via email: vgarcia@hgcengineering.com

Victor Garcia
HGC Engineering
2000 Argentia Road
Plaza One, Suite 203
Mississauga, Ontario  L5N 1P7

Dear Sir/Madam:

Re: Rail Traffic Volumes, CP Mileage 37.88, Hamilton Subdivision, S Grimsby Road 5, Smithville

This is in reference to your request for rail traffic data in the vicinity of S Grimsby Road 5 in the City of Smithville. The study area is located at mile 37.88 of our Hamilton Subdivision, which is classified as a Principal Main line.

The information requested is as follows:

1. Number of freight trains between 0700 & 2300: 3
   Number of freight trains between 2300 & 0700: 6
2. Maximum cars per train freight: 129
3. Number of locomotives per train: 2 to 4
4. Maximum permissible train speed: 50 mph on main
   10 mph on siding
5. The whistle signal is sounded approaching public grade crossings through the study area and may also be sounded if deemed necessary by the train crew for safety reasons at any time.
6. There is 1 main line track with continuously welded rail and 1 siding track.

The information provided is based on recent rail traffic. Variations of the above may exist on a day-to-day basis. Specific measurements may also vary significantly depending on customer needs.

Yours truly,

 Josie Tomei
Specialist Real Estate Sales & Acquisitions - Ontario
APPENDIX C

Sample STAMSON 5.04 Output
Description: Lot 40 with flanking exposure to railway

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

Train ! Trains ! Trains ! Speed ! loc ! Cars! Eng !Cont
Type ! (Left) ! (Right) ! (km/h) !/Train!/Train! type !weld

* 1. Freight ! 2.0/3.9 ! 2.0/3.9 ! 80.0 ! 4.0 !129.0 !Diesel! Yes

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

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

1. Freight ! 1.5/3.0 ! 1.5/3.0 ! 2.50 ! 11.00 !

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

Angle1 Angle2 : 0.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 46.80 / 46.80 m
Receiver height : 7.50 / 7.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Whistle Angle : 5 deg Track 1
Reference angle : 0.00

Results segment # 1: CP (day)

LOCOMOTIVE (0.00 + 57.59 + 0.00) = 57.59 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>90</td>
<td>0.41</td>
<td>68.53</td>
<td>-6.94</td>
<td>-4.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>57.59</td>
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</tbody>
</table>

WHEEL (0.00 + 50.33 + 0.00) = 50.33 dBA

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<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
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<tbody>
<tr>
<td>0</td>
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<td>0.51</td>
<td>62.00</td>
<td>-7.46</td>
<td>-4.20</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>50.33</td>
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<tr>
<td></td>
<td>Angle1</td>
<td>Angle2</td>
<td>Alpha</td>
<td>RefLeq</td>
<td>D.Adj</td>
<td>F.Adj</td>
<td>W.Adj</td>
<td>H.Adj</td>
<td>B.Adj</td>
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<td>-------</td>
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<tr>
<td>LEFT WHISTLE (0.00 + 43.13 + 0.00) = 43.13 dBA</td>
<td>0</td>
<td>5</td>
<td>0.41</td>
<td>65.64</td>
<td>-6.94</td>
<td>-15.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>5</td>
<td>83</td>
<td>0.41</td>
<td>65.64</td>
<td>-6.94</td>
<td>-4.45</td>
<td>0.00</td>
<td>0.00</td>
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<td>Segments Leq :</td>
<td>59.86 dBA</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Total Leq All Segments:</td>
<td>59.86 dBA</td>
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<td></td>
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<tr>
<td>Results segment # 1: CP (night)</td>
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<tr>
<td>LOCOMOTIVE (0.00 + 63.50 + 0.00) = 63.50 dBA</td>
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<td>90</td>
<td>0.41</td>
<td>74.44</td>
<td>-6.94</td>
<td>-4.00</td>
<td>0.00</td>
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<td>0.00</td>
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<tr>
<td>WHEEL (0.00 + 56.24 + 0.00) = 56.24 dBA</td>
<td>0</td>
<td>90</td>
<td>0.51</td>
<td>67.91</td>
<td>-7.46</td>
<td>-4.20</td>
<td>0.00</td>
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<tr>
<td>LEFT WHISTLE (0.00 + 49.04 + 0.00) = 49.04 dBA</td>
<td>0</td>
<td>5</td>
<td>0.41</td>
<td>71.55</td>
<td>-6.94</td>
<td>-15.57</td>
<td>0.00</td>
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<tr>
<td>RIGHT WHISTLE (0.00 + 60.16 + 0.00) = 60.16 dBA</td>
<td>5</td>
<td>83</td>
<td>0.41</td>
<td>71.55</td>
<td>-6.94</td>
<td>-4.45</td>
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<td>Segments Leq :</td>
<td>65.77 dBA</td>
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<td>Total Leq All Segments:</td>
<td>65.77 dBA</td>
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</tbody>
</table>
TOTAL Leq FROM ALL SOURCES (DAY): 59.86 dBA
(NIGHT): 65.77 dBA
EOLA
STAMSON 5.0 NORMAL REPORT Date: 07-08-2020 08:36:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: eola.te Time Period: 16 hours
Description: OLA of lot 40 with flanking exposure to the railway

Rail data, segment # 1: CP
----------------------------------------
Train ! Trains ! Speed !(km/h) !/Train!/Train! type !weld
Type ! ! Cars! Eng !Cont
----------------------------------------
1. Freight ! 4.0/7.6 ! 80.0 ! 4.0 !129.0 !Diesel! Yes

Data for Segment # 1: CP
----------------------------------------
Angle1 Angle2 : -90.00 deg -60.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 49.60 m
Receiver height : 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1 : -90.00 deg Angle2 : -60.00 deg
Barrier height : 10.00 m
Barrier receiver distance : 3.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Rail data, segment # 2: CP
----------------------------------------
Train ! Trains ! Speed !(km/h) !/Train!/Train! type !weld
Type ! ! Cars! Eng !Cont
----------------------------------------
1. Freight ! 4.0/7.6 ! 80.0 ! 4.0 !129.0 !Diesel! Yes

Data for Segment # 2: CP
----------------------------------------
Angle1 Angle2 : -60.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 49.60 m
Receiver height : 1.50 m
Topography: 1 (Flat/gentle slope; no barrier)

Results segment # 1: CP

Barrier height for grazing incidence

<table>
<thead>
<tr>
<th>Source</th>
<th>Receiver</th>
<th>Barrier</th>
<th>Elevation of Height (m)</th>
<th>Height (m)</th>
<th>Height (m)</th>
<th>Height (m)</th>
<th>Barrier Top (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCOMOTIVE (0.00 + 39.53 + 0.00) = 39.53 dBA</td>
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<tr>
<td>WHEEL (0.00 + 31.65 + 0.00) = 31.65 dBA</td>
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</tbody>
</table>

Segment Leq: 40.19 dBA

Results segment # 2: CP

LOCOMOTIVE (0.00 + 58.53 + 0.00) = 58.53 dBA

WHEEL (0.00 + 51.51 + 0.00) = 51.51 dBA

Segment Leq: 59.32 dBA

Total Leq All Segments: 59.37 dBA
TOTAL Leq FROM ALL SOURCES: 59.37 dBA