June 2014

## DUNDAS SQUARE GARDENS

# Noise & Vibration Impact Statement

**Submitted to:**
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REPORT

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Golder Associates

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# 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Dundas Square Gardens Inc. to prepare a Noise & Vibration Impact Statement (NVIS) for a proposed multi-family residential condominium development with ground floor retail and city spaces. The development is proposed to be located in the City of Toronto and include the following street addresses 200 Dundas Street East, 241 – 251 Jarvis Street, and 280 George Street. This study will present the noise and vibration assessment results along with preliminary noise control and warning clause recommendations.

## 1.1 OVERVIEW OF AN NVIS

The purpose of this study is to assess the following:

- The noise impact of the environment on the development;
- The noise impact of the development on the environment; and
- The noise impact of the development on itself.

Section 2 of this report describes the noise impact of the environment on the development, which is dominated by noise from road and street car traffic, and provides recommendations to ensure indoor noise levels within each suite and outdoor living spaces, as specified by the Ontario Ministry of the Environment (MOE) and other regulatory authorities are achieved. Noise from adjacent building rooftops is also addressed.

Section 3 describes the noise impact of the development on the environment, which includes the noise impact of stationary noise sources associated with the development and the increased road traffic due to the project.

Section 4 describes the noise impact of the development onto itself, which considers noise transmission within the building itself, which is required to achieve the requirements of the Ontario Building Code, ASHRAE, and good acoustical engineering practices.

# 2.0 IMPACT OF THE ENVIRONMENT ON THE DEVELOPMENT

Golder has assessed the impact of the future noise environment on the development using traffic data obtained from the City of Toronto and TTC websites. Vibration has been assessed based on site-specific measurements.

## 2.1 CRITERIA AND GUIDELINES

In preparing this report, Golder has considered applicable criteria and guidelines from publications prepared by the Ontario Ministry of the Environment (MOE), International Standards Organization (ISO), and the Canadian National (CN) Railway Company including:

- NPC-300 Environmental Noise Guidelines;
- NPC-101 Technical Definitions;
- NPC-102 Instrumentation;
- NPC-103 Procedures;
- NPC-104 Sound Level Adjustments;
- NPC-206 Sound Levels Due to Road Traffic;
- ISO-2631-2 Evaluation of Human Exposure to Whole-body Vibration: Human Exposure to Continuous and Shock-induced Vibration in Buildings (1 Hz to 80 Hz); and
- CN Rail Noise, Vibration and Safety Impact Policy Principal Main Line Requirements.

### 2.1.1 Traffic Noise Sources

Indoor and outdoor traffic noise sound level limits used for this type of development are specified in the MOE publication NPC-300. The guideline specifically addresses the following:

1) sound levels in indoor living areas – for building component requirements;

2) sound levels at the plane of a window – for ventilation requirements; and

3) sound levels in the outdoor living areas – for barrier requirements.

#### *2.1.1.1 Indoor Traffic Noise Levels and Ventilation Requirements*

The MOE guidelines suggest that the sound level in 'living quarters', such as a living room and/or dining room, could be up to a maximum of a daytime equivalent indoor sound level ($L_{eq}$ [16 hour]) of 45 dBA due to road traffic and 40 dBA due to rail traffic (i.e., TTC street car traffic). Similarly, for sleeping quarters, such as a bedroom, the allowable maximum equivalent night-time indoor sound level ($L_{eq}$ [8 hour]) is 40 dBA due to road traffic and 35 dBA due to rail traffic. These limits are summarised in Table 1.

**Table 1: MOE Indoor Sound Level due to Road and Rail**

| Space | Road (dBA) | Rail (dBA) |
|---|---|---|
| Living quarters - Living/dining areas of residneces, libraries, daycare centres etc. (Time period 16 hours; 07:00- 23:00) – $L_{eq}$ [16 hours] | 45 | 40 |
| Sleeping quarters - Bedrooms of residences and hotels (Time period 8 hours; 23:00- 07:00) – $L_{eq}$ [8 hours] | 40 | 35 |

The guidelines also require the installation of central air conditioning in developments where the traffic sound levels at the plane of window exceed 60 dBA during the night-time or 65 dBA during the daytime to allow windows to remain closed. Similarly the guidelines require a minimum forced air ventilation system with provisions for installation of central air conditioning in developments where the traffic sound levels at the plane of window exceed 50 dBA (and less than 60 dBA) during night-time or 55 dBA (and less than 65 dBA) during the daytime. For traffic sound levels below 50 dBA during night-time or 55 dBA during the daytime; noise guidelines do not dictate the requirements for a ventilation system.

MOE guidelines also suggest including warning clauses to inform future owner/tenant of the potential noise level excess. A warning clause similar to the one below should be included in all development agreements, offers/agreements of purchase, sale or lease agreements. This clause is only a sample and can be modified as needed.

"*This dwelling unit has been supplied with a central air conditioning system which allows windows and exterior doors to remain closed, thereby allowing indoor road and rail traffic sound levels to satisfy the Municipality's and Ministry of the Environment noise criteria*".

### *2.1.1.2 Outdoor Living Areas and Barrier Requirements*

According to the MOE guidelines, an Outdoor Living Area (OLA) is anywhere that 'quiet' enjoyment of the outdoor environment or passive recreation is expected to occur. An OLA includes but is not limited to; backyards, gardens, terraces, patios, open balconies that are at least 4 m deep, or communal use areas such as amenity areas of apartment buildings, condominiums, group homes, campgrounds or other areas identified as being noise sensitive by the municipality such as parks.

MOE guidelines indicate that if the predicted daytime sound levels in an OLA is less than or equal to 55 dBA, no noise control is required. A sound level excess of up to 5 dB (i.e., less than 60 dBA) may be acceptable provided that future tenants/owners are made aware of a potential elevated noise levels through appropriate warning clauses.

As required in NPC-300, if the predicted noise levels exceed 60 dBA, physical noise control measures will be required to achieve the 55 dBA criterion. However, if such noise controls are not technically, economically and / or administratively feasible, sound levels up to 60 dBA with noise control may be acceptable with appropriate warning clauses to inform future tenants/owners of expected elevated noise levels.

### 2.1.2 Stationary Noise Sources

Stationary sources are defined as sources that do not move and generally operate within specified premises. Sound level criteria for such sources are defined in terms of hourly equivalent sound level ($L_{eq}$[1 hour]) at the plane of window. In accordance with MOE publication NPC-300 for urban settings, the applicable daytime limit is the greater of 50 dBA or the minimum hourly $L_{eq}$ daytime background noise level due to road traffic noise. Similarly the urban night-time limit is the greater of 45 dBA or minimum hourly $L_{eq}$ night-time background noise level due to road traffic.

While the background noise level due to road traffic surrounding the development is generally expected to be high, not all windows are directly exposed to road traffic noise and during the day and night there will be lulls in activity. On a preliminary basis, applicable stationary noise source sound level limits are the MOE exclusions limits as indicated in table below.

**Table 2: MOE Plane of Window Sound Level due to Stationary Noise Source**

| Location | Time Period | Hourly $L_{eq}$ (dBA) |
|---|---|---|
| Plane of window to noise-senstive space | Daytime 0700 – 1900 | 50 |
| | Evening 1900-2300 | 50 |
| | Nighttime 2300 - 0700 | 45 |

### 2.1.3 Vibration Sources

Perceptible vibration can affect humans in many ways. To minimize the potential for adverse effects due to rail vibration (i.e., TTC street cars), current standards accepted in Ontario are based on CN Railway requirements. The CN standards were developed based on ISO 2613. Following these guidelines, the overall rail vibration velocity summed between 4 Hz and 200 Hz with a 1 second averaging time constant should be less than 0.14 mm/s for all pass-bys.

## 2.2 ASSESSMENT OF TRAFFIC NOISE SOURCES

This section will summarize our approach to noise level predictions for the development.

### 2.2.1 Calculation Method

Due to the complexity of the road system and intervening structures in the vicinity of the development, the road traffic noise predictions were carried out using Cadna/A software based on the RLS-90 method instead of the DOS-based STAMSON software provided by the MOE. The model was used to calculate the future traffic noise levels at the development consistent with MOE guidelines. Table 3 provides a summary of the traffic data incorporated into the prediction model.

**Table 3: Summary of Road Traffic Data**

| Parameter | Jarvis Street | | Dundas Street East | |
|---|---|---|---|---|
| AADT / Date | 29,132 | Nov. 2009 | 22,560 | June 2010 |
| AADT 2024[1] | 39,208 | | 29,767 | |
| % of Trucks (Day / Night) | 10% / 5% | | 10% / 5% | |
| Day / Night Traffic Split | 90% /10% | | 90% / 10% | |
| Posted Speed Limit | 50 km/hr | | 50 km/hr | |
| Gradient of Road | 2% | | 0% | |

Note:
1) A 2% annual growth factor has been assumed and used to calculate anticipated traffic volumes for the year 2024

TTC streetcar noise levels predictions were performed using a moving-point source in the Cadna/A software. The sound power input was determined based on data for steel-wheel Automated-Guideway Transit (AGT) vehicles from Federal Transportation Associated (FTA) method for rail transit sources. The moving-point source was calibrated to give the same hourly $L_{eq}$ at 50 metres as the FTA method. The predictions were then adjusted in Cadna/A for street car traffic volumes, which were determined based on the Dundas street car schedule as summarised below in Table 4 below.

**Table 4: Summary of Streetcar Traffic Data**

| Direction of Travel | Number of Daytime/Evening Streetcars (0700-2300) | Number of Nighttime Streetcars (2300-0700) |
|---|---|---|
| Eastbound | 159 | 23 |
| Westbound | 156 | 26 |
| Total | 315 | 49 |

### 2.2.2 Results

The predicted day and night noise levels are summarized in Table 4. Figures 1 through 4 illustrate the predicted noise level contours due to both road and rail noise sources along each facade.

**Table 5: Predicted Future Maximum Sound Levels Along Facades**

| Façade Direction | Maximum $L_{eq}$ Sound Level on Facade (dBA) | | | |
|---|---|---|---|---|
| | Road | | Rail | |
| | Day 0700-2300 | Night 2300-0700 | Day 0700-2300 | Night 2300-0700 |
| **East Facade** | 69 | 63 | 66 | 60 |
| **South Facade** | 75 | 69 | 70 | 65 |
| **West Facade** | 76 | 68 | 66 | 60 |
| **North Facade** | 65 | 57 | 55 | 47 |

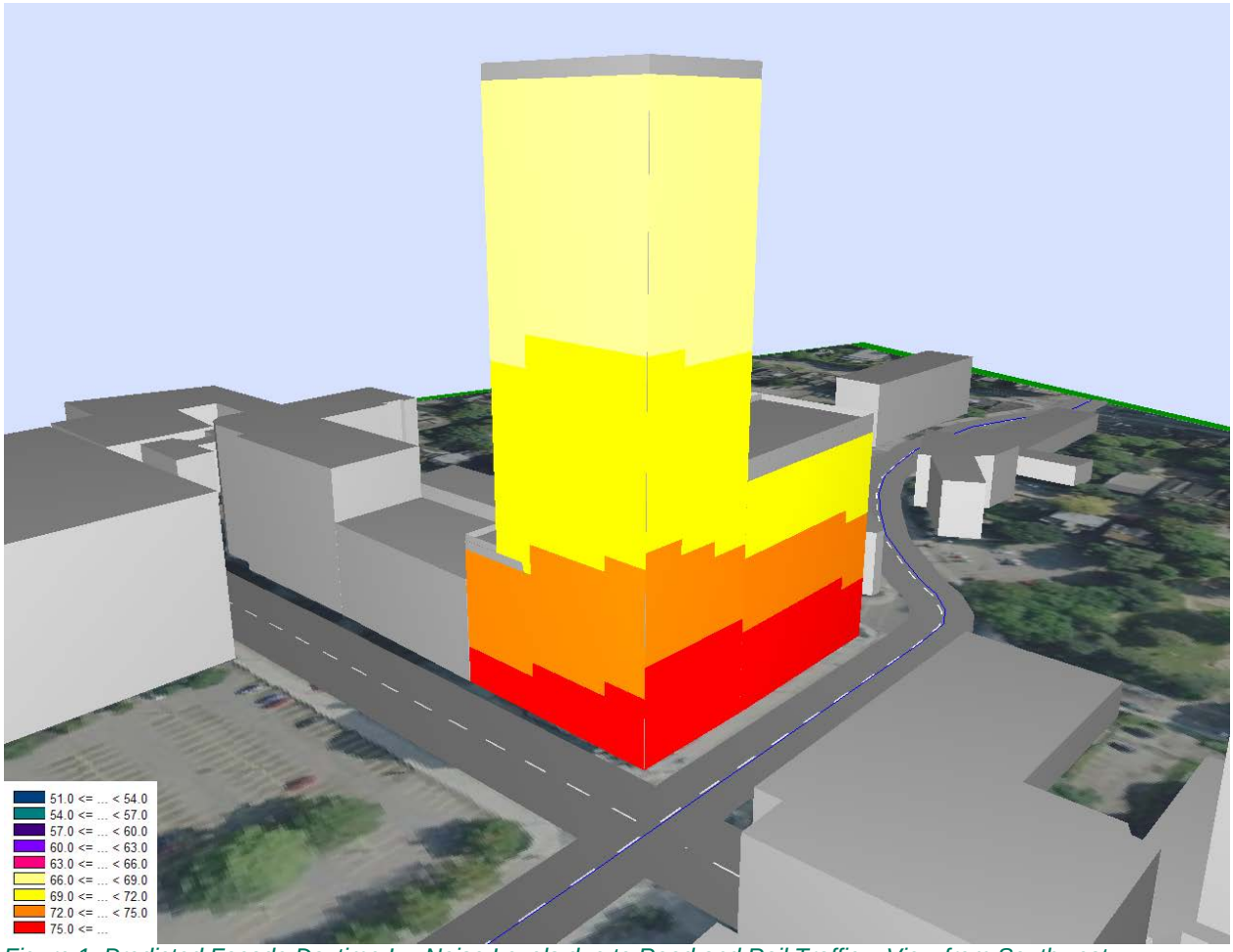


*Figure 1: Predicted Facade Daytime $L_{eq}$ Noise Levels due to Road and Rail Traffic – View from Southwest*

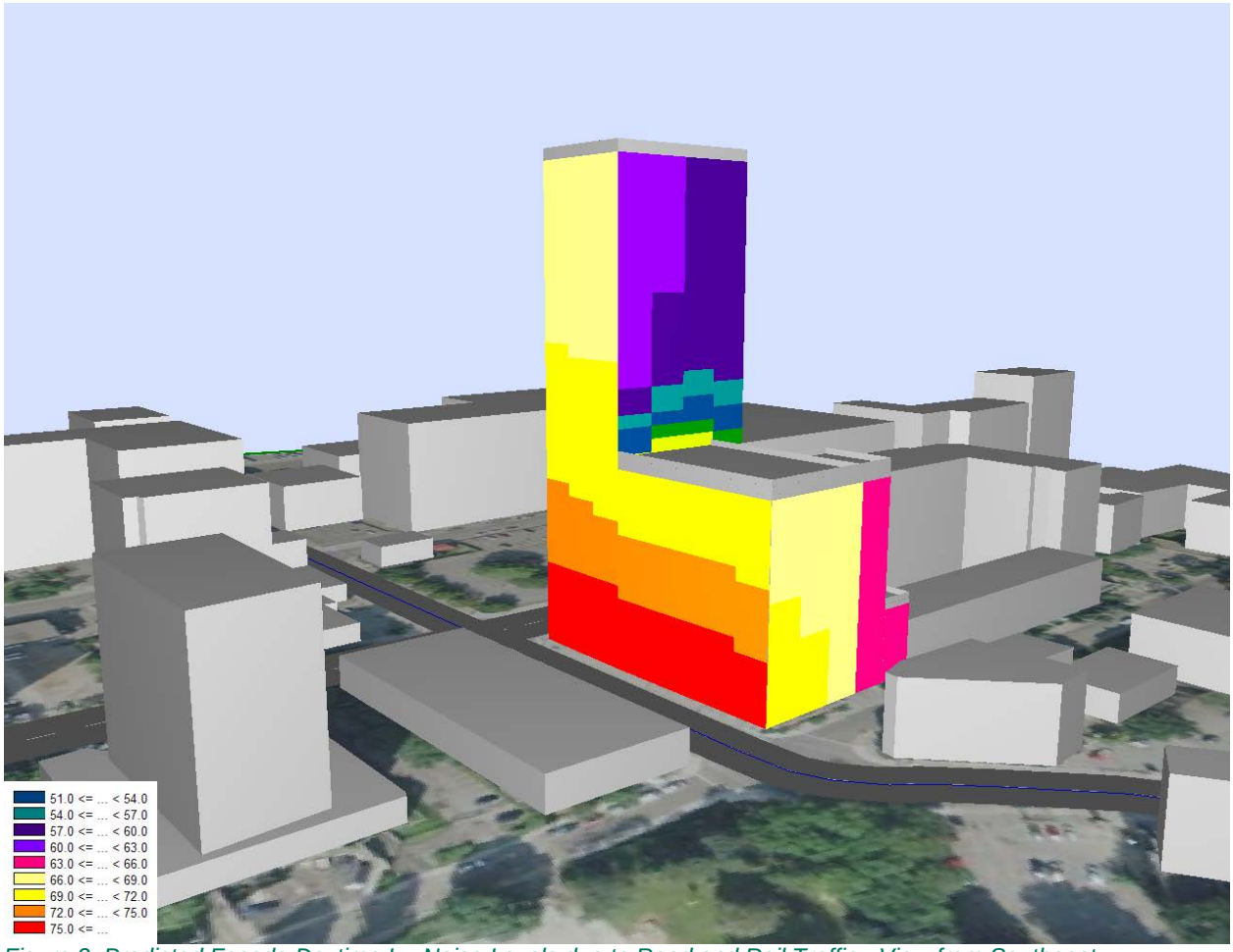


*Figure 2: Predicted Facade Daytime $L_{eq}$ Noise Levels due to Road and Rail Traffic - View from Southeast*

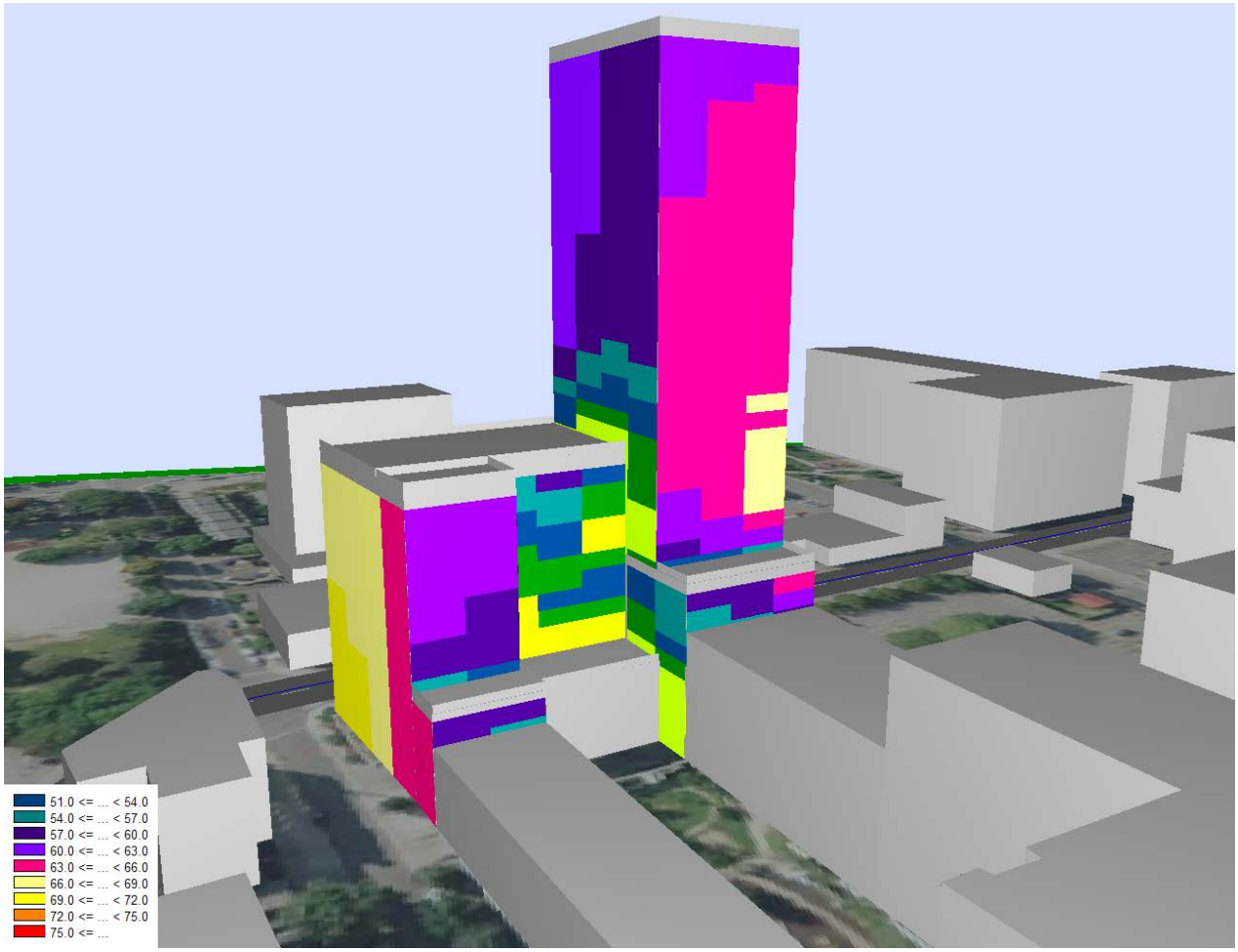


*Figure 3: Predicted Facade Daytime $L_{eq}$ Noise Levels due to Road and Rail Traffic - View from Northeast*

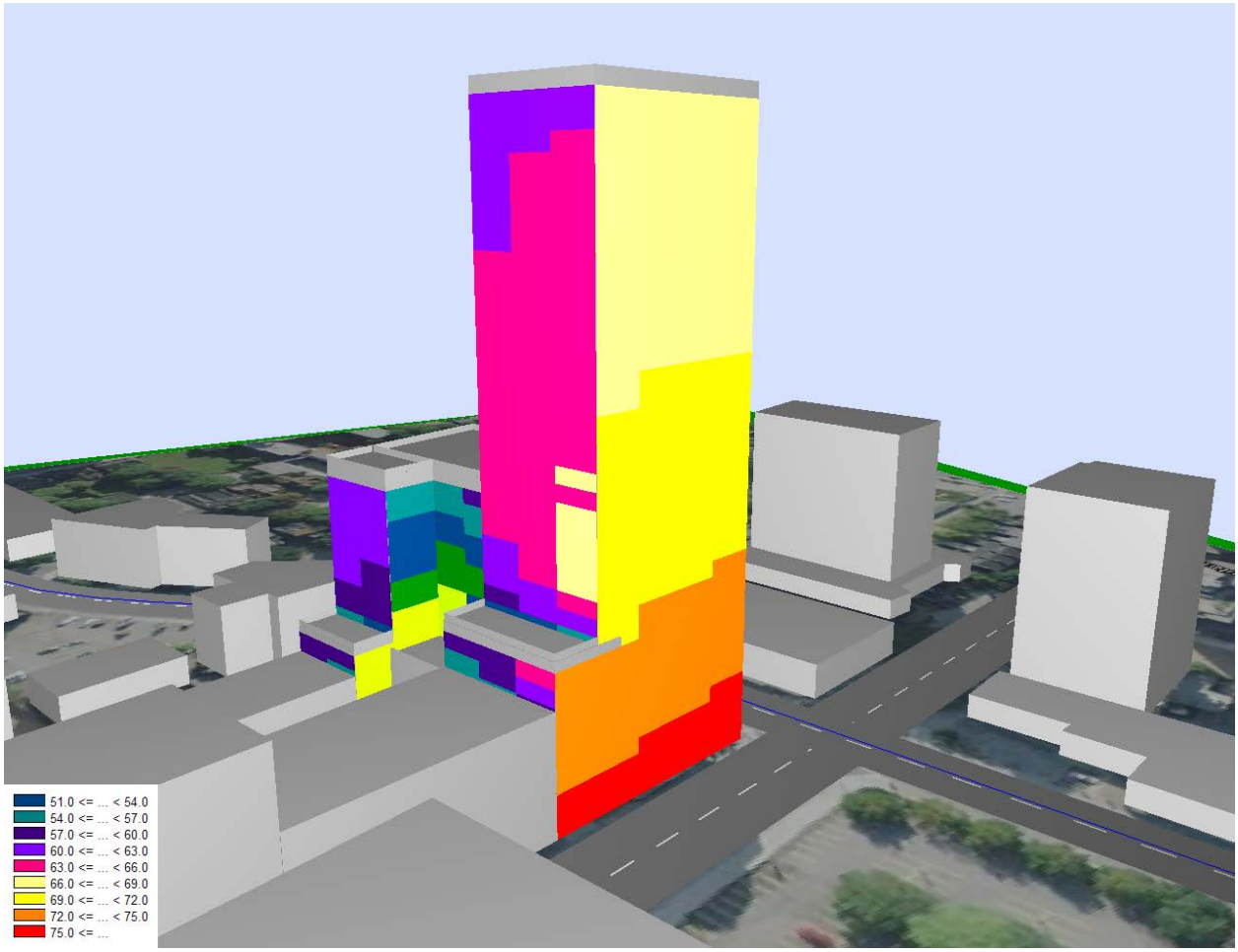


*Figure 4: Predicted Façade Daytime $L_{eq}$ Noise Levels due to Road and Rail Traffic - View from Northwest*

Predictions were also performed to assess the road and rail traffic noise levels for the proposed OLAs without the addition of any noise control features (e.g., barriers). The assessment locations are indicated in Figure 5 below and the predicted results are summarized in Table 6 below.

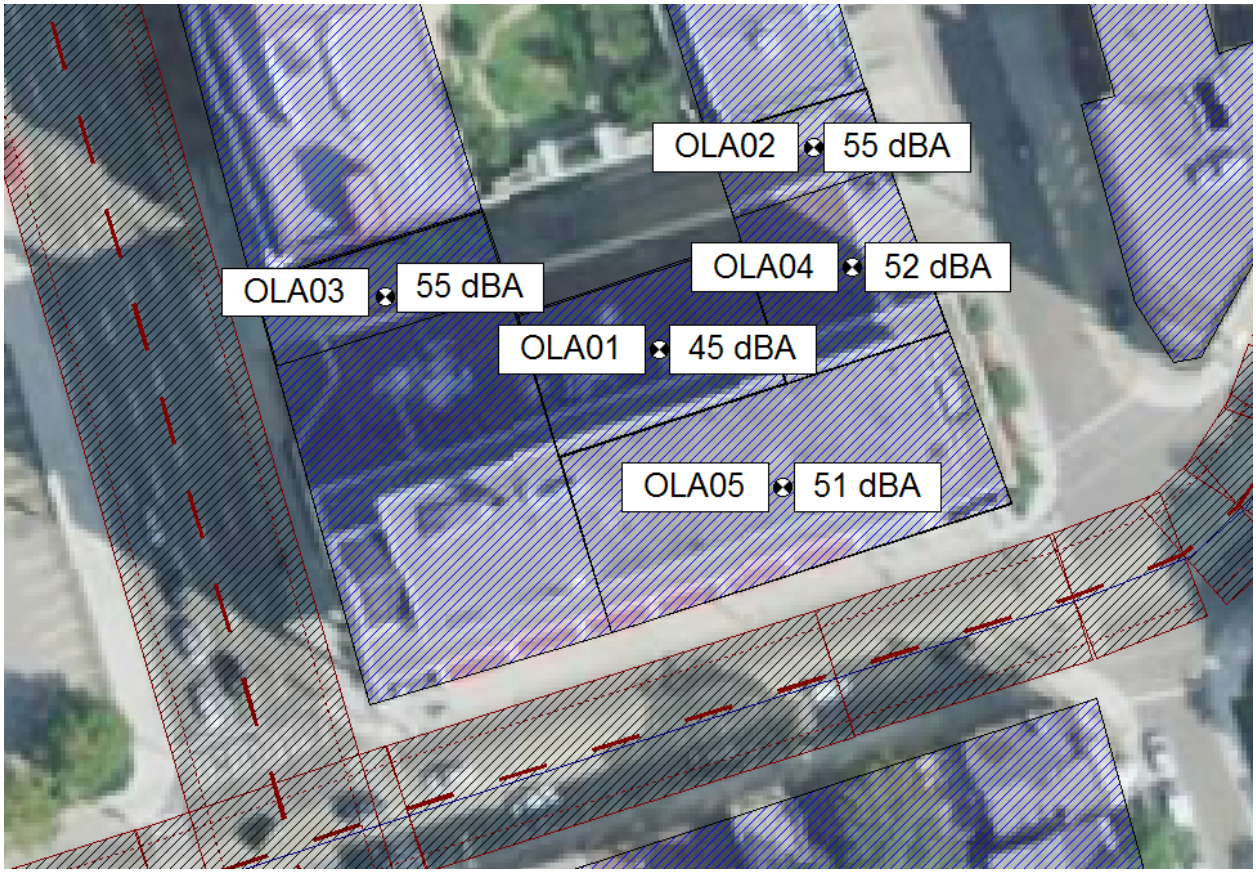


*Figure 5: Predicted Outdoor Living Area Daytime $L_{eq}$ Noise Levels*

**Table 6: Predicted Road and Rail Noise Levels within Outdoor Living Areas without Noise Control**

| Label | Outdoor Living Area Location | Daytime Predicted Noise Level (dBA) |
|---|---|---|
| OLA01 | 3 Floor OLA | 45 |
| OLA02 | 5 Floor OLA | 55 |
| OLA03 | 9 Floor OLA | 55 |
| OLA04 | 15 Floor OLA | 52 |
| OLA05 | 17 Floor OLA | 51 |

### 2.2.3 Discussion and Recommendations

This section will provide discussion and recommendations on the indicated results.

#### *2.2.3.1 Ventilation Requirements*

Predicted façade sound levels indicate that the development will require central air conditioning and it is expected that this will be a standard feature of the development. Window air conditioning systems, such as a package terminal air conditioner, should not be considered for this development. The following warning clause should be included in all development agreements, offers/agreements of purchase, sale or lease agreement. Sample wording is given below, which can be modified as needed:

"*This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby allowing indoor road and rail traffic sound levels to satisfy the sound level limits of the Municipality and the Ministry of Environment*".

#### *2.2.3.2 Façade Sound Isolation Requirements*

As suite layouts were not available at the time this study was prepared, representative assumptions were made for the purpose of determining development feasibility. Based on these assumptions, building envelope sound isolation requirements were determined in order to achieve the indicated MOE road and rail traffic indoor noise level guidelines.

In calculating the sound isolation requirements, the following assumptions were made:

- Bedrooms will not be located on building corners or have exterior doors to balconies to ensure sound isolation requirements for bedrooms are achievable.
- Bedrooms will have up to 80% glazing-to-floor area.
- Bedrooms will have carpeting and soft furnishings providing a high level of acoustical absorption.
- Living rooms (non-corner) will have up to 80% glazing-to-floor area.
- Living rooms (corner) have up to 100% glazing-to-floor area.
- Living rooms will use exterior doors will appropriate acoustical ratings (i.e., hinged doors with seals provided better performance than sliding doors).
- Living rooms will have hard floors and some soft furnishings providing an intermediate level of acoustical absorption.

Based on the predicted outdoor sound levels and the above assumptions, the following minimum STC requirements have been determined for each façade.

**Table 7: Non-Corner Suite Sound Isolation Requirements**

| Façade Direction | Recommended Minimum STC Performance | |
|---|---|---|
| | Glazing & Doors for Living Rooms | Glazing for Bedrooms |
| East Facade | STC 35 | STC 35 |
| South Facade | STC 40 | STC 40 |
| West Facade | STC 40 | STC 40 |
| North Facade | STC 30 | STC 30 |

Due to the higher glazing-to-floor area allowance for corner living rooms, the following minimum sound isolation requirements have been determined.

**Table 8: Corner Suite Sound Isolation Requirements**

| Corner Direction | Recommended Minimum STC Performance |
|---|---|
| | Glazing & Doors for Living Rooms |
| Southeast Corner | STC 40 |
| Southwest Corner | STC 41 |
| Northeast Corner | STC 31 |
| Northwest Corner | STC 39 |

In addition to building façade components meeting the above STC recommendations, the following warning clause should be included in all development agreements, offers/agreements of purchase, sale or lease agreement:

*"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to road and rail traffic will be audible and may on occasion interfere with activities of the dwelling occupants".*

#### 2.2.3.3 Selection of Façade Building Components

Based on the recommended sound isolation requirements for the building envelope, additional discussion is being provided in this section to assist in the preliminary selection of façade building components.

The use of swing doors instead of sliding doors to balconies from living rooms is recommended in order to assist with achieving the sound isolation requirements, especially for the south and west facades; and southeast, southwest, and northwest corner living rooms.

In order to achieve the indoor noise level, the selected exterior wall assemblies including spandrel should provide sound isolation performance of STC 50. The selected wall assembly including any bulkheads should be reviewed to estimate expected sound isolation performance. However, if the amount of spandrel or exterior wall used on the project is low, this may not represent a major issue.

In selecting façade components, manufacturers should provide systems meeting the required sound isolation ratings. The accepted method is through documented laboratory test data on actual constructions. Currently, many manufacturers use tabulated ratings based on glazing configuration alone that can underestimate actual installed sound isolation performance. These cannot be used as the basis of approval for Tarion certification.

It should be noted that as part TARION's home warranty program, Golder are required to measure background sound levels in suites prior to occupancy to verify that MOE noise guidelines are satisfied. If the building envelope does not meet the required level of sound isolation performance, field testing results may not be favourable and it may not be possible for Golder to provide final clearance for the development until the issue is resolved.

#### 2.2.3.4 Outdoor Living Area Noise Control Requirements

As hourly-averaged predicted noise levels for outdoor living areas on the 3$^{rd}$, 5$^{th}$, 9$^{th}$, 15$^{th}$, and 17$^{th}$ rooftop OLAs are predicted to be 55 dBA or less, the inclusion of additional noise control features (e.g., barriers) is not specifically required. However, since the level of impact will vary an appropriate warning clause should be included in all development agreements, offers/agreements of purchase, sale or lease agreement. Sample wording is given below, which can be modified as needed:

"*Purchasers/tenants are advised that sound levels due to road and TTC rail traffic may occasionally exceed MOE sound level limits and interfere with activities of the dwellings occupants within the building's outdoor living areas*".

## 2.3 ASSESSMENT OF STATIONARY NOISE SOURCES

Due to the proximity of the proposed development to a variety of other buildings, the primary stationary noise sources under consideration are on the rooftops of these buildings.

It is difficult to predict the total sound level contribution of all rooftop stationary noise sources surrounding the development. During the daytime, the ambient sound levels are expected to be dominated by road and TTC traffic, and it is unlikely that rooftop stationary noise sources will represent a significant concern. However, noisy equipment that operates during the night may be a problem.

Based on a review of the area, there is potential for equipment on the rooftop of the building to north, specifically the mechanical penthouse and cooling tower, to generate noise in excess of the MOE sound level limits at the plane of windows for the proposed development. However, since the site of the proposed development currently contains a hotel, the adjacent building (i.e., equipment owner) is currently required to comply with MOE environmental noise guidelines. It is therefore assumed that this equipment does meet with MOE sound level limits by inclusion of appropriate noise controls, but further investigation is recommended to verify.

To provide some protection in the event of an unforeseen issue, a warning clause is recommended to be included in all development agreements, offers/agreements of purchase, sale or lease agreements of all units similar to the following:

"*Purchasers are advised that due to the proximity of adjacent buildings, sound levels produced by the operation of these building's electro-mechanical equipment may at times be audible* and produce sound levels in excess of Ministry of Environment sound level limits."

## 2.4 ASSESSMENT OF VIBRATION SOURCES

The only significant source of vibration considered was rail vibration from TTC street car pass-bys. Vibration propagation is very site-specific depending on the characteristics of vibration source and surrounding soil conditions. As a result, vibration predictions are not a reliable means of assessment.

For this project, site vibration measurements were performed on the 2nd floor within the existing hotel building and at-grade in soil approximately 15 metres from the street car tracks. For the 2nd floor measurements, it was not possible to visually see the street cars during the measurements to verify speed. However, for at-grade measurement all street cars were observed to be moving at a typical TTC street car speed. The results are summarized in Table 8 below.

**Table 9: Vibration Measurement Results**

| Location | Streetcar Pass-by | Maximum-hold Vibration Velocity (mm/s) 4 Hz to 200 Hz with 1 s averaging time |
|---|---|---|
| 2nd Floor on slab | 1 | 0.028 |
| | 2 | 0.035 |
| | 3 | 0.045 |
| | 4 | 0.026 |
| | 5 | 0.027 |
| | 6 | 0.029 |
| At-grade in soil | 7 | 0.094 |
| | 8 | 0.077 |
| | 9 | 0.058 |
| | 10 | 0.060 |
| | 11 | 0.051 |

Based on the results, the vibration levels in the soil and on the 2nd floor of the existing building are less than 0.14 mm/s. Vibration from street cars is not expected to be an issue for the development and no vibration mitigation measurements are recommended.

# 3.0 IMPACT OF THE DEVELOPMENT ON THE ENVIRONMENT

The proposed development could impact the noise environment in two different manners:

1) noise emission due to the increase in automobile traffic of the future residents; and

2) noise from stationary sources such as rooftop equipment associated with the development.

Operation of certain types of equipment such as emergency generators, even for testing, may require an Environmental Compliance Approval (Air & Noise) in accordance with NPC-300. The impact of the development on the environment including applicable criteria is discussed in this section.

## 3.1 CRITERIA

There is no specific noise related criteria for road traffic noise other than road traffic criterion discussed in Section 2 of this report.

For stationary sources associated with this development, MOE environmental noise guideline publication NPC-300 is applicable. The proposed development is located in a high ambient noise environment in Toronto, Ontario. Therefore, the Site and its surroundings are best classified as Class 1 (Urban), as per NPC-300. The sound level limits previously defined in Table 2 would also to adjacent receptors to development

## 3.2 ROAD TRAFFIC NOISE

The existing acoustic environment in the vicinity of the development is dominated by road noise. Considering four to five movements per parking space per day, the increase in noise level due to this traffic is not expected to be significant. Therefore, the traffic noise impact on the environment is not expected to be a concern.

## 3.3 STATIONARY NOISE SOURCES

The stationary noise sources associated with the proposed development include underground parking exhaust fans, air handling units, cooling towers, intake and discharge louvers of mechanical rooms, emergency generator room vents and combustion exhaust. With proper noise controls, the energy equivalent hourly sound level from these sources at the nearest point(s) of reception (at the plane of window) including those associated with the development should not exceed 50 dBA during the daytime/evening or 45 dBA during the night on an Hourly $L_{eq}$ basis.

# 4.0 IMPACT OF THE DEVELOPMENT ON ITSELF

Noise issues that are localized to within the development itself are summarized in this section. This includes noise transmission between suites, mechanical rooms, and other areas such as indoor amenity areas.

Section 9.11 of Ontario Building Code (OBC), requires that all dwelling units within a residential building should be separated by a partition with the following STC requirements:

- Suite/Suite – Wall or Floor STC-50
- Suite/Elevator Hoist-way or Refuse Chute STC-55

There are also some best practice guidelines for indoor sound level from electro-mechanical equipment. American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) suggest the acceptable background levels in terms of Noise Criterion (NC) levels. It is suggested that the development be designed to meet these guidelines, which are summarized below:

- Living Rooms, Dining Rooms, Bedrooms NC-30

Additional guidance, with respect to OBC and good engineering practice, will be provided during the detailed design stage of the project.

# 5.0 CONCLUSIONS

Golder Associates Ltd. has been retained by Dundas Square Gardens Inc. to prepare a Noise & Vibration Impact Statement (NVIS) in support of site plan approval for the development at Jarvis & Dundas in Toronto, Ontario. The NVIS considers the impact of the environment on the development, the development on the environment, and the development on itself. This includes noise from surrounding road traffic, TTC rail traffic, and building electro-mechanical equipment. The predict noises levels were assessed against Ministry of Environment (MOE) environmental noise guidelines as defined in the NPC-300 publication.

A prediction model was used to assess the noise impact of the environment on the development. Based on the predicted levels of road and rail noise, air conditioning is a mandatory requirement for the suites of the development along with a related noise warning clause. Noise control recommendations were provided for building façade component's to reduce the impact of road and rail traffic noise and achieve the MOE's indoor noise guidelines. A related noise warning clause related is also recommended since traffic noise can vary. There are no major stationary noise sources (i.e., industry) in close proximity to the development. The most significant sources of noise are expected to be electro-mechanical equipment associated with adjacent buildings. The building to the north of the site appears to contain significant rooftop equipment (i.e., cooling towers), which may operate during the night. Since the site currently contains a hotel, this equipment is assumed to currently comply with MOE noise guidelines. It is recommended to further investigate this issue and include a suitable noise warning clause.

Vibration measurements were used to assess the vibration impact of the environment on the development. Based on the measured levels of vibration generated by TTC street cars pass-bys, no vibration mitigation measures are recommended.

The noise impact of the development on the environment is expected to be minimal. The increase of road traffic due to the development is insignificantly. Since the development's mechanical equipment will located on top of the largest tower, it will be effectively shielded from surrounding buildings. Still noise controls will be included to ensure the noise impact of the development complies with MOE stationary noise source sound level limits.

The noise impact of the development on itself will depend on the yet to be completed detailed design. Golder will work with the design team to ensure appropriate design and applicable of noise controls are included to achieve the MOE, Ontario Building Code, and ASHRAE requirements and good acoustical engineering practice. This will be followed by a TARION home warranty design certification and final construction clearance.

# 6.0 LIMITATIONS

In evaluating the impacts on the proposed, Golder has relied in good faith on information provided by others. We accept no responsibility for any deficiency, misstatements, or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of other persons involved.

Golder prepared this report using its commercially reasonable best efforts consistent with the level and skill ordinarily exercised by members of the profession currently practicing under similar conditions.

# Report Signature Page

**GOLDER ASSOCIATES LTD.**

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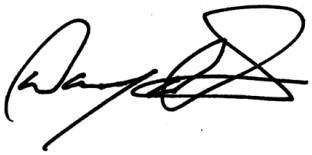

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RB/Dd/ng



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