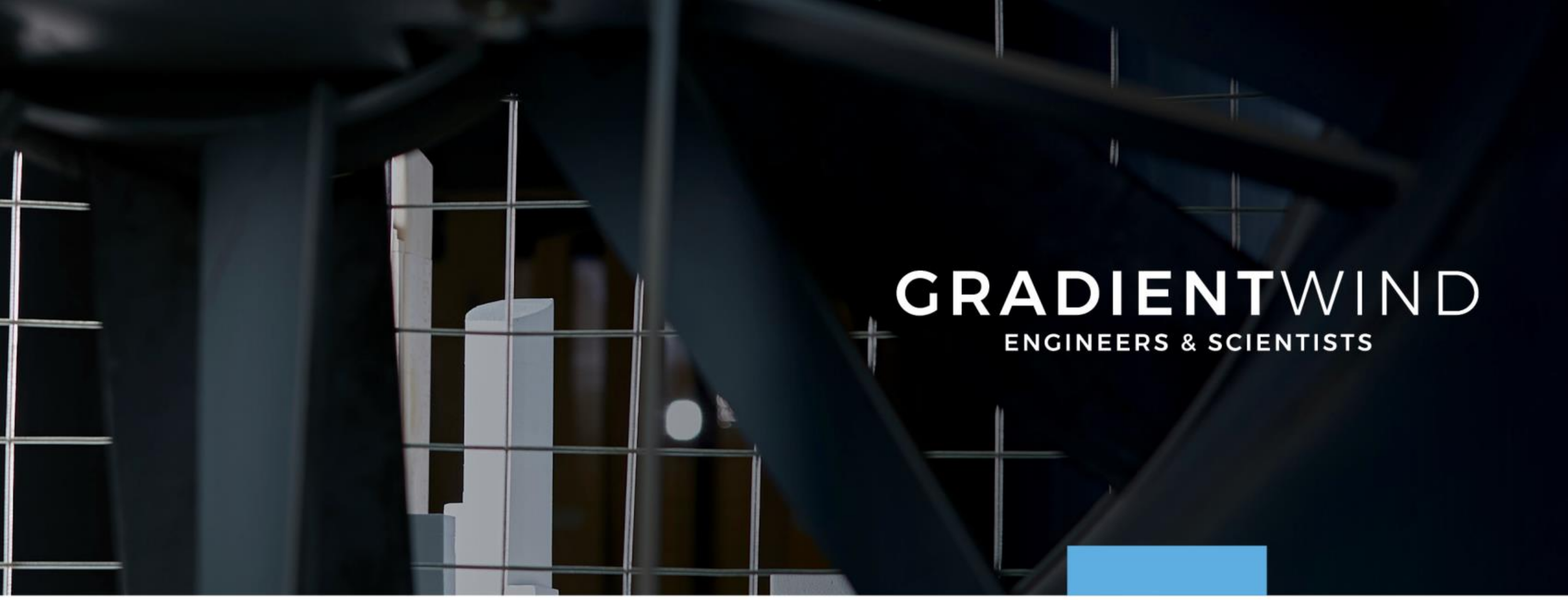
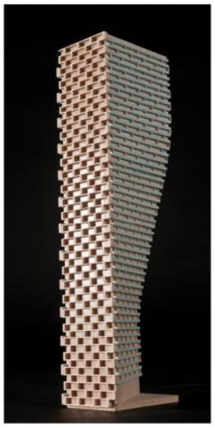
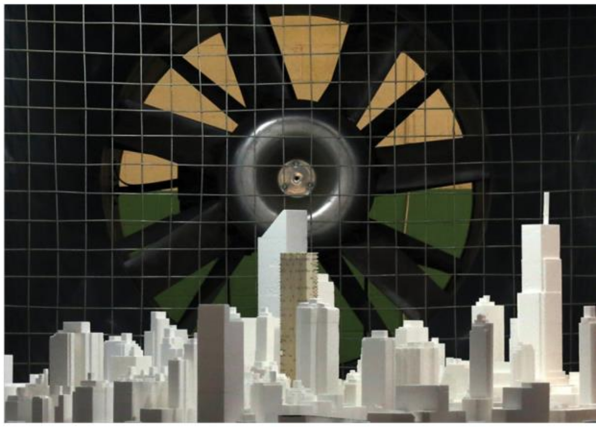



# ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

473 Albert Street
Ottawa, Ontario

REPORT: GWE19-215 – Transportation Noise & Vibration





December 5, 2019

PREPARED FOR
Attn: Curt Millar
**InterRent No. 3 Limited Partnership**
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PREPARED BY
Michael Lafortune, C.E.T., Environmental Scientist
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# EXECUTIVE SUMMARY

This report describes a transportation noise & vibration assessment performed for a proposed redevelopment located at 473 Albert Street in Ottawa, Ontario. The redevelopment comprises renovation of the existing 11-storey office to include residential-use. The major source of transportation noise is Albert Street, with some influence from Slater Street and Bronson Avenue. The Confederation Line LRT is located below Queen Street to the north and is considered as a minor source of ground vibrations. Figure 1 illustrates the site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings received from Linebox Studio.

The results of the current analysis indicate that noise levels will range between 57 and 70 dBA during the daytime period (07:00-23:00) and between 59 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade, which is nearest and most exposed to Albert Street. Building components with a higher Sound Transmission Class (STC) rating will be required where noise levels exceed 65 dBA, as indicated in Figure 3.

In addition to upgraded windows, the installation of central air conditioning (or similar mechanical system) will be required for all units in the development, which will allow occupants to keep windows closed and maintain a comfortable living environment. A Warning Clause will be required in all Agreements of Lease, Purchase and Sale for these units, as summarized in Section 6.

Results of vibration monitoring for a period of 24 hours found vibration levels from more than 200 LRT train passes at a distance of 50-55 metres from the rail centreline were below the minimum trigger level for the seismograph units, therefore below 0.14 mm/s PPV. In all cases, the measured vibration levels fall below the criterion of 0.1 mm/s RMS (72 dBV).

With regards to stationary noise impacts, a stationary noise study will be performed once mechanical plans for the proposed building become available. The study will determine noise impacts from rooftop mechanical units (i) of the surrounding, existing buildings on the proposed residential building, and (ii) of the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits.

# TABLE OF CONTENTS

## 1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by InterRent No. 3 Limited Partnership to undertake a transportation noise and vibration assessment for the proposed redevelopment at 473 Albert Street in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a transportation noise and ground vibration assessment.

The present scope of work involves assessing exterior and interior noise levels generated by local transportation sources, as well as vibration levels generated by local light rail transit (LRT) activity. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings received from Linebox Studio, with future roadway traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

## 2. TERMS OF REFERENCE

The redevelopment comprises renovation of the existing 11-storey office building located at 473 Albert Street in Ottawa, Ontario. The existing building will be converted to residential apartments. The ground floor comprises office space at the west side, a lobby and lounge at the centre and a coffee shop/restaurant at the east side. Level 2 is reserved for office space, while residential units occupy Levels 3 and above. A private basketball court and dog run area are located at the northwest corner of the site at grade. The rooftop of the building will provide outdoor amenity areas at all sides. The solid envelope of the mechanical penthouse at Level 12 will be partially removed to provide a glazed, pavilion structure accommodating indoor amenity space, including a gym, private dining area, common kitchen and common kitchen/recreation area. The size of the mechanical penthouse at Level 13 will be increased and screens around the perimeter will be installed. The existing two levels of underground parking will remain. In most areas the existing building façade will remain with some areas removed to add new Julian balconies.

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[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

[2] Ontario Ministry of the Environment, Conservation and Parks – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

The site is surrounded by low and medium-rise residential and office-use buildings in all directions. The major source of transportation noise is Albert Street, with some influence from Slater Street and Bronson Avenue. The Confederation Line LRT is located below Queen Street to the north and is considered as a minor source of ground vibrations. Figure 1 illustrates a complete site plan with surrounding context.

# 3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the study building produced by local transportation sources, (ii) calculate the future vibration levels on the study building produced by local LRT traffic, and (iii) ensure that interior noise levels and vibration levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4 of this report.

# 4. METHODOLOGY

## 4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level ($2\times10^{-5}$ Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

## 4.2 Roadway Traffic Noise

### 4.2.1 Criteria for Roadway Traffic Noise

For vehicle traffic, the equivalent sound energy level, $L_{eq}$, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level that has the same energy as a time varying noise level over a period of time. For roadways, the $L_{eq}$ is commonly calculated on the basis of a 16-hour ($L_{EQ16}$) daytime (07:00-23:00) / 8-hour ($L_{EQ8}$) nighttime

(23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for office/retail, living rooms and sleeping quarters, respectively, as listed in Table 1. However, to account for deficiencies in building construction and control peak noise, these levels should be targeted toward 47, 42 and 37 dBA.

### TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [3]

| Type of Space | Time Period | $L_{eq}$ (dBA) | |
|---|---|---|---|
| | | Road | Rail |
| **General offices**, reception areas, **retail stores**, etc. | 07:00 – 23:00 | 50 | 45 |
| Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc. | 07:00 – 23:00 | 45 | 40 |
| Sleeping quarters of hotels/motels | 23:00 – 07:00 | 45 | 40 |
| Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc. | 23:00 – 07:00 | 40 | 35 |

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning (or similar systems). Where noise levels exceed 65 dBA daytime and 60 dBA nighttime building components will require higher levels of sound attenuation[5].

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

Noise levels at outdoor living areas should be limited to 55 dBA where technically and administratively feasible. The City of Ottawa preferences for noise control prescribe the following hierarchy:

(i) Increased distance setback with absorptive ground cover (vegetation)
(ii) Relocation of noise sensitive areas away from roadways
(iii) Earth berms
(iv) Acoustic barriers

### 4.2.2 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[6] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

**TABLE 2: ROADWAY TRAFFIC DATA**

| Segment | Roadway Traffic Data | Speed Limit (km/h) | Traffic Volumes |
|---|---|---|---|
| Albert Street | 2-UAU | 50 | **15,000** |
| Slater Street | 2-UAU | 50 | **15,000** |
| Bronson Avenue | 2-UAU | 50 | **15,000** |

### 4.2.3 Roadway Traffic Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road and rail analysis. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road segment as a separate line source of noise, and by using existing building locations as noise barriers. In addition to the traffic volumes summarized in Table 4, theoretical noise predictions were based on the following parameters:

[6] City of Ottawa Transportation Master Plan, November 2013

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92%/8% respectively for all streets.
- Ground surfaces were taken to be reflective based on specific source-receiver path ground characteristics, which comprise paved surfaces.
- Site topography was considered to be flat or gently sloping.
- STAMSON input parameters are illustrated in Figures 4-6.

Noise receptors were strategically placed at 3 locations around the study area (see Figure 2). In some cases, source-receiver distances were less than 15 m, which is the minimum distance required for entry in STAMSON. A distance adjustment calculation shown in equation 1 from ORNAMENT was used to calculate the adjustment value, which was added to the calculated noise level from STAMSON[7]. The equation is as follows:

$$Distance\ Adjustment\ Value = 10\ (1{+}\propto)\log(\frac{D_{ref}}{D}) \qquad \textbf{(1)}$$

Where the parameters are:

$D_{ref}$= Distance used in STAMSON, 15 metres

D= Actual distance of source-receiver

α= Ground Absorption Factor (Hard Ground = 0, Soft Ground =1)

## 4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. The proposed redevelopment will retain the existing exterior wall assemblies, which comprises concrete panels and will exceed STC 45. Curtainwall systems typically provide around STC 35, depending on the glazing elements. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40 depending on the window manufacturer,

[7] ORNAMENT Technical Document, October 1989, Section 4

pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

According to the ENCG, when daytime noise levels (from road and rail sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[8] considers:

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room
- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

Based on published research[9], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, final detailed floor layouts and building elevations were unavailable and therefore detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

## 4.4 Ground Vibration & Ground-borne Noise

Transit systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through a medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when

[8] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985
[9] CMHC, Road & Rail Noise: Effects on Housing

there is excitation of the ground, such as from a train. Repetitive motion of the wheels on the track or rubber tires passing over uneven surface causes vibrations to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is 0.5 mm/s RMS (or 85 dBV), five times higher than the perception threshold, whereas the threshold for significant structural damage is 10 mm/s RMS (or 112 dBV), at least one hundred times higher than the perception threshold level.

### 4.4.1 Ground Vibration Criteria

In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by a partnership between the MECP and the Toronto Transit Commission[10]. These standards indicate that the appropriate criteria for residential buildings is 0.10 mm/s RMS for vibrations. For main line railways, a document titled Guidelines for New Development in Proximity to Railway Operations[11], indicates that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one second time-period at the first floor and above of the proposed building. As the main vibration source is due to the LRT lines, which will have frequent events,

[10] MECP/TTC Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Subway Loop, June 16, 1993

[11] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013

the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground borne noise criteria were adopted for this study.

### 4.4.2 Field Measurement Assessment Procedure

Existing levels of ground vibrations due to the Confederation Line LRT were determined by field measurements using Instantel model MiniMate Plus and MicroMate seismographs capable of recording three components of ground velocity: one vertical and two horizontal. Two measurement sites were selected along the northern foundation edge of the basement, nearest to the Confederation Line, as identified in Table 3. At the measurement locations, the seismograph was installed approximately 50-55 metres from the Confederation Line centerline, and left for a period of 24 hours. Seismograph measurements were set to a minimum trigger level of 0.14 mm/s peak partial velocity (ppv).

**TABLE 3: VIBRATION MEASUREMENT LOCATIONS**

| Receptor | Location Description | Placement of Seismographs from the Rail centerline (m) |
|---|---|---|
| V1 | Northeast Generator Room | 50 |
| V2 | West Storage Room | 55 |

## 5. RESULTS AND DISCUSSION

### 5.1 Transportation Noise Levels

The results of the roadway noise calculations are summarized in Table 4 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

**TABLE 4: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES**

| Receptor Number | Plane of Window Receptor Location | STAMSON 5.04 Noise Level (dBA) | |
|---|---|---|---|
| | | Day | Night |
| 1 | 11th Floor – South Façade | 70 | 63 |
| 2 | 11th Floor – West Façade | 66 | 59 |
| 3 | Rooftop Terrace | 57 | N/A |

The results of the current analysis indicate that noise levels will range between 57 and 70 dBA during the daytime period (07:00-23:00) and between 59 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade, which is nearest and most exposed to Albert Street.

## 5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Bedroom Windows (Including spandrel panels)**

(i) Bedroom windows facing south will require a minimum STC of 33

(ii) Bedroom windows facing west will require a minimum STC of 30

(iii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Living Room Windows (Including spandrel panels)**

(i) Living room windows facing south will require a minimum STC of 28

(ii) Living room windows facing west will require a minimum STC of 25

(iii) All other living room windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Retail/Office Windows**

(i) Retail/office windows facing south and west will require a minimum STC of 25

(ii) All other retail/office windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Exterior Walls**

(i) Exterior wall components on the south and west façades will require a minimum STC of 45, which will be achieved with the existing concrete panel construction.

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

### 5.3 Ground Vibrations & Ground-borne Noise Levels

Results of vibration monitoring for a period of 24 hours found vibration levels from more than 200 LRT train passes at a distance of 50-55 metres from the rail centreline were below the minimum trigger level for the seismograph units, therefore below 0.14 mm/s PPV. In all cases, the measured vibration levels fall below the criterion of 0.1 mm/s RMS (72 dBV).

According to the United States Federal Transit Authority's vibration assessment protocol, ground borne noise can be estimated by subtracting 35 dB from the velocity vibration level in dBV. Since measured vibration levels were found to be less than 0.14 mm/s PPV, ground borne noise levels are also expected to be below the ground borne noise criteria of 35 dB.

## 6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 57 and 70 dBA during the daytime period (07:00-23:00) and between 59 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 70 dBA) occurs along the south façade, which is nearest and most exposed to Albert Street. Building components with a higher Sound Transmission Class (STC) rating will be required where noise levels exceed 65 dBA, as indicated in Figure 3.

In addition to upgraded windows, the installation of central air conditioning (or similar mechanical system) will be required for all units in the development, which will allow occupants to keep windows closed and maintain a comfortable living environment. The following Warning Clause[12] will be required in all Agreements of Lease, Purchase and Sale for these units:

> *"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 roadway traffic may, on occasion, interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*

[12] City of Ottawa Environmental Noise Control Guidelines, January 2016

- *STC rated multi-pane glass glazing elements and spandrel panels*
  - *South Façade Office/Living Room/Bedroom Windows: STC 25/28/33*
  - *West Façade Office/Living Room/Bedroom Windows: STC 25/25/30*
- *East, south and west façade upgraded exterior walls achieving STC 45 or greater*

*This dwelling unit has also been designed with air conditioning (or similar mechanical system). Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.*

*To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."*

Results of vibration monitoring for a period of 24 hours found vibration levels from more than 200 LRT train passes at a distance of 50-55 metres from the rail centreline were below the minimum trigger level for the seismograph units, therefore below 0.14 mm/s PPV. In all cases, the measured vibration levels fall below the criterion of 0.1 mm/s RMS (72 dBV).

With regards to stationary noise impacts, a stationary noise study will be performed once mechanical plans for the proposed building become available. The study will determine noise impacts from rooftop mechanical units (i) of the surrounding, existing buildings on the proposed residential building, and (ii) of the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits.

This concludes our assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

***Gradient Wind Engineering Inc.***

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Dec 5, 2019
PROVINCE OF ONTARIO

Michael Lafortune, C.E.T.
Environmental Scientist

Joshua Foster, P.Eng.
Principal

*Gradient Wind File #19-215 – Transportation Noise & Vibration*


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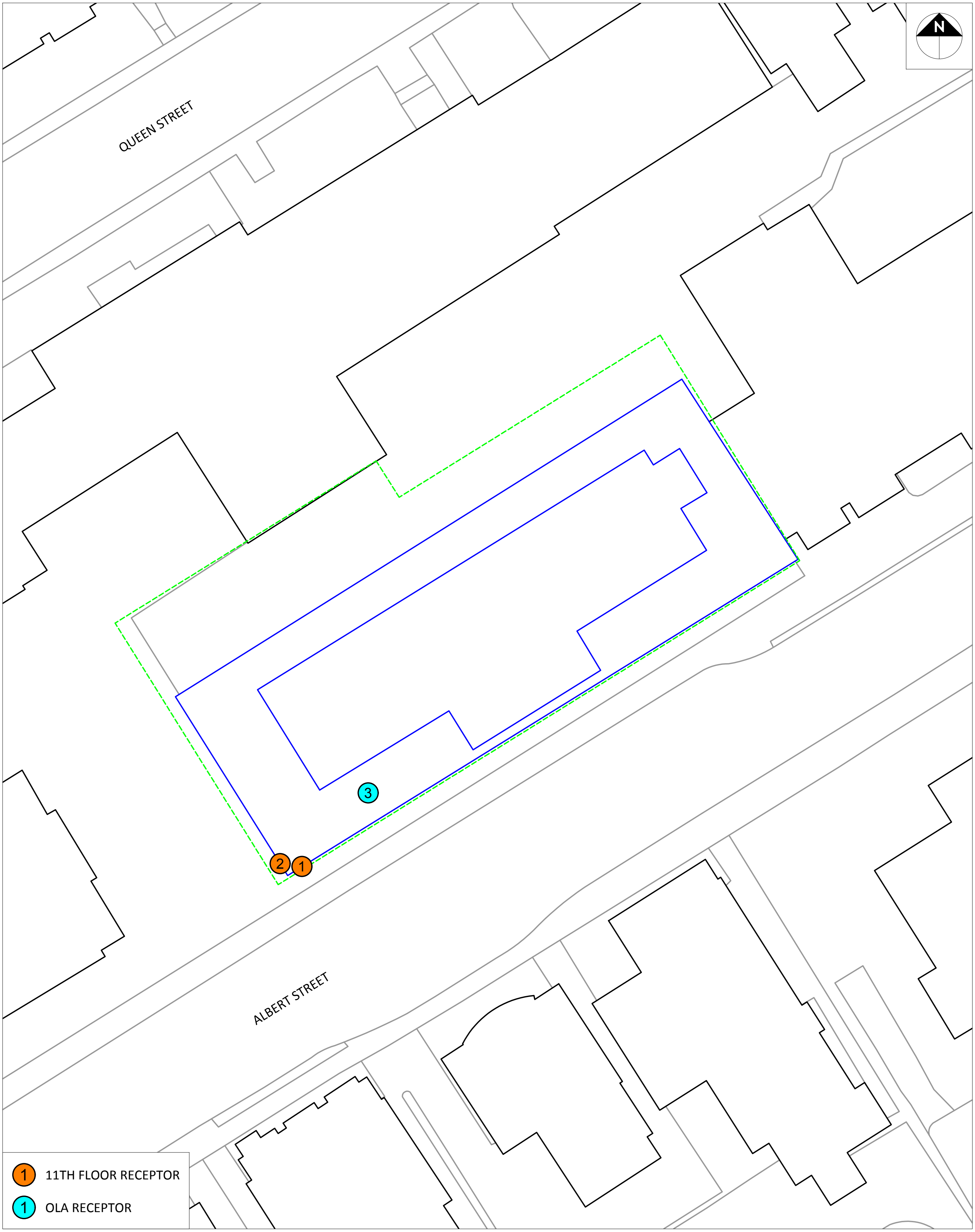
|---|---|---|---|
| GRADIENTWIND ENGINEERS & SCIENTISTS<br>127 WALGREEN ROAD , OTTAWA, ON<br>613 836 0934 • GRADIENTWIND.COM | PROJECT: 473 ALBERT STREET, OTTAWA TRANSPORTATION NOISE & VIBRATION ASSESSMENT | | DESCRIPTION: FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT |
| | SCALE: 1:1000 (APPROX.) | DRAWING NO.: GWE19-215-1 | |
| | DATE: NOVEMBER 14, 2019 | DRAWN BY: M.L. | |

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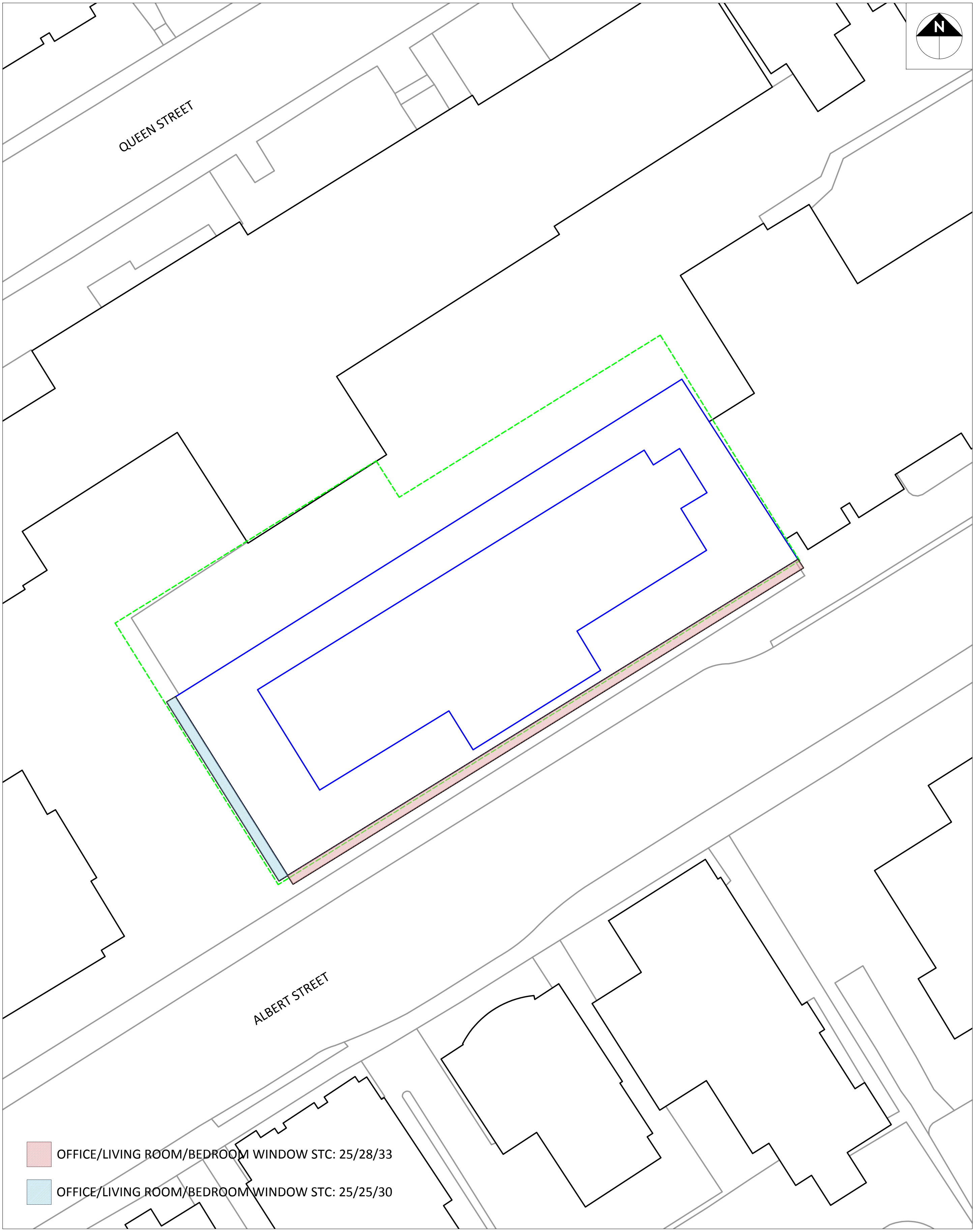
| DRAWING NO. | GWE19-215-2 |
| DATE | NOVEMBER 14, 2019 |
| DRAWN BY | M.L. |
| DESCRIPTION | FIGURE 2:<br>RECEPTOR LOCATIONS |

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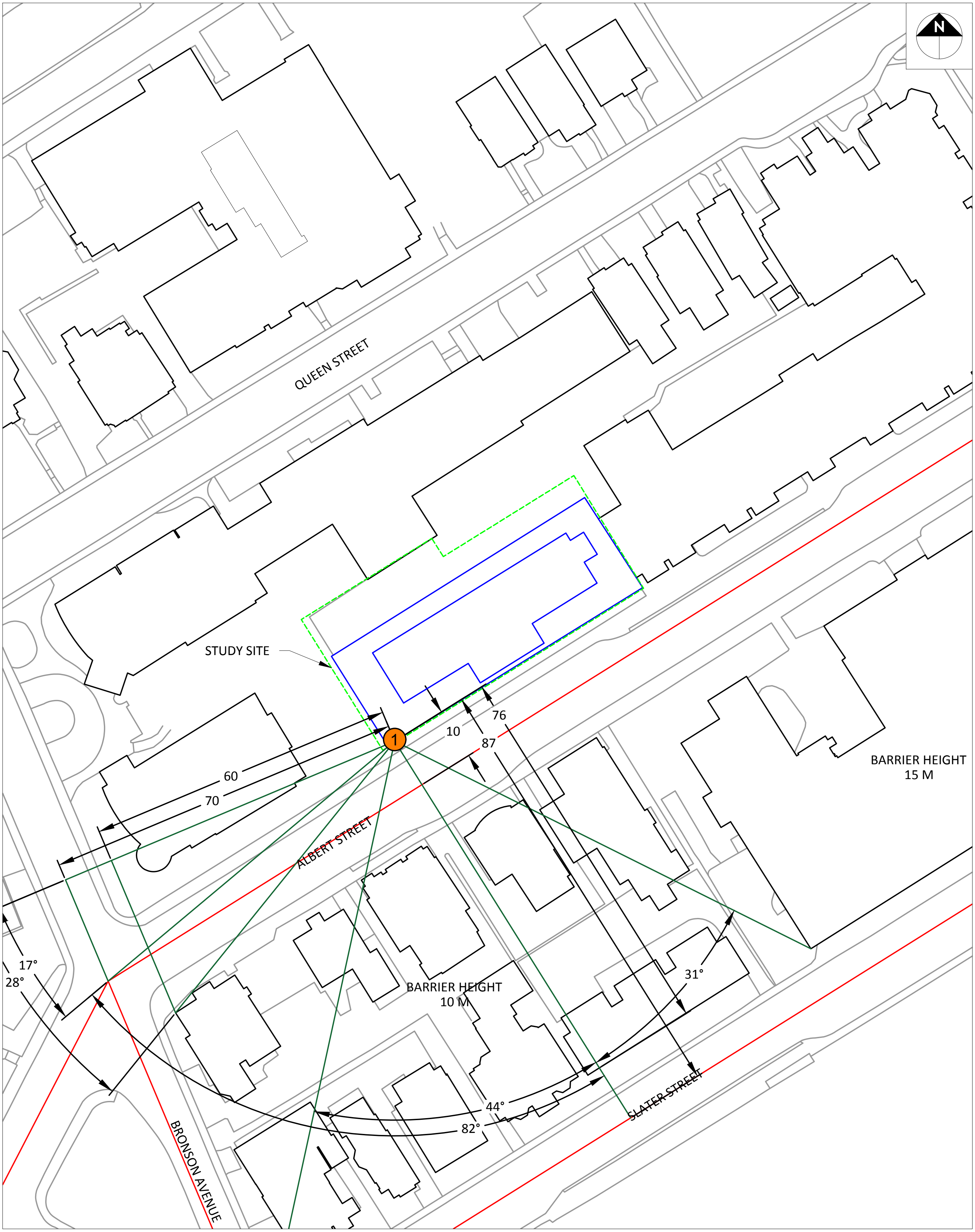


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| PROJECT: 473 ALBERT STREET, OTTAWA<br>TRANSPORTATION NOISE & VIBRATION ASSESSMENT | | DESCRIPTION: FIGURE 4:<br>STAMSON INPUT PARAMETERS - RECEPTOR 1 |
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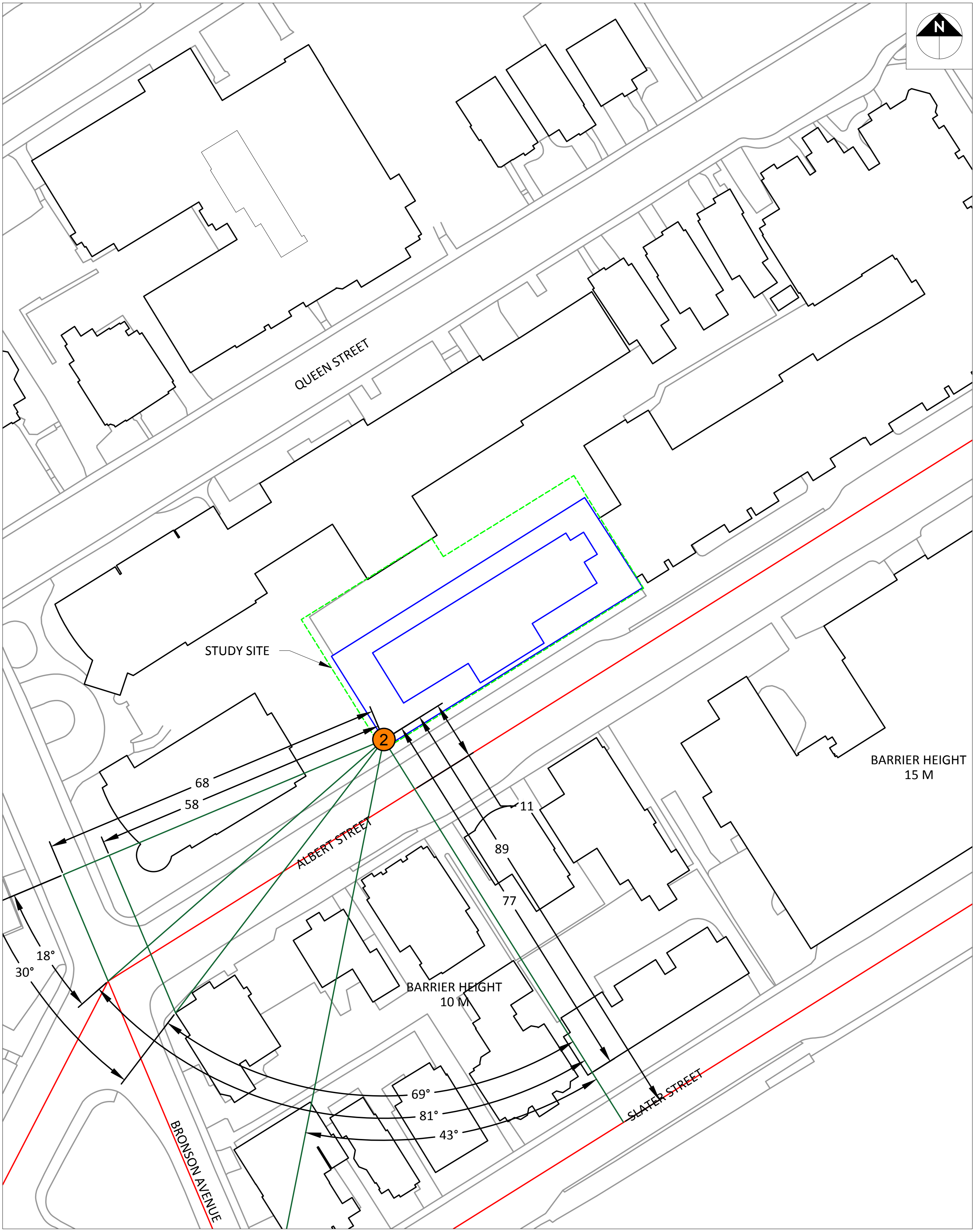
| DATE: NOVEMBER 14, 2019 | DRAWN BY: M.L. | |

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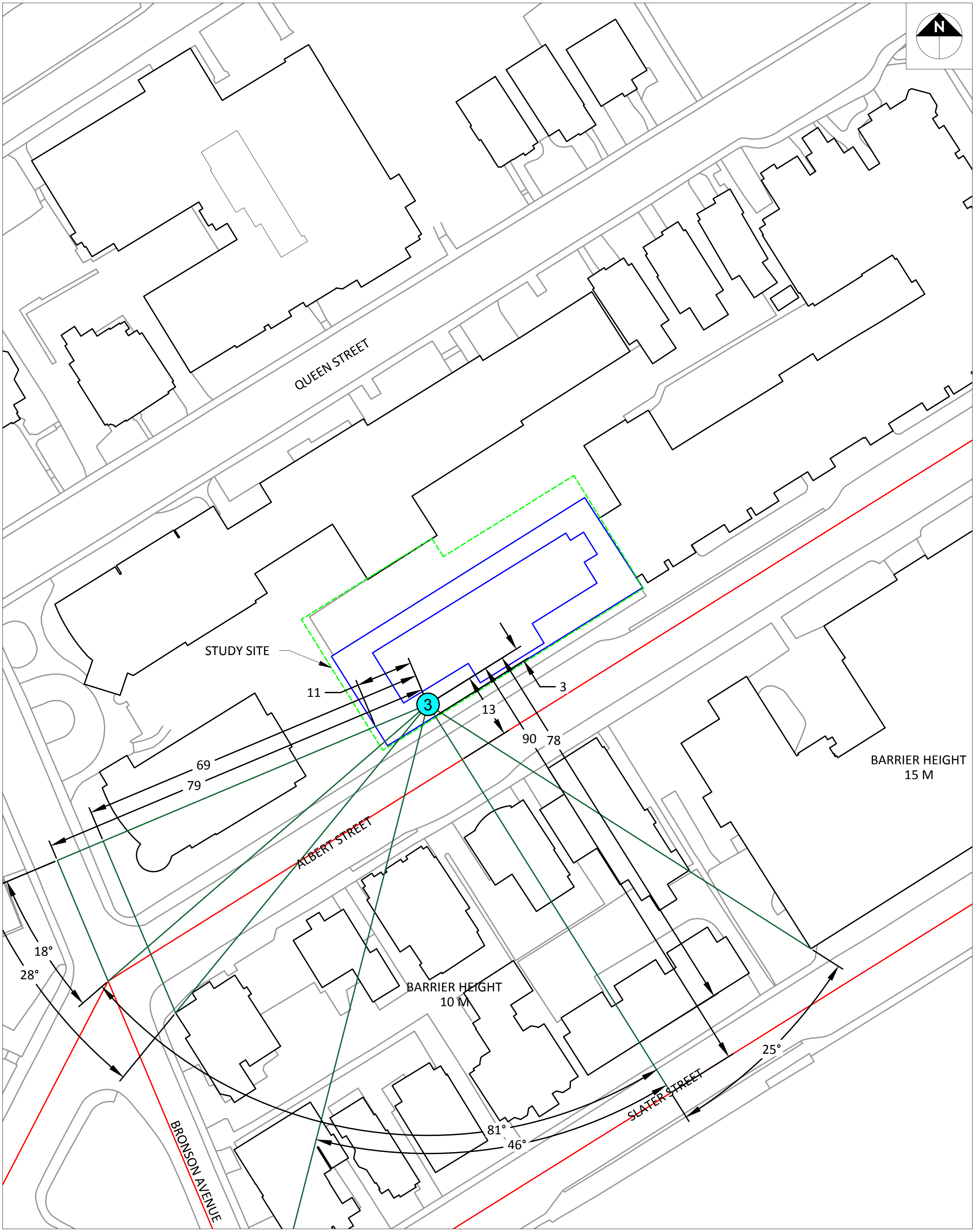
| DATE | NOVEMBER 14, 2019 | DRAWN BY | M.L. |

DESCRIPTION

FIGURE 5:
STAMSON INPUT PARAMETERS - RECEPTOR 2

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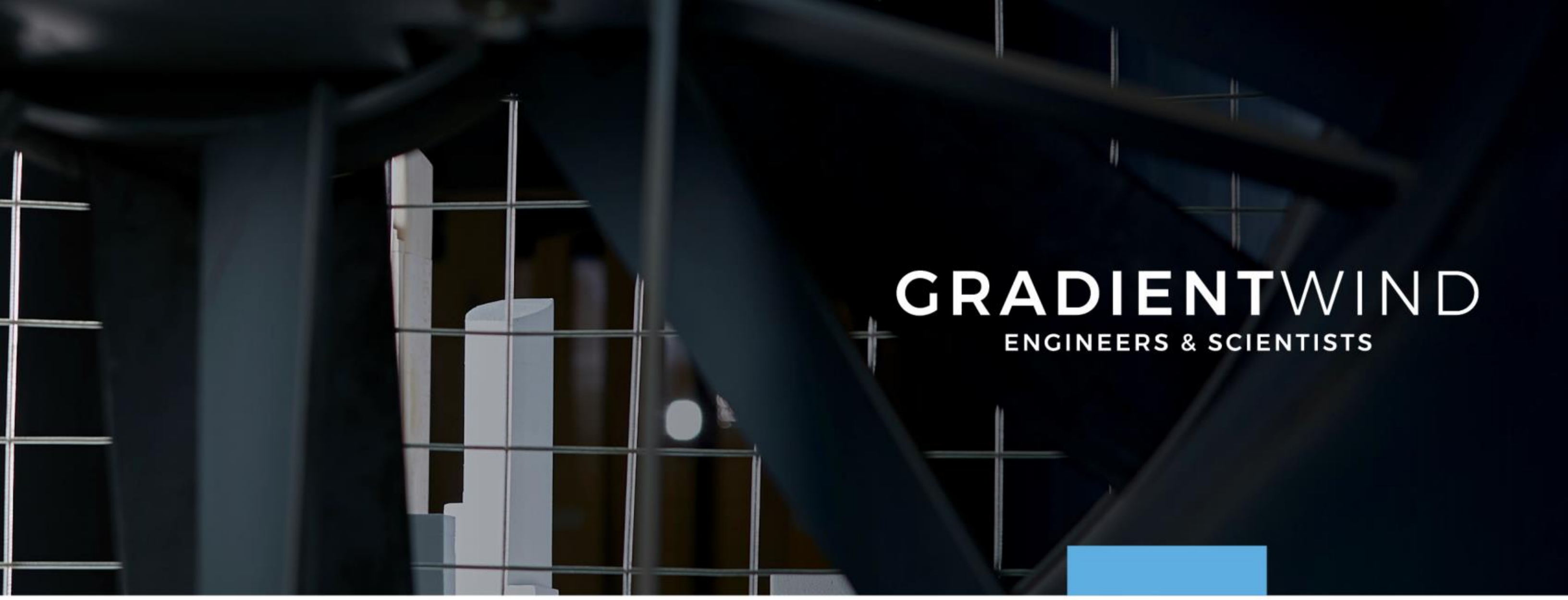
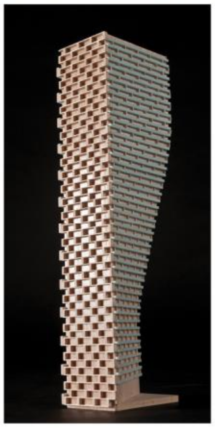
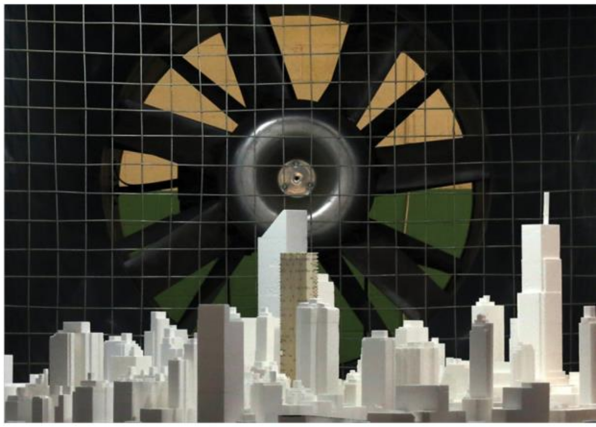
| PROJECT: 473 ALBERT STREET, OTTAWA<br>TRANSPORTATION NOISE & VIBRATION ASSESSMENT | | DESCRIPTION: FIGURE 6:<br>STAMSON INPUT PARAMETERS - RECEPTOR 3 |
| SCALE: 1:1000 (APPROX.) | DRAWING NO.: GWE19-215-6 | |
| DATE: NOVEMBER 14, 2019 | DRAWN BY: M.L. | |





## APPENDIX A

## STAMSON 5.04 – INPUT AND OUTPUT DATA

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

```
STAMSON 5.0        NORMAL REPORT        Date: 13-11-2019 14:48:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Albert (day/night)
------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Albert (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   82.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Slater1 (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Slater1 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -31.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -31.00 deg
Barrier height            :  15.00 m
Barrier receiver distance :  76.00 / 76.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Slater2 (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: Slater2 (day/night)
-----------------------------------------
Angle1   Angle2           : -31.00 deg   44.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -31.00 deg   Angle2 : 44.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  76.00 / 76.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: Bronson (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 4: Bronson (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -17.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  70.00 / 70.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -28.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  60.00 / 60.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Albert (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.28 + 0.00) = 68.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     82   0.00  68.48   0.00   0.00  -0.20   0.00   0.00   0.00  68.28
----------------------------------------------------------------------------

Segment Leq : 68.28 dBA


Results segment # 2: Slater1 (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.29 !         5.29

ROAD (0.00 + 40.04 + 0.00) = 40.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -31   0.00  68.48   0.00  -7.63  -4.84   0.00   0.00 -15.96  40.04
----------------------------------------------------------------------------

Segment Leq : 40.04 dBA


Results segment # 3: Slater2 (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.29 !         5.29

ROAD (0.00 + 40.44 + 0.00) = 40.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -31     44   0.00  68.48   0.00  -7.63  -3.80   0.00   0.00 -16.60  40.44
----------------------------------------------------------------------------

Segment Leq : 40.44 dBA
```

```
Results segment # 4: Bronson (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.78 !         5.78

ROAD (0.00 + 45.70 + 49.65) = 51.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -28   0.00  68.48   0.00  -6.69  -4.63   0.00   0.00 -11.46  45.70
----------------------------------------------------------------------------
   -28    -17   0.00  68.48   0.00  -6.69 -12.14   0.00   0.00   0.00  49.65
----------------------------------------------------------------------------

Segment Leq : 51.12 dBA

Total Leq All Segments: 68.38 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 60.69 + 0.00) = 60.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     82   0.00  60.88   0.00   0.00  -0.20   0.00   0.00   0.00  60.69
----------------------------------------------------------------------------

Segment Leq : 60.69 dBA


Results segment # 2: Slater1 (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.29 !         5.29

ROAD (0.00 + 32.45 + 0.00) = 32.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -31   0.00  60.88   0.00  -7.63  -4.84   0.00   0.00 -15.96  32.45
----------------------------------------------------------------------------

Segment Leq : 32.45 dBA


Results segment # 3: Slater2 (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.29 !         5.29

ROAD (0.00 + 32.85 + 0.00) = 32.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -31     44   0.00  60.88   0.00  -7.63  -3.80   0.00   0.00 -16.60  32.85
----------------------------------------------------------------------------

Segment Leq : 32.85 dBA
```

```
Results segment # 4: Bronson (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.78 !         5.78

ROAD (0.00 + 38.11 + 42.05) = 43.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -28   0.00  60.88   0.00  -6.69  -4.63   0.00   0.00 -11.46  38.11
----------------------------------------------------------------------------
   -28    -17   0.00  60.88   0.00  -6.69 -12.14   0.00   0.00   0.00  42.05
----------------------------------------------------------------------------

Segment Leq : 43.52 dBA

Total Leq All Segments: 60.79 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.38
                         (NIGHT): 60.79
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-11-2019 14:48:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Albert (day/night)
------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Albert (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   81.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Slater (day/night)
------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Slater (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   43.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  89.00 / 89.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 43.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  77.00 / 77.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Bronson (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: Bronson (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -18.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  68.00 / 68.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -30.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  58.00 / 58.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Albert (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.01 + 0.00) = 65.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     81   0.00  68.48   0.00   0.00  -3.47   0.00   0.00   0.00  65.01
----------------------------------------------------------------------------

Segment Leq : 65.01 dBA


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

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.54 !         5.54

ROAD (0.00 + 38.69 + 0.00) = 38.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     43   0.00  68.48   0.00  -7.73  -6.22   0.00   0.00 -15.84  38.69
----------------------------------------------------------------------------

Segment Leq : 38.69 dBA


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

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver     ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.91 !         5.91

ROAD (0.00 + 45.97 + 50.15) = 51.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -30   0.00  68.48   0.00  -6.56  -4.77   0.00   0.00 -11.18  45.97
----------------------------------------------------------------------------
   -30    -18   0.00  68.48   0.00  -6.56 -11.76   0.00   0.00   0.00  50.15
----------------------------------------------------------------------------

Segment Leq : 51.56 dBA

Total Leq All Segments: 65.21 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 57.42 + 0.00) = 57.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
     0     81   0.00  60.88   0.00   0.00  -3.47   0.00   0.00   0.00  57.42
-----------------------------------------------------------------------------

Segment Leq : 57.42 dBA


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

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.54 !         5.54

ROAD (0.00 + 31.09 + 0.00) = 31.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
     0     43   0.00  60.88   0.00  -7.73  -6.22   0.00   0.00 -15.84  31.09
-----------------------------------------------------------------------------

Segment Leq : 31.09 dBA


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

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        5.91 !         5.91

ROAD (0.00 + 38.37 + 42.56) = 43.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90    -30   0.00  60.88   0.00  -6.56  -4.77   0.00   0.00 -11.18  38.37
-----------------------------------------------------------------------------
   -30    -18   0.00  60.88   0.00  -6.56 -11.76   0.00   0.00   0.00  42.56
-----------------------------------------------------------------------------

Segment Leq : 43.96 dBA

Total Leq All Segments: 57.62 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 65.21
                         (NIGHT): 57.62
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-11-2019 14:48:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Albert (day/night)
------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Albert (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   81.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :  34.70 / 34.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 81.00 deg
Barrier height            :  33.20 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Slater1 (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Slater1 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -25.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  90.00 / 90.00  m
Receiver height           :  34.70 / 34.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -25.00 deg
Barrier height            :  15.00 m
Barrier receiver distance :  78.00 / 78.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Slater2 (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: Slater2 (day/night)
-----------------------------------------
Angle1   Angle2           : -25.00 deg   46.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  90.00 / 90.00  m
Receiver height           :  34.70 / 34.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -25.00 deg   Angle2 : 46.00 deg
Barrier height            :  10.00 m
Barrier receiver distance :  78.00 / 78.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: Bronson (day/night)
-------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 4: Bronson (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -18.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  79.00 / 79.00  m
Receiver height           :  34.70 / 34.70  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -18.00 deg
Barrier height            :  33.20 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Albert (day)
---------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !       28.06 !        28.06

ROAD (0.00 + 54.71 + 0.00) = 54.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90     81   0.00  68.48   0.00   0.00  -0.22   0.00   0.00 -13.55  54.71
--------------------------------------------------------------------------------

Segment Leq : 54.71 dBA


Results segment # 2: Slater1 (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !        5.92 !         5.92

ROAD (0.00 + 40.61 + 0.00) = 40.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -90    -25   0.00  68.48   0.00  -7.78  -4.42   0.00   0.00 -15.67  40.61
--------------------------------------------------------------------------------

Segment Leq : 40.61 dBA


Results segment # 3: Slater2 (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !        5.92 !         5.92

ROAD (0.00 + 41.64 + 0.00) = 41.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------------
   -25     46   0.00  68.48   0.00  -7.78  -4.04   0.00   0.00 -15.02  41.64
--------------------------------------------------------------------------------

Segment Leq : 41.64 dBA
```

```
Results segment # 4: Bronson (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !       30.08 !        30.08

ROAD (0.00 + 46.83 + 0.00) = 46.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -18   0.00  68.48   0.00  -7.22  -3.98   0.00   0.00 -10.46  46.83
----------------------------------------------------------------------------

Segment Leq : 46.83 dBA

Total Leq All Segments: 55.68 dBA
```

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

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !       28.06 !        28.06

ROAD (0.00 + 47.11 + 0.00) = 47.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     81   0.00  60.88   0.00   0.00  -0.22   0.00   0.00 -13.55  47.11
----------------------------------------------------------------------------

Segment Leq : 47.11 dBA


Results segment # 2: Slater1 (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !        5.92 !         5.92

ROAD (0.00 + 33.01 + 0.00) = 33.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90    -25   0.00  60.88   0.00  -7.78  -4.42   0.00   0.00 -15.67  33.01
----------------------------------------------------------------------------

Segment Leq : 33.01 dBA


Results segment # 3: Slater2 (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !        5.92 !         5.92

ROAD (0.00 + 34.05 + 0.00) = 34.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -25     46   0.00  60.88   0.00  -7.78  -4.04   0.00   0.00 -15.02  34.05
----------------------------------------------------------------------------

Segment Leq : 34.05 dBA
```

```
Results segment # 4: Bronson (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       34.70 !       30.08 !        30.08

ROAD (0.00 + 39.23 + 0.00) = 39.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90    -18   0.00  60.88   0.00  -7.22  -3.98   0.00   0.00 -10.46  39.23
--------------------------------------------------------------------------

Segment Leq : 39.23 dBA

Total Leq All Segments: 48.08 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 55.68
                         (NIGHT): 48.08
```