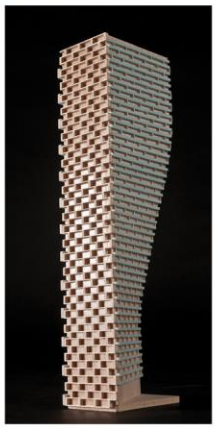
GRADIENTWIND
ENGINEERS & SCIENTISTS

# ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

211 Centrum Boulevard
Ottawa, Ontario

Report: 20-070-Noise & Vibration R2



November 20, 2020


PREPARED FOR
Le Group Maurice
2400 Rue de Nations, Bureau 137
Saint-Laurent, QC H4R 3G4

PREPARED BY
Samantha Phillips, B.Eng., Environmental Scientist
Joshua Foster, P.Eng., Principal

# EXECUTIVE SUMMARY

This report describes an environmental noise and vibration assessment to satisfy the requirements for a Site Plan Control application (SPA) submission for a proposed multi-building retirement residence located at 211 Centrum Boulevard in Ottawa, Ontario. The development comprises two buildings with rectangular planforms at grade connected by a 4-storey podium. The 'North Block', of 17 storeys, is located at the north of the site, with the long axis oriented along the Queensway (Highway 174). The 'South Block', of 9 storeys, is located at the west side of the site with the long axis oriented along Place D'Orléans Drive. The major sources of transportation noise are Centrum Boulevard, Place D'Orléans Drive, Highway 174, and the future Light Rail Transit (LRT) Confederation line. 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 OC Transpo information; (iv) architectural drawings of the subject site provided by Hobin Architecture Inc. in November 2020 (ref. Hobin Architecture Incorporated 'Le Groupe Maurice Centrum Retirement – Issued for SPC & Zoning', dated November 20, 2020); (v) satellite imagery; and (vi) Gradient Wind's experience with similar projects.

The results of the traffic noise analysis indicate that noise levels will range between 54 and 76 dBA during the daytime period (07:00-23:00) and between 46 and 69 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 76 dBA) occurs along the north façade of the North Block, which are nearest and most exposed to Highway 174 and the future LRT system.

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.

Noise levels at the grade-level OLA at the southeast corner of the site are below the acceptable level of 60 dBA, and therefore, no mitigation will be required.

For the stationary noise assessment, the impact of each of the surrounding buildings were evaluated separately. The results indicate that the noise levels produced by existing sources of stationary noise located at grade and the rooftops of each of the noted surrounding buildings fall below the stationary noise criteria of 50 dBA for daytime and 45 dBA nighttime, and therefore, no mitigation is required.

Vibration levels due to LRT activity in the area are expected to fall below the criterion of 0.10 mm/s at the nearest building foundation to the LRT rail line. Therefore, mitigation for ground vibrations will not be required.

With regard to stationary noise impacts of the development's mechanical equipment onto surrounding noise sensitive properties, a stationary noise study will be performed for the site during the detailed design once mechanical plans become available. This study would assess impacts of stationary noise from rooftop mechanical units and any other stationary sources serving the proposed building on surrounding noise-sensitive areas. Based on preliminary discussions with the project's Mechanical Engineer (Goodkey, Weedmark & Associates Limited), the development will include one or two air cooled chillers on the rooftop of the North Block and an emergency generator. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment. The best noise strategy would be to locate noisier pieces of equipment on the center of the roof or in a mechanical penthouse. Where necessary noise screens and silencers can be incorporated into the design.

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## 1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Le Group Maurice to undertake an environmental noise and vibration assessment to satisfy the requirements for a Site Plan Control application (SPA) submission for a proposed multi-building retirement residence located at 211 Centrum Boulevard in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to an environmental noise and ground vibration assessment.

The present scope of work involves assessing exterior and interior noise levels generated by local transportation and existing stationary sources, as well as vibration levels generated by local, future 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 of the subject site provided by Hobin Architecture Inc. in November 2020 (ref. Hobin Architecture Incorporated 'Le Groupe Maurice Centrum Retirement – Issued for SPC & Zoning', dated November 20, 2020) with future roadway traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications and LRT information based on previous project experience. The stationary noise assessment was based on Gradient Wind's experience with various types of HVAC equipment and satellite imagery of the surrounding properties.

## 2. TERMS OF REFERENCE

The focus of this environmental noise and vibration assessment is the planned multi-building retirement residence located on an irregular parcel of land at 211 Centrum Boulevard in Ottawa, Ontario. The subject site is bounded by the Queensway

*Architectural Rendering, Southeast Perspective*
*(Courtesy of Hobin Architecture Inc.)*

[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

(Highway 174) to the north, Brisebois Crescent to the east, Centrum Boulevard to the south, and Place D'Orléans Drive to the west.

The subject site comprises two buildings with rectangular planforms at grade connected by a 4-storey podium. The 'North Block', of 17 storeys, is located at the north of the site, with the long axis oriented along the Queensway. The 'South Block', of 9 storeys, is located at the west of the site with the long axis oriented along Place D'Orléans Drive. The ground floor comprises residential space, lobby space and amenity areas. Levels 2 and above comprise residential units. The main building entrance is located west of the drop off area in the subject site, at the southeast corner of the 4-storey podium. Exterior amenity courtyards are provided at grade, near the northwest and southeast corners of the podium. The northwest courtyard was not considered as an outdoor living area (OLA) in this assessment, as it is not programmed for the quiet enjoyment of the outdoors. At Level 2, the floorplate sets back from the east side at the central section of the podium. As the balconies are no more than 4 metres in depth, they do not require consideration as OLAs.

The major sources of transportation noise transportation noise are Centrum Boulevard, Place D'Orléans Drive, Highway 174, and the future Light Rail Transit (LRT) Confederation line. For all directions from the east clockwise to the west, the site surroundings comprise low-rise commercial buildings with low-rise dwellings to the south beyond St Joseph Boulevard. Highway 174 is located to the immediate north followed by low-rise dwellings. Figure 1 illustrates a complete site plan with surrounding context.

Existing buildings including the Place D'Orléans Shopping Mall, Petro-Canada Car Wash, Holiday Inn hotel, Shenkman Arts Centre, and various commercial facilities located to the south of the development feature existing stationary sources of noise on their rooftops as well as at grade-level. The major sources of stationary noise surrounding the site include a car wash, rooftop HVAC equipment, loading areas, idling cars and reefer trucks, and garbage compactors.

## 3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the development produced by local transportation and stationary sources, (ii) calculate the future vibration levels on the development 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 Transportation Noise

### 4.2.1 Criteria for Transportation 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 45 and 40 dBA for 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 42 and 37 dBA.

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

| Type of Space | Time Period | $L_{eq}$ (dBA) |
|---|---|---|
| General offices, reception areas, retail stores, etc. | 07:00 – 23:00 | 50 |
| 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 |
| Sleeping quarters of hotels/motels | 23:00 – 07:00 | 45 |
| Sleeping quarters of residences, hospitals, **nursing/retirement homes**, etc. | 23:00 – 07:00 | 40 |

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].

The sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime (07:00 to 23:00). However, given the location of the development, a daytime sound level of 60 dBA would be acceptable. When noise levels exceed 60 dBA, mitigation must be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion.

### 4.2.2 Roadway and LRT 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

[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

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 and LRT line included in this assessment.

**TABLE 2: ROADWAY AND LRT TRAFFIC DATA**

| Segment | Roadway Traffic Data | Speed Limit (km/h) | Traffic Volume |
|---|---|---|---|
| Centrum Boulevard | 2-Lane Urban Collector (2-UCU) | 40 | **8,000** |
| Place D'Orléans Drive (Aligned East-West, North of Mall) | 4-Lane Urban Arterial-Divided (4-UAD) | 60 | **35,000** |
| Place D'Orléans Drive (Aligned North-South, East of Mall) | 4-Lane Urban Arterial-Undivided (4-UAU) | 60 | **30,000** |
| Highway 174 | 6-Lane Highway | 100 | **110,000** |
| Confederation Line | LRT | 70 | **540/60*** |

* Daytime / nighttime volumes

### 4.2.3 Theoretical Transportation 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. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- 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 due to the presence of hard (paved) ground.

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

- Highway 174, Place D'Orléans Drive, and the future LRT system were assumed to be depressed by approximately 5-metres below the ground floor of the development (local grade).
- The future LRT system was modelled using 4-car SRT vehicle type in STAMSON.
- Surrounding buildings and the study buildings themselves were considered as noise barriers, as applicable, partially or fully obstructing exposure to the source as illustrated by exposure angles.
- Noise receptors were strategically placed at thirteen (13) locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 1A-10A found in Appendix A.

## 4.3 Stationary Noise

### 4.3.1 Criteria for Stationary Noise

For stationary sources, the $L_{eq}$ is commonly calculated on an hourly interval, while for roadways, the $L_{eq}$ is calculated on the basis of a 16-hour daytime/8-hour nighttime split as previously mentioned in Section 4.2.1. Stationary sources are defined in the ENCG as "all sources of sound and vibration, whether fixed or mobile, that exist or operate on a premises, property or facility, the combined sound and vibration levels of which are emitted beyond the property boundary of the premises, property or facility, unless the source(s) is (are) due to construction" [7].

Noise criteria taken from the ENCG and NPC-300 apply to outdoor points of reception (POR). A POR is defined under NPC-300 as "any location on a noise sensitive land use where noise from a stationary source is received"[8]. A POR can be located on an existing or zoned for future use premises of permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, campgrounds, and noise sensitive buildings such as schools and places of worship. This applies to the plane of window and outdoor amenity spaces serving the development.

The recommended maximum noise levels for a Class 1 area in a suburban environment adjacent to major roadways at a POR are outlined in Table 3 below. The study site is considered to be in a Class 1 area because it is located in proximity to arterial and collector roadways, a major highway (Highway 174) and a future LRT system. These conditions indicate that the sound field is dominated by manmade sources.

[7] City of Ottawa Environmental Noise Control Guidelines, page 10
[8] NPC – 300, page 14

The applicable sound level limit is the higher of either the values in Table 3 or background noise levels due to sources such as transportation.

**TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 1 AREA**

| Time of Day | Class 1 | |
|---|---|---|
| | Outdoor Points of Reception | Plane of Window |
| 07:00 – 19:00 | 50 | 50 |
| 19:00 – 23:00 | 50 | 50 |
| 23:00 – 07:00 | N/A | 45 |

### 4.3.2 Assumptions

The closest existing facilities include the Place D'Orléans Shopping Mall, Petro-Canada Car Wash, Holiday Inn hotel, Shenkman Arts Centre, and various commercial facilities located to the south of the development. The following assumptions have been included in the analysis:

(ii) The quantity, location and sound power of rooftop equipment and delivery trucks has been assumed based on satellite imagery and Gradient Wind's experience on similar projects.

(iii) The rooftop air handling units are assumed to operate continuously over a 1-hour period during the daytime and nighttime periods, and at 50% operation during the nighttime period.

(iv) The garbage compactors at Farm Boy and the Place D'Orléans Shopping Mall operate for six minutes per hour during the daytime. No garbage compactor operation occurs during the nighttime.

(v) A refrigerated (reefer) truck idles at the loading dock at Farm Boy for thirty minutes per hour during the daytime period. No idling trucks are expected at the loading dock during the nighttime period. The City of Ottawa Noise By-law No.2017-255 prohibits deliveries during the nighttime period.

(vi) One truck movement occurs per hour for Farm Boy and each of the loading areas at Place D'Orléans Shopping Mall during daytime.

(vii) An idling car at the entrance of the car wash assumes to operate continuously over a 1-hour period during the daytime period.

(viii) The car wash entrance and exit doors operate for 30 minutes per hour during the daytime period and 6 minutes per hour during the nighttime period.

(ix) Screening effects of parapets have been conservatively excluded in the modelling.

(x) Topography was considered in the model.

### 4.3.3 Determination of Noise Source Power Levels

Sound power data for the equipment were assumed based on Gradient Wind's experience with similar types of equipment that are present on the surrounding commercial facilities as well as truck deliveries. Table 4 summarizes the sound power assumed for each source used in the analysis. The location of the relevant sources included in this assessment can be seen in Figures 3-6.

**TABLE 4: EQUIPMENT SOUND POWER LEVELS (dBA)**

| Source ID | Description | Height Above Grade / Rooftop (m) | Frequency (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | Total |
| S1 | MAU | 1.0 | - | - | - | - | 90 | - | - | - | 90 |
| S5, S11-27, S29-42, S45, S52, S60 | Small RTU | 1.0 | - | 74 | 76 | 75 | 74 | 71 | 64 | 59 | 81 |
| S2-4, S6, S8, S9, S28, S47, S53-59, S61-63 | Medium RTU | 1.0 | 57 | 70 | 77 | 81 | 80 | 76 | 73 | 69 | 86 |
| S7, S46, S48 | Chiller | 1.0 | - | - | - | - | 92 | - | - | - | 92 |
| S51, S65, S66 | Truck Movements | 2.0 | 65 | 75 | 76 | 85 | 90 | 89 | 83 | 74 | 94 |
| S50 | Idling Reefer Truck | 2.7 | - | - | - | - | 98 | - | - | - | 98 |
| S67 | Idling Car | 0.75 | 55 | 65 | 57 | 65 | 66 | 63 | 62 | 54 | 72 |
| S43 | Car Wash Entrance | 2.0 | 60 | 68 | 73 | 89 | 90 | 90 | 88 | 85 | 96 |
| S44 | Car Wash Exit | 2.0 | 65 | 77 | 81 | 96 | 97 | 96 | 91 | 82 | 102 |
| S49, S64 | Garbage Compactor | 0.5 | - | - | - | - | 75 | - | - | - | - |

### 4.3.4 Stationary Source Noise Predictions

The impact of the surrounding stationary noise sources on the development was determined by computer modelling. Stationary noise source modelling is based on the software program *Predictor-Lima* developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. This computer program is capable of representing three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The methodology has been used on numerous assignments and has been accepted by the MECP as part of Environmental Compliance Approvals applications.

Ten (10) individual noise sensor locations were selected in the *Predictor-Lima* model to measure the noise impact at points of reception (POR) during the daytime (07:00 – 19:00) and nighttime (19:00 – 07:00) periods (see Figure 7). For each location, various heights were examined for a total of 19 sensors. POR locations included the outdoor living areas (OLA's) and the plane of windows (POW's) of the development. All mechanical equipment was represented as point sources in the model. All rooftop units, idling vehicles and grade-level garbage compactors were represented as point sources and the truck deliveries were modelled as line sources in the Predictor model. Table 5 below contains Predictor-Lima calculation settings. These are typical settings that have been based on ISO 9613 standards and guidance from the MECP. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. Modelling files and outputs are available upon request.

**TABLE 5: CALCULATION SETTINGS**

| Parameter | Setting |
|---|---|
| Meteorological correction method | Single value for C0 |
| Value C0 | 2.0 |
| Default ground attenuation factor | 1 |
| Ground attenuation factor for roadways and paved areas | 0 |
| Temperature (K) | 283.15 |
| Pressure (kPa) | 101.33 |
| Air humidity (%) | 70 |

## 4.4 Transportation 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. For example, concrete and masonry walls can achieve STC 50 or more. 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, 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 LRT 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[9] 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[10], 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).

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

## 4.5 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 there is excitation of the ground, such as from a train. Repetitive motion of the wheels on the track or rubber tires passing over an 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.

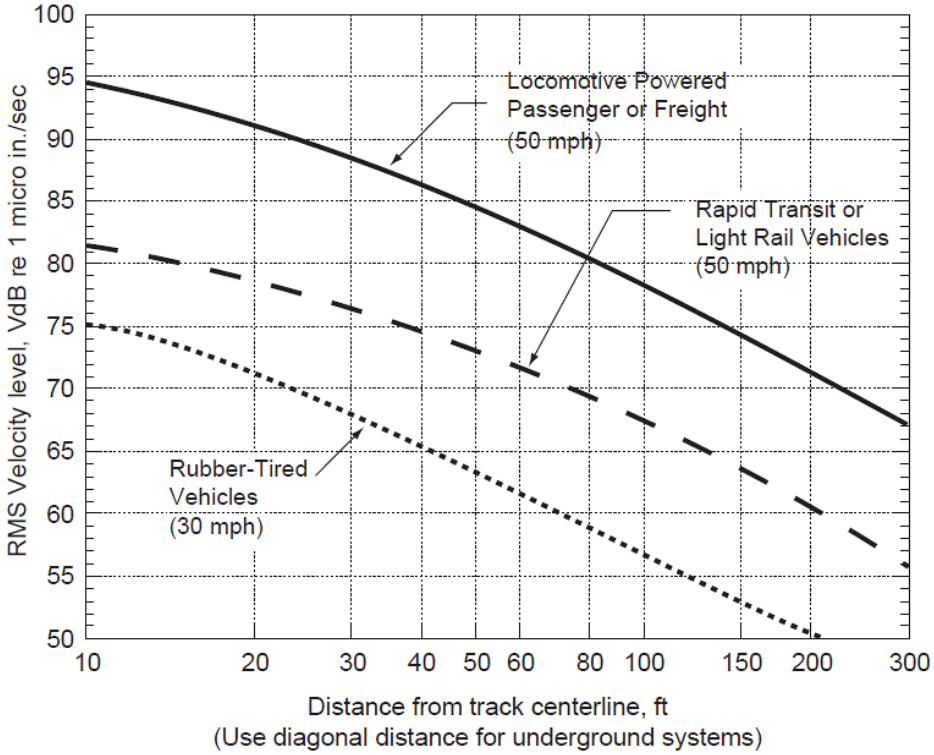
### 4.5.1 Ground Vibration Criteria

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[11]. 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[12], 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 future LRT Confederation line, which will have frequent events, the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground borne noise criteria were adopted for this study.

### 4.5.2 Theoretical Ground Vibration Prediction Procedure

At the time of this study, the Confederation Line in the area of the site has not yet been constructed, therefore theoretical calculations were used to assess vibrations. Potential vibration impacts of the future Confederation LRT rail line, currently planned, were predicted using the FTA's Transit Noise and Vibration Impact Assessment[13] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure below, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as operating speed of vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. Based on the setback distance of the closest building, initial vibration levels were deduced from a curve for light rail trains at 50 miles per hour (mph) and applying an adjustment factor of 3 dBV to account for an operational speed of 43.4 mph (70 km/h). The track was assumed to have welded joints. Details of the vibration calculations are presented in Appendix B.

[11] MECP/TTC Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Subway Loop, June 16, 1993
[12] Dialog and J.E. Coulter Associates Limited, prepared for The Federation of Canadian Municipalities and The Railway Association of Canada, May 2013
[13] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006.




**FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)**

# 5. RESULTS AND DISCUSSION

## 5.1 Transportation Noise Levels

The results of the transportation noise calculations are summarized in Table 6 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

**TABLE 6: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES**

| Receptor Number | Height above Local Grade (metres) | Receptor Location | STAMSON 5.04 Noise Level (dBA) | |
|---|---|---|---|---|
| | | | Day | Night |
| 1 | 44.5 | North Block – POW, Level 14, East Façade | 72 | 64 |
| 2 | 44.5 | North Block – POW, Level 14, North Façade | 76 | 69 |
| 3 | 44.5 | North Block – POW, Level 14, West Façade | 74 | 67 |
| 4 | 44.5 | North Block – POW, Level 14, South Façade | 65 | 57 |
| 5 | 26.5 | South Block – POW, Level 9, North Façade | 73 | 66 |
| 6 | 26.5 | South Block – POW, Level 9, West Façade | 74 | 66 |
| 7 | 26.5 | South Block – POW, Level 9, South Façade | 68 | 60 |
| 8 | 26.5 | South Block – POW, Level 9, East Façade | 66 | 59 |
| 9 | 11.5 | Podium – POW, Level 4, South Façade | 67 | 60 |
| 10 | 11.5 | Podium – POW, Level 4, East Façade | 62 | 55 |
| 11 | 11.5 | Podium – POW, Level 4 (Centre), South Façade | 54 | 46 |
| 12 | 11.5 | Podium – POW, Level 4 (Centre), East Façade | 66 | 58 |
| 13 | 1.5 | OLA – Grade-Level at Southeast Corner | 57 | N/A* |

*Noise levels at the OLAs during the nighttime period do not need to be considered as per the ENCG.

The results of the current analysis indicate that noise levels will range between 54 and 76 dBA during the daytime period (07:00-23:00) and between 46 and 69 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 76 dBA) occurs along the north façade of the North Block, which are nearest and most exposed to Highway 174 and the future LRT system. The noise levels at the grade-level OLA at the southeast corner of the site are below 60 dBA, and therefore, no mitigation will be required.

## 5.2 Noise Control Measures

The noise levels predicted due to transportation sources exceed the criteria listed in the ENCG for building components. As discussed in Section 4.4, 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 in Table 8 below and also illustrated in Figure 8.

**TABLE 8: STC REQUIREMENTS FOR WINDOWS**

| Location | Façade | Bedroom Window STC | Living Room Window STC |
|---|---|---|---|
| North Block | North | 39 | 34 |
| | East | 35 | 30 |
| | West | 37 | 32 |
| South Block | North | 37 | 33 |
| | East | 29 | 24 |
| | West | 37 | 32 |
| | South | 31 | 26 |
| Podium (South) | South | 31 | 26 |
| Podium (Centre) | East | 29 | 24 |
| | West | 37 | 32 |

Note: Exterior wall components on these façades are recommended to have a minimum STC of 45 where a window/wall system is used, which can be achieved with brick cladding or an acoustical equivalent to NRC test data[14]

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. 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

[14] J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.

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 Stationary Noise Levels

The noise levels at the development from existing stationary sources around the study site were predicted for the following surrounding buildings:

(i) Holiday Inn Hotel
(ii) Shenkman Arts Centre
(iii) 250 Centrum Boulevard
(iv) 240 Centrum Boulevard
(v) 210 Centrum Boulevard
(vi) Petro-Canada Car Wash
(vii) Farm Boy
(viii) Place D'Orléans Shopping Mall

The impact of each of the noted buildings was evaluated separately. The results indicate that the noise levels produced by existing sources of stationary noise located at grade and the rooftops of each of the noted buildings are within the acceptable sound level limits, as summarized in Table 10-12 below. Therefore, no mitigation is required. The anticipated sound levels are based on the assumptions outlined in Section 4.3.2. Based on the results, the buildings with the greatest impact on the development are the Holiday Inn Hotel and the Place D'Orléans Shopping Mall. A 3-dimentional view of the study building with vertical contours around the building elevations and horizontal noise contours at 1.5 m above grade can

be seen in Figure 9-12 for daytime and nighttime conditions for the Holiday Inn Hotel and the Place D'Orléans Shopping Mall. As can be seen in the tables below noise levels fall below the stationary noise criteria of 50 dBA for daytime and 45 dBA nighttime.

## TABLE 10: NOISE LEVELS FROM STATIONARY SOURCES AT HOLIDAY INN, SHENKMAN ARTS CENTRE AND 250 CENTRUM BOULEVARD

| Receptor Number | Height Above Local Grade (metres) | Receptor Location | Holiday Inn | | Shenkman Arts Centre | | 250 Centrum Boulevard | |
|---|---|---|---|---|---|---|---|---|
| | | | Noise Level (dBA) | | Noise Level (dBA) | | Noise Level (dBA) | |
| | | | Day | Night | Day | Night | Day | Night |
| R1_A | 1.5 | South Block – POR, West Façade | 12 | 9 | 20 | 17 | 16 | 14 |
| R1_B | 14.5 | | 12 | 9 | 20 | 17 | 18 | 15 |
| R1_C | 26.5 | | 13 | 10 | 21 | 18 | 23 | 22 |
| R2_A | 14.5 | South Block – POR, South Façade | 15 | 12 | 26 | 23 | 40 | 37 |
| R2_B | 26.5 | | 15 | 12 | 27 | 24 | 40 | 37 |
| R3_A | 8.5 | Podium (South) – POR, South Façade | 16 | 13 | 23 | 20 | 32 | 31 |
| R4_A | 5.5 | Podium (South) – POR, East Façade | 36 | 33 | 41 | 38 | 33 | 33 |
| R5_A | 1.5 | South Block – POR, East Façade | 19 | 16 | 34 | 31 | 32 | 33 |
| R5_B | 14.5 | | 40 | 37 | 43 | 40 | 40 | 37 |
| R5_C | 26.5 | | 40 | 37 | 43 | 40 | 40 | 37 |
| R6_A | 8.5 | Podium (Centre) – POR, East Façade | 36 | 33 | 46 | 43 | 35 | 33 |
| R7_A | 5.5 | North Block – POR, South Façade | 23 | 20 | 45 | 42 | 33 | 33 |
| R7_B | 23.5 | | 37 | 34 | 46 | 43 | 40 | 37 |
| R7_C | 44.5 | | 36 | 33 | 47 | 44 | 40 | 37 |
| R8_A | 5.5 | North Block – POR, East Façade | 29 | 26 | 43 | 40 | 30 | 30 |
| R8_B | 23.5 | | 48 | 45 | 46 | 43 | 40 | 37 |
| R8_C | 44.5 | | 47 | 44 | 47 | 44 | 40 | 37 |
| R9_A | 1.5 | Podium (South) – POR, South Façade | 14 | 11 | 27 | 24 | 30 | 32 |
| R10_A | 1.5 | OPOR – Southeast Amenity Area | 22 | N/A | 35 | N/A | 34 | N/A |

## TABLE 11: NOISE LEVELS FROM STATIONARY SOURCES AT 210 & 240 CENTRUM BOULEVARD AND PETRO-CANADA CAR WASH

| Receptor Number | Height Above Local Grade (metres) | Receptor Location | 240 Centrum Boulevard | | 210 Centrum Boulevard | | Petro – Can Car Wash | |
|---|---|---|---|---|---|---|---|---|
| | | | Noise Level (dBA) | | Noise Level (dBA) | | Noise Level (dBA) | |
| | | | Day | Night | Day | Night | Day | Night |
| R1_A | 1.5 | South Block – POR, West Façade | 18 | 15 | 23 | 20 | 44 | 37 |
| R1_B | 14.5 | | 18 | 15 | 27 | 24 | 44 | 37 |
| R1_C | 26.5 | | 22 | 19 | 28 | 25 | 44 | 37 |
| R2_A | 14.5 | South Block – POR, South Façade | 37 | 34 | 42 | 39 | 45 | 38 |
| R2_B | 26.5 | | 41 | 38 | 42 | 39 | 45 | 38 |
| R3_A | 8.5 | Podium (South) – POR, South Façade | 40 | 37 | 44 | 41 | 46 | 39 |
| R4_A | 5.5 | Podium (South) – POR, East Façade | 39 | 36 | 43 | 40 | 40 | 33 |
| R5_A | 1.5 | South Block – POR, East Façade | 38 | 35 | 35 | 32 | 25 | 18 |
| R5_B | 14.5 | | 39 | 36 | 37 | 34 | 24 | 17 |
| R5_C | 26.5 | | 40 | 37 | 40 | 37 | 28 | 21 |
| R6_A | 8.5 | Podium (Centre) – POR, East Façade | 38 | 35 | 35 | 32 | 23 | 16 |
| R7_A | 5.5 | North Block – POR, South Façade | 37 | 34 | 34 | 31 | 23 | 16 |
| R7_B | 23.5 | | 37 | 34 | 36 | 33 | 32 | 25 |
| R7_C | 44.5 | | 37 | 34 | 36 | 33 | 38 | 31 |
| R8_A | 5.5 | North Block – POR, East Façade | 35 | 32 | 33 | 30 | 22 | 15 |
| R8_B | 23.5 | | 36 | 33 | 34 | 31 | 22 | 15 |
| R8_C | 44.5 | | 37 | 34 | 35 | 32 | 30 | 23 |
| R9_A | 1.5 | Podium (South) – POR, South Façade | 31 | 28 | 41 | 38 | 46 | 39 |
| R10_A | 1.5 | OPOR – Southeast Amenity Area | 39 | N/A | 36 | N/A | 28 | N/A |

## TABLE 12: NOISE LEVELS FROM STATIONARY SOURCES AT FARM BOY AND PLACE D'ORLÉANS SHOPPING MALL

| Receptor Number | Height Above Local Grade (metres) | Receptor Location | Farm Boy | | Place D'Orléans Shopping Mall | |
|---|---|---|---|---|---|---|
| | | | Noise Level (dBA) | | Noise Level (dBA) | |
| | | | Day | Night | Day | Night |
| R1_A | 1.5 | South Block – POR, West Façade | 40 | 22 | 41 | 38 |
| R1_B | 14.5 | | 41 | 30 | 48 | 45 |
| R1_C | 26.5 | | 41 | 30 | 48 | 45 |
| R2_A | 14.5 | South Block – POR, South Façade | 40 | 28 | 44 | 41 |
| R2_B | 26.5 | | 41 | 29 | 44 | 41 |
| R3_A | 8.5 | Podium (South) – POR, South Façade | 40 | 28 | 41 | 38 |
| R4_A | 5.5 | Podium (South) – POR, East Façade | 23 | 16 | 25 | 22 |
| R5_A | 1.5 | South Block – POR, East Façade | 21 | 12 | 20 | 17 |
| R5_B | 14.5 | | 20 | 11 | 20 | 17 |
| R5_C | 26.5 | | 21 | 13 | 22 | 19 |
| R6_A | 8.5 | Podium (Centre) – POR, East Façade | 20 | 11 | 18 | 15 |
| R7_A | 5.5 | North Block – POR, South Façade | 18 | 9 | 17 | 13 |
| R7_B | 23.5 | | 19 | 12 | 37 | 34 |
| R7_C | 44.5 | | 36 | 24 | 40 | 37 |
| R8_A | 5.5 | North Block – POR, East Façade | 17 | 8 | 16 | 13 |
| R8_B | 23.5 | | 18 | 8 | 20 | 17 |
| R8_C | 44.5 | | 21 | 15 | 25 | 22 |
| R9_A | 1.5 | Podium (South) – POR, South Façade | 41 | 30 | 27 | 23 |
| R10_A | 1.5 | OPOR – Southeast Amenity Area | 22 | N/A | 20 | N/A |

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

Based on an offset distance of 79 m between the Confederation line railway centerline and the nearest building foundation (northwest corner), the estimated vibration level at the nearest point of reception is expected to be 0.009 mm/s RMS (51 dBV) based on the FTA protocol. Details of the calculation are provided in Appendix B. Since predicted vibration levels are below the criterion of 0.10 mm/s RMS, no mitigation will be required.

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 0.10 mm/s peak partial velocity (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 traffic noise analysis indicate that noise levels will range between 54 and 76 dBA during the daytime period (07:00-23:00) and between 46 and 69 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 76 dBA) occurs along the north façade of the North Block, which are nearest and most exposed to Highway 174 and the future LRT system. Building components with a higher Sound Transmission Class (STC) rating will be required where noise levels exceed 65 dBA, as indicated in Figure 8.

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[15] 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 and light rail transit (LRT) 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*

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

*Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*

- *STC rated multi-pane glass glazing elements and spandrel panels for North Block and South Block as well as the podium as detailed in Table 8 above*
- *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."*

Noise levels at the grade-level OLA at the southeast corner of the site are below the acceptable level of 60 dBA, and therefore, no mitigation will be required.

For the stationary noise assessment, the impact of each of the noted surrounding buildings was evaluated separately. The results indicate that the noise levels produced by existing sources of stationary noise located at grade and the rooftops of each of the noted buildings fall below the stationary noise criteria of 50 dBA for daytime and 45 dBA nighttime and therefore, no mitigation is required.

Vibration levels due to railway activity in the area are expected to fall below the criterion of 0.10 mm/s at the nearest building foundation to the LRT rail line. Thus, mitigation for vibrations is not required.

With regard to stationary noise impacts of the development's mechanical equipment onto surrounding noise sensitive properties, a stationary noise study will be performed for the site during the detailed design once mechanical plans become available. This study would assess impacts of stationary noise from rooftop mechanical units and any other stationary sources serving the proposed building on surrounding noise-sensitive areas. Based on preliminary discussions with the project's Mechanical Engineer (Goodkey, Weedmark & Associates Limited), the development will include one or two air cooled chillers on the rooftop of the North Block and an emergency generator. This study will include recommendations for any

noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment. Where necessary noise screens and silencers can be incorporated into the design

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.***

Samantha Phillips, B.Eng.
Environmental Scientist


Joshua Foster, P.Eng.
Principal

Gradient Wind File 20-070-Noise & Vibration R2

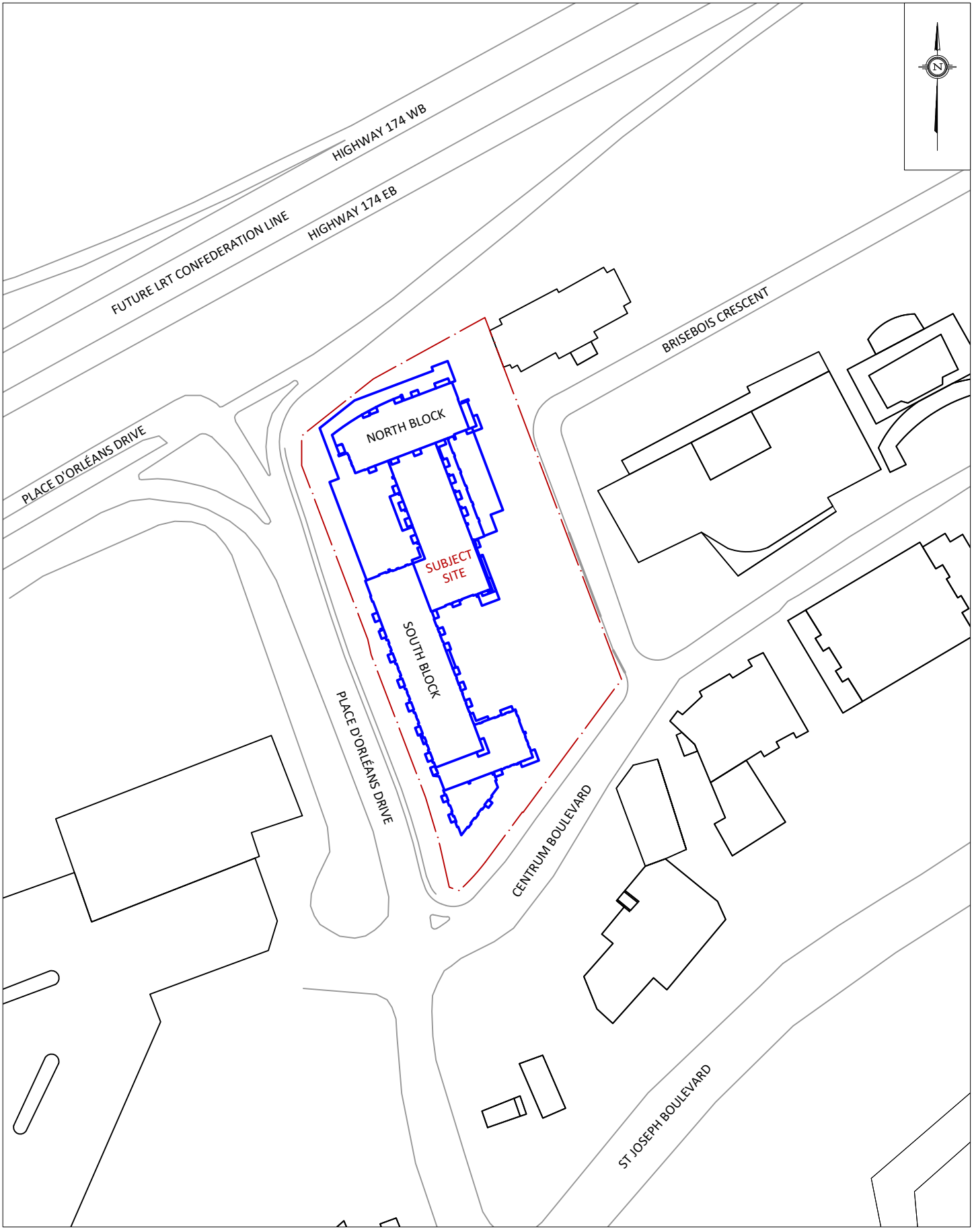



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FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

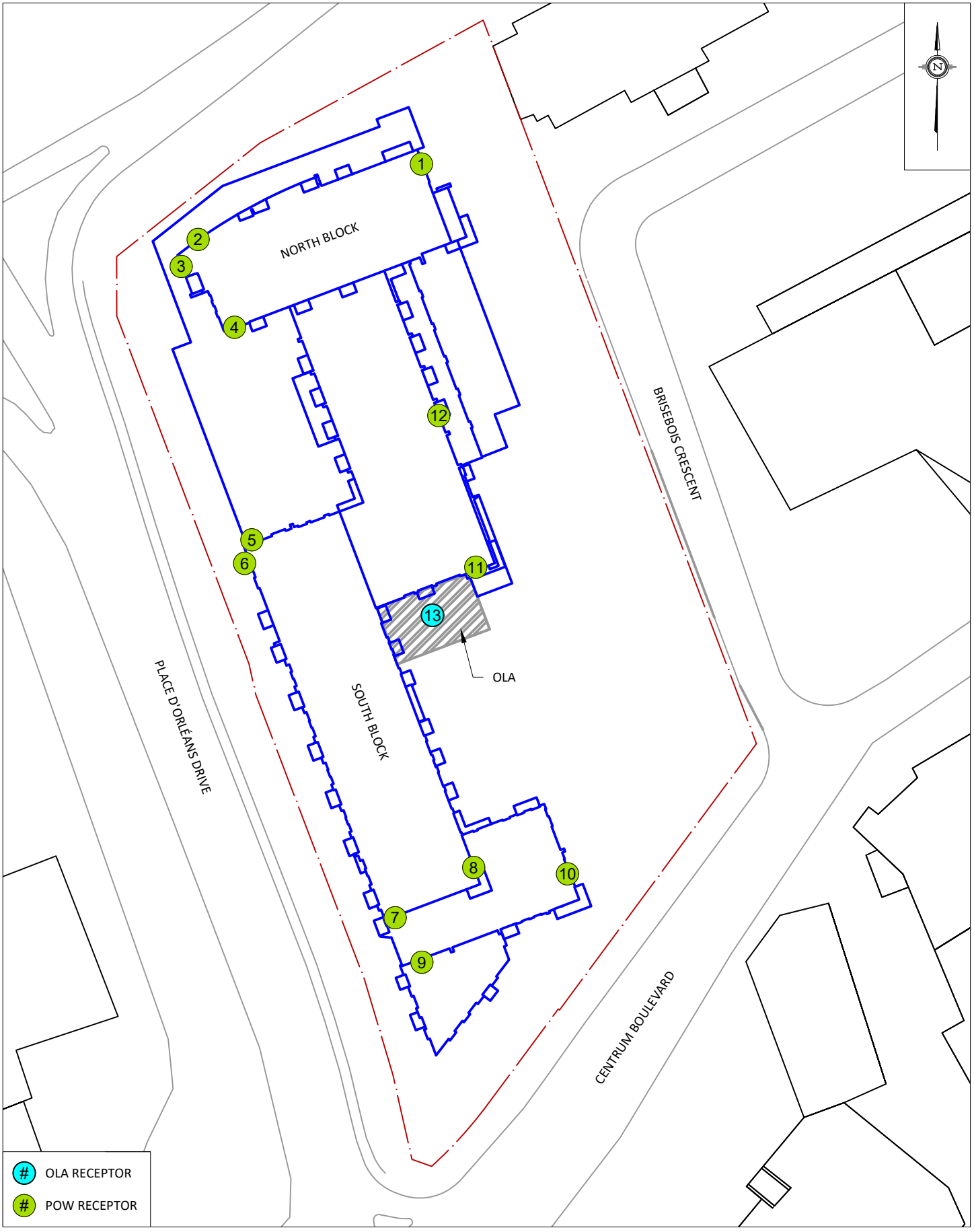


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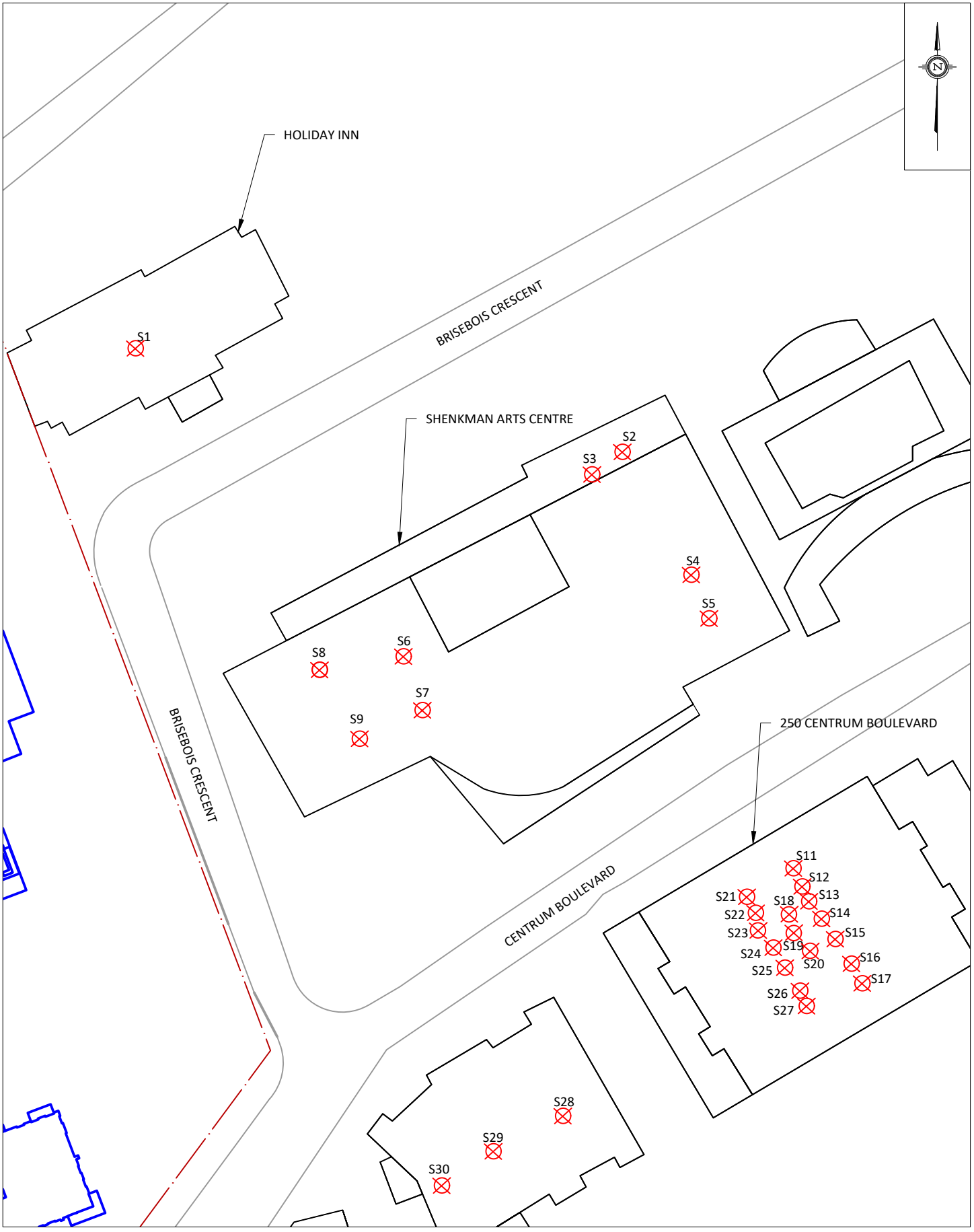
FIGURE 2:
TRANSPORTATION NOISE RECEPTOR LOCATIONS

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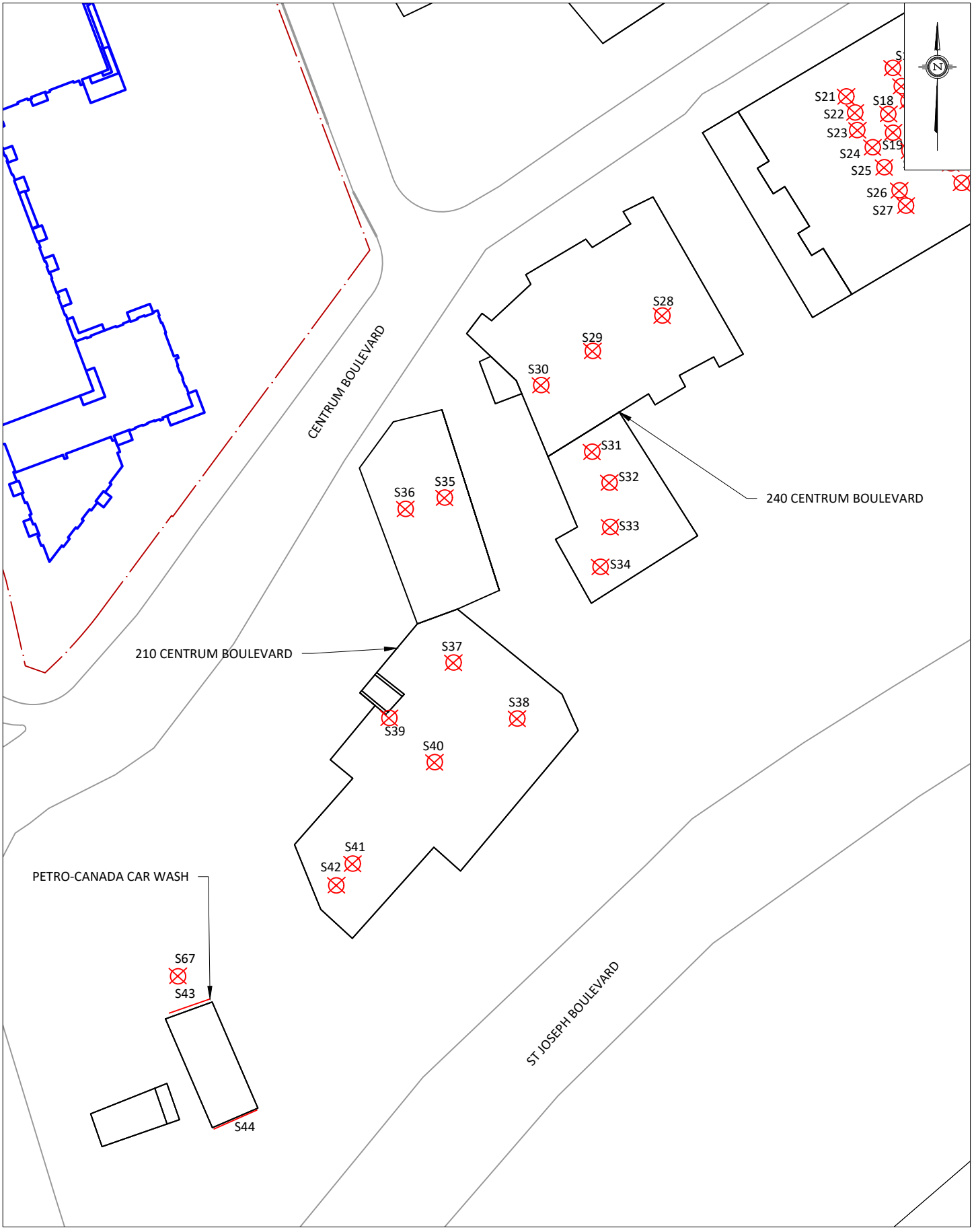
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

FIGURE 3:
EXISTING STATIONARY NOISE SOURCES

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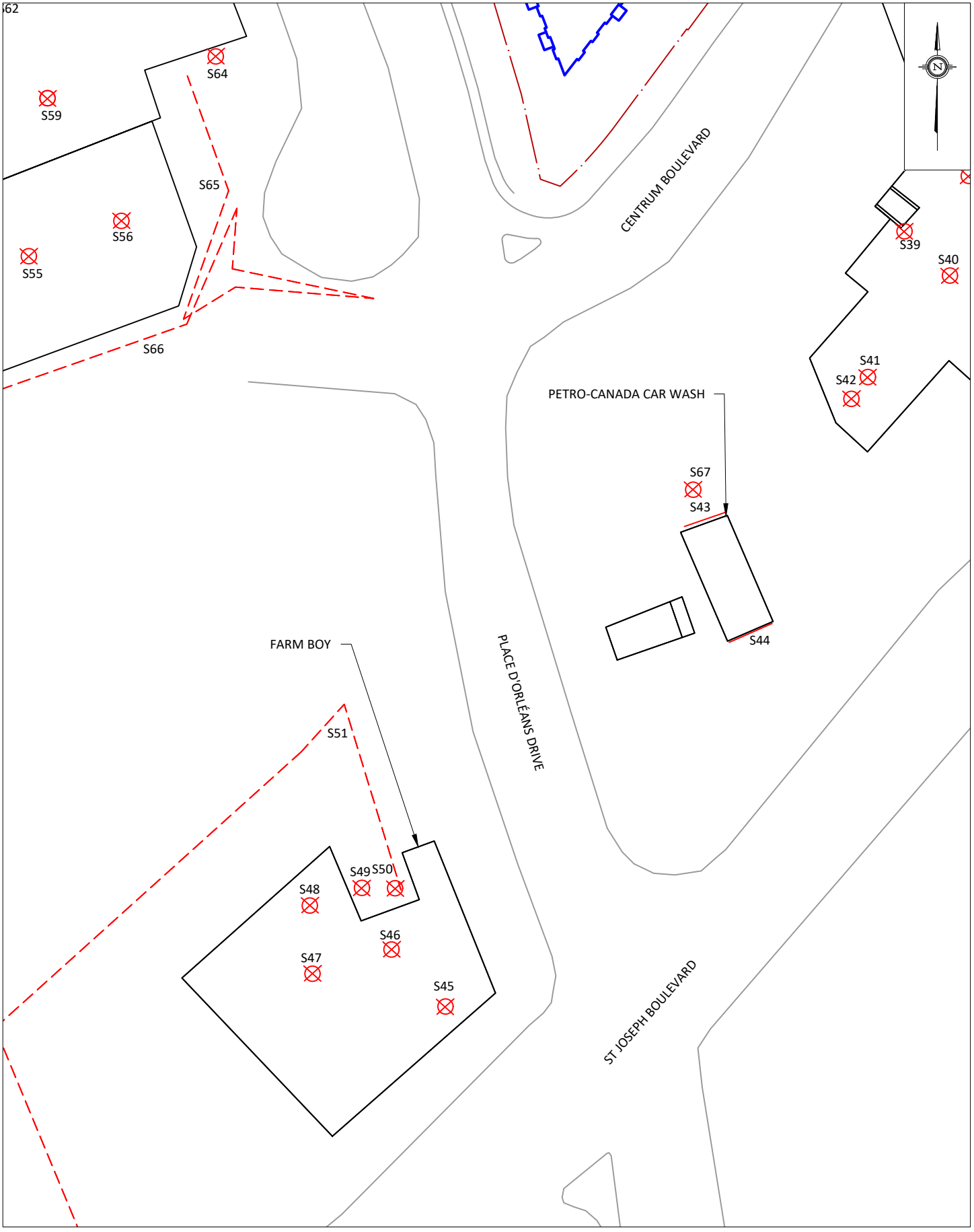
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

FIGURE 4:
EXISTING STATIONARY NOISE SOURCES

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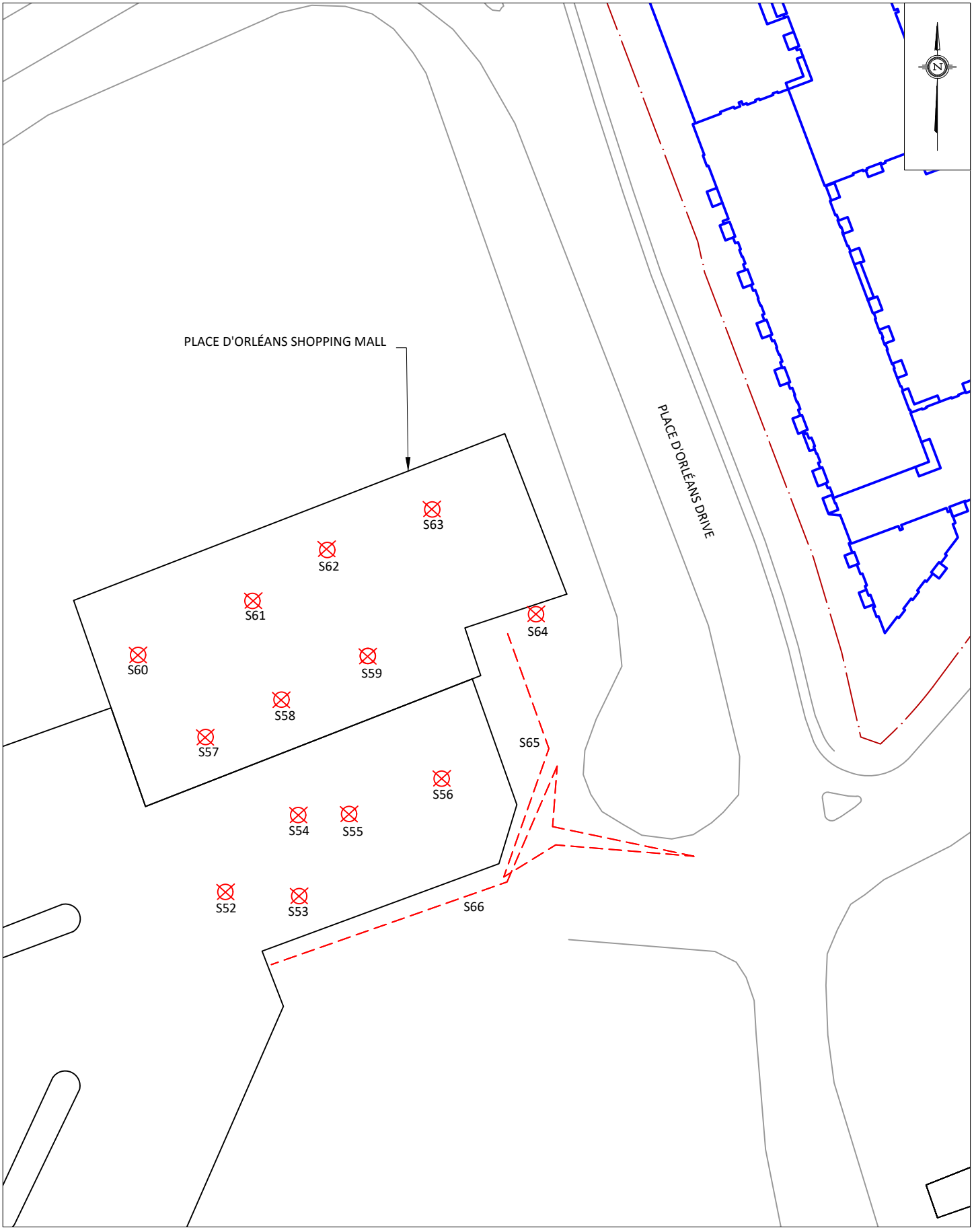
| SCALE | 1:1000 (APPROX.) | DRAWING NO. GW20-070-5 | FIGURE 5:<br>EXISTING STATIONARY NOISE SOURCES |
| DATE | NOVEMBER 19, 2020 | DRAWN BY S.P. | |

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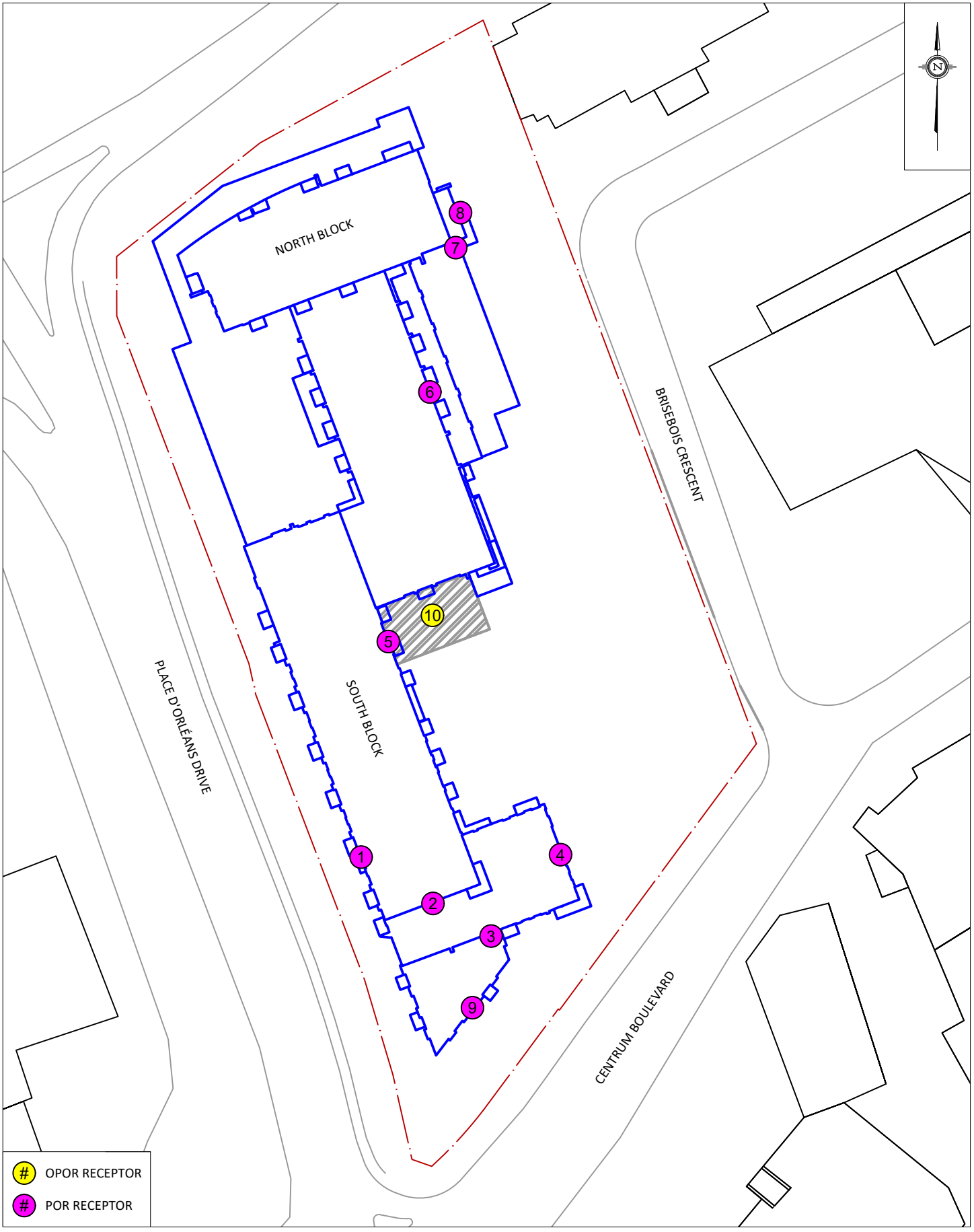
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-6 |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 6:
EXISTING STATIONARY NOISE SOURCES

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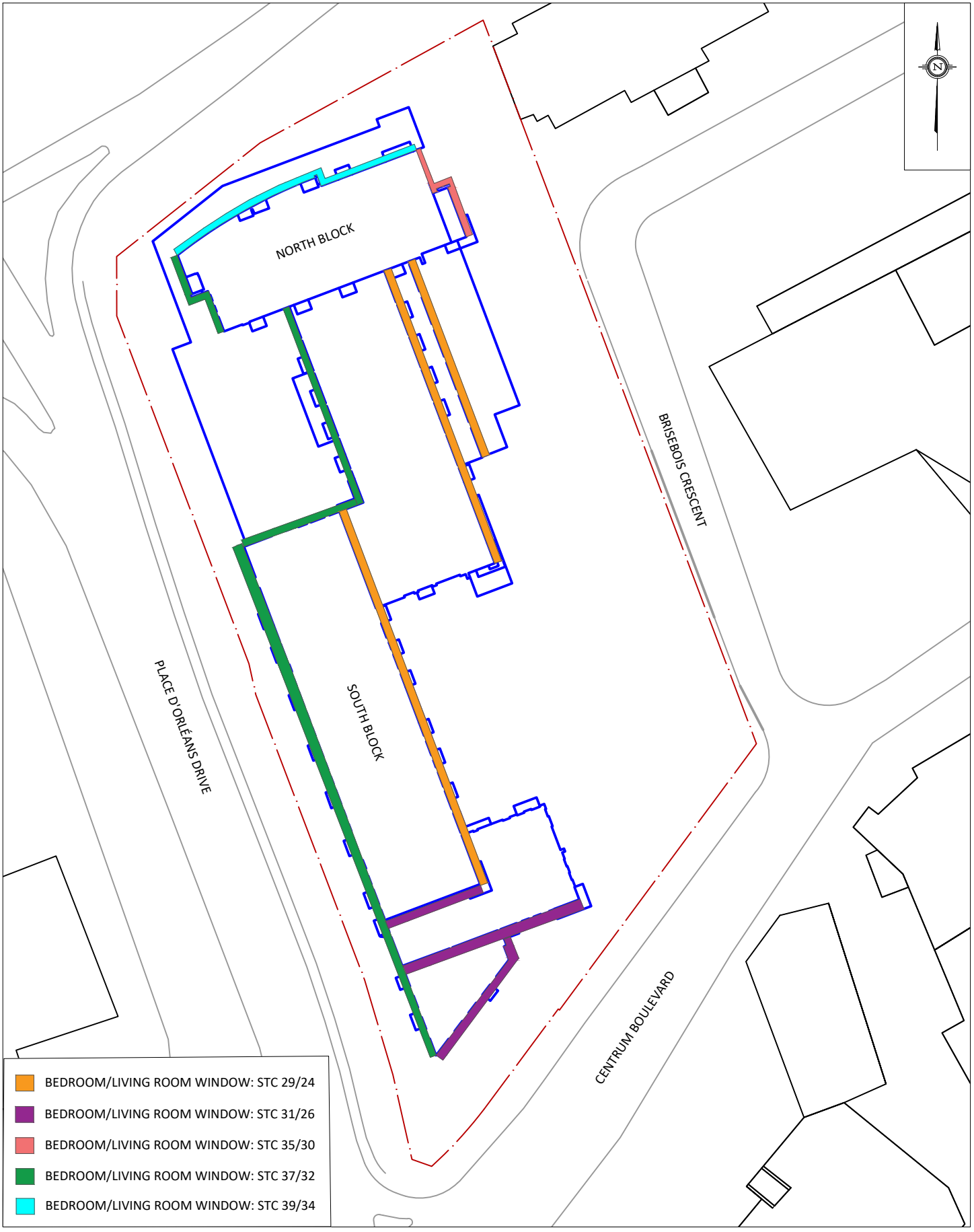
DESCRIPTION

FIGURE 7:
STATIONARY NOISE RECEPTOR LOCATIONS

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| SCALE | 1:1000 (APPROX.) |
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| DATE | NOVEMBER 19, 2020 |
| DRAWN BY | S.P. |
| DESCRIPTION | FIGURE 8:<br>TRANSPORTATION NOISE - WINDOW STC REQUIREMENTS |

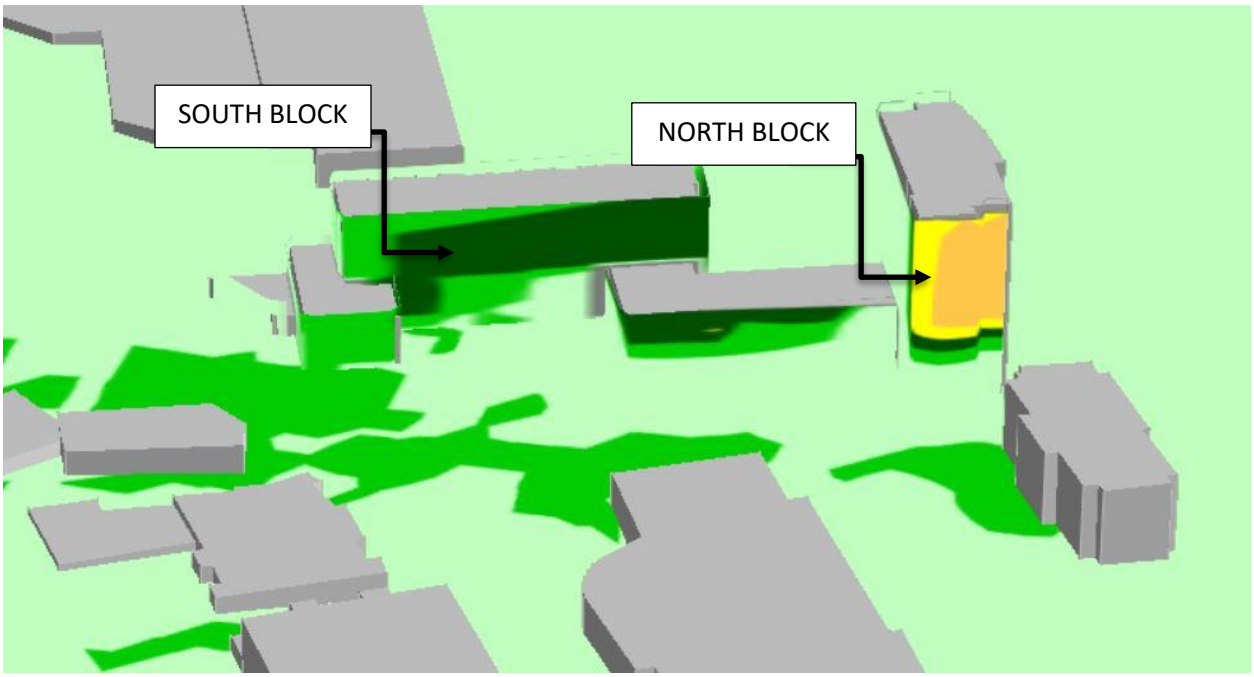



**FIGURE 9: HOLIDAY INN HOTEL - STATIONARY SOURCES NOISE CONTOURS (DAYTIME PERIOD)**

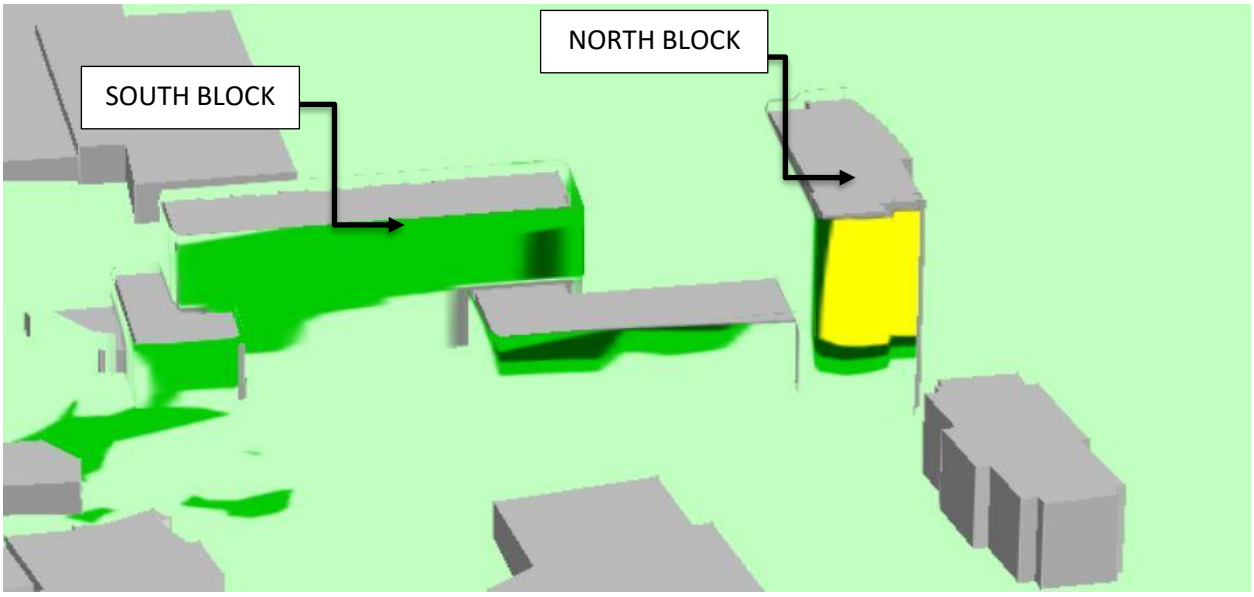



**FIGURE 10: HOLIDAY INN - STATIONARY SOURCES NOISE CONTOURS (NIGHTTIME PERIOD)**

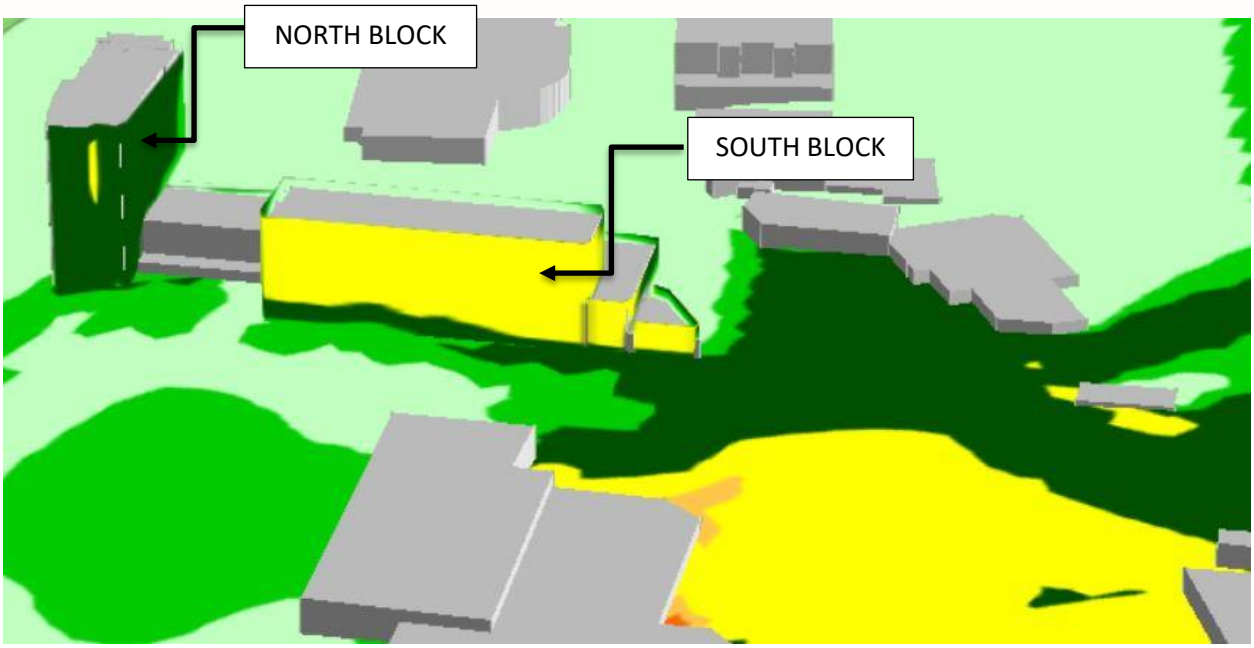
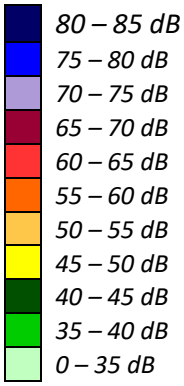



**FIGURE 11: PLACE D'ORLÉANS SHOPPING MALL - STATIONARY SOURCES NOISE CONTOURS (DAYTIME PERIOD)**



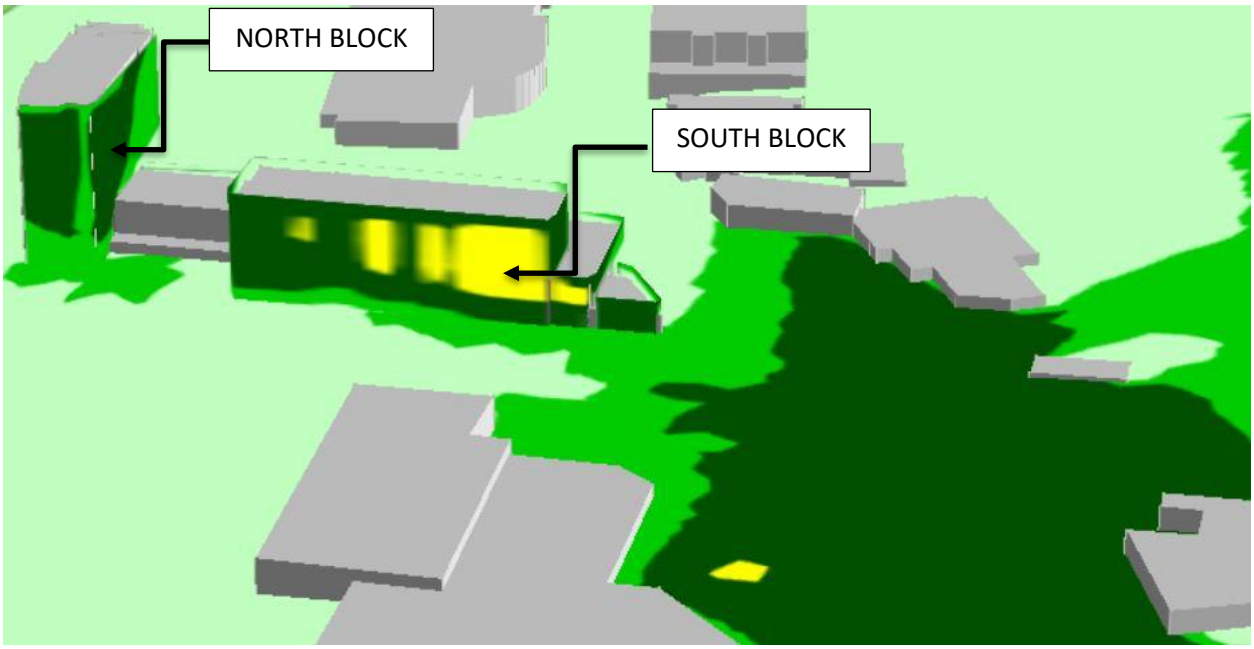



**FIGURE 12: PLACE D'ORLÉANS SHOPPING MALL - STATIONARY SOURCES NOISE CONTOURS (NIGHTTIME PERIOD)**










# APPENDIX A

## STAMSON 5.04 – INPUT AND OUTPUT DATA AND SUPPORTING INFORMATION

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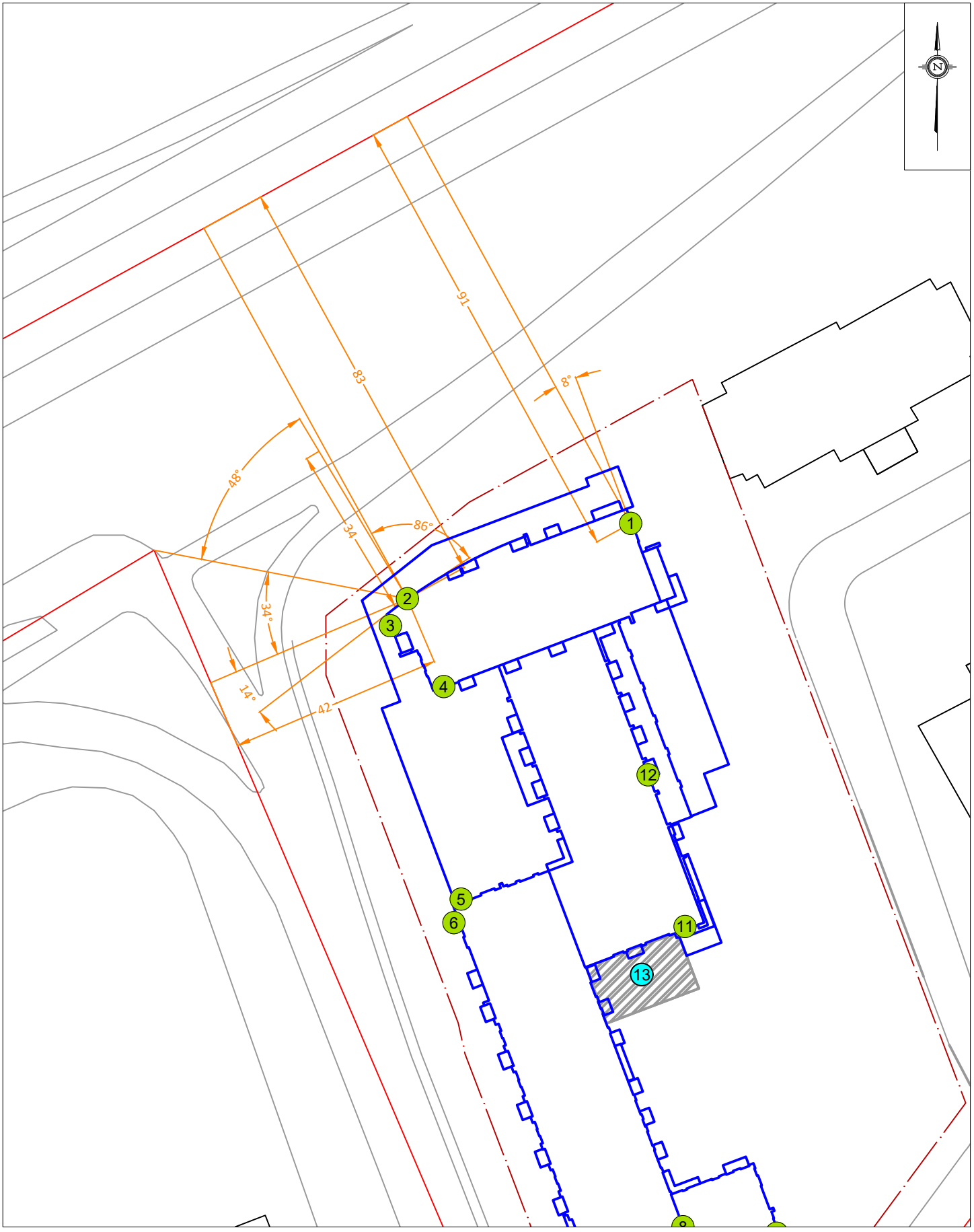


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DESCRIPTION

FIGURE 1A:
STAMSON INPUT PARAMETERS - RECEPTORS 1 & 2

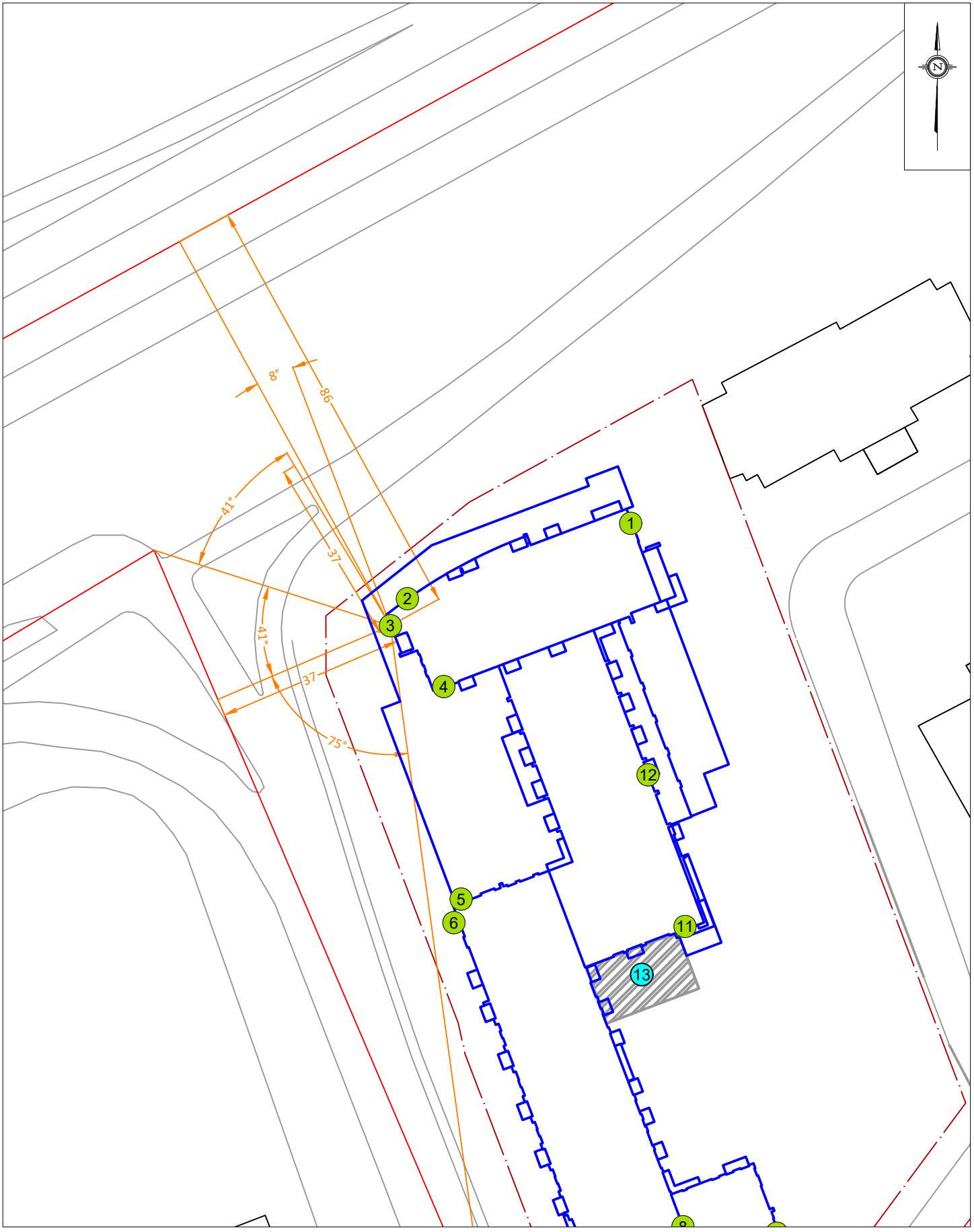


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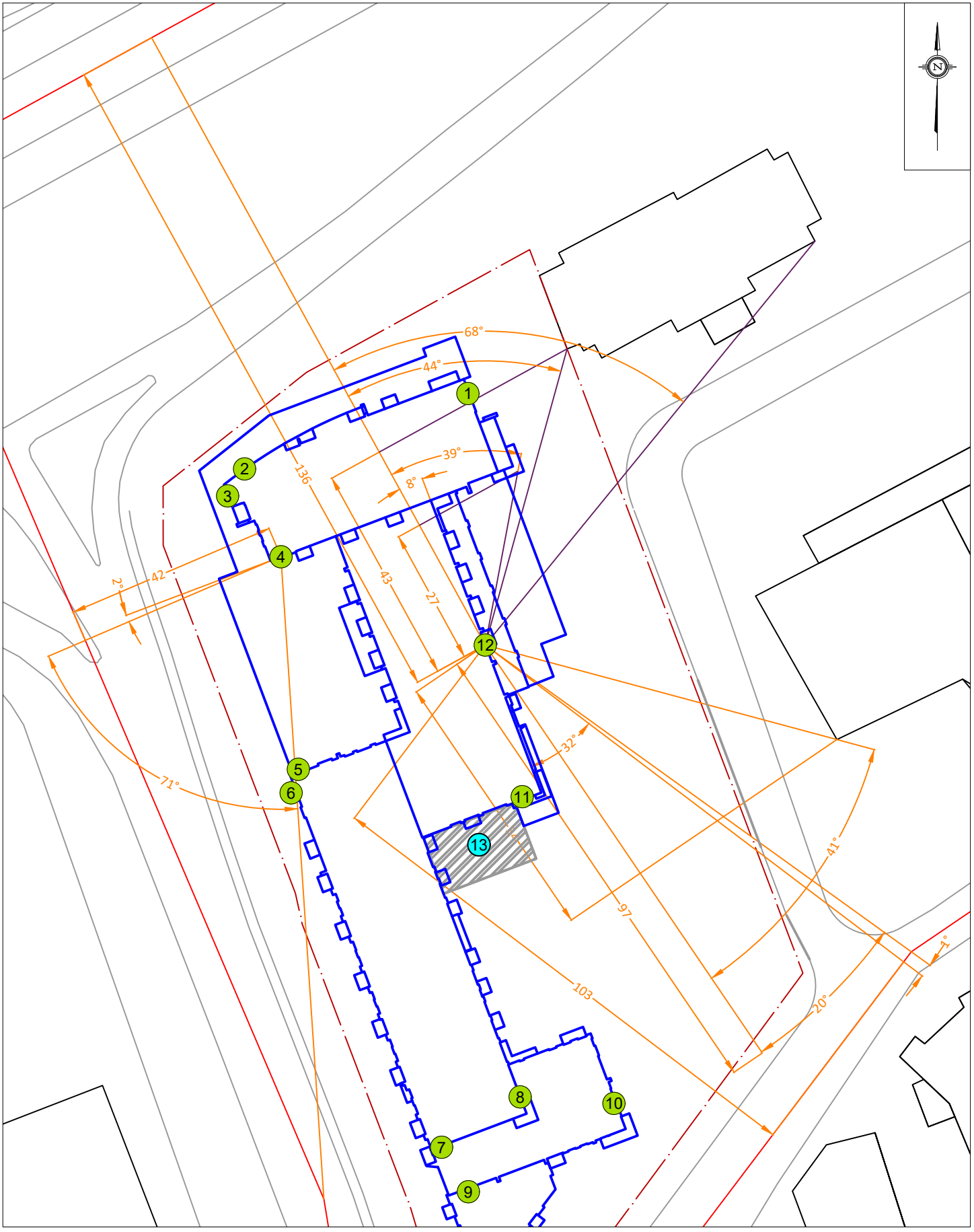
FIGURE 2A:
STAMSON INPUT PARAMETERS - RECEPTOR 3

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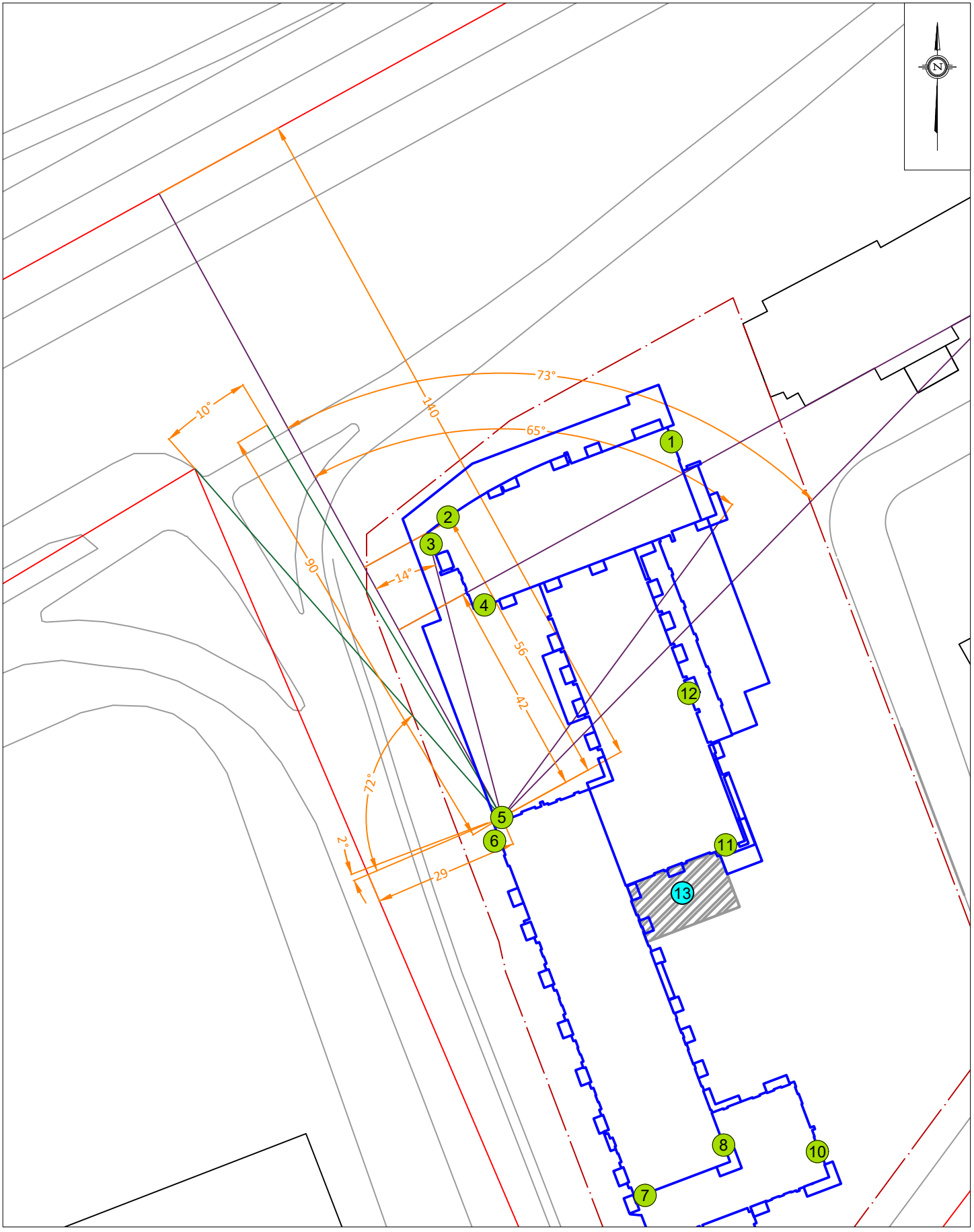
| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-3A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 3A:
STAMSON INPUT PARAMETERS - RECEPTORS 4 & 12

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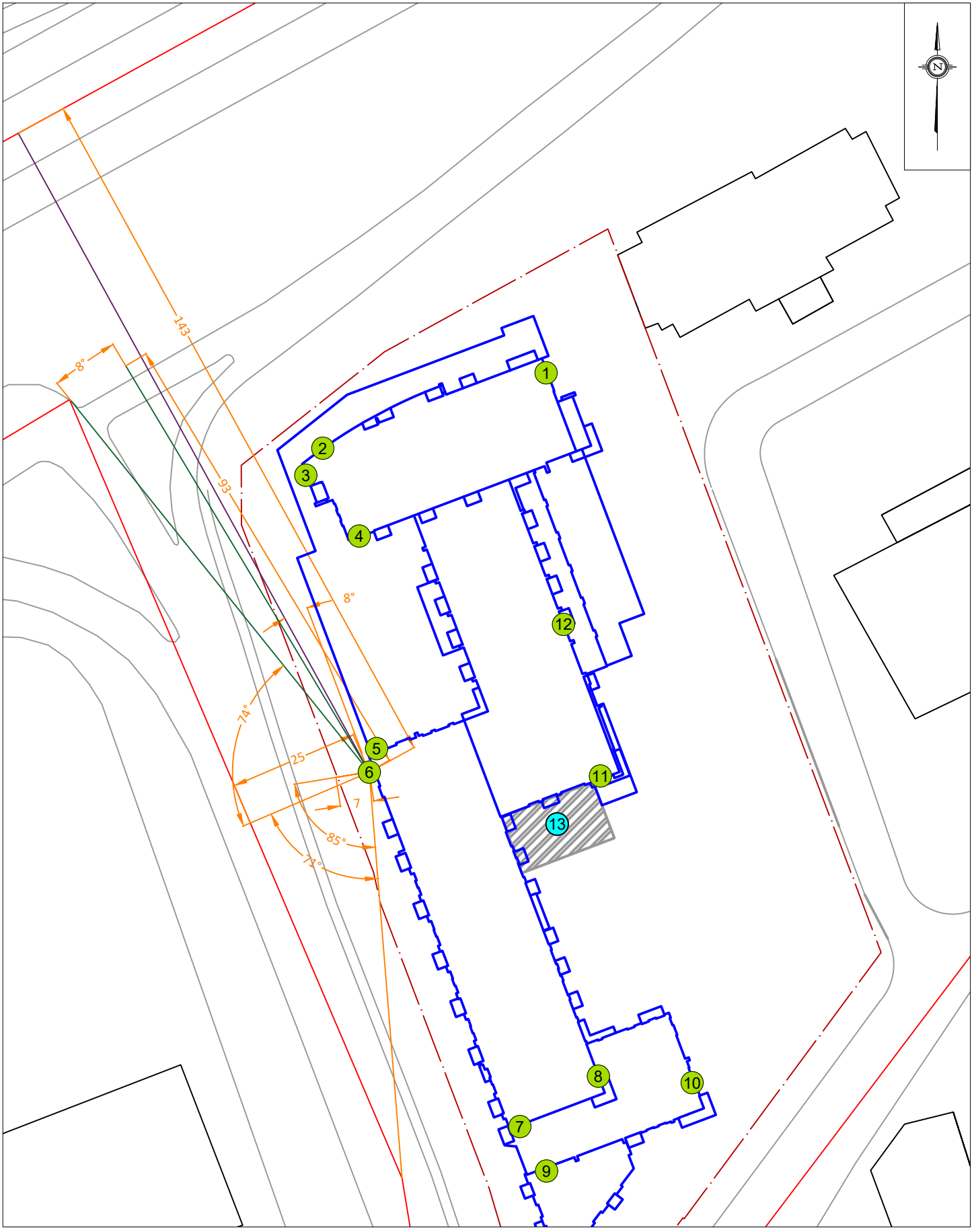
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-4A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 4A:
STAMSON INPUT PARAMETERS - RECEPTOR 5

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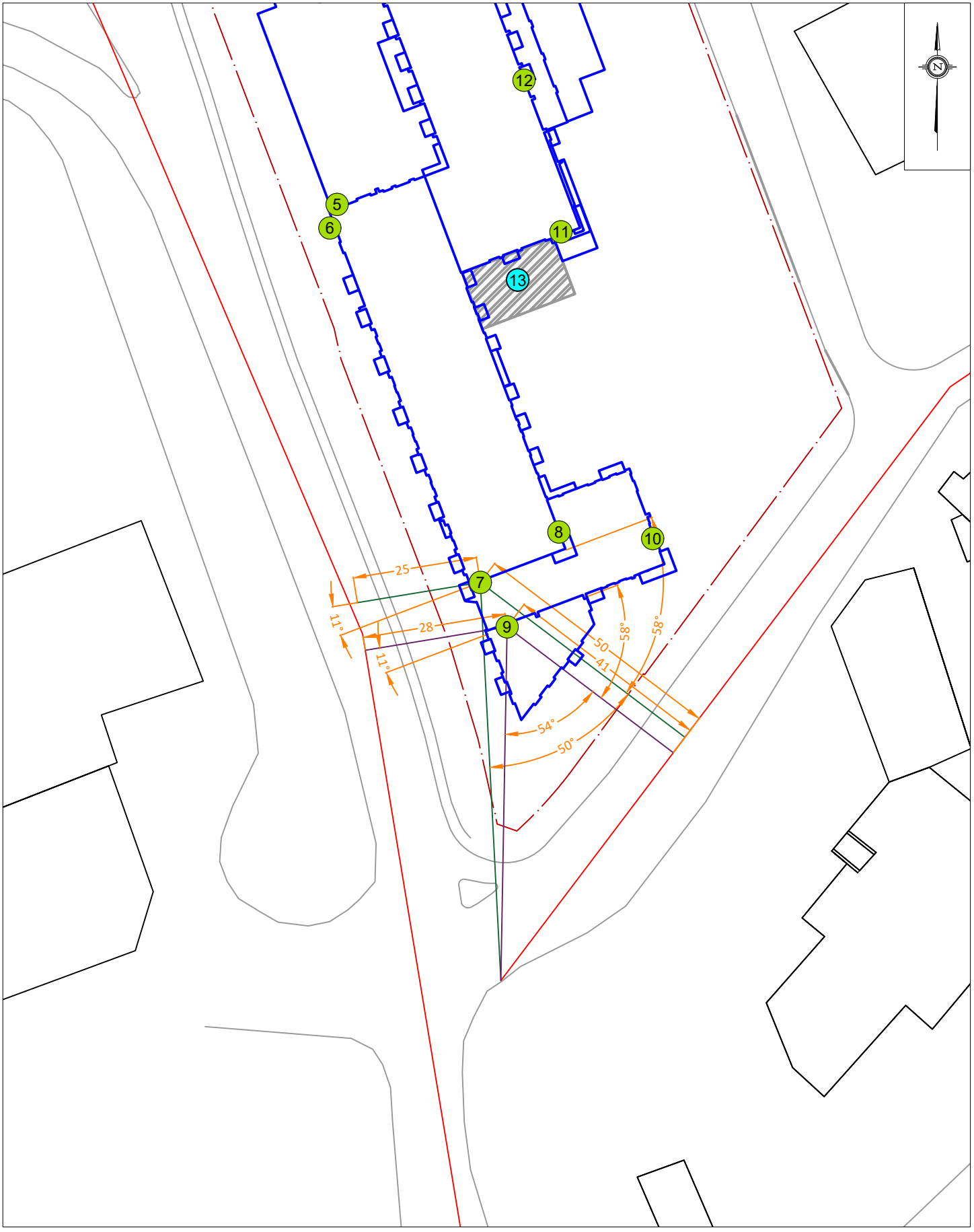
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-5A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 5A:
STAMSON INPUT PARAMETERS - RECEPTOR 6

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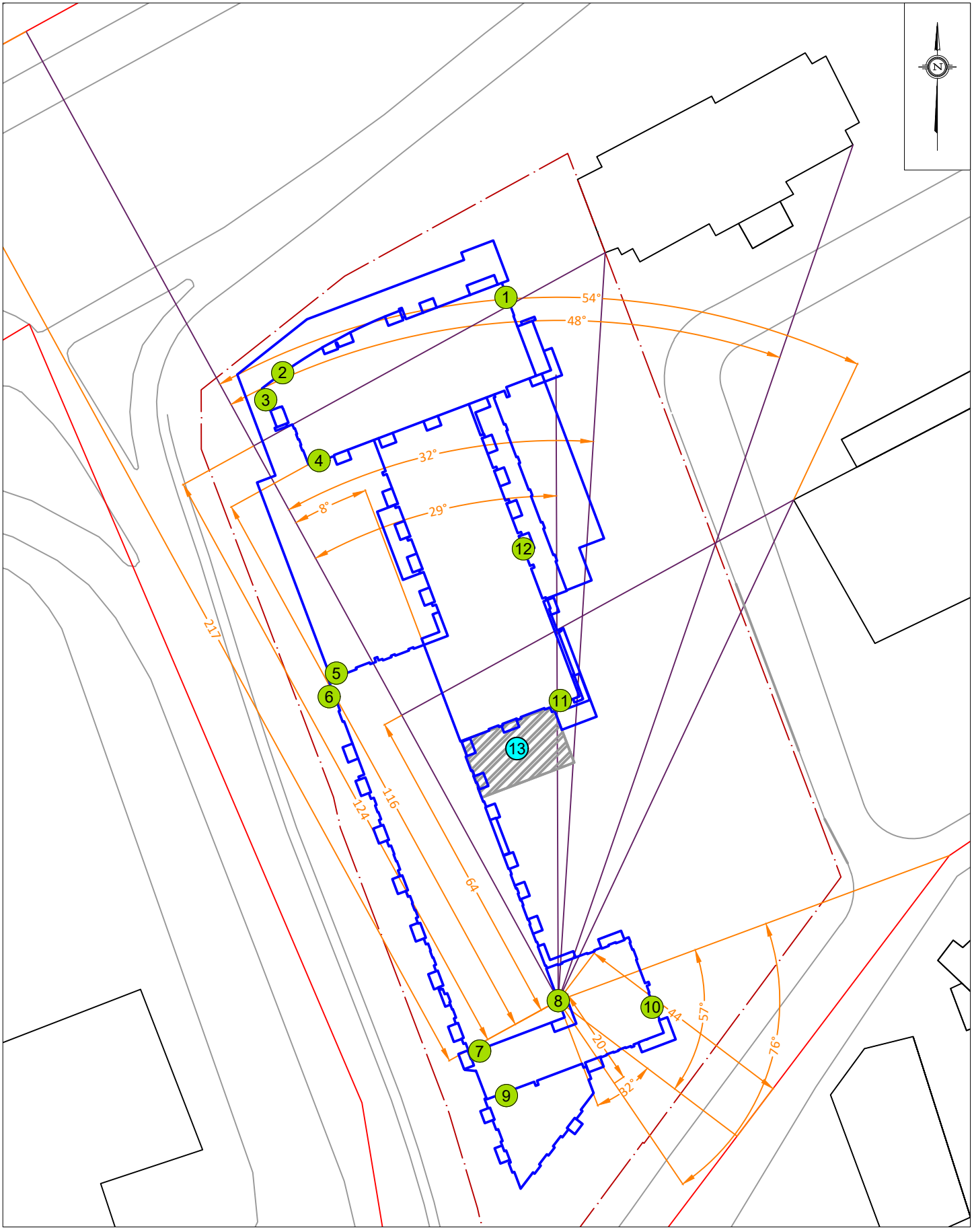
| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | DESCRIPTION |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. GW20-070-6A | FIGURE 6A:<br>STAMSON INPUT PARAMETERS - RECEPTORS 7 & 9 |
| DATE | NOVEMBER 19, 2020 | DRAWN BY S.P. | |

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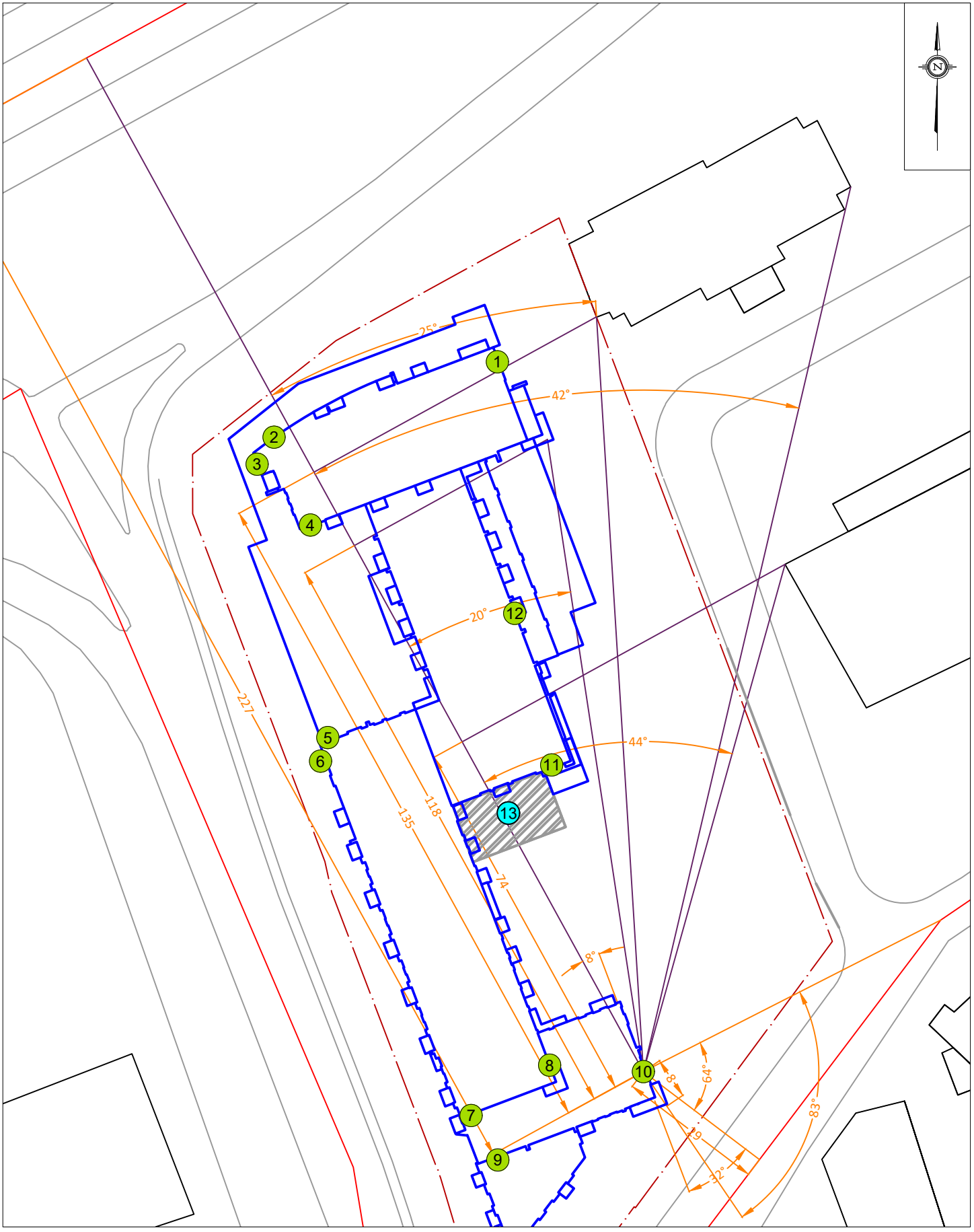
| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-7A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 7A:
STAMSON INPUT PARAMETERS - RECEPTOR 8

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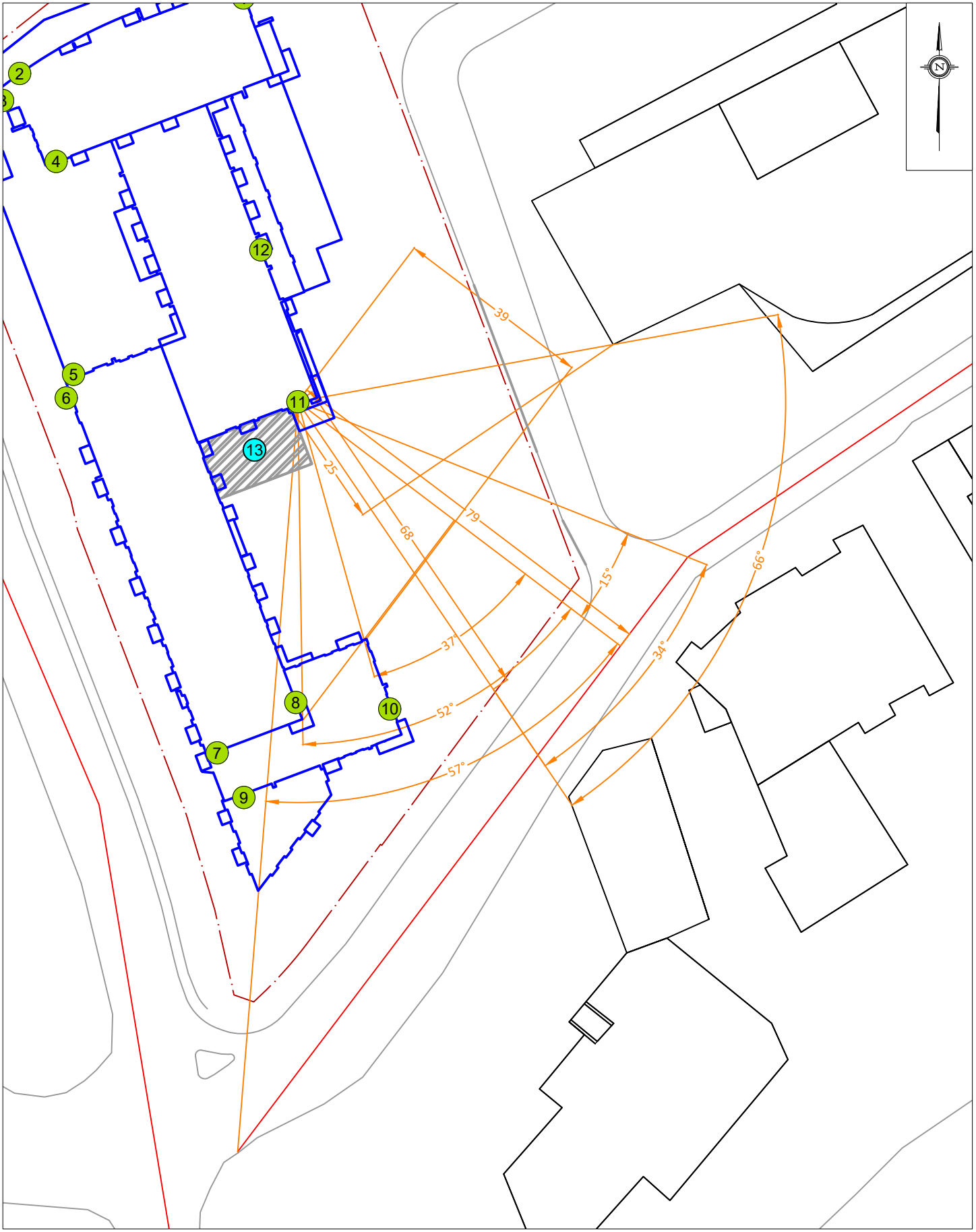
| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | DESCRIPTION |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-8A |
| DATE | NOVEMBER 10, 2020 | DRAWN BY | S.P. |

FIGURE 8A:
STAMSON INPUT PARAMETERS - RECEPTOR 10

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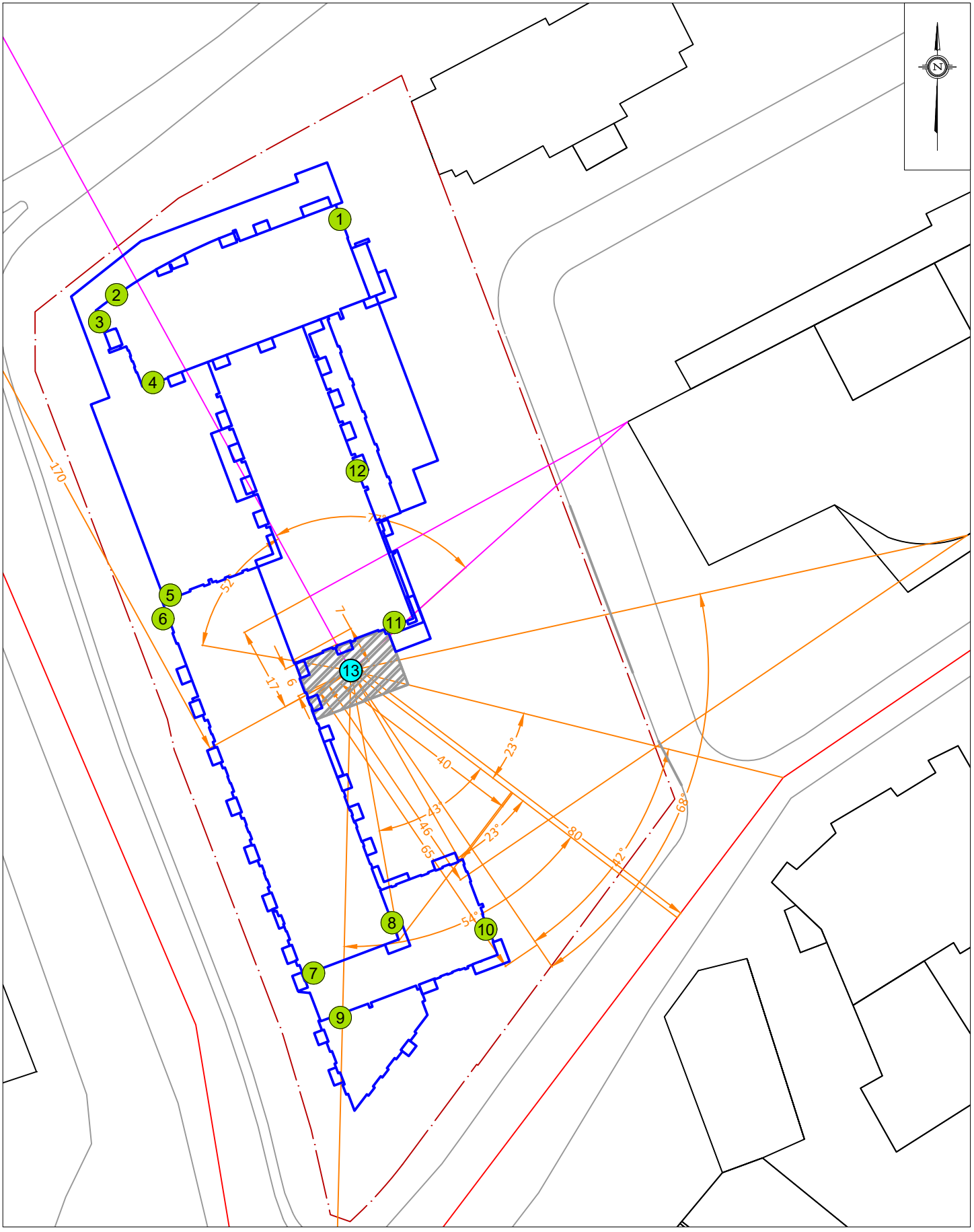
| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | DESCRIPTION |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-9A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

FIGURE 9A:
STAMSON INPUT PARAMETERS - RECEPTOR 11

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| | | | |
|---|---|---|---|
| PROJECT | 211 CENTRUM BOULEVARD, OTTAWA<br>ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT | | |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. | GW20-070-10A |
| DATE | NOVEMBER 19, 2020 | DRAWN BY | S.P. |

DESCRIPTION

FIGURE 10A:
STAMSON INPUT PARAMETERS - RECEPTOR 13

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:10:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R1.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 (day/night)
-----------------------------------------
Angle1   Angle2           :   8.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  91.00 / 91.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Results segment # 1: HWY 174 (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 71.91 + 0.00) = 71.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     8     90   0.00  83.16   0.00  -7.83  -3.41   0.00   0.00   0.00
71.91
-------------------------------------------------------------------------
--

Segment Leq : 71.91 dBA

Total Leq All Segments: 71.91 dBA


Results segment # 1: HWY 174 (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.32 + 0.00) = 64.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     8     90   0.00  75.56   0.00  -7.83  -3.41   0.00   0.00   0.00
64.32
-------------------------------------------------------------------------
--

Segment Leq : 64.32 dBA

Total Leq All Segments: 64.32 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   8.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  91.00 / 91.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00

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

Source height = 0.50 m

RT/Custom (0.00 + 52.19 + 0.00) = 52.19 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     8     90   0.00  63.44  -7.83  -3.41   0.00   0.00   0.00  52.19
-------------------------------------------------------------------------

Segment Leq : 52.19 dBA

Total Leq All Segments: 52.19 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 45.66 + 0.00) = 45.66 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
     8     90   0.00  56.91  -7.83  -3.41   0.00   0.00   0.00  45.66
-------------------------------------------------------------------------

Segment Leq : 45.66 dBA

Total Leq All Segments: 45.66 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 71.96
                           (NIGHT): 64.38
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:15:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R2.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   86.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  83.00 / 83.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Orleans EW (day/night)
----------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: Orleans EW (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -48.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  34.00 / 34.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Orleans NS (day/night)
----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: Orleans NS (day/night)
--------------------------------------------
Angle1   Angle2           : -14.00 deg   34.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  42.00 / 42.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Results segment # 1: HWY 174 (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 75.63 + 0.00) = 75.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     86   0.00  83.16   0.00  -7.43  -0.10   0.00   0.00   0.00
75.63
-------------------------------------------------------------------------
--

Segment Leq : 75.63 dBA

Results segment # 2: Orleans EW (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.80 + 0.00) = 63.80 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -48   0.00  73.68   0.00  -3.55  -6.32   0.00   0.00   0.00
63.80
-------------------------------------------------------------------------
--

Segment Leq : 63.80 dBA
```

```
Results segment # 3: Orleans NS (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.79 + 0.00) = 62.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -14     34   0.00  73.01   0.00  -4.47  -5.74   0.00   0.00   0.00
62.79
-------------------------------------------------------------------------
--

Segment Leq : 62.79 dBA

Total Leq All Segments: 76.11 dBA


Results segment # 1: HWY 174 (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.03 + 0.00) = 68.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     86   0.00  75.56   0.00  -7.43  -0.10   0.00   0.00   0.00
68.03
-------------------------------------------------------------------------
--

Segment Leq : 68.03 dBA
```

```
Results segment # 2: Orleans EW (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.21 + 0.00) = 56.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -48   0.00  66.08   0.00  -3.55  -6.32   0.00   0.00   0.00
56.21
-------------------------------------------------------------------------
--

Segment Leq : 56.21 dBA


Results segment # 3: Orleans NS (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.20 + 0.00) = 55.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -14     34   0.00  65.41   0.00  -4.47  -5.74   0.00   0.00   0.00
55.20
-------------------------------------------------------------------------
--

Segment Leq : 55.20 dBA

Total Leq All Segments: 68.51 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   86.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  83.00 / 83.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 55.91 + 0.00) = 55.91 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     86   0.00  63.44  -7.43  -0.10   0.00   0.00   0.00  55.91
-------------------------------------------------------------------------

Segment Leq : 55.91 dBA

Total Leq All Segments: 55.91 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 49.38 + 0.00) = 49.38 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     86   0.00  56.91  -7.43  -0.10   0.00   0.00   0.00  49.38
-------------------------------------------------------------------------

Segment Leq : 49.38 dBA

Total Leq All Segments: 49.38 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 76.15
                           (NIGHT): 68.57
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:21:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R3.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  86.00 / 86.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: ORLEANS EW (day/night)
----------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: ORLEANS EW (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -41.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: ORLEANS NS (day/night)
----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS NS (day/night)
--------------------------------------------
Angle1   Angle2           : -75.00 deg   41.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  37.00 / 37.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Results segment # 1: HWY 174 (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 72.93 + 0.00) = 72.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      8   0.00  83.16   0.00  -7.58  -2.64   0.00   0.00   0.00
72.93
-------------------------------------------------------------------------
--

Segment Leq : 72.93 dBA


Results segment # 2: ORLEANS EW (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.10 + 0.00) = 64.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -41   0.00  73.68   0.00  -3.92  -5.65   0.00   0.00   0.00
64.10
-------------------------------------------------------------------------
--

Segment Leq : 64.10 dBA
```

```
Results segment # 3: ORLEANS NS (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.18 + 0.00) = 67.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -75     41   0.00  73.01   0.00  -3.92  -1.91   0.00   0.00   0.00
67.18
-------------------------------------------------------------------------
--

Segment Leq : 67.18 dBA

Total Leq All Segments: 74.38 dBA


Results segment # 1: HWY 174 (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.34 + 0.00) = 65.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      8   0.00  75.56   0.00  -7.58  -2.64   0.00   0.00   0.00
65.34
-------------------------------------------------------------------------
--

Segment Leq : 65.34 dBA
```

```
Results segment # 2: ORLEANS EW (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.51 + 0.00) = 56.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -41   0.00  66.08   0.00  -3.92  -5.65   0.00   0.00   0.00
56.51
-------------------------------------------------------------------------------
--

Segment Leq : 56.51 dBA


Results segment # 3: ORLEANS NS (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.58 + 0.00) = 59.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -75     41   0.00  65.41   0.00  -3.92  -1.91   0.00   0.00   0.00
59.58
-------------------------------------------------------------------------------
--

Segment Leq : 59.58 dBA

Total Leq All Segments: 66.79 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   540/60    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  86.00 / 86.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 53.21 + 0.00) = 53.21 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90      8   0.00  63.44  -7.58  -2.64   0.00   0.00   0.00  53.21
-------------------------------------------------------------------------

Segment Leq : 53.21 dBA

Total Leq All Segments: 53.21 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 46.68 + 0.00) = 46.68 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90      8   0.00  56.91  -7.58  -2.64   0.00   0.00   0.00  46.68
-------------------------------------------------------------------------

Segment Leq : 46.68 dBA

Total Leq All Segments: 46.68 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 74.41
                           (NIGHT): 66.83
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:24:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R4.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: ORLEANS NS (day/night)
----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS NS (day/night)
--------------------------------------------
Angle1   Angle2           : -71.00 deg   2.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  42.00 / 42.00  m
Receiver height           :  44.50 / 44.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Results segment # 1: ORLEANS NS (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.62 + 0.00) = 64.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -71      2   0.00  73.01   0.00  -4.47  -3.92   0.00   0.00   0.00
64.62
-------------------------------------------------------------------------
--

Segment Leq : 64.62 dBA

Total Leq All Segments: 64.62 dBA


Results segment # 1: ORLEANS NS (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.02 + 0.00) = 57.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -71      2   0.00  65.41   0.00  -4.47  -3.92   0.00   0.00   0.00
57.02
-------------------------------------------------------------------------
--

Segment Leq : 57.02 dBA

Total Leq All Segments: 57.02 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 64.62
                           (NIGHT): 57.02
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:45:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R5.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   65.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 140.00 / 140.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  14.00 deg   Angle2 : 65.00 deg
Barrier height            :  46.00 m
Barrier receiver distance :  56.00 / 56.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: HWY 174 2 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 2 (day/night)
--------------------------------------------
Angle1   Angle2           :  65.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 140.00 / 140.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  65.00 deg   Angle2 : 73.00 deg
Barrier height            :  20.00 m
Barrier receiver distance :  42.00 / 42.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: ORLEANS EW (day/night)
----------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: ORLEANS EW (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -10.00 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           :  26.50 / 26.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: ORLEANS NS (day/night)
----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS NS (day/night)
--------------------------------------------
Angle1   Angle2           :   2.00 deg   72.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00
```

```
Results segment # 1: HWY 174 (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 !       26.50 !       14.50 !        14.50

ROAD (71.07 + 47.98 + 0.00) = 71.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     14   0.00  83.16   0.00  -9.70  -2.38   0.00   0.00   0.00
71.07
-------------------------------------------------------------------------------
--
    14     65   0.00  83.16   0.00  -9.70  -5.48   0.00   0.00 -20.00
47.98
-------------------------------------------------------------------------------
--

Segment Leq : 71.10 dBA
```

```
Results segment # 2: HWY 174 2 (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 !       26.50 !       17.50 !        17.50

ROAD (0.00 + 53.29 + 63.21) = 63.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    65     73   0.00  83.16   0.00  -9.70 -13.52   0.00   0.00  -6.65
53.29
-------------------------------------------------------------------------------
--
    73     90   0.00  83.16   0.00  -9.70 -10.25   0.00   0.00   0.00
63.21
-------------------------------------------------------------------------------
--

Segment Leq : 63.63 dBA
```

```
Results segment # 3: ORLEANS EW (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.37 + 0.00) = 62.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -10   0.00  73.68   0.00  -7.78  -3.52   0.00   0.00   0.00
62.37
-------------------------------------------------------------------------------
--

Segment Leq : 62.37 dBA


Results segment # 4: ORLEANS NS (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 66.04 + 0.00) = 66.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     2     72   0.00  73.01   0.00  -2.86  -4.10   0.00   0.00   0.00
66.04
-------------------------------------------------------------------------------
--

Segment Leq : 66.04 dBA

Total Leq All Segments: 73.21 dBA
```

```
Results segment # 1: HWY 174 (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 !       26.50 !       14.50 !        14.50

ROAD (63.48 + 40.38 + 0.00) = 63.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     14   0.00  75.56   0.00  -9.70  -2.38   0.00   0.00   0.00
63.48
-------------------------------------------------------------------------------
--
    14     65   0.00  75.56   0.00  -9.70  -5.48   0.00   0.00 -20.00
40.38
-------------------------------------------------------------------------------
--

Segment Leq : 63.50 dBA
```

```
Results segment # 2: HWY 174 2 (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 !       26.50 !       17.50 !         17.50

ROAD (0.00 + 45.69 + 55.61) = 56.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    65     73   0.00  75.56   0.00  -9.70 -13.52   0.00   0.00  -6.65
45.69
-------------------------------------------------------------------------------
--
    73     90   0.00  75.56   0.00  -9.70 -10.25   0.00   0.00   0.00
55.61
-------------------------------------------------------------------------------
--

Segment Leq : 56.03 dBA
```

```
Results segment # 3: ORLEANS EW (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.78 + 0.00) = 54.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -10   0.00  66.08   0.00  -7.78  -3.52   0.00   0.00   0.00
54.78
-------------------------------------------------------------------------
--

Segment Leq : 54.78 dBA

Results segment # 4: ORLEANS NS (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.45 + 0.00) = 58.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     2     72   0.00  65.41   0.00  -2.86  -4.10   0.00   0.00   0.00
58.45
-------------------------------------------------------------------------
--

Segment Leq : 58.45 dBA

Total Leq All Segments: 65.61 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 73.21
                           (NIGHT): 65.61
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:51:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R6.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: HWY 174 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 143.00 / 143.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: ORLEANS EW (day/night)
----------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 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):  35000
    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: ORLEANS EW (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  93.00 / 93.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   5.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: ORLEANS NS 1 (day/night)
-----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS NS 1 (day/night)
-----------------------------------------------
Angle1   Angle2           : -71.00 deg   74.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      3       (Elevated; no barrier)
Elevation                 :   3.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: ORLEANS NS 2 (day/night)
-----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS NS 2 (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   -85.00 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           :  26.50 / 26.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: HWY 174 (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 70.72 + 0.00) = 70.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      8   0.00  83.16   0.00  -9.79  -2.64   0.00   0.00   0.00
70.72
-------------------------------------------------------------------------
--

Segment Leq : 70.72 dBA


Results segment # 2: ORLEANS EW (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.34 + 0.00) = 62.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -8   0.00  73.68   0.00  -7.92  -3.41   0.00   0.00   0.00
62.34
-------------------------------------------------------------------------
--

Segment Leq : 62.34 dBA
```

```
Results segment # 3: ORLEANS NS 1 (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 69.85 + 0.00) = 69.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -71     74   0.00  73.01   0.00  -2.22  -0.94   0.00   0.00   0.00
69.85
-------------------------------------------------------------------------
--

Segment Leq : 69.85 dBA


Results segment # 4: ORLEANS NS 2 (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.44 + 0.00) = 57.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -85   0.00  73.01   0.00   0.00 -15.56   0.00   0.00   0.00
57.44
-------------------------------------------------------------------------
--

Segment Leq : 57.44 dBA

Total Leq All Segments: 73.75 dBA
```

```
Results segment # 1: HWY 174 (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.13 + 0.00) = 63.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      8   0.00  75.56   0.00  -9.79  -2.64   0.00   0.00   0.00
63.13
-------------------------------------------------------------------------
--

Segment Leq : 63.13 dBA


Results segment # 2: ORLEANS EW (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.74 + 0.00) = 54.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     -8   0.00  66.08   0.00  -7.92  -3.41   0.00   0.00   0.00
54.74
-------------------------------------------------------------------------
--

Segment Leq : 54.74 dBA
```

```
Results segment # 3: ORLEANS NS 1 (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.25 + 0.00) = 62.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -71     74   0.00  65.41   0.00  -2.22  -0.94   0.00   0.00   0.00
62.25
-------------------------------------------------------------------------------
--

Segment Leq : 62.25 dBA


Results segment # 4: ORLEANS NS 2 (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.85 + 0.00) = 49.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -85   0.00  65.41   0.00   0.00 -15.56   0.00   0.00   0.00
49.85
-------------------------------------------------------------------------------
--

Segment Leq : 49.85 dBA

Total Leq All Segments: 66.16 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 73.75
                           (NIGHT): 66.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:54:43
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R7.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: ORLEANS (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: ORLEANS (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -11.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: CENTRUM (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: CENTRUM (day/night)
-----------------------------------------
Angle1   Angle2           : -58.00 deg   50.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  50.00 / 50.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 67.21 + 0.00) = 67.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -11   0.00  73.01   0.00  -2.22  -3.58   0.00   0.00   0.00
67.21
-------------------------------------------------------------------------
--

Segment Leq : 67.21 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.51 + 0.00) = 56.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -58     50   0.00  63.96   0.00  -5.23  -2.22   0.00   0.00   0.00
56.51
-------------------------------------------------------------------------
--

Segment Leq : 56.51 dBA

Total Leq All Segments: 67.56 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 59.61 + 0.00) = 59.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -11   0.00  65.41   0.00  -2.22  -3.58   0.00   0.00   0.00
59.61
-------------------------------------------------------------------------
--

Segment Leq : 59.61 dBA


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

Source height = 1.50 m

ROAD (0.00 + 48.92 + 0.00) = 48.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -58     50   0.00  56.36   0.00  -5.23  -2.22   0.00   0.00   0.00
48.92
-------------------------------------------------------------------------
--

Segment Leq : 48.92 dBA

Total Leq All Segments: 59.97 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.56
                           (NIGHT): 59.97
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 16:59:34
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R8.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: hwy 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 (day/night)
-----------------------------------------
Angle1   Angle2           :   8.00 deg   29.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 217.00 / 217.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 29.00 deg
Barrier height            :  46.00 m
Barrier receiver distance : 116.00 / 116.00 m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: hwy 174 2 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 2 (day/night)
-------------------------------------------
Angle1   Angle2           :  29.00 deg   48.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 217.00 / 217.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  32.00 deg   Angle2 : 48.00 deg
Barrier height            :  20.00 m
Barrier receiver distance : 124.00 / 124.00 m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: hwy 174 3 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 3 (day/night)
-------------------------------------------
Angle1   Angle2           :  48.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 217.00 / 217.00 m
Receiver height           :  26.50 / 26.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  54.00 deg   Angle2 : 90.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  64.00 / 64.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: centrum (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum (day/night)
-----------------------------------------
Angle1   Angle2           : -57.00 deg   32.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 5: centrum 2 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 5: centrum 2 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -76.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :  26.50 / 26.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: hwy 174 (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 !       26.50 !       10.46 !        10.46

ROAD (0.00 + 42.22 + 0.00) = 42.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     8     29   0.00  83.16   0.00 -11.60  -9.33   0.00   0.00 -20.00
42.22
-------------------------------------------------------------------------------
--

Segment Leq : 42.22 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       26.50 !        9.35 !         9.35

ROAD (53.77 + 44.47 + 0.00) = 54.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    29     32   0.00  83.16   0.00 -11.60 -17.78   0.00   0.00   0.00
53.77
-------------------------------------------------------------------------------
--
    32     48   0.00  83.16   0.00 -11.60 -10.51   0.00   0.00 -16.57
44.47
-------------------------------------------------------------------------------
--

Segment Leq : 54.25 dBA
```

```
Results segment # 3: hwy 174 3 (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 !       26.50 !       17.65 !        17.65

ROAD (56.78 + 64.56 + 0.00) = 65.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    48     54   0.00  83.16   0.00 -11.60 -14.77   0.00   0.00   0.00
56.78
-------------------------------------------------------------------------
--
    54     90   0.00  83.16   0.00 -11.60  -6.99   0.00   0.00  -0.99
63.57*
    54     90   0.00  83.16   0.00 -11.60  -6.99   0.00   0.00   0.00
64.56
-------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 65.23 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.22 + 0.00) = 56.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -57     32   0.00  63.96   0.00  -4.67  -3.06   0.00   0.00   0.00
56.22
-------------------------------------------------------------------------
--

Segment Leq : 56.22 dBA
```

```
Results segment # 5: centrum 2 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.61 + 0.00) = 51.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -76   0.00  63.96   0.00  -1.25 -11.09   0.00   0.00   0.00
51.61
-------------------------------------------------------------------------
--

Segment Leq : 51.61 dBA

Total Leq All Segments: 66.21 dBA


Results segment # 1: hwy 174 (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 !       26.50 !       10.46 !        10.46

ROAD (0.00 + 34.63 + 0.00) = 34.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     8     29   0.00  75.56   0.00 -11.60  -9.33   0.00   0.00 -20.00
34.63
-------------------------------------------------------------------------
--

Segment Leq : 34.63 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       26.50 !        9.35 !         9.35

ROAD (46.18 + 36.87 + 0.00) = 46.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    29     32   0.00  75.56   0.00 -11.60 -17.78   0.00   0.00   0.00
46.18
-------------------------------------------------------------------------------
--
    32     48   0.00  75.56   0.00 -11.60 -10.51   0.00   0.00 -16.57
36.87
-------------------------------------------------------------------------------
--

Segment Leq : 46.66 dBA
```

```
Results segment # 3: hwy 174 3 (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 !       26.50 !       17.65 !        17.65

ROAD (49.19 + 56.97 + 0.00) = 57.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    48     54   0.00  75.56   0.00 -11.60 -14.77   0.00   0.00   0.00
49.19
-------------------------------------------------------------------------------
--
    54     90   0.00  75.56   0.00 -11.60  -6.99   0.00   0.00  -0.99
55.98*
    54     90   0.00  75.56   0.00 -11.60  -6.99   0.00   0.00   0.00
56.97
-------------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 57.64 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 48.63 + 0.00) = 48.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -57     32   0.00  56.36   0.00  -4.67  -3.06   0.00   0.00   0.00
48.63
-------------------------------------------------------------------------
--

Segment Leq : 48.63 dBA

Results segment # 5: centrum 2 (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 44.02 + 0.00) = 44.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -76   0.00  56.36   0.00  -1.25 -11.09   0.00   0.00   0.00
44.02
-------------------------------------------------------------------------
--

Segment Leq : 44.02 dBA

Total Leq All Segments: 58.62 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.21
                           (NIGHT): 58.62
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 17:01:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R9.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: centrum (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum (day/night)
-----------------------------------------
Angle1   Angle2          : -58.00 deg   54.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      2       (Reflective ground surface)
Receiver source distance :  41.00 / 41.00  m
Receiver height          :  11.50 / 11.50  m
Topography               :      1       (Flat/gentle slope; no barrier)
Reference angle          :   0.00
```

```
Road data, segment # 2: orleans (day/night)
------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    60 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):  30000
    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: orleans (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -11.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  28.00 / 28.00  m
Receiver height           :  11.50 / 11.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 57.53 + 0.00) = 57.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -58     54   0.00  63.96   0.00  -4.37  -2.06   0.00   0.00   0.00
57.53
-------------------------------------------------------------------------
--

Segment Leq : 57.53 dBA


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

Source height = 1.50 m

ROAD (0.00 + 66.72 + 0.00) = 66.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -11   0.00  73.01   0.00  -2.71  -3.58   0.00   0.00   0.00
66.72
-------------------------------------------------------------------------
--

Segment Leq : 66.72 dBA

Total Leq All Segments: 67.21 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 49.93 + 0.00) = 49.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -58     54   0.00  56.36   0.00  -4.37  -2.06   0.00   0.00   0.00
49.93
-------------------------------------------------------------------------
--

Segment Leq : 49.93 dBA


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

Source height = 1.50 m

ROAD (0.00 + 59.12 + 0.00) = 59.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -11   0.00  65.41   0.00  -2.71  -3.58   0.00   0.00   0.00
59.12
-------------------------------------------------------------------------
--

Segment Leq : 59.12 dBA

Total Leq All Segments: 59.61 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.21
                           (NIGHT): 59.61
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 17:05:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R10.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: hwy 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 (day/night)
-----------------------------------------
Angle1   Angle2           :   8.00 deg   20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 227.00 / 227.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 20.00 deg
Barrier height            :  46.00 m
Barrier receiver distance : 118.00 / 118.00 m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: hwy 174 2 (day/night)
---------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 2 (day/night)
-------------------------------------------
Angle1   Angle2           :  20.00 deg   42.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 227.00 / 227.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  25.00 deg   Angle2 : 42.00 deg
Barrier height            :  20.00 m
Barrier receiver distance : 135.00 / 135.00 m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: hwy 174 3 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 3 (day/night)
-------------------------------------------
Angle1   Angle2           :  42.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 227.00 / 227.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  44.00 deg   Angle2 : 90.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  74.00 / 74.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: centrum (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum (day/night)
-----------------------------------------
Angle1   Angle2           : -64.00 deg   32.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :  11.50 / 11.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 5: centrum 2 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 5: centrum 2 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -83.00 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           :  11.50 / 11.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: hwy 174 (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 !       11.50 !        3.70 !         3.70

ROAD (0.00 + 39.60 + 0.00) = 39.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     8     20   0.00  83.16   0.00 -11.80 -11.76   0.00   0.00 -20.00
39.60
-------------------------------------------------------------------------------
--

Segment Leq : 39.60 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       11.50 !        2.58 !         2.58

ROAD (55.80 + 41.11 + 0.00) = 55.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    20     25   0.00  83.16   0.00 -11.80 -15.56   0.00   0.00   0.00
55.80
-------------------------------------------------------------------------------
--
    25     42   0.00  83.16   0.00 -11.80 -10.25   0.00   0.00 -20.00
41.11
-------------------------------------------------------------------------------
--

Segment Leq : 55.94 dBA
```

```
Results segment # 3: hwy 174 3 (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 !       11.50 !        6.61 !         6.61

ROAD (51.82 + 56.20 + 0.00) = 57.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    42     44   0.00  83.16   0.00 -11.80 -19.54   0.00   0.00   0.00
51.82
-------------------------------------------------------------------------------
--
    44     90   0.00  83.16   0.00 -11.80  -5.93   0.00   0.00  -9.23
56.20
-------------------------------------------------------------------------------
--

Segment Leq : 57.55 dBA


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

Source height = 1.50 m

ROAD (0.00 + 58.36 + 0.00) = 58.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -64     32   0.00  63.96   0.00  -2.86  -2.73   0.00   0.00   0.00
58.36
-------------------------------------------------------------------------------
--

Segment Leq : 58.36 dBA
```

```
Results segment # 5: centrum 2 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.85 + 0.00) = 49.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -83   0.00  63.96   0.00   0.00 -14.10   0.00   0.00   0.00
49.85
-------------------------------------------------------------------------
--

Segment Leq : 49.85 dBA

Total Leq All Segments: 62.44 dBA


Results segment # 1: hwy 174 (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 !       11.50 !        3.70 !         3.70

ROAD (0.00 + 32.00 + 0.00) = 32.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     8     20   0.00  75.56   0.00 -11.80 -11.76   0.00   0.00 -20.00
32.00
-------------------------------------------------------------------------
--

Segment Leq : 32.00 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       11.50 !        2.58 !         2.58

ROAD (48.20 + 33.51 + 0.00) = 48.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    20     25   0.00  75.56   0.00 -11.80 -15.56   0.00   0.00   0.00
48.20
-------------------------------------------------------------------------------
--
    25     42   0.00  75.56   0.00 -11.80 -10.25   0.00   0.00 -20.00
33.51
-------------------------------------------------------------------------------
--

Segment Leq : 48.34 dBA
```

```
Results segment # 3: hwy 174 3 (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 !       11.50 !        6.61 !         6.61

ROAD (44.22 + 48.60 + 0.00) = 49.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    42     44   0.00  75.56   0.00 -11.80 -19.54   0.00   0.00   0.00
44.22
-------------------------------------------------------------------------------
--
    44     90   0.00  75.56   0.00 -11.80  -5.93   0.00   0.00  -9.23
48.60
-------------------------------------------------------------------------------
--

Segment Leq : 49.95 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 50.77 + 0.00) = 50.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -64     32   0.00  56.36   0.00  -2.86  -2.73   0.00   0.00   0.00
50.77
-------------------------------------------------------------------------
--

Segment Leq : 50.77 dBA


Results segment # 5: centrum 2 (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 42.26 + 0.00) = 42.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -83   0.00  56.36   0.00   0.00 -14.10   0.00   0.00   0.00
42.26
-------------------------------------------------------------------------
--

Segment Leq : 42.26 dBA

Total Leq All Segments: 54.84 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 62.44
                           (NIGHT): 54.84
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 17:09:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R11.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: centrum (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum (day/night)
-----------------------------------------
Angle1   Angle2           : -15.00 deg   52.00 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           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  37.00 deg   Angle2 : 52.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  39.00 / 39.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: centrum 2 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum 2 (day/night)
--------------------------------------------
Angle1   Angle2           :  52.00 deg   57.00 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           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  52.00 deg   Angle2 : 57.00 deg
Barrier height            :  28.00 m
Barrier receiver distance :  39.00 / 39.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: centrum 3 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum 3 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -34.00 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           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -66.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  25.00 / 25.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: centrum (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 !       11.50 !        6.56 !         6.56

ROAD (51.35 + 29.73 + 0.00) = 51.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -15     37   0.00  63.96   0.00  -7.22  -5.39   0.00   0.00   0.00
51.35
-------------------------------------------------------------------------------
--
    37     52   0.00  63.96   0.00  -7.22 -10.79   0.00   0.00 -16.22
29.73
-------------------------------------------------------------------------------
--

Segment Leq : 51.38 dBA
```

```
Results segment # 2: centrum 2 (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 !       11.50 !        6.56 !         6.56

ROAD (0.00 + 21.18 + 0.00) = 21.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    52     57   0.00  63.96   0.00  -7.22 -15.56   0.00   0.00 -20.00
21.18
-------------------------------------------------------------------------------
--

Segment Leq : 21.18 dBA
```

```
Results segment # 3: centrum 3 (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 !       11.50 !        7.82 !         7.82

ROAD (0.00 + 39.21 + 49.89) = 50.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -66   0.00  63.96   0.00  -6.56  -8.75   0.00   0.00  -9.43
39.21
-------------------------------------------------------------------------------
--
   -66    -34   0.00  63.96   0.00  -6.56  -7.50   0.00   0.00   0.00
49.89
-------------------------------------------------------------------------------
--

Segment Leq : 50.25 dBA

Total Leq All Segments: 53.86 dBA
```

```
Results segment # 1: centrum (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 !       11.50 !        6.56 !         6.56

ROAD (43.75 + 22.13 + 0.00) = 43.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -15     37   0.00  56.36   0.00  -7.22  -5.39   0.00   0.00   0.00
43.75
-------------------------------------------------------------------------------
--
    37     52   0.00  56.36   0.00  -7.22 -10.79   0.00   0.00 -16.22
22.13
-------------------------------------------------------------------------------
--

Segment Leq : 43.78 dBA
```

```
Results segment # 2: centrum 2 (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 !       11.50 !        6.56 !         6.56

ROAD (0.00 + 13.58 + 0.00) = 13.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    52     57   0.00  56.36   0.00  -7.22 -15.56   0.00   0.00 -20.00
13.58
-------------------------------------------------------------------------------
--

Segment Leq : 13.58 dBA
```

```
Results segment # 3: centrum 3 (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 !       11.50 !        7.82 !         7.82

ROAD (0.00 + 31.62 + 42.30) = 42.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -66   0.00  56.36   0.00  -6.56  -8.75   0.00   0.00  -9.43
31.62
-------------------------------------------------------------------------------
--
   -66    -34   0.00  56.36   0.00  -6.56  -7.50   0.00   0.00   0.00
42.30
-------------------------------------------------------------------------------
--

Segment Leq : 42.65 dBA

Total Leq All Segments: 46.26 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 53.86
                           (NIGHT): 46.26
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-06-2020 17:13:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R12.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: hwy 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 (day/night)
-----------------------------------------
Angle1   Angle2           :   8.00 deg   39.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 136.00 / 136.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 39.00 deg
Barrier height            :  46.00 m
Barrier receiver distance :  27.00 / 27.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: hwy 174 2 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 2 (day/night)
--------------------------------------------
Angle1   Angle2           :  39.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 136.00 / 136.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  44.00 deg   Angle2 : 68.00 deg
Barrier height            :  20.00 m
Barrier receiver distance :  43.00 / 43.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: centrum (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum (day/night)
-----------------------------------------
Angle1   Angle2           :  -1.00 deg   32.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 103.00 / 103.00 m
Receiver height           :  11.50 / 11.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 4: centrum2 (day/night)
----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum2 (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   -20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  97.00 / 97.00  m
Receiver height           :  11.50 / 11.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -41.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  54.00 / 54.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: hwy 174 (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 !       11.50 !        8.52 !         8.52

ROAD (0.00 + 45.94 + 0.00) = 45.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     8     39   0.00  83.16   0.00  -9.57  -7.64   0.00   0.00 -20.00
45.94
-------------------------------------------------------------------------------
--

Segment Leq : 45.94 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       11.50 !        6.76 !         6.76

ROAD (58.02 + 45.40 + 64.45) = 65.39 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    39     44   0.00  83.16   0.00  -9.57 -15.56   0.00   0.00   0.00
58.02
-------------------------------------------------------------------------------
--
    44     68   0.00  83.16   0.00  -9.57  -8.75   0.00   0.00 -19.43
45.40
-------------------------------------------------------------------------------
--
    68     90   0.00  83.16   0.00  -9.57  -9.13   0.00   0.00   0.00
64.45
-------------------------------------------------------------------------------
--

Segment Leq : 65.39 dBA
```

```
Results segment # 3: centrum (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 48.22 + 0.00) = 48.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    -1     32   0.00  63.96   0.00  -8.37  -7.37   0.00   0.00   0.00
48.22
-------------------------------------------------------------------------
--

Segment Leq : 48.22 dBA


Results segment # 4: centrum2 (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 !       11.50 !        5.93 !         5.93

ROAD (0.00 + 38.29 + 46.52) = 47.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -41   0.00  63.96   0.00  -8.11  -5.65   0.00   0.00 -11.91
38.29
-------------------------------------------------------------------------
--
   -41    -20   0.00  63.96   0.00  -8.11  -9.33   0.00   0.00   0.00
46.52
-------------------------------------------------------------------------
--

Segment Leq : 47.13 dBA

Total Leq All Segments: 65.58 dBA
```

```
Results segment # 1: hwy 174 (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 !       11.50 !        8.52 !         8.52

ROAD (0.00 + 38.35 + 0.00) = 38.35 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     8     39   0.00  75.56   0.00  -9.57  -7.64   0.00   0.00 -20.00
38.35
-------------------------------------------------------------------------------
--

Segment Leq : 38.35 dBA
```

```
Results segment # 2: hwy 174 2 (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 !       11.50 !        6.76 !         6.76

ROAD (50.42 + 37.80 + 56.86) = 57.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    39     44   0.00  75.56   0.00  -9.57 -15.56   0.00   0.00   0.00
50.42
-------------------------------------------------------------------------------
--
    44     68   0.00  75.56   0.00  -9.57  -8.75   0.00   0.00 -19.43
37.80
-------------------------------------------------------------------------------
--
    68     90   0.00  75.56   0.00  -9.57  -9.13   0.00   0.00   0.00
56.86
-------------------------------------------------------------------------------
--

Segment Leq : 57.79 dBA


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

Source height = 1.50 m

ROAD (0.00 + 40.63 + 0.00) = 40.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    -1     32   0.00  56.36   0.00  -8.37  -7.37   0.00   0.00   0.00
40.63
-------------------------------------------------------------------------------
--

Segment Leq : 40.63 dBA
```

```
Results segment # 4: centrum2 (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 !       11.50 !        5.93 !         5.93

ROAD (0.00 + 30.69 + 38.92) = 39.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -41   0.00  56.36   0.00  -8.11  -5.65   0.00   0.00 -11.91
30.69
-------------------------------------------------------------------------------
--
   -41    -20   0.00  56.36   0.00  -8.11  -9.33   0.00   0.00   0.00
38.92
-------------------------------------------------------------------------------
--

Segment Leq : 39.53 dBA

Total Leq All Segments: 57.98 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.58
                           (NIGHT): 57.98
```

```
STAMSON 5.0        NORMAL REPORT        Date: 06-07-2020 17:15:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: hwy 174 (day/night)
-------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -52.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 170.00 / 170.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -52.00 deg
Barrier height            :  28.00 m
Barrier receiver distance :   7.00 / 7.00   m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: hwy 174 2 (day/night)
----------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 2 (day/night)
--------------------------------------------
Angle1   Angle2           : -52.00 deg   77.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 170.00 / 170.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -52.00 deg   Angle2 : 77.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: hwy 174 3 (day/night)
---------------------------------------------
Car traffic volume  : 89056/7744  veh/TimePeriod  *
Medium truck volume :  7084/616   veh/TimePeriod  *
Heavy truck volume  :  5060/440   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT): 110000
    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: hwy 174 3 (day/night)
-------------------------------------------
Angle1   Angle2           :  77.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 170.00 / 170.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  77.00 deg   Angle2 : 90.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  17.00 / 17.00  m
Source elevation          :  -5.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 4: centrum 1 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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: centrum 1 (day/night)
--------------------------------------------
Angle1   Angle2           : -23.00 deg   43.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  80.00 / 80.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  23.00 deg   Angle2 : 43.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  40.00 / 40.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 5: centrum 2 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 5: centrum 2 (day/night)
--------------------------------------------
Angle1   Angle2           :  43.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  80.00 / 80.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  43.00 deg   Angle2 : 90.00 deg
Barrier height            :  28.00 m
Barrier receiver distance :  40.00 / 40.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 6: centrum 3 (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    40 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):   8000
    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 # 6: centrum 3 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -42.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -68.00 deg
Barrier height            :  13.00 m
Barrier receiver distance :  46.00 / 46.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: hwy 174 (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 !        1.50 !        1.29 !         1.29

ROAD (0.00 + 47.06 + 0.00) = 47.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -52   0.00  83.16   0.00 -10.54  -6.75   0.00   0.00 -18.79
47.06
-------------------------------------------------------------------------------
--

Segment Leq : 47.06 dBA


Results segment # 2: hwy 174 2 (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 !        1.50 !        1.32 !         1.32

ROAD (0.00 + 51.17 + 0.00) = 51.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -52     77   0.00  83.16   0.00 -10.54  -1.45   0.00   0.00 -20.00
51.17
-------------------------------------------------------------------------------
--

Segment Leq : 51.17 dBA
```

```
Results segment # 3: hwy 174 3 (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 !        1.50 !        1.00 !         1.00

ROAD (0.00 + 48.85 + 0.00) = 48.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    77     90   0.00  83.16   0.00 -10.54 -11.41   0.00   0.00 -12.35
48.85
-------------------------------------------------------------------------------
--

Segment Leq : 48.85 dBA
```

```
Results segment # 4: centrum 1 (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 !        1.50 !        1.50 !         1.50

ROAD (50.76 + 27.14 + 0.00) = 50.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -23     23   0.00  63.96   0.00  -7.27  -5.93   0.00   0.00   0.00
50.76
-------------------------------------------------------------------------------
--
    23     43   0.00  63.96   0.00  -7.27  -9.54   0.00   0.00 -20.00
27.14
-------------------------------------------------------------------------------
--

Segment Leq : 50.78 dBA
```

```
Results segment # 5: centrum 2 (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 32.25 + 0.00) = 32.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    43     90   0.00  63.96   0.00  -7.27  -5.83   0.00   0.00 -18.61
32.25
-------------------------------------------------------------------------------
--

Segment Leq : 32.25 dBA
```

```
Results segment # 6: centrum 3 (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 34.26 + 49.18) = 49.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -68   0.00  63.96   0.00  -6.37  -9.13   0.00   0.00 -14.20
34.26
-------------------------------------------------------------------------------
--
   -68    -42   0.00  63.96   0.00  -6.37  -8.40   0.00   0.00   0.00
49.18
-------------------------------------------------------------------------------
--

Segment Leq : 49.32 dBA

Total Leq All Segments: 56.68 dBA
```

```
Results segment # 1: hwy 174 (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 !        1.50 !        1.29 !         1.29

ROAD (0.00 + 39.47 + 0.00) = 39.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -52   0.00  75.56   0.00 -10.54  -6.75   0.00   0.00 -18.79
39.47
-------------------------------------------------------------------------------
--

Segment Leq : 39.47 dBA


Results segment # 2: hwy 174 2 (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 !        1.50 !        1.32 !         1.32

ROAD (0.00 + 43.57 + 0.00) = 43.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -52     77   0.00  75.56   0.00 -10.54  -1.45   0.00   0.00 -20.00
43.57
-------------------------------------------------------------------------------
--

Segment Leq : 43.57 dBA
```

```
Results segment # 3: hwy 174 3 (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 !        1.50 !        1.00 !         1.00

ROAD (0.00 + 41.25 + 0.00) = 41.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    77     90   0.00  75.56   0.00 -10.54 -11.41   0.00   0.00 -12.35
41.25
-------------------------------------------------------------------------------
--

Segment Leq : 41.25 dBA
```

```
Results segment # 4: centrum 1 (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 !        1.50 !        1.50 !         1.50

ROAD (43.17 + 19.55 + 0.00) = 43.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -23     23   0.00  56.36   0.00  -7.27  -5.93   0.00   0.00   0.00
43.17
-------------------------------------------------------------------------------
--
    23     43   0.00  56.36   0.00  -7.27  -9.54   0.00   0.00 -20.00
19.55
-------------------------------------------------------------------------------
--

Segment Leq : 43.19 dBA
```

```
Results segment # 5: centrum 2 (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 24.65 + 0.00) = 24.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    43     90   0.00  56.36   0.00  -7.27  -5.83   0.00   0.00 -18.61
24.65
-------------------------------------------------------------------------------
--

Segment Leq : 24.65 dBA
```

```
Results segment # 6: centrum 3 (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 26.66 + 41.59) = 41.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -68   0.00  56.36   0.00  -6.37  -9.13   0.00   0.00 -14.20
26.66
-------------------------------------------------------------------------------
--
   -68    -42   0.00  56.36   0.00  -6.37  -8.40   0.00   0.00   0.00
41.59
-------------------------------------------------------------------------------
--

Segment Leq : 41.73 dBA

Total Leq All Segments: 49.08 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 56.68
                           (NIGHT): 49.08
```


# APPENDIX B

## FTA VIBRATION CALCULATIONS

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

GW20-070 19-Nov-20

Possible Vibration Impacts
Predicted using FTA General Assesment

Train Speed 70 km/h 43.5 mph

| | Distance from C/L | |
|---|---|---|
| | (m) | (ft) |
| LRT | 79.0 | 259.2 |
| | | |

Vibration

From FTA Manual Fig 10-1

| | | |
|---|---|---|
| Vibration Levels at distance from track | 57 | dBV re 1 micro in/sec |

Adjustment Factors FTA Table 10-1

| | | |
|---|---|---|
| Speed reference 50 mph | 3 | Speed Limit of 70 km/h (43.5 mph) |
| Vehicle Parameters | 0 | Assume Soft primary suspension, Wheels run true |
| Track Condition | 0 | None |
| Track Treatments | 0 | None |
| Type of Transit Structure | -5 | Station |
| Efficient vibration Propagation | 0 | Propagation through rock |
| Vibration Levels at Fdn | 55 | |
| Coupling to Building Foundation | -10 | Large masonry on piles |
| Floor to Floor Attenuation | 0.0 | Ground Floor Ocupied |
| Amplification of Floor and Walls | 6 | |
| Total Vibration Level | 51 | dBV or 0.009 mm/s |
| Noise Level in dBA | 16 | dBA |

**Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise**

*Factors Affecting Vibration Source*

| Source Factor | Adjustment to Propagation Curve | | | Comment |
|---|---|---|---|---|
| Speed | | Reference Speed | | Vibration level is approximately proportional to 20*log(speed/speed$_{ref}$). Sometimes the variation with speed has been observed to be as low as 10 to 15 log(speed/speed$_{ref}$). |
| | Vehicle Speed | 50 mph | 30 mph | |
| | 60 mph | +1.6 dB | +6.0 dB | |
| | 50 mph | 0.0 dB | +4.4 dB | |
| | 40 mph | -1.9 dB | +2.5 dB | |
| | 30 mph | -4.4 dB | 0.0 dB | |
| | 20 mph | -8.0 dB | -3.5 dB | |
| Vehicle Parameters (not additive, apply greatest value only) | | | | |
| Vehicle with stiff primary suspension | +8 dB | | | Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz. |
| Resilient Wheels | 0 dB | | | Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz. |
| Worn Wheels or Wheels with Flats | +10 dB | | | Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track. |
| Track Conditions (not additive, apply greatest value only) | | | | |
| Worn or Corrugated Track | +10 dB | | | If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time. |
| Special Trackwork | +10 dB | | | Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track. |
| Jointed Track or Uneven Road Surfaces | +5 dB | | | Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit. |
| Track Treatments (not additive, apply greatest value only) | | | | |
| Floating Slab Trackbed | -15 dB | | | The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration. |
| Ballast Mats | -10 dB | | | Actual reduction is strongly dependent on frequency of vibration. |
| High-Resilience Fasteners | -5 dB | | | Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz. |

**Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise (Continued)**

*Factors Affecting Vibration Path*

| Path Factor | Adjustment to Propagation Curve | Comment |
|---|---|---|
| Resiliently Supported Ties | -10 dB | Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration. |
| Track Configuration (not additive, apply greatest value only) | | |
| Type of Transit Structure | Relative to at-grade tie & ballast:<br>Elevated structure -10 dB<br>Open cut 0 dB | The general rule is the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration. |
| | Relative to bored subway tunnel in soil:<br>Station -5 dB<br>Cut and cover -3 dB<br>Rock-based - 15 dB | |
| Ground-borne Propagation Effects | | |
| Geologic conditions that promote efficient vibration propagation | Efficient propagation in soil +10 dB | Refer to the text for guidance on identifying areas where efficient propagation is possible. |
| | Propagation in rock layer: Dist. / Adjust.<br>50 ft +2 dB<br>100 ft +4 dB<br>150 ft +6 dB<br>200 ft +9 dB | The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source. |
| Coupling to building foundation | Wood Frame Houses -5 dB<br>1-2 Story Masonry -7 dB<br>3-4 Story Masonry -10 dB<br>Large Masonry on Piles -10 dB<br>Large Masonry on Spread Footings -13 dB<br>Foundation in Rock 0 dB | The general rule is the heavier the building construction, the greater the coupling loss. |

*Factors Affecting Vibration Receiver*

| Receiver Factor | Adjustment to Propagation Curve | Comment |
|---|---|---|
| Floor-to-floor attenuation | 1 to 5 floors above grade: -2 dB/floor<br>5 to 10 floors above grade: -1 dB/floor | This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building. |
| Amplification due to resonances of floors, walls, and ceilings | +6 dB | The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections. |
| *Conversion to Ground-borne Noise* | | |
| Noise Level in dBA | Peak frequency of ground vibration:<br>Low frequency (<30 Hz): -50 dB<br>Typical (peak 30 to 60 Hz): -35 dB<br>High frequency (>60 Hz): -20 dB | Use these adjustments to estimate the A-weighted sound level given the average vibration velocity level of the room surfaces. See text for guidelines for selecting low, typical or high frequency characteristics. Use the high-frequency adjustment for subway tunnels in rock or if the dominant frequencies of the vibration spectrum are known to be 60 Hz or greater. |