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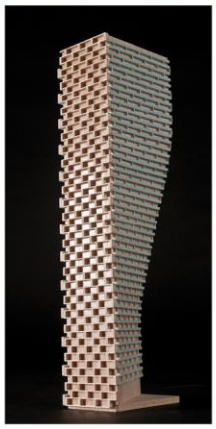
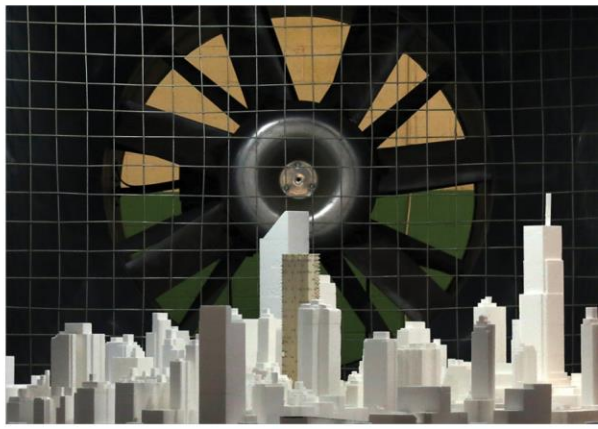
ROADWAY TRAFFIC NOISE ASSESSMENT

275 King Edward Avenue
Ottawa, Ontario

GRADIENT WIND REPORT: 21-223 – Roadway Traffic Noise





July 29, 2021

PREPARED FOR

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PREPARED BY

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EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken for a proposed mixed-use building located at the intersection of King Edward Avenue and Murray Street/St. Patrick Street in Ottawa, Ontario. The proposed development currently comprises an 8-storey hotel with retail space at grade. The primary sources of roadway traffic noise on the development include King Edward Avenue and Murray Street/St Patrick Street. Figure 1 illustrates a complete site plan with the surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings provided by Woodman Architects and Associates Ltd dated June 2021.

The results of the current analysis indicate that noise levels from traffic at the proposed building due to traffic will range between 49 and 72 dBA during the daytime period (07:00-23:00) and between 53 and 64 dBA during the nighttime period (23:00-07:00). The highest noise level (72 dBA) occurs at the west façade, which is most exposed to King Edward Avenue. Results of the calculations also indicate that the development will require central air conditioning, which will allow the windows to be kept closed and a comfortable living environment to be maintained. As well, noise levels exceed 65 dBA at the west, north, and south façade, thus, upgraded building components will be required at these locations.

With respect to noise impacts from the buildings on the surroundings and the building itself, noise from HVAC equipment can be minimized by judicious selection and placement of the equipment. Locating large pieces of equipment, such as cooling towers, generators, and air handling units, on a high roof, allows the building to shield nearby sensitive areas from noise exposure. Where necessary noise levels can be controlled by adding silencers, acoustic barriers, or noise screens. A stationary noise study will be conducted for the site during the detailed design once mechanical plans for the proposed building become available. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below NPC-300 limits. The surrounding the site includes a mix of residential and retails buildings. As such, there are no significant existing stationary noise sources surrounding the site.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 165177 Canada Inc. to undertake a roadway traffic noise assessment for a proposed mixed-use building located at the intersection of King Edward Avenue and Murray Street/St. Patrick Street in Ottawa, Ontario, in support of a Zoning By-Law (ZBA) and Site Plan Control (SPA) application. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic and stationary noise sources.

Our work is based on 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 provided by Woodman Architects and Associates Ltd dated June 2021 with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The subject site comprises a principal 8-storey hotel development with a nominally 'L'-shaped planform situated on a rectangular parcel of land bounded by St Patrick Street to the north, King Edward Avenue to the west, Clarence Street to the south, and existing low-rise dwellings to the east. Above three levels of underground parking, the ground floor comprises a retail area, lobby, and various building support functions, as well as a drive-through isle that provides access from Clarence Street (primary) and Murray Street (secondary). A partial mezzanine level creates double-height ground floor spaces and provides additional hotel support functions. Hotel suites occupy the remaining floor levels (2-8), while at Level 5 the planform becomes irregular.

The primary sources of roadway traffic noise impacting the development include King Edward Avenue, and Murray Street/St. Patrick Street. Figure 1 illustrates a complete site plan with the surrounding context.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 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 (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, 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, which 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 for schools for roadway noise as listed in Table 1. Based on Gradient Wind's experience, more comfortable indoor noise levels should be targeted, towards 42 to control peak noise and deficiencies in building envelope construction.

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]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. 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 triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[6].

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

[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 7.8
[6] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Roadway Noise Predictions

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

Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources 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 for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- For select sources where appropriate, the surrounding buildings were considered as a barrier partially or fully obstructing exposure of the receptors to the source.
- Receptor distances and exposure angles are illustrated in Figures 3-5.
- Noise receptors were strategically placed at 5 locations around the study area (see Figure 2).

4.2.3 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[7] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

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

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
King Edward Avenue	6-Lane Urban Arterial Divided (6-UAD)	50	**50,000**
Murray Street/St Patrick Street	2-Lane Urban Arterial Undivided (2-UCU)	40	**15,000**

5. ENVIRONMENTAL NOISE RESULTS

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	24.2	POW – 8th Floor – West Façade	72	64
2	24.2	POW – 8th Floor – North Façade	70	62
3	21.4	POW – 8th Floor – East Façade	60	53
4	24.2	POW – 8th Floor – South Façade	67	59
5	24.2	OLA– 8th Floor –Terrace	49	N/A*

*Nighttime noise levels at OLA receptors are not considered as per ENCG.

The results of the current analysis indicate that noise levels will range between 49 and 72 dBA during the daytime period (07:00-23:00) and between 59 and 64 dBA during the nighttime period (23:00-07:00). The highest noise level (72 dBA) occurs at the west façade, which is nearest and most exposed to King Edward Avenue.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). Detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below (see Figure 7):

Bedroom Windows

(i) Bedroom windows facing west will require a minimum STC of 35.

(ii) Bedroom windows facing north will require a minimum STC of 33.

(iii) Bedroom windows facing south will require a minimum STC of 30.

Living Room Windows

(i) Living room windows facing west will require a minimum STC of 30.

(ii) Living room windows facing north will require a minimum STC of 28.

(iii) Living room windows facing south will require a minimum STC of 25.

Reception/Retail Windows

(i) Reception/retail windows facing west will require a minimum STC of 25.

(ii) Reception/retail windows facing north will require a minimum STC of 23.

(iii) Reception/retail windows facing south will require a minimum STC of 20.

Exterior Walls

(i) Exterior wall components on the north, south, and west façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[8].

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 punch window and wall system is used. A review of window supplier literature indicates that the specified STC ratings

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

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

The results of the calculations also indicate that the development will require central air conditioning, which will allow the windows to be kept closed and a comfortable living environment to be maintained.

Noise levels at the outdoor living area (OLA) described by receptor 5 (see Figure 2) do not exceed ENCG criteria since the building itself behaves as a noise barrier. No mitigation is required for this location.

6. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Noise levels at the south, west, and north façades exceed ENCG criteria and upgraded building components will be required. Noise levels on the east façade fall below 65 dBA, therefore, no upgraded building components are required at this façade. Results of the calculations also indicate that the development will require central air conditioning or a similar system, which will allow occupants to keep windows closed and maintain a comfortable living environment.

Noise levels at the outdoor living area (OLA) described by receptor 5 (see Figure 2) do not exceed the ENCG criteria. Therefore, no mitigation will be required.

Off-site stationary noise impacts can generally be minimized by judicious selection and placement of the equipment. Where necessary, noise screens and silencers can be placed into the design. It is recommended a stationary noise study be conducted once mechanical plans for the proposed building become available. This study would assess the impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include

recommendations for any noise control measures that may be necessary to ensure noise levels fall below NPC-300 limits.

The surrounding buildings are primarily mixed-use, residential and office buildings. These generally have small rooftop equipment that is not considered a significant noise source. An observation of the satellite view of the area revealed that the only rooftop equipment that is close to the study building is located at 256 King Edward Avenue. However, as the traffic noise levels will be the dominant noise source impacting the building, the noise levels generated by this equipment will be negligible.

This concludes our roadway traffic noise 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.

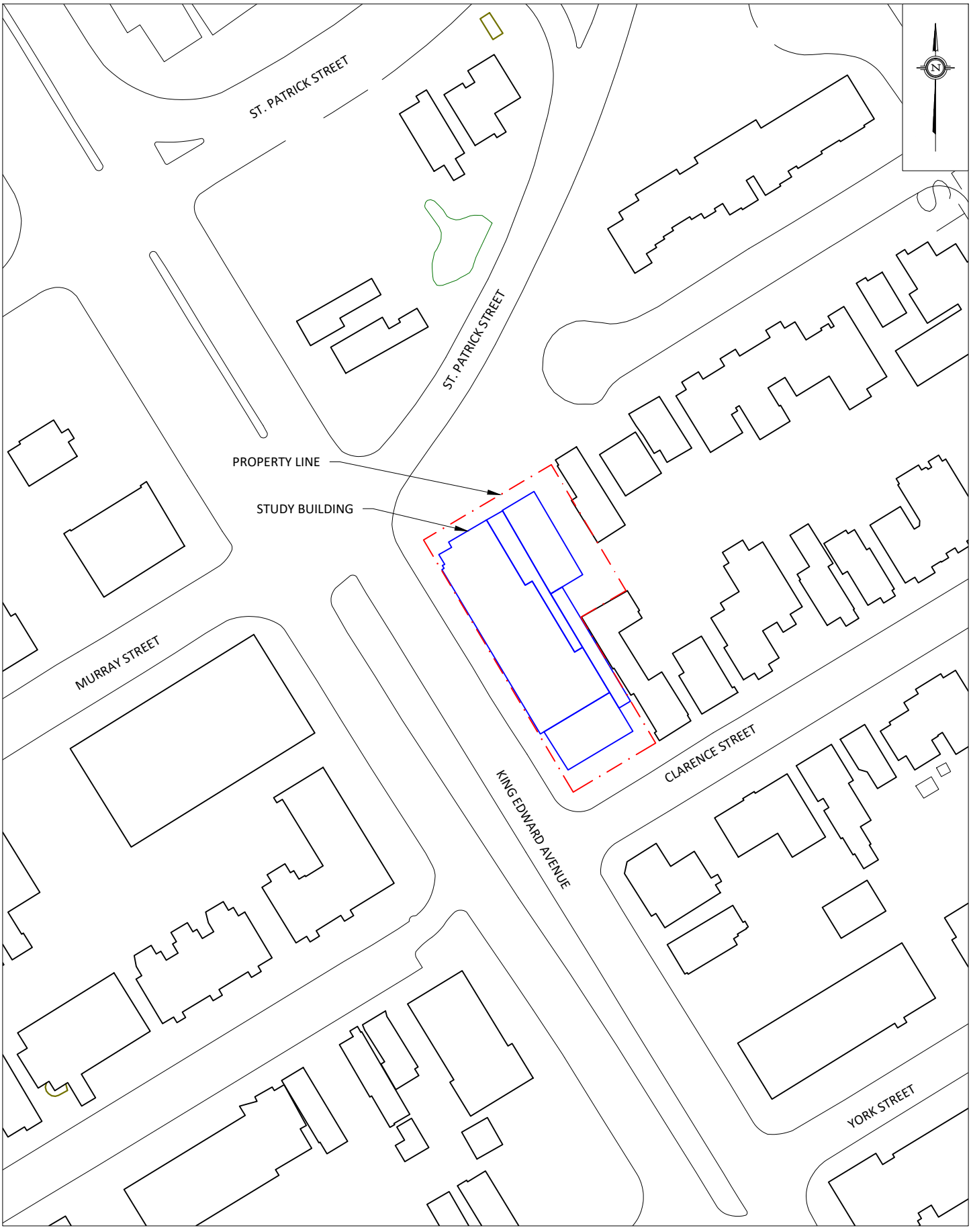
Sincerely,

Gradient Wind Engineering Inc.

Caleb Alexander, B.Eng.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind Report #21-223 – Traffic Noise



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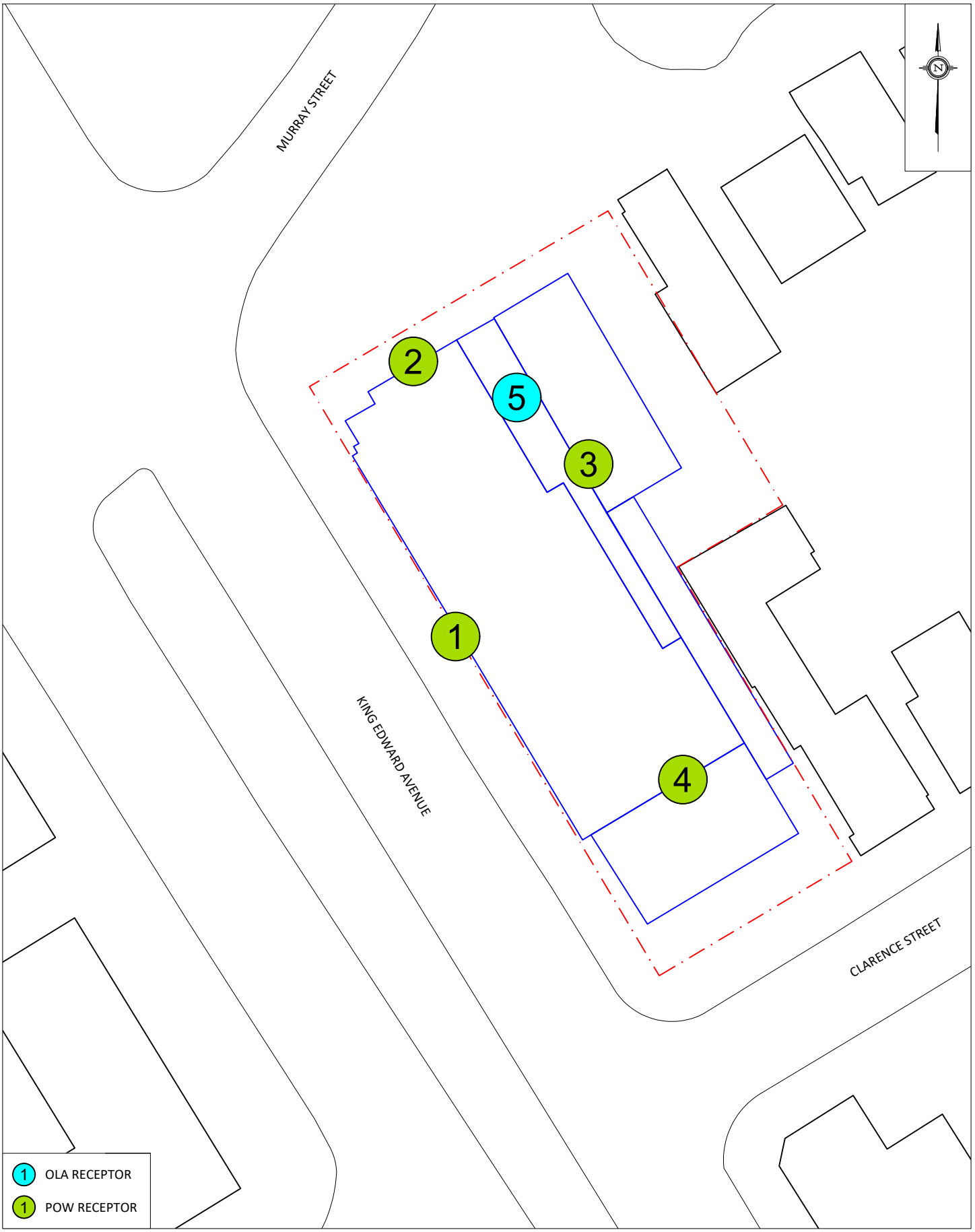
PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE21-223-1
DATE	JULY 9, 2021	DRAWN BY	C.A.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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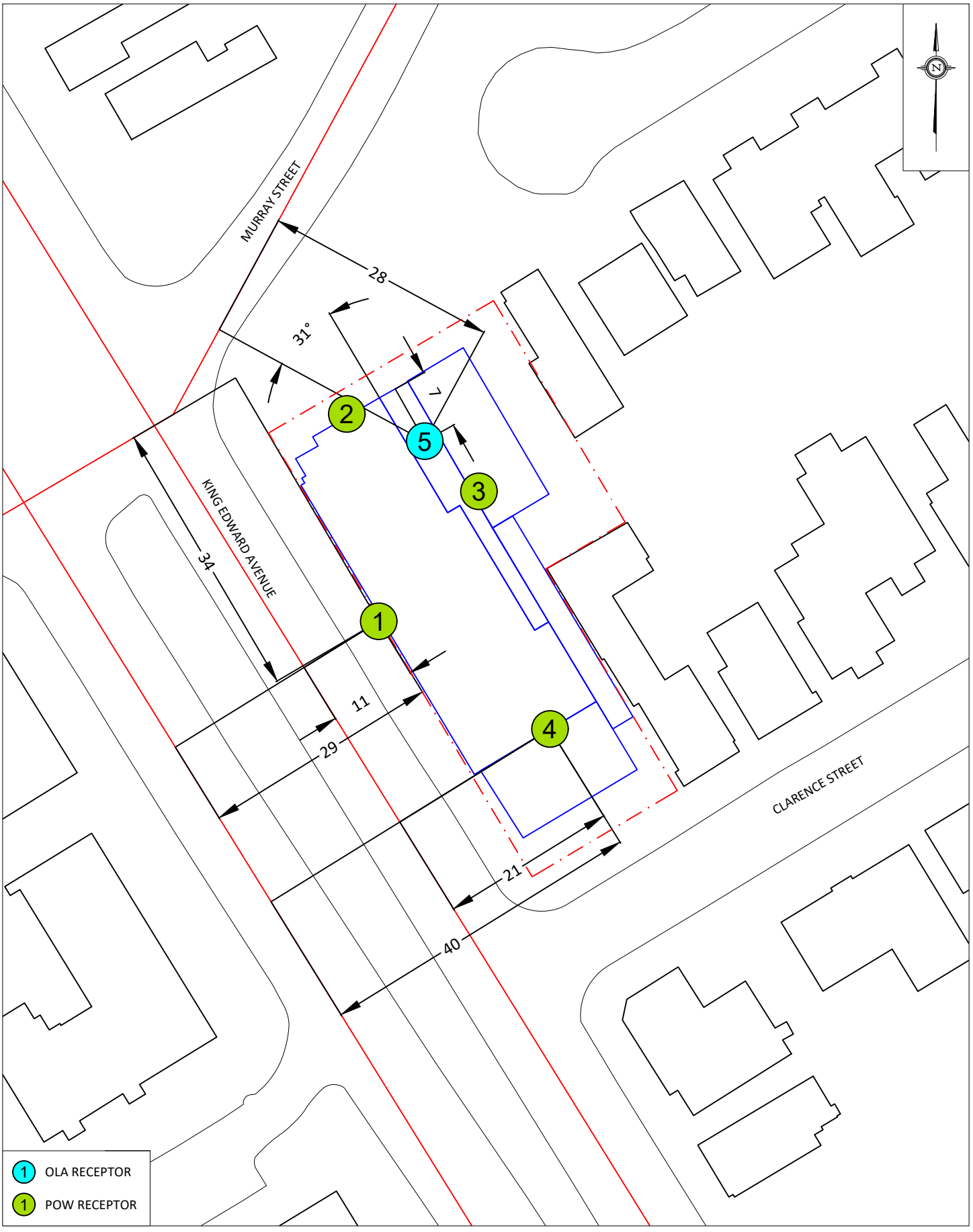
PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE21-223-2
DATE	JULY 9, 2021
DRAWN BY	C.A.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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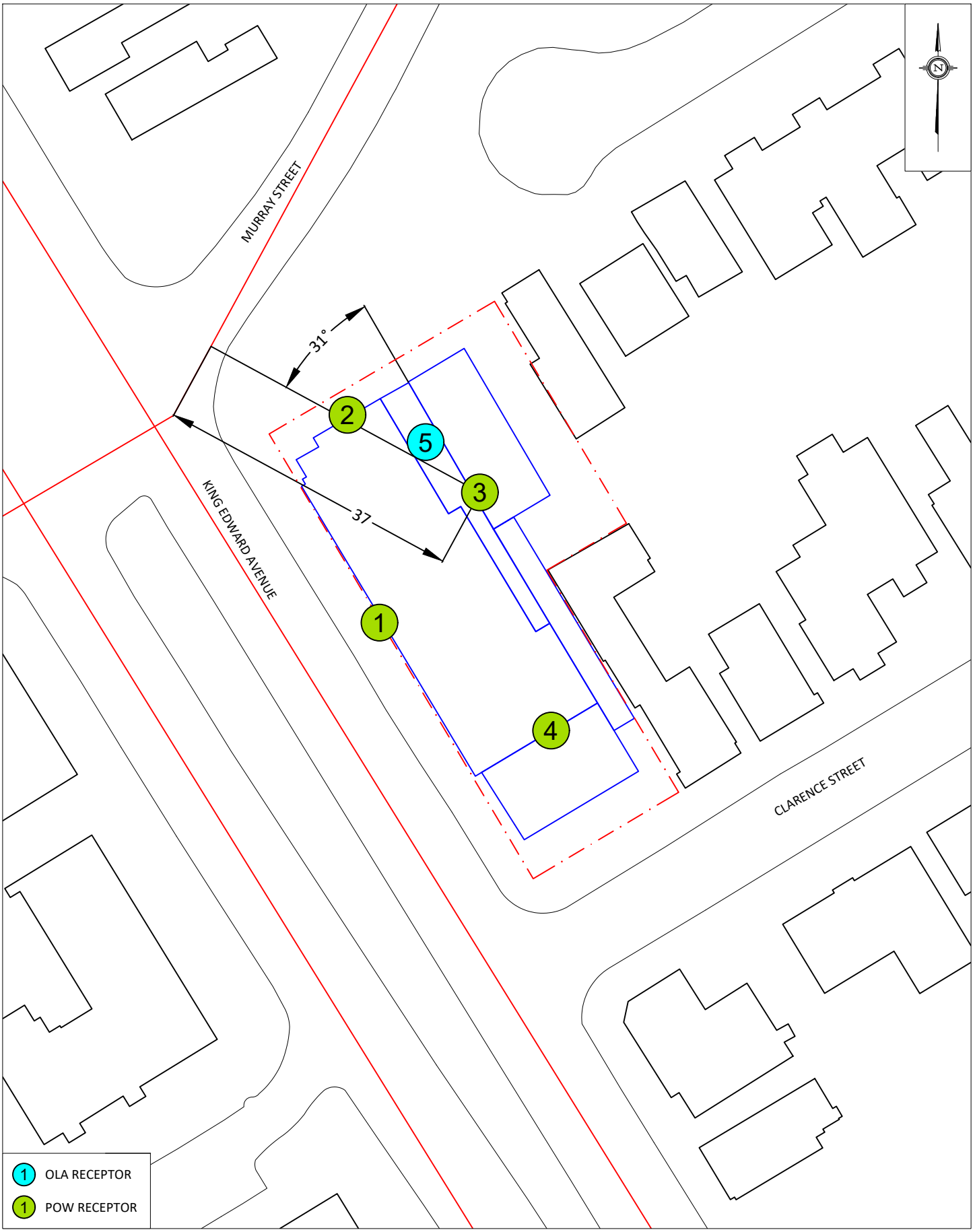
PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE21-223-3
DATE	JULY 9, 2021	DRAWN BY	C.A.

FIGURE 3:
RECEPTORS 1, 4, & 5



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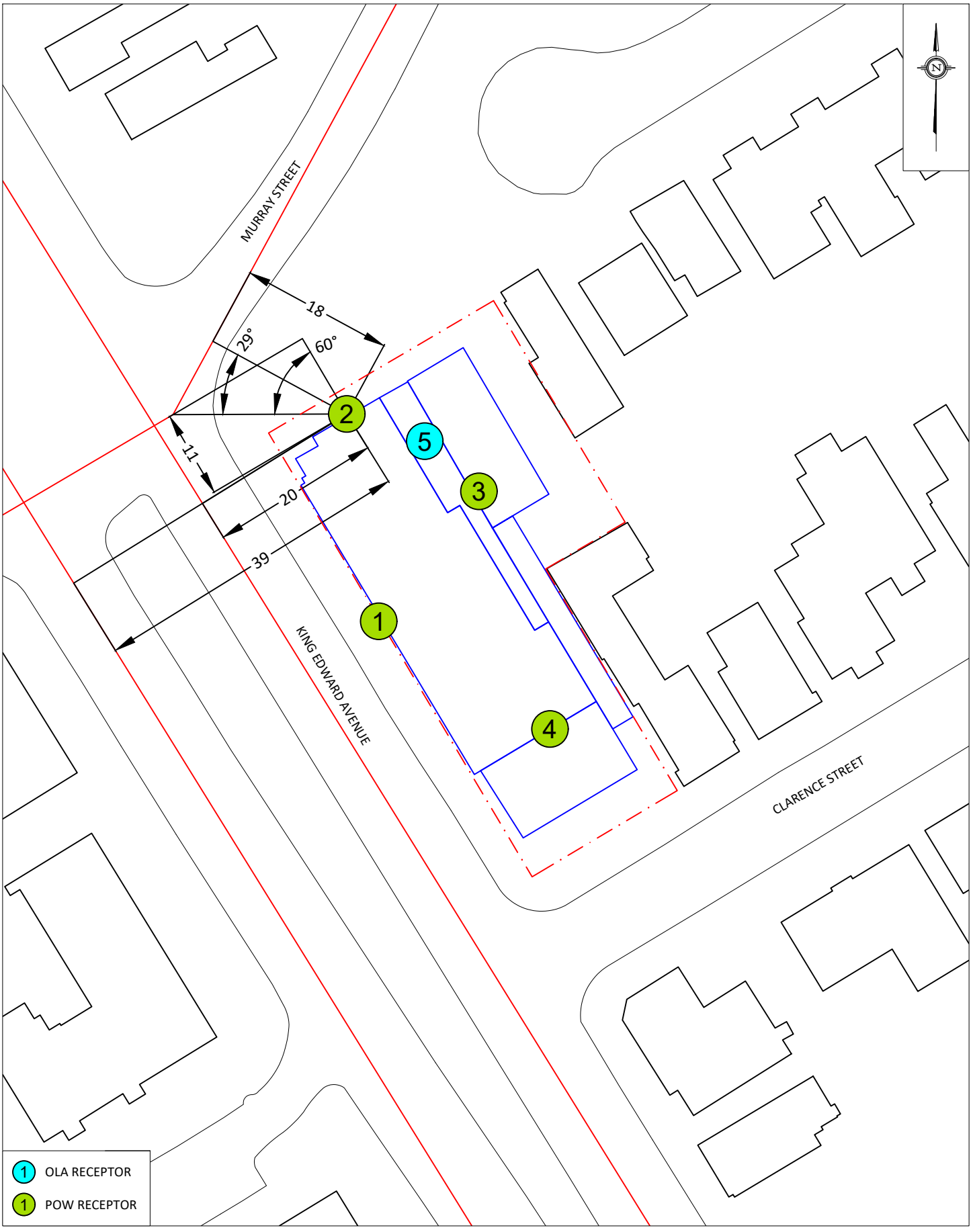
PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE21-223-4
DATE	JULY 9, 2021	DRAWN BY	C.A.

FIGURE 4:
RECEPTOR 3



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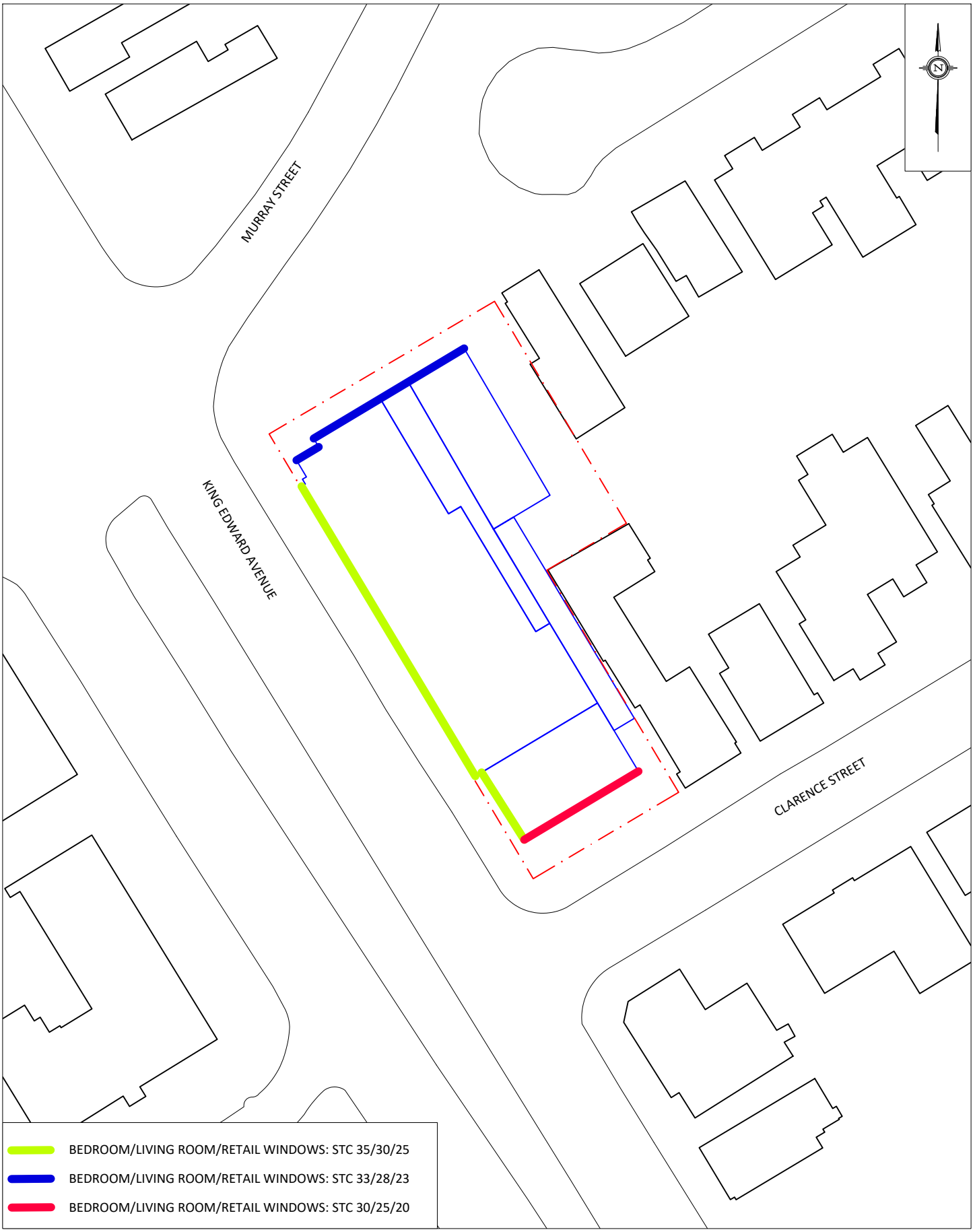
PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE21-223-5
DATE	JULY 9, 2021
DRAWN BY	C.A.

DESCRIPTION

FIGURE 5:
RECEPTOR 2



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PROJECT	275 KING EDWARD AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE21-223-6
DATE	JULY 9, 2021	DRAWN BY	C.A.

FIGURE 6:
STC RATINGS

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2021 10:11:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: King 1 (day/night)
-----------------------------------------
Car traffic volume  : 20010/1740  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  25000
    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     :   6.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: King 1 (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 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           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: King 2 (day/night)
------------------------------------------
Car traffic volume  : 20240/1760  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1150/100   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):  25000
    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: King 2 (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 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           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

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

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

Data for Segment # 3: Murray (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 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           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.57 m

ROAD (0.00 + 69.45 + 0.00) = 69.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  69.45   0.00   0.00   0.00   0.00   0.00   0.00  69.45
-------------------------------------------------------------------------------

Segment Leq : 69.45 dBA


Results segment # 2: King 2 (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
-------------------------------------------------------------------------------
   -90     90   0.00  68.90   0.00  -2.86   0.00   0.00   0.00   0.00  66.04
-------------------------------------------------------------------------------

Segment Leq : 66.04 dBA


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

Source height = 1.50 m

ROAD (0.00 + 61.92 + 0.00) = 61.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  68.48   0.00  -3.55  -3.01   0.00   0.00   0.00  61.92
-------------------------------------------------------------------------------

Segment Leq : 61.92 dBA

Total Leq All Segments: 71.58 dBA
```

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

Source height = 1.57 m

ROAD (0.00 + 61.85 + 0.00) = 61.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  61.85   0.00   0.00   0.00   0.00   0.00   0.00  61.85
-------------------------------------------------------------------------------

Segment Leq : 61.85 dBA


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

Source height = 1.50 m

ROAD (0.00 + 58.44 + 0.00) = 58.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  61.31   0.00  -2.86   0.00   0.00   0.00   0.00  58.44
-------------------------------------------------------------------------------

Segment Leq : 58.44 dBA


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

Source height = 1.50 m

ROAD (0.00 + 54.32 + 0.00) = 54.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  60.88   0.00  -3.55  -3.01   0.00   0.00   0.00  54.32
-------------------------------------------------------------------------------

Segment Leq : 54.32 dBA

Total Leq All Segments: 63.98 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 71.58
                           (NIGHT): 63.98
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2021 10:11:28
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: King 1 (day/night)
-----------------------------------------
Car traffic volume  : 20010/1740  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  25000
    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     :   6.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: King 1 (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 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           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: King 2 (day/night)
------------------------------------------
Car traffic volume  : 20240/1760  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1150/100   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):  25000
    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: King 2 (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  39.00 / 39.00  m
Receiver height           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

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

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

Data for Segment # 3: Murray (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   -60.00 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           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 4: Murray 2 (day/night)
----------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

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

Data for Segment # 4: Murray 2 (day/night)
----------------------------------------
Angle1   Angle2           : -29.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  18.00 / 18.00  m
Receiver height           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.57 m

ROAD (0.00 + 65.19 + 0.00) = 65.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  69.45   0.00  -1.25  -3.01   0.00   0.00   0.00  65.19
-------------------------------------------------------------------------------

Segment Leq : 65.19 dBA


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

Source height = 1.50 m

ROAD (0.00 + 61.74 + 0.00) = 61.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  68.90   0.00  -4.15  -3.01   0.00   0.00   0.00  61.74
-------------------------------------------------------------------------------

Segment Leq : 61.74 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 60.70 + 0.00) = 60.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -60   0.00  68.48   0.00   0.00  -7.78   0.00   0.00   0.00  60.70
-------------------------------------------------------------------------------

Segment Leq : 60.70 dBA


Results segment # 4: Murray 2 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.89 + 0.00) = 65.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -29     90   0.00  68.48   0.00  -0.79  -1.80   0.00   0.00   0.00  65.89
-------------------------------------------------------------------------------

Segment Leq : 65.89 dBA

Total Leq All Segments: 69.94 dBA


Results segment # 1: King 1 (night)
-----------------------------------

Source height = 1.57 m

ROAD (0.00 + 57.59 + 0.00) = 57.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  61.85   0.00  -1.25  -3.01   0.00   0.00   0.00  57.59
-------------------------------------------------------------------------------

Segment Leq : 57.59 dBA
```

```
Results segment # 2: King 2 (night)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.15 + 0.00) = 54.15 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  61.31   0.00  -4.15  -3.01   0.00   0.00   0.00  54.15
-------------------------------------------------------------------------------

Segment Leq : 54.15 dBA


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

Source height = 1.50 m

ROAD (0.00 + 53.10 + 0.00) = 53.10 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -60   0.00  60.88   0.00   0.00  -7.78   0.00   0.00   0.00  53.10
-------------------------------------------------------------------------------

Segment Leq : 53.10 dBA


Results segment # 4: Murray 2 (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.29 + 0.00) = 58.29 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -29     90   0.00  60.88   0.00  -0.79  -1.80   0.00   0.00   0.00  58.29
-------------------------------------------------------------------------------

Segment Leq : 58.29 dBA

Total Leq All Segments: 62.34 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 69.94
                           (NIGHT): 62.34
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2021 10:11:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Murray (day/night)
-----------------------------------------
Car traffic volume  : 12006/1044  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   828/72    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   6.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Murray (day/night)
----------------------------------------
Angle1   Angle2           :  31.00 deg   90.00 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           :  21.40 / 21.40  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.57 m

ROAD (0.00 + 60.22 + 0.00) = 60.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    31     90   0.00  68.98   0.00  -3.92  -4.84   0.00   0.00   0.00  60.22
-------------------------------------------------------------------------------

Segment Leq : 60.22 dBA

Total Leq All Segments: 60.22 dBA


Results segment # 1: Murray (night)
-----------------------------------

Source height = 1.57 m

ROAD (0.00 + 52.62 + 0.00) = 52.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    31     90   0.00  61.38   0.00  -3.92  -4.84   0.00   0.00   0.00  52.62
-------------------------------------------------------------------------------

Segment Leq : 52.62 dBA

Total Leq All Segments: 52.62 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 60.22
                           (NIGHT): 52.62
```


```
STAMSON 5.0         NORMAL REPORT         Date: 12-07-2021 10:11:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: King 1 (day/night)
-----------------------------------------
Car traffic volume  : 20010/1740  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1380/120   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):  25000
    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     :   6.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: King 1 (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  21.00 / 21.00  m
Receiver height           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: King 2 (day/night)
------------------------------------------
Car traffic volume  : 20240/1760  veh/TimePeriod  *
Medium truck volume :  1610/140   veh/TimePeriod  *
Heavy truck volume  :  1150/100   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):  25000
    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: King 2 (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :  22.80 / 22.80  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00



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

Source height = 1.57 m

ROAD (0.00 + 64.98 + 0.00) = 64.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  69.45   0.00  -1.46  -3.01   0.00   0.00   0.00  64.98
-------------------------------------------------------------------------------

Segment Leq : 64.98 dBA
```

```
Results segment # 2: King 2 (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 61.63 + 0.00) = 61.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  68.90   0.00  -4.26  -3.01   0.00   0.00   0.00  61.63
-------------------------------------------------------------------------------

Segment Leq : 61.63 dBA

Total Leq All Segments: 66.63 dBA


Results segment # 1: King 1 (night)
-----------------------------------

Source height = 1.57 m

ROAD (0.00 + 57.38 + 0.00) = 57.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  61.85   0.00  -1.46  -3.01   0.00   0.00   0.00  57.38
-------------------------------------------------------------------------------

Segment Leq : 57.38 dBA


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

Source height = 1.50 m

ROAD (0.00 + 54.04 + 0.00) = 54.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  61.31   0.00  -4.26  -3.01   0.00   0.00   0.00  54.04
-------------------------------------------------------------------------------

Segment Leq : 54.04 dBA

Total Leq All Segments: 59.03 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 66.63
                           (NIGHT): 59.03
```

```
STAMSON 5.0        NORMAL REPORT        Date: 12-07-2021 10:12:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Murray (day/night)
-----------------------------------------
Car traffic volume  : 12006/1044  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   828/72    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   6.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Murray (day/night)
----------------------------------------
Angle1   Angle2           :  31.00 deg   90.00 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           :  24.20 / 24.20  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  31.00 deg   Angle2 : 90.00 deg
Barrier height            :  22.80 m
Barrier receiver distance :   7.00 / 7.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.57 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.57 !       24.20 !       18.54 !        18.54

ROAD (0.00 + 49.05 + 0.00) = 49.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    31     90   0.00  68.98   0.00  -2.71  -4.84   0.00   0.00 -12.38  49.05
-------------------------------------------------------------------------------

Segment Leq : 49.05 dBA

Total Leq All Segments: 49.05 dBA


Results segment # 1: Murray (night)
-----------------------------------

Source height = 1.57 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.57 !       24.20 !       18.54 !        18.54

ROAD (0.00 + 41.45 + 0.00) = 41.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    31     90   0.00  61.38   0.00  -2.71  -4.84   0.00   0.00 -12.38  41.45
-------------------------------------------------------------------------------

Segment Leq : 41.45 dBA

Total Leq All Segments: 41.45 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 49.05
                           (NIGHT): 41.45
```