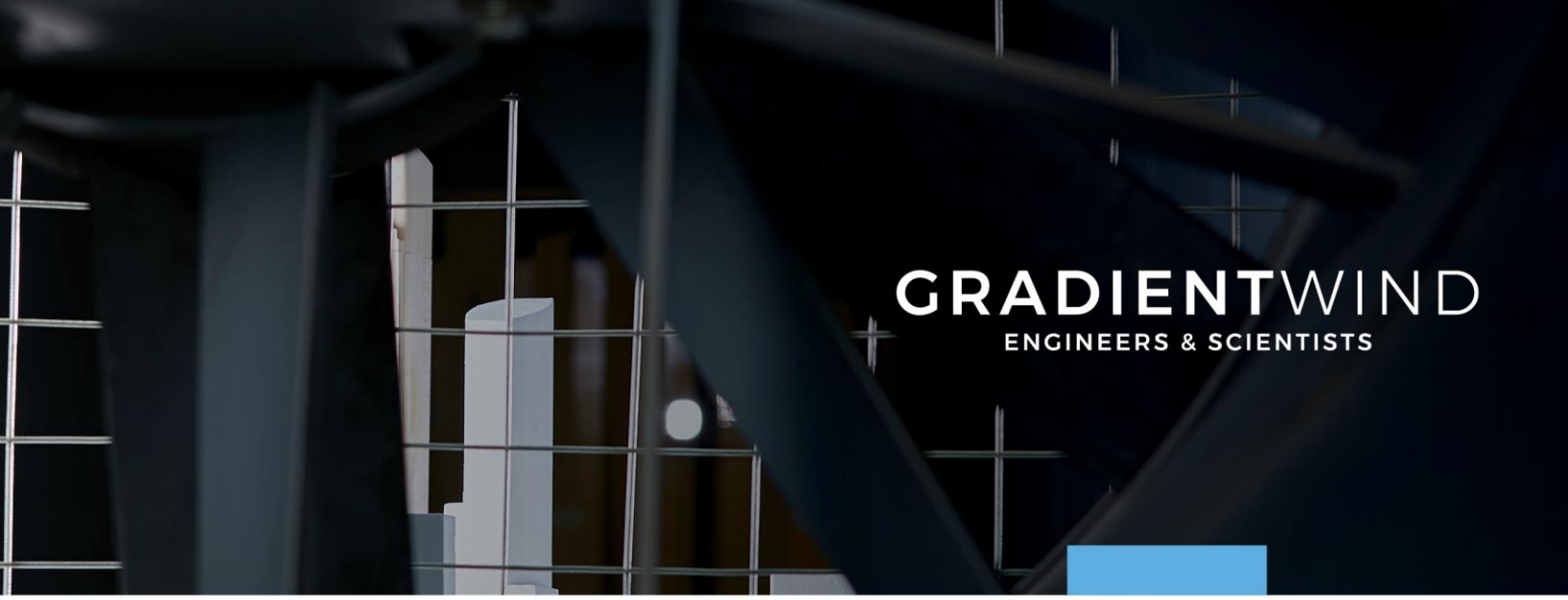
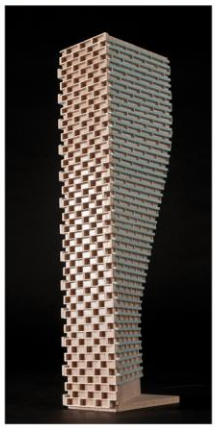


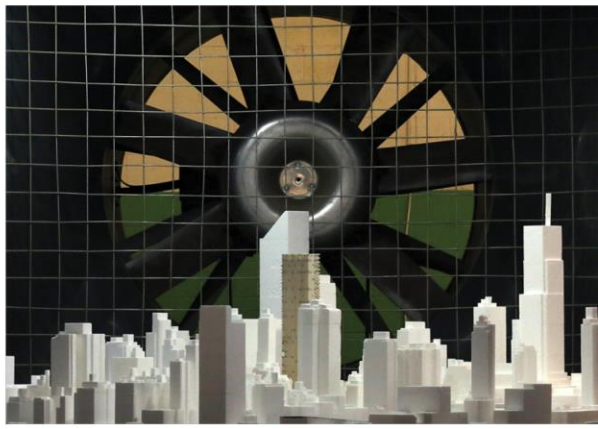
GRADIENTWIND
ENGINEERS & SCIENTISTS

ROADWAY TRAFFIC NOISE ASSESSMENT

989 Somerset Street West
Ottawa, Ontario

REPORT: 13-116 – Traffic Noise





June 8, 2021

PREPARED FOR

Taggart Realty Management
225 Metcalfe Street, Suite 708
Ottawa, ON K2P 1P9

PREPARED BY

Caleb Alexander, B,Eng., Junior Environmental Scientist
Joshua Foster, P.Eng., Principal

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

EXECUTIVE SUMMARY

This document describes a traffic noise assessment performed for a proposed apartment building located at 989 Somerset Street West, Ottawa, Ontario. The development will rise 43 meters above local grade. Figure 1 illustrates a site plan with surrounding context. The major source of roadway noise affecting the development is roadway traffic along Somerset Street West. Noise impacts from the O-Train have been analysed and considered to be insignificant.

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) and Ministry of the Environment, Conservation and Parks NPC-300; (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan right of way allowances; and (iv) architectural drawings received from Alcaide Webster Architects Inc.

The results of the current analysis indicate that noise levels will range between 46 and 72 dBA during the daytime period (07:00-23:00) and between 39 and 65 dBA during the nighttime period (23:00-07:00). The highest noise level (72 dBA) occurs at the south façade, which is nearest and most exposed to the Somerset Street West. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

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. A Warning Clause will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

Outdoor Living Area (OLA) noise levels were found to fall below 55 dBA during the daytime period at the rooftop outdoor amenity (Receptor 5), which is below the ENCG criteria; therefore, no mitigation will be required.

It should be noted that the development is surrounded by low-rise commercial buildings to the west and south, and low-rise residential buildings to the north and east. The commercial and residential buildings are

serviced by standard HVAC equipment. Given the set-back distance from the existing nearby HVAC equipment and the small scale of the equipment, stationary noise impacts from nearby existing properties are expected to be insignificant.

With regard to off-site stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess 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 ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

TABLE OF CONTENTS

1. INTRODUCTION 1

2. TERMS OF REFERENCE 1

3. OBJECTIVES 2

4. METHODOLOGY 2

4.1 Background 2

4.2 Roadway Traffic Noise 2

4.2.1 Criteria for Roadway Traffic Noise 2

4.2.2 Theoretical Roadway Noise Predictions 4

4.2.3 Roadway Traffic Volumes 4

4.3 Insignificant Sources 5

4.4 Indoor Noise Calculations 5

5. RESULTS AND DISCUSSION 7

5.1 Roadway Traffic Noise Levels 7

5.2 Noise Control Measures 7

6. CONCLUSIONS AND RECOMMENDATIONS 9

FIGURES

APPENDICES

Appendix A – STAMSON 5.04 Input and Output Data and Supporting Information

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Taggart to undertake a roadway traffic noise assessment of the proposed residential and commercial development at 989 Somerset Street West in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a roadway traffic noise assessment. Gradient Wind's scope of work involved assessing exterior and interior noise levels generated by local roadway and railway traffic. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa's[1] and Ministry of the Environments guidelines. Calculations were based on architectural drawings received from Alcaide Webster Architects Inc. with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP).

2. TERMS OF REFERENCE

The focus of this roadway traffic noise assessment is a proposed 15-storey apartment development. The development is located on the southeast corner at the intersection of Spruce Street and City Centre Avenue. The major source of roadway traffic noise is Somerset Street West. The site is surrounded on all sides with mixed-use land, specifically commercial and residential. Figure 1 illustrates a complete site plan with surrounding context.

Upon completion, the development will consist of a 7-storey 'L' shaped (plan form) podium supporting a rectangular 15-storey building. The first and second floors will house commercial space, while the remaining floors occupy residential space only. One Outdoor Living Area (OLA) is located on site, specifically a rooftop podium level terrace. Balconies/terraces extending less than 4 metres (m) in depth from the façade do not require consideration as OLAs, as mentioned in the ENCG.

It should be noted that the development is surrounded by low-rise commercial buildings to the west and south, and low-rise residential buildings to the north and east. The commercial and residential buildings are serviced by standard HVAC equipment. These buildings are expected to be in compliance with ENCG noise guidelines as they would have required their own stationary noise assessment prior to construction. With

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

that notion, as well as the set-back distance from the existing nearby HVAC equipment and the proposed development, stationary noise impacts from nearby existing properties are expected to be insignificant.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local transportation sources, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the ENCG, 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 NPC-300 guidelines specify that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for commercial/reception areas, living rooms and sleeping quarters respectively, as listed in Table 1.

However, to account for deficiencies in building construction and to control peak noise, these levels should be targeted toward 47, 42, and 37 dBA.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)

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[2]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[3]. 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[4].

The sound level criterion for outdoor living areas (OLA) is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation should be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion. Furthermore, noise levels at the OLA must not exceed 60 dBA if mitigation can be technically and administratively achieved.

[2] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[3] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[4] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Roadway Noise Predictions

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.
- 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. However, Somerset Street West road gradient was taken as 2.5%.
- Noise receptors were strategically placed at 5 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3 & 4.
- For select sources where appropriate, receptors considered the proposed and/or existing buildings as a barrier partially or fully obstructing exposure to the source, as illustrated by exposure angles in Figures 3 & 4.

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 which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Somerset Street West	4-Lane Urban Arterial Undivided	50	**30,000**

4.3 Insignificant Sources

Test calculations were done to assess the noise levels from the O-Train on the most exposed receptor, Receptor 2. Future train schedules were obtained from the City of Ottawa, one train arriving at Bayview station every 8 minutes. The O-Train was modelled in STAMSON as a 4-car SRT (Scarborough Rapid Transit) vehicle; operating at an assumed speed of 60 km/h. Results showed that the daytime noise impacts from the O-Train were 45 dBA, over 10 dB less than the noise impacts from Somerset Street West. As such, the O-Train has not been included in the noise calculations for the remaining receptors.

4.4 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, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. 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.

As per Section 4.2, when daytime noise levels from road 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[5] 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[6], 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, detailed floor layouts and building elevations have not been finalized; 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).

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

5. RESULTS AND DISCUSSION

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	7.5	POW – 4th Floor – South Façade	72	65
2	7.5	POW – 4th Floor – West Side	70	63
3	24.7	POW – 10th Floor – North Side	46	39
4	24.7	POW – 10th Floor – East Side	67	59
5	42.5	OLA – Rooftop Podium	49	N/A*

*Outdoor Living Areas (OLA) during the nighttime are not considered as per the ENCG.

The results of the current analysis indicate that noise levels will range between 46 and 72 dBA during the daytime period (07:00-23:00) and between 39 and 65 dBA during the nighttime period (23:00-07:00). The highest noise level (72 dBA) occurs at the south façade, which is nearest and most exposed to Somerset Street West.

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 for various units within the development (see Figure 5):

- **Bedroom Windows**

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

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

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

- **Living Room Windows**

(iv) Living room windows facing south will require a minimum STC of 30.

(v) Living room windows facing west will require a minimum STC of 28.

(vi) Living room windows facing east will require a minimum STC of 25.

- **Reception/Retail Windows**

(vii) Reception/Retail windows facing south will require a minimum STC of 25.

(viii) Reception/Retail windows facing west will require a minimum STC of 23.

(ix) Reception/Retail windows facing east will require a minimum STC of 20.

- **Exterior Walls**

(i) Exterior wall components on east, 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[7].

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 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

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

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.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 46 and 72 dBA during the daytime period (07:00-23:00) and between 39 and 65 dBA during the nighttime period (23:00-07:00). The highest noise level (72 dBA) occurs at the south façade, which is nearest and most exposed to the Somerset Street West. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

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. The following Warning Clause will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

Type D

> *"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."*

Outdoor Living Area (OLA) noise levels were found to fall below 55 dBA during the daytime period at the rooftop outdoor amenity (Receptor 5), which is below the ENCG criteria; therefore, no mitigation will be required.

It should be noted that the development is surrounded by low-rise commercial buildings to the west and south, and low-rise residential buildings to the north and east. The commercial and residential buildings are

serviced by standard HVAC equipment. These buildings are expected to be in compliance with ENCG noise guidelines as they would have required their own stationary noise assessment prior to construction. With that notion, as well as the set-back distance from the existing nearby HVAC equipment and the proposed development, stationary noise impacts from nearby existing properties are expected to be insignificant.

With regard to off-site stationary noise impacts, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess 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 ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

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.

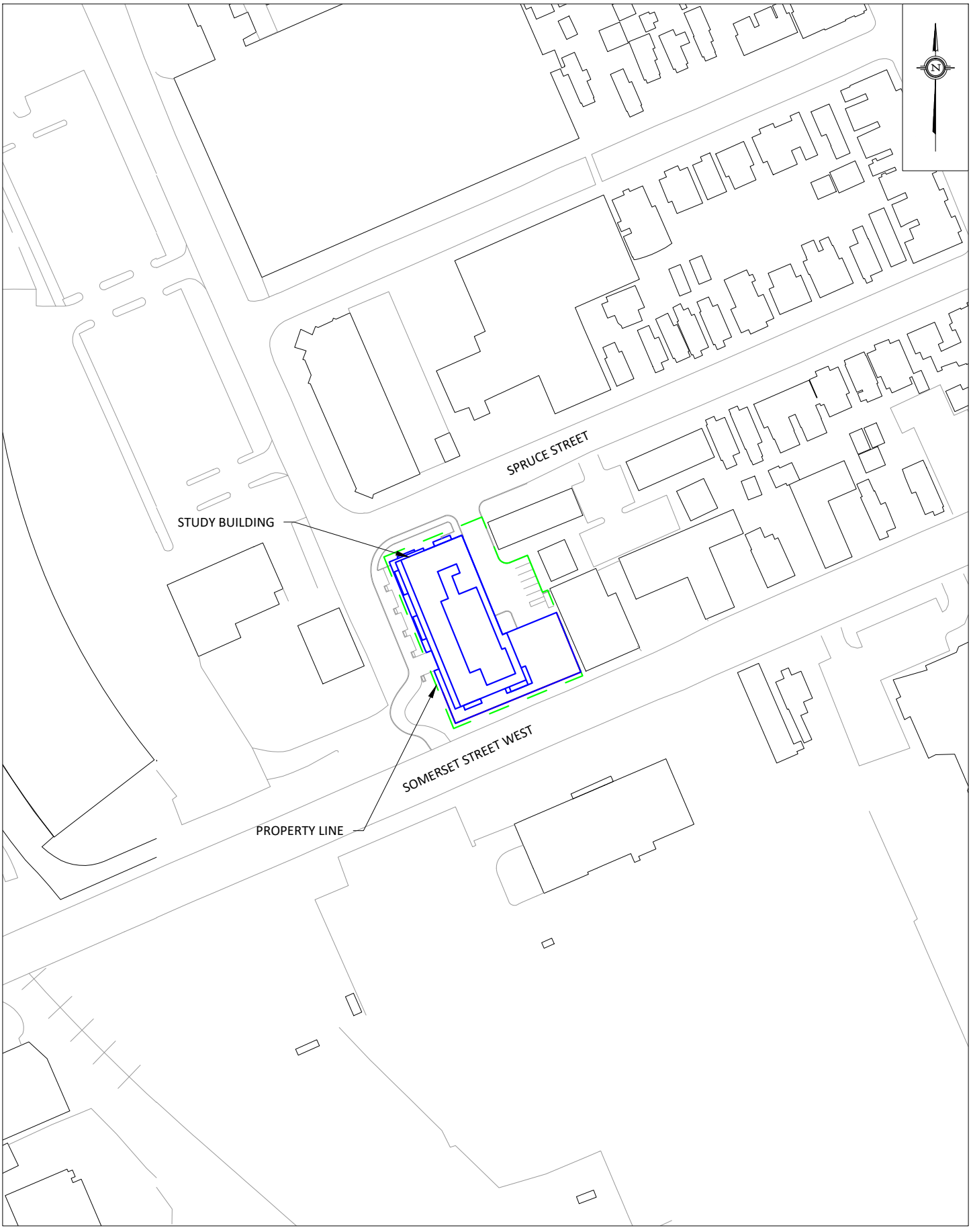
Sincerely,

Gradient Wind Engineering Inc.

Caleb Alexander, B.Eng.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #13-116-Traffic Noise



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	989 SOMERSET OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW13-116-1
DATE	MAY 21, 2021	DRAWN BY	C.A.

DESCRIPTION

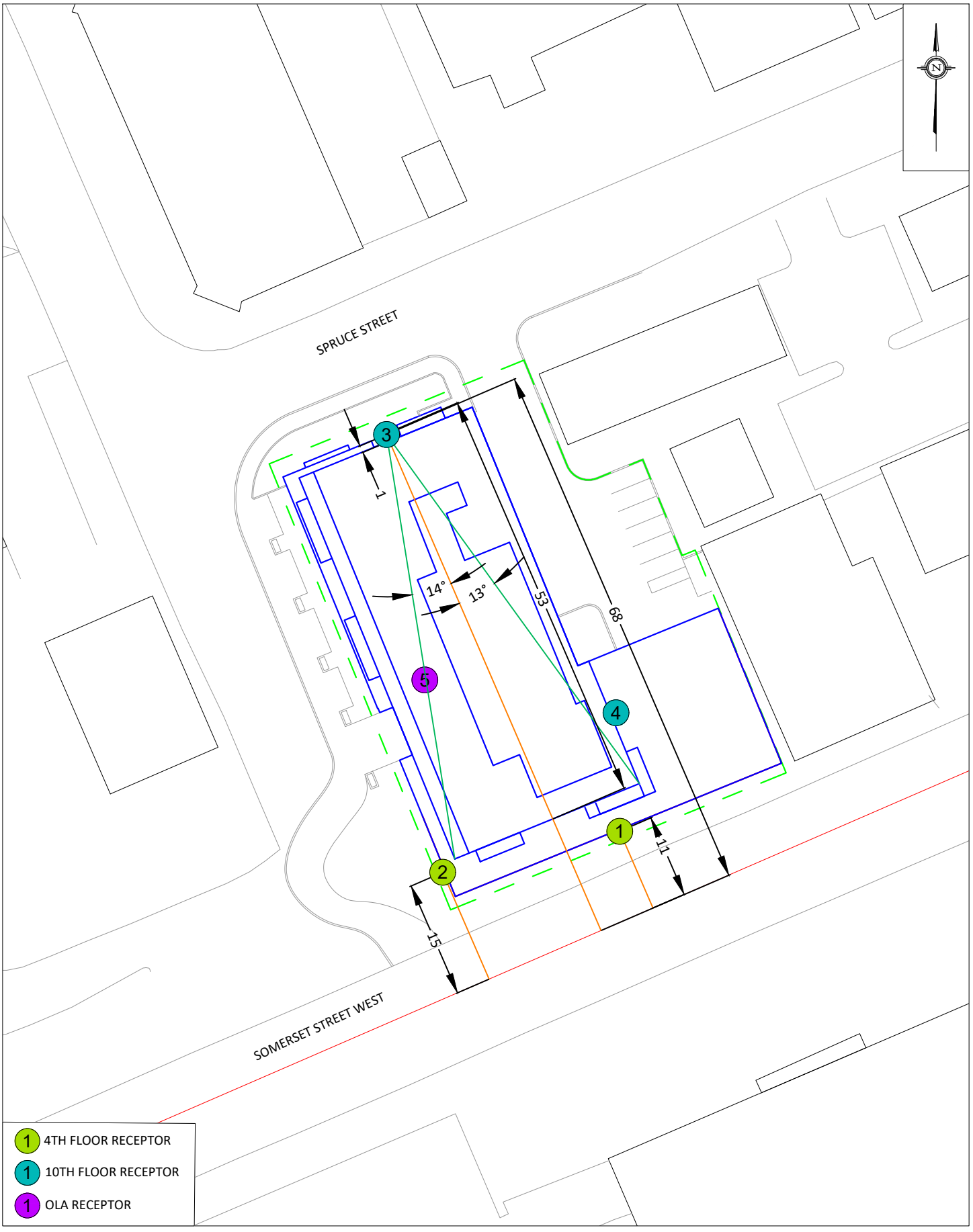
FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	989 SOMERSET OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW13-116-2
DATE	MAY 21, 2021	DRAWN BY	C.A.

FIGURE 2:
RECEPTOR LOCATIONS



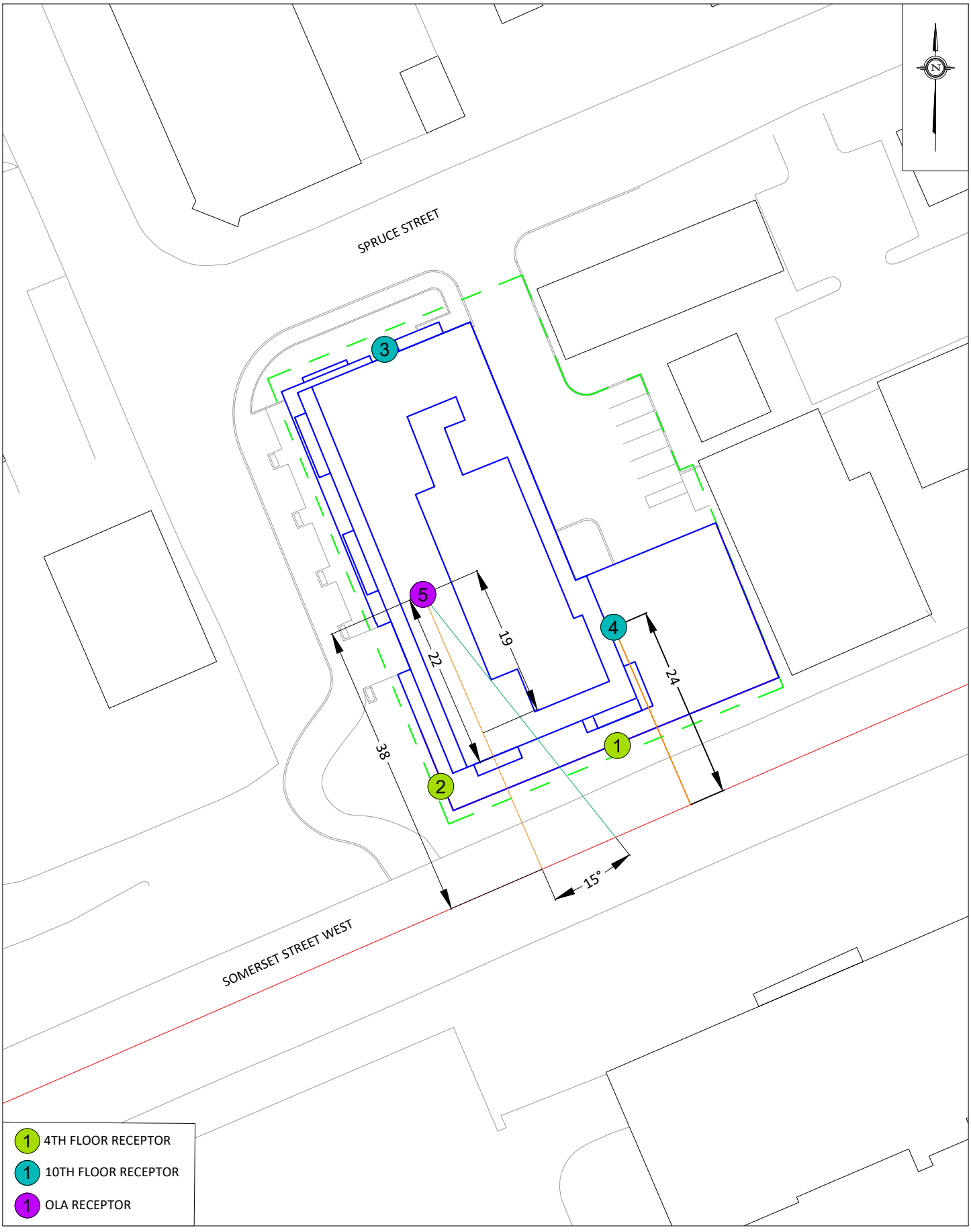
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	989 SOMERSET OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW13-116-3
DATE	MAY 21, 2021
DRAWN BY	C.A.

DESCRIPTION

FIGURE 3:
RECEPTORS 1-3



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	989 SOMERSET OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW13-116-4
DATE	MAY 21, 2021
DRAWN BY	C.A.

DESCRIPTION

FIGURE 4:
RECEPTORS 4&5

GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	989 SOMERSET OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW13-116-5
DATE	MAY 21, 2021
DRAWN BY	C.A.
DESCRIPTION	FIGURE 5: STC RATINGS

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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

```
STAMSON 5.0        NORMAL REPORT        Date: 20-05-2021 17:50:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Somerset (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  :    50 km/h
Road gradient       :     2 %
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: Somerset (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           :   9.90 / 9.90   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 72.12 + 0.00) = 72.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  72.12   0.00   0.00   0.00   0.00   0.00   0.00  72.12
-------------------------------------------------------------------------------

Segment Leq : 72.12 dBA

Total Leq All Segments: 72.12 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 64.52 + 0.00) = 64.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  64.52   0.00   0.00   0.00   0.00   0.00   0.00  64.52
-------------------------------------------------------------------------------

Segment Leq : 64.52 dBA

Total Leq All Segments: 64.52 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 72.12
                           (NIGHT): 64.52
```

```
STAMSON 5.0        NORMAL REPORT        Date: 21-05-2021 18:21:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Somerset (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  :    50 km/h
Road gradient       :     2 %
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: Somerset (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  :  15.00 / 15.00  m
Receiver height           :   9.90 / 9.90   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 69.11 + 0.00) = 69.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  72.12   0.00   0.00  -3.01   0.00   0.00   0.00  69.11
-------------------------------------------------------------------------------

Segment Leq : 69.11 dBA

Total Leq All Segments: 69.11 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 61.51 + 0.00) = 61.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  64.52   0.00   0.00  -3.01   0.00   0.00   0.00  61.51
-------------------------------------------------------------------------------

Segment Leq : 61.51 dBA

Total Leq All Segments: 61.51 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 69.11
                           (NIGHT): 61.51
```

```
STAMSON 5.0         NORMAL REPORT         Date: 08-06-2021 11:58:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Somerset 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  :    50 km/h
Road gradient       :     2 %
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: Somerset 1 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -13.00 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           :  27.90 / 27.90  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -13.00 deg
Barrier height            :  43.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Somerset 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  :    50 km/h
Road gradient       :     2 %
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: Somerset 2 (day/night)
--------------------------------------------
Angle1   Angle2           : -13.00 deg   14.00 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           :  27.90 / 27.90  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -13.00 deg   Angle2 : 14.00 deg
Barrier height            :  43.00 m
Barrier receiver distance :  53.00 / 53.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Somerset 3 (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  :    50 km/h
Road gradient       :     2 %
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: Somerset 3 (day/night)
--------------------------------------------
Angle1   Angle2           :  14.00 deg   90.00 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           :  27.90 / 27.90  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  14.00 deg   Angle2 : 90.00 deg
Barrier height            :  43.00 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Somerset 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 !       27.90 !       27.51 !        27.51

ROAD (0.00 + 42.57 + 0.00) = 42.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -13   0.00  72.12   0.00  -6.56  -3.69   0.00   0.00 -19.30  42.57
-------------------------------------------------------------------------------

Segment Leq : 42.57 dBA


Results segment # 2: Somerset 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 !       27.90 !        7.32 !         7.32

ROAD (0.00 + 37.31 + 0.00) = 37.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -13     14   0.00  72.12   0.00  -6.56  -8.24   0.00   0.00 -20.00  37.31
-------------------------------------------------------------------------------

Segment Leq : 37.31 dBA
```

```
Results segment # 3: Somerset 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 !       27.90 !       27.51 !        27.51

ROAD (0.00 + 42.52 + 0.00) = 42.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    14     90   0.00  72.12   0.00  -6.56  -3.74   0.00   0.00 -19.29  42.52
-------------------------------------------------------------------------------

Segment Leq : 42.52 dBA

Total Leq All Segments: 46.16 dBA


Results segment # 1: Somerset 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 !       27.90 !       27.51 !        27.51

ROAD (0.00 + 34.97 + 0.00) = 34.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -13   0.00  64.52   0.00  -6.56  -3.69   0.00   0.00 -19.30  34.97
-------------------------------------------------------------------------------

Segment Leq : 34.97 dBA
```

```
Results segment # 2: Somerset 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 !       27.90 !        7.32 !         7.32

ROAD (0.00 + 29.72 + 0.00) = 29.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -13     14   0.00  64.52   0.00  -6.56  -8.24   0.00   0.00 -20.00  29.72
-------------------------------------------------------------------------------

Segment Leq : 29.72 dBA


Results segment # 3: Somerset 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 !       27.90 !       27.51 !        27.51

ROAD (0.00 + 34.92 + 0.00) = 34.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
    14     90   0.00  64.52   0.00  -6.56  -3.74   0.00   0.00 -19.29  34.92
-------------------------------------------------------------------------------

Segment Leq : 34.92 dBA

Total Leq All Segments: 38.56 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 46.16
                           (NIGHT): 38.56
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-05-2021 18:43:21
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Somerset (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  :    50 km/h
Road gradient       :     2 %
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: Somerset (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  :  27.00 / 27.00  m
Receiver height           :  27.90 / 27.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 66.55 + 0.00) = 66.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  72.12   0.00  -2.55  -3.01   0.00   0.00   0.00  66.55
-------------------------------------------------------------------------------

Segment Leq : 66.55 dBA

Total Leq All Segments: 66.55 dBA


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

Source height = 1.50 m

ROAD (0.00 + 58.96 + 0.00) = 58.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.00  64.52   0.00  -2.55  -3.01   0.00   0.00   0.00  58.96
-------------------------------------------------------------------------------

Segment Leq : 58.96 dBA

Total Leq All Segments: 58.96 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.55
                           (NIGHT): 58.96
```

```
STAMSON 5.0         NORMAL REPORT         Date: 21-05-2021 18:20:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Somerset1 (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  :    50 km/h
Road gradient       :     2 %
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: Somerset1 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -15.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  38.00 / 38.00  m
Receiver height           :  42.50 / 9.90   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -15.00 deg
Barrier height            :   3.50 m
Barrier receiver distance :  19.00 / 19.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :  41.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Somerset2 (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  :    50 km/h
Road gradient       :     2 %
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: Somerset2 (day/night)
-------------------------------------------
Angle1   Angle2           : -15.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  38.00 / 38.00  m
Receiver height           :  42.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -15.00 deg   Angle2 : 90.00 deg
Barrier height            :   1.20 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :  41.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Somerset1 (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 !       42.50 !      -19.00 !        22.00

ROAD (0.00 + 45.65 + 0.00) = 45.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  72.12   0.00  -4.04  -3.80   0.00   0.00 -18.63  45.65
-------------------------------------------------------------------------------

Segment Leq : 45.65 dBA


Results segment # 2: Somerset2 (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 !       42.50 !      -22.24 !        18.76

ROAD (0.00 + 46.80 + 0.00) = 46.80 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -15     90   0.00  72.12   0.00  -4.04  -2.34   0.00   0.00 -18.94  46.80
-------------------------------------------------------------------------------

Segment Leq : 46.80 dBA

Total Leq All Segments: 49.27 dBA
```

```
Results segment # 1: Somerset1 (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 !        9.90 !      -35.30 !         5.70

ROAD (0.00 + 37.01 + 0.00) = 37.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -15   0.00  64.52   0.00  -4.04  -3.80   0.00   0.00 -19.67  37.01
-------------------------------------------------------------------------------

Segment Leq : 37.01 dBA


Results segment # 2: Somerset2 (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 !        4.50 !      -38.24 !         2.76

ROAD (0.00 + 38.37 + 0.00) = 38.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -15     90   0.00  64.52   0.00  -4.04  -2.34   0.00   0.00 -19.77  38.37
-------------------------------------------------------------------------------

Segment Leq : 38.37 dBA

Total Leq All Segments: 40.75 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 49.27
                           (NIGHT): 40.75
```