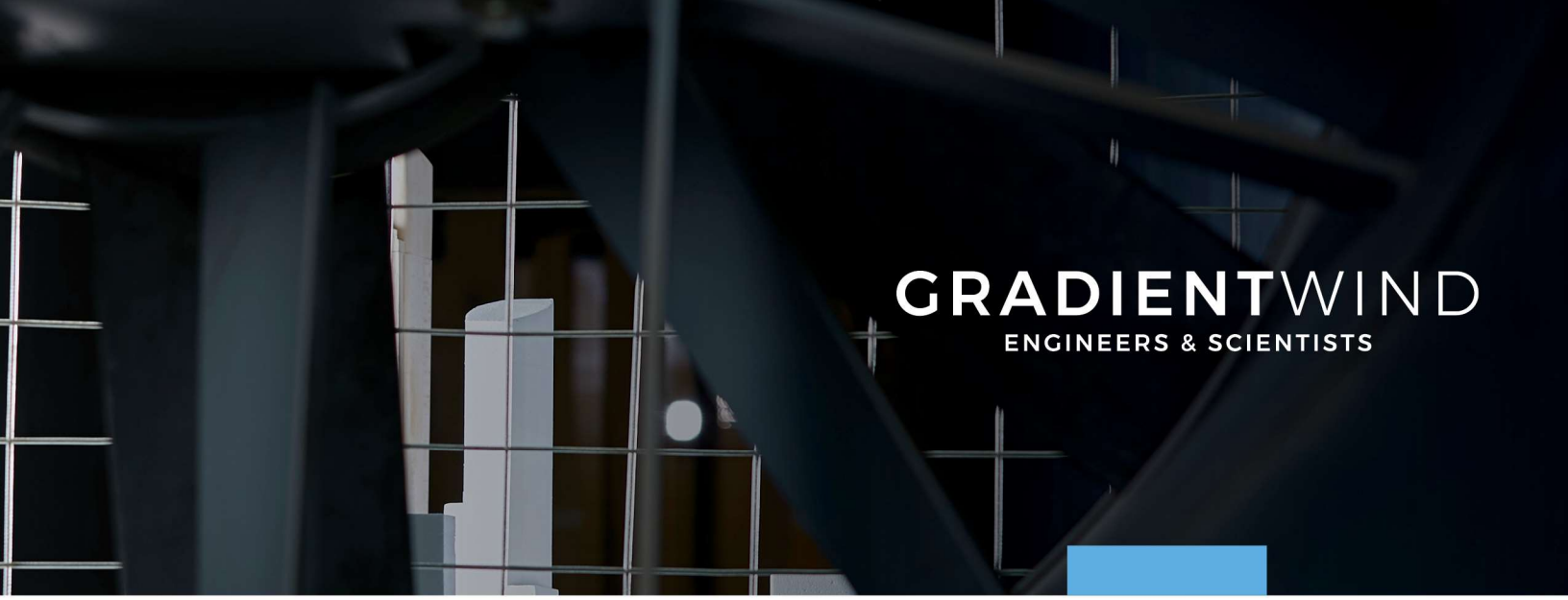

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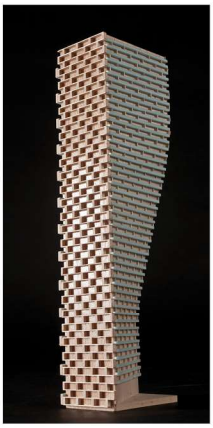
ROADWAY TRAFFIC NOISE ASSESSMENT

91 and 93 Holland Avenue
Ottawa, Ontario

REPORT: GW21-033 – Traffic Noise



September 14, 2021

PREPARED FOR
Nicholson Gluckstein Lawyers
249 McLeod Street
Ottawa, ON K2P 1A1

PREPARED BY
Tanyon Matheson-Fitchett, 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 report describes a roadway traffic noise assessment undertaken in support of a Site Plan Control Application (SPA) for the proposed residential apartment development located at 91 and 93 Holland Avenue in Ottawa, Ontario. The development is a six-storey building with residential and commercial units at grade, and residential units comprising the remaining floors above. An outdoor amenity area is provided on the building rooftop. The major sources of traffic noise are Holland Avenue to the west of the site, and Wellington Street West to the south. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings of the development prepared by Chmiel Architects Inc., dated August 27, 2021.

The results of the current analysis indicate that noise levels at the Plane of Window (POW) will range between 57 and 71 dBA during the daytime period (07:00-23:00) and between 49 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the west façade, which is nearest and most exposed to Holland Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 7.

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 in all Lease, Purchase and Sale Agreements.

Noise levels at the rooftop terrace (Receptor 4) are expected to approach 58 dBA during the daytime period. If this area is to be used as an outdoor living area, noise control measures are recommended to reduce the L_{eq} to 55 dBA. Further analysis investigated the noise mitigating impact of incorporating a noise barrier surrounding the terrace. Results of the investigation proved that noise levels can be reduced to 57 dBA with a 1.5 m noise barrier, and to 55 dBA with a 2.0 m noise barrier. The proposed barrier location is identified in Figure 8. If no barrier is provided, a Warning Clause will be required as per Section 6.

The guardrail must be constructed from materials having a minimum surface density of 20 kg/m^2 (STC rating of 30) and contain no gaps. Design of the guardrail will conform to the requirements outlined in Part 5 of the ENCG. The following information will be required by the City for review prior to installation of the barrier:

1. Shop drawings, signed and sealed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing the details of the acoustic barrier systems components, including material specifications.
2. Structural drawing(s), signed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing foundation details and specifying design criteria, climatic design loads, as well as applicable geotechnical data used in the design.
3. Layout plan, and wall elevations, showing proposed colours and patterns.

The building's proposed HVAC equipment has the potential for noise impacts on surrounding buildings and the study building itself. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed. A stationary noise study will be performed 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 ENCG limits. Regarding off-site stationary noise impacts on the proposed development, the surrounding area was evaluated for sources of stationary noise. No significant stationary noise sources were identified, therefore, impacts are expected to be insignificant.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Tallis Project Management Inc., on behalf of Nicholson Gluckstein Lawyers, to undertake a roadway traffic noise assessment in support of a Site Plan Control Application (SPA) for the proposed residential apartment development located at 91 and 93 Holland Avenue in Ottawa, Ontario (hereinafter referred to as "study building" or "proposed development"). This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

The assessment is based on (i) theoretical noise prediction methods that conform to the City of Ottawa Environmental Noise Control Guidelines (ENCG); (ii) noise level criteria as specified by the ENCG guidelines; (iii) future vehicular traffic volumes corresponding to roadway classification and roadway traffic volumes obtained from the City of Ottawa[1]; and (iv) architectural drawings of the development prepared by Chmiel Architects Inc., dated August 27, 2021.

2. TERMS OF REFERENCE

The proposed development is located at 91 and 93 Holland Avenue on the east elevation of Holland Avenue, mid-block between Wellington Street West and Armstrong Avenue. Throughout this report, the Holland Avenue elevation is referred to as the west elevation.

The proposed development comprises a six-storey building plus mechanical penthouse. Above one level of underground parking, the grade level has a nearly square planform and comprises residential suites along the east elevation, commercial space fronting Holland Avenue at the southwest corner, and a residential lobby fronting Holland Avenue along the west elevation. Access to the underground parking is provided by a ramp at the northwest corner via Holland Avenue. Levels 2 through 6 comprise residential units with protruding balconies on all façades. Above Level 6, the mechanical penthouse level comprises mechanical space along the east elevation and an elevator lobby on the west elevation which opens to a rooftop amenity terrace.

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

The study building is surrounded by mostly low-rise residential buildings to the east, west and north, with taller buildings to the south which front Wellington Street West and Holland Avenue. Directly on the south side of the study building is a mid-rise apartment building of similar height, and farther south, a high-rise building fronting Wellington Street West.

The major source of traffic noise impacting the development is Holland Avenue directly to the west of the site, and Wellington Street West approximately 80 meters to the south. The Tunney's Pasture LRT Corridor and Highway 417 are each more than 500 meters to the north and south of the site respectively, and therefore are not included in the analysis. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings 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 50, 45, and 40 dBA for retail, living rooms, and sleeping quarters respectively for roadway 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) [2]

Type of Space	Time Period	Leq (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[3]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[4]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation

[2] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[3] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[4] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

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[5].

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.

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 absorptive or reflective based on specific source-receptor path.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- Receptor height was taken to be 16.5 metres at Level 6 for the centre of the window (height to 6th floor slab + 1.5 metres) for Receptors 1-3, and 19.5 m for rooftop Receptor 4.
- For select sources where appropriate, Receptors 1-4 considered near-field mid-rise and high-rise buildings as barriers partially or fully obstructing exposure to the source, as illustrated in Figures 3-6.
- A standard 1.1 m tall parapet was assumed to enclose the terrace.
- Noise receptors were strategically placed at four locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3-6.

[5] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.1 Roadway Traffic Volumes

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

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Holland Avenue	4 Lane Major Collector	50	**24,000**
Wellington Street West	2 Lane Urban Arterial	40	**15,000**

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. 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.

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

As per Section 4.2, when daytime noise levels (from road and rail sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[7] 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[8], 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).

[7] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985
[8] 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	16.5	POW – 6th Floor – West Façade	71	63
2	16.5	POW – 6th Floor – North Façade	67	60
3	16.5	POW – 6th Floor – East Façade	57	49
4	19.5	OLA – Rooftop Terrace	58	N/A*

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

The results of the current analysis indicate that noise levels at the Plane of Window (POW) will range between 57 and 71 dBA during the daytime period (07:00-23:00) and between 49 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the west façade, which is nearest and most exposed to Holland Avenue. The noise level at the 7th floor terrace is expected to approach 58 dBA during the daytime period.

5.2 Noise Control Measures

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

- **Bedroom Windows**

(i) Bedroom windows facing west will require a minimum STC of 34

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

- **Living Room Windows**

(i) Living room windows facing west will require a minimum STC of 29

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

- **Retail Windows**

(iii) Retail windows facing west will require a minimum STC of 24

(iv) All other retail windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Exterior Walls**

(i) Exterior wall components on the west and north façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[9]

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 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

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

to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

5.3 Noise Barrier Investigation

Noise levels at the rooftop receptor (Receptor 4) are expected to approach 58 dBA during the daytime period. If this area is to be used as an outdoor living area, noise control measures are recommended to reduce the L_{eq} to 55 dBA. Further analysis investigated the noise mitigating impact of raising the parapet from a standard height of 1.1 m (base case) to 1.5 m, and to 2.0 m above the walking surface (see Figure 8). Results of the investigation proved that noise levels can be reduced to 57 dBA with a 1.5 m noise barrier and to 55 dBA with a 2.0 m noise barrier. The proposed barrier location is identified in Figure 8. Table 4 summarizes the results of the barrier investigation. If no barrier is provided, a warning clause will be required as per Section 6.

TABLE 4: RESULTS OF NOISE BARRIER INVESTIGATION

Location	Receptor Height Above Grade (m)	Receptor Location	Daytime Leq Noise Levels (dBA)		
			1.1m Parapet	1.5m Barrier	2.0m Barrier
4	19.5	OLA – Rooftop Terrace	58	57	55

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels at the Plane of Window (POW) will range between 57 and 71 dBA during the daytime period (07:00-23:00) and between 49 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the west façade, which is nearest and most exposed to Holland Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 7.

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[10] will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *" Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation, this development includes:*
>
> - *STC rated multi-pane glazing elements and spandrel panels*
> - *STC rated exterior walls*
>
> *This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment.*
>
> *To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."*

Noise levels at the rooftop terrace (Receptor 4) are expected to approach 58 dBA during the daytime period. If this area is to be used as an outdoor living area, noise control measures are recommended to reduce the L_{eq} to 55 dBA. Further analysis investigated the noise mitigating impact of raising the parapet

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

from a standard height of 1.1 m (base case) to 1.5 m, and to 2.0 m above the walking surface. Results of the investigation proved that noise levels can be reduced to 57 dBA with a 1.5 m noise barrier, and to 55 dBA with a 2.0 m noise barrier. The proposed barrier location is identified in Figure 8.

The guardrail must be constructed from materials having a minimum surface density of 20 kg/m^2 (STC rating of 30) and contain no gaps. Design of the guardrail will conform to the requirements outlined in Part 5 of the ENCG. The following information will be required by the City for review prior to installation of the barrier:

1. Shop drawings, signed and sealed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing the details of the acoustic barrier systems components, including material specifications.
2. Structural drawing(s), signed by a qualified Professional Engineer licenced by the Professional Engineers of Ontario, showing foundation details and specifying design criteria, climatic design loads, as well as applicable geotechnical data used in the design.
3. Layout plan, and wall elevations, showing proposed colours and patterns.

Should a barrier not be provided, a Warning Clause[10] will be required to be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *"Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."*

The building's proposed HVAC equipment has the potential for noise impacts on surrounding buildings and the study building itself. Typically, noise levels can be controlled by judicious selection and placement of the equipment and the introduction of silencers or noise screens where needed. A stationary noise study will be performed 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 ENCG limits. Regarding off-site stationary noise impacts on the proposed development, the surrounding area was evaluated for sources of stationary noise. No significant stationary noise sources were identified, therefore, impacts are expected to be insignificant.

This concludes our 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.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Sep 14, 2021
PROVINCE OF ONTARIO

Tanyon Matheson-Fitchett, B.Eng.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #21-033-Traffic Noise Assessment

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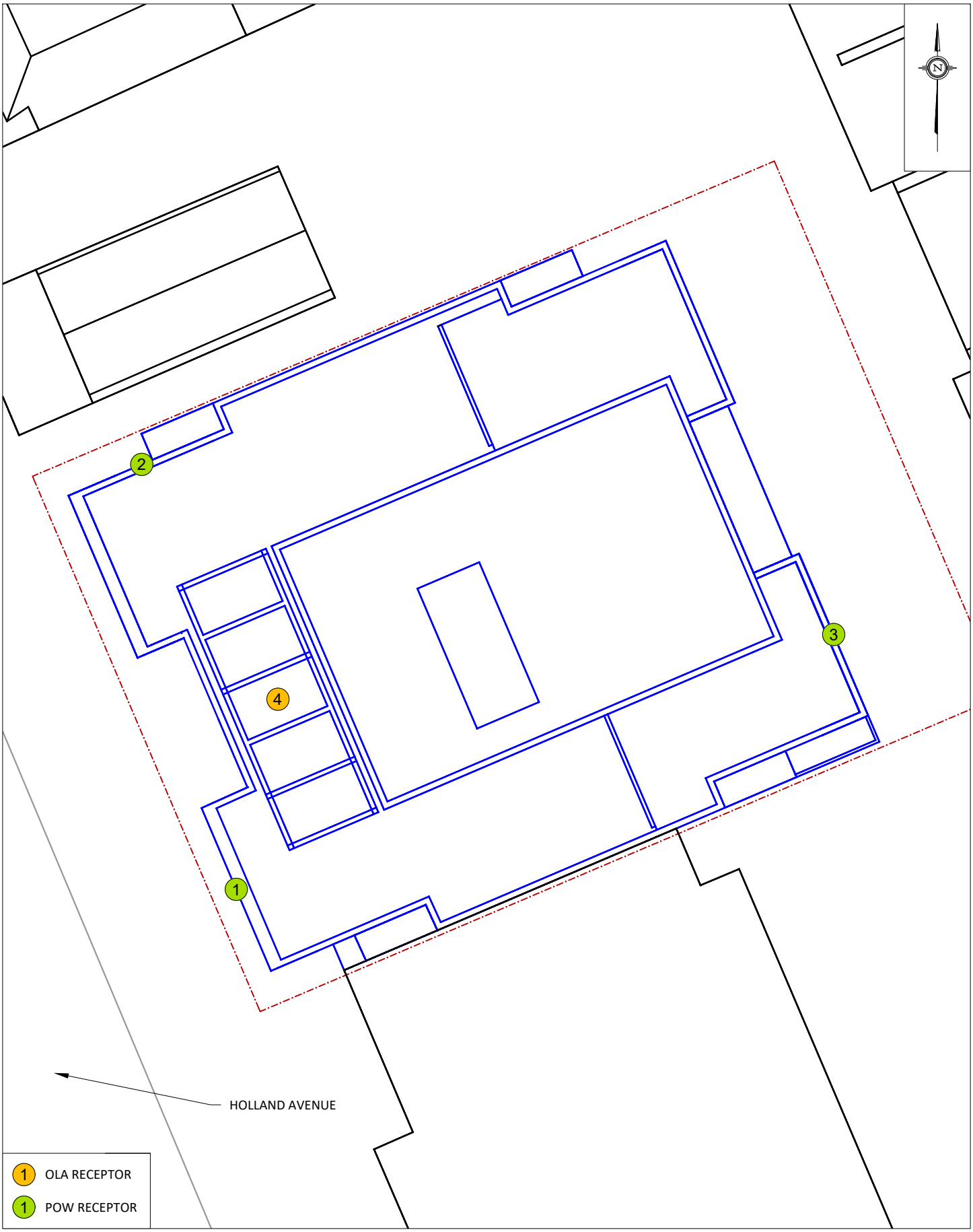
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO. GWE21-033-1	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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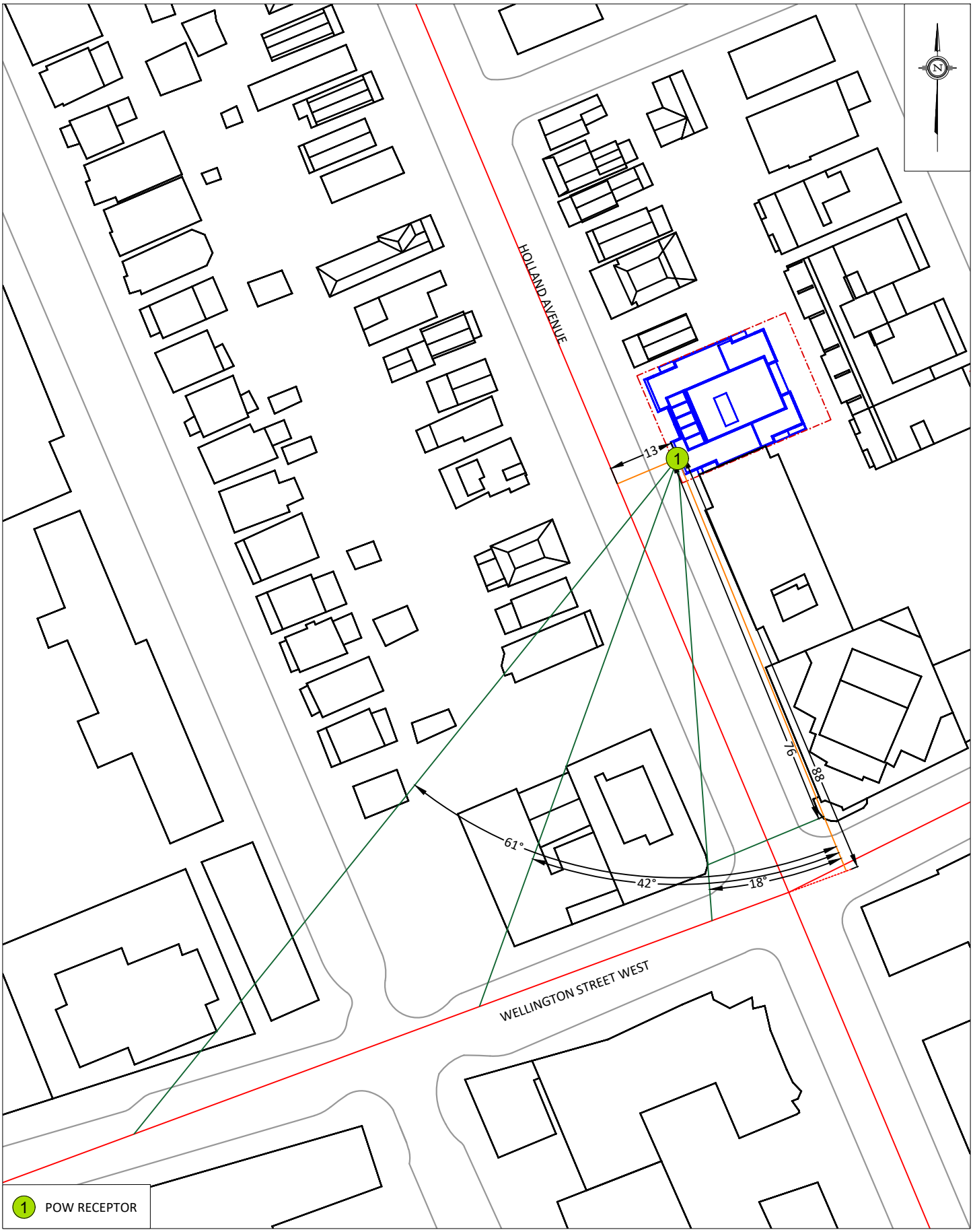
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:200 (APPROX.)	DRAWING NO. GWE21-033-2	FIGURE 2: RECEPTOR LOCATIONS
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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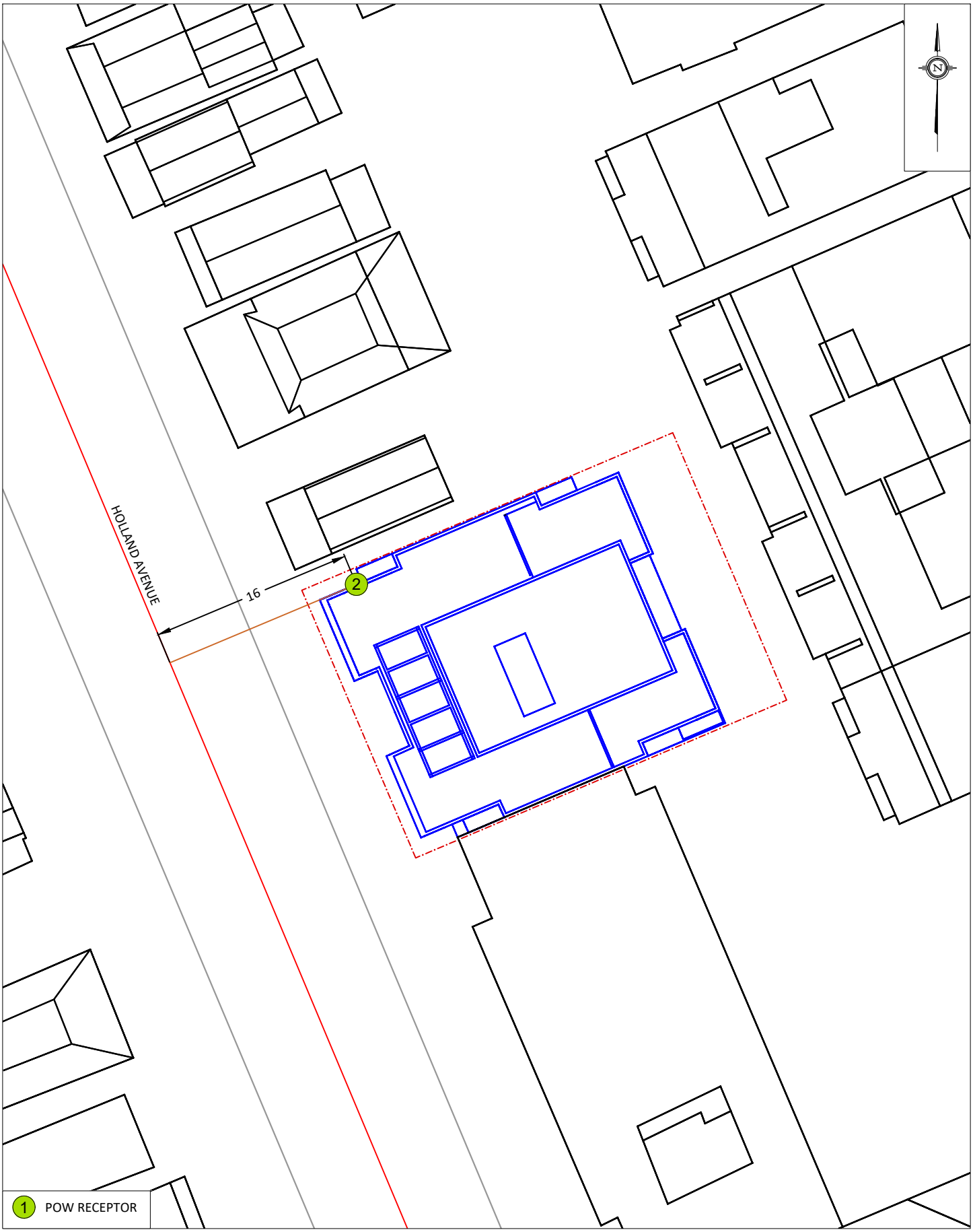
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO. GWE21-033-3	FIGURE 3: RECEPTOR 1 STAMSON INPUT PARAMETERS
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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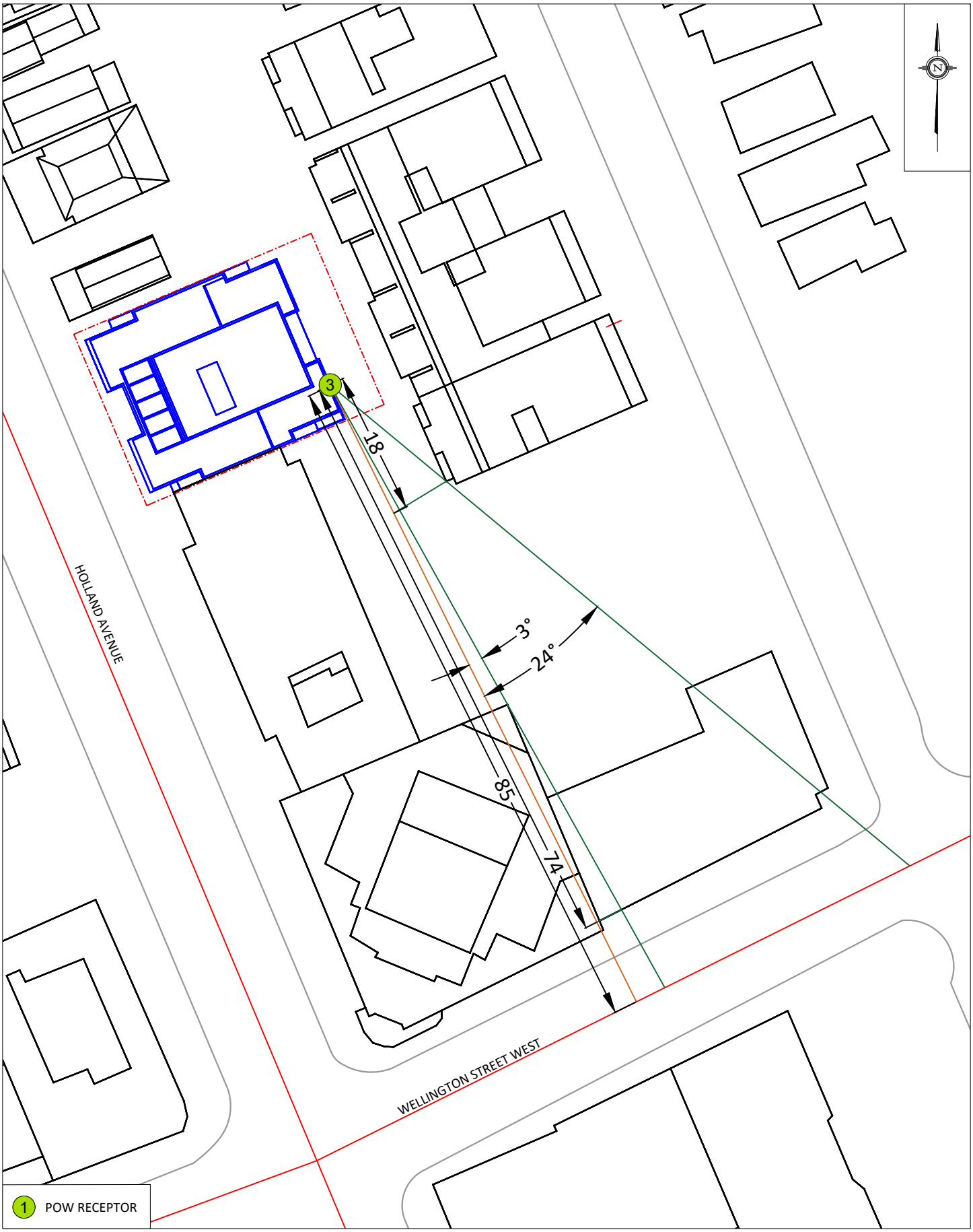
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:400 (APPROX.)	DRAWING NO. GWE21-033-4	FIGURE 4: RECEPTOR 2 STAMSON INPUT PARAMETERS
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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SCALE	1:600 (APPROX.)
DRAWING NO.	GWE21-033-5
DATE	APRIL 30, 2021
DRAWN BY	T.M.F.
DESCRIPTION	FIGURE 5: RECEPTOR 3 STAMSON INPUT PARAMETERS

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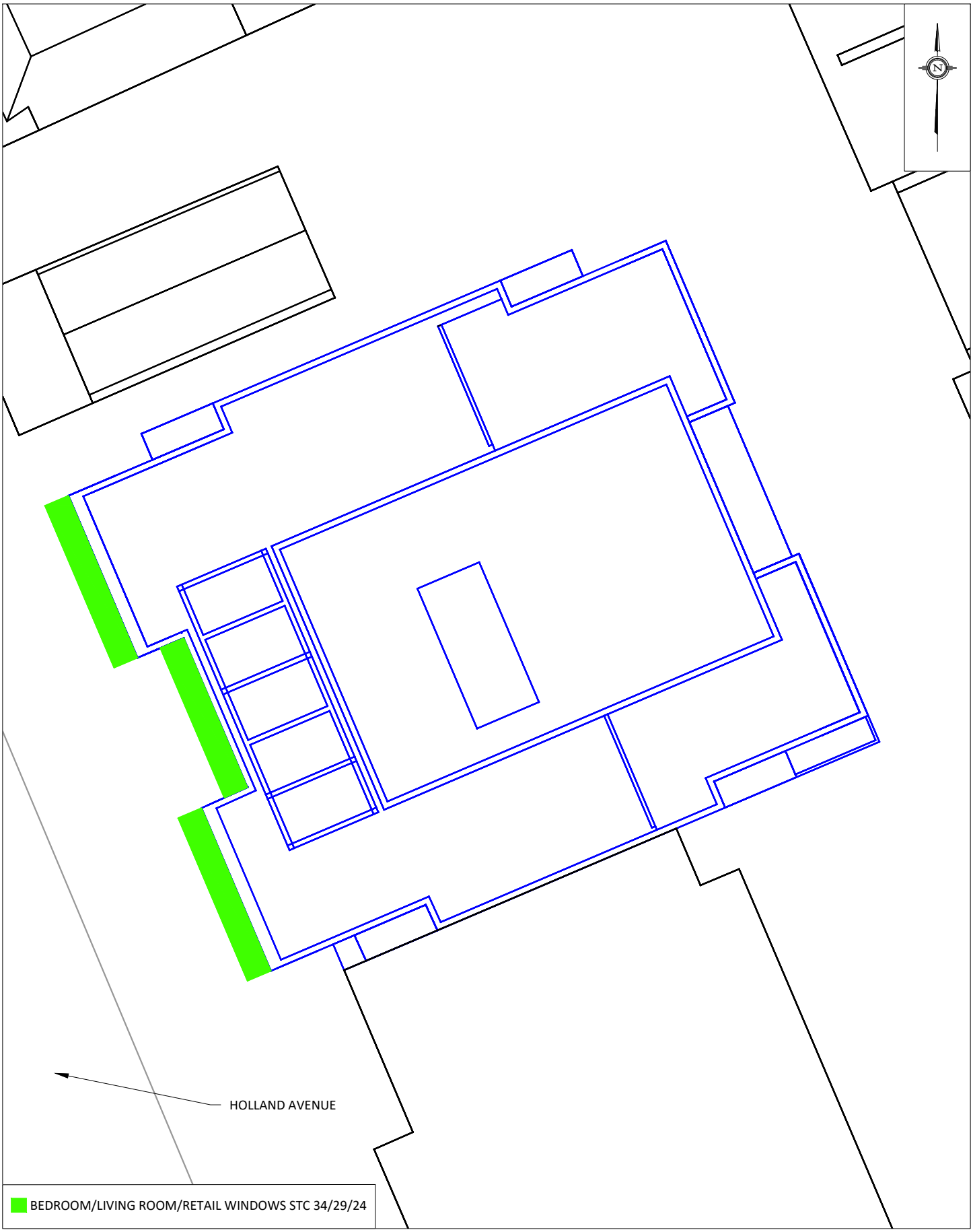
SCALE	1:1000 (APPROX.)	DRAWING NO. GWE21-033-3	FIGURE 6: RECEPTOR 4 STAMSON INPUT PARAMETERS
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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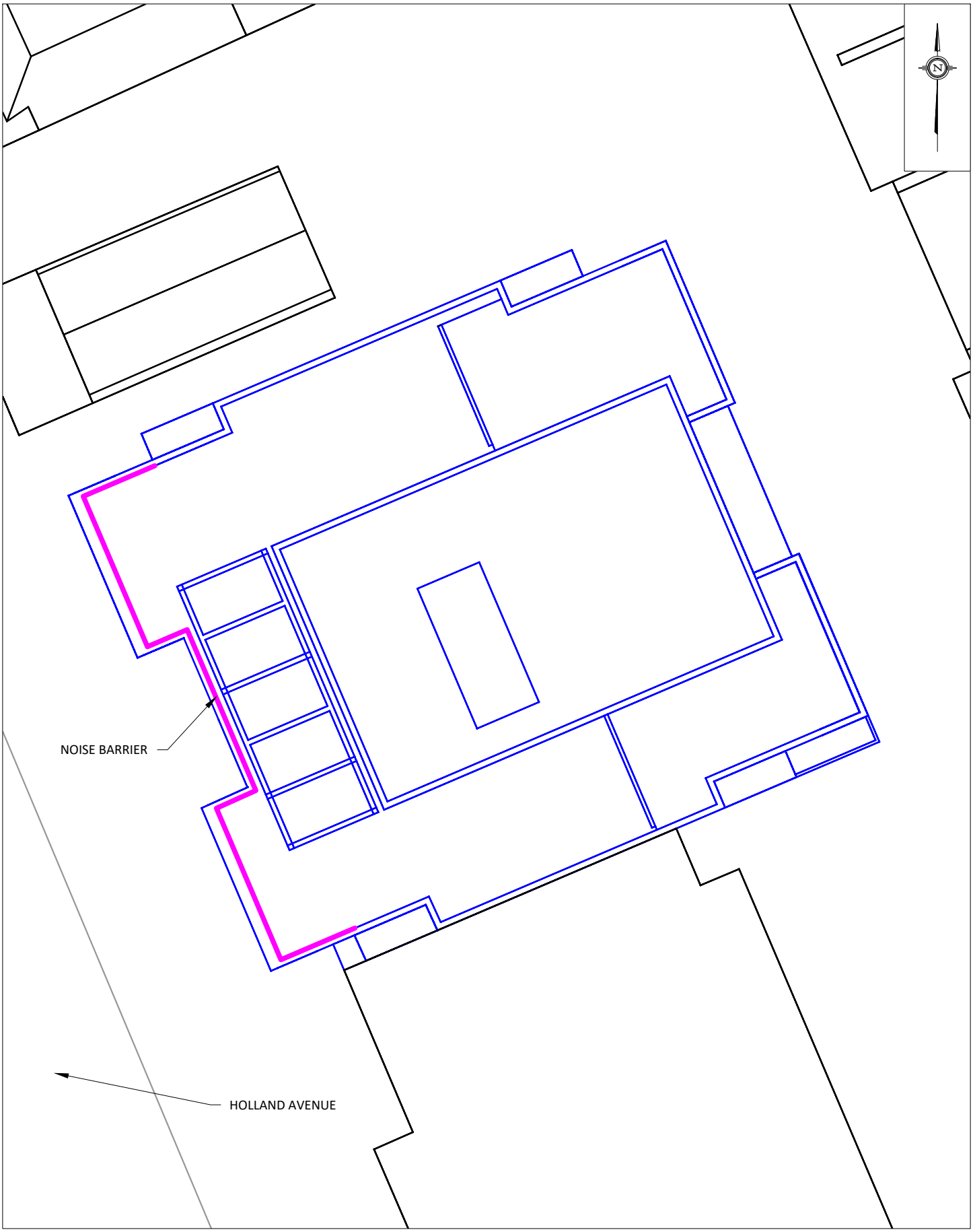
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:200 (APPROX.)	DRAWING NO. GWE21-033-7	FIGURE 7: WINDOW STC REQUIREMENTS
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	



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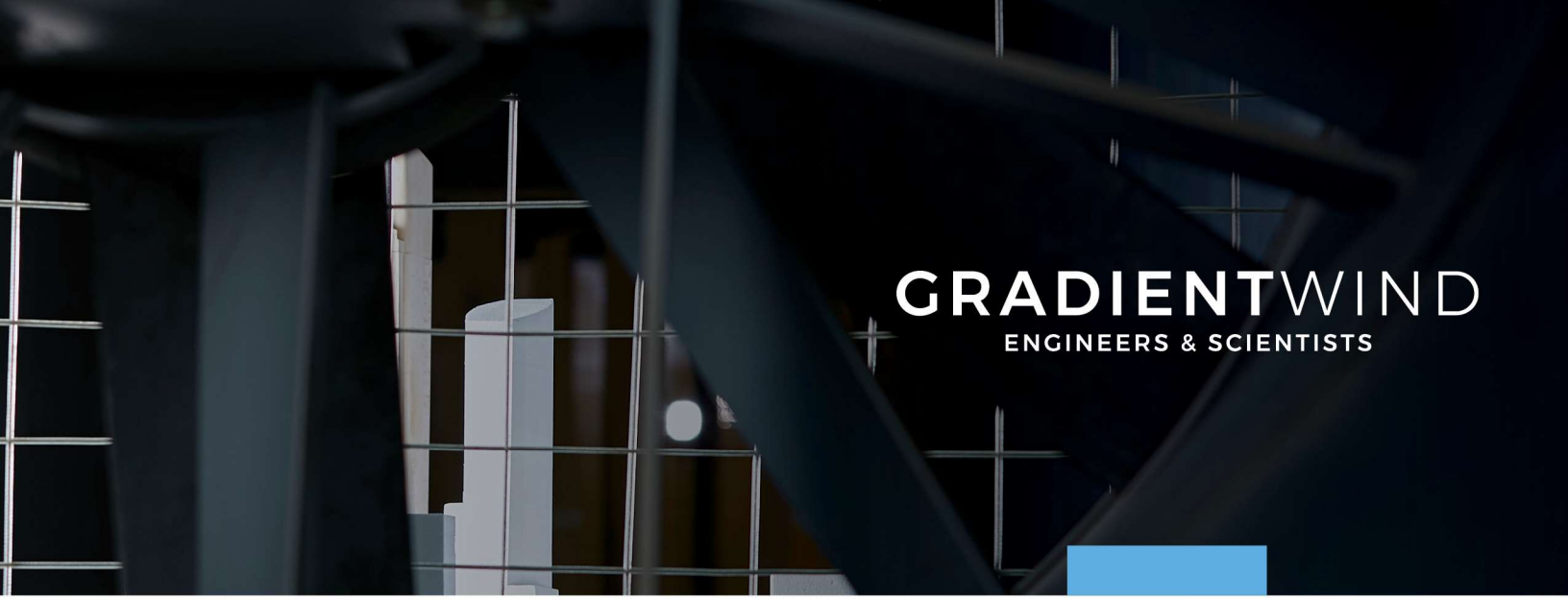
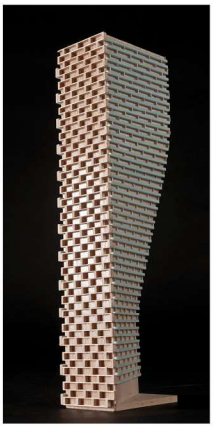
PROJECT	91 - 93 HOLLAND AVENUE, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:200 (APPROX.)	DRAWING NO. GWE21-033-8	FIGURE 8: NOISE BARRIER INVESTIGATION
DATE	APRIL 30, 2021	DRAWN BY T.M.F.	





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: 29-04-2021 12:01:37
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: HOLLAND (day/night)
-------------------------------------------
Car traffic volume  : 19430/1690  veh/TimePeriod  *
Medium truck volume :  1546/134   veh/TimePeriod  *
Heavy truck volume  :  1104/96    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):  24000
    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: HOLLAND (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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: WELLINGTON (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
```

```
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: WELLINGTON (day/night)
---------------------------------------------
Angle1   Angle2           :   0.00 deg   61.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  88.00 / 88.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  18.00 deg   Angle2 : 42.00 deg
Barrier height            :  18.00 m
Barrier receiver distance :  76.00 / 76.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 70.52 + 0.00) = 70.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  70.52   0.00   0.00   0.00   0.00   0.00   0.00
70.52
--------------------------------------------------------------------------
--

Segment Leq : 70.52 dBA

Results segment # 2: WELLINGTON (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 !       16.50 !        4.91 !         4.91

ROAD (49.00 + 30.25 + 49.24) = 52.16 dBA
```

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------
--
     0     18   0.00  66.69   0.00  -7.68 -10.00   0.00   0.00   0.00
49.00
-----------------------------------------------------------------------
--
    18     42   0.00  66.69   0.00  -7.68  -8.75   0.00   0.00 -20.00
30.25
-----------------------------------------------------------------------
--
    42     61   0.00  66.69   0.00  -7.68  -9.77   0.00   0.00   0.00
49.24
-----------------------------------------------------------------------
--

Segment Leq : 52.16 dBA

Total Leq All Segments: 70.58 dBA

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

Source height = 1.50 m

ROAD (0.00 + 62.92 + 0.00) = 62.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------
--
   -90     90   0.00  62.92   0.00   0.00   0.00   0.00   0.00   0.00
62.92
-----------------------------------------------------------------------
--

Segment Leq : 62.92 dBA

Results segment # 2: WELLINGTON (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 !       16.50 !        4.91 !         4.91

ROAD (41.41 + 22.65 + 41.64) = 44.56 dBA
```

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     18   0.00  59.09   0.00  -7.68 -10.00   0.00   0.00   0.00
41.41
-------------------------------------------------------------------------
--
    18     42   0.00  59.09   0.00  -7.68  -8.75   0.00   0.00 -20.00
22.65
-------------------------------------------------------------------------
--
    42     61   0.00  59.09   0.00  -7.68  -9.77   0.00   0.00   0.00
41.64
-------------------------------------------------------------------------
--

Segment Leq : 44.56 dBA

Total Leq All Segments: 62.98 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.58
                          (NIGHT): 62.98
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-04-2021 13:54:51
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: HOLLAND (day/night)
-------------------------------------------
Car traffic volume  : 19430/1690  veh/TimePeriod  *
Medium truck volume :  1546/134   veh/TimePeriod  *
Heavy truck volume  :  1104/96    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):  24000
    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: HOLLAND (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  :  16.00 / 16.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 67.23 + 0.00) = 67.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.00  70.52   0.00  -0.28  -3.01   0.00   0.00   0.00
67.23
--------------------------------------------------------------------------
--

Segment Leq : 67.23 dBA
```

```
Total Leq All Segments: 67.23 dBA

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

Source height = 1.50 m

ROAD (0.00 + 59.63 + 0.00) = 59.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     0     90   0.00  62.92   0.00  -0.28  -3.01   0.00   0.00   0.00
59.63
--------------------------------------------------------------------------
--

Segment Leq : 59.63 dBA

Total Leq All Segments: 59.63 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.23
                         (NIGHT): 59.63
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-04-2021 13:55:51
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: WELLINGTON1 (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: WELLINGTON1 (day/night)
---------------------------------------------
Angle1   Angle2           : -90.00 deg   -24.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -24.00 deg
Barrier height            :  19.00 m
Barrier receiver distance :  18.00 / 18.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: WELLINGTON2 (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: WELLINGTON2 (day/night)
---------------------------------------------
Angle1   Angle2           : -24.00 deg   -3.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  85.00 / 85.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -24.00 deg   Angle2 : -3.00 deg
Barrier height            :   4.00 m
Barrier receiver distance :  74.00 / 74.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: WELLINGTON1 (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 !       16.50 !       19.58 !        19.58

ROAD (0.00 + 55.96 + 0.00) = 55.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -24   0.00  66.69   0.00  -6.37  -4.36   0.00   0.00  -4.71
51.25*
   -90    -24   0.00  66.69   0.00  -6.37  -4.36   0.00   0.00   0.00
55.96
-------------------------------------------------------------------------
--

 * Bright Zone !
```

```
Segment Leq : 55.96 dBA

Results segment # 2: WELLINGTON2 (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 !       16.50 !        4.73 !         4.73

ROAD (0.00 + 49.82 + 0.00) = 49.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -24     -3   0.00  66.69   0.00  -7.53  -9.33   0.00   0.00  -3.57
46.26*
   -24     -3   0.00  66.69   0.00  -7.53  -9.33   0.00   0.00   0.00
49.82
--------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 49.82 dBA

Total Leq All Segments: 56.91 dBA

Results segment # 1: WELLINGTON1 (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 !       16.50 !       19.58 !        19.58

ROAD (0.00 + 48.36 + 0.00) = 48.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
```

```
   -90    -24   0.00  59.09   0.00  -6.37  -4.36   0.00   0.00  -4.71
43.66*
   -90    -24   0.00  59.09   0.00  -6.37  -4.36   0.00   0.00   0.00
48.36
-----------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 48.36 dBA

Results segment # 2: WELLINGTON2 (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 !       16.50 !        4.73 !         4.73

ROAD (0.00 + 42.23 + 0.00) = 42.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----------------------------------------------------------------------------
--
   -24     -3   0.00  59.09   0.00  -7.53  -9.33   0.00   0.00  -3.57
38.66*
   -24     -3   0.00  59.09   0.00  -7.53  -9.33   0.00   0.00   0.00
42.23
-----------------------------------------------------------------------------
--

 * Bright Zone !

Segment Leq : 42.23 dBA

Total Leq All Segments: 49.31 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 56.91
                         (NIGHT): 49.31
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-04-2021 15:24:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: HOLLAND (day/night)
-------------------------------------------
Car traffic volume  : 19430/1690  veh/TimePeriod  *
Medium truck volume :  1546/134   veh/TimePeriod  *
Heavy truck volume  :  1104/96    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):  24000
    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: HOLLAND (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  :  17.00 / 17.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  29.10 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: WELLINGTON (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: WELLINGTON (day/night)
--------------------------------------------
Angle1   Angle2           :   8.00 deg   58.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  94.00 / 94.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 58.00 deg
Barrier height            :  29.10 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 57.57 + 0.00) = 57.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  70.52   0.00  -0.54   0.00   0.00   0.00 -12.41
57.57
--------------------------------------------------------------------------
--

Segment Leq : 57.57 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 47.78 + 0.00) = 47.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  66.69   0.00  -7.97  -5.56   0.00   0.00  -5.37
47.78
--------------------------------------------------------------------------
--

Segment Leq : 47.78 dBA

Total Leq All Segments: 58.00 dBA

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 49.97 + 0.00) = 49.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  62.92   0.00  -0.54   0.00   0.00   0.00 -12.41
49.97
--------------------------------------------------------------------------
--

Segment Leq : 49.97 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 40.19 + 0.00) = 40.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  59.09   0.00  -7.97  -5.56   0.00   0.00  -5.37
40.19
--------------------------------------------------------------------------
--

Segment Leq : 40.19 dBA

Total Leq All Segments: 50.40 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 58.00
                         (NIGHT): 50.40
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-04-2021 15:26:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4b.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HOLLAND (day/night)
-------------------------------------------
Car traffic volume  : 19430/1690  veh/TimePeriod  *
Medium truck volume :  1546/134   veh/TimePeriod  *
Heavy truck volume  :  1104/96    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):  24000
    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: HOLLAND (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  :  17.00 / 17.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  19.50 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: WELLINGTON (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: WELLINGTON (day/night)
--------------------------------------------
Angle1   Angle2           :   8.00 deg   58.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  94.00 / 94.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 58.00 deg
Barrier height            :  19.50 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 56.36 + 0.00) = 56.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  70.52   0.00  -0.54   0.00   0.00   0.00 -13.62
56.36
--------------------------------------------------------------------------
--

Segment Leq : 56.36 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 45.33 + 0.00) = 45.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  66.69   0.00  -7.97  -5.56   0.00   0.00  -7.83
45.33
--------------------------------------------------------------------------
--

Segment Leq : 45.33 dBA

Total Leq All Segments: 56.69 dBA

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 48.76 + 0.00) = 48.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  62.92   0.00  -0.54   0.00   0.00   0.00 -13.62
48.76
--------------------------------------------------------------------------
--

Segment Leq : 48.76 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 37.73 + 0.00) = 37.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  59.09   0.00  -7.97  -5.56   0.00   0.00  -7.83
37.73
--------------------------------------------------------------------------
--

Segment Leq : 37.73 dBA

Total Leq All Segments: 49.09 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 56.69
                         (NIGHT): 49.09
```

```
STAMSON 5.0        NORMAL REPORT        Date: 29-04-2021 15:43:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4b2.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HOLLAND (day/night)
-------------------------------------------
Car traffic volume  : 19430/1690  veh/TimePeriod  *
Medium truck volume :  1546/134   veh/TimePeriod  *
Heavy truck volume  :  1104/96    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):  24000
    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: HOLLAND (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  :  17.00 / 17.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Road data, segment # 2: WELLINGTON (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  :    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):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: WELLINGTON (day/night)
--------------------------------------------
Angle1   Angle2           :   8.00 deg   58.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  94.00 / 94.00  m
Receiver height           :  19.50 / 19.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   8.00 deg   Angle2 : 58.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 54.96 + 0.00) = 54.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  70.52   0.00  -0.54   0.00   0.00   0.00 -15.02
54.96
--------------------------------------------------------------------------
--

Segment Leq : 54.96 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 41.58 + 0.00) = 41.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  66.69   0.00  -7.97  -5.56   0.00   0.00 -11.57
41.58
--------------------------------------------------------------------------
--

Segment Leq : 41.58 dBA

Total Leq All Segments: 55.15 dBA

Results segment # 1: HOLLAND (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 !       19.50 !       26.21 !        26.21

ROAD (0.00 + 47.36 + 0.00) = 47.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  62.92   0.00  -0.54   0.00   0.00   0.00 -15.02
47.36
--------------------------------------------------------------------------
--

Segment Leq : 47.36 dBA

Results segment # 2: WELLINGTON (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 !       19.50 !       28.90 !        28.90

ROAD (0.00 + 33.99 + 0.00) = 33.99 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
     8     58   0.00  59.09   0.00  -7.97  -5.56   0.00   0.00 -11.57
33.99
--------------------------------------------------------------------------
--

Segment Leq : 33.99 dBA

Total Leq All Segments: 47.56 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.15
                         (NIGHT): 47.56
```