GRADIENTWIND
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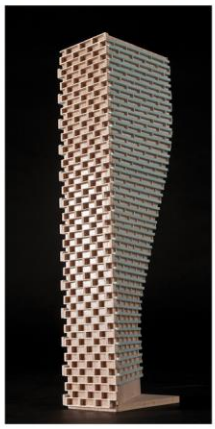
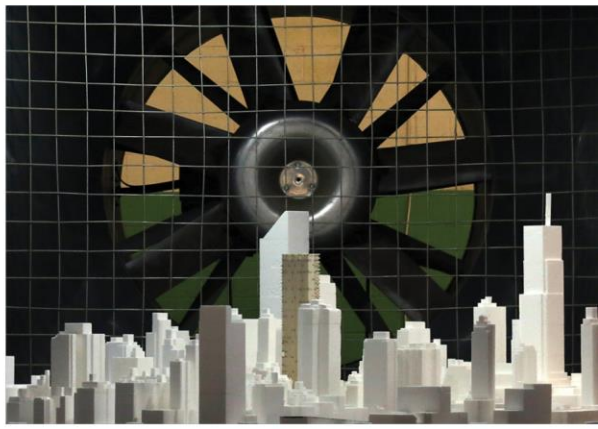
TRAFFIC NOISE ASSESSMENT

455 Wanaki Road
Ottawa, Ontario

REPORT: GWE19-090 – Traffic Noise R1





September 9, 2019

PREPARED FOR

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EXECUTIVE SUMMARY

This report describes a traffic noise assessment undertaken in support of site plan application for a proposed residential development at 455 Wanaki Road in Ottawa, Ontario. The development is an apartment of stacked townhouses in an "L" shape plan form. An outdoor amenity area is provided on the west side of the building. The major sources of traffic noise are Wanaki to the east of the site. 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) site plan drawings prepared by CSV Architects dated April 15 2019.

The results of the current analysis indicate that noise levels will range between 45 and 63 dBA during the daytime period (07:00-23:00) and between 41 and 55 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east facade, which is nearest and most exposed to Wanaki Road. Building components in compliance with the Ontario Building Code will be sufficient to ensure indoor sound levels remain below the ENCG criteria when windows are closed. The development will require a forced air heating system designed to accommodate central air conditioning, to be installed at the building owners discretion and would allow occupants to keep windows closed and maintain a comfortable living environment. Warning clauses as drafted in Section 6 will be required to be placed on all purchase, sale, and lease agreements.

With regards to stationary noise impacts, the building is expected to be serviced by several small heating air conditioning units. Given the setback distance to surrounding noise-sensitive properties, impacts are expected to be insignificant.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Colonnade Bridgeport on behalf of Habitat for Humanity to undertake a traffic noise assessment in support of site plan application for a proposed residential development at 455 Wanaki Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings prepared by CSV Architects dated April 15, 2019, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this traffic noise assessment is a proposed Habitat for Humanity housing development at the intersection of Wanaki Road and Provender Ave. The study site is located on the edge of a residential subdivision in an infill lot. The site is bounded by Wanaki Road to the east, Provender Ave to the south, Burma Road to the west and north.

The proposed development is an apartment building intended for Habitat for Humanity's families. The floor plate is in an 'L' shape with access to the buildings off Wanaki Road. Shared parking lot and amenity space is contained on the east side of the site. Other than the shared amenity area there are no other outdoor living areas located on site. The site is surrounded by low-rise residential buildings to the east. Vacant land and open space to the north and south. Open space and the institutional land use to the west.

The major sources of noise are related to traffic along the major collector, Wanaki Road. All other surrounding streets are local and insignificant sources of noise. There are no other arterial or collector

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

streets within 100 metres of the study site which would need consideration as per ENCG Section 2.1. 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 45 and 40 dBA for living rooms and sleeping quarters respectively for roadway as listed in Table 1.

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

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 10dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[6].

Although not relevant for this study, the sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation must be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion.

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[6] MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Roadway Noise Predictions

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

Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be absorptive due to the presence of grass lands (soft) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- Receptor height was taken to be 4.5 metres at Level 2 for the centre of the window
- For the amenity area the proposed building was considered to be acting as a barrier obstructing the line of sight between the source and receiver. The assumed barrier height of 6 meter, was used in the calculation.
- Noise receptors were strategically placed at 5 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 3-5.

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

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

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Wanaki Road	2 Lane Major Collector	50	**12,000**

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.

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[8] considers:

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

[8] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

Based on published research[9], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for site plan approval, 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. 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	4.5	POW – North end of Building	60	52
2	4.5	POW – East side of the building	63	55
3	4.5	POW – Amenity Area,	48	41
4	4.5	POW – North side of the building	59	52
5	4.5	POW – West side of building	45	45

The results of the current analysis indicate that noise levels will range between 45 and 63 dBA during the daytime period (07:00-23:00) and between 41 and 55 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east façade, which is nearest and most exposed to Wanaki Road.

[9] CMHC, Road & Rail Noise: Effects on Housing

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic do not exceed the criteria listed in Section 4.2 for building components. Therefore, window and exterior walls in compliance with the Ontario Building Code will be sufficient to attenuate indoor sound levels assuming windows are closed. However, a forced air heating system designed for the provisions of adding a central air conditioning system are required for this development. It installed by the homeowner air conditioning would allow occupants to keep windows closed thereby ensuring a comfortable and quite indoor environment. Noise levels at the north amenity space (Receptor 4) exceed 55 dBA but fall below 60 dBA. Because the dwelling occupants have adequate outdoor living area behind the building (Receptor 5), barriers are not required. 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 45 and 63 dBA during the daytime period (07:00-23:00) and between 41 and 55 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east facade, which is nearest and most exposed to Wanaki Road.

Results of the calculations also indicate that building components in compliance with the Ontario Building Code will be sufficient to ensure indoor sound levels remain below the ENCG criteria when windows are closed. The development will require a forced air heating system designed to accommodate central air conditioning, to be installed at the building owners discretion and would allow occupants to keep windows closed and maintain a comfortable living environment. Per the City of Ottawa, the following Warning Clause[10] will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *"Purchasers/tenants are advised that sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.*
>
> *This dwelling unit has also been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning will allow*

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

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 Environment, Conservation and Parks."

Noise levels at the north amenity space (Receptor 4) exceed 55 dBA but fall below 60 dBA. Because the dwelling occupants have adequate outdoor living area behind the building (Receptor 5), barriers are not required.

With regards to stationary noise impacts, the building is expected to be serviced by several small heating and air conditioning units. Given the setback distance to surrounding noise-sensitive properties, impacts are expected to be insignificant.

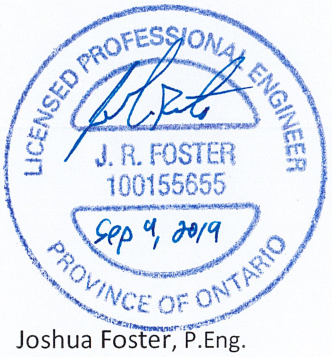
This concludes our traffic noise assessment and report. If you have any questions or wish to discuss our findings, please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

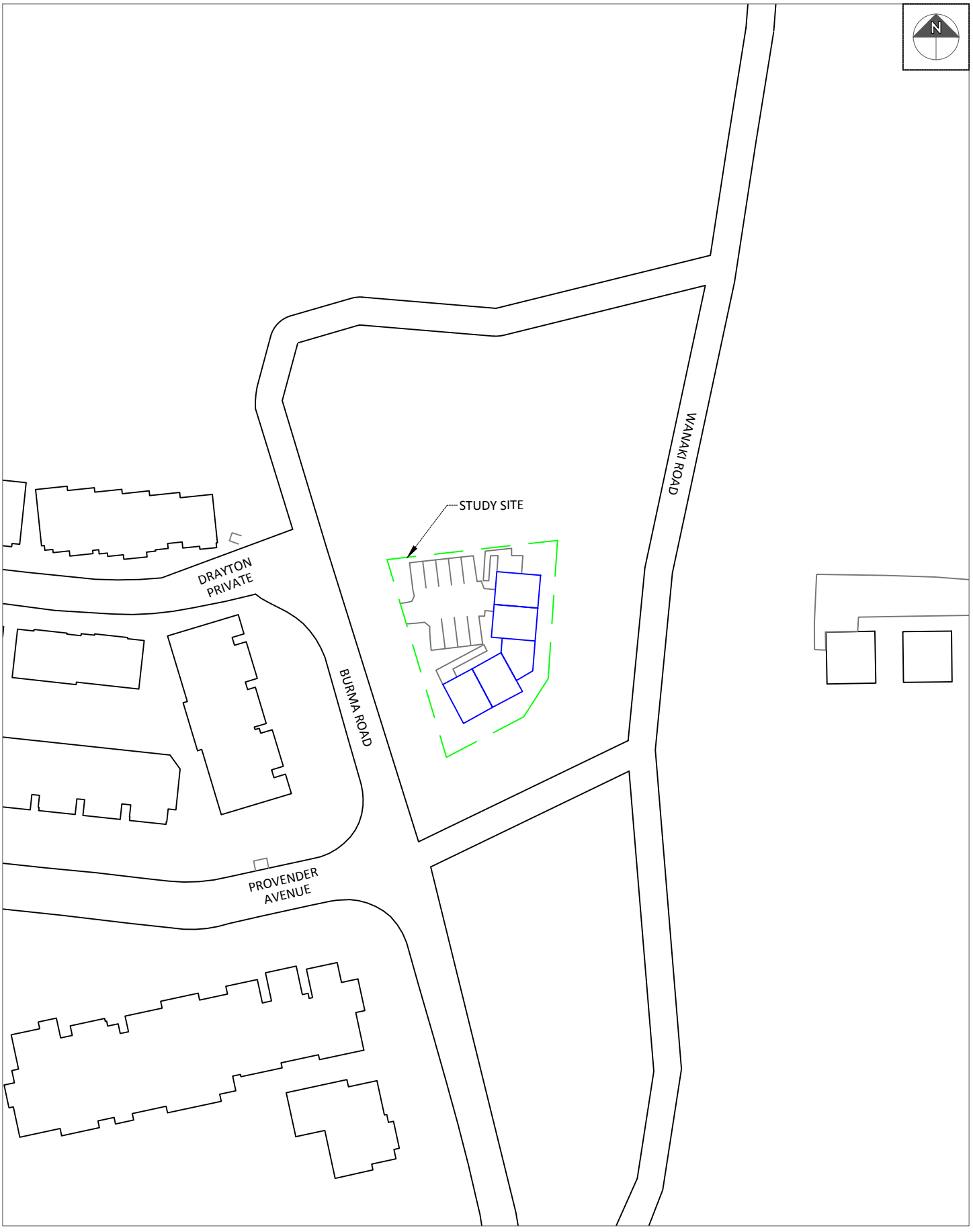
P.P.

Cindy Hachem
Junior Environmental Scientist



Joshua Foster, P.Eng.
Principal

GWE19-090 – Traffic Noise R1



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PROJECT	HABITAT FOR HUMANITY - TRAFFIC NOISE STUDY		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE19-090-1
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 1:
STUDY SITE

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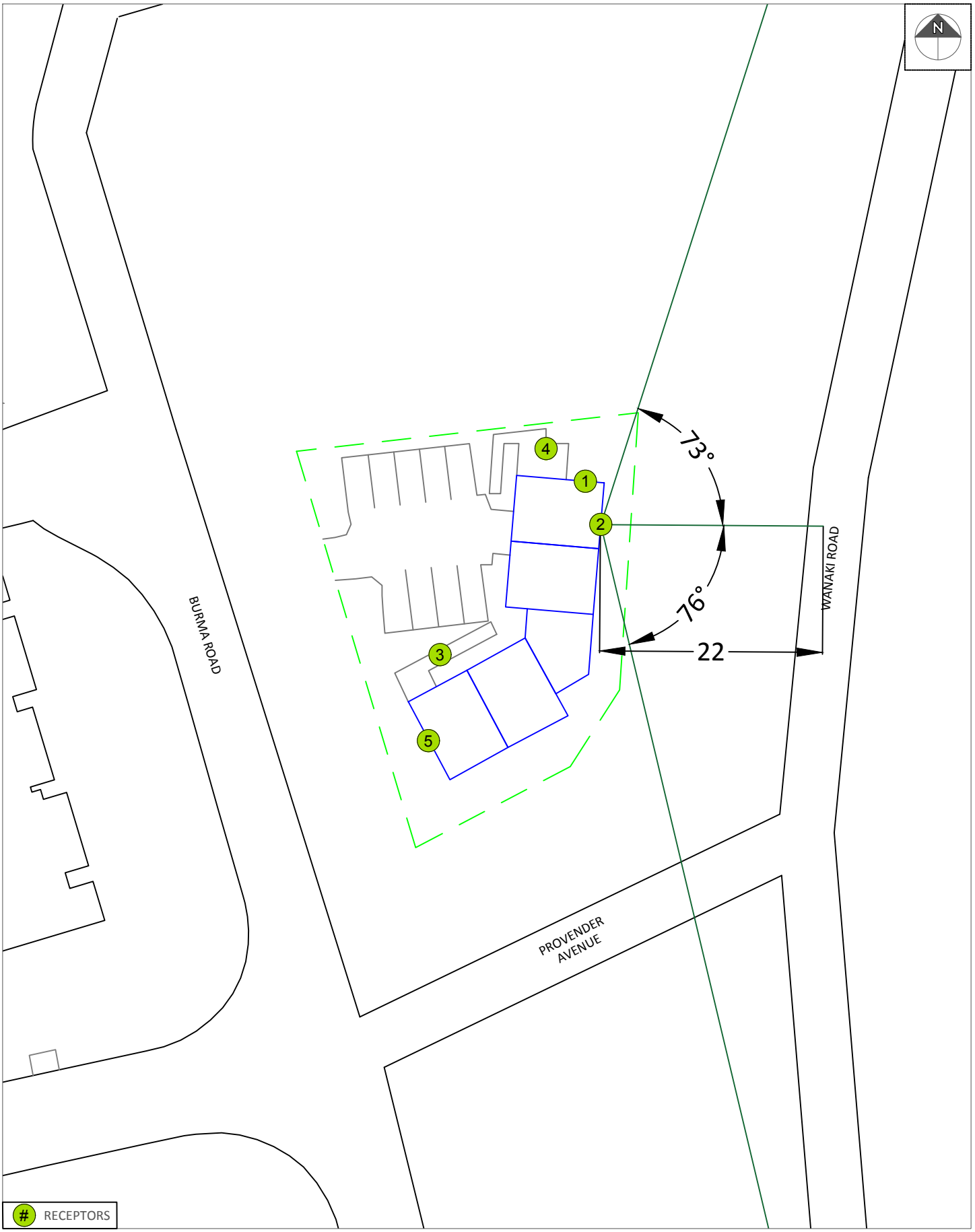
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-090-2
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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PROJECT	HABITAT FOR HUMANITY - TRAFFIC NOISE STUDY		
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-090-3
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 3:
RECEPTOR 2

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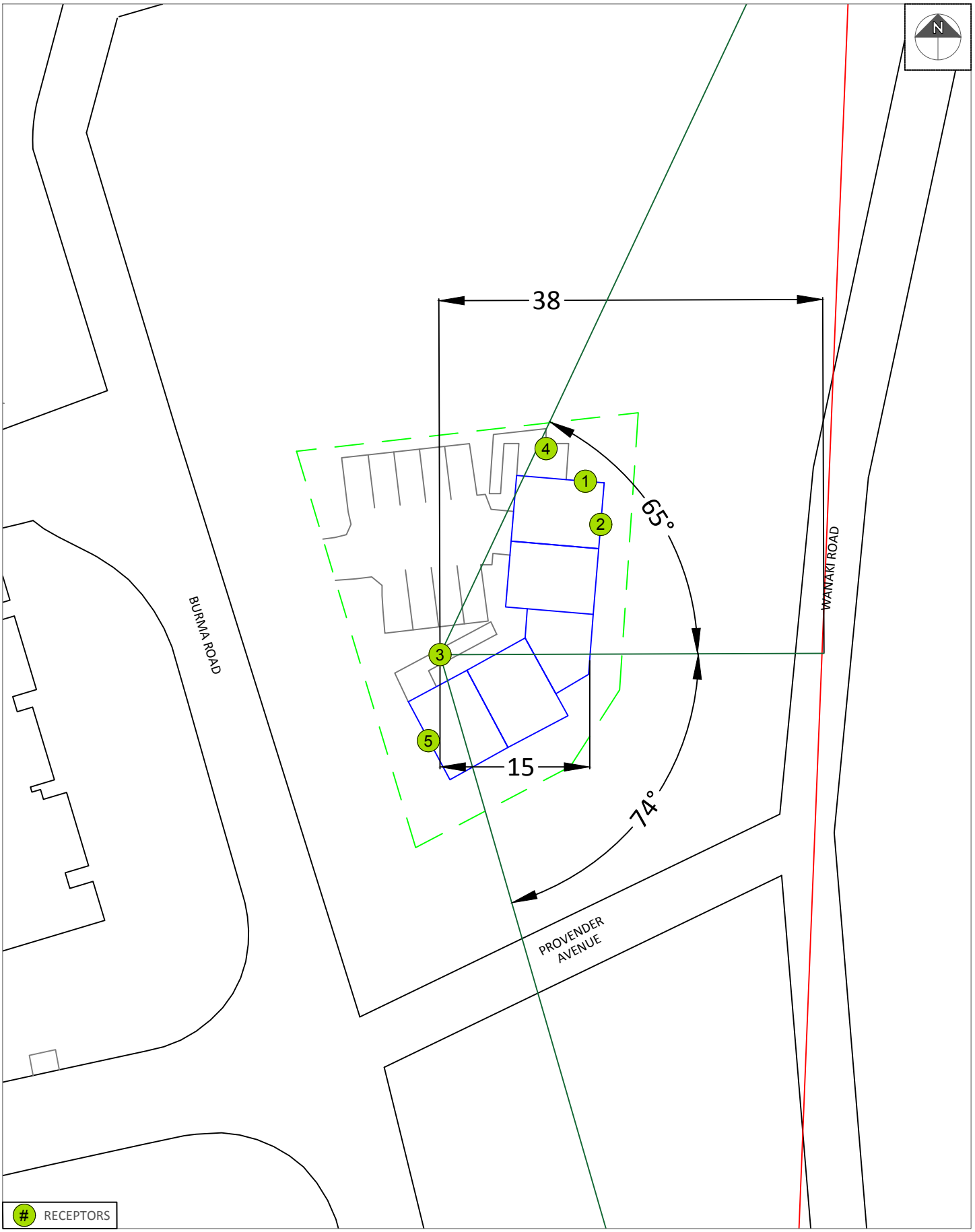
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-090-4
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 4:
RECEPTOR 4



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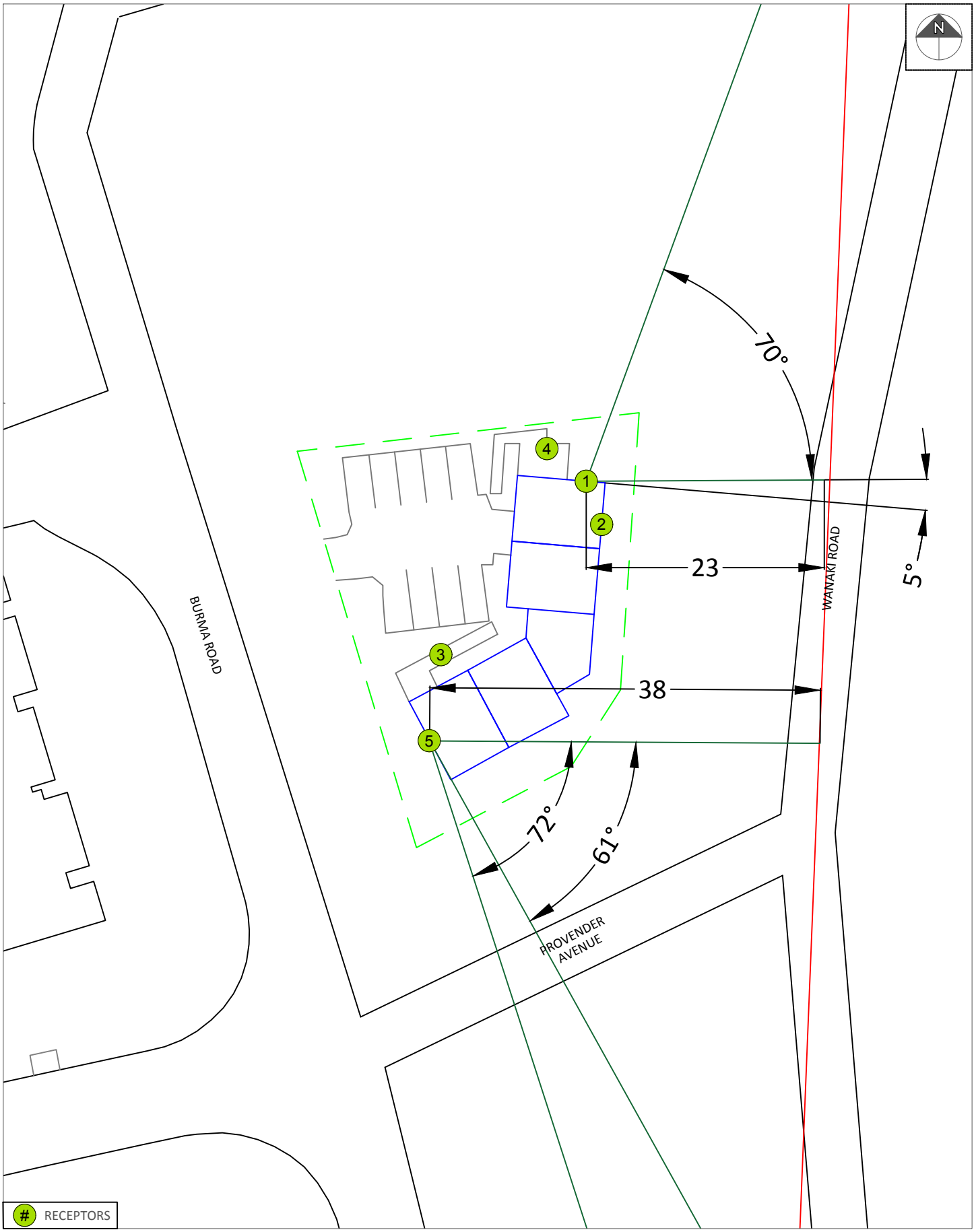
PROJECT	HABITAT FOR HUMANITY - TRAFFIC NOISE STUDY		
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-090-5
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 5:
RECEPTOR 3



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PROJECT	HABITAT FOR HUMANITY - TRAFFIC NOISE STUDY		
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-090-6
DATE	AUGUST 29, 2019	DRAWN BY	C.H.

DESCRIPTION

FIGURE 6:
RECEPTORS 1 AND 5

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: 16-05-2019 11:18:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Wanaki (day/night)
-----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Wanaki (day/night)
----------------------------------------
Angle1   Angle2           : -70.00 deg   5.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  23.37 / 23.37  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 60.04 + 0.00) = 60.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -70      5   0.57  67.51   0.00  -3.02  -4.44   0.00   0.00   0.00  60.04
-------------------------------------------------------------------------

Segment Leq : 60.04 dBA

Total Leq All Segments: 60.04 dBA

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

Source height = 1.50 m

ROAD (0.00 + 52.45 + 0.00) = 52.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -70      5   0.57  59.91   0.00  -3.02  -4.44   0.00   0.00   0.00  52.45
-------------------------------------------------------------------------

Segment Leq : 52.45 dBA

Total Leq All Segments: 52.45 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.04 dBA
                           (NIGHT): 52.45 dBA
```

```
STAMSON 5.0        NORMAL REPORT        Date: 16-05-2019 11:56:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Wanaki (day/night)
-----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Wanaki (day/night)
----------------------------------------
Angle1   Angle2           : -73.00 deg   76.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  21.90 / 21.90  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 63.31 + 0.00) = 63.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -73     76   0.57  67.51   0.00  -2.58  -1.62   0.00   0.00   0.00  63.31
-------------------------------------------------------------------------

Segment Leq : 63.31 dBA

Total Leq All Segments: 63.31 dBA

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

Source height = 1.50 m

ROAD (0.00 + 55.71 + 0.00) = 55.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -73     76   0.57  59.91   0.00  -2.58  -1.62   0.00   0.00   0.00  55.71
-------------------------------------------------------------------------

Segment Leq : 55.71 dBA

Total Leq All Segments: 55.71 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.31 dBA
                           (NIGHT): 55.71 dBA
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-05-2019 09:35:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Wanaki (day/night)
-------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Wanaki (day/night)
----------------------------------------
Angle1   Angle2           : -65.00 deg   74.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  37.70 / 37.70  m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -65.00 deg   Angle2 : 74.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  14.70 / 14.70  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Wanaki (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 !        4.50 !        3.33 !         3.33

ROAD (0.00 + 48.98 + 0.00) = 48.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -65     74   0.21  67.51   0.00  -4.84  -1.39   0.00   0.00 -12.30  48.98
-------------------------------------------------------------------------

Segment Leq : 48.98 dBA

Total Leq All Segments: 48.98 dBA

Results segment # 1: Wanaki (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 !        3.33 !         3.33

ROAD (0.00 + 41.38 + 0.00) = 41.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -65     74   0.21  59.91   0.00  -4.84  -1.39   0.00   0.00 -12.30  41.38
-------------------------------------------------------------------------

Segment Leq : 41.38 dBA

Total Leq All Segments: 41.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 48.98
                           (NIGHT): 41.38
```

```
STAMSON 5.0         NORMAL REPORT         Date: 29-08-2019 11:14:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Wanaki (day/night)
-----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Wanaki (day/night)
----------------------------------------
Angle1   Angle2           : -76.00 deg   46.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  20.00 deg   Angle2 : 46.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

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

ROAD (59.28 + 35.51 + 0.00) = 59.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -76     20   0.66  67.51   0.00  -4.75  -3.48   0.00   0.00   0.00  59.28
-------------------------------------------------------------------------------
    20     46   0.30  67.51   0.00  -3.72  -8.65   0.00   0.00 -19.64  35.51
-------------------------------------------------------------------------------

Segment Leq : 59.30 dBA

Total Leq All Segments: 59.30 dBA


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

Source height = 1.50 m

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

ROAD (51.68 + 27.91 + 0.00) = 51.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -76     20   0.66  59.91   0.00  -4.75  -3.48   0.00   0.00   0.00  51.68
-------------------------------------------------------------------------------
    20     46   0.30  59.91   0.00  -3.72  -8.65   0.00   0.00 -19.64  27.91
-------------------------------------------------------------------------------

Segment Leq : 51.70 dBA

Total Leq All Segments: 51.70 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 59.30
                           (NIGHT): 51.70
```

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

Road data, segment # 1: Wanaki (day/night)
------------------------------------------
Car traffic volume  :  7040/3520  veh/TimePeriod
Medium truck volume :   560/280   veh/TimePeriod
Heavy truck volume  :   400/200   veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Wanaki (day/night)
------------------------------------------
Angle1   Angle2           :  61.00 deg   72.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  36.88 / 36.88  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 45.55 + 0.00) = 45.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
    61     72   0.57  66.11   0.00  -6.13 -14.43   0.00   0.00   0.00  45.55
-------------------------------------------------------------------------

Segment Leq : 45.55 dBA

Total Leq All Segments: 45.55 dBA

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

Source height = 1.50 m

ROAD (0.00 + 45.55 + 0.00) = 45.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
    61     72   0.57  66.11   0.00  -6.13 -14.43   0.00   0.00   0.00  45.55
-------------------------------------------------------------------------

Segment Leq : 45.55 dBA

Total Leq All Segments: 45.55 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 45.55 dBA
                           (NIGHT): 45.55 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.04 dBA
```