Traffic Noise Assessment

1545 Bank Street
Ottawa, Ontario

REPORT: GWE18-128 – Traffic Noise

Prepared For:

Michael Akinniyi
Financial Eastern Star
100-878 Boyd Avenue
Ottawa, Ontario K2A 2E3
Canada

Prepared By:

Giuseppe Garro, BASc., Junior Environmental Scientist
Joshua Foster, P.Eng., Principal

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127 Walgreen Road, Ottawa, Ontario K0A 1L0
T (613) 836-0934 ● www.gradientwind.com

EXECUTIVE SUMMARY

This document describes a traffic noise assessment in support of site plan application for a proposed residential development at 1545 Bank Street in Ottawa, Ontario. The proposed development is an eight-storey 'J'-shape planform building with 2 levels of underground parking, amenity space, retail and residential suites at grade and residential units in all the levels above. Private balconies provided as amenity space are not considered as Outdoor Living Areas (OLA) as they are less than 4-meters in depth. The major source of traffic noise is due to Bank Street to the west. 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 received from Chmiel Architect dated October 12, 2018.

The results of the current analysis indicate that noise levels will range between 64 and 70 dBA during the daytime period (07:00-23:00) and between 56 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (70 dBA) occurs on the west façade of the development, most exposed to Bank Street. Predicted noise levels due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Therefore, upgraded building components are required where noise levels exceed 65 dBA as shown in Figure 3.

In addition to upgraded building components, the development requires central air conditioning with applicable Warning Clauses. If installed, this would allow occupants to keep windows closed to maintain a quiet indoor environment. Additionally, Warning Clauses will be included in all Agreements of Lease, Purchase and Sale as described in Section 6.

With regards to stationary noise impacts from roof top mechanical units situated on the study building to the surrounding noise-sensitive areas, once the mechanical plans for the proposed building become available, a stationary noise study will be performed. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels at the surrounding noise-sensitive buildings due to mechanical equipment on the roof of the proposed building are below the City of Ottawa's Noise Guidelines.

CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Financial Eastern Star to undertake a traffic noise assessment in support of site plan application for a proposed residential development at Bank Street in Ottawa, Ontario. The development will contain 8 floors with 2 levels of underground parking, amenity space, retail and residential suites at grade and residential units in all the levels above. This report summarizes the methodology, results, and recommendations related to a traffic noise assessment. GWE's scope of work involved assessing exterior and interior noise levels generated by local roadway traffic. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks[2] guidelines. Noise calculations were based on architectural drawings received from Chmiel Architect, 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 proposed a residential development at 1545 Bank Street in Ottawa, Ontario. The development will contain 8 floors with 2 levels of underground parking, amenity space, retail and residential suites at grade and residential units in all the levels above. Additionally, amenity space is also provided in the form of private balconies on the various floors. As the private balconies are less than 4-metres in depth, they are not considered to be Outdoor Living Areas (OLA). The building planform is composed of a 'J'-shape rectangular structure with access to underground parking via a garage door located on the southeast corner of the planform. The development is oriented along the intersection of Bank Street and Evans Boulevard.

The site is surrounded in the immediate vicinity by commercial buildings to the North, West and South, and low-density residential areas to the East. The major source of traffic noise is Bank Street to the West. Figure 1 illustrates a complete site plan with surrounding context.

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

3. OBJECTIVES

The main goals of this work are to: (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 of this report.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{EQ}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{EQ} is commonly calculated on the basis of a 16-hour (L_{EQ16}) daytime (07:00-23:00) / 8-hour (L_{EQ8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 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	L_{EQ} (dBA)
		Road
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50
Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation[6].

4.3 Roadway Noise Assessment

4.3.1 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:

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

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92% / 8% respectively for all streets.
- Reflective ground surface between source and receiver for Bank Street.
- Topography assumed to be a flat/gentle slope.
- Receptor height taken to be 23.15 metres which correlates with the center of the POW at the 8th floor. Based on the drawings dated July 18, the POW locations along the West and South walls are comprised of living room areas and sleeping quarters.
- No surrounding buildings used as potential noise barriers.
- Bank Street was modelled as two line segments to account for the curvature of the road. Receptor 2 was the only receptor exposed to both segments.
- Noise receptors were strategically placed at four locations around the study area (see Figure 2).

4.4 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 value used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway / Transit Class	Speed Limit (km/h)	Traffic Volumes
Bank Street	4-UAU	50	**30,000**

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

4.5 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, concrete and masonry walls can achieve STC 50 or more. Curtain wall systems typically provide around STC 35, depending on the glazing elements. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

According to Section 4.2, when daytime noise levels (from road) 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

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).

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

[9] 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	23.15	POW – 8th Floor – North Façade	67	59
2	23.15	POW – 8th Floor – West Façade	70	63
3	23.15	POW – 8th Floor – South Façade	68	58
4	23.15	POW – 8th Floor – East Façade	64	56

The results of the current analysis indicate that noise levels will range between 64 and 70 dBA during the daytime period (07:00-23:00) and between 56 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (70 dBA) occurs on the west façade of the development, most exposed to Bank Street. Predicted noise levels due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Therefore, upgraded building components are required where noise levels exceed 65 dBA as shown in Figure 3.

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 4.5 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). It is recommended detailed STC calculations be performed 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 3):

- **Living Room Windows**

(i) Living room windows facing the North will require a minimum STC of 30

(ii) Living room windows facing West will require a minimum STC of 33

(iii) Living room windows facing the South will require a minimum STC of 30

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

- **Bedroom Windows**

(i) Bedroom windows facing the North will require a minimum STC of 33

(ii) Bedroom windows facing the West will require a minimum STC of 35

(iii) Bedroom windows facing the South will require a minimum STC of 33

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

- **Exterior Walls**

(i) Exterior wall components on the South, West and North façades require a minimum STC of 45. Wall assemblies meeting STC 45 would include steel stud walls a minimum of 92 mm deep filled with batt insulation, exterior dense glass sheathing, and a 16 mm gypsum board on the inside.

The STC requirements would apply to windows, doors, spandrel panels and curtain wall 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 to ventilation requirements, Warning Clauses will also be required to be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6 below.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 64 and 70 dBA during the daytime period (07:00-23:00) and between 56 and 63 dBA during the nighttime period (23:00-07:00). The

highest noise level (70 dBA) occurs on the west façade of the development, most exposed to Bank Street. Predicted noise levels due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Therefore, upgraded building components are required where noise levels exceed 65 dBA as shown in Figure 3.

In addition to upgraded building components, ventilation requirements dictate that the development should have central air conditioning. If installed this would allow occupants to keep windows closed to maintain a quiet indoor environment. The following Warning Clause[10] in all Agreements of Lease, Purchase and Sale will be required for these units:

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic will interfere with some activities as the sound levels exceed the sound level limits of the City and the Ministry of the Environment and Climate Change.*
>
> *To help address the need for sound attenuation this development has been designed so as to provide an indoor environment that is within provincial guidelines. Measures for sound attenuation include:*
>
> - *STC multi-pane glass glazing elements*
> - *Upgraded exterior walls achieving STC 45 or greater*
>
> *To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features.*
>
> *To ensure that provincial sound level limits are not exceeded internally, this dwelling unit has been designed with central air conditioning. The installation of central 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 and Climate Change."*

With regards to stationary noise impacts from roof top mechanical units situated on the study building to the surrounding noise-sensitive areas, once the mechanical plans for the proposed building become available, a stationary noise study will be performed. This study will include

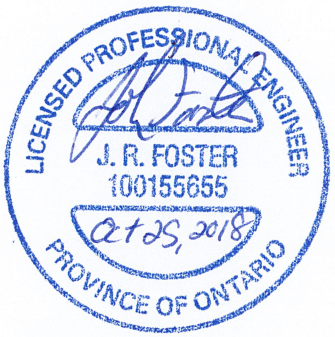
[10] City of Ottawa, Environmental Noise Control Guidelines, January 2016

recommendations for any noise control measures that may be necessary to ensure noise levels at the surrounding noise-sensitive buildings due to mechanical equipment on the roof of the proposed building are below the City of Ottawa's Noise Guidelines.

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

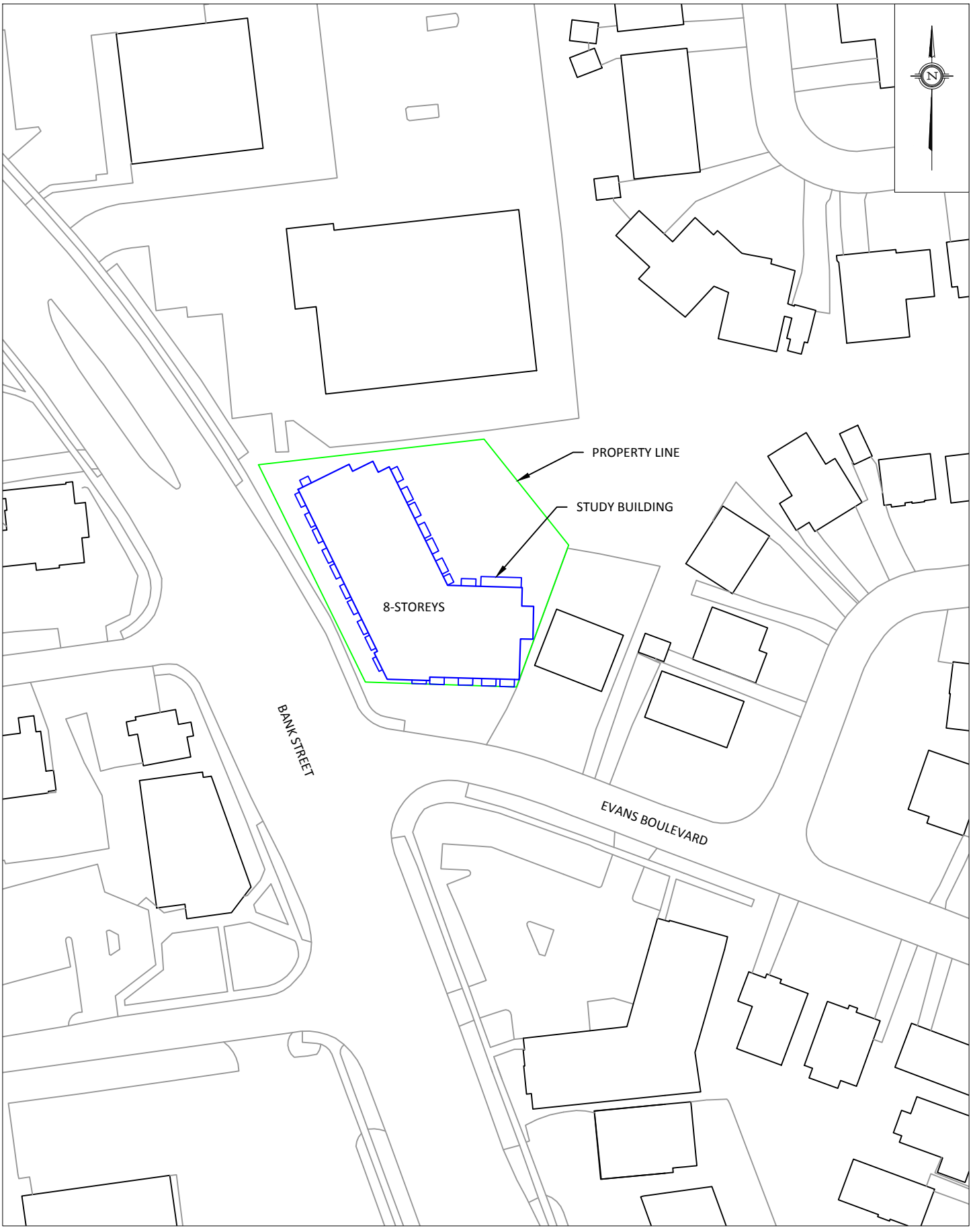
Yours truly,

Gradient Wind Engineering Inc.



Giuseppe Garro, BASc.
Junior Environmental Scientist
GWE18-128 – Traffic Noise

Joshua Foster, P.Eng.
Principal



127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

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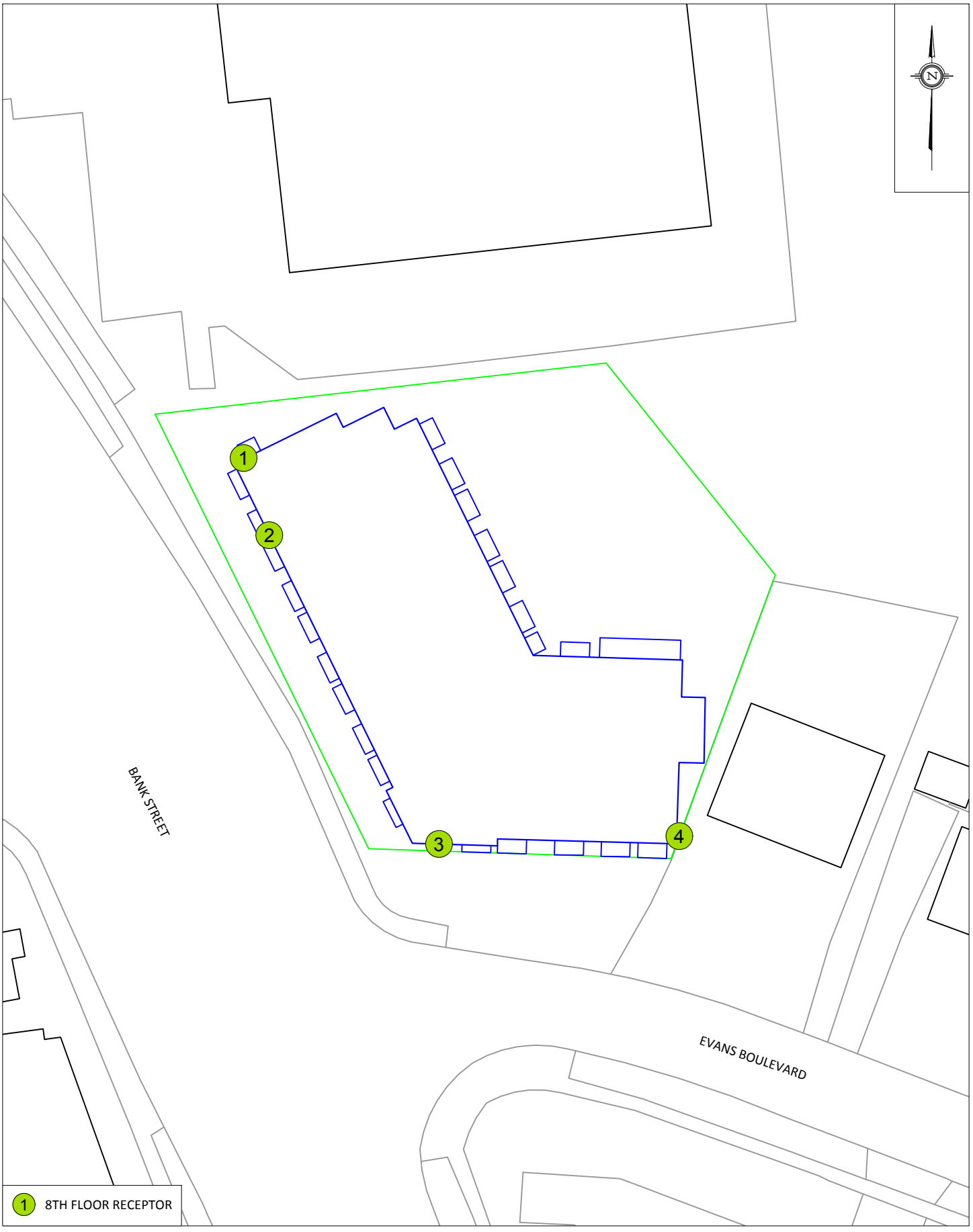
PROJECT	1545 BANK STREET - TRAFFIC NOISE STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE18-128
DATE	OCTOBER 17, 2018
DRAWN BY	G.G.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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(613) 836 0934

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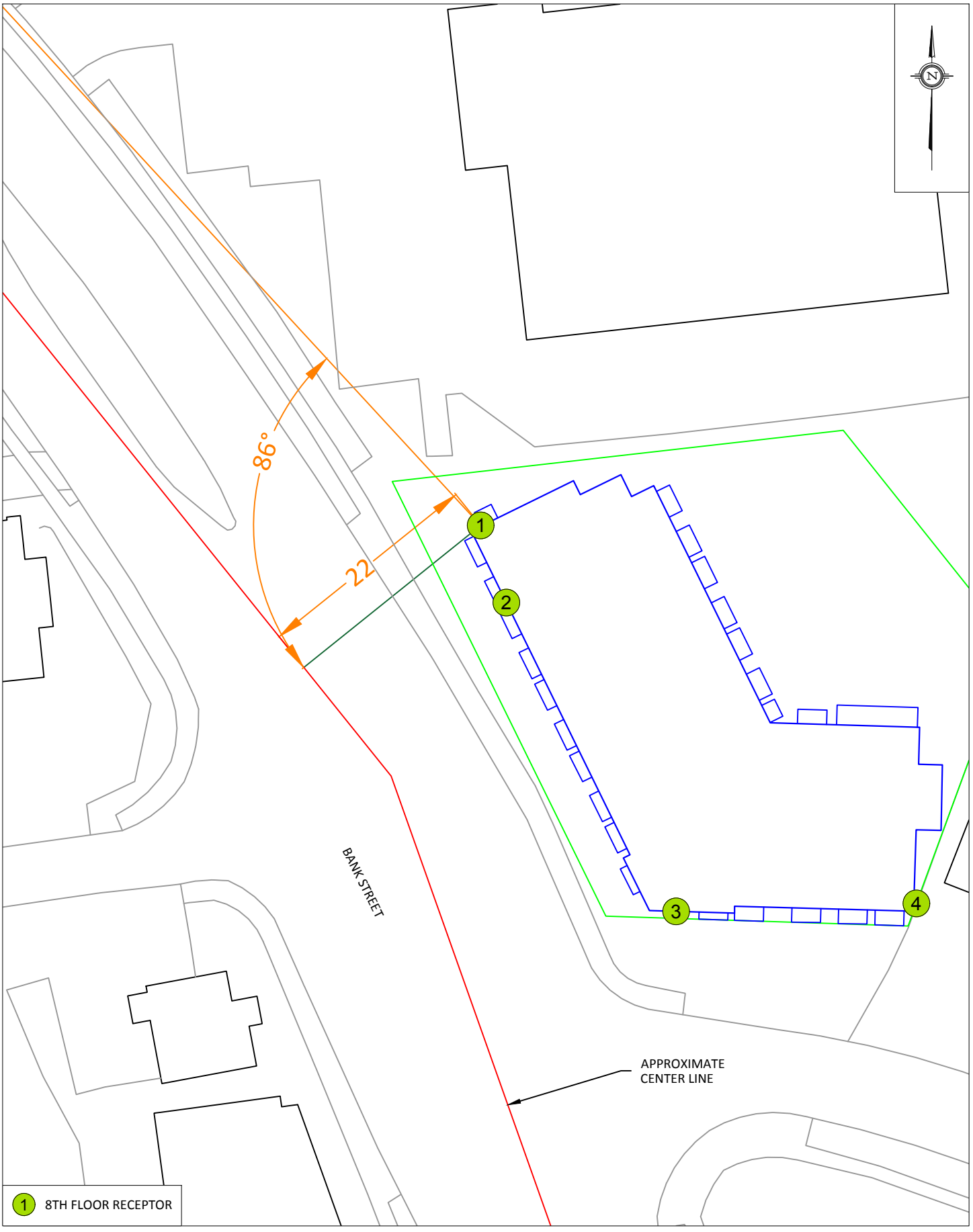
FIGURE 2:
RECEPTOR LOCATIONS



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SCALE	1:500 (APPROX.)	DRAWING NO. GWE18-128	FIGURE 3: RECEPTOR 1 STAMSON INPUT
DATE	OCTOBER 17, 2018	DRAWN BY G.G.	

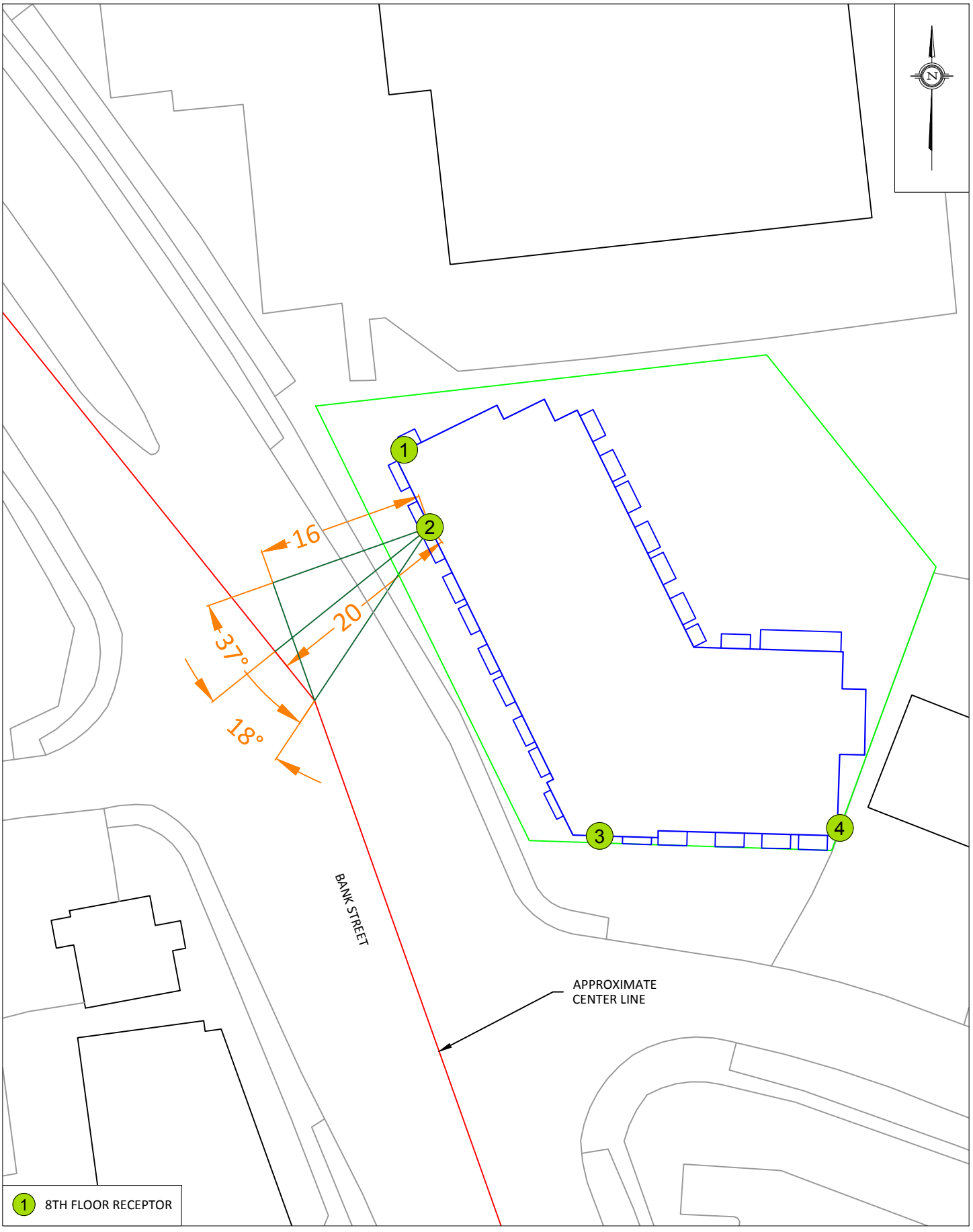

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FIGURE 4:
RECEPTOR 2 STAMSON INPUT

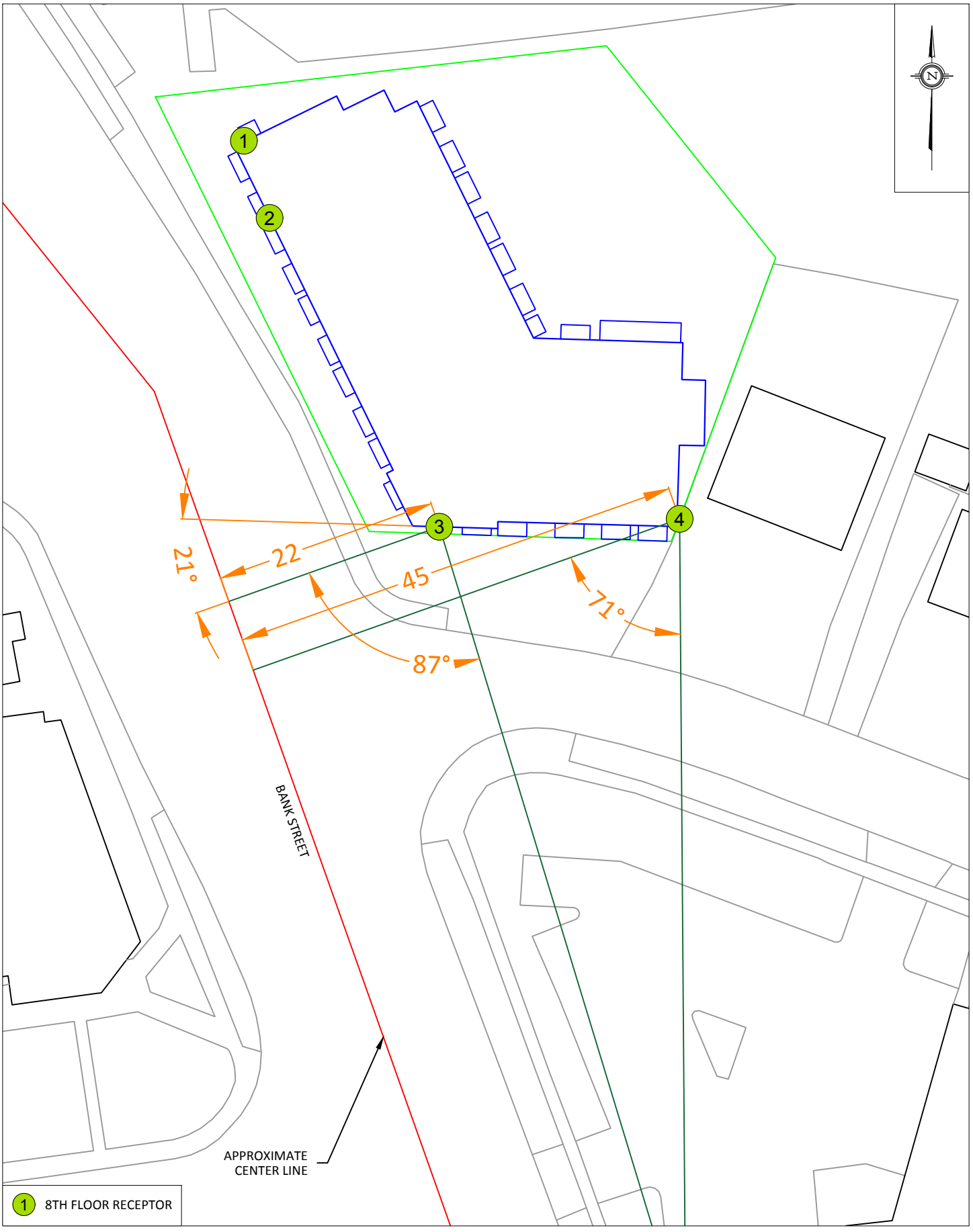

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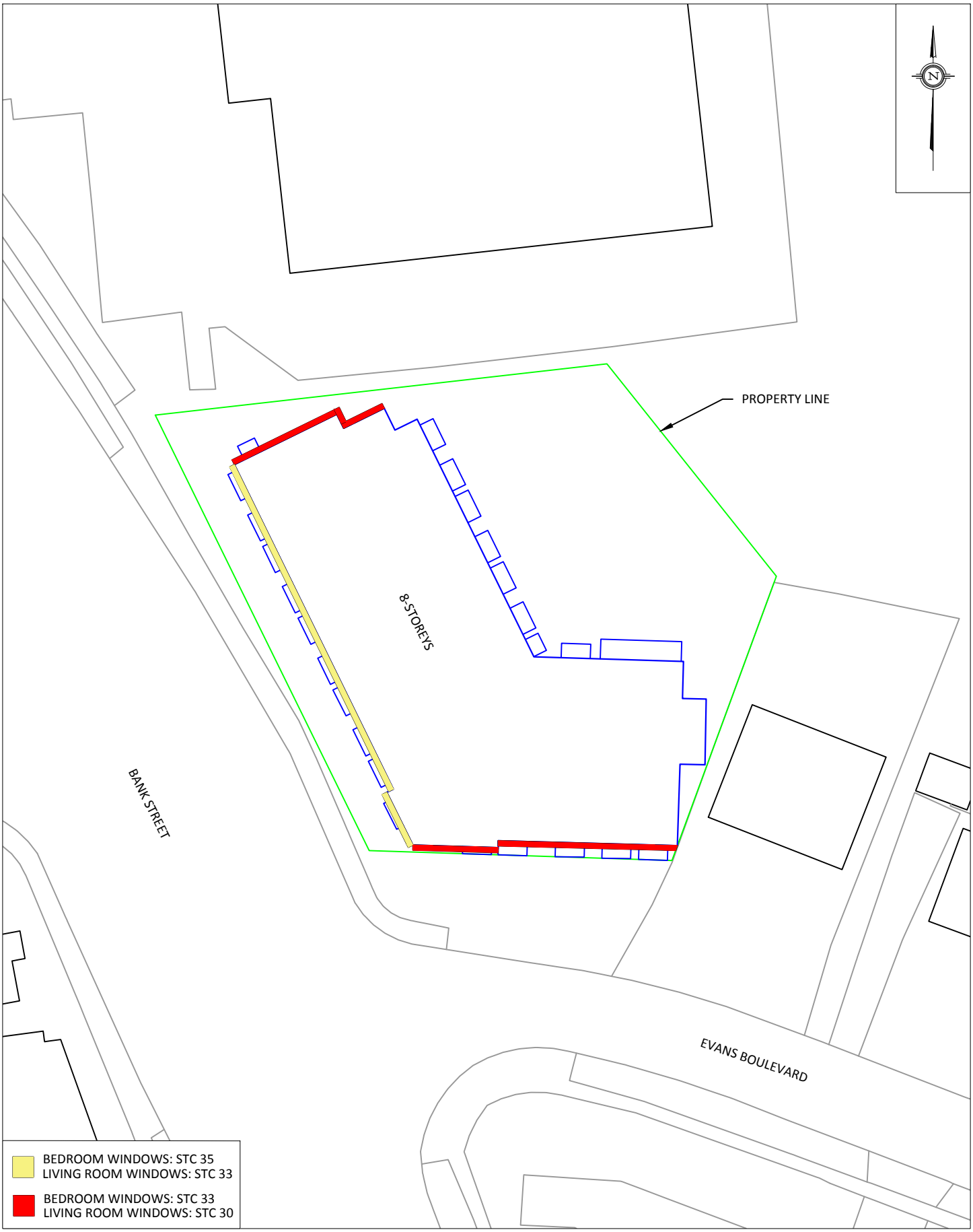
FIGURE 5:
RECEPTOR 3 AND 4 STAMSON INPUT



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DESCRIPTION

FIGURE 6:
BEDROOM AND LIVING ROOM WINDOW STC REQUIREMENTS

APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 17-10-2018 12:35:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           :   0.00 deg   86.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  22.00 / 22.00  m
Receiver height           :  23.15 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

#                     #
```

```
Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 66.62 + 0.00) = 66.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     86   0.00  71.49   0.00  -1.66  -3.21   0.00   0.00   0.00
66.62
-------------------------------------------------------------------------
--

Segment Leq : 66.62 dBA

Total Leq All Segments: 66.62 dBA


Results segment # 1: Bank St (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.02 + 0.00) = 59.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     86   0.00  63.89   0.00  -1.66  -3.21   0.00   0.00   0.00
59.02
-------------------------------------------------------------------------
--

Segment Leq : 59.02 dBA

Total Leq All Segments: 59.02 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 66.62
                           (NIGHT): 59.02
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-10-2018 12:36:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St_1 (day/night)
----------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Bank St_1 (day/night)
-------------------------------------------
Angle1   Angle2           : -18.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :  23.15 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

#                     #
```

```
Road data, segment # 2: Bank St_2 (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  30000
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
    Heavy Truck  % of Total Volume      :   5.00
    Day (16 hrs) % of Total Volume      :  92.00

Data for Segment # 2: Bank St_2 (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   -37.00 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           :  23.15 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: Bank St_1 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.02 + 0.00) = 68.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -18     90   0.00  71.49   0.00  -1.25  -2.22   0.00   0.00   0.00
68.02
-------------------------------------------------------------------------------
--

Segment Leq : 68.02 dBA

#                     #
```

```
Results segment # 2: Bank St_2 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.90 + 0.00) = 65.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -37   0.00  71.49   0.00  -0.28  -5.31   0.00   0.00   0.00
65.90
-------------------------------------------------------------------------
--

Segment Leq : 65.90 dBA

Total Leq All Segments: 70.10 dBA

Results segment # 1: Bank St_1 (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.43 + 0.00) = 60.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -18     90   0.00  63.89   0.00  -1.25  -2.22   0.00   0.00   0.00
60.43
-------------------------------------------------------------------------
--

Segment Leq : 60.43 dBA

#                     #
```

```
Results segment # 2: Bank St_2 (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.30 + 0.00) = 58.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -37   0.00  63.89   0.00  -0.28  -5.31   0.00   0.00   0.00
58.30
-------------------------------------------------------------------------
--

Segment Leq : 58.30 dBA

Total Leq All Segments: 62.50 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.10
                           (NIGHT): 62.50
#                       #
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-10-2018 12:37:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   21.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  22.00 / 22.00  m
Receiver height           :  23.15 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

#                     #
```

```
Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.68 + 0.00) = 67.68 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     21   0.01  71.49   0.00  -1.68  -2.13   0.00   0.00   0.00
67.68
-------------------------------------------------------------------------
--

Segment Leq : 67.68 dBA

Total Leq All Segments: 67.68 dBA

Results segment # 1: Bank St (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.14 + 0.00) = 58.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     21   0.57  63.89   0.00  -2.61  -3.14   0.00   0.00   0.00
58.14
-------------------------------------------------------------------------
--

Segment Leq : 58.14 dBA

Total Leq All Segments: 58.14 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.68
                           (NIGHT): 58.14
#                       #
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-10-2018 12:37:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Bank St (day/night)
-------------------------------------------
Car traffic volume  : 24288/2112  veh/TimePeriod  *
Medium truck volume :  1932/168   veh/TimePeriod  *
Heavy truck volume  :  1380/120   veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  30000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Bank St (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :  23.15 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

#                     #
```

```
Results segment # 1: Bank St (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.71 + 0.00) = 63.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      0   0.00  71.49   0.00  -4.77  -3.01   0.00   0.00   0.00
63.71
-------------------------------------------------------------------------
--

Segment Leq : 63.71 dBA

Total Leq All Segments: 63.71 dBA

Results segment # 1: Bank St (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.11 + 0.00) = 56.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      0   0.00  63.89   0.00  -4.77  -3.01   0.00   0.00   0.00
56.11
-------------------------------------------------------------------------
--

Segment Leq : 56.11 dBA

Total Leq All Segments: 56.11 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.71
                           (NIGHT): 56.11
```