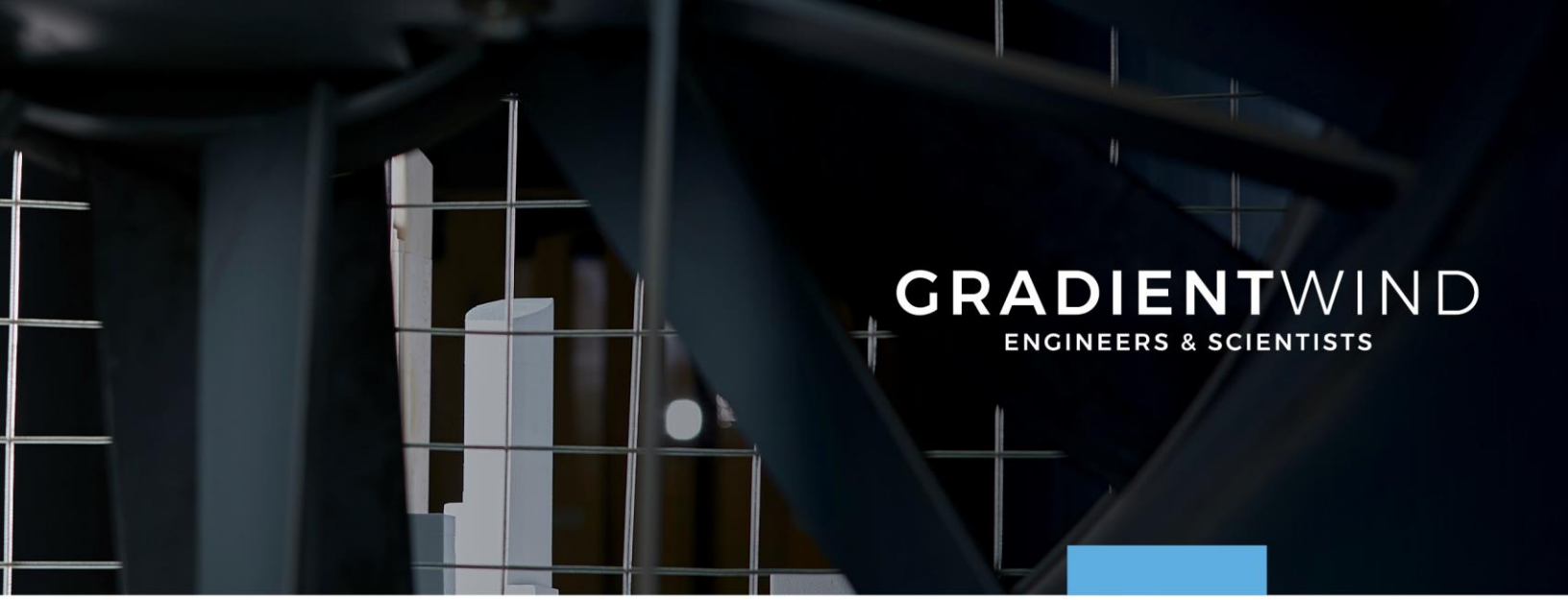
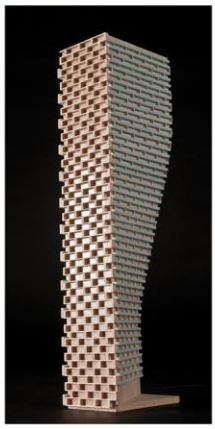


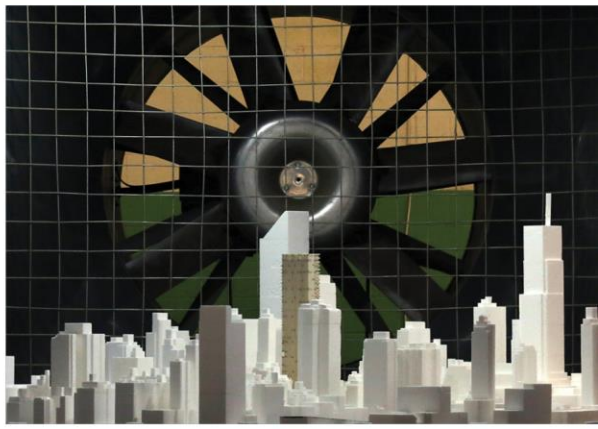
GRADIENTWIND
ENGINEERS & SCIENTISTS

ENVIRONMENTAL NOISE ASSESSMENT

Barrhaven Catholic Elementary School
Ottawa, Ontario

GRADIENT WIND REPORT: 21-285 – Environmental Noise





November 19, 2021

PREPARED FOR

Ottawa Catholic School Board
c/o Pye & Richards-Temprano & Young Architects Inc.
570 West Hunt Club Road
Ottawa, ON K2G 3R4

PREPARED BY

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

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

EXECUTIVE SUMMARY

This report describes an environmental noise assessment undertaken for a proposed elementary school located at the intersection of Flagstaff Drive and Unnamed Street 7 in Ottawa, Ontario. The proposed development currently comprises a one-storey building in the southwest corner of the property with a large yard to the east wrapping around to the north. The primary source of roadway traffic noise on the development is Flagstaff Drive. 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 provided by Pye & Richards Temprano & Young Architects Inc dated September 2021.

The results of the current analysis indicate that noise levels will range between 43 and 63 dBA during the daytime period (07:00-23:00) and between 35 and 55 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the south façade, which is nearest to Flagstaff Drive.

Results of the calculations also indicate that the development will require forced air heating with provisions for central air conditioning, which will allow the windows to be kept closed and a comfortable living environment to be maintained. Noise levels do not exceed 65 dBA, therefore, upgraded building components will not be required.

Results from the stationary noise calculations concluded that the rooftop HVAC equipment on the proposed school will not generate noise levels higher than allowed by the ENCG at nearby points of reception of the surrounding residences. Therefore, no further mitigation for the stationary noise sources is required, provided the assumptions of this report are carried out in the design and construction of the building.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by The Ottawa Catholic School Board to undertake an environmental noise assessment for a proposed elementary school building located at the intersection of Flagstaff Drive and Unnamed Street 7 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 and stationary noise sources.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings provided by Pye & Richards-Temprano & Young Architects Inc. dated September 2021 with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this environmental noise assessment is a proposed elementary school situated on an approximately trapezoidal parcel of land located at the intersection of Flagstaff Drive and Unnamed Street 7. The proposed development comprises a one-storey, elementary school and childcare centre. The primary entrance is provided along Unnamed Street 7. Outdoor seating and rock seating areas are provided on the east side of the building. A bus lay-by is also proposed on Flagstaff Drive.

The primary sources of roadway traffic noise on the development include Flagstaff Drive. The rooftop HVAC units for the proposed school are evaluated as stationary noise sources for their potential impact on surrounding houses. 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 and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, as well as noise levels at the surrounding residential buildings produced by rooftop units from the proposed school, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 of this report.

4. METHODOLOGY

4.1 Background

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

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 for schools for roadway noise as listed in Table 1. Based on Gradient

Wind's experience, more comfortable indoor noise levels should be targeted, towards 42 to control peak noise and deficiencies in building envelope construction.

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

Type of Space	Time Period	L_{eq} (dBA)
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50
Living/dining/den areas of residences, hospitals, **schools**, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

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

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

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

4.2.2 Theoretical Roadway Noise Predictions

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

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

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- For select sources where appropriate, receptors considered the surrounding buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figure 3.
- Noise receptors were strategically placed at 4 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figure 3.

4.2.3 Roadway Traffic Volumes

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

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

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Flagstaff Drive	2-Lane Urban Collector Undivided (2-UCU)	50	**8,000**

4.3 Stationary Noise

4.3.1 Criteria for Stationary Noise

For stationary sources, the L_{eq} is commonly calculated on an hourly interval, while for roadways, the L_{eq} is calculated on the basis of a 16-hour daytime/8-hour nighttime split as previously mentioned in Section 4.2.1.

Noise criteria taken from NPC-300 apply to outdoor points of reception (POR). A POR is defined under NPC-300 as "any location on a noise sensitive land use where noise from a stationary source is received"[8]. This applies to the plane of window and outdoor amenity spaces serving the development. A POR can be located on an existing or zoned for future use premises of permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, campgrounds, and noise sensitive buildings such as schools, places of worship and daycare facilities. According to NPC-300, the recommended maximum noise level for a suburban (Class 2) environment at a POR is either the lowest one-hour background noise level due to other sources, or the exclusionary limits outlined in Table 3, whichever is higher.

TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 2 AREA

Time of Day	Class 2	
	Outdoor Points of Reception	Plane of Window
07:00 – 19:00	50	50
19:00 – 23:00	45	50
23:00 – 07:00	N/A	45

[8] NPC – 300, page 14

4.3.2 Assumptions

Mechanical information for the proposed building was based on information obtained from Pye & Richards-Temprano & Young Architects Inc.. The following assumptions have been made in the analysis:

(i) The rooftop equipment for the existing office building on site is assumed to operate continuously over during the daytime/evening period and for 50% of the time during the nighttime period.

(ii) Locations and quantity of rooftop units has been based on drawings provided by Pye & Richards-Temprano & Young Architects Inc.

(iii) Sound power data for stationary noise sources is based on manufacturer's data.

(iv) Screening effects of buildings have been considered in the analysis.

(v) Default ground surfaces were taken to be reflective due to the presence of hard ground features such as pavement.

4.3.3 Determination of Noise Source Power Levels

Mechanical information for the proposed buildings was taken from data sheets for the equipment. Table 4 summarizes the unmitigated sound power used for each source in the analysis.

TABLE 4: EQUIPMENT SOUND POWER LEVELS, UNMITIGATED (dBA)

Source ID	Description	Height Above Grade/Roof (m)	Frequency (Hz)								
			63	125	250	500	1000	2000	4000	8000	Total
S1	RTU	1	82	82	78	75	73	68	61	54	**87.8**
S2-6	RTU	1.5	85	85	81	78	76	71	64	57	**90.8**

4.3.4 Stationary Source Noise Predictions

The impact of the surrounding stationary noise sources on the development was determined by computer modelling. Stationary noise source modelling is based on the software program *Predictor-Lima* developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. This computer program is capable of representing three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The methodology has been used on numerous assignments and has been accepted by the MECP as part of Environmental Compliance Approvals applications.

Eight (8) individual noise sensor locations were selected in the *Predictor-Lima* model to measure the noise impact at points of reception (POR) for stationary sources during the daytime (07:00 – 23:00) and nighttime (23:00 – 07:00) periods (see Figure 2). All mechanical equipment was represented as point sources in the model. Air temperature, pressure and humidity were set to 10°C, 101.3 kPA and 70%, respectively. Ground absorption over the study area was determined based on topographical features (such as water, concrete, grassland, etc.). A coefficient of 0 was used for hard surfaces, such as concrete and paved areas, and 1 for soft surfaces, such as grass and vegetative areas. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. Modelling data can be provided upon request.

5. ENVIRONMENTAL NOISE RESULTS

5.1 Roadway Traffic Noise Levels

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

TABLE 5: 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	1.5	POW – East Façade	54	47
2	1.5	POW – South Façade	63	55
3	1.5	POW – West Façade	55	47
4	1.5	POW – North Façade	43	35

The results of the current analysis indicate that noise levels will range between 43 and 63 dBA during the daytime period (07:00-23:00) and between 35 and 55 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the south façade, which is nearest to Flagstaff Drive.

5.2 Stationary Noise Levels

The results of the current analysis indicate that noise levels due to stationary sources will range between 36 and 43 dBA during the daytime period (07:00-23:00) and between 33 and 40 dBA during the nighttime period (23:00-07:00). In any case, the noise levels at nearby houses due to the rooftop units on the proposed school are compliant to the ENCG. Therefore, no mitigation is required. Table 6 shows the resulting noise levels.

TABLE 6: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Receptor Height Above Grade/Roof (m)	Receptor Location	Stationary Noise Level (dBA)		Meets MECP Class 2 Criteria	
			Day/ Evening	Night	Day/ Evening	Night
5	4.5	Southeast Houses – POW	38	35	YES	YES
6	4.5	Southeast Houses – POW	38	35	YES	YES
7	4.5	South Houses – POW	41	38	YES	YES
8	4.5	West Houses – POW	43	40	YES	YES
9	4.5	West Houses – POW	43	40	YES	YES
10	4.5	Northwest Houses – POW	41	38	YES	YES
11	4.5	East House – POW	36	33	YES	YES
12	1.5	South Park – OPR	37	N/A*	YES	N/A*

*Nighttime noise limits do not apply to OPR's

5.3 Noise Control Measures

Noise levels do not exceed 65 dBA, therefore, upgraded building components will not be required. However, the resulting noise levels exceed 60 dBA indicating that the development will require forced air heating with provisions for central air conditioning, which will allow the windows to be kept closed and a comfortable living environment to be maintained. Due to the presence of rooftop HVAC units, it is expected that air conditioning will be provided to the building.

6. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Noise levels do not exceed 65 dBA, therefore, upgraded building components will not be required. Since noise levels exceed 60 dBA for this proposed building, it will require forced air heating with provisions for central air conditioning so that windows may be kept closed and a comfortable and quiet environment can be maintained. It is expected that the school will have air conditioning installed due to the presence of rooftop HVAC units.

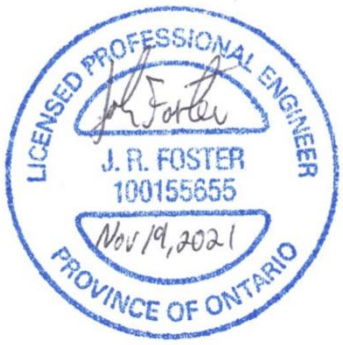
Noise levels present at adjacent properties produced by rooftop HVAC units of the proposed building are presented in Table 6. Noise levels at all outdoor points of reception and other plane of window receptors

due to the stationary noise sources fall below ENCG criteria. As such, the proposed development is expected to be compatible with surrounding residential land use. Noise contours at 4.5 m above grade can be seen in Figure 4 and 5 for daytime/nighttime conditions.

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

Sincerely,

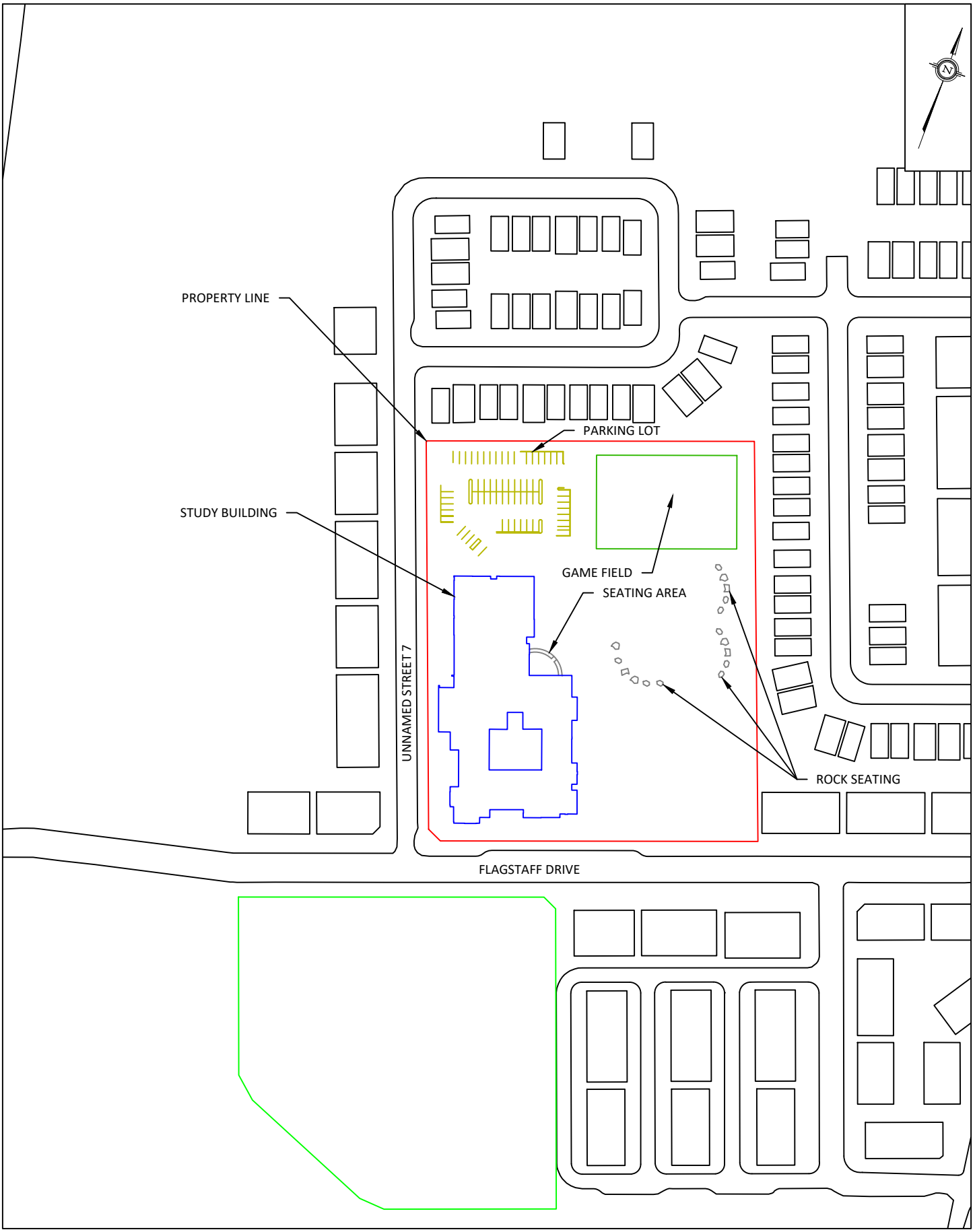
Gradient Wind Engineering Inc.



Caleb Alexander, B.Eng.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind Report #21-285 – Environmental Noise

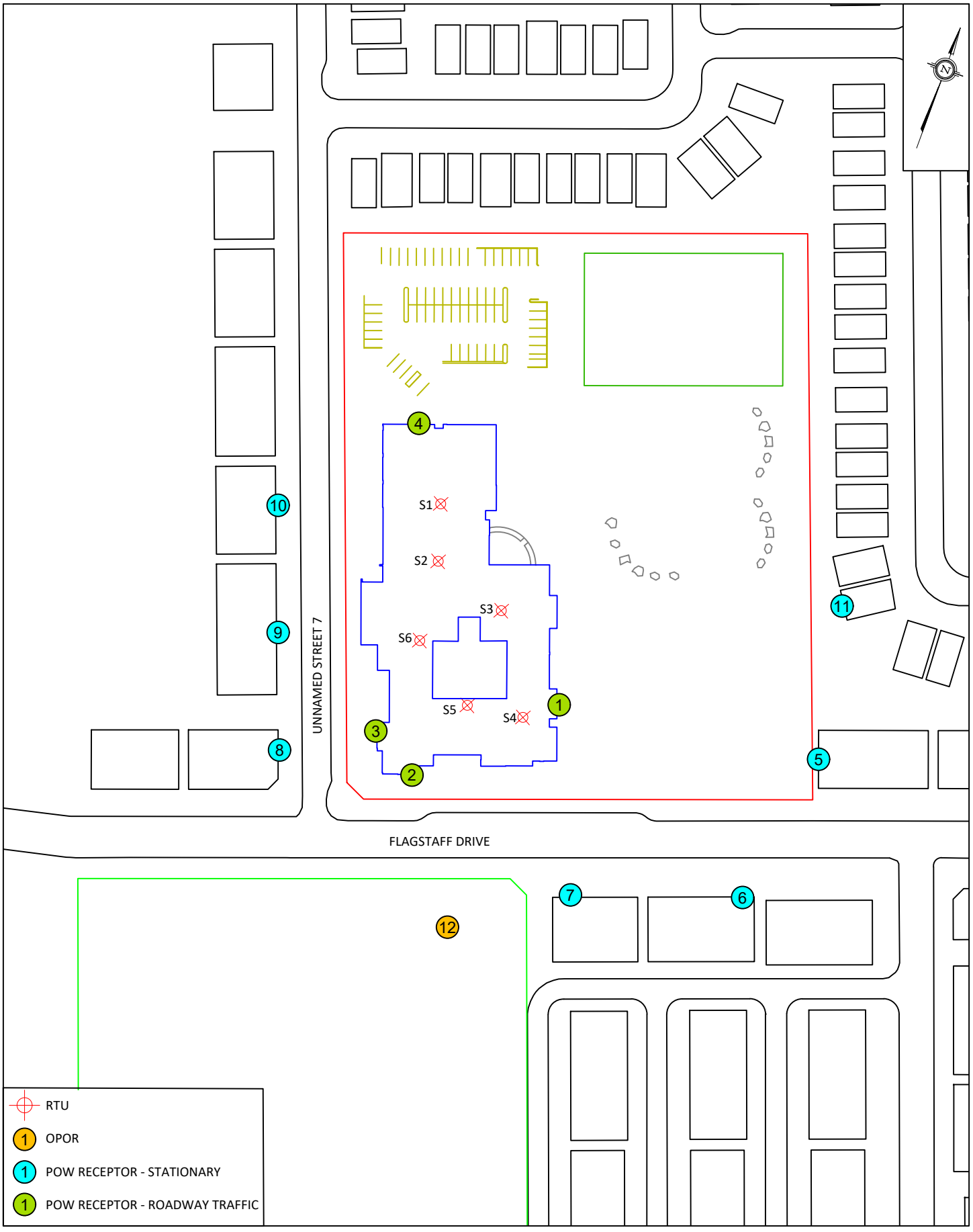


GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	BARRHAVEN CATHOLIC ELEMENTARY SCHOOL, OTTAWA ENVIRONMENTAL NOISE ASSESSMENT		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO.	GW21-285-1
DATE	SEPTEMBER 17, 2021	DRAWN BY	C.A.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



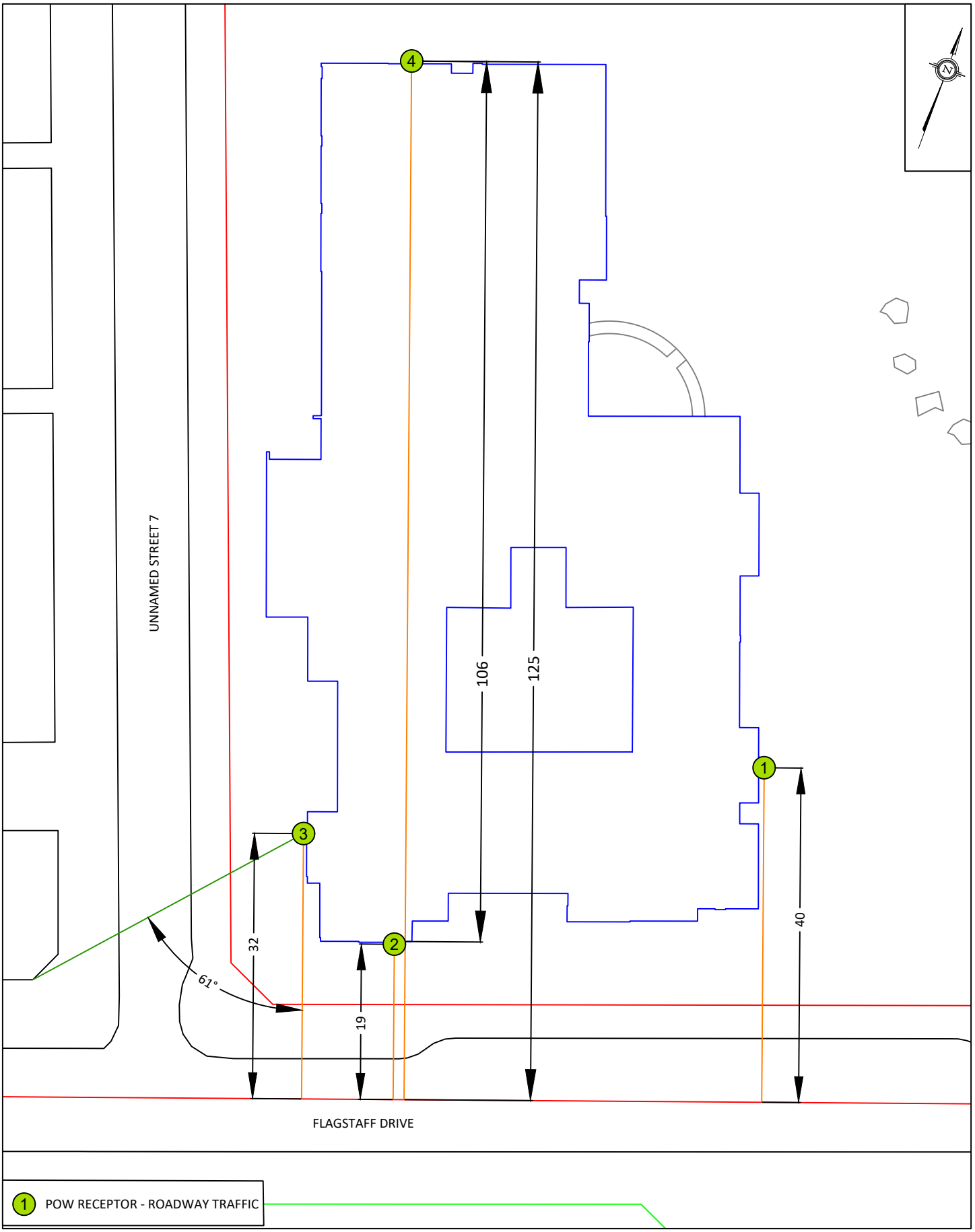
GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	BARRHAVEN CATHOLIC ELEMENTARY SCHOOL, OTTAWA ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:1750 (APPROX.)
DRAWING NO.	GW21-285-2
DATE	SEPTEMBER 17, 2021
DRAWN BY	C.A.

DESCRIPTION

FIGURE 2:
RECEPTOR AND SOURCE LOCATIONS



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	BARRHAVEN CATHOLIC ELEMENTARY SCHOOL, OTTAWA ENVIRONMENTAL NOISE ASSESSMENT		
SCALE	1:500 (APPROX.)	DRAWING NO.	GW21-285-3
DATE	SEPTEMBER 17, 2021	DRAWN BY	C.A.

DESCRIPTION

FIGURE 3:
RECEPTORS 1-4 STAMSON INPUT PARAMETERS

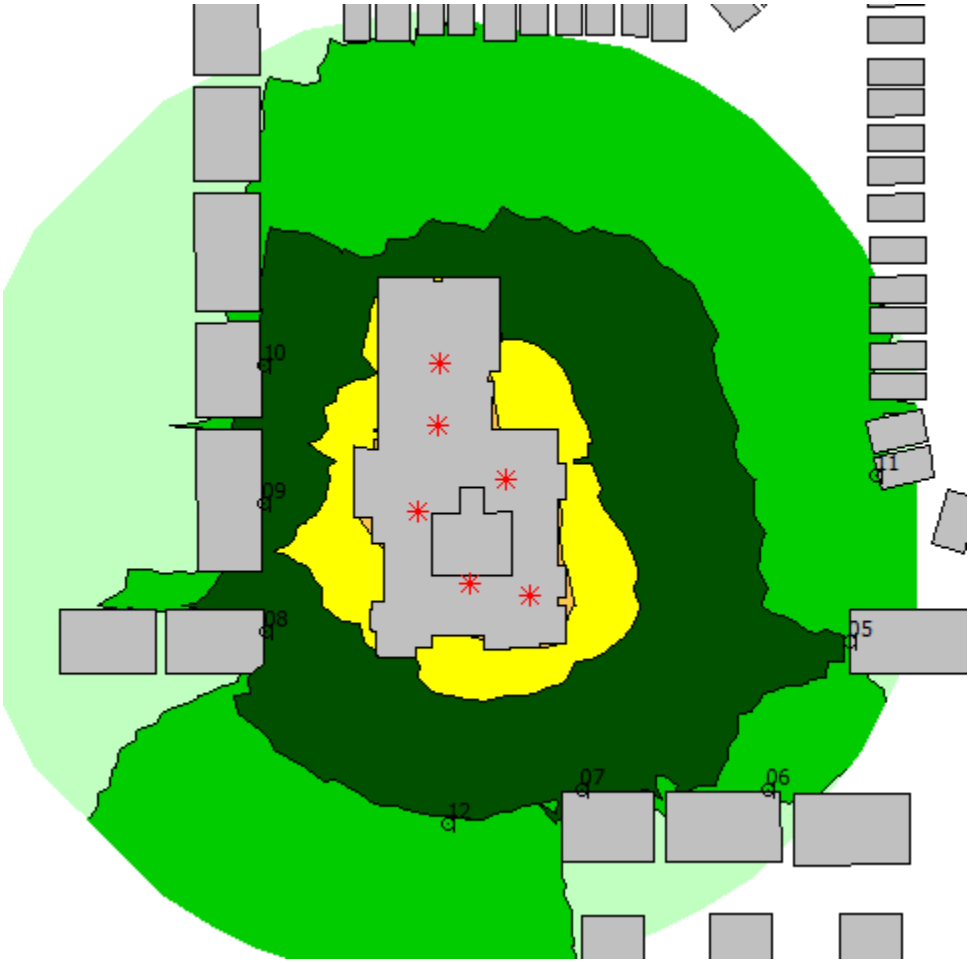


FIGURE 4: DAYTIME NOISE CONTOURS (4.5M ABOVE GRADE)

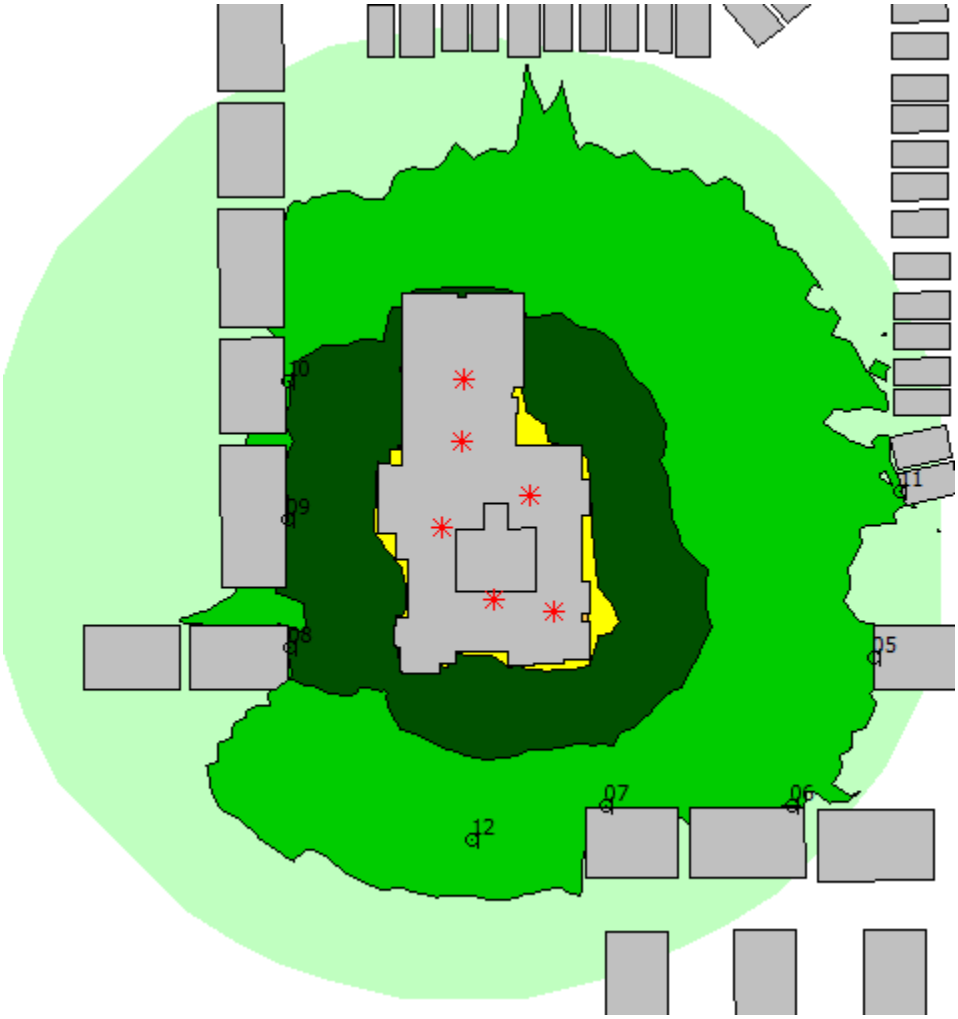


FIGURE 5: NIGHTTIME NOISE CONTOURS (4.5M ABOVE GRADE)

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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

```
STAMSON 5.0        NORMAL REPORT        Date: 17-09-2021 09:02:59
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Flagstaff (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Flagstaff (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  40.00 / 40.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 54.21 + 0.00) = 54.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.66  65.75   0.00  -7.07  -4.47   0.00   0.00   0.00  54.21
-------------------------------------------------------------------------------

Segment Leq : 54.21 dBA

Total Leq All Segments: 54.21 dBA


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

Source height = 1.50 m

ROAD (0.00 + 47.16 + 0.00) = 47.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.57  58.16   0.00  -6.69  -4.31   0.00   0.00   0.00  47.16
-------------------------------------------------------------------------------

Segment Leq : 47.16 dBA

Total Leq All Segments: 47.16 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 54.21
                           (NIGHT): 47.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-09-2021 09:03:08
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Flagstaff (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Flagstaff (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  19.00 / 19.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 62.59 + 0.00) = 62.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.66  65.75   0.00  -1.70  -1.46   0.00   0.00   0.00  62.59
-------------------------------------------------------------------------------

Segment Leq : 62.59 dBA

Total Leq All Segments: 62.59 dBA


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

Source height = 1.50 m

ROAD (0.00 + 55.24 + 0.00) = 55.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.57  58.16   0.00  -1.61  -1.30   0.00   0.00   0.00  55.24
-------------------------------------------------------------------------------

Segment Leq : 55.24 dBA

Total Leq All Segments: 55.24 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 62.59
                           (NIGHT): 55.24
```

```
STAMSON 5.0        NORMAL REPORT        Date: 17-09-2021 09:03:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Flagstaff (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Flagstaff (day/night)
--------------------------------------------
Angle1   Angle2           :   0.00 deg   60.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  32.00 / 32.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 54.95 + 0.00) = 54.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     60   0.66  65.75   0.00  -5.46  -5.33   0.00   0.00   0.00  54.95
-------------------------------------------------------------------------------

Segment Leq : 54.95 dBA

Total Leq All Segments: 54.95 dBA


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

Source height = 1.50 m

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
-------------------------------------------------------------------------------
     0     60   0.66  58.16   0.00  -5.46  -5.33   0.00   0.00   0.00  47.36
-------------------------------------------------------------------------------

Segment Leq : 47.36 dBA

Total Leq All Segments: 47.36 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 54.95
                           (NIGHT): 47.36
```

```
STAMSON 5.0         NORMAL REPORT         Date: 17-09-2021 09:03:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Flagstaff (day/night)
----------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Flagstaff (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 126.00 / 19.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   4.00 m
Barrier receiver distance : 106.00 / 10.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Flagstaff (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 (0.00 + 42.89 + 0.00) = 42.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.42  65.75   0.00 -13.13  -1.02   0.00   0.00  -8.71  42.89
-------------------------------------------------------------------------------

Segment Leq : 42.89 dBA

Total Leq All Segments: 42.89 dBA


Results segment # 1: Flagstaff (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 !        2.92 !         2.92

ROAD (0.00 + 48.22 + 0.00) = 48.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.33  58.16   0.00  -1.37  -0.83   0.00   0.00  -7.74  48.22
-------------------------------------------------------------------------------

Segment Leq : 48.22 dBA

Total Leq All Segments: 48.22 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 42.89
                           (NIGHT): 48.22
```