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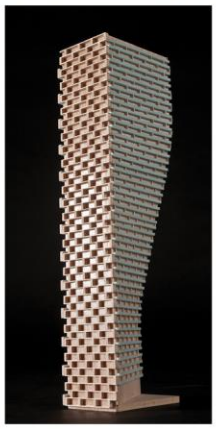
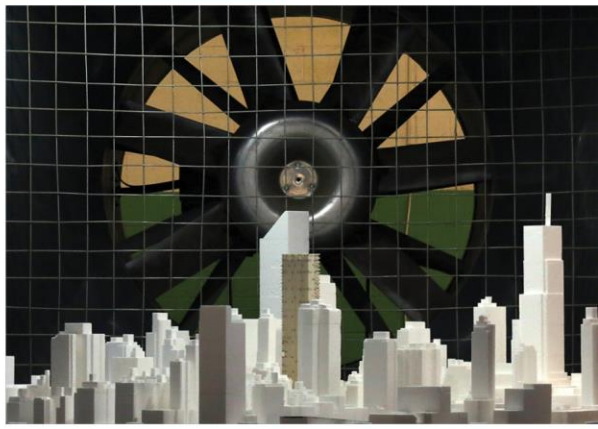
ROADWAY TRAFFIC NOISE ASSESSMENT

Paul-Desmarais School
Ottawa, Ontario

Report: 22-232 –Traffic Noise





February 2nd, 2023

Conseil des Écoles Catholiques du Centre-Est
4000 Labelle Street
Ottawa, ON K1J 1A1

PREPARED BY
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EXECUTIVE SUMMARY

This report describes a roadway traffic noise assessment undertaken for a proposed addition to the Écoles Secondaries Catholique Paul-Desmarais, located at 5315 Abbott Street East in Stittsville (Ottawa), Ontario. The proposed development comprises a two-storey nominally rectangular addition to the school along the north elevation of the existing 2-storey secondary school. The major sources of roadway traffic noise impacting the development are Abbott Street East and Robert Grant Avenue. Figure 1 illustrates the site location with the surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP), Ministry of Transportation of Ontario (MTO), 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 provided by Edward J. Cuhaci & Associates Architects Inc., dated May 5th, 2022.

The results of the current analysis indicated that noise levels will range between 56 and 68 dBA during the daytime period (07:00-23:00) and between 49 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the east façade, which is nearest and most exposed to Robert Grant Avenue. The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Upgraded building components, including STC rated glazing elements and exterior walls, will be required as described in Section 5.2 and indicated in Figure 4.

Noise impacts from exposed mechanical equipment onto the surroundings and the school itself would be considered at a future stage once the mechanical design has progressed and equipment have been selected. Stationary noise sources associated with the development could include rooftop air handling units, cooling towers or dry coolers. Noise from these sources can be controlled to acceptable limits by judicious selection of the equipment, locating the equipment on a high roof away from nearby classroom windows, and where necessary, installing silencers or noise screens.

Gradient Wind conducted a survey of the study site, using the satellite view of the area, and did not identify any significant existing sources of stationary noise impacting the development. Therefore, on-site stationary noise impacts from surrounding properties are considered insignificant.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Conseil des Écoles Catholiques du Centre-Est (CECCE) to undertake a roadway traffic noise assessment for a proposed addition to the Écoles Secondaries Catholique Paul-Desmarais, located at 5315 Abbott Street East in Stittsville (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.

This assessment is based on theoretical noise calculation methods conforming to the Ministry of the Environment, Conservation and Parks (MECP) NPC-300[1], Ministry of Transportation Ontario (MTO)[2], and City of Ottawa Environmental Noise Control Guidelines (ENCG)[3] guidelines. Noise calculations were based on site plan drawings provided by Edward J. Cuhaci & Associates Architects Inc., dated May 5th, 2022, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this roadway traffic noise assessment is a proposed addition to the Écoles Secondaries Catholique Paul-Desmarais, located at 5315 Abbott Street East in Stittsville (Ottawa), Ontario. The proposed development comprises two-storey nominally rectangular addition to the school along the north elevation. The addition includes classrooms, washrooms, and storage at grade. On Level two, there are additional classrooms, washrooms, and laboratories.

The development is surrounded by vacant land to the East and South, and commercial properties to the west. The study site is bounded by Abbott Street East to the south and Iber Road to the west. The major sources of traffic noise impacting the study site are Abbott Street East and the extension of Robert Grant Avenue. The ultimate design of Gobert Grant is for a 4-lane arterial with separated bus rapid transit running down the median of the corridor. Iber Road is not considered to have a significant impact on the study site as it is located approximately 270m west of the development.

[1] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013
[2] Ministry of Transportation Ontario, "*Environmental Guide for Noise*", February 2022
[3] City of Ottawa, Environmental Noise Control Guidelines, January 2016

Gradient Wind conducted a survey of the study site, using the satellite view of the area, and did not identify any significant existing sources of stationary noise impacting the development. Therefore, on-site stationary noise impacts from these properties are considered insignificant.

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) specify that the recommended indoor noise limit range (that is relevant to this study) is 45 for schools for roadway as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [4]

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[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. 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[7].

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

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

Since this study analyses noise impacts onto the north addition to the school, no Outdoor Living Area has been considered.

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 a separate line source of noise, and by using proposed and existing building locations as noise barriers. 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 was taken to be 92% / 8% respectively for all streets.
- The ground surface was modelled as hard (reflective) ground to account for the hard, packed soil present at the site and soft (absorptive) where foliage and grass are present.
- Receptor heights were taken to be 4.5m above grade for the Plane of Window (POW).
- The study site was treated as having flat or gently sloping topography.
- Massing associated with the study site and surrounding buildings were included as potential noise screening elements.
- 3 receptors were strategically placed throughout the study area, as shown in Figure 2. STAMSON parameters are noted 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[8] 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. The Robert Grant BRT traffic volumes are based on the West Transit Way Connections Environmental Assessment. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Abbott Street East	2-Lane Major Collector (2-UMCU)	50	**12,000**
Robert Grant Avenue	4-Lane Divided Arterial (4-UAD)	50	**35,000**
Robert Grant Avenue – BRT Median	Bus Rapid Transit (BRT)	50	**460/40***

*Daytime/Nighttime volumes

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.

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

As per Section 4.2, when daytime noise levels from road sources at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels are achieved. The calculation procedure[9] 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[10], 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, detailed floor layouts 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

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 below.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Predictor-Lima Noise Level (dBA)	
			Day	Night
R1	4.5	POW – West Façade	57	49
R2	4.5	POW – North Façade	64	56
R3	4.5	POW – East Façade	68	60

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

The results of the current analysis indicated that noise levels will range between 56 and 68 dBA during the daytime period (07:00-23:00) and between 49 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the East facade, which is most exposed Robert Grant Avenue.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4 for building components. 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). The estimated STC requirements for the windows are summarized below for various units within the development (see Figure 4):

TABLE 6: STC RECOMMENDATIONS

Façade	Window STC	Exterior Wall STC
East	26	45

Results of the calculations also indicate the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicated that noise levels will range between 56 and 68 dBA during the daytime period (07:00-23:00) and between 49 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (68 dBA) occurs at the East Façade, which is nearest and most exposed to Robert Grant Avenue. The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. Upgraded building components, including STC rated glazing elements and exterior walls, will be required as described in Section 5.2 and indicated in Figure 4.

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Noise impacts from exposed mechanical equipment onto the surroundings and the school itself would be considered at a future stage once the mechanical design has progressed and equipment have been selected. Stationary noise sources associated with the development could include rooftop air handling units, cooling towers or dry coolers. Noise from these sources can be controlled to acceptable limits by judicious selection of the equipment, locating the equipment on a high roof away from nearby classroom windows, and where necessary, installing silencers or noise screens.

Gradient Wind conducted a survey of the study site, using the satellite view of the area, and did not identify any significant existing sources of stationary noise impacting the development. Therefore, on-site stationary noise impacts from these properties are considered insignificant.

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.

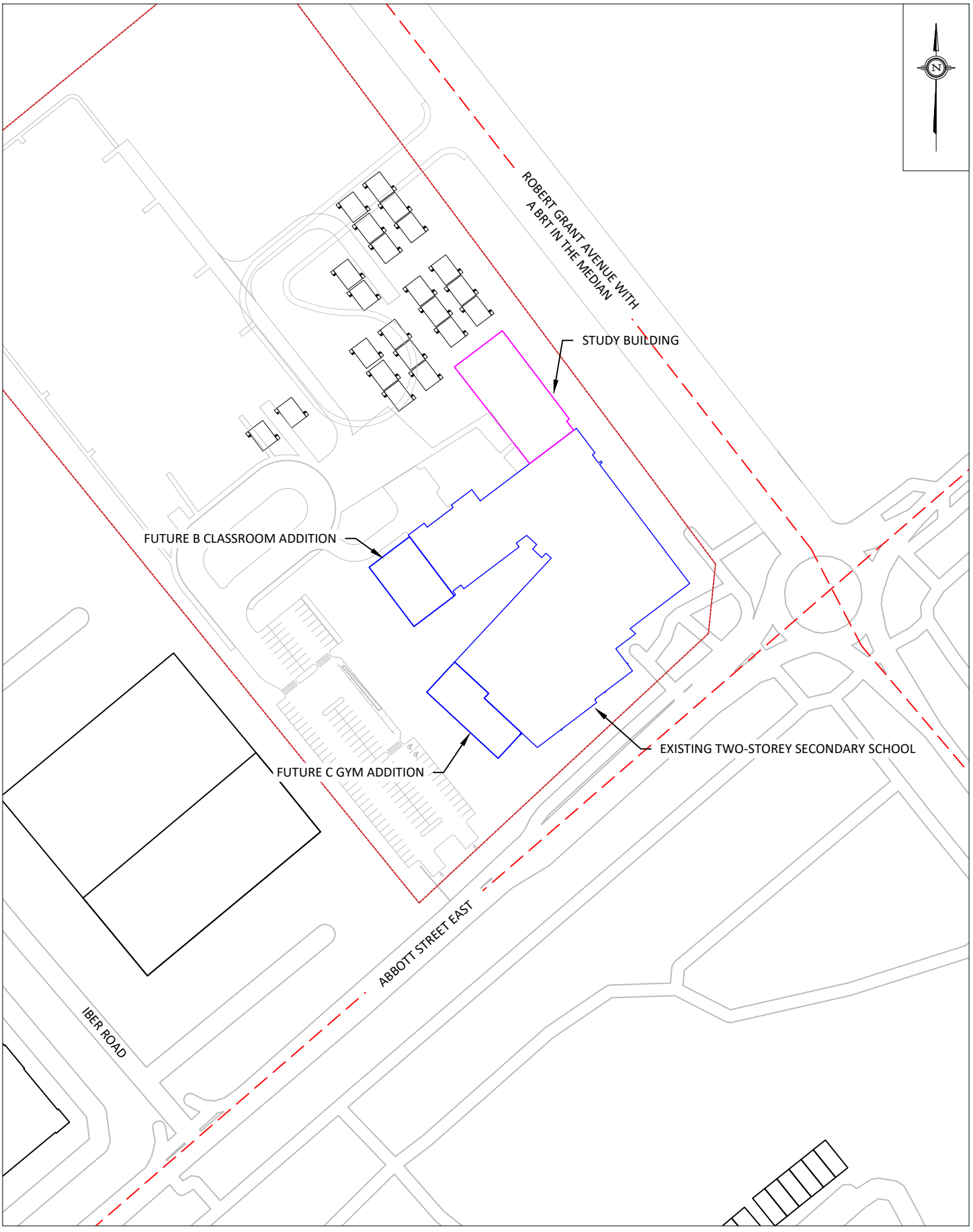
Sincerely,

Gradient Wind Engineering Inc.

Essraa Alqassab, BASc
Junior Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #22-232-Roadway Traffic Noise



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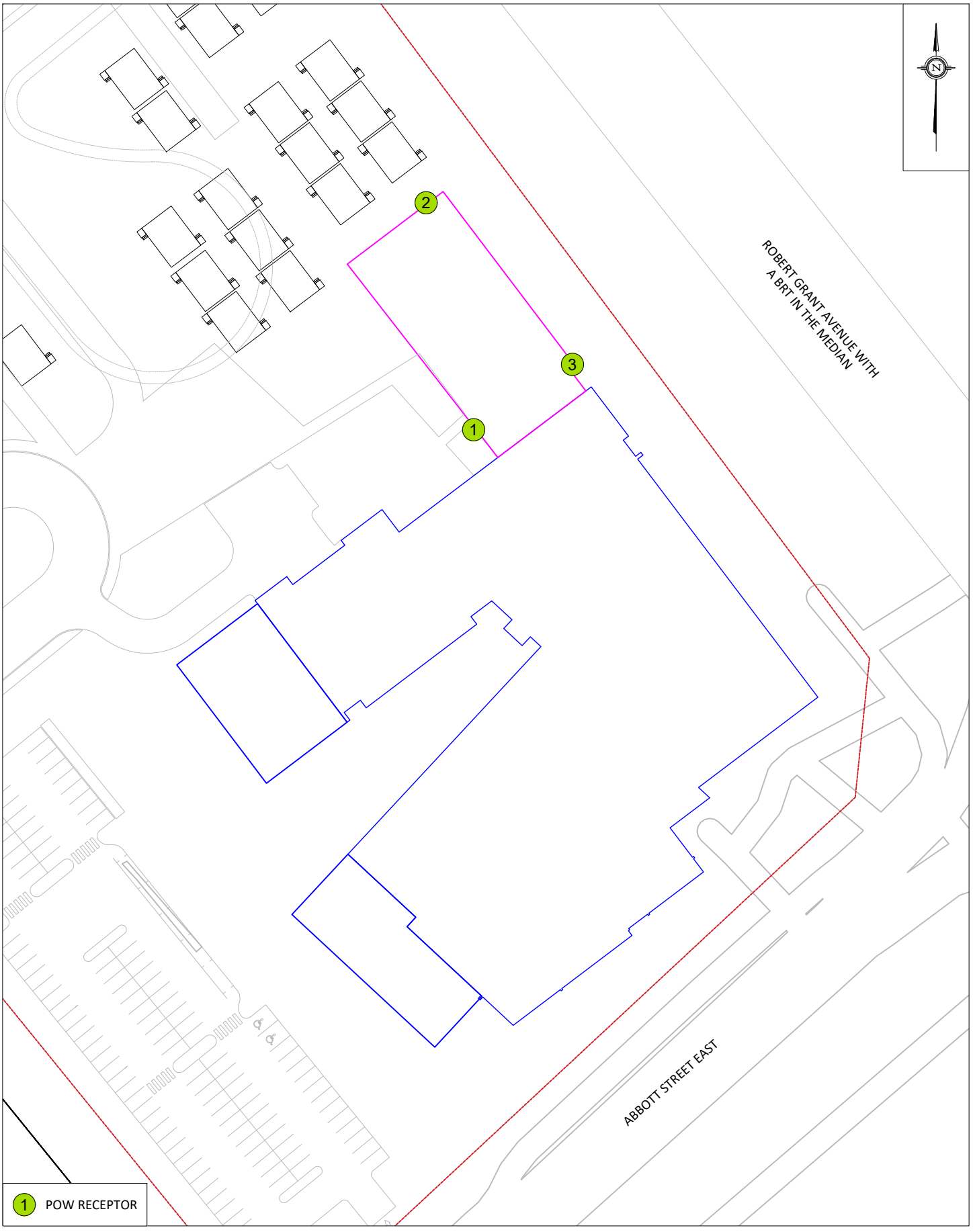
PROJECT	PAUL-DESMARAIS SECONDARY SCHOOL, OTTAWA ROADWAY TRAFFIC ASSESSMENT		
SCALE	1:4000 (APPROX.)	DRAWING NO.	GW22-232-1
DATE	FEBRUARY 2, 2023	DRAWN BY	E.A.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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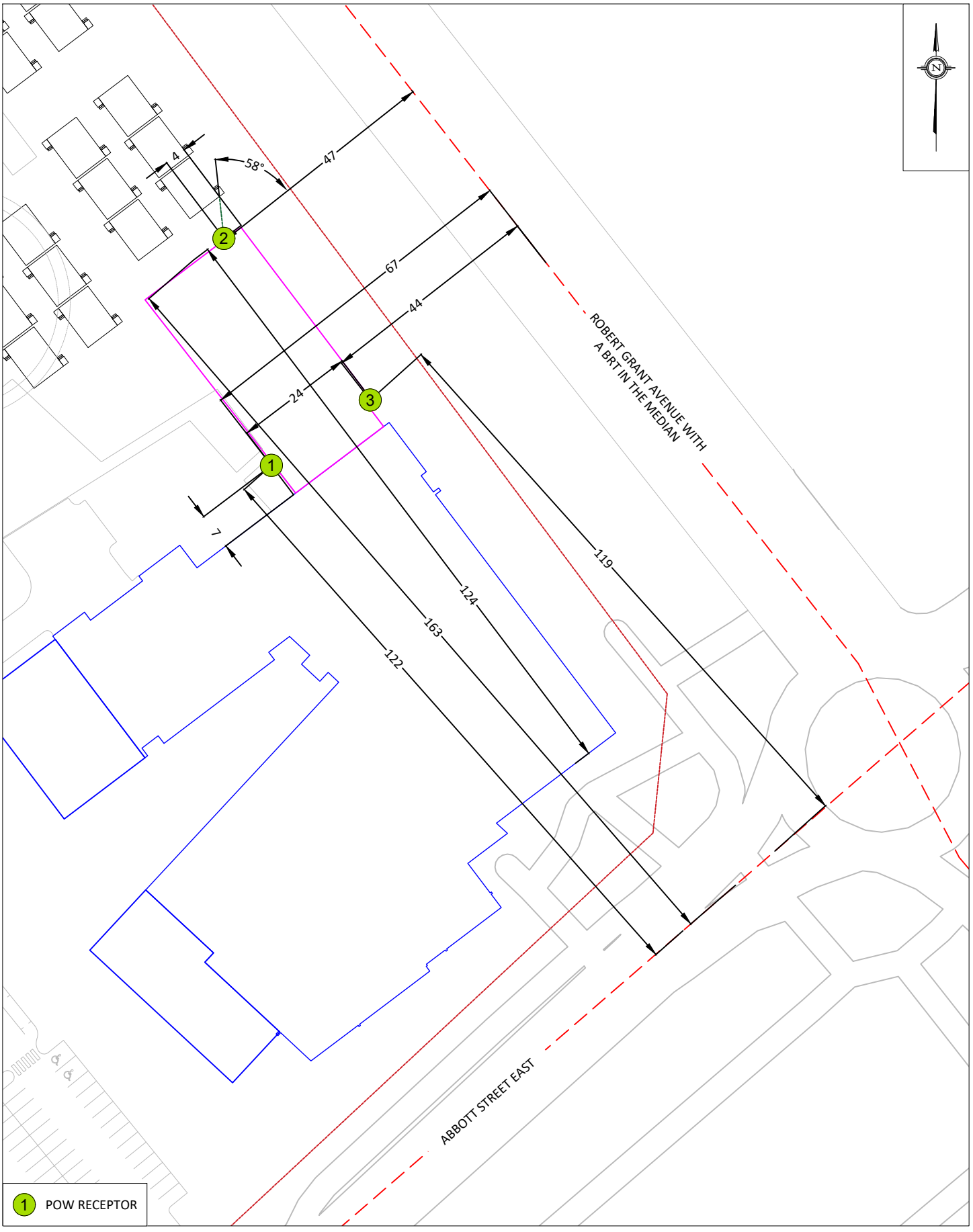
PROJECT	PAUL-DESMARAIS SECONDARY SCHOOL, OTTAWA ROADWAY TRAFFIC ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW22-232-2
DATE	FEBRUARY 2, 2023	DRAWN BY	E.A.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS



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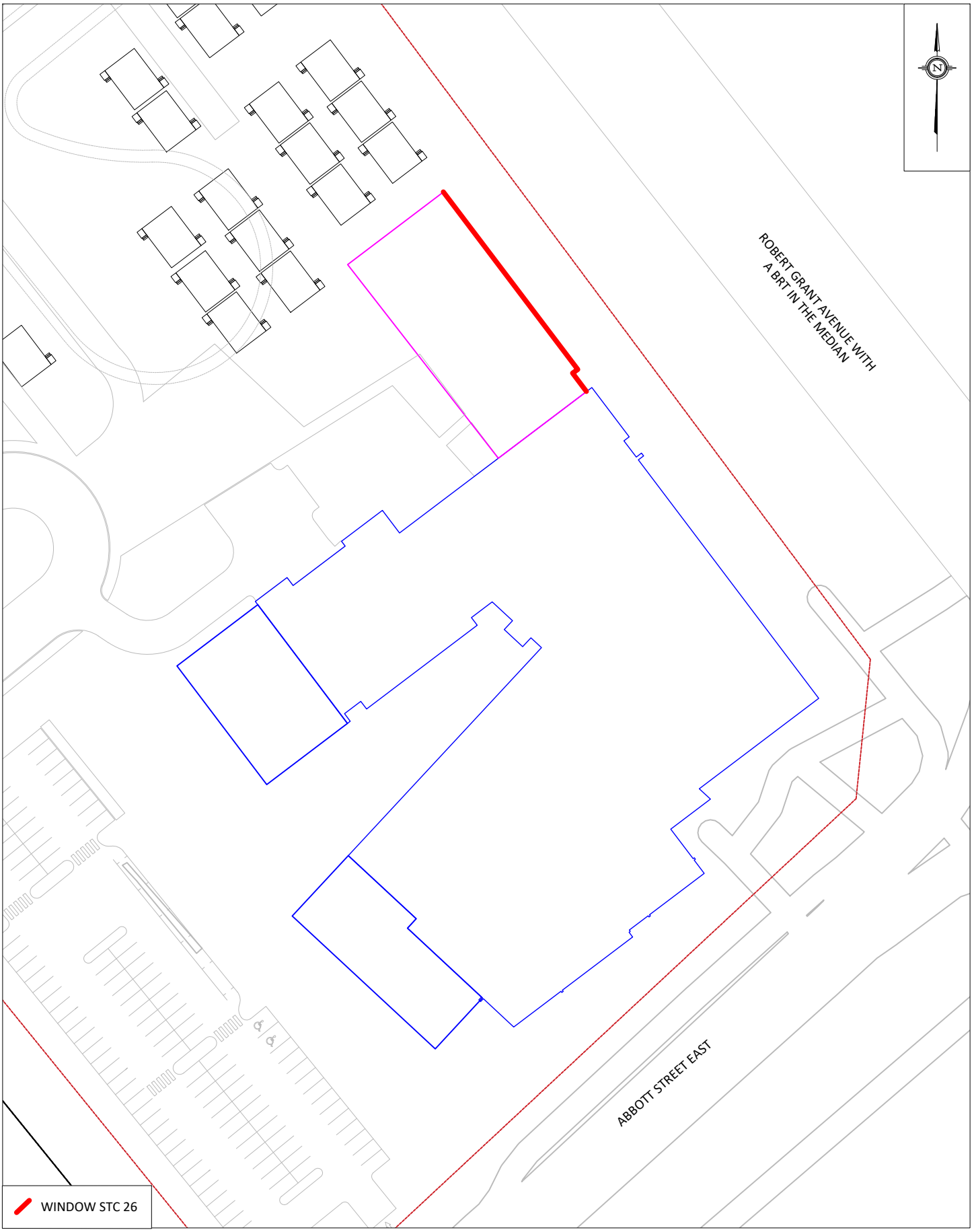
PROJECT	PAUL-DESMARAIS SECONDARY SCHOOL, OTTAWA ROADWAY TRAFFIC ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW22-232-3
DATE	FEBRUARY 2, 2023	DRAWN BY	E.A.

DESCRIPTION

FIGURE 3:
STAMSON PARAMETERS



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PROJECT	PAUL-DESMARAIS SECONDARY SCHOOL, OTTAWA ROADWAY TRAFFIC ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO. GW22-232-4	FIGURE 4: STC RECOMMENDATION
DATE	FEBRUARY 2, 2023	DRAWN BY E.A.	

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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: 16-01-2023 15:56:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Abbott (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: Abbott (day/night)
----------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 122.00 / 122.00 m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.00 m
Barrier receiver distance :   7.00 / 7.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Robert Grant (day/night)
------------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   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):  35000
    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: Robert Grant (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  24.00 / 24.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Abbott (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 !        4.33 !         4.33

ROAD (0.00 + 41.93 + 0.00) = 41.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  67.51   0.00  -9.10  -3.01   0.00   0.00 -13.47  41.93
-------------------------------------------------------------------------------

Segment Leq : 41.93 dBA


Results segment # 2: Robert Grant (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 !        3.42 !         3.42

ROAD (0.00 + 56.60 + 0.00) = 56.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  72.16   0.00  -6.50   0.00   0.00   0.00  -9.06  56.60
-------------------------------------------------------------------------------

Segment Leq : 56.60 dBA

Total Leq All Segments: 56.75 dBA
```

```
Results segment # 1: Abbott (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 !        4.33 !         4.33

ROAD (0.00 + 34.33 + 0.00) = 34.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
     0     90   0.00  59.91   0.00  -9.10  -3.01   0.00   0.00 -13.47  34.33
-------------------------------------------------------------------------------

Segment Leq : 34.33 dBA


Results segment # 2: Robert Grant (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 !        3.42 !         3.42

ROAD (0.00 + 49.00 + 0.00) = 49.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  64.56   0.00  -6.50   0.00   0.00   0.00  -9.06  49.00
-------------------------------------------------------------------------------

Segment Leq : 49.00 dBA

Total Leq All Segments: 49.15 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 56.75
                           (NIGHT): 49.15
```

```
STAMSON 5.0         NORMAL REPORT         Date: 02-02-2023 08:52:11
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Abbott (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: Abbott (day/night)
----------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 163.00 / 163.00 m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.00 m
Barrier receiver distance : 124.00 / 49.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Robert Grant (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: Robert Grant (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  :  47.00 / 47.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -58.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   4.00 / 4.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Abbott (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 !        2.21 !         2.21

ROAD (0.00 + 45.42 + 0.00) = 45.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  67.51   0.00 -10.36   0.00   0.00   0.00 -11.73  45.42
-------------------------------------------------------------------------------

Segment Leq : 45.42 dBA


Results segment # 2: Robert Grant (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 !        4.24 !         4.24

ROAD (0.00 + 59.03 + 61.61) = 63.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     -58   0.00  71.49   0.00  -4.96  -7.50   0.00   0.00  -1.32  57.70*
   -90     -58   0.00  71.49   0.00  -4.96  -7.50   0.00   0.00   0.00  59.03
-------------------------------------------------------------------------------
   -58       0   0.00  71.49   0.00  -4.96  -4.92   0.00   0.00   0.00  61.61
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 63.52 dBA

Total Leq All Segments: 63.59 dBA
```

```
Results segment # 1: Abbott (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 !        3.60 !         3.60

ROAD (0.00 + 39.79 + 0.00) = 39.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.00  59.91   0.00 -10.36   0.00   0.00   0.00  -9.76  39.79
-------------------------------------------------------------------------------

Segment Leq : 39.79 dBA


Results segment # 2: Robert Grant (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 !        4.24 !         4.24

ROAD (0.00 + 51.43 + 54.02) = 55.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -58   0.00  63.89   0.00  -4.96  -7.50   0.00   0.00  -1.32  50.11*
   -90    -58   0.00  63.89   0.00  -4.96  -7.50   0.00   0.00   0.00  51.43
-------------------------------------------------------------------------------
   -58      0   0.00  63.89   0.00  -4.96  -4.92   0.00   0.00   0.00  54.02
-------------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 55.92 dBA

Total Leq All Segments: 56.02 dBA
```

```
RT/Custom data, segment # 1: BRT Median (day/night)
-------------------------------------------------
1 - Bus:
Traffic volume    :   460/50    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: BRT Median (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  :  47.00 / 47.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -58.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   4.00 / 4.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


Results segment # 1: BRT Median (day)
-------------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        4.50 !        4.16 !         4.16

RT/Custom (0.00 + 45.89 + 48.47) = 50.38 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -58   0.00  58.35  -4.96  -7.50   0.00   0.00  -1.59  44.31*
   -90    -58   0.00  58.35  -4.96  -7.50   0.00   0.00   0.00  45.89
-------------------------------------------------------------------------
   -58      0   0.00  58.35  -4.96  -4.92   0.00   0.00   0.00  48.47
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 50.38 dBA

Total Leq All Segments: 50.38 dBA
```

```
Results segment # 1: BRT Median (night)
---------------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        4.50 !        4.16 !         4.16

RT/Custom (0.00 + 39.26 + 41.85) = 43.75 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90    -58   0.00  51.73  -4.96  -7.50   0.00   0.00  -1.59  37.68*
   -90    -58   0.00  51.73  -4.96  -7.50   0.00   0.00   0.00  39.26
-------------------------------------------------------------------------
   -58      0   0.00  51.73  -4.96  -4.92   0.00   0.00   0.00  41.85
-------------------------------------------------------------------------

 * Bright Zone !

Segment Leq : 43.75 dBA

Total Leq All Segments: 43.75 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 63.79
                           (NIGHT): 56.27
```

```
STAMSON 5.0        NORMAL REPORT        Date: 02-02-2023 08:50:28
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Abbott (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: Abbott (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  : 119.00 / 119.00 m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Robert Grant (day/night)
-----------------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   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):  35000
    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: Robert Grant (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 49.08 + 0.00) = 49.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90      0   0.57  67.51   0.00 -14.12  -4.31   0.00   0.00   0.00  49.08
-------------------------------------------------------------------------------

Segment Leq : 49.08 dBA
```

Results segment # 2: Robert Grant (day)

Source height = 1.50 m

ROAD (0.00 + 67.49 + 0.00) = 67.49 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	72.16	0.00	-4.67	0.00	0.00	0.00	0.00	67.49

Segment Leq : 67.49 dBA

Total Leq All Segments: 67.55 dBA

Results segment # 1: Abbott (night)

Source height = 1.50 m

ROAD (0.00 + 41.48 + 0.00) = 41.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.57	59.91	0.00	-14.12	-4.31	0.00	0.00	0.00	41.48

Segment Leq : 41.48 dBA

Results segment # 2: Robert Grant (night)

Source height = 1.50 m

ROAD (0.00 + 59.89 + 0.00) = 59.89 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	64.56	0.00	-4.67	0.00	0.00	0.00	0.00	59.89

Segment Leq : 59.89 dBA

Total Leq All Segments: 59.95 dBA

```
RT/Custom data, segment # 1: BRT Median (day/night)
-------------------------------------------------
1 - Bus:
Traffic volume    :   460/40    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: BRT Median (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Results segment # 1: BRT Median (day)
-------------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 53.68 + 0.00) = 53.68 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  58.35  -4.67   0.00   0.00   0.00   0.00  53.68
-------------------------------------------------------------------------

Segment Leq : 53.68 dBA

Total Leq All Segments: 53.68 dBA


Results segment # 1: BRT Median (night)
---------------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 46.08 + 0.00) = 46.08 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.00  50.76  -4.67   0.00   0.00   0.00   0.00  46.08
-------------------------------------------------------------------------

Segment Leq : 46.08 dBA

Total Leq All Segments: 46.08 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.73
                           (NIGHT): 60.13
```