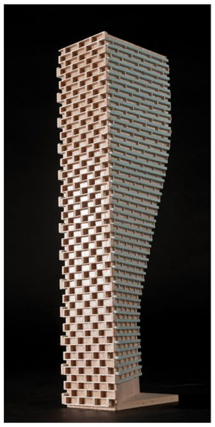
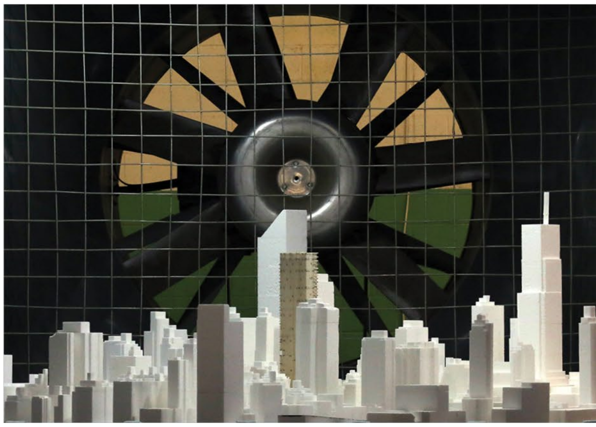
GRADIENTWIND
ENGINEERS & SCIENTISTS

ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT

3713 Borrisokane Road (Drummond Subdivision)
Ottawa, Ontario

Report: 19-236 – Roadway Traffic Noise





June 13, 2023

PREPARED FOR
Caivan (Greenbank North)
3713 Borrisokane Rd
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EXECUTIVE SUMMARY

This report describes a traffic noise feasibility assessment undertaken in support of a Draft Plan Amendment Submission application for a proposed subdivision development, referred to as Drummond Subdivision, located at 3713 Borrisokane Road in Ottawa, Ontario. This report focuses on the lots/blocks primarily located east of Elevation Road and west of the realigned Greenbank Road. Buildings within the development are expected to include a mixture of single dwellings, townhouse buildings, back-to-back townhouse blocks, as well as rear yards for most of the proposed buildings, and two communal parks. The major sources of roadway traffic noise include the realigned Greenbank Road, proposed collectors referred to as Elevation Road and Dundonald Drive, Highway 416, and the Bus Rapid Transit (BRT) lane in the center of the realigned Greenbank Road. 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) subdivision concept plan drawings provided by Caivan Communities in April 2023.

The results of the current study indicate that noise levels due to roadway traffic over the site will range between approximately 50 and 71 dBA during the daytime period (07:00-23:00) and between 43 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façades of Blocks 163, 174, 185, and 186, which are nearest and most exposed to the realigned Greenbank Road.

The properties situated along Greenbank Road and collectors will likely require sound barriers along the edge of the rear yards. Potential noise barrier locations are depicted in Figures 3A and 3B. For the Outdoor Living Area (OLA) of Block 310, it is advised that the noise barrier be constructed such that it will seamlessly connect to the potential noise barrier that will be required for the adjacent block located immediately west (i.e., Block 118). Adding a full-length return for the OLA of Block 310 travelling north is not considered economically and administratively feasible. Proposed barriers for Block 154 and Block 197 should also be constructed such that it will seamlessly connect to the future noise barrier required for the adjacent block. A Warning Clause may be required for Block 310 should noise levels fall between 55 dBA and 60 dBA with the proposed noise barrier.

Additionally, the calculations indicate that dwellings exposed to the collector(s) or Highway 416 will require internal ventilation such as forced air heating with provisions for central air conditioning. Similarly, dwellings exposed to or near the realigned Greenbank Road will require upgraded building components and internal ventilation such as central air conditioning. Either a Type C or Type D Warning Clause will also be required on purchase, sale, and lease agreements as summarized in Section 6.

A detailed roadway traffic noise study will be required at the time of subdivision registration to determine specific noise control measures for each lot and block within the development.

Regarding stationary noise impacts, Gradient Wind has prepared a stationary noise assessment and memoranda for the proposed industrial development located at 3713 Borrisokane Road in Ottawa, Ontario (*ref. Gradient Wind report #19-228 – Stationary Noise R1, dated December 16, 2019 and Gradient Wind memoranda #19-228 – Addendum Letter R1, dated May 14, 2020*). The industrial site is located immediately west of Drummond Subdivision. The results of the study indicate that noise levels at Drummond Subdivision due to the industrial facility are expected to fall below the ENCG and NPC-300 noise criteria.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Caivan (Greenbank North) to undertake a roadway traffic noise feasibility assessment for a proposed subdivision development, referred to as Drummond Subdivision, located at 3713 Borrisokane Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a roadway traffic noise feasibility assessment and was prepared in consideration of the client's Draft Plan Amendment Submission application. Gradient Wind's scope of work involved assessing exterior noise generated by local roadway traffic levels for a majority of the lots/blocks situated between Elevation Road and the realigned Greenbank Road.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1], Ministry of the Environment, Conservation and Parks (MECP)[2], and Ministry of Transportation of Ontario (MTO)[3] guidelines. Noise calculations were based on subdivision concept plan drawings provided by Caivan Communities in April 2023, 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 feasibility assessment is a proposed residential subdivision development located at 3713 Borrisokane Road in Ottawa, Ontario. The proposed subdivision, referred to as Drummond Subdivision, is on a nearly rectangular lot and comprises a mixture of detached homes, standard townhomes, and back-to-back townhomes. Two communal park areas are proposed for the site; one situated to the northwest and the other to the east. The development will include the creation of new walkways and residential streets feeding into the subdivision from the realigned Greenbank Road. The development site is bound by future residential developments to the north and south, a commercial facility and stormwater management pond to the west, and realigned Greenbank Road to the east. The future residential development to the north is set to be completed prior to the subject site. The study site is located

[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, King's Printer for Ontario, Toronto, 2023
[3] Ministry of Transportation, Environmental Guide for Noise, 2021

east of the urban boundary line which travels north and south, signifying urban development west of the boundary is restricted.

Gradient Wind's scope of work involved assessing exterior noise generated by local roadway traffic levels for a majority of the lots/blocks situated between Elevation Road and the realigned Greenbank Road (i.e., east half of the site). Exterior noise impacts for the remainder of the site (i.e., west half) will be conducted as part of a future separate development application, with the exclusion of Block 119 which was included in this assessment.

The major sources of roadway traffic noise include the realigned Greenbank Road, proposed collectors referred to as Elevation Road and Dundonald Drive, Highway 416, and the Bus Rapid Transit (BRT) lane in the center of the realigned Greenbank Road. Figure 1 illustrates the site location with the surrounding context.

3. OBJECTIVES

The principal objective of this work is to calculate the future noise levels on the study site produced by local roadway traffic and explore the potential for noise mitigation where required. Noise calculations are based on concept plan drawings provided by Caivan Communities, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

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) [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

[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

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.

As this assessment was conducted for a development concept plan, noise control recommendations are of a general nature. Specific mitigation requirements would be the work of a future study in support of a Registration of Subdivision application once the lot and block locations have been finalized.

4.2.2 Theoretical Roadway Noise Predictions

The impact of transportation noise sources on the development was determined by two computer modelling programs. To provide a general sense of noise across the site, the employed software program was Predictor-Lima which utilizes the United States Federal Highway Administration's Traffic Noise Model (TNM) to represent the roadway line sources. The TNM model is also being accepted in the updated Environmental Guide for Noise of Ontario, 2021 by the Ministry of Transportation (MTO)[8]. This computer program can represent three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. A set of comparative calculations were performed in the current Ontario traffic noise prediction model STAMSON for comparisons to Predictor simulation results. The STAMSON model is, however, older and requires each receptor to be calculated separately. STAMSON also does not accurately account for building reflections and multiple screening elements, and curved road geometry. A total of fifteen receptor locations were identified around the site, as illustrated in Figures 2A and 2B.

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[7] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

[8] Ministry of Transportation, Environmental Guide for Noise, 2021. Retrieved from https://prod-environmental-registry.s3.amazonaws.com/2021-08/Environmental%20Guide%20for%20Noise%20 2021%20%28Aug%202021 %29.pdf

Roadway noise calculations were performed by treating each road segment as separate line sources of noise, and by using existing and proposed 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 for all roads was taken to be 92% / 8%, respectively.
- The ground surface was modelled as absorptive where grass and foliage (soft ground) are present, and as reflective where pavement and concrete (hard ground) are present.
- Topography was assumed to be a flat/gentle slope surrounding the study site.
- Roadways exceeding a distance of 800 m from a discrete receptor were omitted.
- Fifteen (15) receptor heights were taken to be 4.5 m and 1.5 m above grade, representative of the second level Plane of Window (POW), as well as at-grade amenity areas, respectively.
- Three (3) POW receptors were calculated in STAMSON in order to display the correlation between the Predictor and STAMSON calculation results.
- Massing items associated with the focus area were included as potential noise screening elements.
- Detached and standard townhouse buildings were modelled with height of 9 m above local grade. Similarly, back-to-back townhouse buildings were modelled with a height of 12 m above local grade.
- The site elevation was based on a grading plan provided by Caivan Communities in December 2021.
- The future residential development to the north is set to be completed prior to the subject site. Block 41 (associated with the north development) is expected to include a 2.5m noise barrier along the east property line to mitigate noise generated from the realigned Greenbank Road (see Figure 2A).
- Receptor distances and exposure angles are illustrated in Appendix A.

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[9] 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 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	Assumed Volumes
Greenbank Road (Realigned)	4-Lane Urban Arterial Divided (4-UAD)	70	**35,000**	-
Veterans Memorial Highway (Highway 416)	4 Lane Freeway	100	**18,333/Lane**	-
Bus Rapid Transit	BRT	80	-	***191/67**
Elevation Road, Dundonald Drive	2-Lane Urban Collector Undivided (2-UCU)	40	**8,000**	-

*Daytime and nighttime volumes based on correspondence with the City of Ottawa

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

5. RESULTS AND DISCUSSION

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 ID	Receptor Location	Receptor Height (m)	PREDICTOR-LIMA Noise Level (dBA)	
			Day	Night
R1	POW - Block 310 - South Facade	4.5	62	54
R2	POW - Block 171 - East Facade	4.5	68	61
R3	POW - Block 185 - East Facade	4.5	71	63
R4	POW - Block 142 - South Facade	4.5	61	54
R5	POW - Block 311 - East Facade	4.5	51	43
R6	POW - Block 161 - North Facade	4.5	50	43
R7	POW - Block 162 - North Facade	4.5	54	47
R8	POW - Block 163 - North Facade	4.5	68	60
R9	POW - Block 184 - South Facade	4.5	63	56
R10	POW - Block 183 - South Facade	4.5	63	55
R11	OLA - Block 310	1.5	62	N/a*
R12	OLA - Block 163	1.5	69	N/a*
R13	OLA - Block 185	1.5	69	N/a*
R14	OLA - Block 186	1.5	69	N/a*
R15	POW – Block 119 - West Facade	4.5	57	49

*Nighttime noise levels are not considered for OLAs, as per ENCG

The results of the current analysis indicated that noise levels will range between 50 and 71 dBA during the daytime period (07:00-23:00) and between 43 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façades of Blocks 163, 174, 185, and 186, which are nearest and most exposed to the realigned Greenbank Road. Figures 4 and 5 illustrate the daytime and nighttime noise contours throughout the site at a height of 1.5 m above grade.

Table 4 shows a comparison in results between Predictor-Lima and STAMSON. Noise levels calculated in STAMSON were found to have a good correlation with Predictor-Lima and variability between the two programs was within an acceptable level of ±0-3 dBA. Sample calculations are presented Appendix A.

TABLE 4: RESULTS OF STAMSON/PREDICTOR-LIMA CORRELATION

Receptor ID	Receptor Location	Receptor Height (m)	STAMSON 5.04 Noise Level (dBA)		PREDICTOR-LIMA Noise Level (dBA)	
			Day	Night	Day	Night
R1	POW - Block 310 - South Facade	4.5	63	56	62	54
R2	POW - Block 171 - East Facade	4.5	71	63	68	61
R3	POW - Block 185 - East Facade	4.5	73	66	71	63

5.2 Noise Control Measures

Results of the roadway traffic noise calculations indicate that lots/blocks adjacent to and having direct exposure to the collector(s) and Greenbank Road will likely require noise control measures. With respect to the OLAs, below is a list of noise control measures, subscribing to Table 2.3a in the ENCG and listed in order of preference, which can be implemented to reduce the L_{eq} to 55 dBA:

- Distance setback with soft ground.
- Insertion of noise insensitive land uses between the source and sensitive points of reception.
- Orientation of buildings to provide sheltered zones in rear yards.
- Shared outdoor amenity areas.
- Earth berms (sound barriers).
- Acoustic barriers.

Given the current concept plan, properties situated along Greenbank Road will likely require sound barriers along the edge of the rear yards. Massing elements along the edge of the development are expected block direct line of sight of the roadways and act as sound barriers, reducing the sound experienced at the inner bocks within the subdivision. Similarly, lots/blocks with rear yards siding onto the collectors will likely require sound barriers as well. Potential noise barrier locations are depicted in Figure 3A and 3B. For the OLA of Block 310, it is advised that the noise barrier be constructed such that it will seamlessly connect to the potential noise barrier that will be required for the adjacent block located immediately west (i.e., Block 118). Adding a full-length return for the OLA of Block 310 travelling north is not considered economically and administratively feasible. Proposed barriers for Block 154 and Block 197 should also be constructed such that it will seamlessly connect to the future noise barrier required for the adjacent block. A Warning Clause may be required for Block 310 should noise levels fall between 55 dBA and 60 dBA with the proposed noise barrier.

Similarly, properties that experience noise levels above 65 dBA during the daytime and 60 dBA during the nighttime will require upgraded building components and ventilation requirements to reduce indoor noise levels to appropriate levels outlined in the ENCG and NPC-300. Based on expected noise levels, lots/blocks in the dark red region in Figure 4 will likely require upgraded building components and central air conditioning. This region is primarily influenced by the realigned Greenbank Road. Blocks in the dark orange and red regions in Figure 4 will require forced air heating with provisions for central air conditioning. These regions are primarily influenced by the proposed collectors. Block 119 will also require forced air heating with provisions for central air conditioning due to minor noise impacts from Highway 416. Warning Clauses will also be required on purchase, sale, and lease agreements as summarized in Section 6.

A detailed roadway traffic noise study will be required at the time of subdivision registration to determine specific noise control measures for each lot and block within the development.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels due to roadway traffic over the site will range between approximately 50 and 71 dBA during the daytime period (07:00-23:00) and between 43 and 63 dBA during the nighttime period (23:00-07:00). The highest noise level (71 dBA) occurs at the east façades of Blocks 163, 174, 185, and 186, which are nearest and most exposed to the realigned Greenbank Road.

The properties situated along Greenbank Road and collectors will likely require sound barriers along the edge of the rear yards. Potential noise barrier locations are depicted in Figure 3A and 3B. For Block 310, it is advised that the noise barrier be constructed such that it will seamlessly connect to the potential noise barrier that will be required for the adjacent block located immediately west (i.e., Block 118). Adding a full-length return for Block 310 traveling north is not considered economically and administratively feasible. Proposed barriers for Block 154 and Block 197 should also be constructed such that it will seamlessly connect to the future noise barrier required for the adjacent block. A Warning Clause may be required for Block 310 should noise levels fall between 55 dBA and 60 dBA with the proposed noise barrier.

Additionally, the calculations indicate that dwellings exposed to the collector(s) or Highway 416 will require internal ventilation such as forced air heating with provisions for central air conditioning. Similarly, dwellings exposed to or near the realigned Greenbank Road will require upgraded building components and internal ventilation such as central air conditioning. Either a Type C or Type D Warning Clause will also be required on purchase, sale, and lease agreements as summarized below:

Type C

> *"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks."*

Type D

> *"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks."*

A detailed roadway traffic noise study will be required at the time of subdivision registration to determine specific noise control measures for each lot and block within the development.

Regarding stationary noise impacts, Gradient Wind has prepared a stationary noise assessment and memoranda for the proposed industrial development located at 3713 Borrisokane Road in Ottawa, Ontario (*ref. Gradient Wind report #19-228 – Stationary Noise R1, dated December 16, 2019 and Gradient Wind memoranda #19-228 – Addendum Letter R1, dated May 14, 2020*). The industrial site is located immediately west of Drummond Subdivision. The results of the study indicate that noise levels at Drummond Subdivision due to the industrial facility are expected to fall below the ENCG and NPC-300 noise criteria.

This concludes our roadway traffic noise feasibility 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.

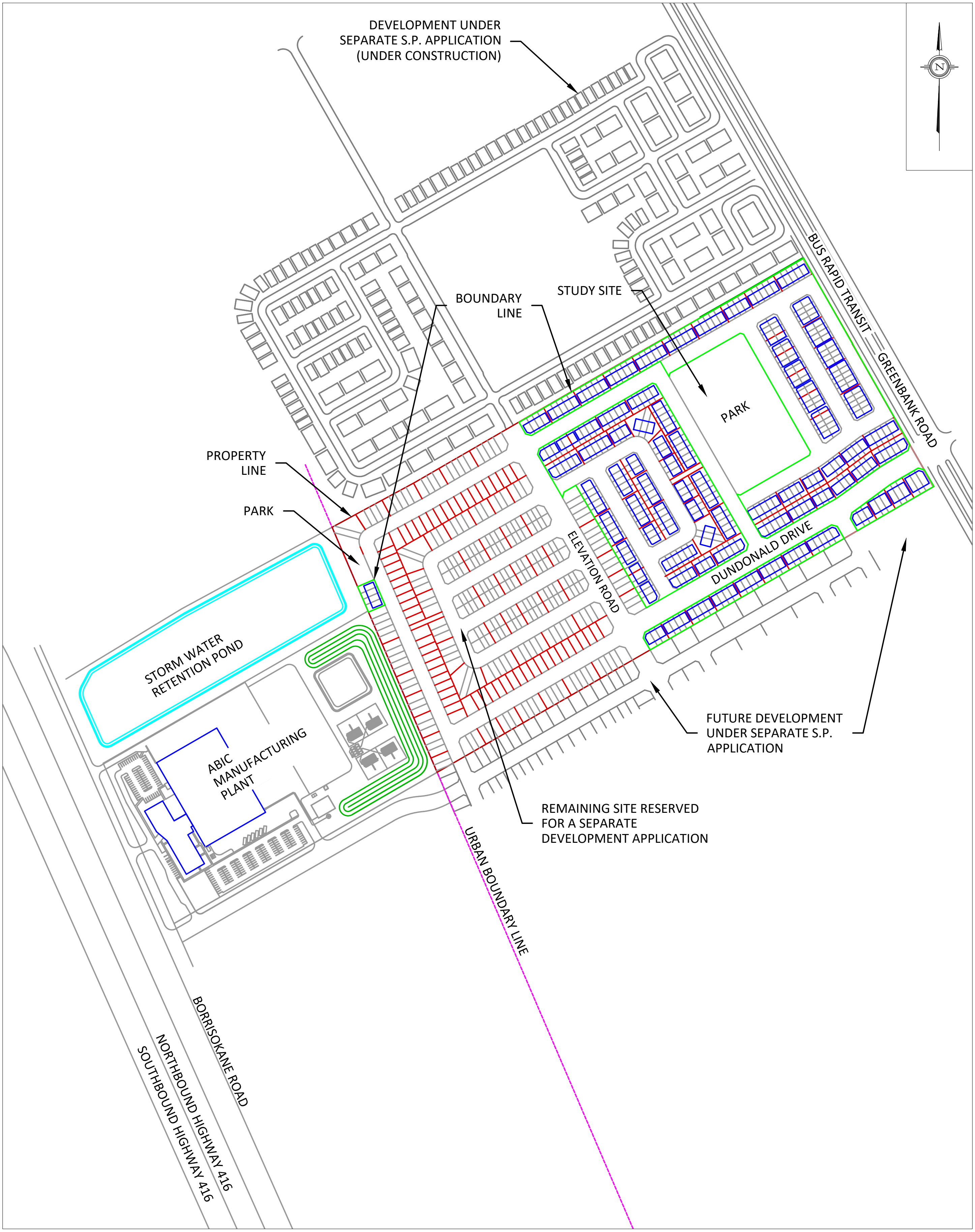
Sincerely,

Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Environmental Scientist

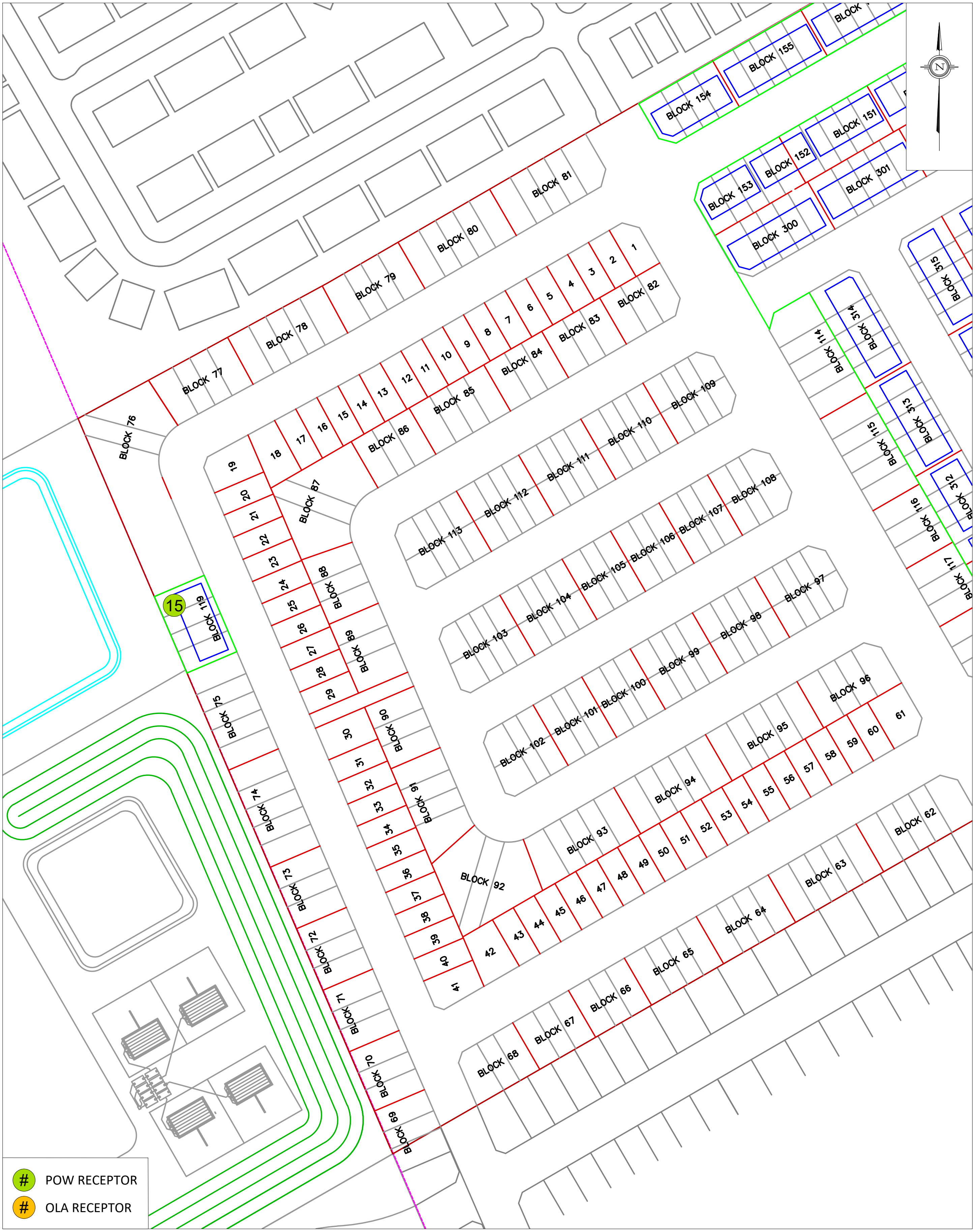
Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File #19-236 – Roadway Traffic Noise



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:6000 (APPROX.)		DRAWING NO. GW19-236-1	
	DATE MAY 23, 2023		DRAWN BY G.G.	

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION FIGURE 2A: RECEPTOR LOCATIONS
	SCALE 1:2000 (APPROX.)	DRAWING NO. GW19-236-2A	
	DATE MAY 23, 2023	DRAWN BY G.G.	



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PROJECT	3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW19-236-2B
DATE	MAY 23, 2023
DRAWN BY	G.G.
DESCRIPTION	FIGURE 2B: RECEPTOR LOCATIONS

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 3A: PROPOSED BARRIER LOCATIONS
	SCALE: 1:1500 (APPROX.)	DRAWING NO.: GW19-236-3A	
	DATE: MAY 23, 2023	DRAWN BY: G.G.	

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE 3B: PROPOSED BARRIER LOCATIONS
	SCALE: 1:1500 (APPROX.)	DRAWING NO.: GW19-236-3B	
	DATE: MAY 23, 2023	DRAWN BY: G.G.	

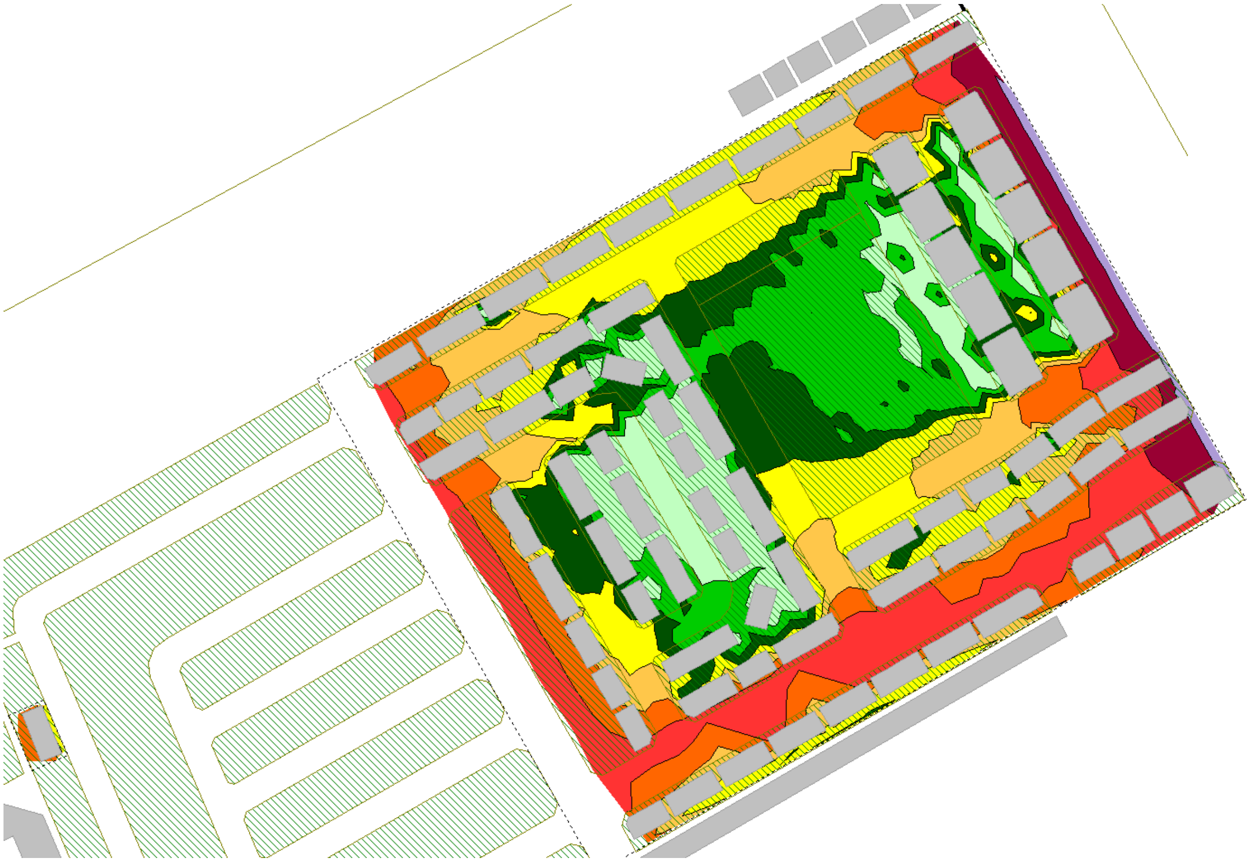
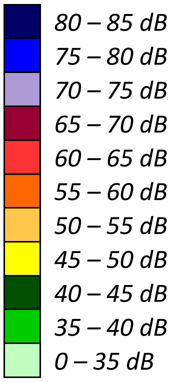


FIGURE 4: DAYTIME TRAFFIC NOISE CONTOURS (1.5 M ABOVE GRADE)



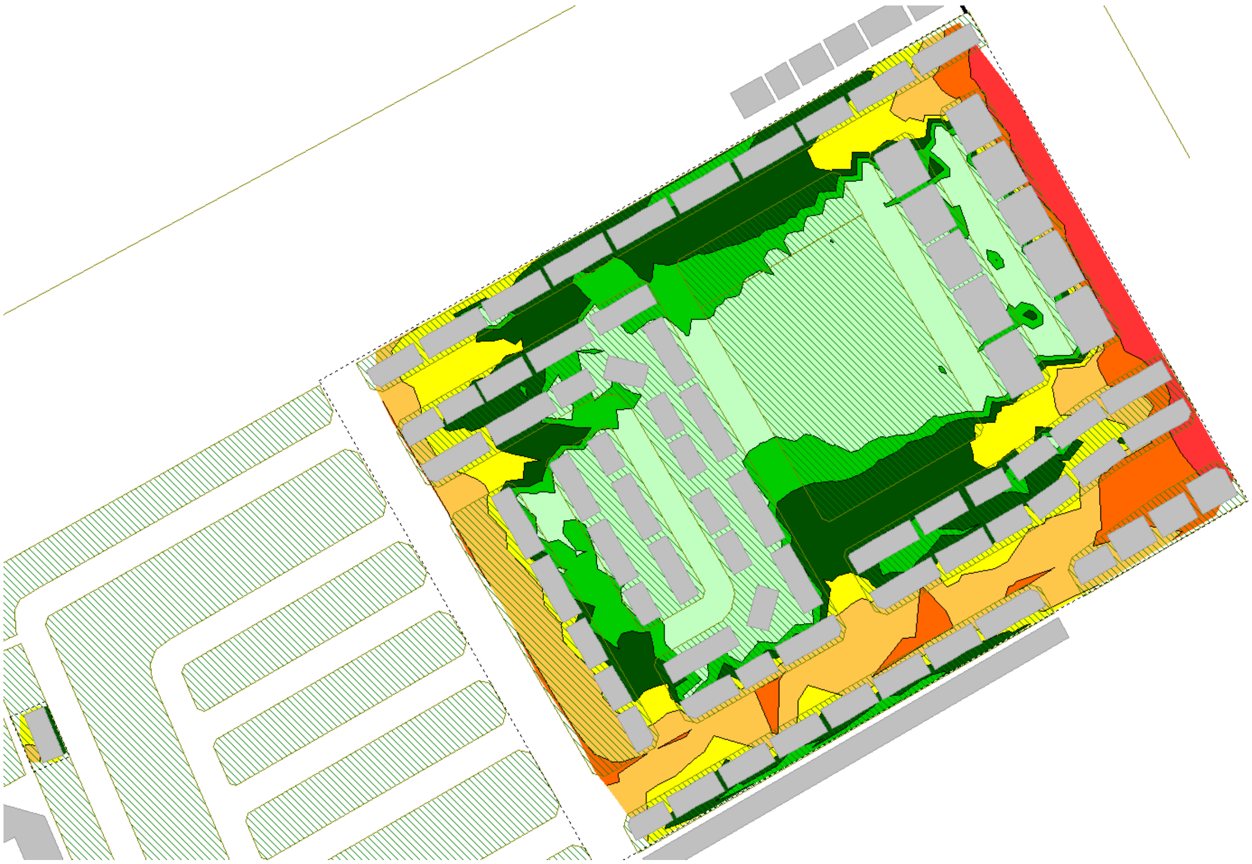
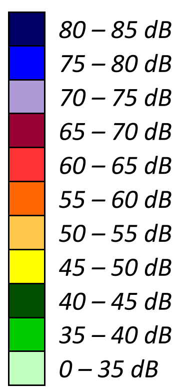


FIGURE 5: NIGHTTIME TRAFFIC NOISE CONTOURS (1.5 M ABOVE GRADE)



APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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

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STAMSON 5.0        NORMAL REPORT        Date: 16-02-2023 14:42:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: ED (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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: ED (day/night)
------------------------------------
Angle1   Angle2           : -49.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  43.00 / 43.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: DD (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 2: DD (day/night)
------------------------------------
Angle1   Angle2            : -90.00 deg   68.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  18.00 / 18.00  m
Receiver height            :   4.50 / 4.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 53.73 + 0.00) = 53.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -49      0   0.00  63.96   0.00  -4.57  -5.65   0.00   0.00   0.00
53.73
--------------------------------------------------------------------------
--

Segment Leq : 53.73 dBA


Results segment # 2: DD (day)
-----------------------------

Source height = 1.50 m

ROAD (0.00 + 62.60 + 0.00) = 62.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     68   0.00  63.96   0.00  -0.79  -0.57   0.00   0.00   0.00
62.60
--------------------------------------------------------------------------
--

Segment Leq : 62.60 dBA
```

```
Total Leq All Segments: 63.13 dBA


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

Source height = 1.50 m

ROAD (0.00 + 46.14 + 0.00) = 46.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -49      0   0.00  56.36   0.00  -4.57  -5.65   0.00   0.00   0.00
46.14
--------------------------------------------------------------------------
--

Segment Leq : 46.14 dBA


Results segment # 2: DD (night)
-------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.00 + 0.00) = 55.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     68   0.00  56.36   0.00  -0.79  -0.57   0.00   0.00   0.00
55.00
--------------------------------------------------------------------------
--

Segment Leq : 55.00 dBA

Total Leq All Segments: 55.53 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 63.13
                         (NIGHT): 55.53
```

```
STAMSON 5.0        NORMAL REPORT        Date: 16-02-2023 14:42:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: GREENBANK RD (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  :    70 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 # 1: GREENBANK RD (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   :  41.00 / 41.00  m
Receiver height            :   4.50 / 4.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00


Results segment # 1: GREENBANK RD (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 70.63 + 0.00) = 70.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  75.00   0.00  -4.37   0.00   0.00   0.00   0.00
70.63
-------------------------------------------------------------------------
--
```

```
Segment Leq : 70.63 dBA

Total Leq All Segments: 70.63 dBA


Results segment # 1: GREENBANK RD (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.03 + 0.00) = 63.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  67.40   0.00  -4.37   0.00   0.00   0.00   0.00
63.03
--------------------------------------------------------------------------
--

Segment Leq : 63.03 dBA

Total Leq All Segments: 63.03 dBA


RT/Custom data, segment # 1: BRT (day/night)
--------------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80  km/h

Data for Segment # 1: BRT (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    :  41.00 / 41.00  m
Receiver height             :   4.50 / 4.50   m
Topography                  :      1       (Flat/gentle slope; no barrier)
Reference angle             :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 55.05 + 0.00) = 55.05 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
```

```
--------------------------------------------------------------------------
   -90      90    0.00  59.41  -4.37    0.00    0.00    0.00    0.00  55.05
--------------------------------------------------------------------------

Segment Leq : 55.05 dBA

Total Leq All Segments: 55.05 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 53.51 + 0.00) = 53.51 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
--------------------------------------------------------------------------
   -90      90    0.00  57.87  -4.37    0.00    0.00    0.00    0.00  53.51
--------------------------------------------------------------------------

Segment Leq : 53.51 dBA

Total Leq All Segments: 53.51 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 70.75
                         (NIGHT): 63.49
```

```
STAMSON 5.0        NORMAL REPORT        Date: 16-02-2023 14:42:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: GREENBANK RD (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  :    70 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 # 1: GREENBANK RD (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  :  24.00 / 24.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: DUN. DR. (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  :    40 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):   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 # 2: DUN. DR. (day/night)
------------------------------------------
Angle1   Angle2           : -46.00 deg   0.00 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           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: GREENBANK RD (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 72.95 + 0.00) = 72.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  75.00   0.00  -2.04   0.00   0.00   0.00   0.00
72.95
--------------------------------------------------------------------------
--

Segment Leq : 72.95 dBA

Results segment # 2: DUN. DR. (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.37 + 0.00) = 56.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -46      0   0.00  63.96   0.00  -1.66  -5.93   0.00   0.00   0.00
56.37
--------------------------------------------------------------------------
--

Segment Leq : 56.37 dBA

Total Leq All Segments: 73.04 dBA
```

```
Results segment # 1: GREENBANK RD (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.36 + 0.00) = 65.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90     90   0.00  67.40   0.00  -2.04   0.00   0.00   0.00   0.00
65.36
----------------------------------------------------------------------------
--

Segment Leq : 65.36 dBA

Results segment # 2: DUN. DR. (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 48.77 + 0.00) = 48.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -46      0   0.00  56.36   0.00  -1.66  -5.93   0.00   0.00   0.00
48.77
----------------------------------------------------------------------------
--

Segment Leq : 48.77 dBA

Total Leq All Segments: 65.45 dBA

RT/Custom data, segment # 1: BRT (day/night)
--------------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: BRT (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   :  24.00 / 24.00  m
Receiver height            :   4.50 / 4.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
```

```
Reference angle          :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 57.37 + 0.00) = 57.37 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  59.41  -2.04   0.00   0.00   0.00   0.00  57.37
----------------------------------------------------------------------

Segment Leq : 57.37 dBA

Total Leq All Segments: 57.37 dBA


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

Source height = 0.50 m

RT/Custom (0.00 + 55.83 + 0.00) = 55.83 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.00  57.87  -2.04   0.00   0.00   0.00   0.00  55.83
----------------------------------------------------------------------

Segment Leq : 55.83 dBA

Total Leq All Segments: 55.83 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 73.16
                         (NIGHT): 65.90
```

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 3717 BORRISOKANE ROAD, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT		DESCRIPTION: FIGURE A1: STAMSON INPUT PARAMETERS
	SCALE: 1:2000 (APPROX.)	DRAWING NO. GW19-236-A1	
	DATE: MAY 23, 2023	DRAWN BY: G.G.	