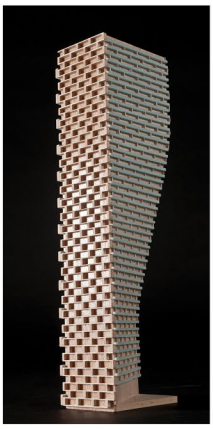
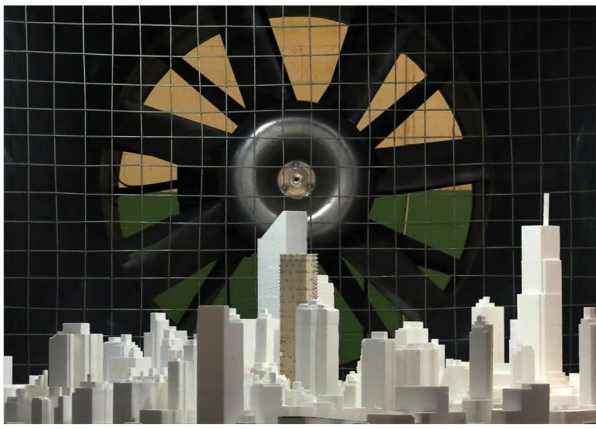
GRADIENTWIND
ENGINEERS & SCIENTISTS

TRANSPORTATION NOISE & VIBRATION ASSESSMENT

2475 Regina Street
Ottawa, Ontario

Report: 22-068 T.Noise Assessment





February 5, 2024

PREPARED FOR

Parkway House Development LP
400-300 Richmond Road
Ottawa, ON, K1Z 6X6

PREPARED BY

Adam Bonello, BASc., Junior Environmental Scientist
Joshua Foster, P.Eng., Lead Engineer

EXECUTIVE SUMMARY

This report describes a transportation noise and vibration assessment for a proposed residential development located at 2475 Regina Street in Ottawa, Ontario. The development comprises 3 buildings with unique shapes and heights. The major sources of transportation noise are Richmond Road, the Sir John A Macdonald Parkway, and the Confederation Line LRT. As the LRT right of way is more then 75 m from the subject site, a vibration study is not required as per the City's Official Plan 10.2.1 15. 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 LRT volumes based on the theoretical ultimate buildout of the system as detailed in Section 4.2.3; and (iv) architectural drawings prepared by Diamond Schmitt, in January 2024.

The results of the current analysis indicate that noise levels will range between 47 and 63 dBA during the daytime period (07:00-23:00) and between 40 and 56 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east façade of the building T2, which is nearest and most exposed to the Sir John A Macdonald Parkway.

Results of the calculations indicate that standard building components will be sufficient to achieve acceptable indoor noise levels. All buildings will require forced air heating systems, with provisions for central air conditioning to be added by the homeowners if desired. Installation of air conditioning would allow windows and doors to remain close, thus providing a quiet and comfortable indoor environment. Due to the nature of the development, air conditioning is likely to be provided. Therefore, the following Type D Warning Clause[1] will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

[1] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 8

Additionally, results of the barrier study indicate that an outdoor living area will be exposed to sound levels of 61 dBA, requiring mitigation and exceeding the 55 dBA OLA criterion. With a 1.1m noise screen (as seen in Figure 3), noise levels at receptor 3 can be reduced to under 55 dBA. However, due to noise levels at other OLA's in building T2 exceeding 55 dBA, a Type A Warning Clause[2] should be applied to building T2 as seen in Section 6.

Regarding stationary noise impacts from the development on the surroundings and the development itself, these can be minimized by judicious placement mechanical equipment such as its placement on a roof or in a mechanical penthouse, or the incorporation of silencers and noise screens as necessary. Due to the size and nature of the development, the HVAC equipment is expected to be located in the mechanical penthouses. The building will be designed to comply with NPC-300 sound level limits and local noise by-laws, thus eliminating any potential impacts on surrounding noise sensitive properties.

[2] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 8

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Parkway House Development LP to undertake a transportation noise and vibration study for the proposed multi-building residential development located at 2475 Regina Street in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). This report summarizes the methodology, results, and recommendations related to the assessment of exterior noise levels generated by local transportation.

The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[3] and Ministry of the Environment, Conservation and Parks (MECP)[4] guidelines. Noise calculations were based on site plan drawings prepared by Diamond Schmitt, in January 2024.

2. TERMS OF REFERENCE

The subject site is located at 2475 Regina Street in Ottawa; situated on a parcel of land bounded by Regina Street to the south, Lincoln Heights Road to the west, and Pinecrest Creek Pathway to the north and east. The proposed development comprises of buildings A1, T1, and T2. Below grade parking will also be implemented across the entire development.

A1 is a 7-storey, L shaped building along the north side of the development. It comprises of a parkway house on the ground level, and 6 floors of residential above. There is a roof terrace on the south side of the building, and incremental terraces on the east. The tallest part of the building has a green roof, and mechanical penthouse.

T1 is a 16-storey, rectangular building located in the center of the development. The building is strictly residential and contains a green roof, and rooftop terrace.

T2 is a 28-storey, rectangular building along the east side of the development. This building is also entirely residential and has incremental terraces on the north side. T2 has a green roof, and rooftop terrace on the main tower.

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

Any private terraces with a depth less than 4 m are not considered as OLA's per ENCG guidelines.

The major sources of roadway noise are Richmond Road and the Sir John A Macdonald Parkway. The LRT noise source is the O-Train Confederation Line that is east of the proposed development. Since the LRT railway is greater than 75m from the proposed development a vibration assessment is not required as per the City's Official plan Section 10.2.1 paragraph 15). Collector and arterial roadways located more than 100 m from the site are considered to be insignificant sources of roadway traffic noise as per ENCG. The site is surrounded by low-high rise residential buildings and commercial buildings to the west. Figure 1 illustrates the site location with surrounding context.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local roadway traffic, and (ii) explore potential noise mitigation options, where required.

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/LRT Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For vehicle traffic, 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 NPC-300 guidelines specify that the recommended indoor noise limits (that is relevant to this study) is 50, 45 and 40 dBA for general offices/retail stores, residence living rooms and hotel sleeping quarters, and sleeping quarters respectively, as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD AND LRT) [5]

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise while a standard closed window is capable of providing a minimum 20 dBA noise reduction[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].

For designated Outdoor Living Areas (OLAs), the sound level limit is 55 dBA during the daytime period. An excess above the limit, between 55 dBA and 60 dBA, is acceptable only in cases where the required noise

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

control measures are not feasible for technical, economic or administrative reasons. The development proposes several terraces on top of the podium roof sections. As such, these terraces have been identified as noise sensitive OLAs and were included in the assessment. Furthermore, balconies and terraces extending less than 4 metres in depth from the façade do not require consideration as Outdoor Living Areas and were excluded from the analysis.

4.2.2 Theoretical Roadway/LRT Noise Predictions

The impact of roadway traffic noise sources on the development was determined by computer modelling. Traffic noise source modelling is based on the software program *Predictor-Lima* which utilizes the United States Federal Highway Administration's Traffic Noise Model (TNM) to represent the roadway line sources. The TNM analysis model as been recognised by the Ministry of Transportation Ontario (MTO) as the recommend noise model for transportation projects (ref. Environmental Guide for Noise, dated August 2021[8]). The Ministry of Environment, Conservation and Parks has also adopted the TMN model as per their "Draft Guideline Noise Pollution Control Publications 306 (NPC-306)[9] 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 free field environment for comparisons to the current Ontario traffic noise prediction model STAMSON. The STAMSON model is however older and requires receptors to be calculated individually. Additionally, STAMSON does not accurately account for building reflections, multiple screening elements, and curved road geometry. Noise levels were found to be within an imperceptible level of 0-3 dBA of those predicted in Predictor, as seen in Table 4.

Roadway traffic and LRT noise calculations were performed by treating each roadway segment as a separate line source of noise, and by using 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:

[8] Ministry of Transportation Ontario, "*Environmental Guide for Noise*", August 2021, pg. 16
[9] Ministry of Environment, Conservation and Parks, Ontario, "Methods to determine Sound Levels Due to Road and Rail Traffic", Draft February 12, 2020

- Truck traffic on all roadways was taken to comprise 7% medium trucks and 5% large trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Default 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 buildings.
- Noise receptors were strategically placed at 18 locations around the study area, see Figure 2.
- Proposed and existing buildings were considered to provide shielding to noise receptors.
- Noise from the LRT was modelled using equivalent noise levels produced from the 4-car Scarborough Rapid Transit (SRT).

4.2.3 Roadway/LRT 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[10] 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. The LRT traffic volumes are based on the environmental assessment performed by Gradient Wind for Phase 2 of the O-Train Confederation Line which considered train volumes for the ultimate buildout of the system.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Sir John A. Macdonald Parkway	4-Lane Arterial Divided	60	**35,000**
Richmond Road	2-Lane Arterial	50	**15,000**
O-Train Confederation Line	LRT	70	**485/76***

*Daytime/Nighttime traffic volumes

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

5. RESULTS AND DISCUSSION

5.1 Roadway/LRT Traffic Noise Levels

The results of the current analysis indicate that noise levels will range between 47 and 63 dBA during the daytime period (07:00-23:00) and between 40 and 56 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east façade of the building T2, which is nearest and most exposed to the Sir John A Macdonald Parkway. The results of the roadway/LRT traffic noise calculations are summarized in Table 3 below.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD AND LRT TRAFFIC

Receptor Number	Receptor Height (m)	Receptor Location	Total Noise Level (dBA)	
			Day	Night
Outdoor Living Area				
1	1.5	A1 – Terrace	51	N/A*
2	1.5	T1 – Roof Terrace	53	N/A*
3	1.5	T2 – Terrace 1	61	N/A*
4	1.5	T2 – Terrace 2	58	N/A*
5	1.5	T2 – Terrace 3	57	N/A*
6	1.5	T2 – Roof Terrace	56	N/A*
Plane of Window				
7	22.3	A1 – South Façade	51	43
8	22.3	A1 – East Façade	57	49
9	22.3	A1 – North Façade	57	49
10	22.3	A1 – West Façade	47	40
11	49.3	T1 – South Façade	56	48
12	49.3	T1 – East Façade	56	49
13	49.3	T1 – North Façade	56	49
14	49.3	T1 – West Façade	52	45
15	86.6	T2 – South Façade	62	55
16	86.6	T2 – East Façade	63	56
17	86.6	T2 – North Façade	58	50
18	86.6	T2 – West Façade	52	45

*Noise levels at OLAs during the nighttime are not considered, as per the ENCG.

Table 4 below shows a comparison between Predictor-Lima and STAMSON. Noise levels calculated in STAMSON were found to have a strong correlation with Predictor-Lima and variability between the two programs was within an acceptable level of 0-3 dBA.

TABLE 4: RESULT CORRELATION WITH STAMSON

Receptor Number	Receptor Location	Receptor Height (m)	PREDICTOR-LIMA Noise Level (dBA)		STAMSON 5.04 Noise Level (dBA)	
			Day	Night	Day	Night
15	T2 – South Façade	86.6	62	55	65	58
16	T2 – East Façade	86.6	63	56	66	59

The results of the comparison between the Predictor-Lima and STAMSON analysis indicate that the STAMSON values are more conservative, but otherwise very similar. The difference between the analyses are equal to 3 dBA, which is considered imperceivable to most human observers. The STAMSON and Predictor roadway traffic calculations can be found in Appendix A and Appendix B respectively.

5.2 Noise Control Measures

Noise levels predicted due to roadway traffic do not exceed the criteria listed in NPC-300 for building components, therefore upgraded building components will not be required and OBC compliant building components will be adequate.

However, all buildings will require forced air heating systems, with provisions for central air conditioning to be added by the homeowners if desired. Installation of air conditioning would allow windows and doors to remain close, thus providing a quiet and comfortable indoor environment. Due to the nature of the development, air conditioning is likely to be provided. Therefore, the following Type D Warning Clause[11] will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6.

5.2.1 Noise Barrier Calculations

Noise levels at selects OLA's are expected to exceed the 55 dBA OLA noise criterion during the daytime period. Additionally, noise levels at receptor 3 (T2 – Terrace 1) are 61 dBA and thus require mitigation to

[11] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 8

reduce noise levels below 60 dBA. Further analysis investigated the benefit of implementing a 1.1m tall solid noise screen around the perimeter of the receptor 3 OLA. Table 5 (below) summarizes the results of the barrier investigation. Results of the investigation proved that noise levels can be reduced to below 60 dBA with a 1.1 m tall noise screen around the terrace perimeter. The location of the noise screen can be seen in Figure 3.

TABLE 5: RESULTS OF NOISE BARRIER INVESTIGATION

Receptor Number	Receptor Location	Daytime L_{eq} Noise Levels (dBA)	
		No Barrier	With 1.1m Barrier
3	T2 – Terrace 1	61	54

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 47 and 63 dBA during the daytime period (07:00-23:00) and between 40 and 56 dBA during the nighttime period (23:00-07:00). The highest noise level (63 dBA) occurs at the east façade of the building T2, which is nearest and most exposed to the Sir John A Macdonald Parkway.

Results of the calculations indicate that standard building components will be sufficient to achieve acceptable indoor noise levels. All buildings will require forced air heating systems, with provisions for central air conditioning to be added by the homeowners if desired. Installation of air conditioning would allow windows and doors to remain close, thus providing a quiet and comfortable indoor environment. Due to the nature of the development, air conditioning is likely to be provided. Therefore, the following Type D Warning Clause[12] will also be required on all Lease, Purchase and Sale Agreements, as summarized below:

[12] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 8

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."*

Additionally, results of the barrier study indicate that an outdoor living area will be exposed to sound levels of 61 dBA, requiring mitigation and exceeding the 55 dBA OLA criterion. With a 1.1m noise screen (as seen in Figure 3), noise levels at receptor 3 can be reduced to under 55 dBA. However, due to noise levels at other OLA's in building T2 exceeding 55 dBA, a Type A Warning Clause[13] should be applied to building T2, as seen below:

Type A:

> *"Purchasers/tenants are advised that sound levels due to increasing road and light rail transit traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."*

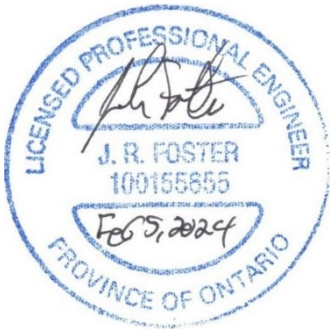
Regarding stationary noise impacts from the development on the surroundings and the development itself, these can be minimized by judicious placement mechanical equipment such as its placement on a roof or in a mechanical penthouse, or the incorporation of silencers and noise screens as necessary. Due to the size and nature of the development, the HVAC equipment is expected to be located in the mechanical penthouses. The building will be designed to comply with NPC-300 sound level limits and local noise by-laws, thus eliminating any potential impacts on surrounding noise sensitive properties.

[13] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 8

This concludes our environmental 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,

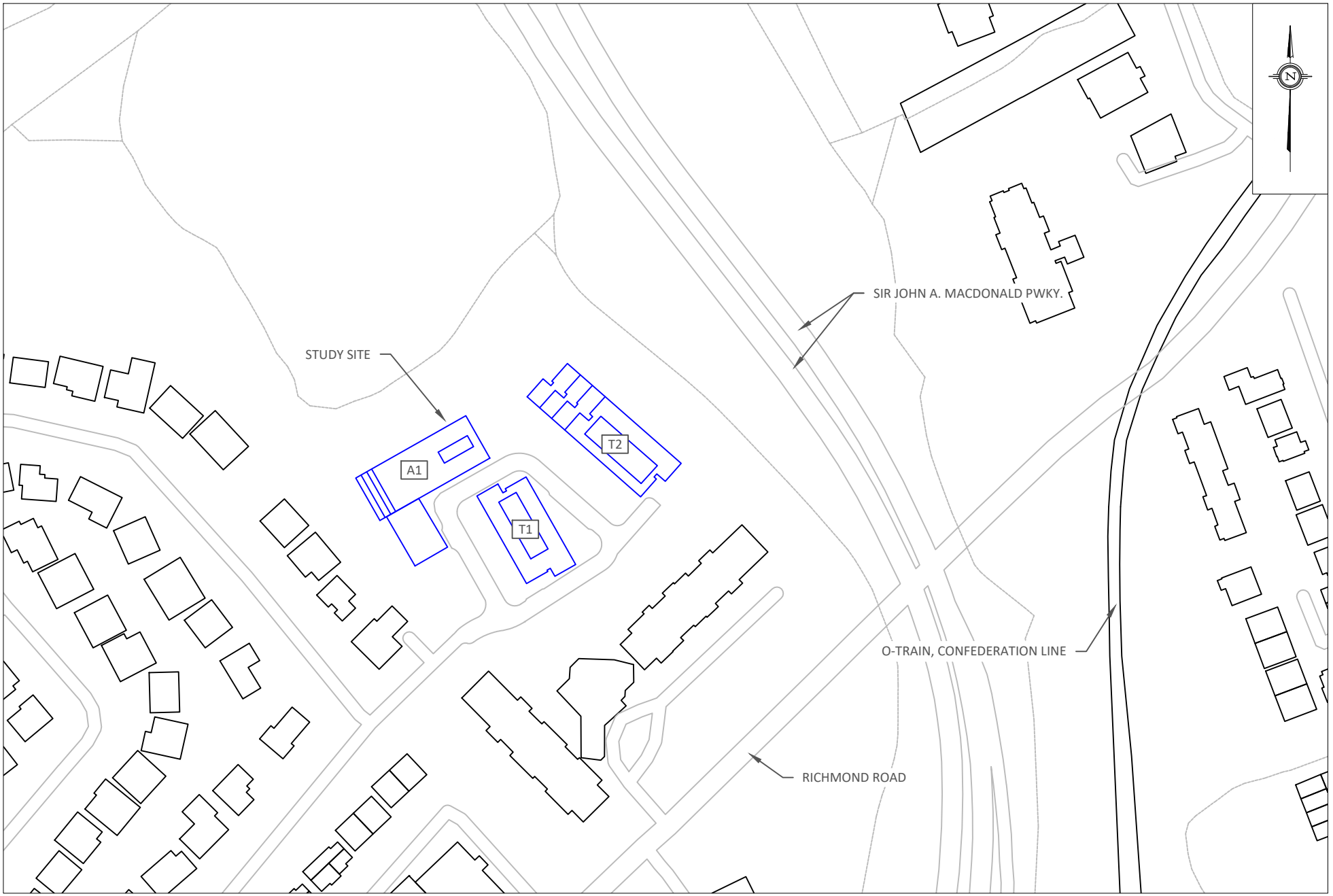
Gradient Wind Engineering Inc.



Adam Bonello, BASc.
Junior Environmental Scientist

Joshua Foster, P.Eng.
Lead Engineer

Gradient Wind File 22-068 T.Noise Assessment



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	2475 REGINA STREET, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW22-068-1
DATE	JANUARY 19, 2024
DRAWN BY	A.B.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

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

PROJECT	2475 REGINA STREET, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW22-068-2
DATE	JANUARY 19, 2024	DRAWN BY	A.B.

DESCRIPTION

FIGURE 2:
TRAFFIC NOISE RECEPTOR LOCATIONS

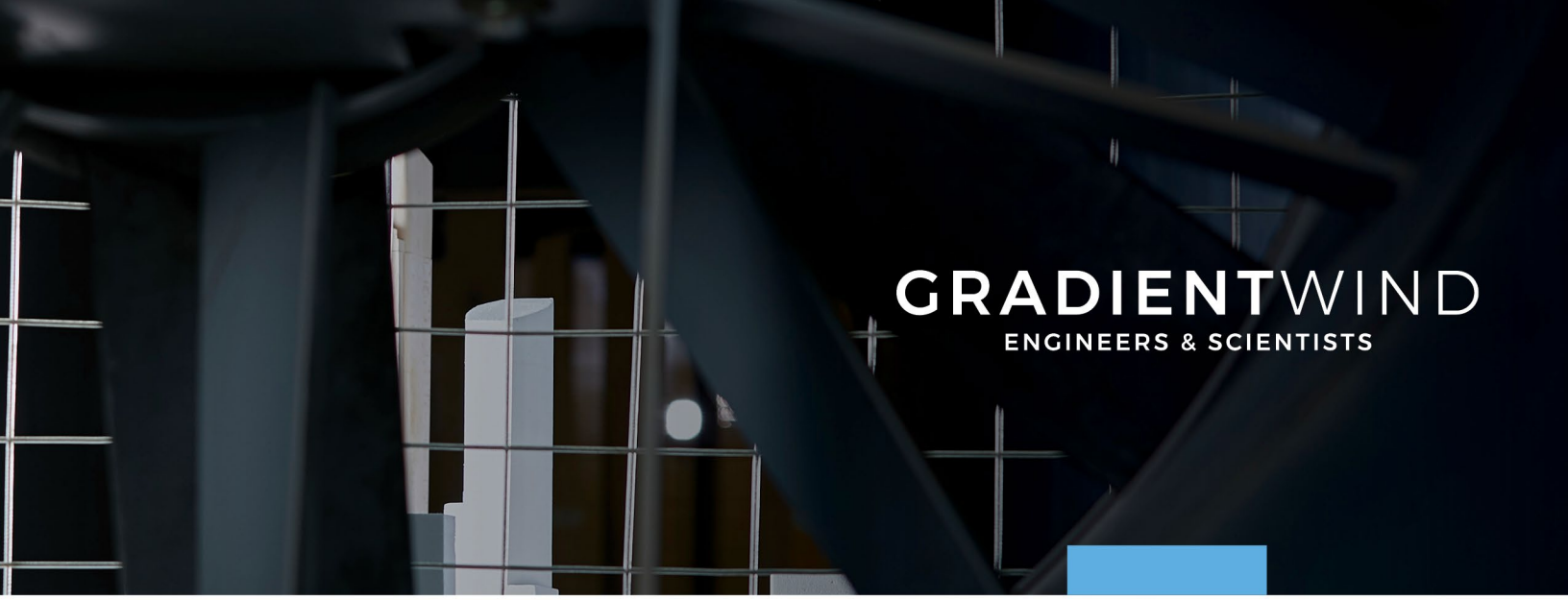
GRADIENTWIND
ENGINEERS & SCIENTISTS

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

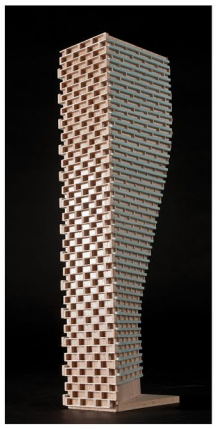
PROJECT	2475 REGINA STREET, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-068-3
DATE	JANUARY 19, 2024
DRAWN BY	A.B.

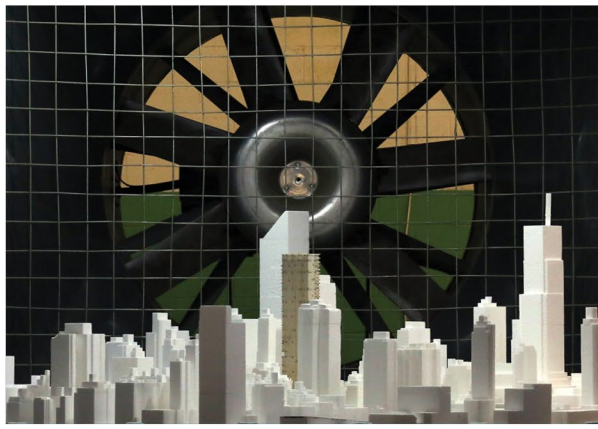
DESCRIPTION

FIGURE 3:
NOISE SCREEN LOCATION



GRADIENTWIND
ENGINEERS & SCIENTISTS





APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

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

GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	2475 REGINA STREET, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GW22-068-A1
DATE	JANUARY 19, 2024
DRAWN BY	A.B.

DESCRIPTION

FIGURE A1:
RECEPTOR DISTANCES AND EXPOSURE ANGLES

STAMSON 5.0 NORMAL REPORT Date: 17-01-2024 14:20:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R15.te Time Period: Day/Night 16/8 hours
Description:

```
Road data, segment # 1: SJA (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  :    60 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: SJA (day/night)
---------------------------------------
Angle1   Angle2           : -12.00 deg   82.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Richmond (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  96.00 / 96.00  m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 64.55 + 0.00) = 64.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -12     82   0.00  73.68   0.00  -6.30  -2.82   0.00   0.00   0.00  64.55
-------------------------------------------------------------------------------

Segment Leq : 64.55 dBA

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

Source height = 1.50 m

ROAD (0.00 + 57.00 + 0.00) = 57.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     -8   0.00  68.48   0.00  -8.06  -3.41   0.00   0.00   0.00  57.00
-------------------------------------------------------------------------------

Segment Leq : 57.00 dBA

Total Leq All Segments: 65.25 dBA

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

Source height = 1.50 m

ROAD (0.00 + 56.96 + 0.00) = 56.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -12     82   0.00  66.08   0.00  -6.30  -2.82   0.00   0.00   0.00  56.96
-------------------------------------------------------------------------------

Segment Leq : 56.96 dBA

Results segment # 2: Richmond (night)
```

```
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.41 + 0.00) = 49.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     -8   0.00  60.88   0.00  -8.06  -3.41   0.00   0.00   0.00  49.41
-------------------------------------------------------------------------------

Segment Leq : 49.41 dBA

Total Leq All Segments: 57.66 dBA

RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   485/76    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -52.00 deg   34.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 173.00 / 173.00 m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 0.50 m

RT/Custom (0.00 + 49.14 + 0.00) = 49.14 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -52     34   0.00  62.97 -10.62  -3.21   0.00   0.00   0.00  49.14
-------------------------------------------------------------------------

Segment Leq : 49.14 dBA

Total Leq All Segments: 49.14 dBA

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

Source height = 0.50 m

RT/Custom (0.00 + 44.10 + 0.00) = 44.10 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
```

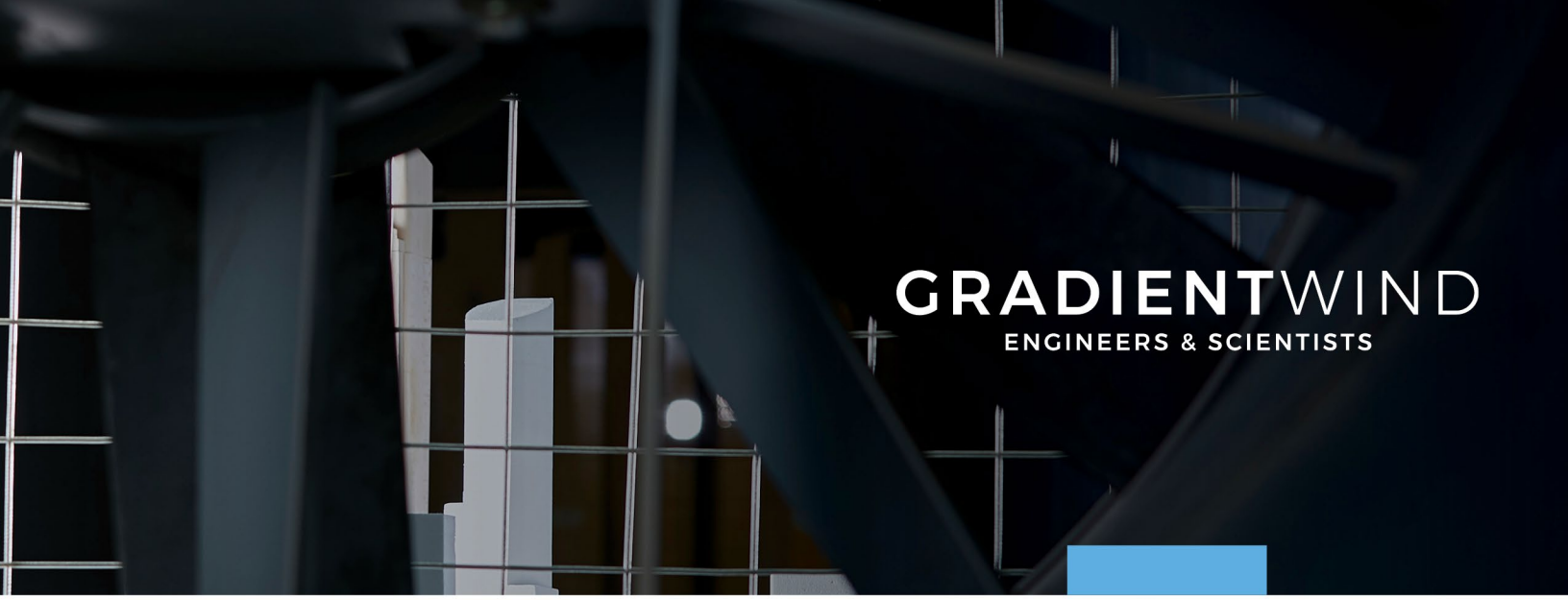
```
-------------------------------------------------------------------------
   -52      34    0.00  57.93 -10.62  -3.21    0.00    0.00    0.00  44.10
-------------------------------------------------------------------------

Segment Leq : 44.10 dBA

Total Leq All Segments: 44.10 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.36
                           (NIGHT): 57.85
```

```
STAMSON 5.0          NORMAL REPORT          Date: 17-01-2024 14:26:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r16.te                 Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: SJA (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  :    60 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: SJA (day/night)
---------------------------------------
Angle1   Angle2           : -90.00 deg   78.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Richmond (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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
```

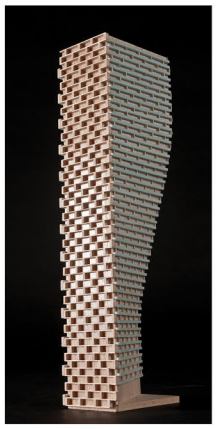
```
Data for Segment # 2: Richmond (day/night)
-----------------------------------------
Angle1   Angle2           : -90.00 deg   -12.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 126.00 / 126.00 m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 67.01 + 0.00) = 67.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     78   0.00  73.68   0.00  -6.37  -0.30   0.00   0.00   0.00  66.01
-------------------------------------------------------------------------------

Segment Leq : 66.01 dBA

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

Source height = 1.50 m

ROAD (0.00 + 55.61 + 0.00) = 55.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -12   0.00  68.48   0.00  -9.24  -3.63   0.00   0.00   0.00  55.61
-------------------------------------------------------------------------------

Segment Leq : 55.61 dBA

Total Leq All Segments: 66.31 dBA

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

Source height = 1.50 m

ROAD (0.00 + 59.41 + 0.00) = 59.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     78   0.00  66.08   0.00  -6.37  -0.30   0.00   0.00   0.00  58.41
-------------------------------------------------------------------------------

Segment Leq : 58.41 dBA

Results segment # 2: Richmond (night)
```

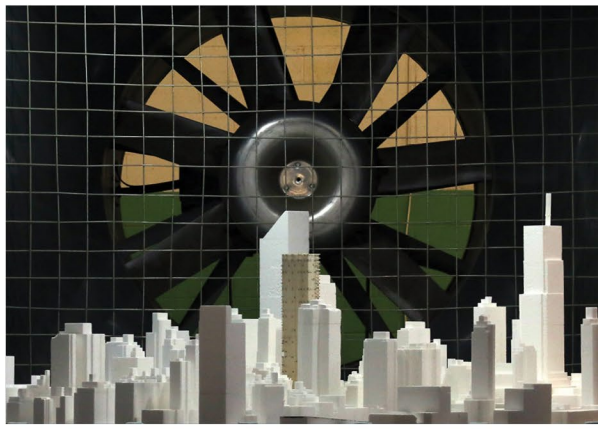
```
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 48.01 + 0.00) = 48.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90    -12   0.00  60.88   0.00  -9.24  -3.63   0.00   0.00   0.00  48.01
-------------------------------------------------------------------------------

Segment Leq : 48.01 dBA

Total Leq All Segments: 58.71 dBA

RT/Custom data, segment # 1: LRT (day/night)
-----------------------------------------
1 - 4-car SRT:
Traffic volume    :   485/76    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -30.00 deg   38.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 193.00 / 193.00 m
Receiver height           :  86.60 / 86.60  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 0.50 m

RT/Custom (0.00 + 47.65 + 0.00) = 47.65 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -30     38   0.00  62.97 -11.09  -4.23   0.00   0.00   0.00  47.65
-------------------------------------------------------------------------

Segment Leq : 47.65 dBA

Total Leq All Segments: 47.65 dBA

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

Source height = 0.50 m

RT/Custom (0.00 + 42.61 + 0.00) = 42.61 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
```

```
-------------------------------------------------------------------------
   -30      38    0.00  57.93 -11.09  -4.23    0.00    0.00    0.00  42.61
-------------------------------------------------------------------------

Segment Leq : 42.61 dBA

Total Leq All Segments: 42.61 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.36
                           (NIGHT): 58.80
```



GRADIENTWIND
ENGINEERS & SCIENTISTS





APPENDIX B

PREDICTOR-LIMA – INPUT AND OUTPUT DATA

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

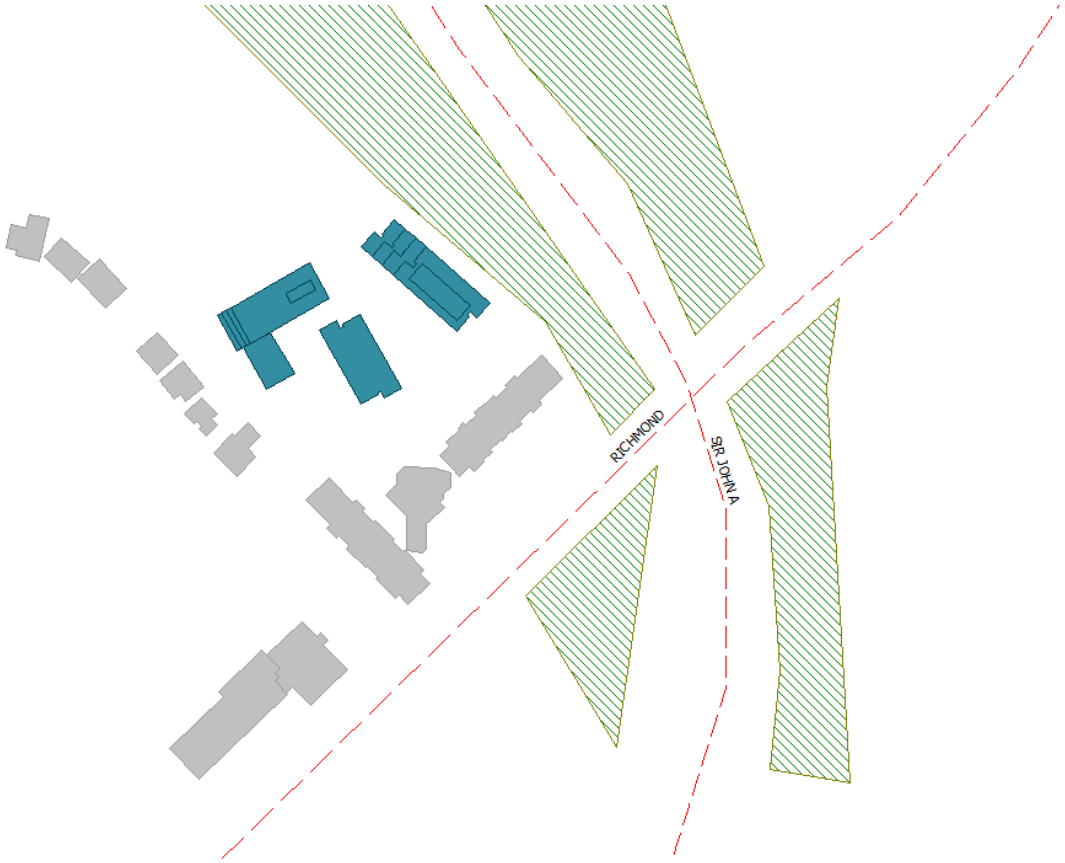


FIGURE B1: ROADWAY SITE PLAN AND SURROUNDINGS

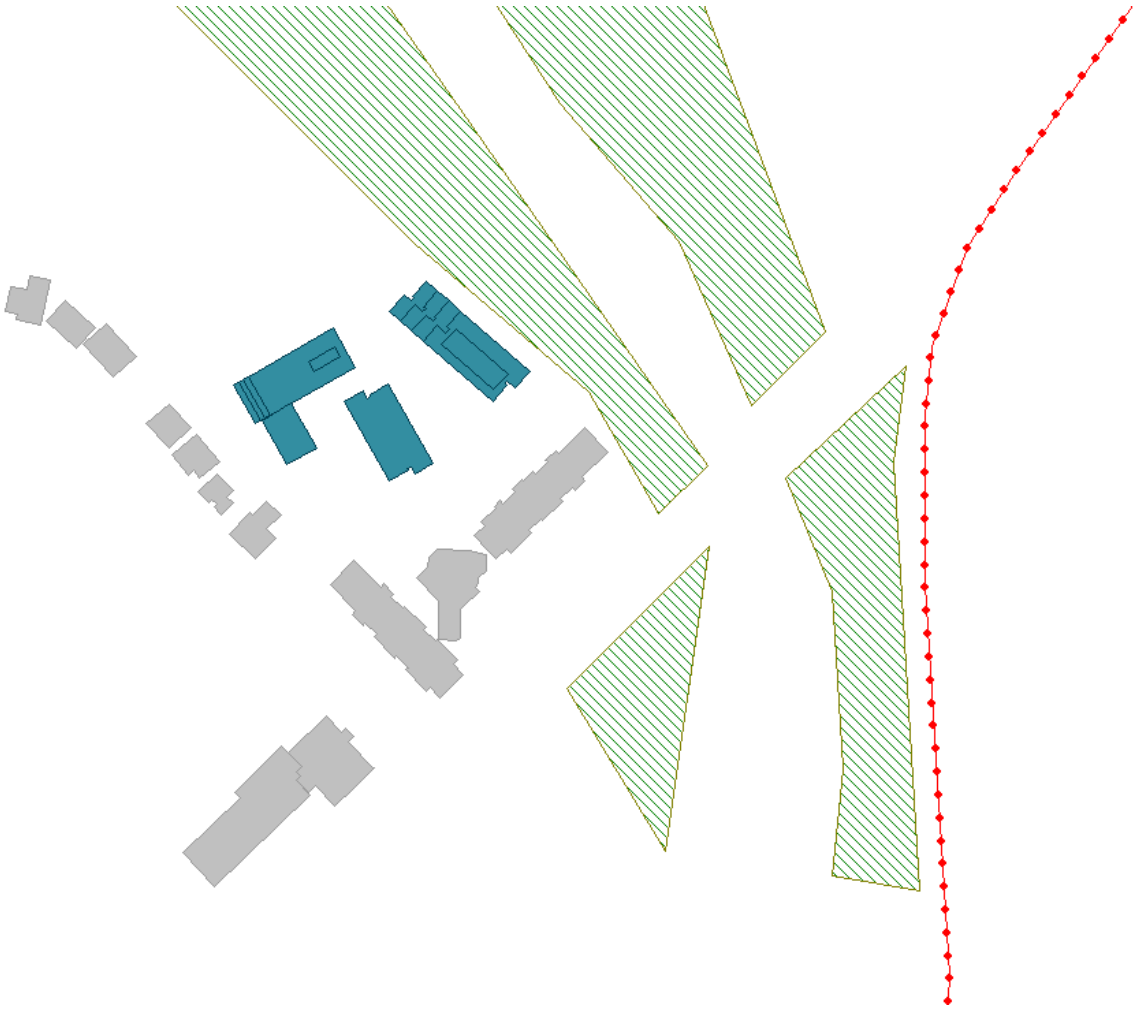


FIGURE B2: LRT SITE PLAN AND SURROUNDINGS

FIGURE B3: TRAFFIC NOISE RECEPTOR LOCATIONS

Name	Description	Height	Day	Night
R10_A		22.30	47.0	39.6
R11_A		49.30	55.2	47.7
R12_A		49.30	55.7	48.1
R13_A		49.30	56.3	48.7
R14_A		49.30	52.3	44.8
R15_A		86.60	61.7	54.2
R16_A		86.60	63.0	55.5
R17_A		86.60	57.8	50.3
R18_A		86.60	52.0	44.5
R1_A	OLA	1.50	50.6	43.1
R2_A	OLA	1.50	52.4	44.9
R3_A	OLA	1.50	60.9	53.4
R4_A	OLA	1.50	58.0	50.5
R5_A	OLA	1.50	57.3	49.8
R6_A	OLA	1.50	55.0	47.5
R7_A		22.30	50.7	43.2
R8_A		22.30	56.9	49.4
R9_A		22.30	56.5	48.9

FIGURE B4: ROADWAY NOISE RESULTS

Name	Description	Height	Day	Night
R10_A		22.30	17.3	12.3
R11_A		49.30	45.3	40.2
R12_A		49.30	43.5	38.5
R13_A		49.30	22.1	17.1
R14_A		49.30	36.0	31.0
R15_A		86.60	51.6	46.5
R16_A		86.60	49.9	44.8
R17_A		86.60	24.5	19.5
R18_A		86.60	37.8	32.7
R1_A	OLA	1.50	25.0	20.0
R2_A	OLA	1.50	42.2	37.2
R3_A	OLA	1.50	43.4	38.4
R4_A	OLA	1.50	34.6	29.6
R5_A	OLA	1.50	42.8	37.8
R6_A	OLA	1.50	46.8	41.8
R7_A		22.30	22.6	17.6
R8_A		22.30	26.6	21.6
R9_A		22.30	18.5	13.5

FIGURE B5: RAILWAY NOISE RESULTS