

**ROADWAY TRAFFIC NOISE
FEASIBILITY ASSESSMENT**

Lansdowne 2.0
Ottawa, Ontario

Report: 23-053- Traffic Noise Feasibility R1



September 1st, 2023

PREPARED FOR

City of Ottawa

110 Laurier Avenue West
Ottawa, ON K1P 1J1

PREPARED BY

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EXECUTIVE SUMMARY

This report describes a roadway traffic noise feasibility assessment undertaken for a proposed multi-building development, known as Lansdowne 2.0, located east of Bank Street in Ottawa, Ontario. The proposed development comprises two towers rising 40 and 25 stories. This redevelopment will also demolish and re-build the north stadium stands to add additional accessible seating and standing areas. The primary sources of roadway traffic noise impacting the site include Bank Street and Queen Elizabeth Driveway. This assessment also considers noise impacts from the stadium and surrounding noise generating spaces. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings provided by Hobin Architecture in August 2023.

The results of the current analysis indicate that noise levels at the building façades will range between 50 and 60 dBA during the daytime period (07:00-23:00) and between 42 and 52 dBA during the nighttime period (23:00-07:00). The highest noise level (60 dBA) occurs at the west façade of Tower 1 which is nearest and most exposed to Bank Street. Results indicate that acoustic mitigation will not be required for any of the identified outdoor amenity areas or terraces as noise levels do not exceed 55 dBA.

Noise impacts from the stadium onto the development are expected to reach 75 dBA. As such, upgraded building components will be required at select facades for all towers (see Figure 5). Air conditioning, or a similar mechanical system is also required to ensure a comfortable indoor environment. Type D and Type E Warning Clauses are required to be placed on all Lease, Purchase, and Sale Agreements for all dwellings in the residential towers, as summarized in Section 6.

Noise generated from pedestrians congregating at exhibition Way, Aberdeen Pavilion, the new event center, or any near-by entertainment venue, is not expected to be a major concern, and would blend in with the existing vibrant establishments already on site. The same noise control measures used to address traffic noise will also help reduce noise generated by crowds.



Stationary noise impacts from mechanical equipment serving surrounding buildings are not expected to be a concern due to the size of the equipment and the setback distance. With regards to stationary noise impacts from the development onto the environment, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed development become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed towers on surrounding noise sensitive areas and each other. As the mechanical equipment will primarily reside in the mechanical level located on the high roof, noise levels on the surrounding noise sensitive properties are expected to be negligible. Noise impacts can generally be minimized by judicious selection and placement of the equipment.

TABLE OF CONTENTS

1. INTRODUCTION 1

2. TERMS OF REFERENCE 1

3. OBJECTIVES 1

4. METHODOLOGY..... 3

4.1 Background.....3

4.2 Roadway Traffic Noise.....3

4.2.1 Criteria for Roadway Traffic Noise3

4.2.2 Roadway Traffic Volumes.....4

4.2.3 Theoretical Roadway Noise Predictions5

4.3 Noise Impacts from the Stadium.....6

5. RESULTS AND DISCUSSION 6

5.1 Roadway Traffic Noise Levels.....6

5.2 Noise Impacts from Surrounding Noise-Generating Spaces8

6. CONCLUSIONS AND RECOMMENDATIONS 8

FIGURES

APPENDICES

Appendix A – STAMSON 5.04 Input and Output Data and Supporting Information



1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by the City of Ottawa to undertake a roadway traffic noise feasibility assessment for a proposed multi-building development, known as Lansdowne 2.0. This report summarizes the methodology, results, and recommendations related to the assessment of exterior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa¹ and Ministry of the Environment, Conservation and Parks (MECP)² guidelines. Noise calculations were based on architectural drawings provided by Hobin Architecture in August 2023, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The proposed Zoning By-law & Official Plan Amendments for Lansdowne 2.0 represent the next step in the evolution and progression of Lansdowne towards a redevelopment approach that will allow the site to succeed as an important residential, sports, culture, recreation, commercial, and entertainment destination, and a more vibrant day-to-day hub for Ottawa.

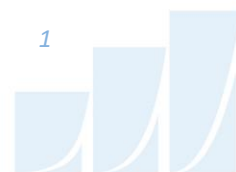
The work described below requires both an Official Plan and Zoning By-law Amendment to align the proposed development plan with the City's planning policy framework. In general, the proposed development includes two components – a public infrastructure component and a private infrastructure component.

These two principal components are advanced through a number of important elements, including:

- / Increase residential density to foster daily vibrancy to the area through proposing three high-rise towers including a combination of condominium and rental including affordable housing units.
 - o The private infrastructure component could include up to 1,200 new residential units on-site, which could be provided in three new towers atop the proposed retail podium.

¹ City of Ottawa Environmental Noise Control Guidelines, January 2016

² Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013



- The proposed heights of the towers as per the 2022 Council-endorsed concept are 29, 34, and 40 storeys, with the proposed maximum height limited to 40 storeys. Approximately 739 new parking spaces could be provided for the new residential units and located within the underground parking lot and within Level 1 and Level 1.5 (mezzanine) of the podium and north stadium stands.
- / Add mixed-used retail space through replacing the current 3,809m² (41,000 ft²) retail space attached to the arena/stadium complex along Exhibition Way, with 9,290m² (100,000 ft²) of new mixed-use retail space in the podium of the new residential towers.
 - The new north stadium stands will be integrated with a new retail podium, which will provide additional retail options to the existing Lansdowne Park, enhance the existing public realm along Exhibition Way, and enhance the protected viewpoint of Aberdeen Pavilion from Bank Street.
- / Replace the existing City facilities on-site through proposing a new 5,500-seat standalone multipurpose Event Centre and a re-designed and reconstructed 12,000-seat north stadium stands.
 - The public infrastructure component will include a new event centre which is intended to replace the existing 9,500 seat TD Place Arena which is located within the north stadium stands.
 - In addition to the new event centre, the north stadium stands will be replaced with 11,200 new seats, which will accommodate 12,000 spectators with additional standing-only areas.
- / Consolidate service access & loading through including a common access point for service & loading is provided for the Event Centre, Stadium, Residential and Retail.
- / Facilitate City-led enhancements to the public realm and programming as per the direction of the Lansdowne Guiding Principles which will form an important part of Lansdowne 2.0.

Overall, the proposal intends to re-visit the form and function of Lansdowne, and specifically Exhibition Way, as a place of exhibition, open to the City as a whole that fosters public gathering, vibrancy, and a centre of activity for the City. There will be a continued focus on placemaking, and the careful integration and enhancement of all new features with the objectives of the existing site – including a shared commitment to recognizing and celebrating Algonquin history, art and culture, respecting heritage



building views, animating Exhibition Way, providing access to the Great Lawn, and preserving an incorporating existing public and private components of Lansdowne today.

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 surrounding noise-generating spaces, 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 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 50, 45 and 40 dBA for retail space, living rooms and sleeping quarters, respectively, for roadway traffic as listed in Table 1.

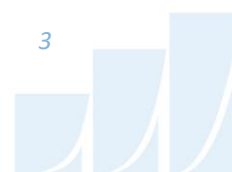


TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)³

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

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction⁴. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment⁵. 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 attenuation⁶.

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

4.2.2 Roadway Traffic Volumes

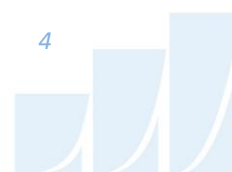
The ENCG dictates that noise calculations should consider future sound levels based on a roadway’s classification at the mature state of development. Therefore, traffic volumes are based on the roadway

³ Adapted from ENCG 2016 – Tables 2.2b and 2.2c

⁴ Burberry, P.B. (2014). Mitchell’s Environment and Services. Routledge, Page 125

⁵ MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

⁶ MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3



classifications outlined in the City of Ottawa’s Official Plan (OP) and Transportation Master Plan⁷ which provide additional details on future roadway expansions. Queen Elizabeth Driveway is classified in the TMP as a Federally Owned Road. Based on experience, this roadway acts as an urban collector, therefore, has been considered in this assessment as such. 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.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Bank Street	4-Lane Arterial (Divided)	40	35,000
Queen Elizabeth Driveway	2-Lane Urban Collector	40	8,000

4.2.3 Theoretical Roadway Noise Predictions

Noise predictions were determined by computer modelling using two programs: Predictor-Lima and STAMSON 5.04. To provide a general understanding of noise across the site, the employed software program was Predictor-Lima, which incorporates the United States Federal Highway Administration’s (FHWA) Transportation Noise Model (TNM) 2.5. This computer program is capable of representing three-dimensional surface and first reflections of sound waves over a suitable spectrum for human hearing. A receptor grid was placed across the subject site, along with a number of discrete receptors at key sensitive areas. Although this program is useful for outputting noise contours, it is not the approved calculation method for roadway predictions by the City of Ottawa. Therefore, the results were confirmed by performing discrete noise calculations with the MECP computerized noise assessment program, STAMSON 5.04, at two sample receptor locations. Receptor distances and exposure angles are illustrated in Figure A1. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road segment as a separate line source of noise, and by using existing buildings as noise barriers. In addition to the traffic volumes summarized in

⁷ City of Ottawa Transportation Master Plan, November 2013

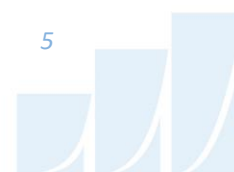


Table 1, theoretical noise predictions were based on the parameters listed below. This was used for both the Predictor-Lima and STAMSON models.

- The day/night split was taken to be 92%/8% respectively for all streets.
- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be flat/gentle slope surrounding the subject site.
- Noise receptors were strategically placed at 8 locations around the study area, see Figure 2.
- Receptor distances and exposure angles used in the STAMSON calculations are illustrated in Figures A1 and A2.

4.3 Noise Impacts from the Stadium

Crowd noise impacts from the stadium have been considered in this analysis. According to *Crowd Noise Measurements and Simulation in Large Stadium Using Beamforming*⁸, crowd noise levels at a typical football game ranges between 95 to 105 dBA, with occasional peaks approaching 110 dB. The maximum peak has been used in the analysis for conservatism. The noise level is then extrapolated to the Plane of Window of the south façade, with a setback distance of 16 m using standard outdoor noise propagation calculations consistent with ISO 9613. Results are detailed in Section 5.2

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

The results of the current analysis indicate that noise levels at the building façades will range between 50 and 60 dBA during the daytime period (07:00-23:00) and between 42 and 52 dBA during the nighttime period (23:00-07:00). The highest noise level (60 dBA) occurs at the west façade of Tower 1 which is nearest and most exposed to Bank Street. Figures 4 and 5 illustrate daytime and nighttime noise contours throughout the site 40 m above grade.

⁸ *Crowd Noise Measurements and Simulation in Large Stadium Using Beamforming*, University of Michigan, February 2008



Results also indicate that acoustic mitigation will not be required for any of the identified outdoor living areas as noise levels do not exceed 55 dBA. Results can be seen in Table 3.

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC

Receptor Number	Absolute Receptor Height (m)	Receptor Location	Noise Level (dBA)	
			Day	Night
R1	126.5	Tower 1 North Façade Level 40	57	50
R2	126.5	Tower 1 West Façade Level 40	60	52
R3	126.5	Tower 1 South Façade Level 40	57	49
R4	9.8	Tower 1 North Façade Level 2	54	47
R5	81.5	Tower 2 South Façade Level 25	52	44
R6	81.5	Tower 2 East Façade Level 25	50	42
R7	1.5	Tower 2 Level 2 Outdoor Amenity	43	N/A
R8	1.5	Level 5 Common Outdoor Amenity	42	N/A

*Above podium roof

Table 4 shows a comparison between the calculated noise levels using Predictor-Lima and STAMSON. Noise levels calculated in STAMSON were found to have good correlation with Predictor-Lima and variability between the two programs was within an acceptable level of ± 1 -3dBA. Appendix A includes the STAMSON 5.04 input and output data.

TABLE 4: RESULT CORRELATION BETWEEN PREDICTOR AND STAMSON

Receptor Number	Receptor Location	Absolute Receptor Height (m)	STAMSON 5.04 Noise Level (dBA)		PREDICTOR-LIMA Noise Level (dBA)	
			Day	Night	Day	Night
R1	Tower 1 North Façade Level 40	Tower 1 North Façade Level 40	60	52	57	50
R2	Tower 1 West Façade Level 40	Tower 1 West Façade Level 40	63	55	60	52

5.2 Noise Impacts from Surrounding Noise-Generating Spaces

Results of the analysis show that the crowd noise impacts from the stadium onto the towers is approximately 75 dBA outside the window. Since the targeted indoor noise levels for bedrooms/living rooms/retail spaces are: 40, 45, and 50 dBA, respectively, minimum window STC requirements have been estimated based on the difference between the outdoor noise level and the targeted indoor noise level. Facades that require upgraded window components are detailed in Table 5 and Figure 5:

TABLE 5: MINIMUM WINDOW STC REQUIREMENTS

Tower	Façade	Minimum STC
Tower 1 / 2 podium	South, East, West	35
Tower 1		
Tower 2		

Furthermore, the development will also require air conditioning, or a similar system, to ensure a comfortable indoor environment. Warning Clauses will be required to be placed to be placed on all Lease, Purchase, and Sale Agreements, as detailed in Section 6.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels at the building façades will range between 50 and 60 dBA during the daytime period (07:00-23:00) and between 42 and 52 dBA during the nighttime period (23:00-07:00). The highest noise level (60 dBA) occurs at the west façade of Tower 1 which is nearest and most exposed to Bank Street. Results indicate that acoustic mitigation will not be required for any of the identified outdoor amenity areas or terraces as noise levels do not exceed 55 dBA.

Noise impacts from the stadium onto the development are expected to reach 75 dBA. As such, upgraded building components will be required at select facades for all towers (see Figure 5). Air conditioning, or a similar mechanical system is also required to ensure a comfortable indoor environment. Warning Clause Type D will be required to be placed on all Lease, Purchase, and Sale Agreements for all towers, as seen below:

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."

As the development is in close proximity to the stadium, a Warning Clause Type E is required, as seen below:

Type E:

"Purchasers/tenants are advised that due to the proximity of the adjacent entertainment facility noise from the stadium and event centre may at times be audible."

Noise generated from pedestrians congregating at exhibition Way, Aberdeen Pavilion, the new event center, or any near-by entertainment venue, is not expected to be a major concern, and would blend in with the existing vibrant establishments already on site.

Stationary noise impacts from mechanical equipment serving surrounding buildings are not expected to be a concern due to the size of the equipment and the setback distance. With regards to stationary noise impacts from the development onto the environment, a stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed development become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed towers on surrounding noise sensitive areas. As the mechanical equipment will primarily reside in the mechanical level located on the high roof, noise levels on the surrounding noise sensitive properties are expected to be negligible. Noise impacts can generally be minimized by judicious selection and placement of the equipment.



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,

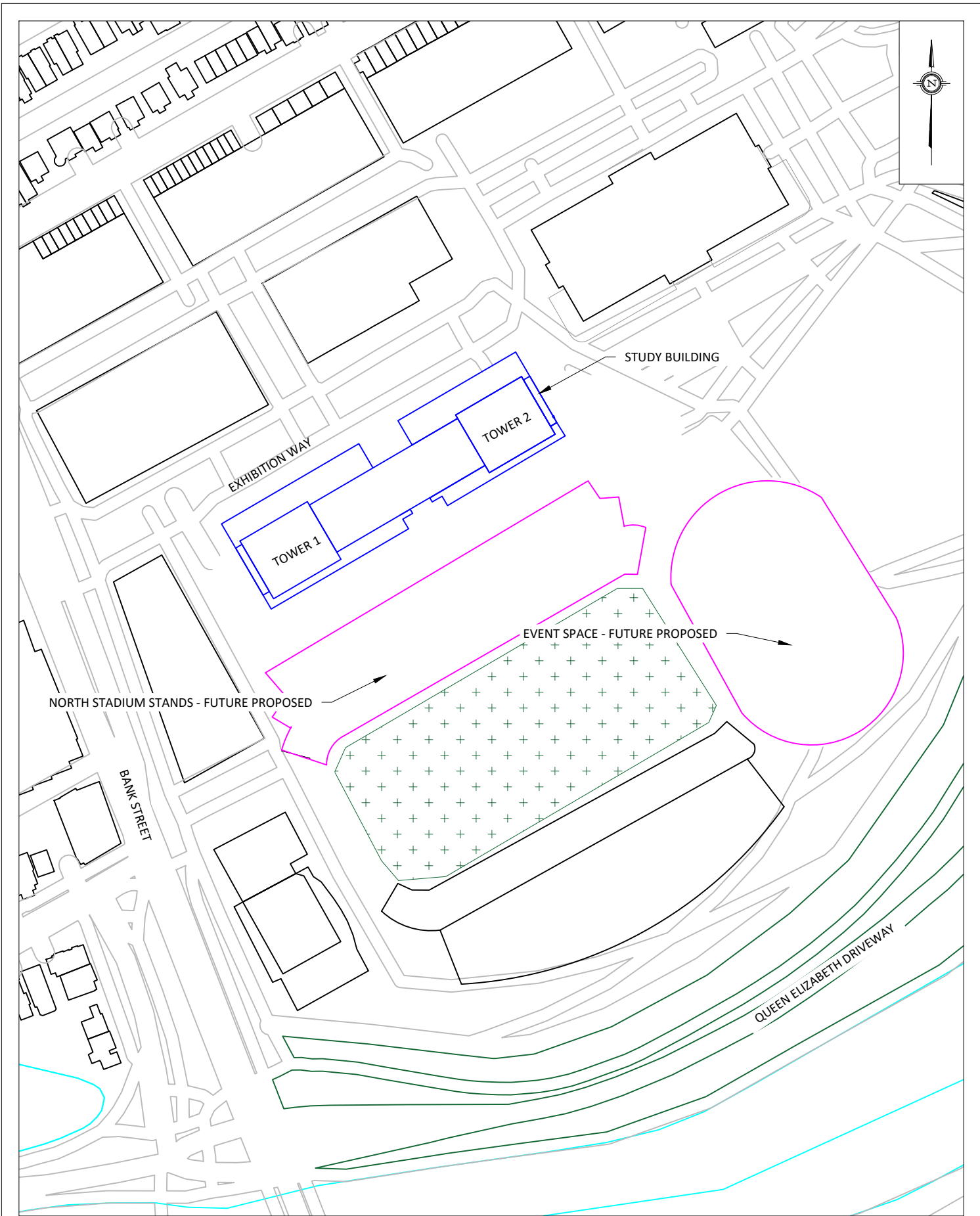
Gradient Wind Engineering Inc.



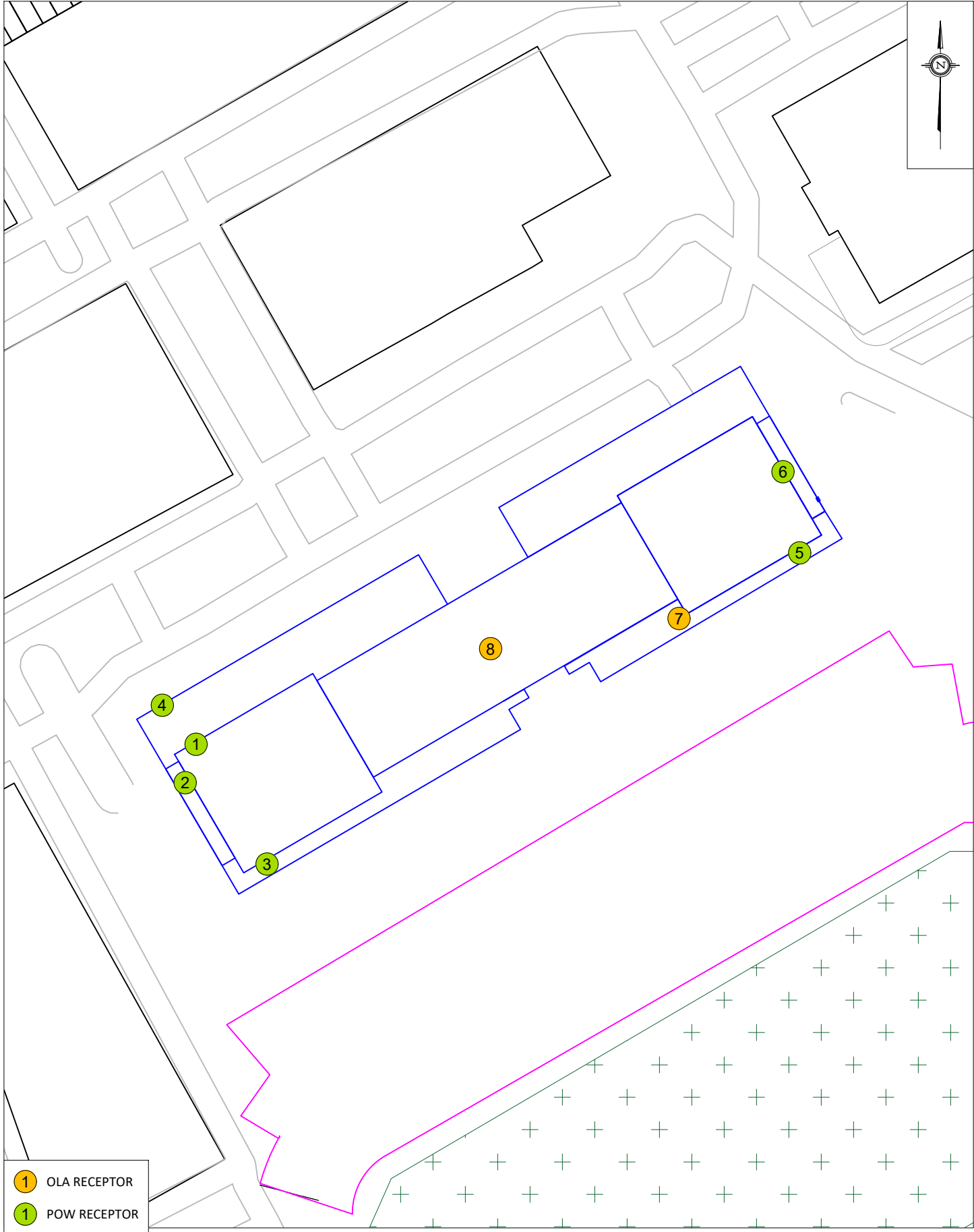
Essraa Alqassab, B.A.Sc.
Junior Environmental Scientist
Gradient Wind File 23-053- Traffic Noise Feasibility



Joshua Foster, P.Eng.
Lead Engineer

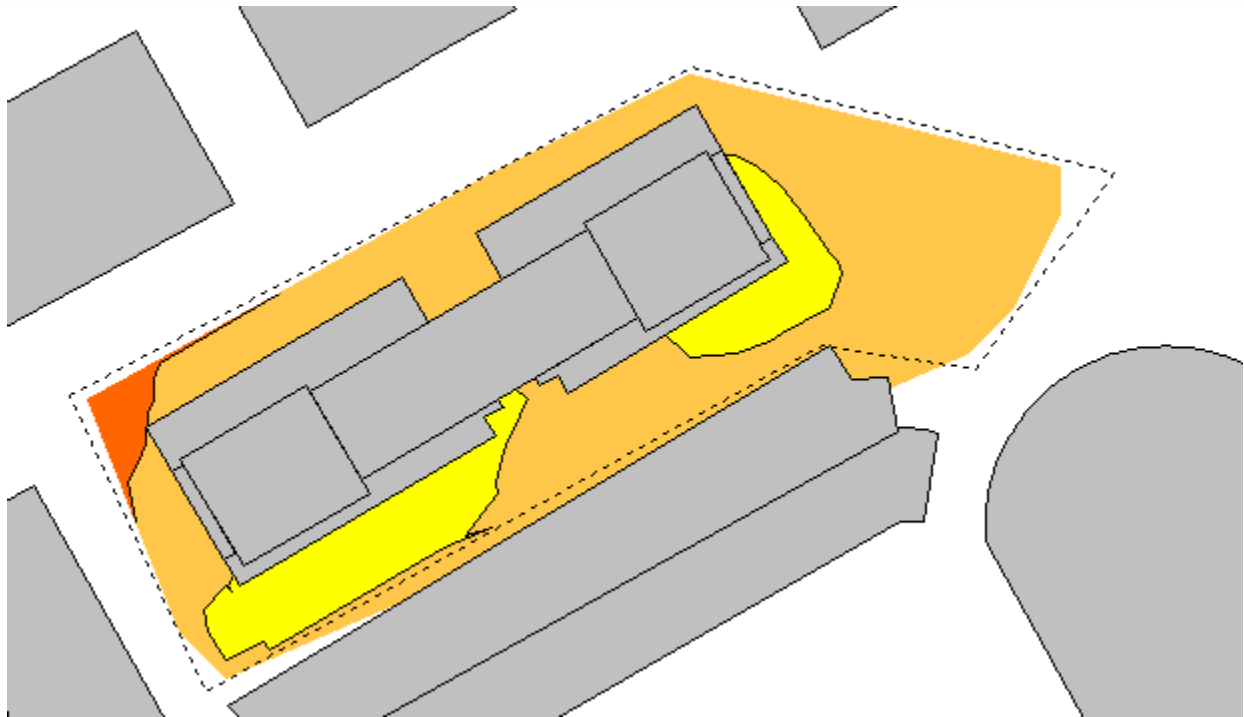


GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	LANSDOWNE 2.0, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
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	DATE	AUGUST 28, 2023	DRAWN BY	E.A.	

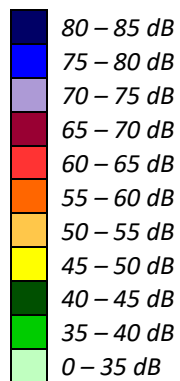


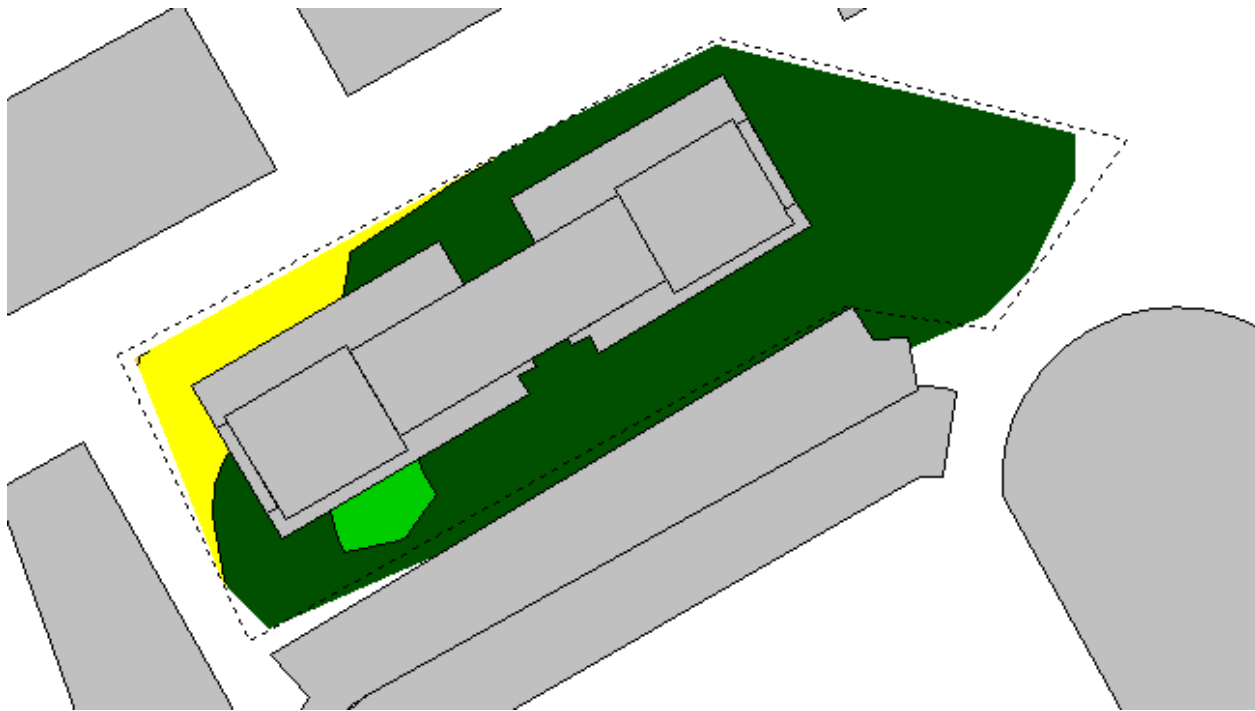
- ① OLA RECEPTOR
- ① POW RECEPTOR

PROJECT	LANSDOWNE 2.0, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT	
SCALE	1:2000 (APPROX.)	DRAWING NO. GW23-053-2
DATE	AUGUST 28, 2023	DRAWN BY E.A.

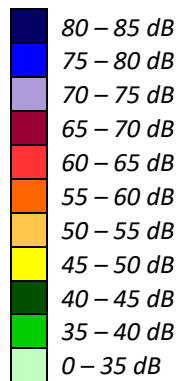


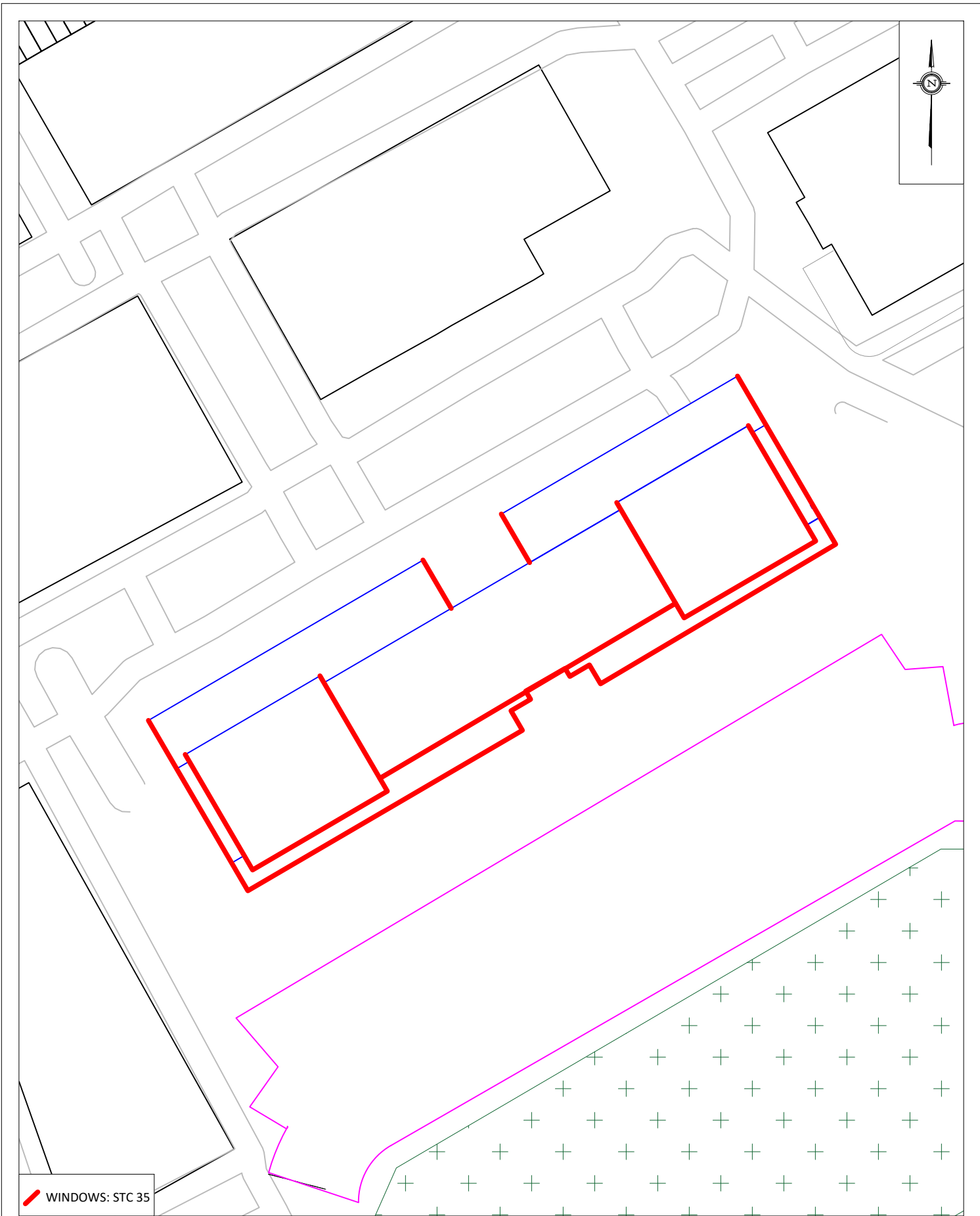
**FIGURE 3: DAYTIME TRAFFIC NOISE CONTOURS
(40 M ABOVE GRADE)**






**FIGURE 4: NIGHTTIME TRAFFIC NOISE CONTOURS
(40 M ABOVE GRADE)**





 WINDOWS: STC 35

PROJECT	LANSDOWNE 2.0, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT	
SCALE	1:2000 (APPROX.)	DRAWING NO. GW23-053-5
DATE	AUGUST 28, 2023	DRAWN BY E.A.

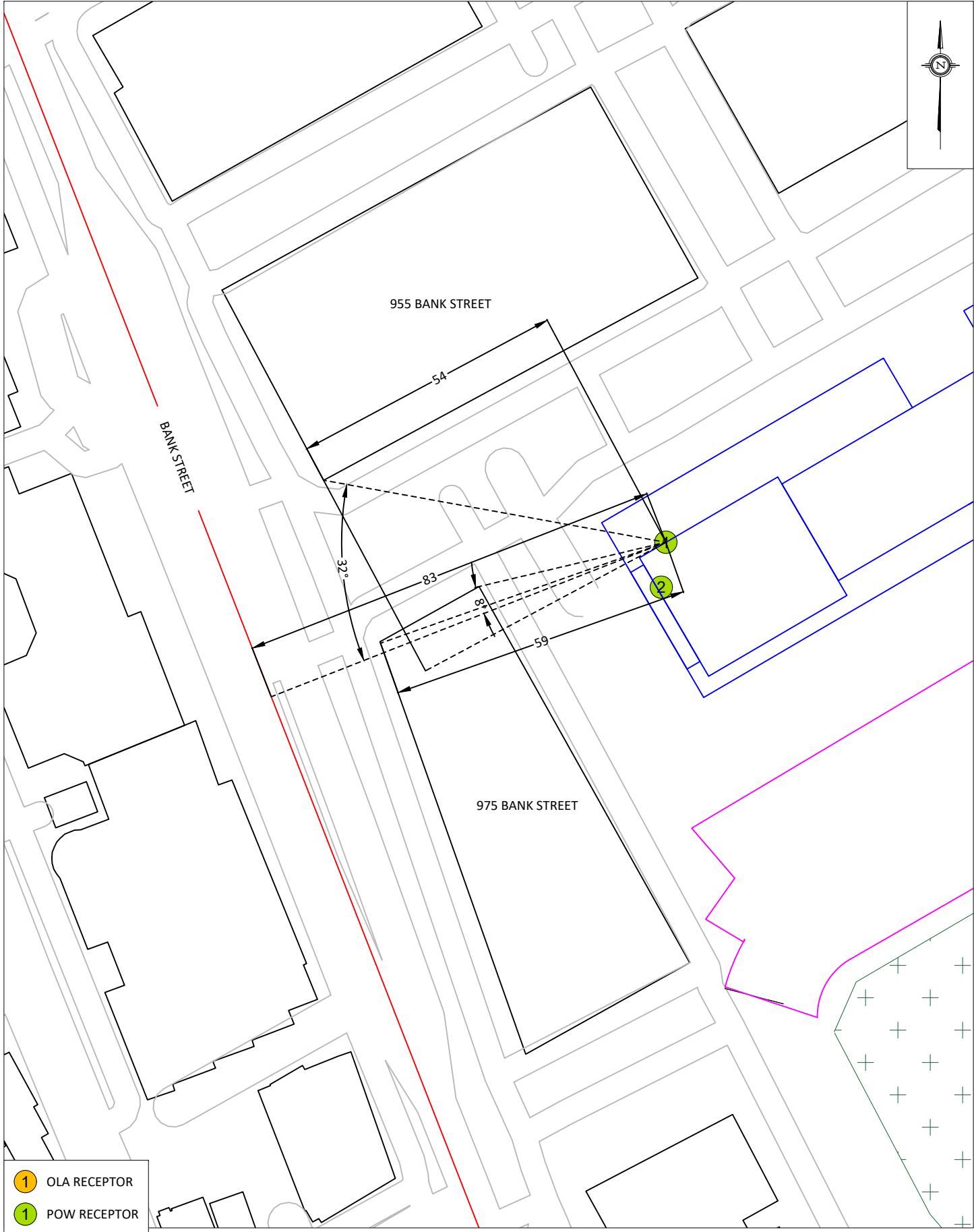
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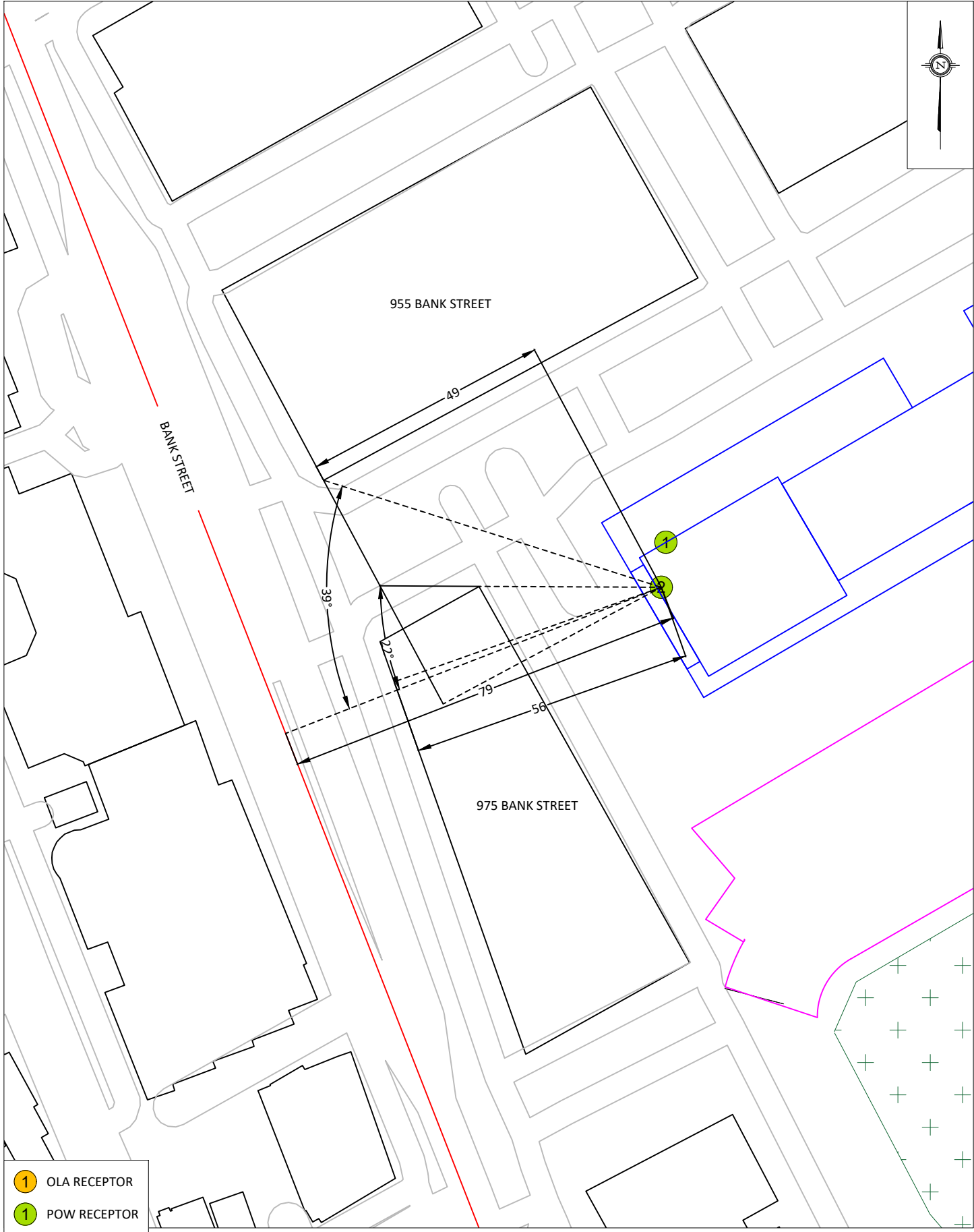
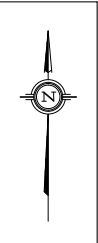
APPENDIX A

STAMSON CALCULATIONS



- 1 OLA RECEPTOR
- 1 POW RECEPTOR

PROJECT	LANSLOWNE 2.0, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT	
SCALE	1:1000 (APPROX.)	DRAWING NO. GW23-053-A1
DATE	AUGUST 28, 2023	DRAWN BY E.A.



- 1 OLA RECEPTOR
- 1 POW RECEPTOR

PROJECT	LANSDOWNE 2.0, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT	
SCALE	1:1000 (APPROX.)	DRAWING NO. GW23-053-A2
DATE	AUGUST 28, 2023	DRAWN BY E.A.

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STAMSON 5.0 NORMAL REPORT Date: 28-08-2023 10:05:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank-S1 (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 : 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): 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: Bank-S1 (day/night)

Angle1 Angle2 : 0.00 deg 8.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 83.00 / 83.00 m
Receiver height : 126.50 / 126.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : 0.00 deg Angle2 : 8.00 deg
Barrier height : 26.00 m
Barrier receiver distance : 59.00 / 59.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Bank-S2 (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 : 40 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)



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* 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: Bank-S2 (day/night)

```

-----
Angle1   Angle2           : 8.00 deg  90.00 deg
Wood depth           : 0          (No woods.)
No of house rows    : 0 / 0
Surface             : 2          (Reflective ground surface)
Receiver source distance : 83.00 / 83.00 m
Receiver height     : 126.50 / 126.50 m
Topography          : 2          (Flat/gentle slope; with barrier)
Barrier angle1      : 32.00 deg  Angle2 : 90.00 deg
Barrier height      : 15.00 m
Barrier receiver distance : 54.00 / 54.00 m
Source elevation    : 0.00 m
Receiver elevation  : 0.00 m
Barrier elevation    : 0.00 m
Reference angle     : 0.00
    
```

Results segment # 1: Bank-S1 (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 !      126.50 !      37.64 !      37.64
    
```

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
    
```

```

-----
--
    0      8  0.00  70.37  0.00  -7.43 -13.52  0.00  0.00  0.00
49.41*
    0      8  0.00  70.37  0.00  -7.43 -13.52  0.00  0.00  0.00
49.41
-----
--
    
```



* Bright Zone !

Segment Leq : 49.41 dBA

Results segment # 2: Bank-S2 (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	126.50	45.17	45.17

ROAD (54.18 + 58.02 + 0.00) = 59.52 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

8	32	0.00	70.37	0.00	-7.43	-8.75	0.00	0.00	0.00
54.18									

32	90	0.00	70.37	0.00	-7.43	-4.92	0.00	0.00	-0.02
58.00*									

32	90	0.00	70.37	0.00	-7.43	-4.92	0.00	0.00	0.00
58.02									

* Bright Zone !

Segment Leq : 59.52 dBA

Total Leq All Segments: 59.92 dBA

Results segment # 1: Bank-S1 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)



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1.50 ! 126.50 ! 37.64 ! 37.64

ROAD (0.00 + 41.82 + 0.00) = 41.82 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--										
	0	8	0.00	62.77	0.00	-7.43	-13.52	0.00	0.00	0.00
41.82*										
	0	8	0.00	62.77	0.00	-7.43	-13.52	0.00	0.00	0.00
41.82										

--										

* Bright Zone !

Segment Leq : 41.82 dBA

Results segment # 2: Bank-S2 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	! Receiver Height (m)	! Barrier Height (m)	! Elevation of Barrier Top (m)
1.50	!	126.50	!
		45.17	!
			45.17

ROAD (46.59 + 50.42 + 0.00) = 51.92 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--										
	8	32	0.00	62.77	0.00	-7.43	-8.75	0.00	0.00	0.00
46.59										

--										
	32	90	0.00	62.77	0.00	-7.43	-4.92	0.00	0.00	-0.02
50.40*										
	32	90	0.00	62.77	0.00	-7.43	-4.92	0.00	0.00	0.00
50.42										

--										

* Bright Zone !

Segment Leq : 51.92 dBA



Total Leq All Segments: 52.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.92
(NIGHT): 52.32

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STAMSON 5.0 NORMAL REPORT Date: 28-08-2023 10:51:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank S1 (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 : 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): 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: Bank S1 (day/night)

Angle1 Angle2 : -90.00 deg 22.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 79.00 / 79.00 m
Receiver height : 126.50 / 126.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 22.00 deg
Barrier height : 26.00 m
Barrier receiver distance : 59.00 / 59.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Bank S2 (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 : 40 km/h
Road gradient : 0 %



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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: Bank S2 (day/night)

```

-----
Angle1   Angle2      : 22.00 deg   90.00 deg
Wood depth      : 0           (No woods.)
No of house rows : 0 / 0
Surface         : 2           (Reflective ground surface)
Receiver source distance : 79.00 / 79.00 m
Receiver height  : 126.50 / 126.50 m
Topography      : 2           (Flat/gentle slope; with barrier)
Barrier angle1   : 39.00 deg   Angle2 : 90.00 deg
Barrier height   : 15.00 m
Barrier receiver distance : 49.00 / 49.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
    
```

Results segment # 1: Bank S1 (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 !      126.50 !      33.14 !      33.14
    
```

ROAD (0.00 + 61.09 + 0.00) = 61.09 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

```

-----
--
-90      22      0.00  70.37  0.00  -7.22  -2.06  0.00  0.00  -0.23
60.86*
-90      22      0.00  70.37  0.00  -7.22  -2.06  0.00  0.00  0.00
61.09
    
```



--

* Bright Zone !

Segment Leq : 61.09 dBA

Results segment # 2: Bank S2 (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	126.50	48.97	48.97

ROAD (52.90 + 57.67 + 0.00) = 58.92 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

22	39	0.00	70.37	0.00	-7.22	-10.25	0.00	0.00	0.00
52.90									

39	90	0.00	70.37	0.00	-7.22	-5.48	0.00	0.00	-0.02
57.65*									
39	90	0.00	70.37	0.00	-7.22	-5.48	0.00	0.00	0.00
57.67									

--

* Bright Zone !

Segment Leq : 58.92 dBA

Total Leq All Segments: 63.15 dBA

Results segment # 1: Bank S1 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source	Receiver	Barrier	Elevation of
--------	----------	---------	--------------

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```

Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !       126.50 !       33.14 !       33.14
  
```

ROAD (0.00 + 53.49 + 0.00) = 53.49 dBA

```

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj
SubLeq
-----
  
```

```

--
-90      22      0.00  62.77   0.00  -7.22  -2.06   0.00   0.00  -0.23
53.26*
-90      22      0.00  62.77   0.00  -7.22  -2.06   0.00   0.00   0.00
53.49
-----
  
```

* Bright Zone !

Segment Leq : 53.49 dBA

Results segment # 2: Bank S2 (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 !       126.50 !       48.97 !       48.97
  
```

ROAD (45.31 + 50.08 + 0.00) = 51.33 dBA

```

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj
SubLeq
-----
  
```

```

--
  22      39      0.00  62.77   0.00  -7.22 -10.25   0.00   0.00   0.00
45.31
-----
--
  39      90      0.00  62.77   0.00  -7.22  -5.48   0.00   0.00  -0.02
50.06*
  39      90      0.00  62.77   0.00  -7.22  -5.48   0.00   0.00   0.00
50.08
-----
  
```

* Bright Zone !



Segment Leq : 51.33 dBA

Total Leq All Segments: 55.55 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.15
(NIGHT): 55.55