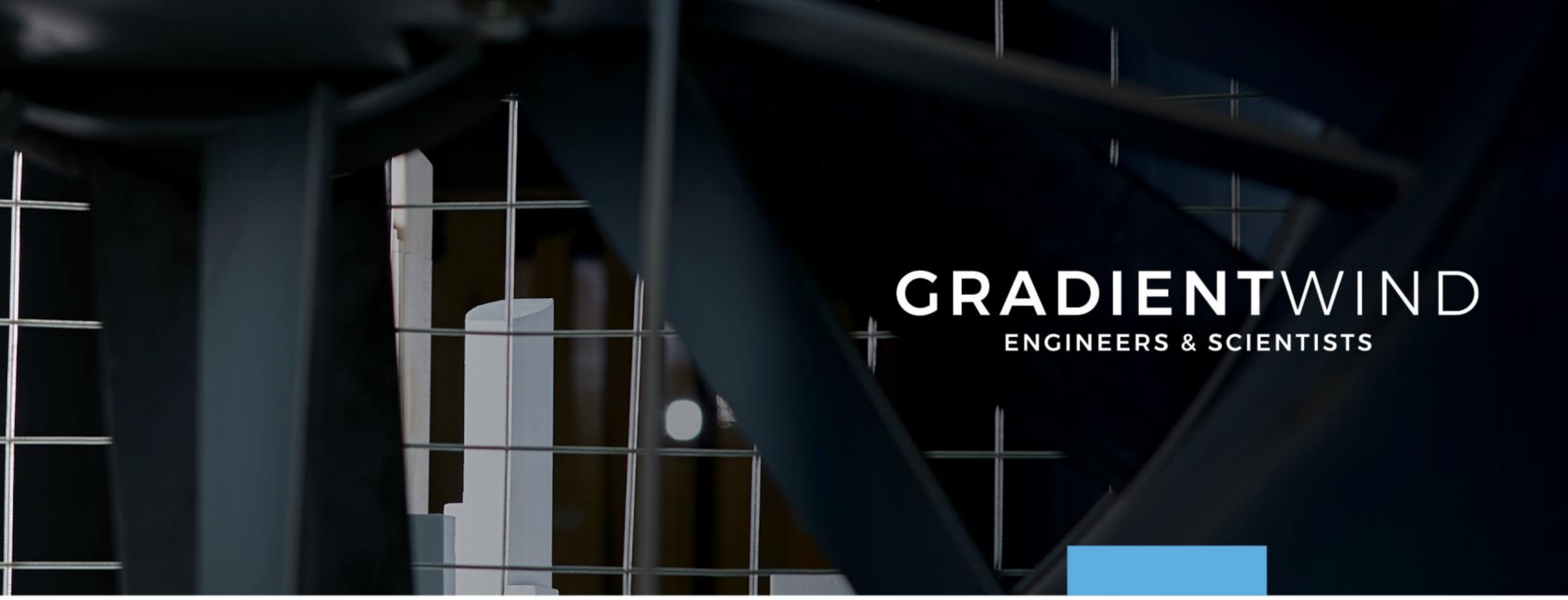
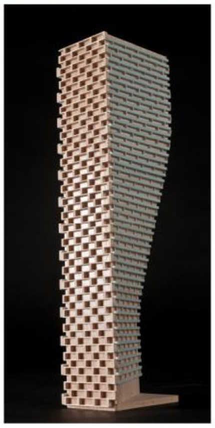
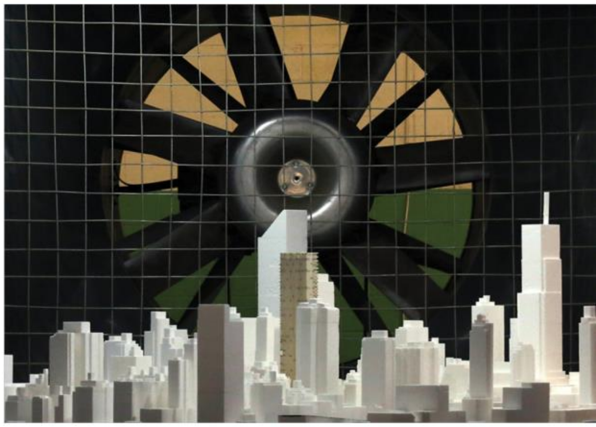


STATIONARY NOISE ASSESSMENT

1420 Richmond Road & 365 Forest Street
Ottawa, Ontario

REPORT: GWE19-084– Stationary Noise





May 28, 2021

PREPARED FOR
11061917 Canada Inc.
769 Boulevard St. Joseph
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PREPARED BY
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EXECUTIVE SUMMARY

This report describes a stationary noise assessment performed for a proposed high-rise residential development located at 1420 Richmond Road and 365 Forest Street in Ottawa, Ontario. The proposed development consists of two irregular-shaped, 12-storey towers; Tower A and Tower B. The subject site is located at the southeast corner of the intersection of Richmond Road and Forest Street. The site is bordered by Richmond Road to the north, Bond Street to the south and Forest Street to the west. The towers comprise a mechanical penthouse and rooftop mechanical terraces. The major sources of stationary noise are the condenser units and fluid coolers located at the rooftop mechanical terrace of each tower, and the generator and makeup air units located in the mechanical penthouse. Figure 1 illustrates a site plan with the surrounding context.

The focus of this study is the exterior noise levels generated by the rooftop mechanical equipment, which consists of two fluid coolers and condenser units at the rooftop of each tower, and makeup air units, located in the mechanical penthouse of each tower, and a generator located in the mechanical penthouse of Tower B. 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) architectural drawings prepared by Lapalme Rheault Architectes et Associés; and (iv) mechanical equipment data provided by Quadrant Engineering.

The results of the current study indicate that noise levels at nearby points of reception are expected to fall below the ENCG noise criteria provided that the assumptions outlined in Section 2.1 and the noise screen design, as indicated in Section 4.5, are followed and the sound power levels of the fluid cooler, makeup air unit, and generators do not exceed the levels shown in Table 2. As such, the proposed development is expected to be compatible with the existing noise-sensitive land uses.

A review of the equipment selections and locations that will form the requirements of the construction documents/contract has been made by a qualified acoustical engineer; final equipment selections will be verified to meet or exceed the performance requirements prior to the installation of the equipment.

To ensure compliance with the ENCG, the following noise control measures are recorded:

- The sound power levels of the generator, makeup air unit, and fluid cooler should not exceed the levels shown in Table 2.
- A 4-metre high noise screen is provided around the fluid coolers. The noise screen is designed partially with acoustic louvres. Figure 4 illustrates the noise screen and acoustic louvre locations.
- The noise screen should be solid with a minimum surface mass of 20 kg/m² and contain no gaps.
- The noise screen will be installed firmly, resistant to wind and snow loads.
- The fluid coolers should have a maximum sound power rating of 92 dBA.
- Acoustic louvres should provide the noise reductions displayed in Table 5 and contain 40-50% open area to allow air circulation.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 11061917 Canada Inc. to undertake a stationary noise assessment for the proposed high-rise residential development located at 1420 Richmond Road and 365 Forest Street in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a stationary noise assessment.

The present scope of work involves assessing exterior noise levels generated by the rooftop makeup air units and fluid coolers. The assessment was performed based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP) NPC-300[2] guidelines, architectural drawings prepared by Lapalme Rheault Architectes et Associés and mechanical equipment data provided by Quadrant Engineering, surrounding street layouts obtained from the City of Ottawa, and recent site imagery.

2. TERMS OF REFERENCE

The focus of this stationary noise assessment is a proposed high-rise development that consists of two irregular-shaped, 12-storey towers; Tower A and Tower B. The subject site is located at the southeast corner of the intersection of Richmond Road and Forest Street. The site is bordered by Richmond Road to the north, Bond Street to the south and Forest Street to the west. Figure 1 illustrates a site plan with the surrounding context.

The towers comprise a mechanical penthouse and rooftop mechanical terraces. The major sources of stationary noise are the rooftop makeup air units and fluid coolers located at the rooftop mechanical terrace of each tower. Figure 2 illustrates the location of receptors and Figure 3 illustrates the location of noise sources included in this study.

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[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

[2] Ministry of the Environment, Conservation and Parks (MECP), Environmental Noise Guideline – Publication NPC-300, August 2013

2.1 Assumptions

The sound power levels of the fluid coolers, condenser units (CU), and makeup air units (MUA) are based on manufacturer data provided by Quadrant Engineering. The sound power levels of the generator are based on Gradient Wind's past experience with similar projects. A review of the final equipment selections and locations by a qualified acoustical engineer will be required prior to the installation of the equipment.

The following assumptions have been made in the analysis:

(i) The sound power levels of the fluid coolers, condenser units (CU), and makeup air units (MUA) are based on manufacturer data provided by Quadrant Engineering.

(ii) The sound power levels of the generator are based on Gradient Wind's past experience with similar projects.

(iii) The CUs, MUAs, and fluid coolers are assumed to operate continuously at 100% over a 1-hour period during the daytime period, and at 50% during the nighttime period.

(iv) The sound power of the fluid coolers should not exceed 92 dBA (referenced to 1 picowatt).

(v) The generator is assumed to be running continuously at 100% over a 1-hour period during the daytime period.

(vi) A 4-metre high noise screen, which is designed partially with acoustic louvres, is placed around the fluid coolers (see Figure 4 and Section 4.5).

(vii) The makeup air units are located in the mechanical penthouse of each tower and they emit noise through the inlet louvre at the façade of the mechanical penthouse. One generator serving both towers is located in the mechanical penthouse of Tower B and emits noise through an acoustic louvre at the façade.

(viii) The ground region was modelled as reflective (Ground Factor=0) due to the presence of pavement (hard ground).

(ix) 10 receptors were strategically placed on the closest noise-sensitive buildings and the subject site's towers and outdoor amenity areas. The location of the receptors and noise sources can be seen in Figure 2 and 3.

3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the neighbouring noise-sensitive buildings and the proposed development produced by stationary sources and (ii) ensure that exterior noise levels do not exceed the allowable limits specified by the ENCG, as outlined in Section 4 of this report.

4. METHODOLOGY

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

4.1 Perception of Noise

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 source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Its measurement 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 represents the noise perceived by the human ear. With this scale, a doubling of sound power at the source results in a 3 dBA increase in measured noise levels at the receiver and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

Stationary sources are defined in the ENCG as "all sources of sound and vibration, whether fixed or mobile, that exist or operate on a premises, property or facility, the combined sound and vibration levels of which are emitted beyond the property boundary of the premises, property or facility, unless the source(s) is (are) due to construction" [3].

[3] City of Ottawa Environmental Noise Control Guidelines, page 10

4.2 Stationary Noise Criteria

The equivalent sound energy level, L_{eq}, provides a weighted 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 selected period of time. For stationary sources, the L_{eq} is commonly calculated on an hourly interval, while for roadways, the L_{eq} is calculated on the basis of a 16-hour daytime/8-hour nighttime split.

Noise criteria taken from the ENCG and NPC-300 apply to points of reception (POR). A POR is defined under the ENCG as "any location on a noise-sensitive land use where noise from a stationary source is received"[4]. A POR can be located on an existing or zoned for future use premises of permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, campgrounds, and noise-sensitive buildings such as schools and daycares. The recommended maximum noise levels for a Class 1 area in an urban environment adjacent to arterial roadways at a POR are outlined in Table 1 below. The subject site is bordered by Richmond Road, an arterial road, to the north. Therefore, the site is considered to be in a Class 1 area.

TABLE 1: EXCLUSIONARY LIMITS FOR CLASS 1 AREA

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

[4] City of Ottawa Environmental Noise Guidelines, Page 9

4.3 Determination of Noise Source Power Levels

The mechanical information for the fluid coolers, condenser units (CU), and makeup air units (MUA) is based on the manufacturer data provided by Quadrant Engineering. The sound power levels of the generator are based on Gradient Wind's past experience with similar projects. Table 2 summarizes the sound power of each source used in the analysis.

TABLE 2: EQUIPMENT SOUND POWER LEVELS (DBA)

Source ID	Description	Height Above Grade (m)	Frequency (Hz)								
			63	125	250	500	1000	2000	4000	8000	Total
S1-4	Fluid Cooler Tower A&B	40.1	63	70	77	82	85	86	87	81	**92***
S5-6	MUA Inlet Tower A&B	1000X1000**	57	63	62	64	65	64	62	57	**71**
S7-8	CU Casing Tower A&B	38.9	62	72	75	81	84	79	75	63	**87**
S9	Generator	3000X3000**	82	90	92	94	93	92	87	84	**100**

*Maximum permitted sound level
**Louvres were modelled as emitting façades with the noted dimensions in millimetres.

4.4 Stationary Source Noise Predictions

The impact of stationary noise sources on nearby noise-sensitive areas was determined by computer modelling using the software program Predictor-Lima. This program was developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2 and is capable of representing three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The methodology has been used on numerous assignments and has been accepted by the Ministry of the Environment, Conservation and Parks (MECP) as part of Environmental Compliance Approval applications.

A total of 10 receptor locations were chosen on the surrounding noise-sensitive buildings to measure the noise impact at plane of window (POW) AND OPOR receptors during the daytime/evening period (07:00 – 23:00), as well as during the nighttime period (23:00 – 07:00). Receptor locations are described in Table 4 and illustrated in Figure 2.

Condenser units (CU) and fluid coolers were represented as point sources in the Predictor model while MAU inlet and generator louvres were presented as emitting facades. Table 3 below contains Predictor-Lima calculation settings. These are typical settings that have been based on ISO 9613 standards and guidance from the MECP.

Ground absorption over the study area is determined based on topographical features (such as water, concrete, grassland, etc.). An absorption value of 0 is representative of hard ground, while a value of 1 represents grass and similar soft surface conditions. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. A Predictor-Lima sample output is available upon request.

TABLE 3: CALCULATION SETTINGS

Parameter	Setting
Meteorological correction method	Single value for C0
Value C0	2.0
Ground attenuation factor for roadways and paved areas	0
Temperature (K)	283.15
Pressure (kPa)	101.33
Air humidity (%)	70

TABLE 4: RECEPTOR LOCATIONS

Receptor Number	Receptor Location	Height Above Grade (m)
R1	17 Winthrop Prvt – South Façade	8.5
R2	38 Winthrop Prvt – South Façade	8.5
R3	360 Croydon Ave – West Façade	48.0
R4	360 Croydon Ave – West Façade	48.0
R5	370 Forest St – East Façade	20.0
R6	370 Forest St – North Façade	20.0
R7	Tower A – Level 12 Terrace	35.8
R8	Tower B – Level 12 Terrace	35.8
R9	Tower A – East Façade	35.9
R10	Tower B – North Façade	35.9

4.5 Mitigation Measures

The preliminary calculations showed that noise levels at neighbouring buildings will not exceed the ENCG criteria with a 4-metre high noise screen placed around the fluid coolers. The noise screen should be made of solid materials having a surface density of 20 kg/m² or STC 30 and should contain no gaps. The screen was designed partially with acoustic louvres to allow proper air flow to the equipment. The acoustic louvres should have a 40-50% opening for air circulation and provide the minimum noise reductions listed in Table 5. Suitable suppliers of such acoustic lovers include Keinitecs, Vibro-Acoustics, E. H. Price or equivalent.

TABLE 5: NOISE REDUCTION OF ACOUSTIC LOUVRES

Thickness (mm)	Noise Reduction (dB)							
	63	125	250	500	1000	2000	4000	8000
300	5	8	14	22	27	30	30	31

An acoustic louvre with the same features should also be applied to the generator louvre.

5. RESULTS AND DISCUSSION

Noise levels at nearby sensitive receptors are below ENCG criteria for stationary noise, as summarized in Table 6 below. The sound levels listed in Table 6 are based on the assumptions outlined in Section 2.1.

TABLE 6: HVAC NOISE LEVELS WITH 4-METRE NOISE SCREEN

Receptor ID	Receptor Location	Height Above Grade (m)	Noise Level (dBA)		Sound Level Limits		Meets ENCG Class 1 Criteria	
			Day	Night	Day	Night	Day	Night
R1-POW	17 Winthrop Prvt – South Façade	8.5	32	29	50	45	Yes	Yes
R2-POW	38 Winthrop Prvt – South Façade	8.5	31	28	50	45	Yes	Yes
R3-POW	360 Croydon Ave – West Façade	48.0	48	45	50	45	Yes	Yes
R4-POW	360 Croydon Ave – West Façade	48.0	49	45	50	45	Yes	Yes
R5-POW	370 Forest St – East Façade	20.0	35	32	50	45	Yes	Yes
R6-POW	370 Forest St – North Façade	20.0	34	31	50	45	Yes	Yes
R7-OPOR	Tower A – Level 12 Terrace	35.8	47	N/A*	50	N/A*	Yes	Yes
R8-OPOR	Tower B – Level 12 Terrace	35.8	49	N/A*	50	N/A*	Yes	Yes
R9-POW	Tower A – East Façade	35.9	44	41	50	45	Yes	Yes
R10-POW	Tower B – North Façade	35.9	42	39	50	45	Yes	Yes

*OPOR noise levels during the nighttime are not considered as per ENCG

TABLE 7: GENERATOR NOISE LEVELS WITH 4-METRE NOISE SCREEN

Receptor ID	Receptor Location	Height Above Grade (m)	Noise Level (dBA)	Sound Level Limits	Meets ENCG Class 1 Criteria
			Day	Day	Day
R1-POW	17 Winthrop Prvt – South Façade	8.5	26	55	Yes
R2-POW	38 Winthrop Prvt – South Façade	8.5	31	55	Yes
R3-POW	360 Croydon Ave – West Façade	48.0	37	55	Yes
R4-POW	360 Croydon Ave – West Façade	48.0	39	55	Yes
R5-POW	370 Forest St – East Façade	20.0	42	55	Yes
R6-POW	370 Forest St – North Façade	20.0	33	55	Yes
R7-OPOR	Tower A – Level 12 Terrace	35.8	38	55	Yes
R8-OPOR	Tower B – Level 12 Terrace	35.8	44	55	Yes
R9-POW	Tower A – East Façade	35.9	41	55	Yes
R10-POW	Tower B – North Façade	35.9	41	55	Yes

As seen in Table 6 and Table 7, with consideration of Gradient Wind's recommendations and assumptions, the proposed development is expected to be compatible with the existing land uses.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels at nearby points of reception are expected to fall below the ENCG noise criteria provided that the assumptions outlined in Section 2.1 and the noise screen design, as indicated in Section 4.5, are followed and the sound power levels of the fluid cooler, makeup air unit, and generators do not exceed the levels shown in Table 2. As such, the proposed development is expected to be compatible with the existing noise-sensitive land uses.

A review of the equipment selections and locations that will form the requirements of the construction documents/contract has been made by a qualified acoustical engineer; final equipment selections will be verified to meet or exceed the performance requirements prior to the installation of the equipment.

To ensure compliance with the ENCG, the following noise control measures are recorded:

- The sound power levels of the generator, makeup air unit, and fluid cooler should not exceed the levels shown in Table 2.
- A 4-metre high noise screen is provided around the fluid coolers. The noise screen is designed partially with acoustic louvres. Figure 4 illustrates the noise screen and acoustic louvre locations.
- The noise screen should be solid with a minimum surface mass of 20 kg/m² and contain no gaps.
- The noise screen will be installed firmly, resistant to wind and snow loads.
- The fluid coolers should have a maximum sound power rating of 92 dBA.
- Acoustic louvres should provide the noise reductions displayed in Table 5 and contain 40-50% open area to allow air circulation.

This concludes our 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.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
May 28, 2021
PROVINCE OF ONTARIO

Efser Kara, MSc, LEED GA
Acoustic Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #19-084 – Stationary Noise

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 1420 RICHMOND ROAD, OTTAWA STATIONARY NOISE ASSESSMENT		DESCRIPTION: FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
	SCALE: 1:1500 (APPROX.)	DRAWING NO.: GWE19-084-1	
	DATE: MAY 27, 2021	DRAWN BY: E.K.	

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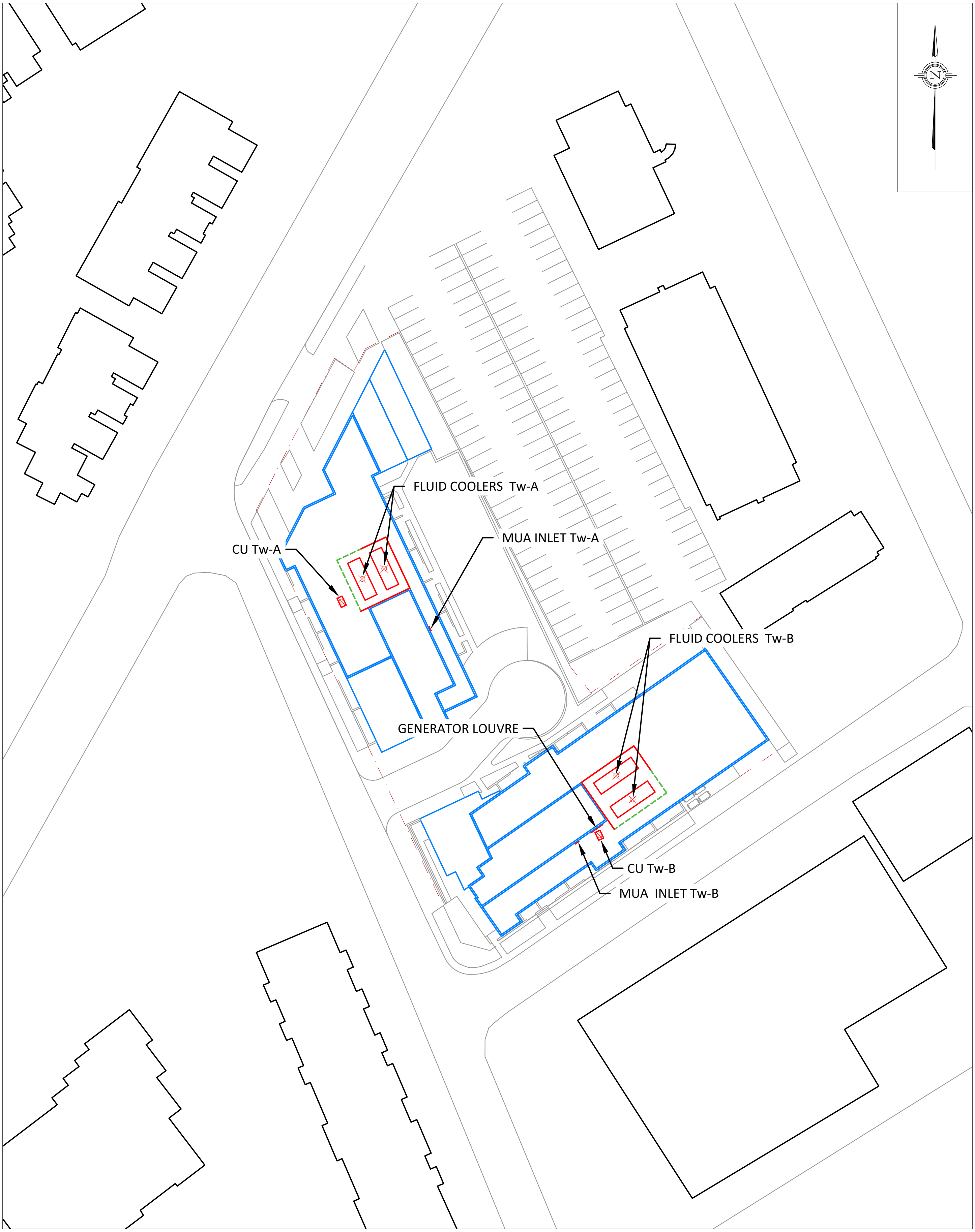
PROJECT	1420 RICHMOND ROAD, OTTAWA STATIONARY NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE19-084-2
DATE	MAY 27, 2021
DRAWN BY	E.K.
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS



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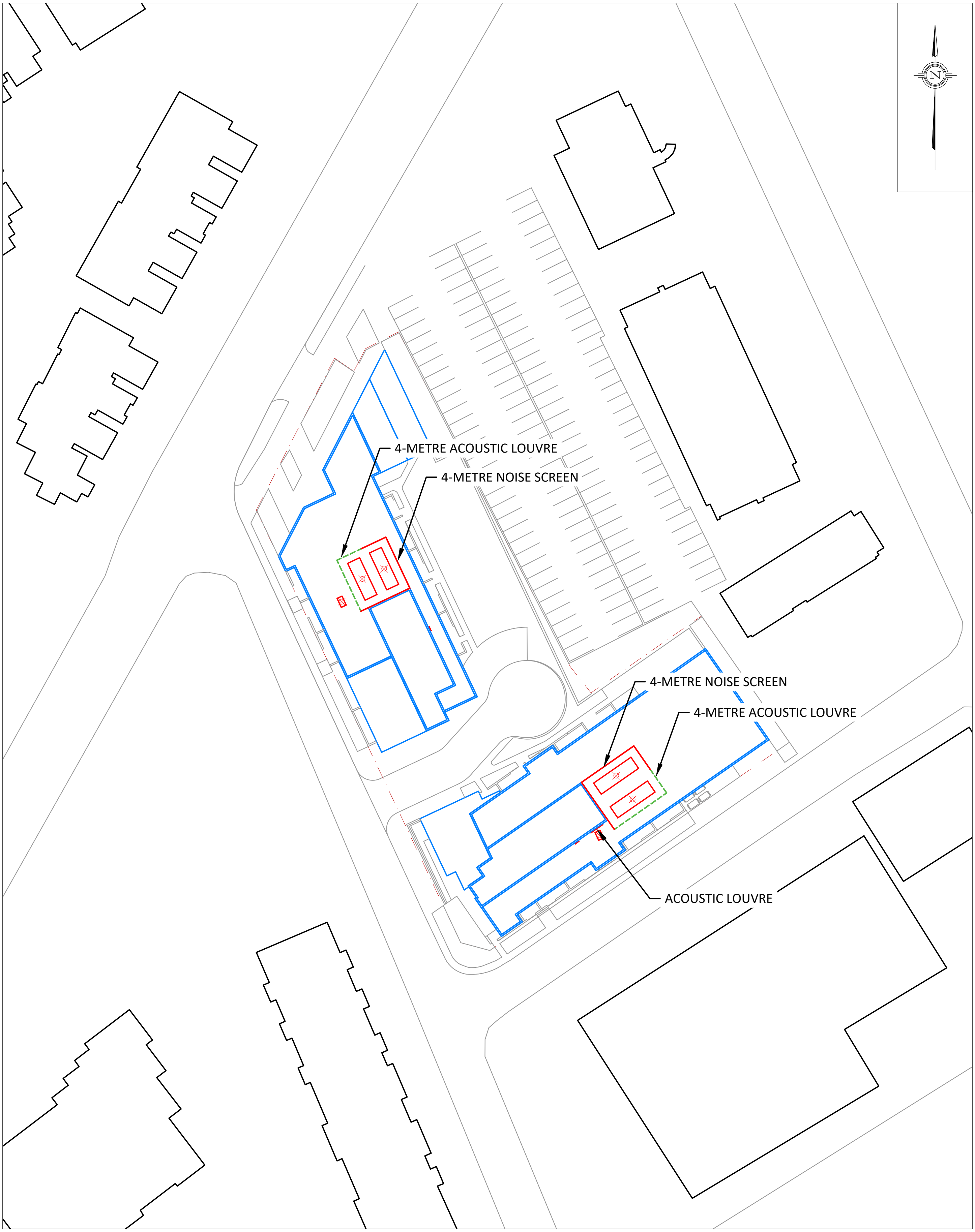
PROJECT	1420 RICHMOND ROAD, OTTAWA STATIONARY NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE19-084-3
DATE	MAY 27, 2021
DRAWN BY	E.K.
DESCRIPTION	FIGURE 3: SOURCE LOCATIONS



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PROJECT: 1420 RICHMOND ROAD, OTTAWA STATIONARY NOISE ASSESSMENT		DESCRIPTION: FIGURE 4: NOISE SCREEN & ACOUSTIC LOUVRE LOCATIONS	
SCALE: 1:1000 (APPROX.)	DRAWING NO.: GWE19-084-4		
DATE: MAY 27, 2021	DRAWN BY: E.K.		

FIGURE 5: HVAC NOISE CONTOURS DAYTIME
(37.4 M ABOVE GRADE, WITH 4-M NOISE SCREEN AND ACOUSTIC LOUVRE)

	80 – 85 dB
	75 – 80 dB
	70 – 75 dB
	65 – 70 dB
	60 – 65 dB
	55 – 60 dB
	50 – 55 dB
	45 – 50 dB
	40 – 45 dB
	35 – 40 dB
	0 – 35 dB

FIGURE 6: HVAC NOISE CONTOURS NIGHTTIME
(37.4 M ABOVE GRADE, WITH 4-M NOISE SCREEN AND ACOUSTIC LOUVRE)

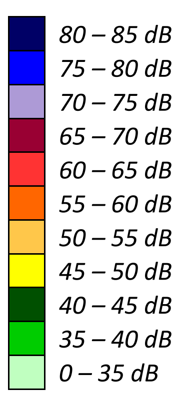

FIGURE 7: GENERATOR NOISE CONTOURS
(37.4 M ABOVE GRADE, WITH ACOUSTIC LOUVRE)

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB