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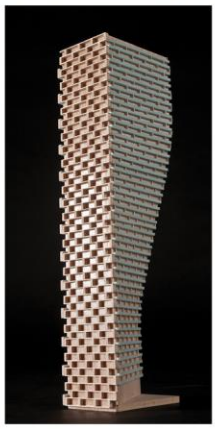
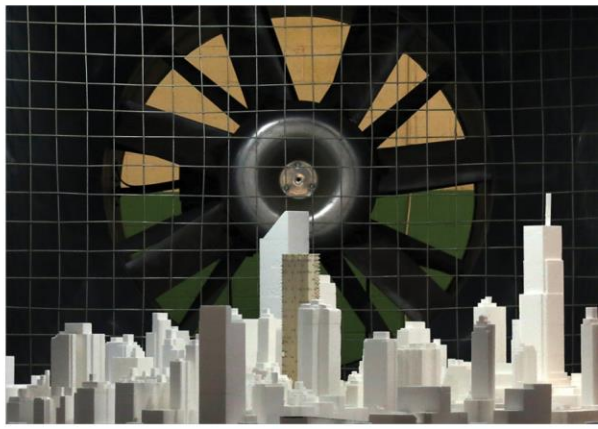
STATIONARY NOISE ASSESSMENT

Mackenzie Building Addition
Carleton University
Ottawa, Ontario

REPORT: GWE19-159 – Stationary Noise





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EXECUTIVE SUMMARY

This report describes a stationary noise assessment performed for the proposed Mackenzie Building addition at the Carleton University Campus located at 1125 Colonel By Drive in Ottawa, Ontario. The proposed development comprises a 3-storey rectangular planform Engineering Design Centre, connected to the existing Mackenzie Engineering Building at the northwest corner. Figure 1 illustrates a site plan with the surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) 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 Diamond Schmitt Architects and KWC Architects Inc.; and (iv) mechanical equipment data provided by Smith + Andersen.

The results of the current assessment indicate that the noise levels at surrounding noise-sensitive buildings (student residences) are expected to fall below the ENCG noise criteria provided that the sound power levels of the rooftop units don't exceed 89 dBA and the assumptions outlined in Section 2.1 are followed during the construction and operation of the building. Therefore, the proposed development is expected to be compatible with the ENCG requirements. 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.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Carleton University to undertake a stationary noise assessment for the proposed expansion of the Mackenzie Building at the Carleton University Campus located at 1125 Colonel By Drive 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 rooftop air handling equipment and a dust collector. 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 Diamond Schmitt Architects and KWC Architects Inc., mechanical equipment data provided by Smith + Andersen, 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 the proposed Mackenzie Building addition at the Carleton University in Ottawa, Ontario. The proposed development comprises a 3-storey rectangular planform Engineering Design Centre, connected to the existing Mackenzie Engineering Building at the northwest corner. The ground floor, labelled Level 200, comprises a central atrium and bay units situated along the north perimeter of the floor. Level 3 comprises three bay units at the northwest corner, a design room at the northeast corner and breakout areas at the centre of the east and west elevations. Building support facilities occupy the remaining spaces. Level 4 comprises three bay units at the northwest corner, two design rooms at the northeast corner and breakout areas at the centre of the east and west elevations. The centre of Level 3 and 4 is open to the central atrium below, with a staircase providing access to the floors from grade.

[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

The site is surrounded by low and medium-rise institutional buildings on the south and east side, and a dormitory building on the north side. Rideau Canal lies on the west side. Figure 1 illustrates the site plan and the surrounding context.

2.1 Assumptions

The sound power levels of the rooftop units and the dust collector are based on manufacturer data provided by Smith + Andersen. 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.

The following assumptions have been made in the analysis:

(i) For rooftop units and the dust collector, sound power levels are based on the data provided by Smith + Andersen.

(ii) The rooftop air handling units are assumed to operate continuously over a 1-hour period during the daytime periods and at 50% during the nighttime periods. The dust collector is assumed to be running 100% of the time during both day and nighttime periods.

(iii) Screening effects of the parapets have been conservatively excluded in the modelling.

(iv) The ground region was modelled as reflective ground due to the presence of hard ground (pavement).

(v) 5 receptors were strategically placed on the closest noise-sensitive building, known as Lanark House.

3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the neighbouring noise-sensitive buildings 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. Five receptor locations were selected for the study site, as illustrated in Figure 2.

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].

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,

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

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 places of worship. 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 study site is considered to be in a Class 1 area because the campus area is surrounded by Bronson Avenue and Colonel By Drive.

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

4.3 Determination of Noise Source Power Levels

Mechanical information for the development has been based on manufacturer data provided by Smith + Andersen. Table 2 summarizes the sound power of each source used in the analysis. The sound power levels of the rooftop units are reduced in the analysis. The total sound power levels of the units, including outlet, inlet, and casing noise levels, should not exceed 89 dBA to provide the required sound levels at plane of window receptors.

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

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	RTU-1	14.10	56	61	75	87	81	82	78	69	89
S2	RTU-2	14.10	59	67	86	86	79	77	73	68	89
S3	Dust Collector (with silencer)	4.75	86	86	78	70	67	65	67	64	89

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 5 receptor locations were chosen on the Lanark House to measure the noise impact at plane of window (POW) receptors during the daytime/evening period (07:00 – 23:00), as well as during the nighttime period (23:00 – 07:00). Sensor locations are described in Table 3 and illustrated in Figure 2. At each receptor location, the noise was assessed at 4 different heights for a total of 20 discrete points of reception. All mechanical units were represented as point sources in the Predictor model. Table 4 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 was 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: RECEPTOR LOCATIONS

Receptor Number	Receptor Location	Height Above Grade (m)
R1	POW – Lanark House	11
		8
		5
		2
R2	POW – Lanark House	11
		8
		5
		2
R3	POW – Lanark House	11
		8
		5
		2
R4	POW – Lanark House	11
		8
		5
		2
R5	POW – Lanark House	11
		8
		5
		2

TABLE 4: CALCULATION SETTINGS

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

5. RESULTS AND DISCUSSION

Noise levels at nearby sensitive receptors are below ENCG criteria for stationary noise, as summarized in Table 5 below. The sound levels listed in Table 5 are based on the assumptions outlined in Section 2.1.

TABLE 5: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Plane of Window Receptor Location	Height	Noise Level (dBA)		Sound Level Limits		Meets ENCG Class 1 Criteria	
			Day*	Night	Day	Night	Day	Night
R1	POW – Lanark House	11	47	44	50	45	Yes	Yes
		8	47	44	50	45	Yes	Yes
		5	45	42	50	45	Yes	Yes
		2	45	42	50	45	Yes	Yes
R2	POW – Lanark House	11	47	44	50	45	Yes	Yes
		8	47	44	50	45	Yes	Yes
		5	45	42	50	45	Yes	Yes
		2	45	42	50	45	Yes	Yes
R3	POW – Lanark House	11	47	44	50	45	Yes	Yes
		8	47	44	50	45	Yes	Yes
		5	46	43	50	45	Yes	Yes
		2	45	42	50	45	Yes	Yes
R4	POW – Lanark House	11	47	44	50	45	Yes	Yes
		8	47	44	50	45	Yes	Yes
		5	46	43	50	45	Yes	Yes
		2	45	42	50	45	Yes	Yes
R5	POW – Lanark House	11	47	44	50	45	Yes	Yes
		8	46	43	50	45	Yes	Yes
		5	45	42	50	45	Yes	Yes
		2	45	42	50	45	Yes	Yes

*Our results for day are inclusive of both day and evening noise levels.

As seen in Table 5, with consideration of Gradient Wind's recommendations, 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 are followed and the sound power levels of the rooftop units don't exceed 89 dBA. 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 total sound power levels (outlet, inlet, and casing noise levels) of the rooftop units should not exceed 89 dBA.

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.

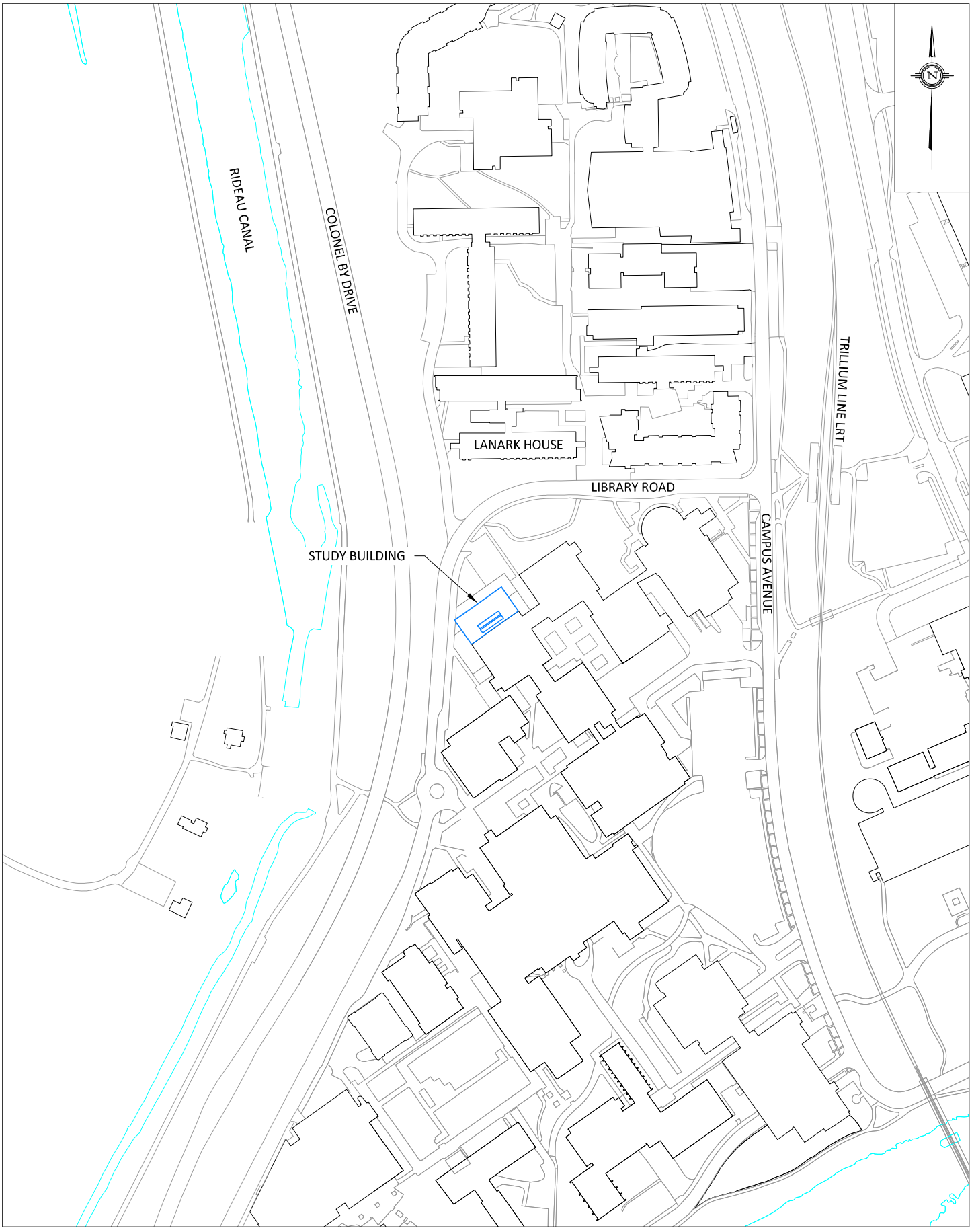
Sincerely,

Gradient Wind Engineering Inc.

Efser Kara, MSc, LEED GA
Acoustic Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #19-159 – Stationary Noise



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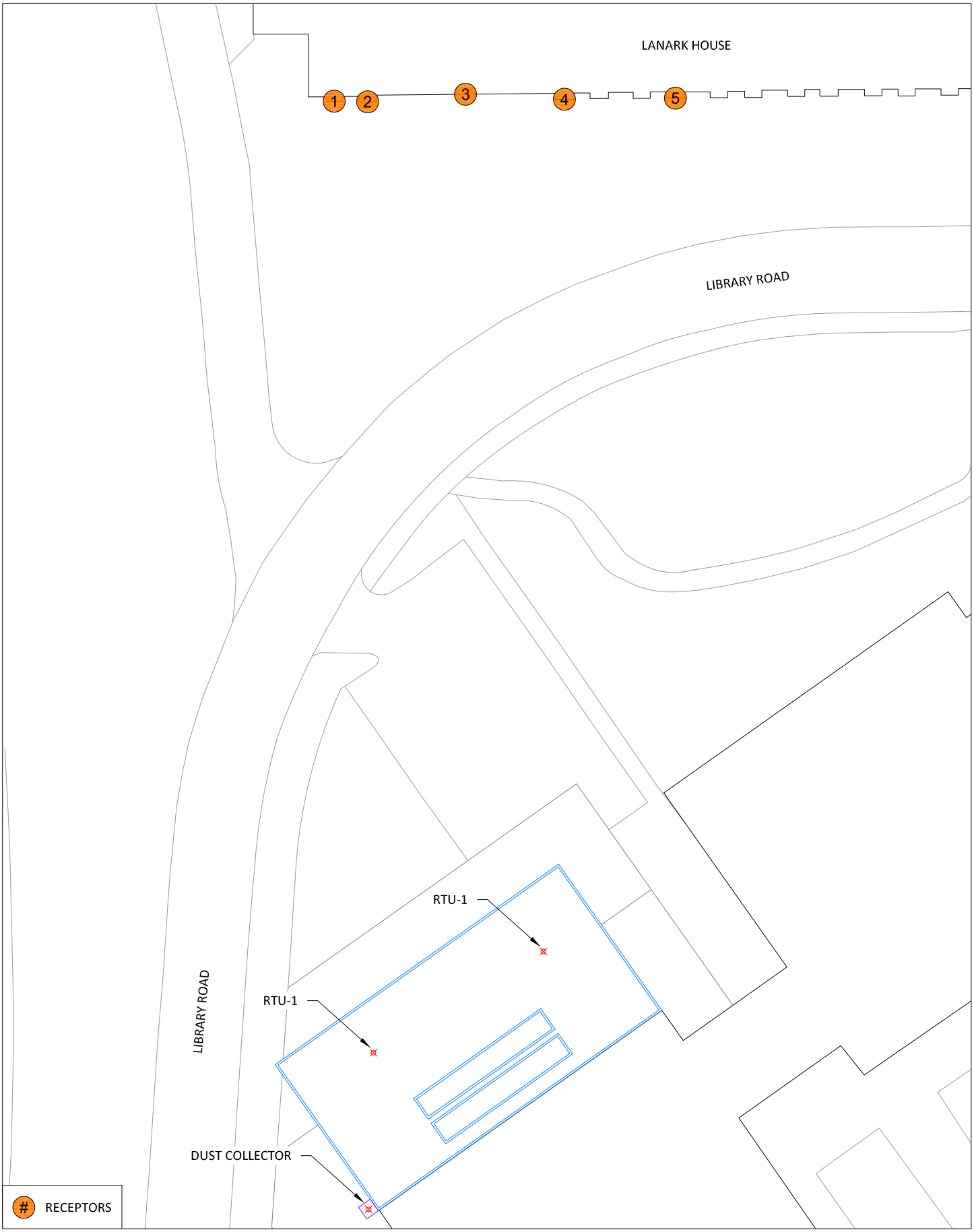
PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA STATIONARY NOISE ASSESSMENT		DESCRIPTION
SCALE	1:3000 (APPROX.)	DRAWING NO.	GWE19-159-1
DATE	JANUARY 10, 2020	DRAWN BY	E.K.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA STATIONARY NOISE ASSESSMENT		
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-159-2
DATE	JANUARY 10, 2020	DRAWN BY	E.K.

DESCRIPTION

FIGURE 2:
RECEPTOR AND NOISE SOURCE LOCATIONS