HUGH WILLIAMSON ASSOCIATES INC.
Ottawa, Ontario

CONSOLIDATED PHASE 1 NOISE CONTROL FEASIBILITY STUDY FOR THE PROPOSED MIXED USE COMMERCIAL AND RESIDENTIAL DEVELOPMENT AT 175 RICHMOND ROAD

CITY OF OTTAWA

Prepared for

Claridge Homes Inc.

Prepared by

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1.0 Introduction

Claridge Homes (Westboro) Inc. (Claridge) owns land at 175 Richmond Road, at the intersection of Richmond Road and Kirkwood Avenue in Ottawa, on which it intends to develop two multi-storey buildings:

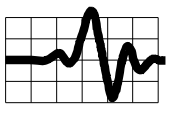
- a 9-storey mixed-use commercial and residential building, and,
- a 6 storey residential building.

The 9-storey building is on the corner of Richmond Rd and Kirkwood Avenue, and the 6-storey building faces Kirkwood Avenue, see Figures 1 and 2. The Canadian Bank Note Company, Limited (CBN) has a manufacturing facility located at 145 Richmond Road on the adjacent property across Kirkwood Avenue from the proposed development. CBN is a long standing industrial use in the midst of a residential area and is surrounded by residential uses on the north, south and east sides.

Claridge has engaged Hugh Williamson Associates Inc. (Williamson) to undertake a Phase 1 Noise Control Feasibility Study of the proposed development at 175 Richmond Road according to the following noise guidelines.

1. City of Ottawa, *Environmental Noise Control Guidelines,* January 2016*,* (ENCG)[1].
2. Ontario Ministry of Environment, Conservation and Parks (MECP) Document NPC-300, *Environmental Noise Guideline Stationary and Transportation Sources - Approval and Planning*, August 2013, (NPC-300)[2].

Note that the City ENCG, references the Provincial NPC-300 Guideline, so that many of the detailed City requirements are contained in NPC-300.



The proposed development at 175 Richmond Road is exposed to two types of noise impacts which are assessed in this report:

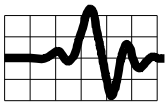
- Noise from stationary sources from the CBN manufacturing facility, and,
- Transportation Noise from the urban arterial road, Richmond Road.

This is a consolidated report in that it addresses noise control requirements for the proposed development for both stationary and transportation sources.

ENCG and NPC-300 guidelines require that noise control measures for transportation and stationary sources of noises be assessed separately, with the final selection of noise control measures ensuring compliance with all applicable sound level limits, see NPC-300, Section C7.7.

> Stationary noise sources, from the CBN manufacturing facility, are considered in Sections 2.0 to 6.0 of this report.
>
> Transportation noise sources, from Richmond Road, are considered in Sections 6.0 to 9.0 of this report.
>
> Conclusions and Recommendations of the consolidated study are contained in Section 10.0 of this report.

This Phase 1 Noise Control Feasibility Study also supports an application to the City of Ottawa to include the property at 175 Richmond Road in Appendix A of Part 1 of the ENCG as an Approved Class 4 Stationary Noise Area, pursuant to the ENCG and NPC-300. As explained in the following Section, Class 4 is a relatively new classification of land for noise assessment purposes recently introduced by the City of Ottawa and the MECP in order to allow new infill development in the vicinity of existing industries in urban areas. This report discusses the noise impacts from the CBN Facility on the residential portions of the proposed development at 175 Richmond Road, and, demonstrates the applicability of a Class 4 designation for 175 Richmond Road.



2.0 Stationary Noise Sources, Area Classifications and Eligibility for Class 4

To determine the sound level limits applicable to a proposed development for noise from stationary sources, the area classification of the proposed development must be determined. This section contains a justification for the City to approve 175 Richmond Road as a Class 4 Area.

Stationary sources of noise are defined 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. Stationary source noise can be generated by individual sources or multiple sources.' See ENCG[1], *Introduction and Glossary*, page 10. In the same section, the ENCG definition further states, 'Facilities that are considered as stationary sources of noise include, for example, industrial facilities, car dealerships, motor vehicle maintenance and repair facilities, snow disposal sites, car washes, motor vehicle racing facilities and transit stations.'

The CBN facility at 145 Richmond Road is a manufacturing facility which clearly fits into the definition of a stationary source of noise.

In the assessment of stationary sources of noise, the City of Ottawa references Provincial guidelines, specifically NPC-300, in which four separate community class areas are defined by their ambient sound level, see Table 3.0 from ENCG Part 1: *Land Use Planning*, reproduced on the following page of this report.

The eligibility criteria for the property at 175 Richmond Road for Class 4 designation are addressed below.

- The proposed development land, 175 Richmond Road, has an acoustic environment which includes significant road traffic noise, urban hum, from nearby Richmond Road as well as other more distant road corridors. In general, virtually all developed urban areas in the City of Ottawa is subject to urban hum. **Because of this acoustic environment, 175 Richmond Road is, in the absence of Class 4 designation, located in a Class 1 or 2 area for the purposes of noise assessment according to the ENCG[1] and NPC-300[2].** The sound of urban traffic, although much less overnight, generally persists in this area on a 24-hour basis. Hence 175 Richmond Road has an acoustic environment which is best described as Class 1.

- **The intended development at 175 Richmond Road, one building of mixed commercial/residential use and one residential building, is a new noise sensitive land use which has not yet been built (see condition i. under the Class 4 definition in Table 3.0).**

- **The adjacent CBN manufacturing facility at 145 Richmond Road is a lawfully established stationary source of noise, with an Environmental Compliance Approval (ECA) from the MECP (see condition ii. under the Class 4 definition in Table 3.0). CBN is a long standing industrial use in the midst of a residential area and is surrounded by residential uses on the north, south and east sides.**

175 Richmond Road meets all the criteria and is exactly the type of property for which Class 4 designation was intended.

Table 3.0: Area Classes for Definition of Stationary Noise Ambient Sound Level*	
Class 1	Means an area with an acoustical environment typical of a major population centre, where the background sound level is dominated by the activities of people, usually road traffic, often referred to as "urban hum". Within the City Class 1 areas generally include all of the urban area as well as lands in proximity to Employment Lands and the 416/417 corridor.
Class 2	Means an area with the acoustical environment that has qualities representative of both Class 1 and Class 3 areas. These are the suburban areas of the City outside of the busy core where the urban hum is evident but within the urban boundary. Class 3 areas also include core areas of large and medium size villages such as Manotick, Greely, Richmond, Carp and Metcalfe. Class 2 areas have the following characteristics: i. sound characteristic of Class 1 during daytime(07:00 to 19:00 or 23:00 hours); and ii. low evening and night background sound level defined by natural environment and infrequent human activity starting as early as 19:00 hours (19:00 or 23:00 to 07:00).
Class 3	Means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as: i. a small community of village; ii. agricultural area; iii. a rural recreational area such as a cottage or a resort area; or iv. a wilderness area. • Within the City, Class 3 areas are found in the rural area, Greenbelt and within small residential oriented villages such as Kinburn, Ashton, Sarsfield and Constance Bay.
Class 4	Means an area or specific site that would otherwise be defined as Class 1 or 2 and which: i. is an area intended for development with new noise sensitive land use(s) that are not yet built; ii. is in proximity to existing, lawfully established stationary source(s); and iii. has formal confirmation (designation) from the City of the Class 4 area classification through Council approval. This classification may not be applied retroactively. Existing noise sensitive land use(s) cannot be classified as Class 4 areas until these land uses are replaced, redeveloped or rebuilt. Class 4 is only applied on a property by property basis and, if the noise source is removed (i.e. the Provincial ECA is removed or lapses), the classification will become consistent with that of the adjacent lands (either Class 1 or 2). Finally, lands adjacent to

	undeveloped industrially zoned properties or areas defined as employment lands in the Official Plan may not be classified as Class 4. Class 4 is considered to be an extraordinary circumstance that, while proposed by an applicant, can only be classified through a City or Ontario Municipal Board approval of a Planning Act application and accompanying noise study. A list and schedule for each Class 4 area that have been approved by the City is found in Appendix E.

* Table 3.0 is taken from ENCG, Part 1: *Land Use Planning*, page 7.

3.0 Sound Level Limits for Noise from Stationary Sources

The sound level limits for noise from stationary sources are based on the one-hour equivalent sound level, Leq, measured in units of dBA (decibels, A-weighted). The limits apply at two types of points of reception (POR's).

> Plane of window POR's: an outdoor location at the centre of a window on any noise sensitive space in a noise sensitive building, such as a residential building[1].
>
> Outdoor POR's: an outdoor location of a dwelling. For a high-rise multi-unit residential building, the outdoor POR should be confined to a common outdoor amenity area[1].

Table 3.2a, taken from ENCG, Part 1: *Land Use Planning*, provides the appropriate sound level limits for steady and varying sound, the type of noise expected from the stationary sources at the CBN facility. Separate limits apply to stationary sources emitting impulsive sound, which are not expected from the CBN facility.

Table 3.2a: Guidelines for Stationary Noise – Steady and Varying Sound

Exclusion Limit Values of One-Hour Equivalent Sound Level (Leq, dBA)

Time of Day	Class 1 Area		Class 2 Area		Class 3 Area		Class 4 Area	
	Outdoor Point of Reception	Plane of Window	Outdoor Point of Reception	Plane of Window	Outdoor Point of Reception	Plane of Window	Outdoor Point of Reception	Plane of Window
07:00 – 19:00	50	50	50	50	45	45	55	60
19:00 – 23:00	50	50	45	50	40	40	55	60
23:00 – 07:00	-	45	-	45	-	40	-	55

* Table 3.2a is taken from ENCG, Part 1: *Land Use Planning*, page 9.

4.0 Assessment of Stationary Noise Sources at CBN

4.1. Assessment of Noise Sources at CBN via Noise Data from CBN

A City approved zoning change for the subject property, 175 Richmond Road, was appealed to the Ontario Municipal Board (OMB) by CBN on the basis of potential noise impacts from CBN on any noise sensitive development on 145 Richmond Road. As a means to resolve the matter, a Noise Mitigation Agreement (Agreement) was put in place between CBN and Claridge in which the parties agreed to work together in good faith to carry out certain work in order to attempt to resolve the OMB appeal. As part of the agreement, CBN has provided acoustic data and an acoustic model to acoustic consultants Hugh Williamson Associates Inc. in order to explore and recommend alternative methods of noise mitigation.

The latest acoustic data and acoustic model, received from CBN on 26 April 2019, has been reviewed by Williamson. The acoustic model and data from CBN allow the calculation of stationary noise impacts at noise sensitive points of reception at the proposed development, as needed in order to the determine what noise mitigation is needed to satisfy the sound level criteria set out in Table 3.2a (previous section) in the ENCG, Part 1, page 9.

Due to the nature of its business, CBN is a highly secure facility. Under the Agreement, Claridge has agreed not to disclose any information it receives from CBN. Hence, the following presents a brief summary of how the proposed development will meet the requirements of the ENCG, assuming that the City approves 175 Richmond Road as a Class 4 Area. No data or information provided by CBN is presented because of the confidentiality required by the Agreement.

Points of reception for the proposed development, most affected by noise from stationary sources at CBN, are shown in Figures 3 to 9. These points of reception include:

- Plane of Window points of reception, an outdoor location at the centre of a window on any noise sensitive spaces within the buildings such as living rooms and bedrooms, and,

- Outdoor points of reception, corresponding to the outdoor amenity areas for the two proposed buildings.

The points of reception relating to the assessment of CBN noise are shown in Figure 3 to 9 using the following designations.

RSx-y, where
S refers to this being a point of reception for the assessment of Stationary noise,
x refers to the horizontal location of the point of reception, and,
y refers to the building floor.

The points of reception used for the assessment of stationary noise from CBN are as follows.

RS3-1, RS3-2, RS3-6 and RS3-9: plane of window on 9-Storey Building facing CBN

RS5: outdoor point of reception, Upper Court Yard of 9-storey Building

RS6-1, RS6-2, RS6-3 and RS6-6: plane of window on 6-Storey Building facing CBN

RS7-1, RS7-2, RS7-3 and RS7-6: plane of window on 6-Storey Building facing CBN

RS8-1, RS8-2, RS8-3 and RS8-6: plane of window on 6-Storey Building facing CBN

RS9-1, RS9-2, RS9-3 and RS9-6: plane of window on 6-Storey Building facing CBN

RS11: outdoor point of reception, 2nd Floor outdoor terrace on 6-storey building on CBN side

Using the latest, April 2019, acoustic modelling and data provided by CBN, sound levels were calculated at the points of reception for daytime (07:00 to 19:00), evening (19:00 to 23:00) and nighttime (23:00 to 07:00) periods. It was found that the noise guideline levels for a Class 4 Area, as set out in Table 3.2a in the previous section were met at all points of reception.

The mitigation measure needed to satisfy these Class 4 sound level limits is to provide a setback of 10 to 15 m from the Kirkwood property line, and, this has been provided in the current design, see Figures 3 to 5.

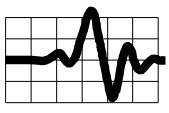
4.2. Assessment of Stationary Noise Sources at CBN via Noise Monitoring

Noise monitoring at 175 Richmond Road undertaken by Williamson in 2013 in an effort to gauge the level of noise impacts from CBN operations. While monitoring is not a definitive method of determining noise impacts from stationary sources, the monitoring results give a strong indication that the proposed development, with the indicated setbacks for the 6-storey building, see Figures 3 to 5, will satisfy the ENCG guidelines for a Class 4 Area.

Noise monitoring over many days from a lower roof location on the existing commercial building at 175 Richmond Road during July 2013, see Figure 10.

Monitoring Location:

- The sound level meter was placed on a lower roof of the existing commercial building, approximately 20 m above grade and 6 m from the property line, with a full view of the CBN facility, see Figure 2.



- The CBN building was approximately 48 m from the sound level meter, implying that the closest CBN stationary noise sources were of the order of 50 m or more from the monitoring location. Other noise sources at CBN would be at greater distances.
- The monitoring location on the lower roof, was shielded from a direct view of Richmond Road by a higher portion of the building. This shielding tended to minimize the level of road traffic noise from Richmond Road received by the meter. Hence the major portion of the noise received by the meter was due to stationary sources of noise at CBN.

Noise Sources at CBN:

- While not specifically identified, the CBN facility has various types of mechanical equipment, such as heating/cooling devices and air conditioning units, located external to the building, both on its roof and at ground level around the building. Some of this equipment is located at ground level on the Kirkwood Avenue side of the CBN building and is visible from Kirkwood Avenue.
- It is understood that operations can occur on a 24-hour basis at the CBN facility.

Monitoring equipment and procedure:

- Monitoring was carried out periodically during July 2013, during periods suitable for outdoor noise measurements, i.e. with no rain and low wind, less than 20 kph.
- The meter measured Leq on a 5-minute basis, with 1-hour based Leq calculated during post processing of the data.
- Noise monitoring measurements were made using a Bruel and Kjaer sound level meter, Type 2250. The microphone was fitted with a 90 mm diameter windscreen during the measurements. The meter was field calibrated using a Bruel and Kjaer Type 4231 Field Calibrator before and after the series of measurements. The field calibration did not vary by more than 0.1 dB over the period of the measurements. In addition, the meter and field calibrator are both laboratory calibrated on an annual basis. Copies of annual calibration certificates for this equipment are attached to this report.

Monitoring Results:

- Monitoring was carried out periodically during July 2013, during periods suitable for outdoor noise measurements, i.e. with no rain and low wind, less than 20 kph.
- Monitoring results are presented in Figures 11 to 20 for monitoring periods between 3rd to the 31st of July 2013.
- It can be seen that the 1-hour Leq levels in the monitoring periods are in the range 53 to 60 dBA.

Interpretation:

- The monitored noise level is a combination of noise from sources at CBN and noise from other sources such as road traffic. Hence the measured sound levels tend to overestimate sound from CBN.
- Noise from vehicles travelling on Kirkwood Avenue can be assumed to make only a minor contribution to the monitored levels because traffic on this section of Kirkwood Avenue is very low.
- Noise from road traffic from Richmond Road was minimized by shielding provided by the existing building at 175 Richmond Road.
- It is expected that noise from CBN is not constant, but varies from time to time, depending on the type and level of production being undertaken.
- Based on the above, and the monitoring results shown in Figures 11 to 20, it is estimated that noise at the monitoring location, due to CBN sources varied over the range of 50 to 60 dBA, depending on the intensity and types of production being undertaken at CBN.

Conclusions from Noise Monitoring

The monitoring location is near the location of the proposed 6-storey building, but closer to CBN by at least 4 m than the proposed building. The monitored 1-hour Leq sound levels at this location are in the range 50 to 60 dBA, with night time sound levels being predominantly below 55 dBA. The 9-storey building is further away from CBN and will be exposed to less CBN noise.

The measured noise level is a combination of noise from CBN plus background noise from traffic and other sources. Hence the measured levels overestimate the noise from CBN.

- The monitoring data indicates that noise from CBN will exceed the Class 1 or Class 2 sound level limits, 50 and 45 dBA, at the nearest plane of window points of reception on the proposed 6-storey building. Although the 9-storey building is further away, monitoring results indicate that the Class 1 or Class 2 sound level limits would be exceeded at this building as well.

- The monitoring data indicates that noise from CBN, without mitigation, will satisfy the Class 4 sound level limits, 55 and 60 dBA, at the nearest plane of window points of reception for the proposed 6-storey building, with the 10 to 15 m setbacks shown in Figures 3 to 5. The proposed 9-storey building is further away, hence the monitoring data indicates that noise from CBN will meet the Class 4 limits at this building.

5.0 Assessment of Feasibility and Mitigation Options, CBN Noise

For a noise sensitive development to be built at 175 Richmond Road, it is clear that noise mitigation will be needed in order to meet the sound level limits set out in the ENCG, see Table 3.2a.

Mitigation to Class 1 or 2

Should the designation remain as Class 1 or 2, the sound level limits to be met at plane of window POR's are 50 dBA during the day and evening, and, 45 dBA at night. Mitigation options with a Class 1 or 2 designation are also limited by the following factors.

- Building siting (i.e. increasing the setback distance between CBN and the proposed building) will not be sufficient to achieve the Class 1 or 2 limits of 50/45 dBA.

- Because the proposed development is multi-storey, the use of barriers or berms to shield noise sources at CBN will not be effective at plane of window POR's which are third floor and above.

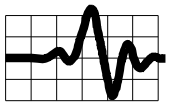
- Designing a multi-storey residential building with either a blank wall facing CBN or no windows onto any noise sensitive spaces facing CBN, would severely limit design options and lead to a relatively inefficient level of occupancy for the building.

- A very significant and costly amount of noise mitigation of the equipment at CBN will be the only option for meeting the Class 1 or 2 sound level limits. Given the large numbers of equipment that would require replacement or extensive sound mitigation at CBN, the cost of such at source mitigation would be very high.

Mitigation to Class 4

Should the City designate 175 Richmond Road as Class 4, not only do the sound level limits at plane of window POR's increase to 60 dBA during the day and evening, and 55 dBA during the night, but the ENCG and NPC-300 also allow additional options for mitigation which are not available under the Class 1 or 2 designations. Mitigation options with a Class 4 designation are as follows.

- Alternative building siting within the 175 Richmond Road property (i.e. increasing the distance between CBN and the proposed building) becomes feasible as a whole or partial mitigation measure due to the small amount of noise reduction needed to achieve the Class 4 limits of 60/55 dBA.



- The proposed setback of 10 to 15 m for the 6-storey building has been shown to satisfy the Class 4 sound level limits. No setback was required for the 9-storey building to satisfy the Class 4 sound level limits.

- Class 4 designation introduces additional mitigation options not permitted under Class 1 or 2, specifically: enhanced construction techniques and materials, air conditioning and ventilation, and, high STC (Sound Transmission Class) materials.

Feasibility

It is concluded that noise mitigation with respect to stationary noise from CBN is feasible for the proposed multi-storey buildings of mixed commercial and residential use at 175 Richmond Road, provided that the property is designated by the City as an Approved Class 4 Stationary Noise Area. Specifically, the proposed noise control/mitigation is a setback of 10 to 15 m from the property line for the 6-storey building as shown in Figures 3 to 5.

Should the designation of the property at 175 Richmond Road remain as Class 1 or 2, mitigation is technically feasible, but very difficult, and could lead to an inefficient occupancy and use of the land. The cost of mitigation under these circumstances would be very high.

6.0 Warning Clause for Stationary Noise Impacts

The following warning clause relating to stationary noise impacts is to be registered on title and included in agreements of purchase and sale for both the 9-storey and 6-storey buildings. This warning clause is taken form the City of Ottawa in the ENCG Part 4, Appendix A.

> *Purchasers/tenants are advised that sound levels due to the adjacent industry (facility) (utility) may interfere with outdoor activities as the sound levels exceed the sound level limits of the City and the Ministry of Environment.*
>
> *Purchasers/tenants are further advised that sound levels due to the adjacent industry (facility) (utility) are required to comply with sound level limits that are protective of indoor areas and are based on the assumption that windows and exterior doors are closed. This dwelling unit has been supplied with a ventilation/air conditioning system which will allow windows and exterior doors to remain closed.*

7.0 Transportation Noise Impacts - Methodology

This section describes an assessment of noise impacts from traffic on Richmond Road on the noise sensitive spaces, including outdoor living areas, bedrooms and indoor living/dining areas, at the proposed development.

The outdoor and indoor noise criteria, sound level limits, are provided in Appendix 1. These limits are to be met by proposed noise sensitive developments using control measures, such as, site design, set-backs, noise barriers, acoustical requirements for building components and ventilation requirements. In some circumstances, warning clauses related to noise are required on titles, leases and sale agreements.

The noise assessment methodology is summarised as follows:

- Noise generated by road traffic is predicted using STAMSON[5], a traffic noise model developed by the MECP. STAMSON takes into account such factors as distance from the road, height, nature of the intervening buildings and terrain, ground absorption, and noise barriers, if present.

- Noise from future road traffic is predicted using STAMSON at critical points of reception at the proposed development. Locations to be considered include Outdoor Living Areas (OLAs) as well as 'plane of window' locations, where rooms for living/dining or sleeping are located in residences. Noise levels are predicted as A-weighted equivalent sound levels, L_{EQ}, (i.e. average levels) for various periods such as Day (07:00 to 23:00) and Night (23:00 to 07:00) periods. A-weighting is a frequency correction to sound pressure levels which approximates the response of the human ear and is used extensively for environmental noise assessments. Results are expressed in dBA, A-weighted decibels.

- Based on the predicted sound levels, the specifications for mitigation measures such as noise barriers, requirement for building component design, ventilation requirements and warning clauses are determined according to criteria established by the City of Ottawa ENCG as described below.

The noise criteria for outdoor living areas and indoor living areas are set out in Tables A1.1 and A1.6, Appendix 1.

Building component requirements depend on the predicted outdoor noise levels at plane of window points of reception and are set out in Table A1.4, Appendix 1. Where building component requirements need to be designed to achieve specific indoor sound levels, restrictions may apply such as the construction and areas of walls, windows, and doors.

The ventilation requirements and corresponding warning clause requirements are dependent on predicted outdoor noise levels at plane of window points of reception and are set out in Tables

A1.4 and A1.5, Appendix 1. Warning clauses, when required, are to be placed on title documents, sale agreements, and lease agreements.

8.0 Transportation Noise Impacts – Points of Reception and Modelling

Points of Reception for Transportation Noise Assessment

For the evaluation of traffic noise impacts points of reception were chosen which demonstrate worst case noise impacts at various locations for the proposed development. The points of reception selected for detailed analysis are listed in Table 1 and shown in Figures 3 to 9 using the following designations.

RTx-y, where
T refers to this being a point of reception for the assessment of Transportation noise,
x refers to the horizontal location of the point of reception, and,
y refers to the building floor.

The predicted sound levels at each point of reception are compared to relevant criteria contained in ENCG and NPC-300 to determine the level of mitigation required to achieve the complying outdoor and indoor sound levels as set out in Appendix 1.

The outdoor living areas for the proposed 9-storey and 6-storey buildings are as follows.

RT5 Upper Court Yard, shown in Figure 6, this location is well shielded from Richmond Road

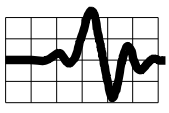
RT11 Outdoor Terrace, shown in Figure 4

Noise Source Modelling and Data

The road traffic data used to assess traffic noise impacts has been taken from the City of Ottawa ENCG, Part 4, Appendix B, which provides ultimate future traffic volume data for various roadways based on roadway class and number of lanes. The traffic data used represents future traffic volumes and correspond to a 'mature state of development', in the City's Official Plan.

- Richmond Road is a 2-Lane Urban Arterial Undivided road (2-UAU), with a future traffic volume of 15,000 AADT, posted speed limit of 50 km/hr.

- The proportions of traffic types and times recommended in the ENCG (Day/Night 92/8, medium trucks 7%, heavy trucks 5 %) were used to develop the traffic data for Richmond Road as shown in Table 2. The surrounding topography was assumed to be a generally flat, reflective surface.



9.0 Transportation Noise Impact Assessment – Noise Control and Warning Clauses

Based on the future traffic projections for Richmond Road, Table 2, sound levels were calculated at each of selected points of reception using the STAMSON[5] noise modelling software. Samples of the outputs of the STAMSON software are provided in Appendix 2.

Calculated future sound levels are shown in Table 3. Note that the STAMSON calculated sound levels, for the same horizontal location do not depend on height. This is because the surface between the source, Richmond Road traffic, and the points of reception has been taken to be reflective, a reasonable assumption given the predominance of concrete and paving in this vicinity. For example, the calculated sound levels are identical at points of reception RT3-1, RT3-2, RT3-6 and RT3-9, which represent points on the 9-storey building at the ground, 2nd, 6th and 9th levels at the same horizontal location.

The implications of the calculated future noise levels, in relation to the ENCG criteria, are set out in Table 3, are discussed below.

Noise Control Measures for the Outdoor Amenity Area

Table 3 presents the calculated future traffic noise levels at the proposed outdoor amenity/living areas for the two buildings. The results are as follows.

RT5	Upper Court Yard, 9-storey building	Daytime level 49.00 dBA
RT11	Terrace, 6-storey building	Daytime level 53.39 dBA

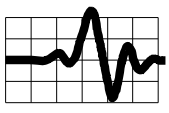
Calculated sound levels do not exceed the daytime 55 dBA criteria, Tables A1.1 and A1.5, hence no mitigation or warning clause is needed for these outdoor living areas.

Hence, noise impacts from future road traffic on Richmond Road will meet the City of Ottawa sound level criteria at the proposed outdoor living area locations.

Building Components

As shown in Table 3, for most of the proposed development plane of window sound levels are low enough that no special design requirements for the façade elements is required, i.e. construction to the Ontario Building Code (OBC) will be satisfactory.

However, for points of reception on the 9-storey building which face or partially face Richmond Road, points RT1-1, 2, 6 & 9, and RT2-1, 2, 6 & 9, design of façade building components need



to be designed to meet the indoor sound level criteria in Tables A1.2 and A1.3, see Table 3 and Figures 6 to 9.

Indoor noise calculations were carried out for the commercial and residential points of reception at RT1, the worst case, using IBANA-calc, a method and software developed by the National Research Council Canada. IBANA-Calc predicts the indoor sound level in a room taking into account: external sound level due to road and rail traffic, window areas, room size and room absorption. The results of the calculations, Table 4, show that construction to the OBC will be satisfactory at the RT1 points of reception. Being less subject to less noise, OBC façade building components will also be acceptable at other points of reception facing Richmond Road on the 9-storey building, such as the RT2 points of reception.

It is concluded that no special design requirements for the façade elements is required in either the 9-storey or the 6-storey buildings, i.e. construction to the Ontario Building Code (OBC) will be satisfactory.

Ventilation Requirements & Warning Clauses

Table 3 presents the calculated future sound levels at plane of window points of reception for both the 9-storey and 6-storey buildings. With respect to ventilation requirements and corresponding warning clauses the results show the following.

- For the 9-storey building, central air conditioning is a requirement for units facing Richmond Road and the provision of central air conditioning is a requirement for the remainder of the building. From a practical perspective the provision of central air conditioning is recommended for the whole of the 9-storey building.

- For the 6-storey building, the provision of central air conditioning is required (meaning that each dwelling is to be designed with a provision for the installation of central air conditioning in the future, at the occupant's discretion) at most locations. Given the nature of the proposed 6-storey building, the provision of central air conditioning is recommended for the whole of the 6-storey building.

Hence, the installation of central air-conditioning is a requirement for the 9-storey building and is recommended for the 6-storey building. The detailed requirements for central air conditioning are set out in NPC-300, Section C7.8.1 and include the following.

- **The noise in the spaces served by the air conditioning should not exceed 40 dBA.**
- **The ventilation system is to be designed by a heating and ventilation professional.**

The following warning clause relating to transportation noise impacts is to be registered on title and included in agreements of purchase and sale for both the 9-storey and 6-storey buildings. This warning clause is recommended by the City of Ottawa in the ENCG Part 4, Appendix A.

> *Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road/rail/Light Rail/transitway traffic may, on occasion, interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of Environment.*
>
> *This dwelling unit has also been supplied with a central air conditioning system and other measures which will allow windows and exterior doors to remain closed, thereby ensuring that indoor sound levels are within the sound level limits of the City and the Ministry of Environment.*

10.0 Recommendations and Conclusions

This consolidated Phase 1 Noise Control Feasibility Study addresses the noise impacts of both stationary sources of noise (Canadian Bank Note at 145 Richmond Road) and transportation sources of noise (road traffic on Richmond Road) on the proposed mixed use commercial and residential development at 175 Richmond Road. The proposed development consists of a 9-storey mixed-use building and a 6-storey residential building as shown in Figures 1 and 2.

The following are the recommendations and conclusions of this report.

10.1 It is recommended that the City of Ottawa include 175 Richmond Road in Appendix A of Part 1 of the Environmental Noise Control Guidelines (ENCG) as an Approved Class 4 Stationary Noise Area, pursuant to the ENCG[1] and NPC-300[2]. Justifications for this recommendation are contained in Section 2.0 of this report.

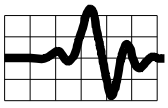
10.2 With respect to the control/mitigation of stationary noise from CBN, it is concluded that the 10 to 15 m setback of the proposed 6-storey building, as shown in Figures 3 to 5, is sufficient to satisfy the sound level limits for a Class 4 Area for the entire proposed development. Hence noise control for the proposed development is feasible, provided the Class 4 designation for 175 Richmond Road is approved by the City of Ottawa.

10.3 With respect to the control/mitigation of stationary noise, it is recommended that the following warning clause relating to stationary noise impacts be registered on title and included in agreements of purchase and sale for both the 9-storey and 6-storey buildings. This warning clause is taken form the City of Ottawa in the ENCG Part 4, Appendix A.

Purchasers/tenants are advised that sound levels due to the adjacent industry (facility) (utility) may interfere with outdoor activities as the sound levels exceed the sound level limits of the City and the Ministry of Environment.

Purchasers/tenants are further advised that sound levels due to the adjacent industry (facility) (utility) are required to comply with sound level limits that are protective of indoor areas and are based on the assumption that windows and exterior doors are closed. This dwelling unit has been supplied with a ventilation/air conditioning system which will allow windows and exterior doors to remain closed.

10.4 In relation to the control of noise from transportation sources, Richmond Road, the installation of central air conditioning is recommended for both the 9-storey and 6-storey buildings of the proposed development. The detailed requirements for central air conditioning are set out in Provincial guideline NPC-300, Section C7.8.1, see Section 9.0 of this report.



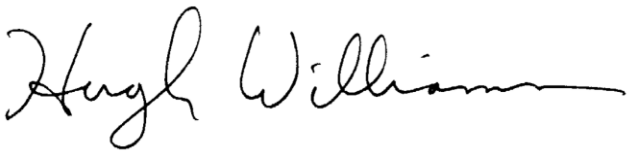
10.5 With respect to the control/mitigation of transportation noise from Richmond Road, it is recommended that the following warning clause be registered on title and included in agreements of purchase and sale for both the 9-storey and 6-storey buildings. This warning clause is taken form the City of Ottawa in the ENCG Part 4, Appendix A.

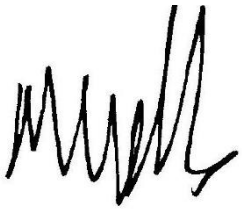
Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road/rail/Light Rail/transitway traffic may, on occasion, interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the City and the Ministry of Environment.

This dwelling unit has also been supplied with a central air conditioning system and other measures which will allow windows and exterior doors to remain closed, thereby ensuring that indoor sound levels are within the sound level limits of the City and the Ministry of Environment.

10.6 With respect to transportation noise from Richmond Road, it is concluded that façade building elements constructed to the Ontario Building Code will satisfy the requirements of the City of Ottawa ENCG.

10.7 With respect to transportation noise from Richmond Road, it is concluded that no additional noise control or warning clauses are required for the outdoor amenity/living areas to satisfy the requirements of the City of Ottawa ENCG.





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Michael Wells, B.Arch. (Hons), B.Sc. Arch.
Registered Architect of NSW, ARN: 8111
Member, Canadian Acoustical Society

References

1. City of Ottawa *Environmental Noise Control Guidelines,* January 2016*,* (ENCG).

2. Ministry of Environment Publication NPC-300, *Environmental Noise Guideline Stationary and Transportation Sources - Approval and Planning*, August 2013, (NPC-300).

3. Ministry of Environment, Conservation and Parks (MECP), *Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT)*, 1989.

4. Ministry of Environment, Conservation and Parks (MECP), *Sound from Trains Environmental Analysis Method (STEAM)*, 1990.

5. Ministry of Environment, Conservation and Parks (MECP), *STAMSON Software, Version 5.04, 2000*. (Software implementation of ORNAMENT and STEAM.)

6. National Research Council Canada, *IBANA-Calc, Version 1.2 Rev. 122*, method and software for calculation of indoor sound levels due to outdoor noise levels.

7. Publications Ontario, *Ontario Building Code*, OBC.

Figures

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Figure 1: Aerial View of Proposed Development and Noise Sources (Source: geoOttawa)

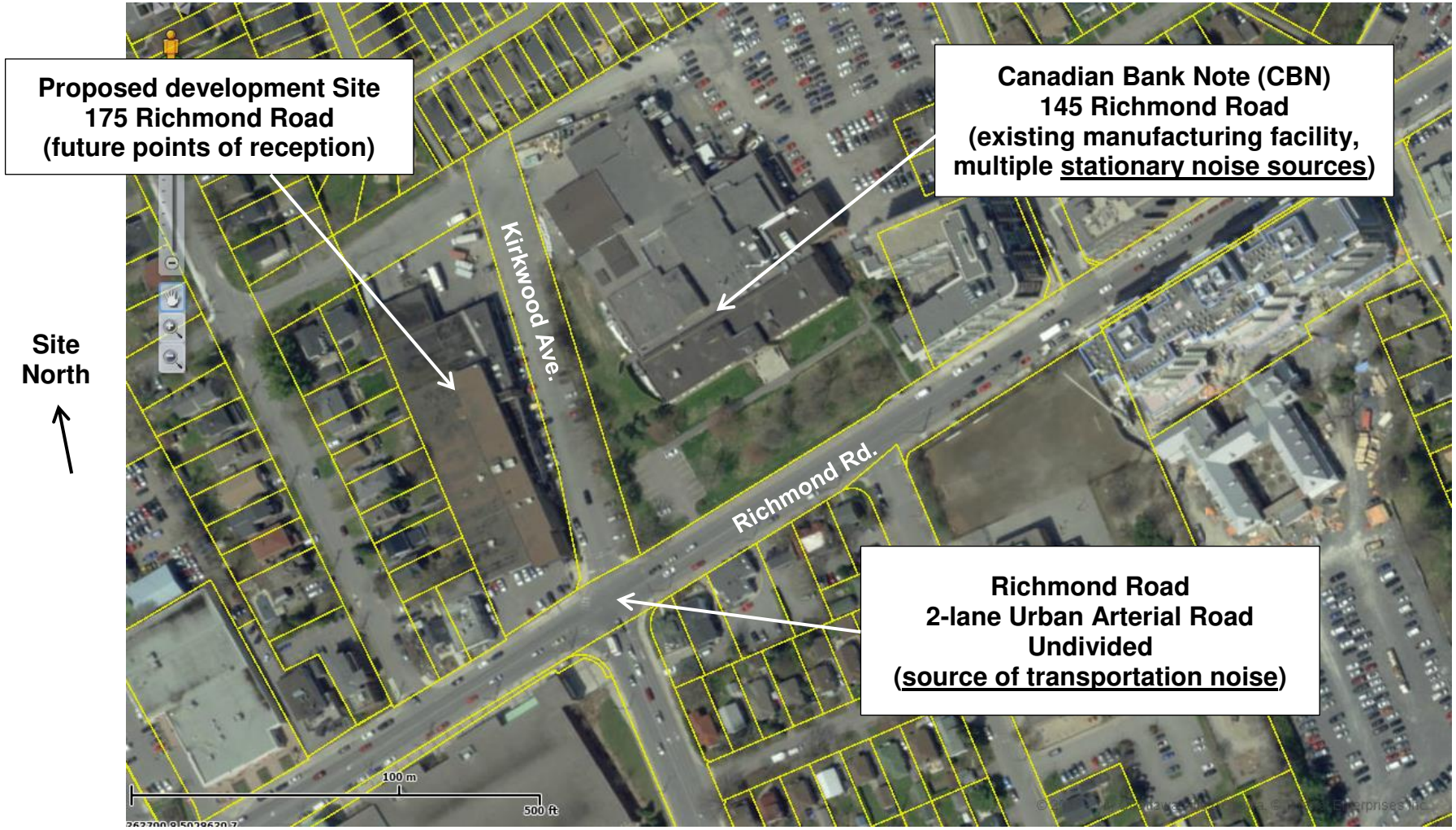


Figure 2: Site Plan, 175 Richmond Road

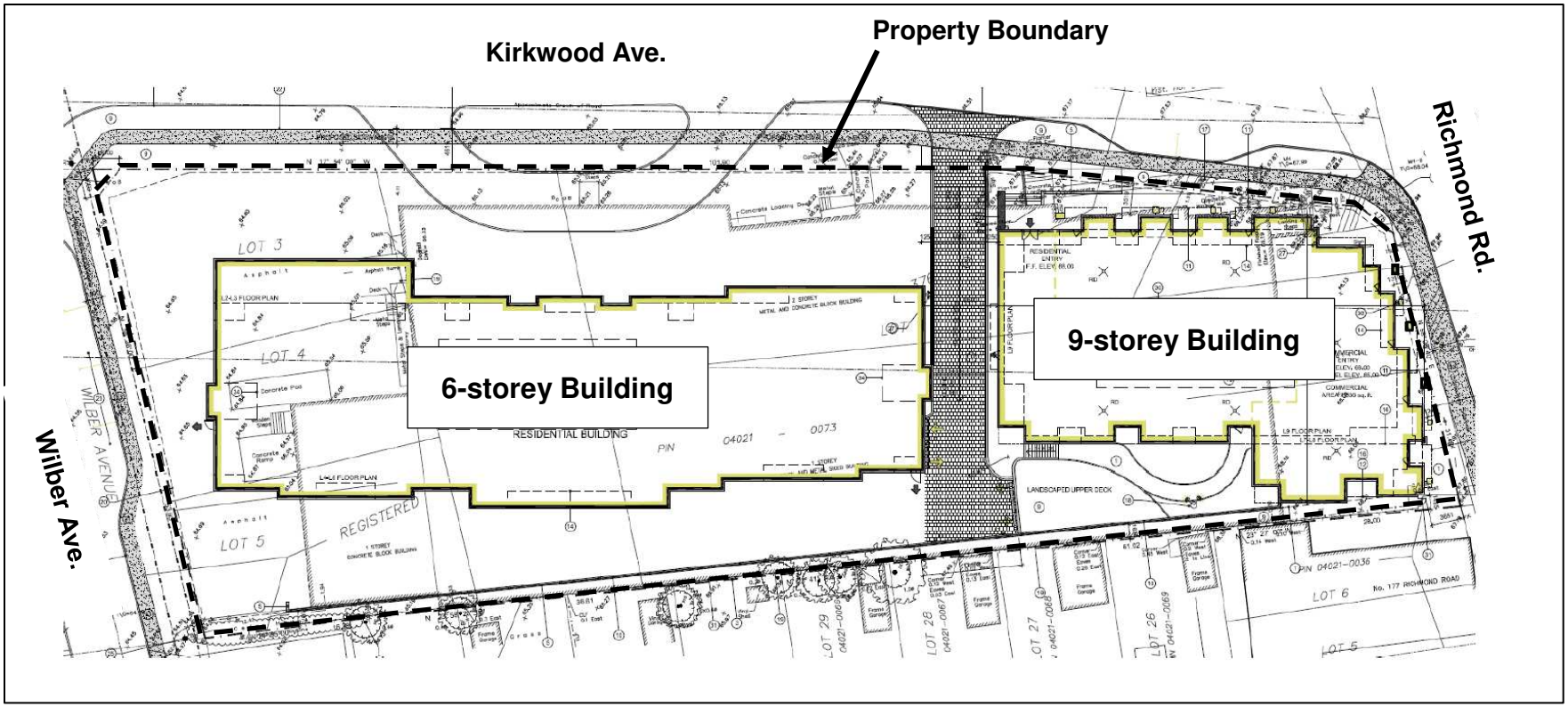
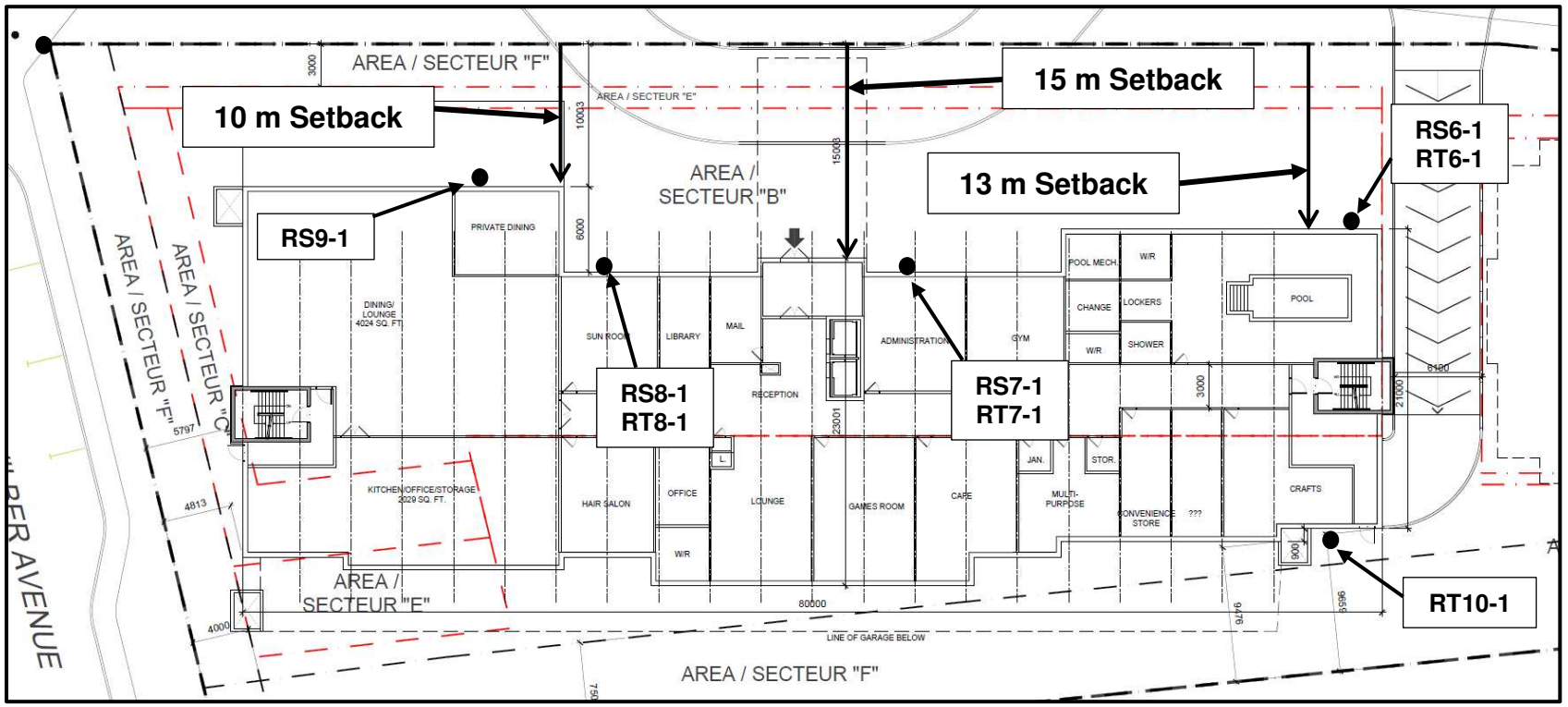


Figure 3: Ground Floor Plan, 175 Richmond Road, 6-storey Building



Site North ←

Figure 4: 2nd & 3rd Floor Plan, 175 Richmond Road, 6-storey Building

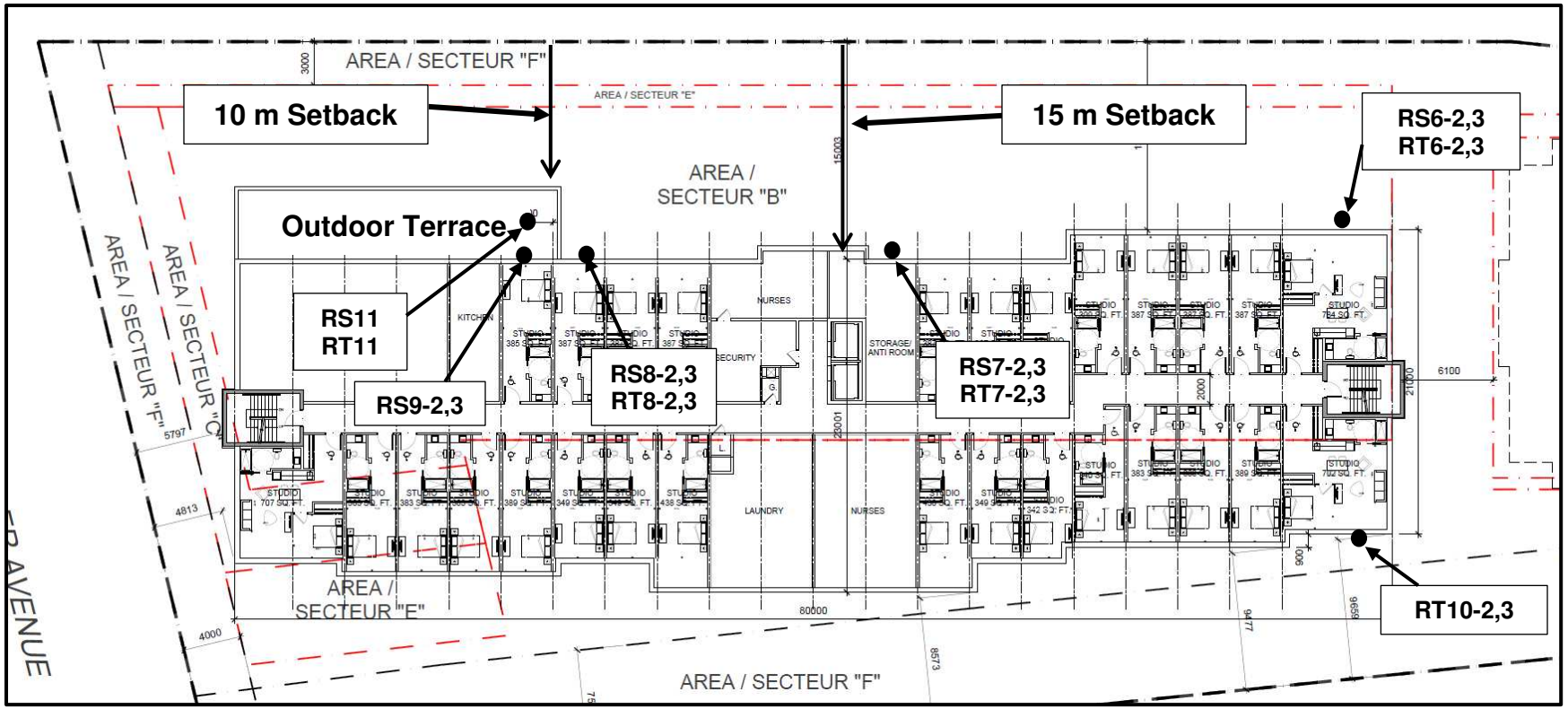


Figure 5: 4th to 6th Floor Plan, 175 Richmond Road, 6-storey Building

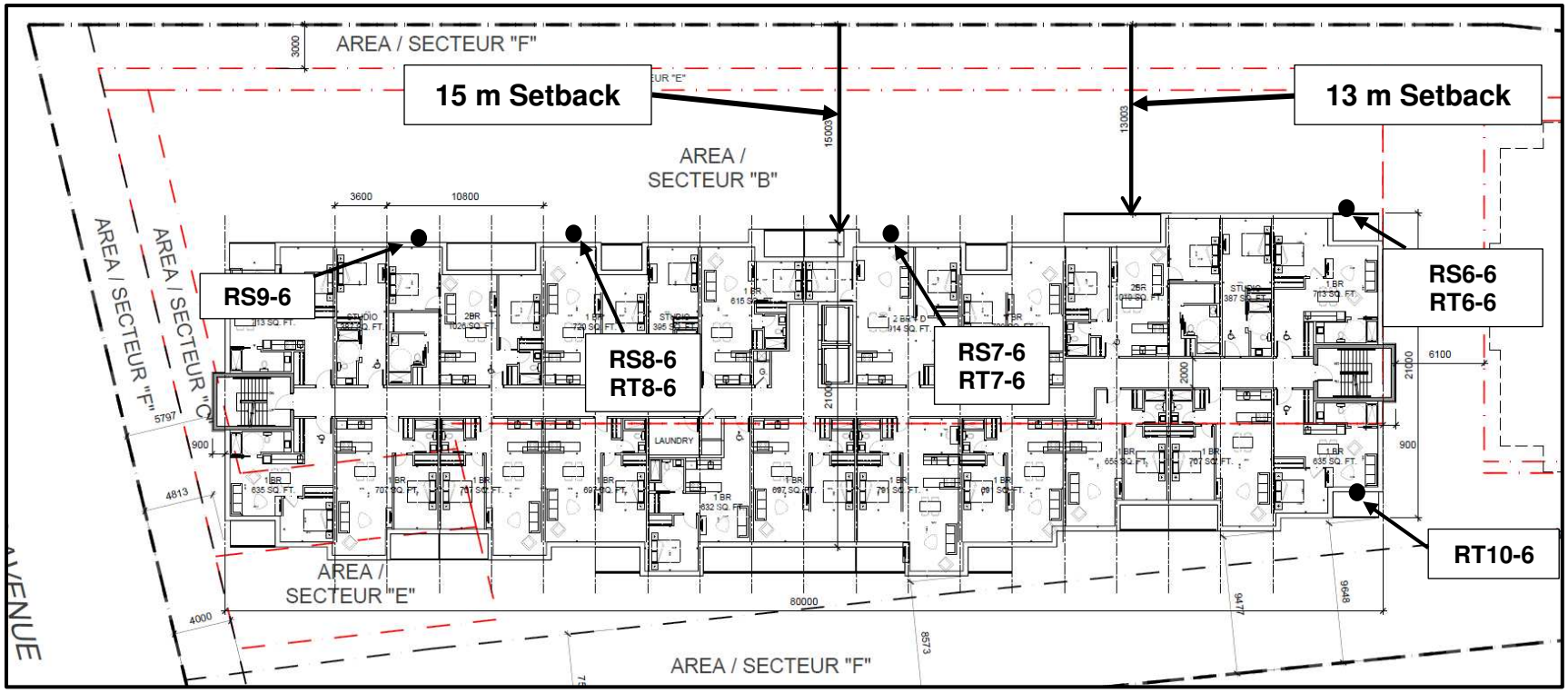


Figure 6: Ground Floor Plan, 175 Richmond Road, 9-storey Building

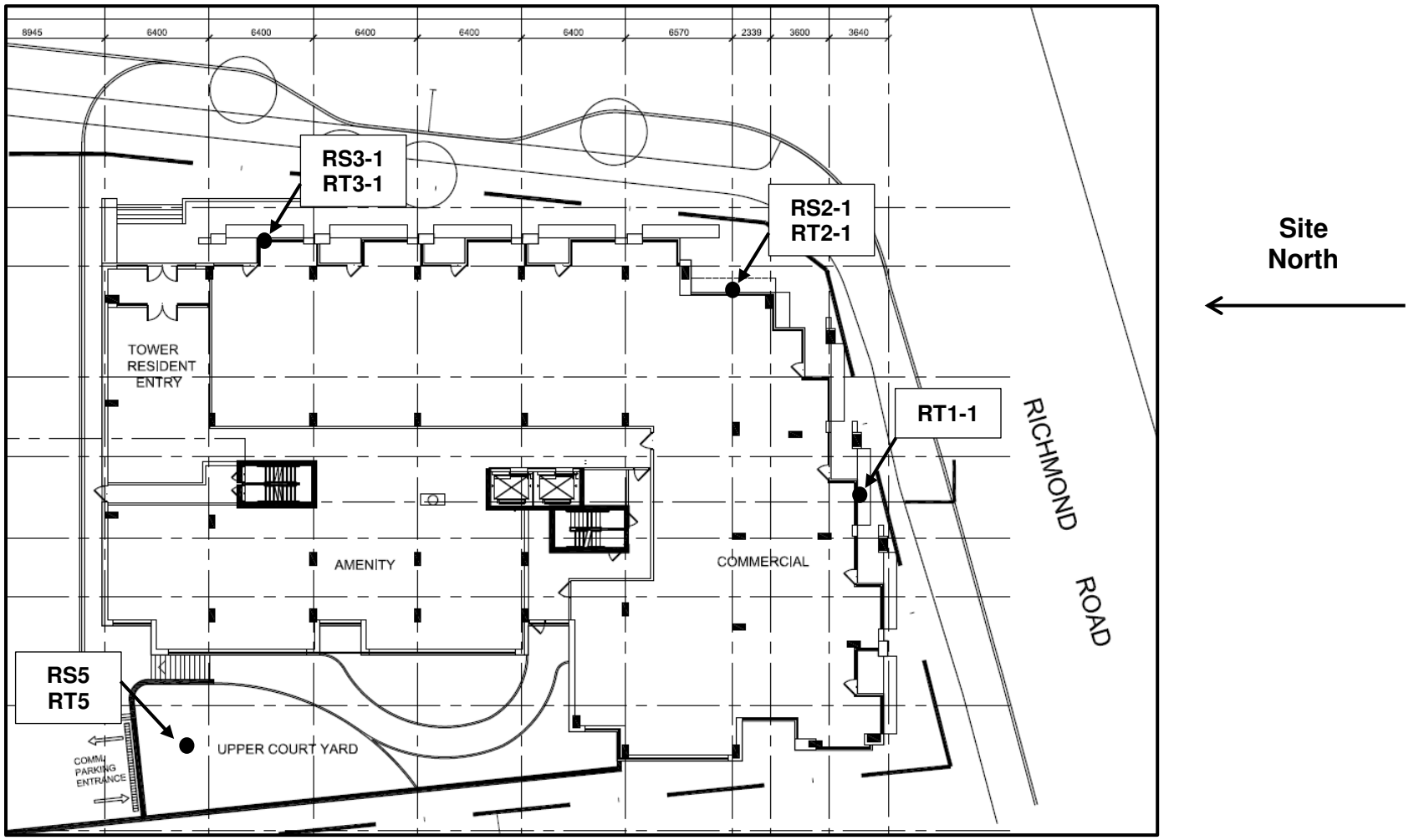


Figure 7: 2nd Floor Plan, 175 Richmond Road, 9-storey Building

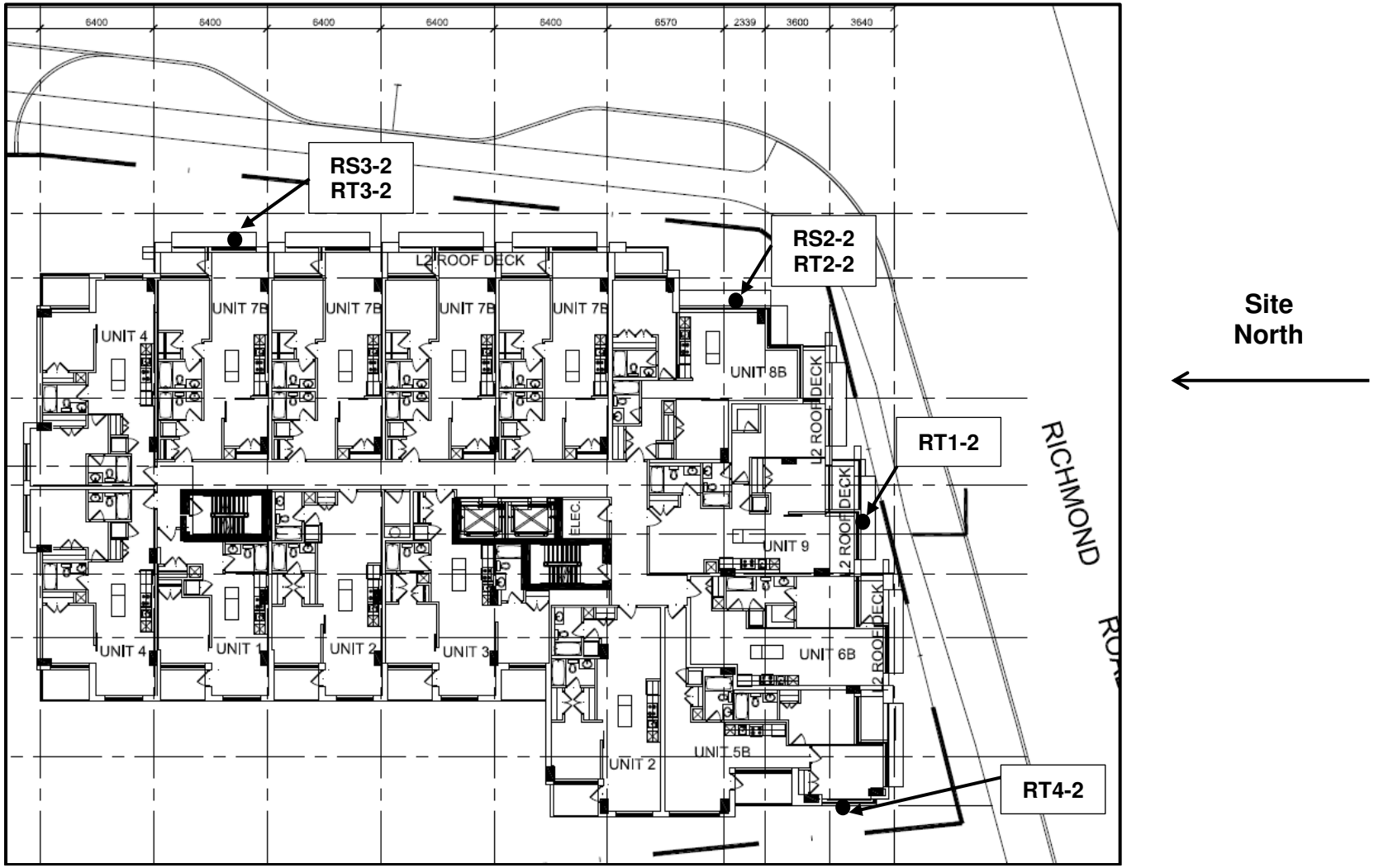


Figure 8: 6th Floor Plan, 175 Richmond Road, 9-storey Building

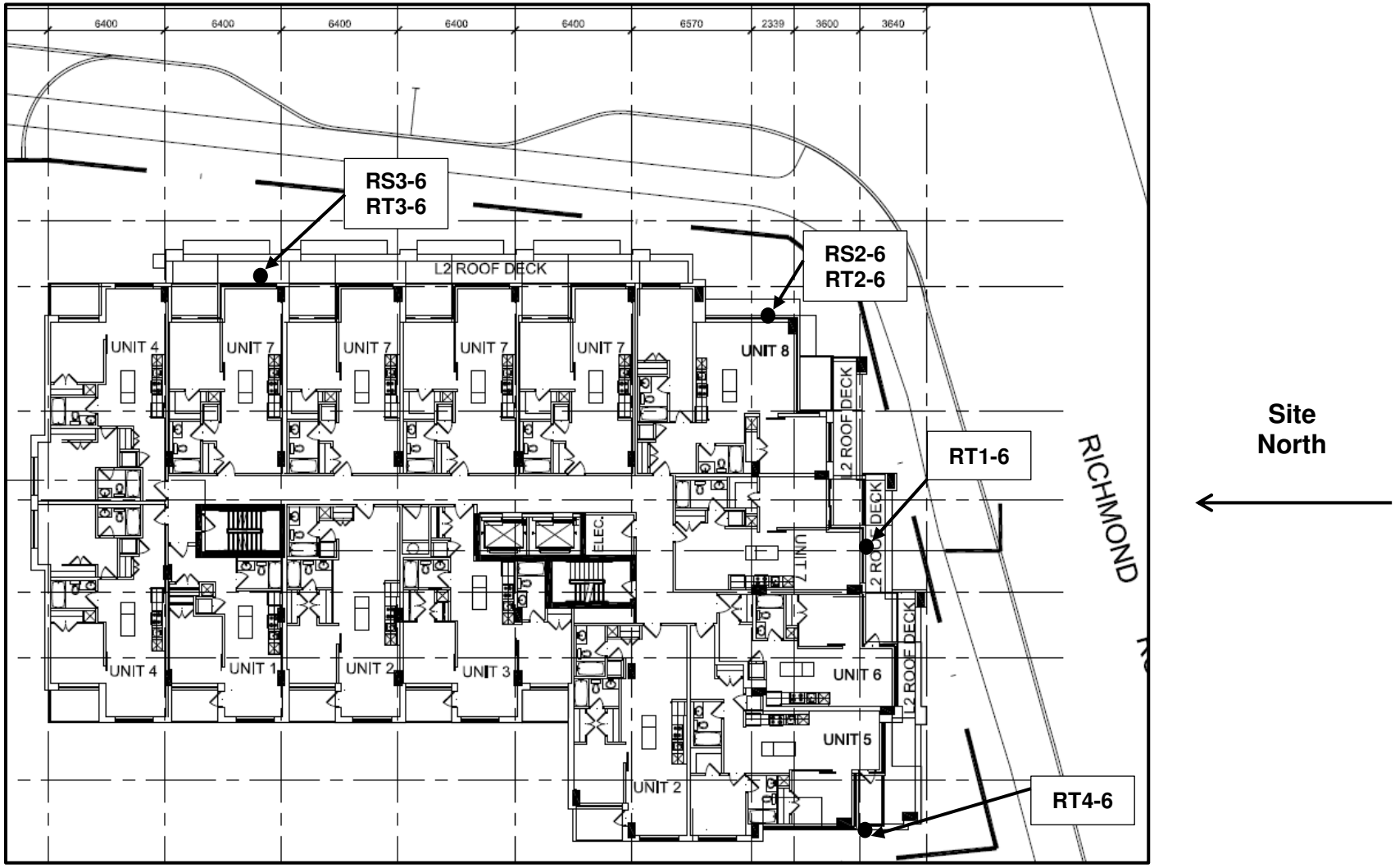


Figure 9: 9th Floor Plan, 175 Richmond Road, 9-storey Building

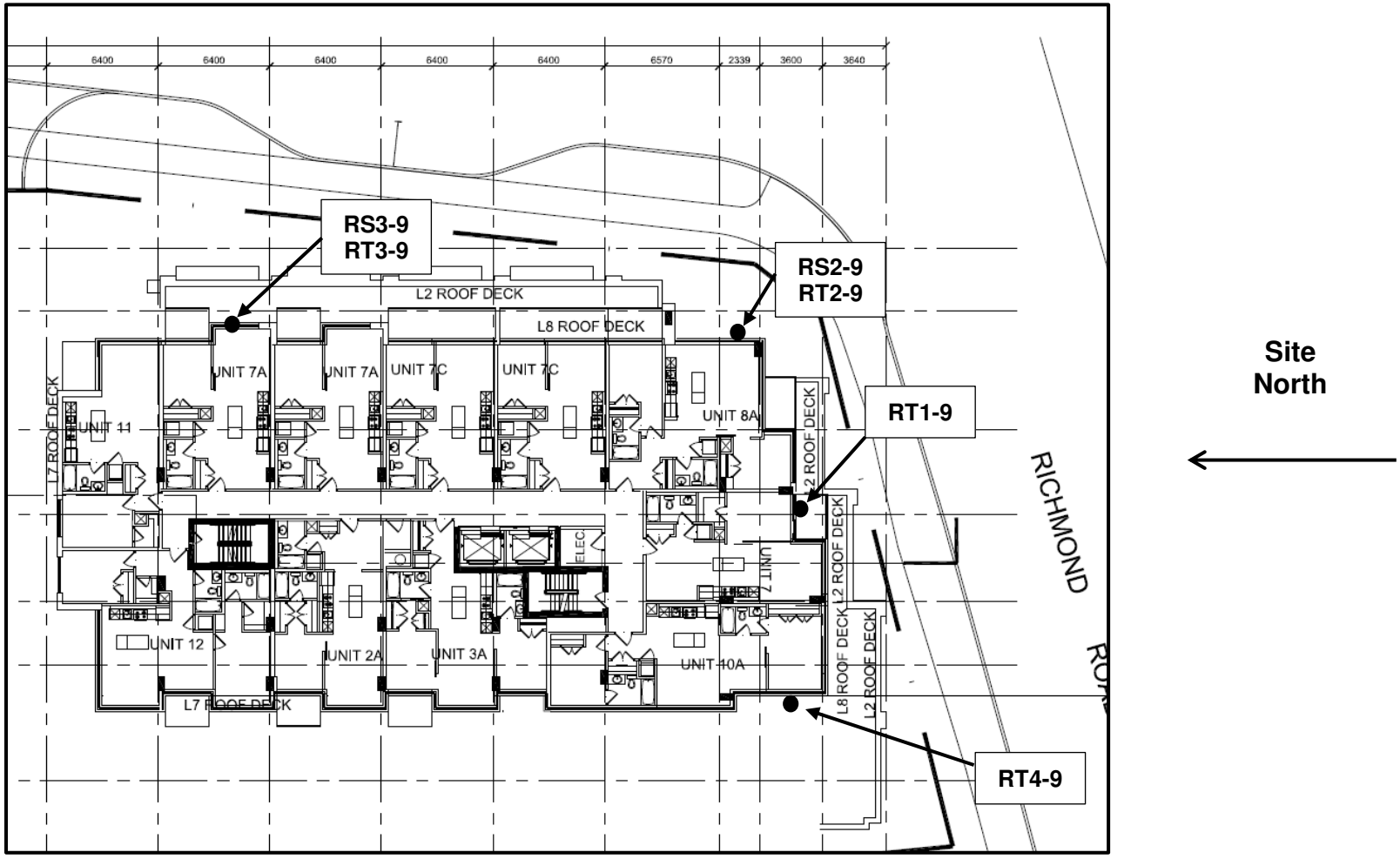


Figure 10: Noise Monitoring Locations, July 2013 (Source: geoOttawa)

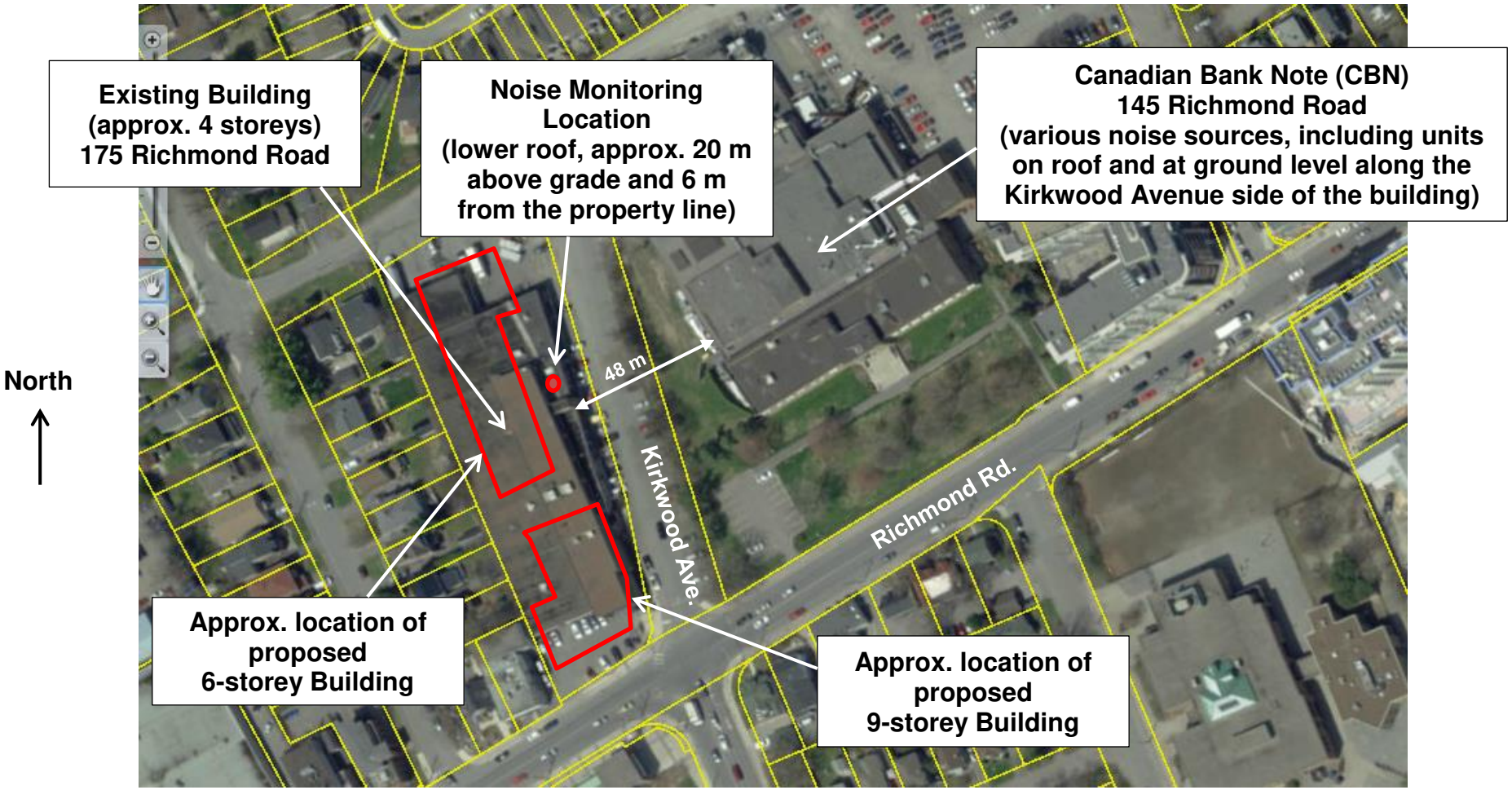


Figure 11: Noise Monitoring Results, Monday 15th July 2013

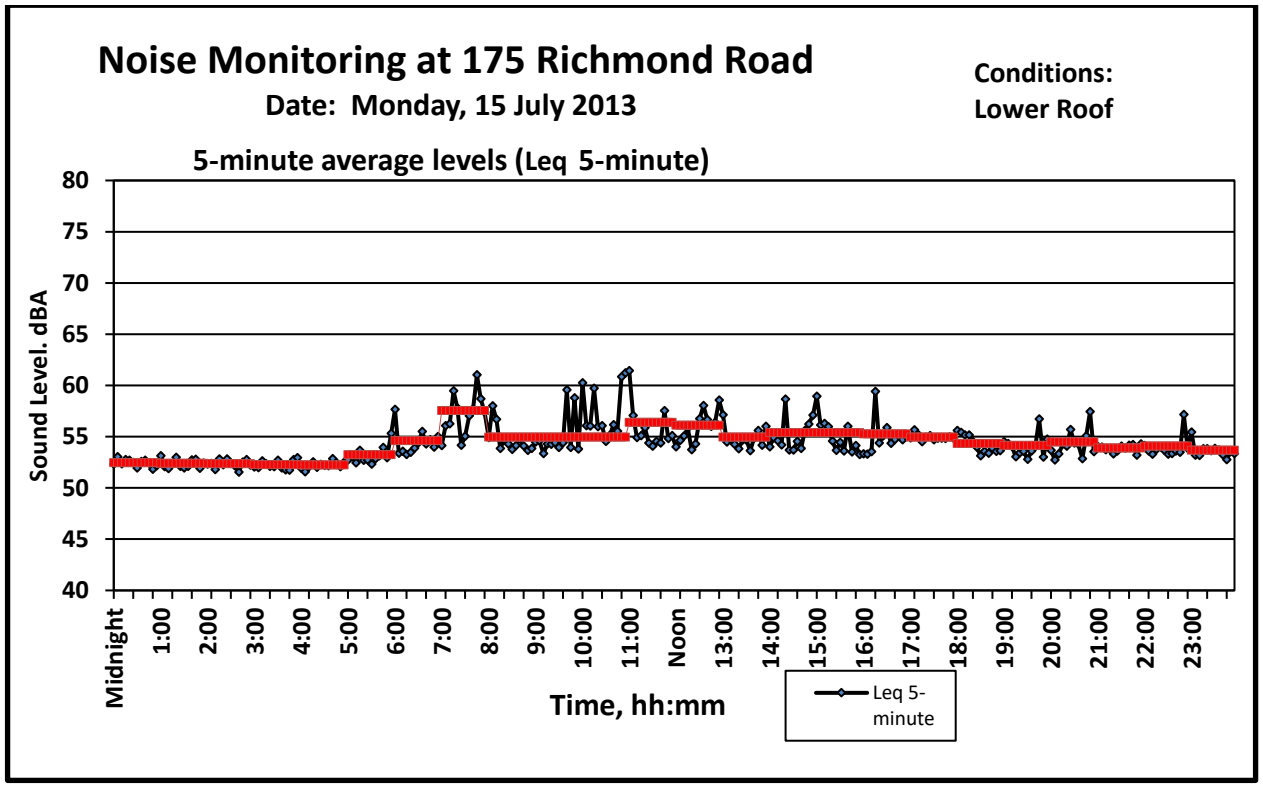


Figure 12: Noise Monitoring Results, Tuesday 16th July 2013

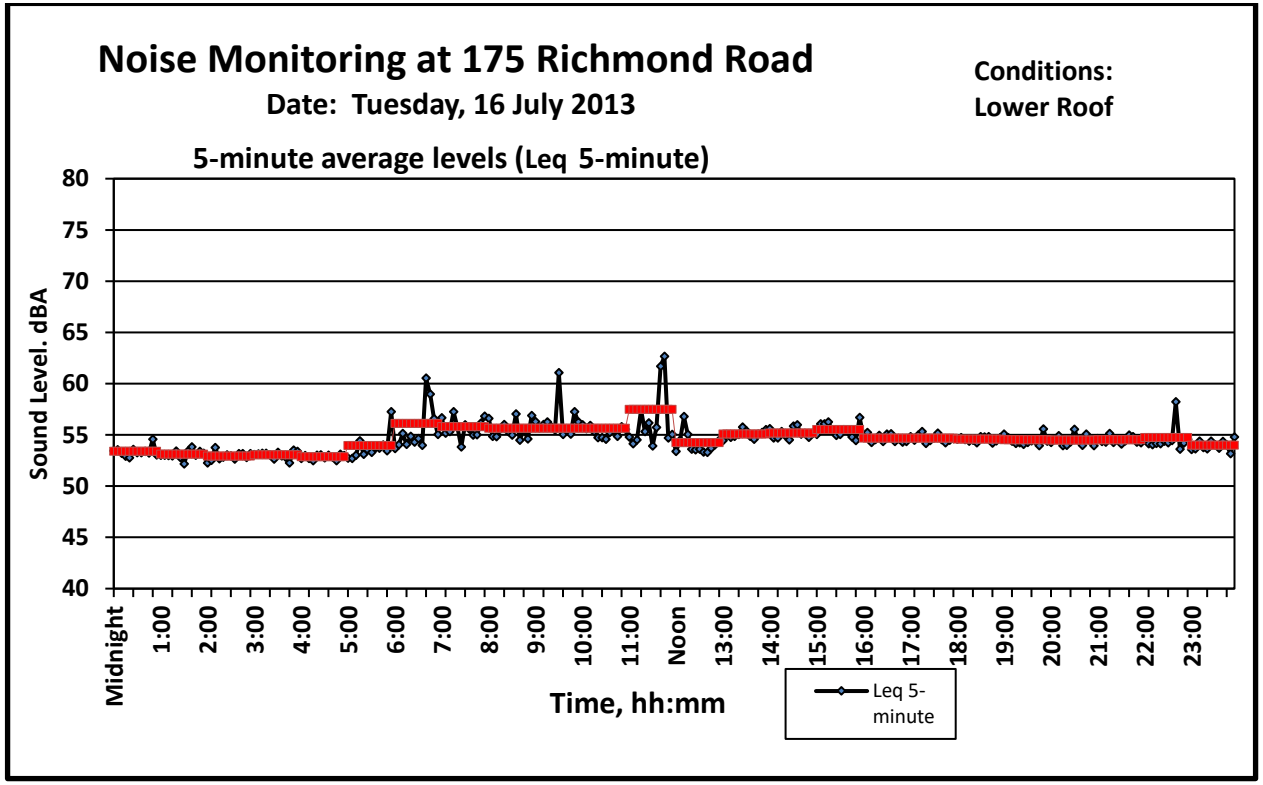


Figure 13: Noise Monitoring Results, Wednesday 17th July 2013

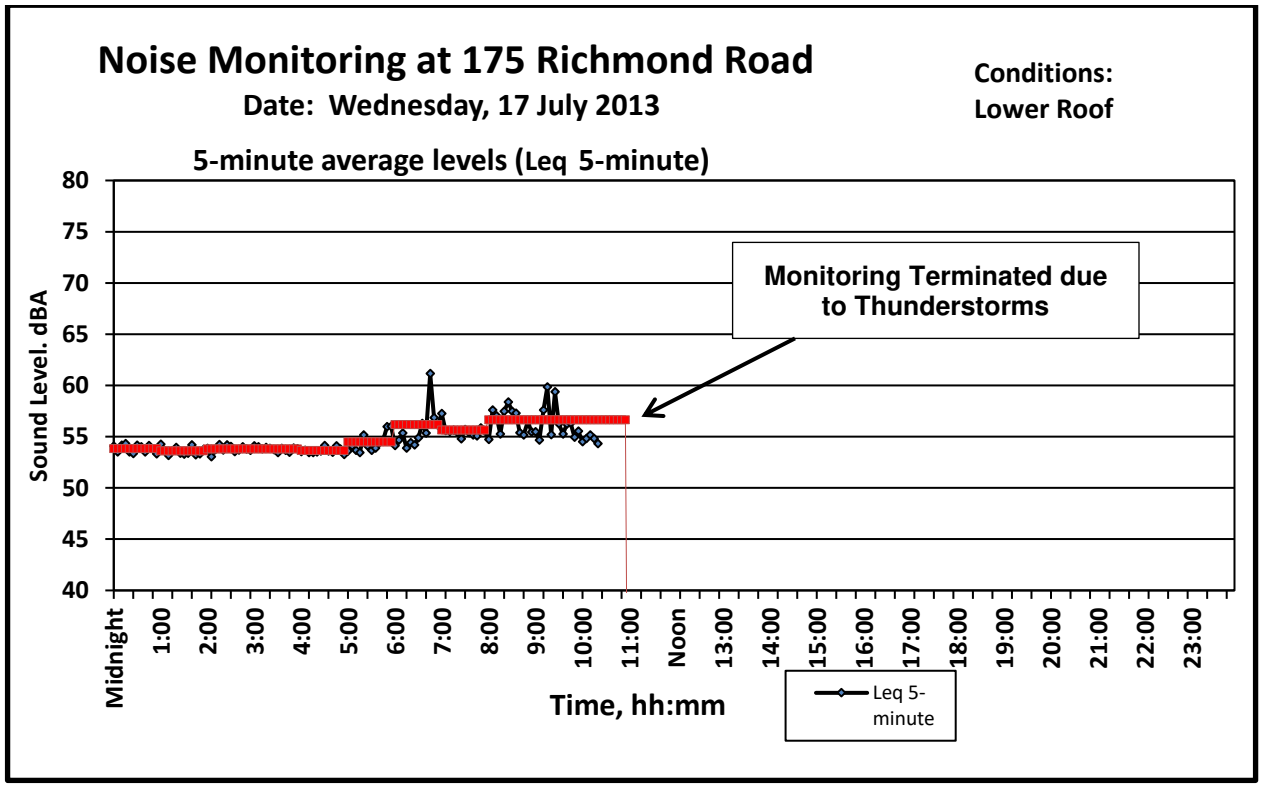


Figure 14: Noise Monitoring Results, Monday 22nd July 2013

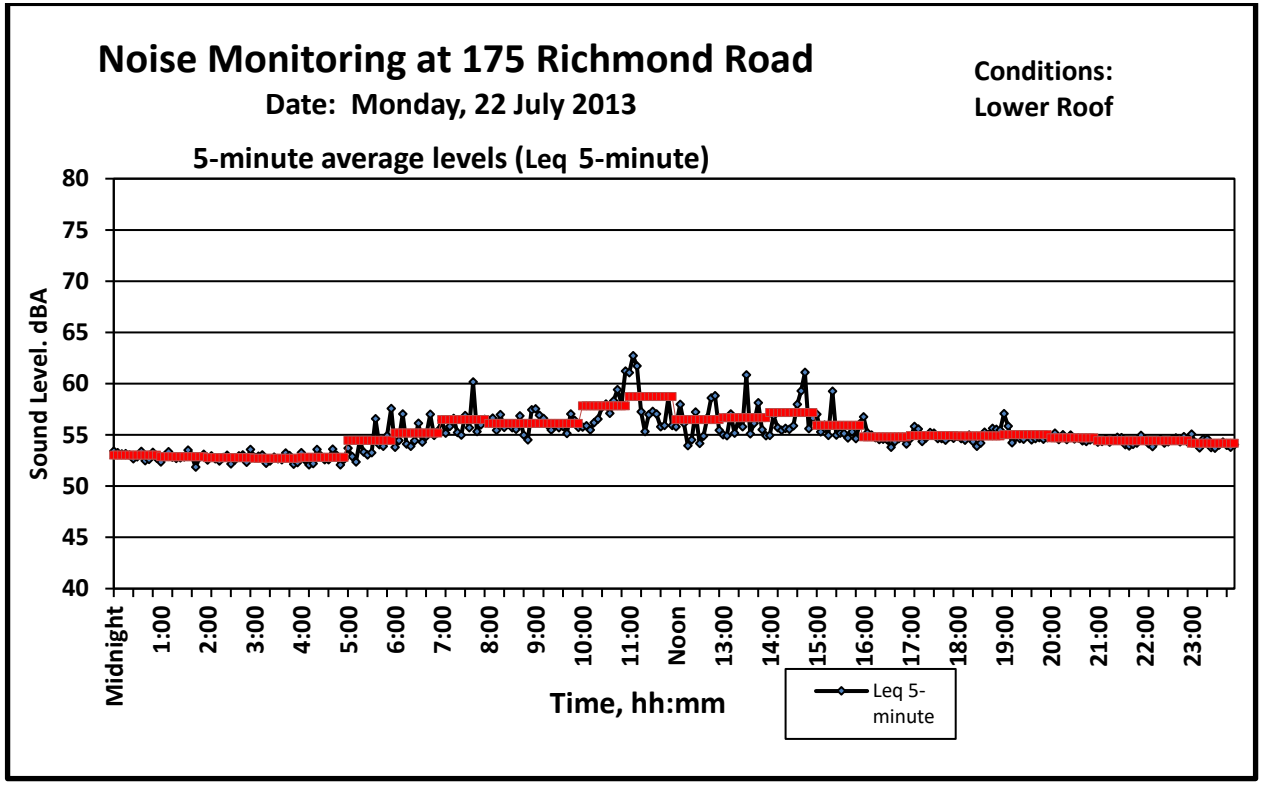


Figure 15: Noise Monitoring Results, Tuesday 23rd July 2013

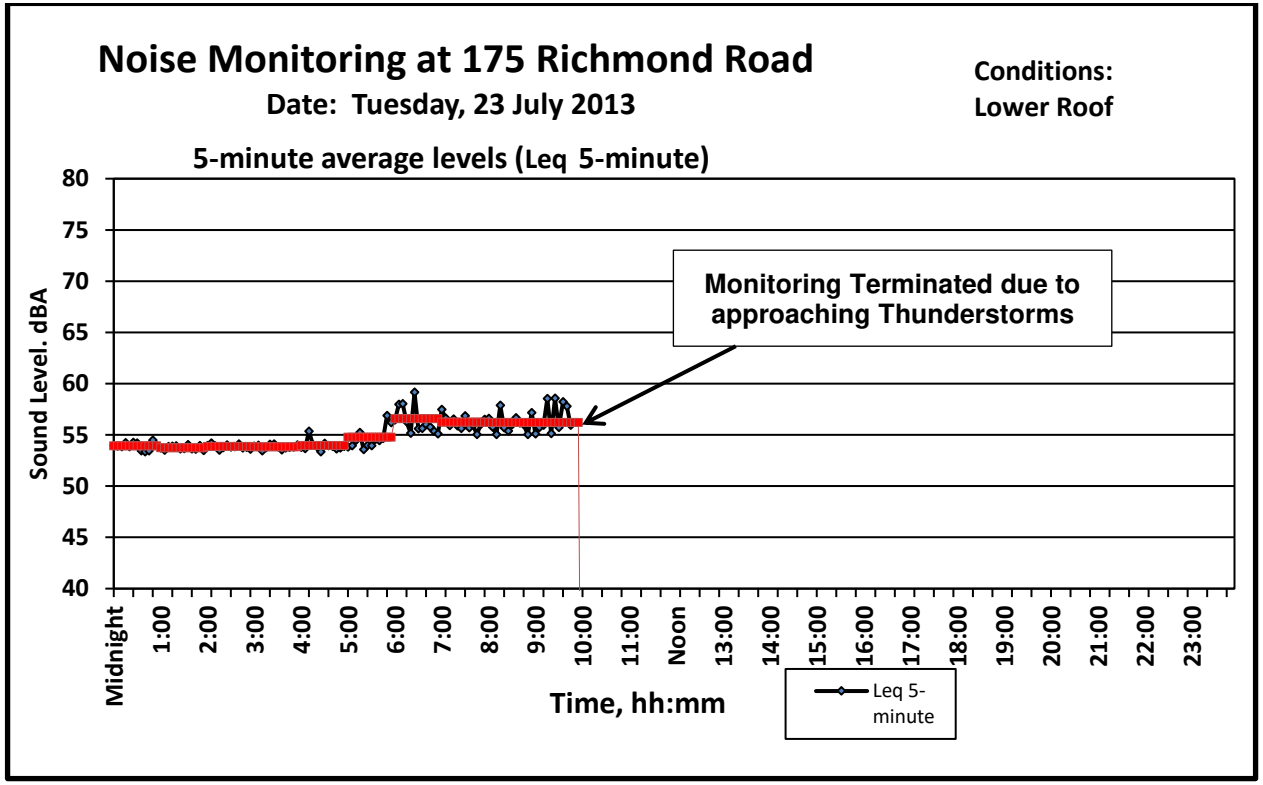


Figure 16: Noise Monitoring Results, Wednesday 24th July 2013

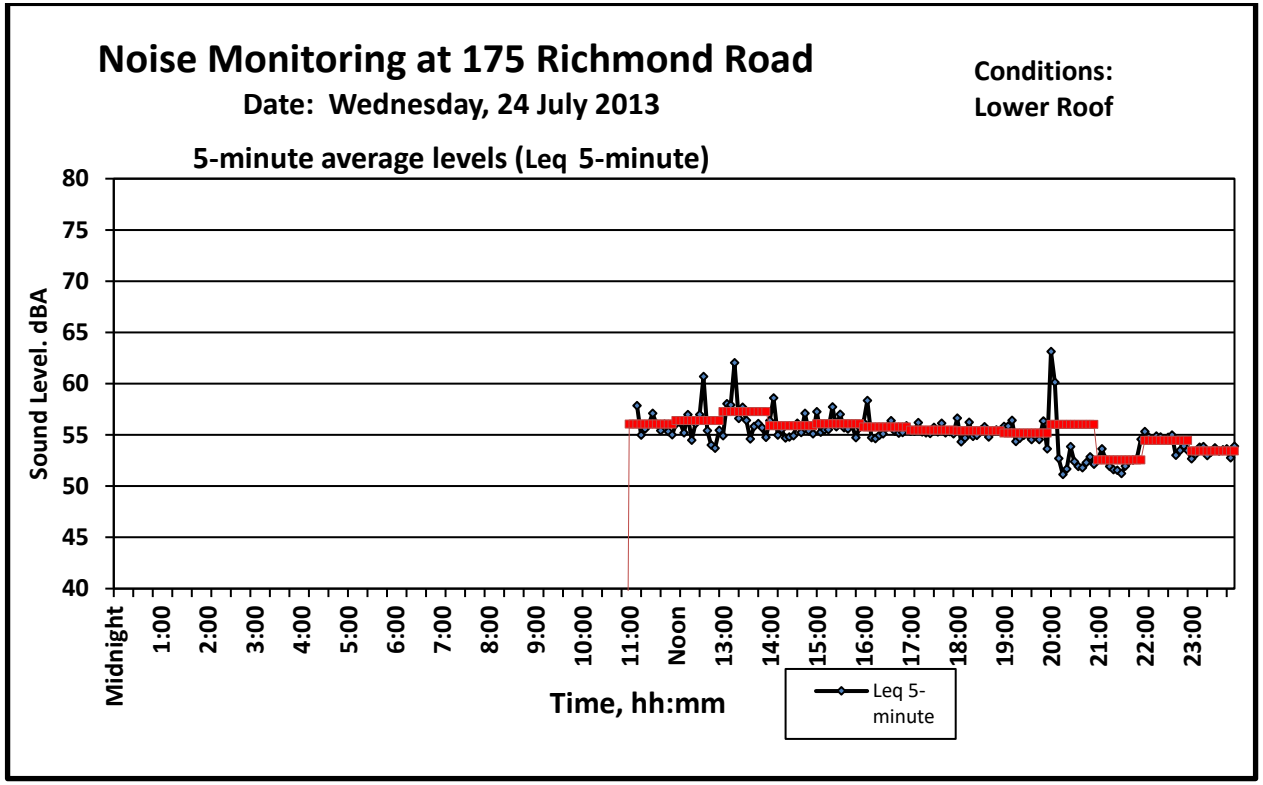


Figure 17: Noise Monitoring Results, Thursday 25th July 2013

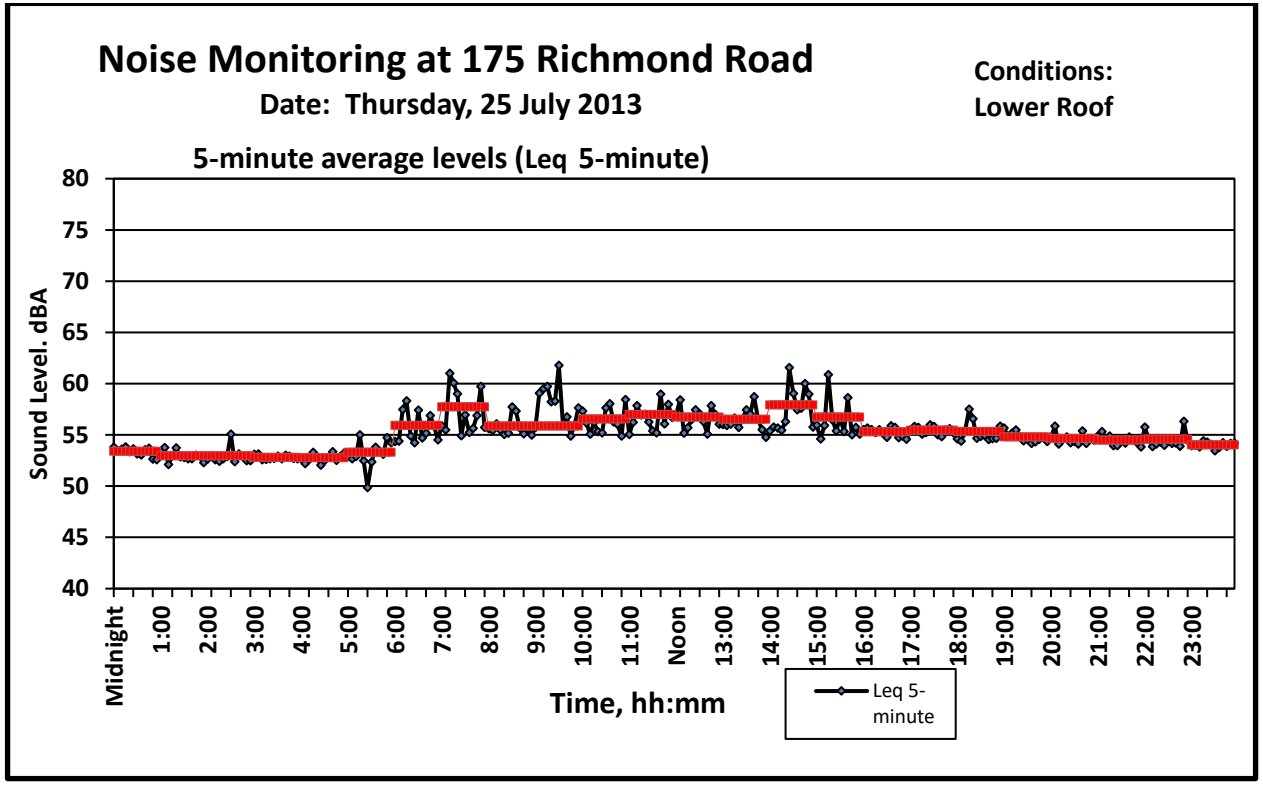


Figure 18: Noise Monitoring Results, Friday 26th July 2013

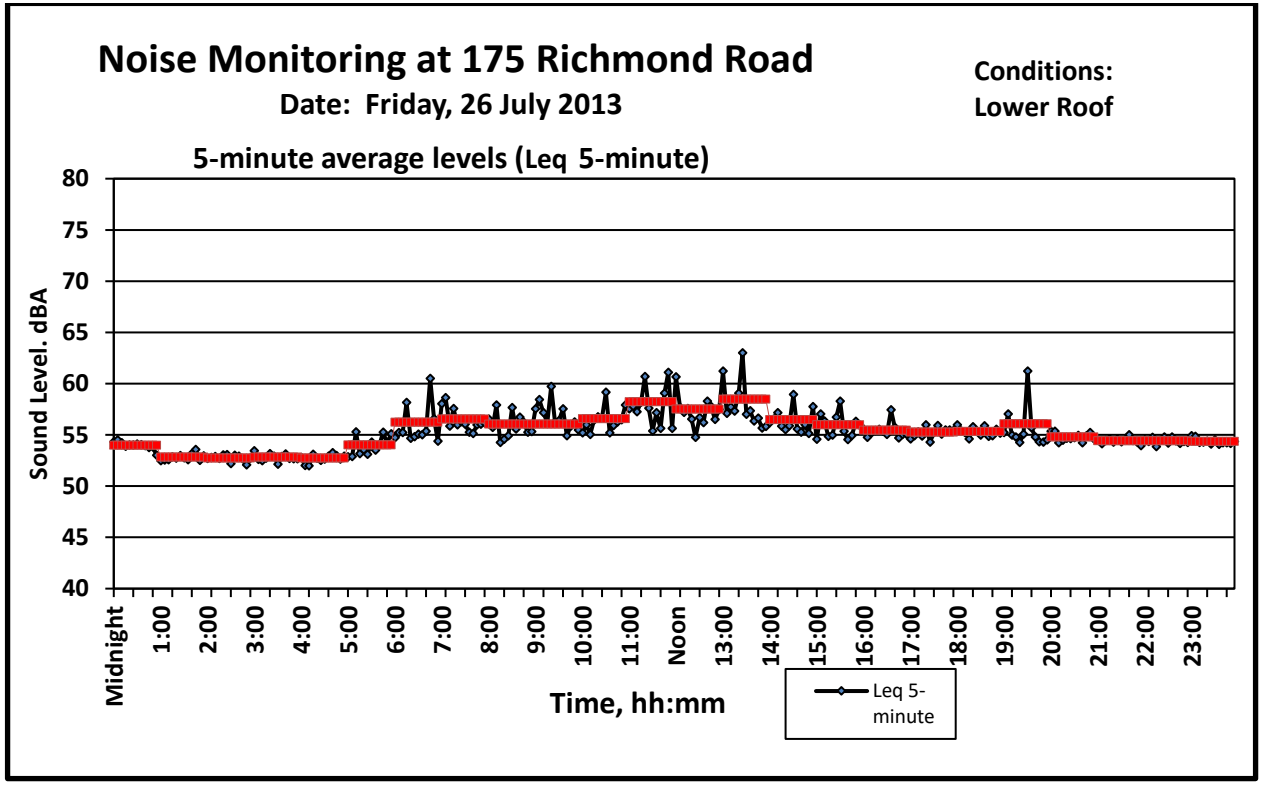


Figure 19: Noise Monitoring Results, Tuesday 30th July 2013

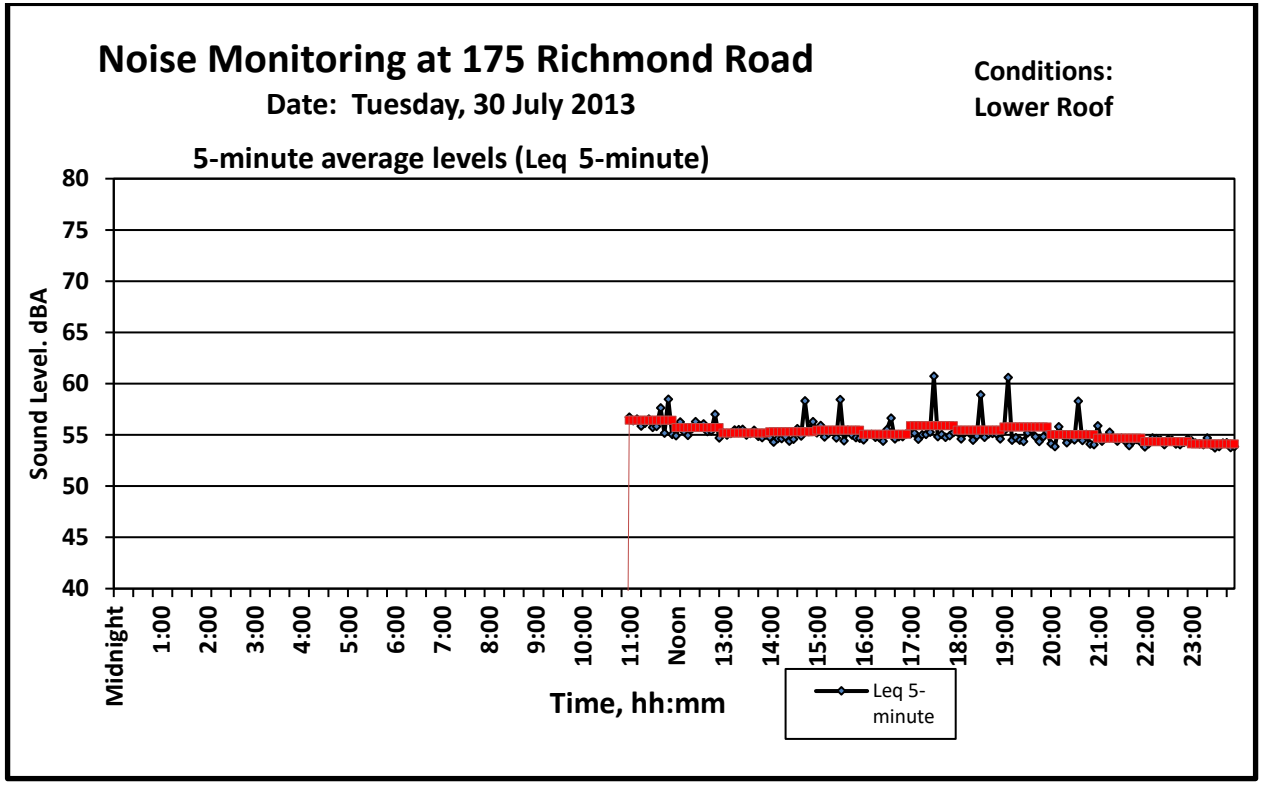
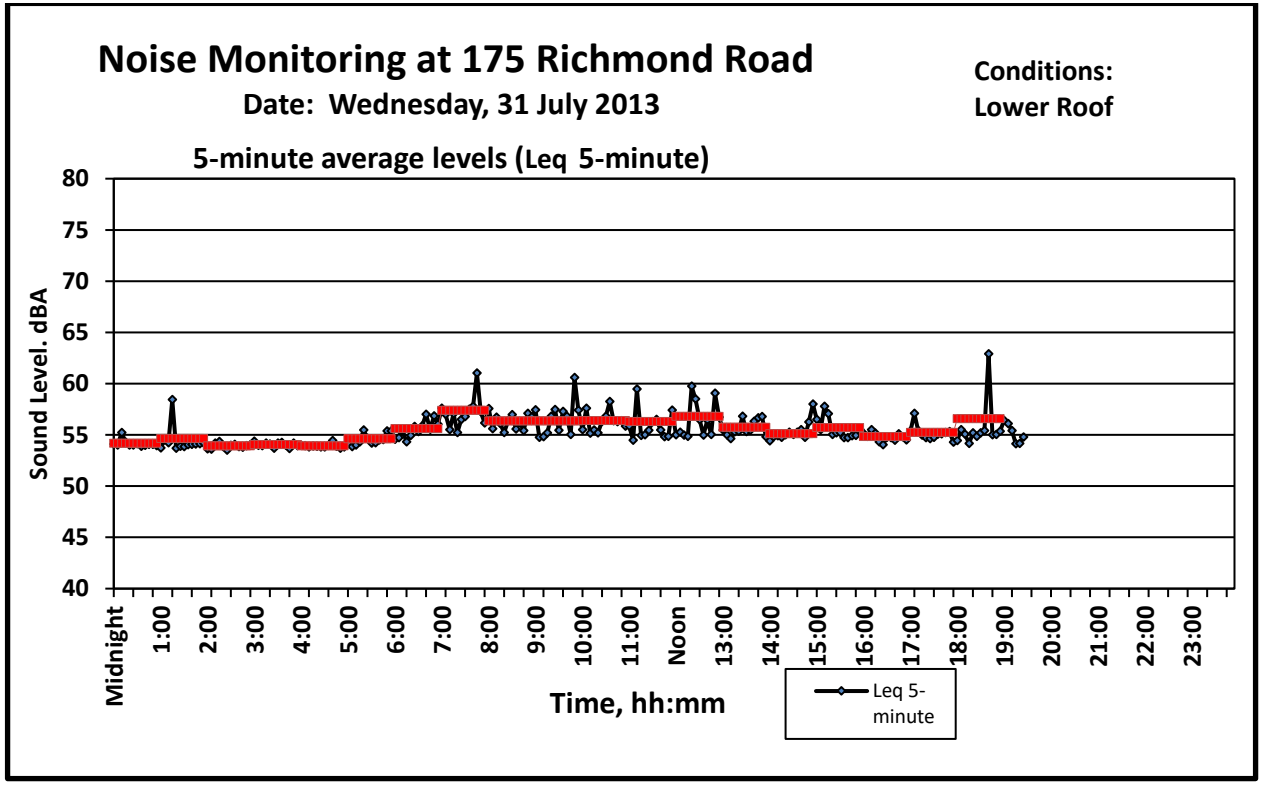


Figure 20: Noise Monitoring Results, Wednesday 31st July 2013



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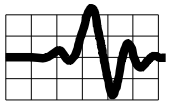


Table 1: Points of Reception for Assessment of Transportation Noise Impacts

Symbol	Description	Point of Reception Geometry with respect to Richmond Road				Use
		Floor	Height (m)	Horizontal Distance (m)	Angle of exposure (°)	
RT1-1	9-storey Bldg., facing Richmond	Gnd.	2.5	13.0	-90,+90	Commercial
RT1-2		2nd	5.5	13.0	-90,+90	Residential
RT1-6		6th	17.5	13.0	-90,+90	Residential
RT1-9		9th	26.5	13.0	-90,+90	Residential
RT2-1	9-storey Bldg., corner Richmond & Kirkwood	Gnd.	2.5	21.0	-45,+90	Commercial
RT2-2		2nd	5.5	21.0	-45,+90	Residential
RT2-6		6th	17.5	21.0	-45,+90	Residential
RT2-9		9th	26.5	21.0	-45,+90	Residential
RT3-1	9-storey Bldg., facing Kirkwood	Gnd.	2.5	43.0	-15,+90	Commercial
RT3-2		2nd	5.5	43.0	-15,+90	Residential
RT3-6		6th	17.5	43.0	-15,+90	Residential
RT3-9		9th	26.5	43.0	-15,+90	Residential
RT4-1	9-storey Bldg., facing west	Gnd.				Shielded, no windows
RT4-2		2nd	5.5	18.0	-90, -15	Residential
RT4-6		6th	17.5	18.0	-90, -15	Residential
RT4-9		9th	26.5	18.0	-90, -15	Residential
R5	Upper Court Yard	2nd	5.5	52.0	-90, -15	Outdoor Living Area
RT6-1	6-storey Bldg., facing Kirkwood	Gnd.	2.5	67.0	+10,+90	Residential
RT6-2		2nd	6.0	67.0	+10,+90	Residential
RT6-6		6th	18.0	67.0	+10,+90	Residential
RT7-1	6-storey Bldg., facing Kirkwood	Gnd.	2.5	93.0	-5,+60	Residential
RT7-2		2nd	6.0	93.0	-5,+60	Residential
RT7-6		6th	18.0	93.0	-5,+90	Residential

Table 1 (Continued): Points of Reception for Assessment of Transportation Noise Impacts

Symbol	Description	Point of Reception Geometry with respect to Richmond Road				Use
		Floor	Height (m)	Horizontal Distance (m)	Angle of exposure (°)	
RT8-1	6-storey Bldg., facing Kirkwood	Gnd.	2.5	118.0	-5,+35	Residential
RT8-2		2nd	6.0	118.0	-5,+35	Residential
RT8-6		6th	18.0	118.0	-5,+90	Residential
RT10-1	6-storey Bldg., facing west	Gnd.	2.5	71.0	-90, -15	Residential
RT10-2		2nd	6.0	71.0	-90, -15	Residential
RT10-6		6th	18.0	71.0	-90, -15	Residential
RT11	Terrace	2nd	6.0	121.0	-10,+35	Outdoor Living Area

Height measured from Richmond Road level to centre of plane of window or 1.5 m above Outdoor Living Area

Table 2: Future Traffic Volumes and Posted Speed Limits*

Road Segment	Input Data							Day Volumes, 7:00 - 23:00			Night Volumes, 23:00 - 7:00		
	Segment Type	AADT (24 hours)	Posted Speed kph	Split Day 7:00-23:00	Split Night 23:00-7:00	Medium Trucks %	Heavy Trucks %	Cars no.	Medium Trucks no.	Heavy Trucks no.	Cars no.	Medium Trucks no.	Heavy Trucks no.
Richmond Road, 2-UAU, 2-Lane Urban Arterial - Future Mature Traffic Volumes from City of Ottawa Guidelines													
Eastbound / Westbound	2-UAU	15,000	50	0.92	0.08	7	5	12144	966	690	1056	84	60

* Traffic and Road Parameters from City of Ottawa, "Environmental Noise Control Guideline" (ENCG), Part 4, Appendix B, January 2016.

Table 3: Calculated Transportation Noise Impacts and ENCG Requirements

Symbol	Description	Calculated Noise (dBA)		ENCG Requirements				
		Day 16-hr	Night 8-hr	OLA Mitigation[a]	Building Components[b]	Ventilation Requiements[c]	Warning Clauses[d]	Use
RT1-1	9-storey Bldg., facing Richmond	69.10	61.50	-	Table A1.3	Central A/C	Type D	Commercial
RT1-2		69.10	61.50	-	Table A1.2	Central A/C	Type D	Residential
RT1-6		69.10	61.50	-	Table A1.2	Central A/C	Type D	Residential
RT1-9		69.10	61.50	-	Table A1.2	Central A/C	Type D	Residential
RT2-1	9-storey Bldg., corner Richmond & Kirkwood	65.77	58.17	-	Table A1.3	Central A/C	Type D	Commercial
RT2-2		65.77	58.17	-	Table A1.2	Central A/C	Type D	Residential
RT2-6		65.77	58.17	-	Table A1.2	Central A/C	Type D	Residential
RT2-9		65.77	58.17	-	Table A1.2	Central A/C	Type D	Residential
RT3-1	9-storey Bldg., facing Kirkwood	61.57	53.97	-	OBC	Provision for Central A/C	Type C	Commercial
RT3-2		61.57	53.97	-	OBC	Provision for Central A/C	Type C	Residential
RT3-6		61.57	53.97	-	OBC	Provision for Central A/C	Type C	Residential
RT3-9		61.57	53.97	-	OBC	Provision for Central A/C	Type C	Residential
RT4-1	9-storey Bldg., facing west							Shielded, no windows
RT4-2		63.89	56.29	-	OBC	Provision for Central A/C	Type C	Residential
RT4-6		63.89	56.29	-	OBC	Provision for Central A/C	Type C	Residential
RT4-9		63.89	56.29	-	OBC	Provision for Central A/C	Type C	Residential
RT5	Upper Court Yard	49.00	n.a.	None required	-	-	Not required	Outdoor Living Area
RT6-1	6-storey Bldg., facing Kirkwood	58.46	50.86	-	OBC	Provision for Central A/C	Type C	Residential
RT6-2		58.46	50.86	-	OBC	Provision for Central A/C	Type C	Residential
RT6-6		58.46	50.86	-	OBC	Provision for Central A/C	Type C	Residential
RT7-1	6-storey Bldg., facing Kirkwood	56.13	50.86	-	OBC	Provision for Central A/C	Type C	Residential
RT7-2		56.13	50.86	-	OBC	Provision for Central A/C	Type C	Residential
RT7-6		57.78	50.18	-	OBC	Provision for Central A/C	Type C	Residential

Table 3 (continued): Calculated Transportation Noise Impacts and ENCG Requirements

Symbol	Description	Calculated Noise (dBA)		ENCG Requirements				
		Day 16-hr	Night 8-hr	OLA Mitigation[a]	Building Components[b]	Ventilation Requiements[c]	Warning Clauses[d]	Use
RT8-1	6-storey Bldg., facing Kirkwood	52.99	45.39	-	OBC	None required	None required	Residential
RT8-2		52.99	45.39	-	OBC	None required	None required	Residential
RT8-6		56.75	49.15	-	OBC	None required	None required	Residential
RT10-1	6-storey Bldg., facing west	57.93	50.33	-	OBC	None required	None required	Residential
RT10-2		57.93	50.33	-	OBC	None required	None required	Residential
RT10-6		57.93	50.33	-	OBC	None required	None required	Residential
RT11	Terrace	53.39	n.a.	None required	-	-	Not required	Outdoor Living Area

Notes on ENCG Requirements:

a. Mitigation required if daytime Outdoor Living Area (OLA) noise greater than 55 dBA, see Table A1.1.

b. Building Component Requirements, see Table A1.4:

b.1 If Daytime level less than or equal to 65 dBA, or, if Nighttime level less than or equal to 60 dBA, then building components are to be compliant with the Ontario Building Code (OBC).
b.2 If Daytime level greater than 65 dBA, or, if Nighttime level greater than 60 dBA, then Building components (walls, windows, etc.) must be designed to achieve the indoor sound level criteria in Tables A1.2 and A1.3.

c. Ventilation Requirements, see Table A1.6.

Central A/C means central air conditioning is to be installed to meet the requirements of NPC-300, Section C7.8.1.
Provision for Central A/C means the dwelling is to be designed with a provision for the installation of central air conditioning in the future, at the occupant's discretion.

d. City of Ottawa requirements for Warning Clause are given in the ENCG, Part 4, Appendix A. These generally follow the Types A, B, C, etc. as set out in NPC-300, see Table A1.7.

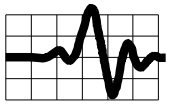


Table 4: Calculated Indoor Sound Levels at Critical Locations, Transportation Noise

POR Figure	Description	Exposure	Outdoor Sound Level from Rail Noise (dBA)	Calculated Indoor Sound Level from IBANA-Calc (dBA)	Noise Criteria (dBA)	Comments
RT1-1	9-storey Building, Ground Floor Facing Richmond Road					
Fig. 6	Commercial Unit, Daytime Floor Area 45 m^2, Window Area 24 m^2	Richmond Rd. -90, +90	69	44	45 Table A1.3	Meets indoor criteria with OBC façade elements
RT1-2,6,9	9-storey Building, Floors 2 - 9 Facing Richmond Road					
Fig. 7,8,9	Bedroom, night Floor Area 12 m^2, Window Area 7.2 m^2	Richmond Rd. -90, +90	61	31	40 Table A1.3	Meets indoor criteria with OBC façade elements
Fig. 7,8,9	Livingroom, daytime Floor Area 20 m^2, Window Area 9.6 m^2	Richmond Rd. -90, +90	69	39	45 Table A1.3	Meets indoor criteria with OBC façade elements

See Appendix 2 for IBANA-Calc Calculations

Appendix 1

Tables of Noise Criteria for Road and Rail Noise Sources and MECP Warning Clauses

For further information refer to:

City of Ottawa, Environmental Noise Control Guidelines[1] (ENCG)

MECP Document NPC-300: Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning, August 2013[2]

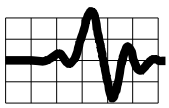


Table A1.1 Sound Level Criteria for Outdoor Living Areas Surface Transportation (Road and Rail)

Time Period	Leq (16 hr. (dBA))
16 hr., 07:00 – 23:00	55

Reference: ENCG[1] Table 2.2a, NPC-300 Table C-1

Table A1.2 Sound Level Limits for Indoor Living Areas, Road and Rail

Type of Space	Time Period	Required Leq (dBA)	
		Road	Rail
Living/dining areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	16 hr., 07:00 – 23:00	45	40
Living/dining areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	8 hr., 23:00 – 07:00	45	40
Sleeping Quarters	16 hr., 07:00 – 23:00	45	40
	8 hr., 23:00 – 07:00	40	35

Reference: ENCG[1] Table 2.2b, NPC-300 Table C-2.
Sound levels are calculated with the windows closed.

Table A1.3 Supplementary Sound Level Limits for Indoor Spaces, Road and Rail

Type of Space	Time Period	Required Leq (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	16 hr., 07:00 – 23:00	50	45
Theatres, places of worship, libraries, individual or semi-private offices, conference rooms, reading rooms, etc.	16 hr., 07:00 – 23:00	45	40
Sleeping quarters of hotels/motels	8 hr., 23:00 – 07:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	8 hr., 23:00 – 07:00	40	35

Reference: ENCG[1] Table 2.2c, NPC-300 Table C-9
Sound levels are calculated with the windows closed.

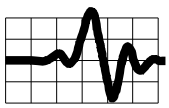


Table A1.4: Road and Rail Noise Building Component Requirements

Assessment Location & Time		Outdoor Leq (dBA)	Building Component Requirements
Outside Bedroom or Living/Dining Room Windows ♦ Day-time (07:00 –23:00)	Road	Less than or equal to 65	Building compliant with Ontario Building Code
		Greater than 65	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria in Table A1.2.
	Rail (Whistle Noise Included)	Less than or equal to 60	Building compliant with Ontario Building Code
		Greater than 60	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria in Table A1.2.
Outside Bedroom or Living/Dining Room Windows ♦ Night-time (23:00 –07:00)	Road	Less than or equal to 60	Building compliant with Ontario Building Code
		Greater than 60	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria in Table A1.2.
	Rail (Whistle Noise Included)	Less than or equal to 55	Building compliant with Ontario Building Code
		Greater than 55	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria in Table A1.2.

Reference: Summary of information from NPC-300, Sections C7.1, C7.2 and C7.3.

Note: For combinations of road and rail noise: 'The assessment of indoor sound levels and the resultant acoustical descriptors of the building components should be done separately for road and rail noise. The resultant acoustical descriptors should be subsequently combined to determine the required components.' NPC-300, Section C7.3.

Table A1.5: Façade Material Requirement for Rail Noise for the First Row of Dwellings next to Railway Tracks

Assessment Location	Distance to Tracks	Sound Level dBA (whistle noise included)	Façade Material Requirement
Outside Bedroom or Living/Dining Room Windows of a Nighttime Receptor ♦ 24 hr.	Less than 100 m	Leq $_{24\ hr}$ less than or equal to 60	No additional requirement
		Leq $_{24\ hr}$ greater than 60	Brick veneer or acoustically equivalent
	Greater than 100 m	Leq $_{24\ hr}$ less than or equal to 60	No additional requirement
		Leq $_{24\ hr}$ greater than 60	No additional requirement

Reference: NPC-300, Section C7.2.3

Table A1.6: Combination of Road and Rail Noise Day-time (07:00 – 23:00) & Night-time (23:00 – 07:00) Outdoor, Ventilation and Warning Clause Requirements

Assessment Location & Time	Outdoor Leq (dBA)	10.1. Ventilation Requirements	10.2. 10.3. Outdoor Control Measures	Warning Clauses (see Table A1.6)
Outdoor Living Area (OLA) ♦ Day-time (07:00 – 23:00)	Less than or equal to 55	N/A	None Required	Not Required
	Greater than 55 to less than 60	N/A	Noise control measures may be applied to reduce the sound level to 55 dBA.	Type A required if resultant Leq exceeds 55 dBA
	Greater than 60	N/A	Control measures (barriers) required to reduce the Leq to 55 dBA. Only in cases where noise control measures are not technically, economically and administratively feasible will a level above 55 dBA be acceptable.	Type B required if resultant Leq exceeds 55 dBA
Outside Bedroom or Living/Dining Room Windows ♦ Day-time (07:00 – 23:00)	Less than or equal to 55	None Required	N/A	Not Required
	Greater than 55 to less than or equal to 65	Provision for installation of central air-conditioning at occupant's discretion	N/A	Required Type C
	Greater than 65	Central air-conditioning required	N/A	Required Type D
Outside Bedroom or Living/Dining Room Windows ♦ Night-time (23:00 – 07:00)	Less than or equal to 50	None Required	N/A	Not Required
	Greater than 50 to less than or equal to 60	Provision for installation of central air-conditioning at occupant's discretion	N/A	Required Type C
	Greater than 60	Central air-conditioning required	N/A	Required Type D

Reference: Summary of information from NPC-300, Sections C7.1, C7.2 and C7.3.
Reference: For air-conditioning system requirements see NPC-300, Sections C7.8.1.
City of Ottawa requirements for Warning Clauses are set out in ENCG Part 4, Appendix A.
For assessment of rail noise in this table, whistle noise is not included.

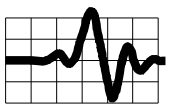
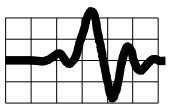


Table A1.7: MECP Warning Clauses (may be used individually or in combination)

Type	Warning Clause
Type A	"Purchasers/Tenants are advised that sound levels due to increasing road traffic (rail traffic) (air 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 Environment."
Type B	"Purchasers/Tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic (rail traffic) (air traffic) may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of Environment."
Type C	"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air-conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of Environment."
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 Environment."
Type E (for Stationary Sources)	"Purchasers/tenants are advised that due to the proximity of the adjacent industry (facility) (utility), sound levels from the industry (facility) (utility) may at times be audible."
Type F (For Class 4 Areas)	"Purchasers/tenants are advised that sound levels due to the adjacent industry (facility) (utility) are required to comply with sound level limits that are protective of indoor areas and are based on the assumption that windows and exterior doors are closed. This dwelling unit has been supplied with a ventilation/air conditioning system which allows windows and exterior doors to remain closed."

Reference: NPC-300, Sections C8.1

Note: City of Ottawa requirements for Warning Clauses are set out in ENCG Part 4, Appendix A.



Appendix 2

Traffic Noise Calculations

Contents:

- Selected STAMSON outputs
- Indoor sound level calculations using IBANA-Calc[6]

STAMSON 5.0 NORMAL REPORT Date: 19-03-2019 17:39:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: RT1_1.te Time Period: Day/Night 16/8 hours

Description: RT1-1, South Building, Ground Floor, on Richmond

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 15.00 / 15.00 m
Receiver height : 2.50 / 2.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

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

Segment Leq : 68.48 dBA

Total Leq All Segments: 68.48 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

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

Segment Leq : 60.88 dBA

Total Leq All Segments: 60.88 dBA

Results for 15 m
TOTAL Leq FROM ALL SOURCES (DAY): 68.48
(NIGHT): 60.88

Actual distance is 13 m, apply correction 10xLog10(15/13 = 0.62 dBA

Results for 15 m
TOTAL Leq FROM ALL SOURCES (DAY): 69.10
(NIGHT): 61.50

STAMSON 5.0 NORMAL REPORT Date: 19-03-2019 17:52:47
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: RT2_1.te Time Period: Day/Night 16/8 hours

Description: RT2-1, South Bldg, Gnd Flr, Cnr Richmond/Kirkwood

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -45.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 21.00 / 21.00 m
Receiver height : 2.50 / 2.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

ROAD (0.00 + 65.77 + 0.00) = 65.77 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.00 68.48 0.00 -1.46 -1.25 0.00 0.00 0.00 65.77

Segment Leq : 65.77 dBA

Total Leq All Segments: 65.77 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

ROAD (0.00 + 58.17 + 0.00) = 58.17 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.00 60.88 0.00 -1.46 -1.25 0.00 0.00 0.00 58.17

Segment Leq : 58.17 dBA

Total Leq All Segments: 58.17 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.77
(NIGHT): 58.17

STAMSON 5.0 NORMAL REPORT Date: 19-03-2019 18:01:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: RT2_6.te Time Period: Day/Night 16/8 hours

Description: RT2-6, South Bldg, 6th Flr, Cnr Richmond/Kirkwood

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -45.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 21.00 / 21.00 m
Receiver height : 17.50 / 17.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

ROAD (0.00 + 65.77 + 0.00) = 65.77 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.00 68.48 0.00 -1.46 -1.25 0.00 0.00 0.00 65.77

Segment Leq : 65.77 dBA

Total Leq All Segments: 65.77 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

ROAD (0.00 + 58.17 + 0.00) = 58.17 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.00 60.88 0.00 -1.46 -1.25 0.00 0.00 0.00 58.17

Segment Leq : 58.17 dBA

Total Leq All Segments: 58.17 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.77 (NIGHT): 58.17

TAMSON 5.0 NORMAL REPORT Date: 20-03-2019 14:49:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: RT4_9.te Time Period: Day/Night 16/8 hours

Description: RT4-9, South Bldg, 9th Flr, facing west

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -90.00 deg -15.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 18.00 / 18.00 m
Receiver height : 26.50 / 26.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

ROAD (0.00 + 63.89 + 0.00) = 63.89 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -15 0.00 68.48 0.00 -0.79 -3.80 0.00 0.00 0.00 63.89

Segment Leq : 63.89 dBA

Total Leq All Segments: 63.89 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

ROAD (0.00 + 56.29 + 0.00) = 56.29 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -15 0.00 60.88 0.00 -0.79 -3.80 0.00 0.00 0.00 56.29

Segment Leq : 56.29 dBA

Total Leq All Segments: 56.29 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.89 (NIGHT): 56.29

STAMSON 5.0 NORMAL REPORT Date: 20-03-2019 15:16:39
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: RT5.te Time Period: Day/Night 16/8 hours

Description: RT5, OLA South Bldg, Upprt Court Yard, Barrier provided by 5 m building at 177 Richmond Road

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -90.00 deg -15.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 52.00 / 52.00 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -15.00 deg
Barrier height : 1.00 m
Elevation : 4.00 m
Barrier receiver distance : 41.00 / 41.00 m
Source elevation : 0.00 m
Receiver elevation : 4.00 m
Barrier elevation : 4.00 m
Reference angle : 0.00

Results segment # 1: Richmond Rd. (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 ! 1.50 ! -1.66 ! 2.34

ROAD (0.00 + 49.00 + 0.00) = 49.00 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -15 0.00 68.48 0.00 -5.40 -3.80 0.00 0.00 -10.27 49.00

Segment Leq : 49.00 dBA

Total Leq All Segments: 49.00 dBA

Results segment # 1: Richmond Rd. (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 ! 1.50 ! -1.66 ! 2.34

ROAD (0.00 + 41.41 + 0.00) = 41.41 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq

---

-90 -15 0.00 60.88 0.00 -5.40 -3.80 0.00 0.00 -10.27 41.41

Segment Leq : 41.41 dBA

Total Leq All Segments: 41.41 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 49.00
(NIGHT): 41.41

STAMSON 5.0 NORMAL REPORT Date: 20-03-2019 15:36:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rt7_6.te Time Period: Day/Night 16/8 hours

Description: RT7-6, North Bldg, 6th Flr, facing Kirkwood

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -5.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 93.00 / 93.00 m
Receiver height : 18.00 / 18.00 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

ROAD (0.00 + 57.78 + 0.00) = 57.78 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-5 90 0.00 68.48 0.00 -7.92 -2.78 0.00 0.00 0.00 57.78

Segment Leq : 57.78 dBA

Total Leq All Segments: 57.78 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

ROAD (0.00 + 50.18 + 0.00) = 50.18 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-5 90 0.00 60.88 0.00 -7.92 -2.78 0.00 0.00 0.00 50.18

Segment Leq : 50.18 dBA

Total Leq All Segments: 50.18 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 57.78 (NIGHT): 50.18

STAMSON 5.0 NORMAL REPORT Date: 20-03-2019 15:53:33
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rt11.te Time Period: Day/Night 16/8 hours

Description: RT11, OLA North Bldg, 2nd Flr, facing Kirkwood

Road data, segment # 1: Richmond Rd. (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)

Data for Segment # 1: Richmond Rd. (day/night)

Angle1 Angle2 : -10.00 deg 35.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 121.00 / 121.00 m
Receiver height : 6.00 / 6.00 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Richmond Rd. (day)

Source height = 1.50 m

ROAD (0.00 + 53.39 + 0.00) = 53.39 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-10	35	0.00	68.48	0.00	-9.07	-6.02	0.00	0.00	0.00	53.39

Segment Leq : 53.39 dBA

Total Leq All Segments: 53.39 dBA

Results segment # 1: Richmond Rd. (night)

Source height = 1.50 m

ROAD (0.00 + 45.80 + 0.00) = 45.80 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-10	35	0.00	60.88	0.00	-9.07	-6.02	0.00	0.00	0.00	45.80

Segment Leq : 45.80 dBA

Total Leq All Segments: 45.80 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 53.39
(NIGHT): 45.80

IBANA-calc Results

RT1-1, Commercial Suite, Facing Richmond

Project: 175 Richmond
ProjectID: 9_Storey
Date:2019-03-25
Outdoor level: Leq 69

Source Spectrum details:

100% ISO 717 Road Traffic
Corrections:

Receiving room:

Floor Area: 45.00 ft²
Absorbtion: 80% of floor area

Construction Description:

Element 1: GL3_AIR13_GL3

Construction Type: Glazing
Area: 24.00 m²
Test ID: CMHC177.961.3
Test Date: 1996-11-01

Thermopane only

Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Indoor Sound Level(dB)
50	57.2
63	54.2
80	43.5
100	39.1
125	41.1
160	40.4
200	40.9
250	45.6
315	44.6
400	40.8
500	37.2
630	34.9
800	32.8
1000	30.0
1250	25.4
1600	19.0
2000	15.8
2500	11.7
3150	12.7
4000	22.8
5000	19.1

A-Weighted Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	A-Wtd Sound Level(dBA)
50	27.0
63	28.0
80	21.0
100	20.0
125	25.0
160	27.0
200	30.0
250	37.0
315	38.0
400	36.0
500	34.0

630	33.0
800	32.0
1000	30.0
1250	26.0
1600	20.0
2000	17.0
2500	13.0
3150	13.9
4000	23.8
5000	19.6

Transmission Loss vs. Frequency - Spectrum Values:

Frequency(Hz)	Transmission Loss(dB)
50	15.0
63	16.0
80	25.0
100	27.0
125	22.0
160	22.0
200	21.0
250	15.0
315	15.0
400	18.0
500	21.0
630	23.0
800	26.0
1000	29.0
1250	32.0
1600	37.0
2000	39.0
2500	41.0
3150	38.0
4000	27.0
5000	29.0

Source Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Source Sound Level(dB)
50	74.0
63	72.0
80	70.3
100	67.9
125	64.9
160	64.2
200	63.7
250	62.4
315	61.4
400	60.6
500	60.0
630	59.7
800	60.6
1000	60.8
1250	59.2
1600	57.8
2000	56.6
2500	54.5
3150	52.6
4000	51.8
5000	50.3

Single Number Ratings

Outdoor Sound Level:	**69 dBA**
Indoor Sound Level:	**44 dBA**
A-wtd Level Reduction:	**25 dB**
OITC Rating:	**22 dB**

IBANA-calc Results

RT1-2, Residential Bedroom, Facing Richmond

Project: 175 Richmond
ProjectID: 9_Storey
Date:2019-03-25
Outdoor level: Leq 61

Source Spectrum details:

100% ISO 717 Road Traffic
Corrections:

Receiving room:

Floor Area: 12.00 ft²
Absorbtion: 120% of floor area

Construction Description:

Element 1: GL3_AIR13_GL6

Construction Type: Glazing
Area: 7.20 m²
Test ID: CMHC177.961.5
Test Date: 1996-11-01

Thermopane only

Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Indoor Sound Level(dB)
50	48.0
63	45.0
80	37.3
100	29.9
125	31.9
160	30.2
200	31.7
250	34.4
315	27.4
400	26.6
500	22.0
630	19.7
800	17.6
1000	14.8
1250	10.2
1600	6.8
2000	6.6
2500	4.5
3150	0.4
4000	0.5
5000	8.8

A-Weighted Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	A-Wtd Sound Level(dBA)
50	17.8
63	18.8
80	14.8
100	10.8
125	15.8
160	16.8
200	20.8
250	25.8
315	20.8
400	21.8
500	18.8

630	17.8
800	16.8
1000	14.8
1250	10.8
1600	7.8
2000	7.8
2500	5.8
3150	1.6
4000	1.5
5000	9.3

Transmission Loss vs. Frequency - Spectrum Values:

Frequency(Hz)	Transmission Loss(dB)
50	15.0
63	16.0
80	22.0
100	27.0
125	22.0
160	23.0
200	21.0
250	17.0
315	23.0
400	23.0
500	27.0
630	29.0
800	32.0
1000	35.0
1250	38.0
1600	40.0
2000	39.0
2500	39.0
3150	41.0
4000	40.0
5000	30.0

Source Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Source Sound Level(dB)
50	66.0
63	64.0
80	62.3
100	59.9
125	56.9
160	56.2
200	55.7
250	54.4
315	53.4
400	52.6
500	52.0
630	51.7
800	52.6
1000	52.8
1250	51.2
1600	49.8
2000	48.6
2500	46.5
3150	44.6
4000	43.8
5000	42.3

Single Number Ratings

Outdoor Sound Level:	**61 dBA**
Indoor Sound Level:	**31 dBA**
A-wtd Level Reduction:	**30 dB**
OITC Rating:	**26 dB**

IBANA-calc Results

RT1-2, Residential Livingroom, Facing Richmond

Project: 175 Richmond
ProjectID: 9_Storey
Date:2019-03-25
Outdoor level: Leq 69

Source Spectrum details:

100% ISO 717 Road Traffic
Corrections:

Receiving room:

Floor Area: 20.00 ft²
Absorbtion: 100% of floor area

Construction Description:

Element 1: GL3_AIR13_GL6

Construction Type: Glazing
Area: 9.60 m²
Test ID: CMHC177.961.5
Test Date: 1996-11-01

Thermopane only

Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Indoor Sound Level(dB)
50	55.8
63	52.8
80	45.1
100	37.7
125	39.7
160	38.0
200	39.5
250	42.2
315	35.2
400	34.4
500	29.8
630	27.5
800	25.4
1000	22.6
1250	18.0
1600	14.6
2000	14.4
2500	12.3
3150	8.3
4000	8.3
5000	16.7

A-Weighted Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	A-Wtd Sound Level(dBA)
50	25.6
63	26.6
80	22.6
100	18.6
125	23.6
160	24.6
200	28.6
250	33.6
315	28.6
400	29.6
500	26.6

630	25.6
800	24.6
1000	22.6
1250	18.6
1600	15.6
2000	15.6
2500	13.6
3150	9.5
4000	9.3
5000	17.2

Transmission Loss vs. Frequency - Spectrum Values:

Frequency(Hz)	Transmission Loss(dB)
50	15.0
63	16.0
80	22.0
100	27.0
125	22.0
160	23.0
200	21.0
250	17.0
315	23.0
400	23.0
500	27.0
630	29.0
800	32.0
1000	35.0
1250	38.0
1600	40.0
2000	39.0
2500	39.0
3150	41.0
4000	40.0
5000	30.0

Source Sound Level vs. Frequency - Spectrum Values:

Frequency(Hz)	Source Sound Level(dB)
50	74.0
63	72.0
80	70.3
100	67.9
125	64.9
160	64.2
200	63.7
250	62.4
315	61.4
400	60.6
500	60.0
630	59.7
800	60.6
1000	60.8
1250	59.2
1600	57.8
2000	56.6
2500	54.5
3150	52.6
4000	51.8
5000	50.3

Single Number Ratings

Outdoor Sound Level:	**69 dBA**
Indoor Sound Level:	**39 dBA**
A-wtd Level Reduction:	**30 dB**
OITC Rating:	**26 dB**

Brüel & Kjær
North America Inc.
The Brüel & Kjær Calibration Laboratory
2815 Colonnades Court
Norcross, GA 30071-1588
Telephone: 770/209-6907
Fax: 770/447-4033
Web site address: http://www.bkhome.com

ACCREDITED
Calibration Certificate Number 1568.01

CERTIFICATE OF CALIBRATION

Certificate No: 1-327894287-801

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	Serial No: 2645066
Microphone:	Brüel & Kjær	4189	Serial No: 2638609
Preamplifier:	Brüel & Kjær	ZC-0032	Serial No: 9181
Supplied Calibrator:	Brüel & Kjær	4231	Serial No: 27030374
Software version:	BZ7222 Version 3.4.3	Instruction manual:	BE1713-23

CLIENT:

Hugh Williamson Associates
Unit 10, 55 Whitemarl Drive
Ottawa, ON K1L 8J9

CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 ± 3°C
Environment conditions See actual values in Environmental Condition sections

SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Brüel and Kjær Calibration Laboratory-Norcross, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

Brüel and Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 4.7 - DB: 4.70 Test Collection 2250-4189.

RESULTS:

As Received Condition	As Received Data	Final Data
_X_ Received in good condition	_X_ Within acceptance criteria	_X_ Within acceptance criteria
___ Damaged - See attached report	___ Outside acceptance criteria	___ Limited test - See attached details
	___ Inoperative	
	___ Data not taken	

Date of Calibration: 06 Dec. 2012

Certificate issued: 07 Dec. 2012

Debra Wilson

Calibration Technician

John Atalik

Quality Representative

Brüel & Kjær
North America Inc.

The Bruel and Kjaer Calibration Laboratory
2815-A Colonnades Court
Norcross, GA 30071-1588
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.bkhome.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION No.: 1-327894287-401

CALIBRATION OF:

Microphone: Brüel & Kjær Type 4189 Serial No. 2638609

CUSTOMER:

Hugh Williamson Associates Inc.
Unit 10, 55 Whitemarl Drive
Ottawa, ON K1L 8J9

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	25.3	°C
	Air pressure:	97.151	kPa
	Relative Humidity:	33	%RH
Applied polarization voltage:	0 Vdc		

SPECIFICATIONS:

This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Bruel and Kjaer Calibration Laboratory-Norcross, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

The calibrations were performed according to the 9721 System procedure: 4189-S251-FF-01

RESULTS:

[X] "As Received" Data: Within Acceptance Criteria
[ ] "As Received" Data: Outside Acceptance Criteria
[X] "Final" Data : Within Acceptance Criteria
[ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor k =2 providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: 10 December 2012

Certificate issued: 11 December 2012

John Kimple
Calibration Technician

Quality Representative

Brüel & Kjær
North America Inc.

The Bruel and Kjaer Calibration Laboratory
2815-A Colonnades Court
Norcross, GA 30071-1588
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.bkhome.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION

No.: 1-327894287-701

CALIBRATION OF:

Calibrator:	Brüel & Kjær	Type 4231 IEC Class: 1		Serial No.:	2730374

CUSTOMER:

Hugh Williamson Associates Inc.
Unit 10, 55 Whitemarl Drive
Ottawa, ON K1L 8J9

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23	°C
	Air pressure:	97.625	kPa
	Relative Humidity:	35	%RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Bruel and Kjaer Calibration Laboratory-Norcross, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 using calibration procedure 4231 Complete

RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration:18 December 2012

Certificate issued:18 December 2012

William Shipman

Calibration Technician

Quality Representative

RESUMÉ: Dr. HUGH WILLIAMSON, P.Eng.

QUALIFICATIONS:

Ph.D. Mechanical Engineering, University of New South Wales, 1972

B.Sc. Mechanical Engineering, (with Distinction), University of Alberta, 1967

Licensed Professional Engineer, Professional Engineers Ontario

Member, Canadian Acoustical Association

Member, American Society of Heating, Refrigeration and Air-conditioning Engineers

KEY COMPETENCIES:

- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning.
- Design and testing for speech privacy and for speech secure spaces.
- Noise impact assessments for development approvals.
- Transportation noise and vibration assessments.

PROFESSIONAL EXPERIENCE:

Hugh Williamson is a professional engineer with many years of experience in the measurement, analysis and control of noise and vibration. Hugh Williamson Associates was incorporated in 1997 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to establishing Hugh Williamson Associates, his career included extensive periods in industry as well as university level research and teaching. He is a former Director of the Acoustics and Vibration Unit at the Australian Defence Force Academy. He has published over 50 engineering and scientific papers and has been an invited speaker on noise and vibration at national and international conferences. He has more than 20 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson Associates provides consulting services to large and small clients including: National Research Council, City of Ottawa, Public Works Government Services Canada, J. L. Richards & Associates, Miller Group, R. W. Tomlinson Limited, Atkinson Schroeter Design Group, and, Bryden Martel Architects.

Postal Address: PO Box 74056, RPO Beechwood, Ottawa, Ontario, K1M 2H9, Canada
Phone/Fax: (613) 747 0983, Email: info@hwacoustics.ca, http://www.hwacoustics.ca

RESUMÉ: MICHAEL WELLS

QUALIFICATIONS:

Registered Architect of NSW, Registration Number: 8111

B. Architecture (Hons), University of Sydney, 2002

B.Sc. Architecture, University of Sydney, 1999

Member, Canadian Acoustical Association

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning.
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.
- Design services including sketch design, design development (development / permit applications), contract documents, tendering and contract administration.

PROFESSIONAL EXPERIENCE:

Michael Wells is a professional Architect registered in NSW with many years of experience in the Architectural and Construction industries. With key competencies in measurement, analysis and control of noise and vibration, Michael Wells joined Hugh Williamson Associates in 2012 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to joining Hugh Williamson Associates, his career includes the founding of Michael Wells Architect in Sydney Australia which specialized in the design of institutional, commercial and residential projects. He is a Director of Architectural Workshops Australia and Vision Blue Pty Ltd. He has more than 10 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson Associates provides consulting services to large and small clients including: National Research Council, National Capital Commission, J. L. Richards & Associates, Barry Padolsky Associates, HOK Urbana Architects, Genivar, Nasittuq Corporation, PWGSC, R. W. Tomlinson, Geo. Tackaberry Construction and Miller Paving.

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