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Moriyama & Teshima Architects – SFPA
Traffic Noise Impact and Mechanical Noise Control to the Exterior of the Building

Dear David,

This report assesses two items; 1) The environmental noise impact from the mechanical equipment located at the new proposed City of Ottawa building located at 3505 Prince of Wales Drive in Ottawa, Ontario to other noise sensitive areas in the surrounding area to meet the City of Ottawa Noise Bylaw limit of 50 dBA during the day and the City of Ottawa Environmental Noise Control Guidelines (ENCG) limit of 45 dBA at night. 2) The traffic noise impact on the exterior envelope of the building from nearby traffic noise sources in order to determine whether the current exterior assemblies for walls and windows are acceptable to meet ENCG maximum road noise levels for indoor areas and propose recommendations to improve the sound isolation if necessary. Both of these analyses are being completed at an early stage of design and therefore certain assumptions regarding equipment and partition assemblies must be made and may require updates at a later stage of design.

This report is based on:

- Architectural “Issued for 33%” Drawings received May 3, 2019
- Mechanical “Issued for 33%” Drawings received May 3, 2019
- Design Development Report, Mechanical and Electrical, 33% Design Development Submission

For the environmental noise assessment, we have constructed a 3D model to predict sound pressure levels at the locations of nearby residences resulting from the mechanical equipment at the proposed new building. As there not yet final selections for mechanical equipment, sound data is not fully available and assumptions have been made regarding noise emissions from mechanical and electrical equipment. We have used a preliminary selection of the rooftop equipment to determine the noise impact on the surrounding properties

For the traffic noise assessment, the noise impact from Prince of Wales Drive was calculated. All other road noise sources are outside of the 100m limit for collectors and arterials and, there is no rail or aircraft noise to be considered as per the City of Ottawa ENCG. Using Cadna/A modeling software, we have calculated the noise impact, and performed a building component assessment using the AIF method. It has been determined that no changes are required to either the exterior wall or window assemblies proposed in the architectural drawings due to noise from traffic from nearby roads.

Contents

1.0 Introduction & Site Description

State of the Art Acoustik Inc. has been commissioned to complete a noise study, including both traffic noise impact on the building and stationary noise impact from the building itself for the new City of Ottawa building to be located at 3505 Prince of Wales Drive, Ottawa, Ontario. The building is composed of two main parts; the north end of the building is to be two storeys (~15.4m height) and the southern portion of the building is to be three storeys (~18m height). It is located in a primarily residential area along the Rideau River with residences and a senior's home surrounding the property. We have analyzed the noise from the equipment at the closest points of reception in order to determine the worst case scenario.

The traffic noise impact onto the new building is from Prince of Wales Drive, approximately 45 m to the east to the closest point of the building. We have analyzed the traffic noise impact onto the new building and have reviewed the proposed wall and glazing assemblies to be used for this building.

1.1 Scaled Area Location Plan

Figure 1.1 and 1.2 below shows the location of the new City of Ottawa building, including the surrounding area and site plan. Adjacent noise sensitive buildings are residential houses, senior's home and houses across the Rideau River.

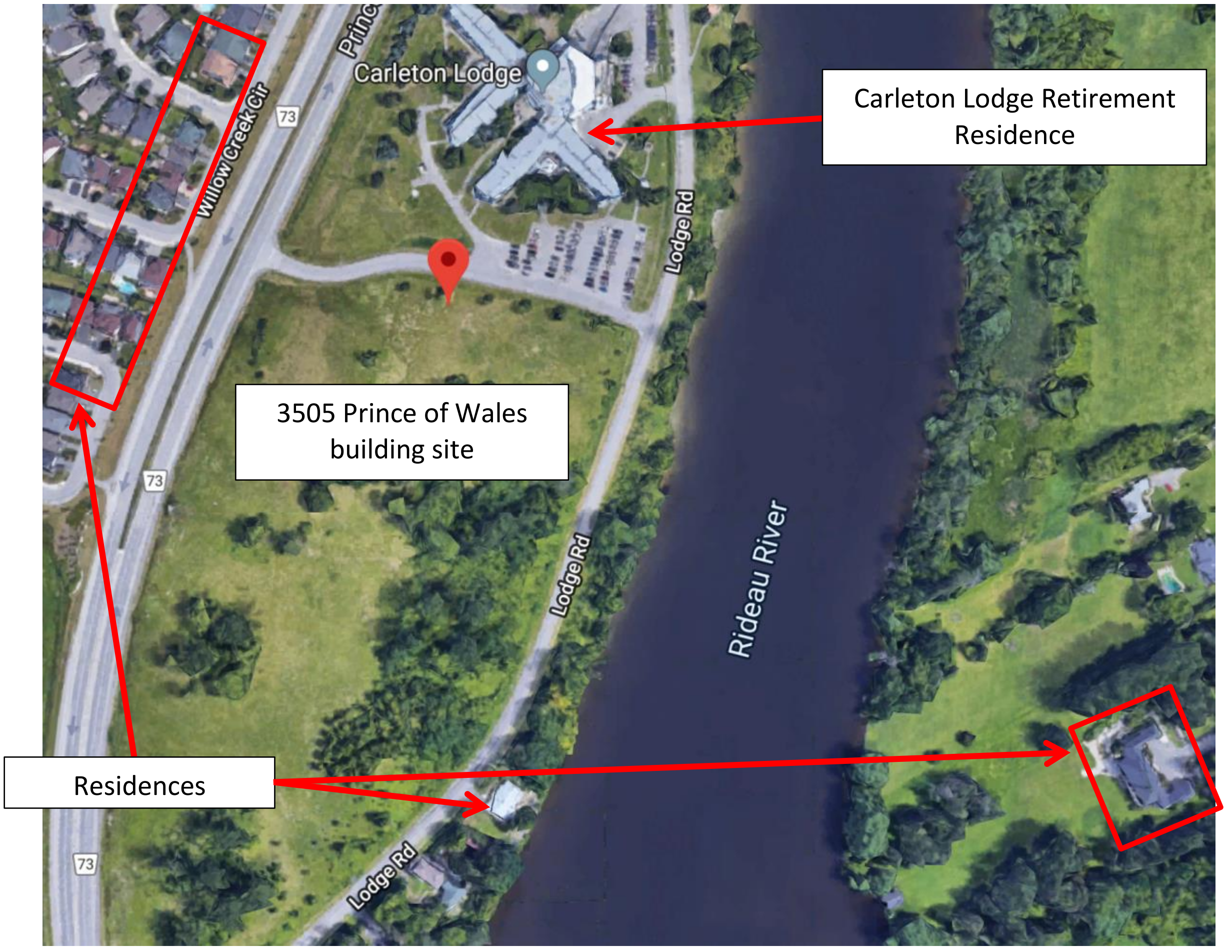

Figure 1.1 – Location of new City of Ottawa building and surrounding area.

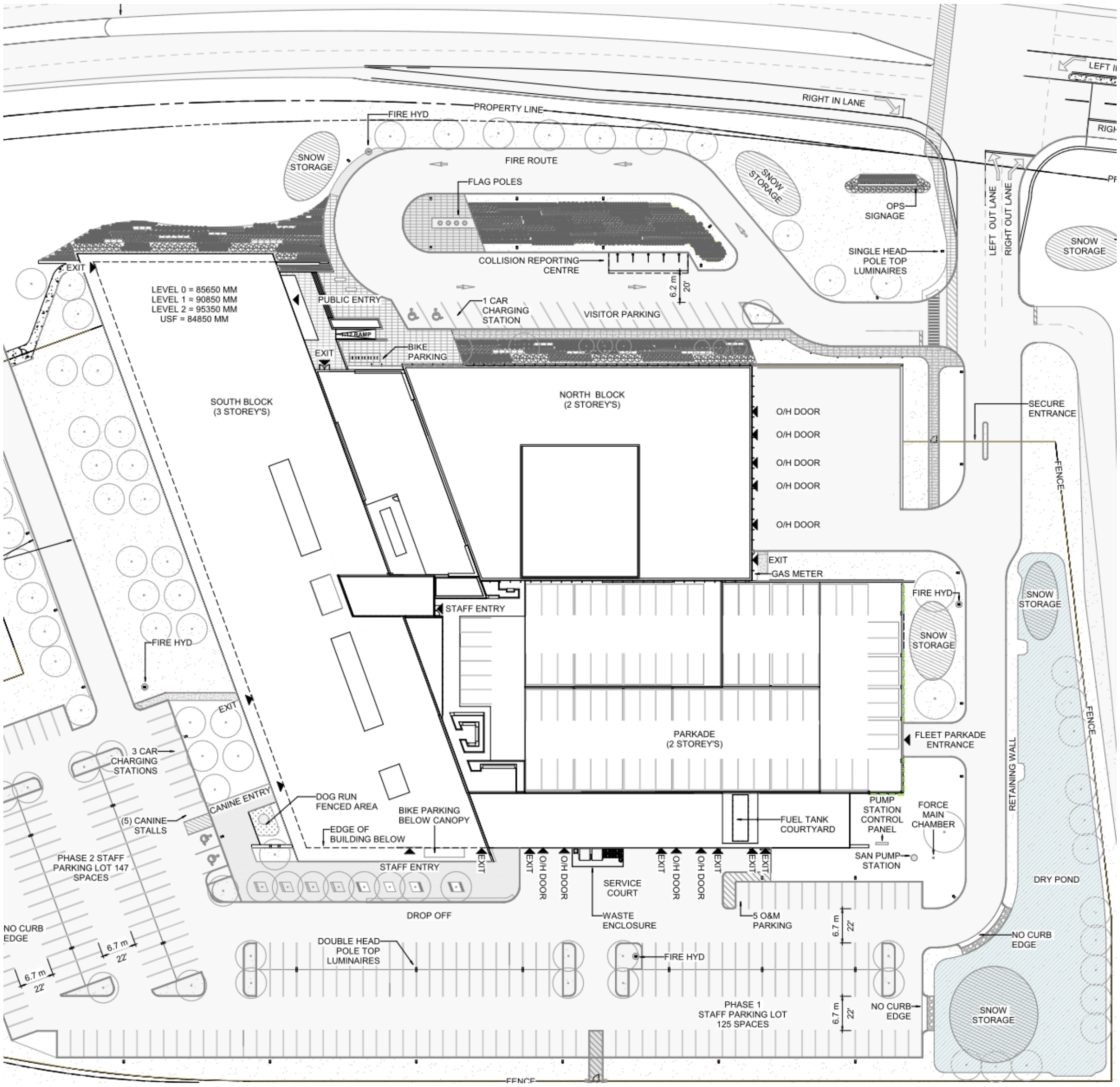

Figure 1.2 – Site plan of new City of Ottawa building.

Environmental Noise Study
3505 Prince of Wales Drive
Ottawa, Ontario

Prepared for:
Moriyama & Teshima Architects

Prepared by:
Patrick Richard

May 10, 2019

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2.0 Environmental Noise Assessment

In this section we provide our environmental noise assessment. We detail the noise limits, noise sources, points of reception used in our modeling, modeling and calculation procedures and predicted noise levels.

2.1 City of Ottawa Noise Bylaw & Enviornmental Noise Guidelines for Environmental Noise

The City of Ottawa Noise Bylaw and ENCG have the same limit for daytime permissible Sound Pressure Level (SPL) at a noise sensitive location in a Class 1 area of 50 dBA. The Bylaw is to be used in conjunction with the City of Ottawa Environmental Noise Control Guidelines (ENCG), which are based on the Ministry of Environment NPC-300 Noise Control Guidelines. The City of Ottawa ENCG requires a 45 dBA SPL at night or ambient noise, whichever is higher. Therefore, when analyzing equipment for environmental noise studies, all non-emergency equipment in operation during the day and at night must meet the ENCG limit of 50 dBA during the day and 45 dBA at night. Both a nighttime and daytime analysis has been undertaken as it is anticipated that there will be mechanical equipment in operation overnight.

There is also new emergency equipment for this development (i.e. generator) and therefore emergency equipment is included in this analysis as well. According to MOE NPC-300, emergency equipment is to be analyzed separately from non-emergency equipment and can be up to 5 dB greater than the overall sound level limit when operating in non-emergency situations, such as maintenance or testing. Therefore, this limit is 55 dBA for testing taking place during the daytime. We have previously discussed this with a City of Ottawa noise specialist, and the MOE NPC-300 approach can be undertaken to meet City of Ottawa noise limits as well. The points of receptions are chosen at the nearest residential homes. This will allow us to calculate the largest noise impact and mitigate it accordingly.

2.2 Significant Noise Sources

There are many significant noise sources within the new building, most of which are contained in mechanical rooms throughout the building. However there are multiple supply and exhaust louvres serving these mechanical rooms and mechanical units directly as well two generators located in a generator room and a cooling tower located on the roof of the second storey. As the design is still in preliminary stages, there is very little information available in terms of precise equipment location, equipment selection and sound data. We have used the mechanical plans to determine approximate locations of the equipment, however once more finalized selections are available both sound data and mitigation measures should be revisited to ensure compliance.

Table 2.1 provides the octave band sound power levels for representative sound power levels (SWL) for the equipment being analyzed. We have gathered this list of sound power levels from previous projects where we have measured at the outlets or inlets of louvres serving mechanical rooms. We have also included sound data from a similarly sized Tower Tech cooling tower. We have received the sound data for the generators and have used this sound data to predict the noise levels at the inlet(s) and the outlet(s) of the generator room as well as the noise from the gas exhaust. These sound power levels were then input into our acoustic model for analysis but again should be revised once the remaining equipment is finalized. The location of the new equipment is shown on the next page in Figure 2.1.

Noise Source	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	dBA
Cooling Tower*	99	112	110	105	102	96	91	81	107
Generators Outlet**	92	100	100	101	97	91	85	79	102
Generator Inlet**	94	99	101	102	100	99	97	92	106
Generator Gas Exhaust	96	119	121	126	130	128	128	126	135
Intake Louvres***	82	80	82	80	74	70	63	56	80
Exhaust Louvres***	81	82	85	79	73	67	59	49	81

Table 2.1 – Octave band sound power levels of noise sources

*Cooling tower data was taken from a similarly sized TowerTech cooling tower model TTXL with four fans and 30 HP similar to the current selection.

**Sound levels from the generator data sheet received from the electrical engineer and were used as a basis for modelling the inlet and outlet of the generator, along with measurements we have previously taken at the inlet and outlet louvres of similarly sized generators.

***Intake and exhaust louvre sound data is based off of measurements we have taken of intake and exhaust louvres for mechanical rooms. This data is representative at the moment and will be updated to be more precise once selections are finalized.

2.3 Equipment Site Plan & Operation Hours

The new noise sources which are being considered for this assessment of the mechanical noise to nearby residences are given in Table 2.1. The generators are located in a generator room which exhausts to the north. The generator intake is to be located within the fuel tank courtyard, which is open to the surrounding environment. The cooling tower is located on the second floor roof, in the mechanical penthouse courtyard and is surrounded on all sides but is open to above. We have currently modelled three mechanical louvres; one intake and exhaust louvre to the penthouse mechanical room and one intake louvre on the roof of the penthouse mechanical room which serves the ground floor mechanical room. The mechanical exhaust louvre serving the ground floor mechanical room exhausts to the parking garage and is not included in our calculations. The locations of the new equipment are shown in Figure 2.1.

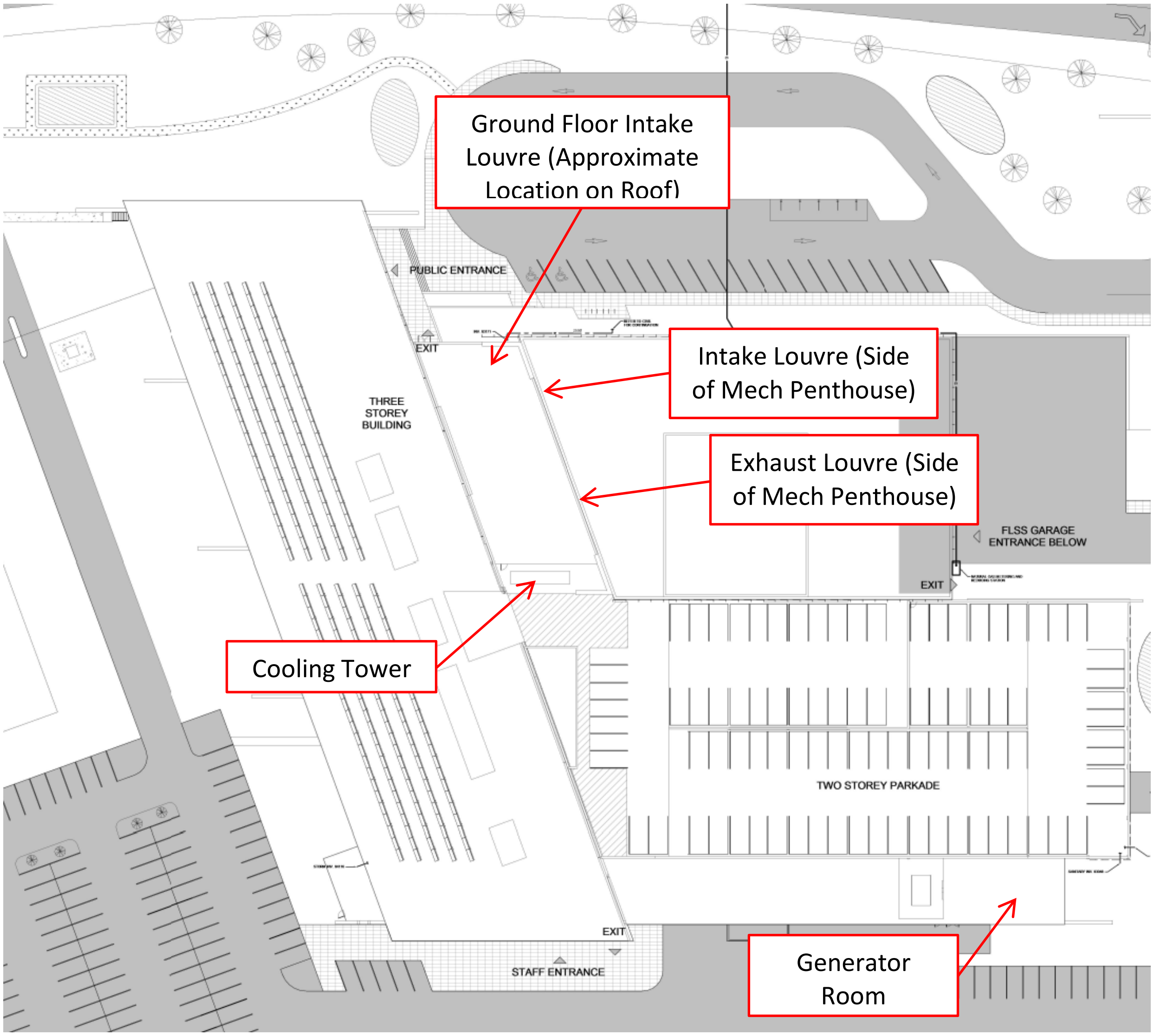

Figure 2.1 – Site plan showing locations of mechanical and electrical noise sources.

It is assumed that all or most mechanical equipment will be running 24 hours a day, 7 days per week, which represents a worst case scenario even if this is not always the case. The generators are to be tested monthly for one hour each in non-emergency situations.

2.4 Points of Reception

Points of reception (POR) have been selected based on the locations of nearby residences. The surrounding residential area is mostly low-lying two or three storey houses as well as a retirement residence. The three PORs chosen represent the worst case scenarios for noise to neighbouring properties. All PORs have a height of 4.5m to represent the second storey of a typical residential house except for POR2 at the retirement lodge which has a height of 1.5m, as the closest sources are the generators, which are at ground level. These points of reception are illustrated in Figure 2.2 and 2.3.

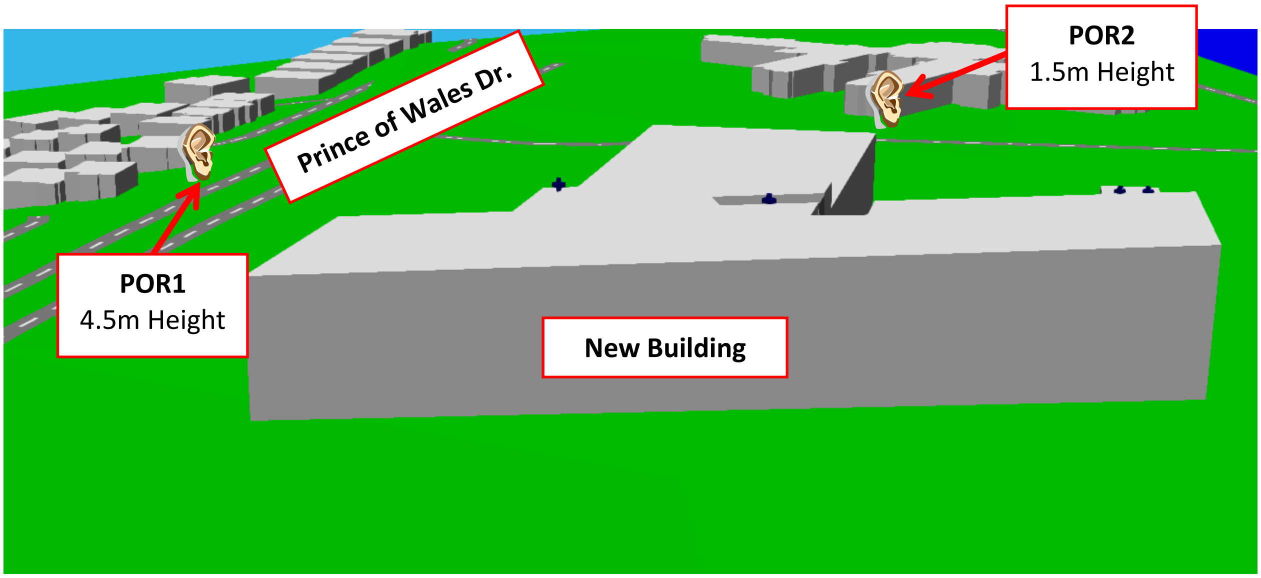

Figure 2.2 – Illustration of points of receptions for stationary noise at new City of Ottawa building.

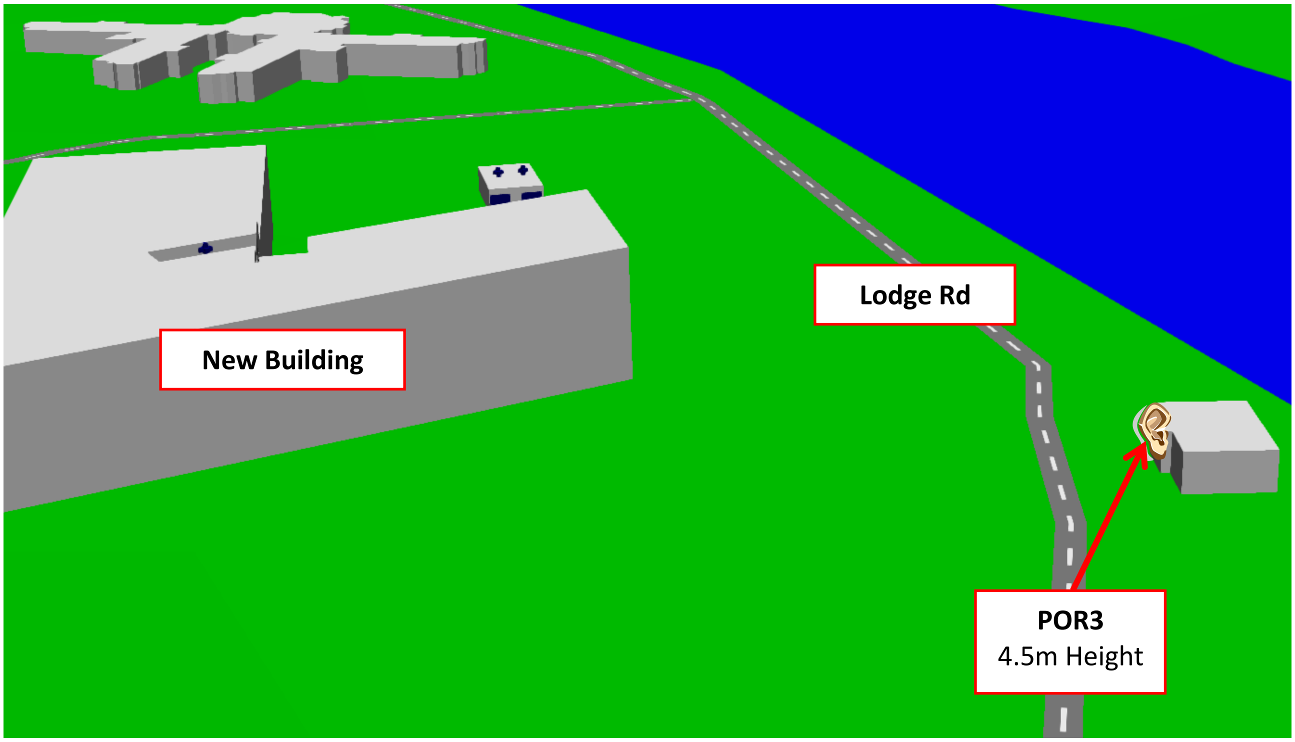

Figure 2.3 – Illustration of points of receptions for stationary noise at new City of Ottawa building.

2.5 Methodology Used in Environmental Noise Impact Calculation

The following sections describe the methodology and software used to model the sound pressure levels at the points of reception due to the noise sources while taking into account parameters such as source levels, distance, topography, barriers and building geometry.

2.5.1 Procedure Used to Assess Noise Impact at Each Point of Reception

This environmental noise analysis was done using an environmental noise modeling software called CadnaA which references ISO 9613. CadnaA predicts environmental noise through calculations based on a 3D model which uses geometrical, landscape and topography data, combined with details of the proposed construction and the noise source power levels.

We created a 3D rendering of the neighbourhood around the building and placed the noise sources in the model at the appropriate locations and then and applied the sound power levels described in this report. The colours on the ground and building represent the sound pressure level in that area. Sound power levels per octave band were entered into the CadnaA at the source's location and the resulting sound pressure levels were calculated at the points of reception.

2.5.2 Other Parameters/Assumptions Used in Calculations

The following table describes the parameters used in the CadnaA model:

Parameter	Value/Condition
Ground Absorption	Default value of 0
Building Reflections	On
Temperature (°C)	10
Relative Humidity (%)	70

Table 2.2 – Parameters used in CadnaA modeling

2.6 Environmental Noise Levels

2.6.1 Daytime and Nighttime Noise Levels from Non-Emergency Equipment

This section summarizes the Cadna/A noise mapping results for non-emergency equipment during the day and at night, as it is assumed that for our current modelling purposes, all equipment except generators is running 24 hours per day, 7 days per week. Figure 2.4 below illustrates the steady state sound pressure levels generated by all the noise sources with the currently selected equipment described above for daytime and nighttime operations with generators excluded.

Figure 2.4 shows the shows the noise grid prediction at 4.5 m height and the sound pressure levels predicted at all the PORs with all equipment operating. For the nighttime case, the ENCG limit of 45 dBA must be met.

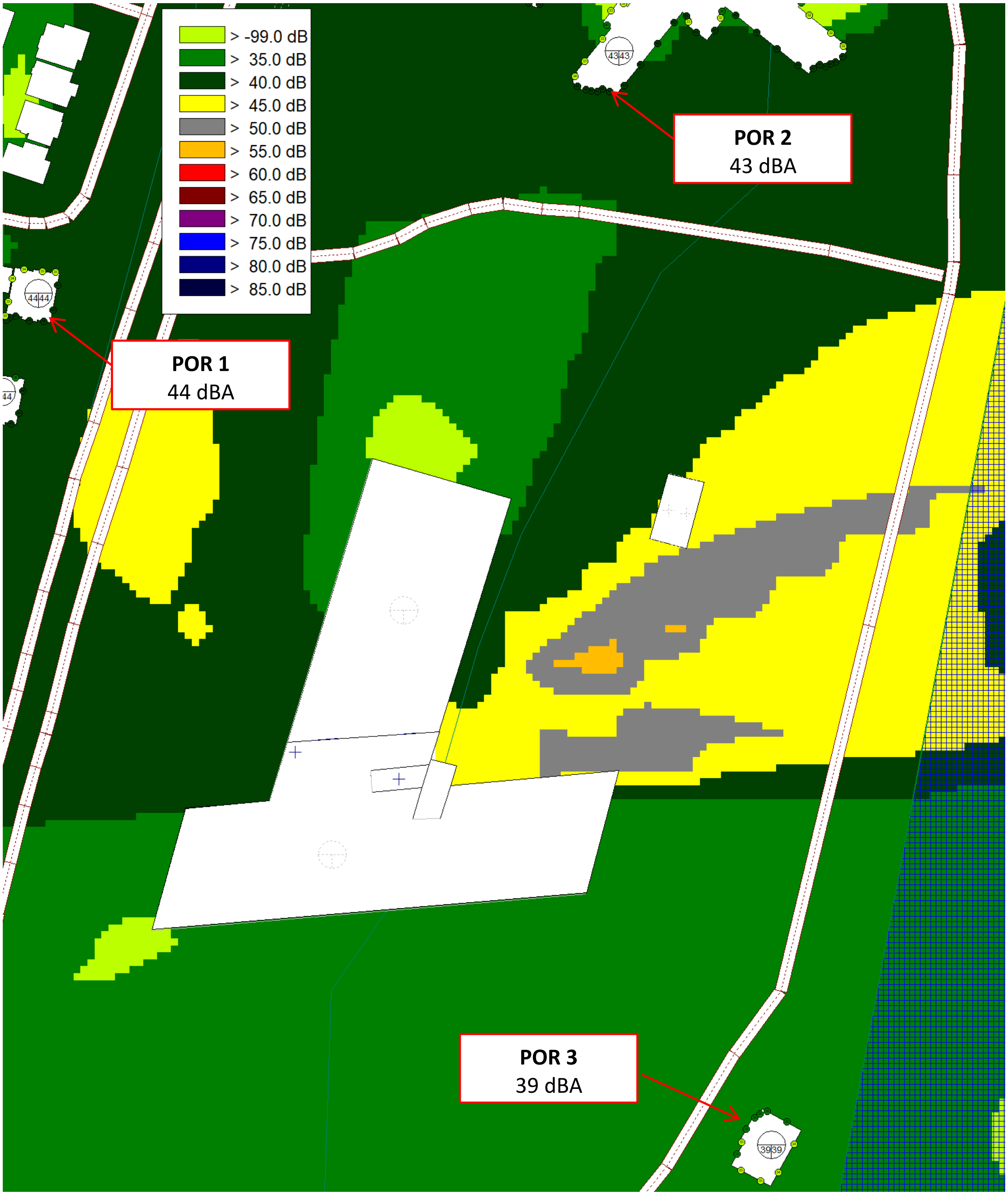

Figure 2.4 – Noise maps at 4.5 m height with current non-emergency equipment for daytime and nighttime conditions.

Figure 2.3 shows that the sound pressure level at PORs 1,2 & 3 are all under 45 dBA, such that POR1 is 44 dBA, POR2 is 43 dBA and POR3 is 39 dBA. Therefore, no additional noise mitigation measures are required provided that the noise levels from the exhaust and intake louvres shown in Table 2.1 are not exceeded. It is possible that once equipment is finalized and more accurate sound data is available, sound levels from the louvres will exceed those given in Table 2.1 and mitigation may be necessary. Mitigation measures may include silencers for MAU/AHU inlets or outlets or acoustic louvres in place of typical mechanical louvres.

2.6.2 Noise Levels from Emergency Equipment

As stated in MOE NPC-300, emergency equipment is to be analyzed separately from non-emergency equipment and is subject to a limit that is 5 dB greater than the daytime limit when operating under non-emergency situations such as maintenance or testing. Figure 2.5 shows the shows the noise grid prediction at 4.5 m height and the sound pressure levels predicted at all the PORs with all emergency equipment operating. For the emergency equipment, the MOE limit of 55 dBA must be met.

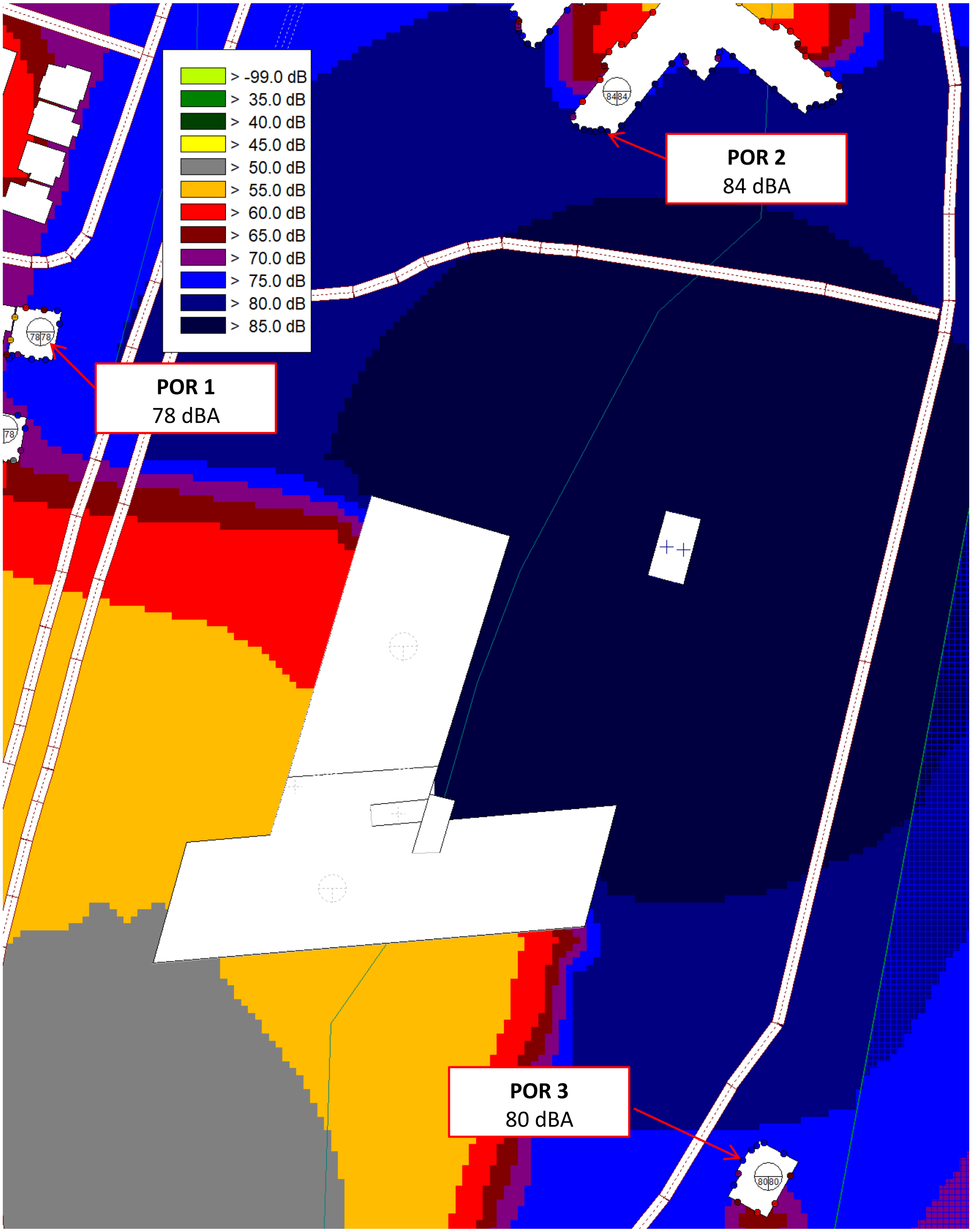

Figure 2.5 – Noise maps at 4.5 m height with current emergency equipment selections.

As can be seen from Figure 2.5, the sound pressure levels at each POR are well above the limit and are at a minimum 78 dBA. This is because there has not been any silencing included for both the gas exhaust (which is the noisiest of the sources) or the intake and exhaust of the generator, which also contribute a significant amount of noise to the surrounding area.

2.6.3 Noise Mitigation of Emergency Equipment

As noted in Section 2.6.2, the noise from the generator intake, exhaust and gas exhaust must be mitigated. This section provides noise mitigation measures for each source of noise and the required insertion losses to meet the 55 dBA limit at all surrounding PORs.

In order to mitigate sound from the gas exhaust, we have recommended a Silex Critical Plus Grade Cylindrical Silencer or equivalent. The insertion losses should be as follows in Table 2.3 or equivalent if a different silencer is chosen.

	Octave Band Insertion Losses (dB)							
Silencer	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1KHz**	**2KHz**	**4KHz**	**8KHz**
Silex Critical Grade Plus	15	33	32	31	30	33	32	30

Table 2.3 – Gas exhaust silencer insertion losses for generators.

We have also determined required insertion losses for attenuation of the inlets and outlets of the generator room in order for sound levels at each POR to be below 55 dBA. The insertion losses are given in Table 2.4 below and are required for any inlet or outlet silencer or acoustic louvre used for attenuation.

	Octave Band Insertion Losses (dB)							
Silencer	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1KHz**	**2KHz**	**4KHz**	**8KHz**
Generator Inlet/Outlet	6	11	15	20	22	22	18	15

Table 2.4 – Insertion loss recommendations for generator inlet/outlet attenuation.

The noise map recalculated with these insertion losses for the two gas exhaust stacks, two inlets and two exhausts is shown in Figure 2.6. As can be seen, the limits are below 55 dBA at each POR.

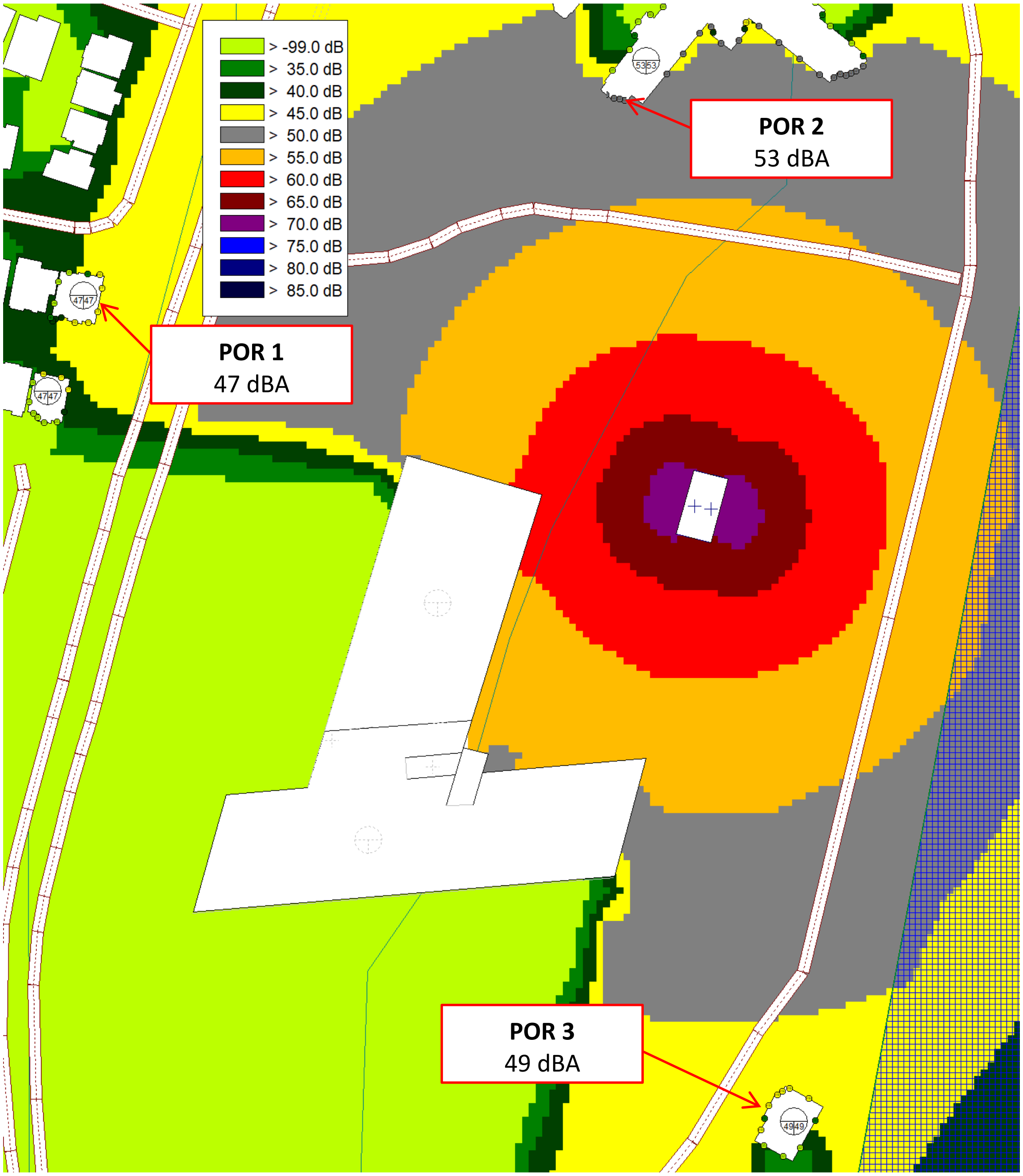

Figure 2.6 – Noise maps at 4.5 m height with current emergency equipment selections with recommended mitigation measures.

2.7 Environmental Noise Assessment Summary

We have reviewed the sound pressure levels in our 3D acoustical model of the new mechanical and electrical equipment at the new City of Ottawa building located at 3505 Prince of Wales Drive. We have found that given the mechanical equipment layout, the noise levels do not exceed the City of Ottawa Environmental Noise Control Guidelines limit of 50 dBA during the day or 45 dBA at night to neighbouring properties. It should be noted however that equipment selections are still being finalized and that we have used representative data for mechanical intake and exhaust louvres and the cooling tower so as to be able to obtain an idea of potential noise issues to the surrounding area. Provided that noise levels from Table 2.1 are not exceeded for mechanical equipment, no noise issues are anticipated however once equipment selections are finalized, it is recommended that our calculations are revised to ensure this is still the case. For emergency equipment (generators) we have recommended silencers for the gas exhaust as well as additional mitigation measures for the intake and exhaust. Provided that these recommendations are followed, the sound levels at each POR will be below the 55 dBA MOE limit for emergency equipment.

Traffic Noise Study
3505 Prince of Wales Drive
Ottawa

Prepared for:
Moriyama & Teshima Architects

Prepared by:
Patrick Richard

May 10, 2019

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3.0 Traffic Noise Study

The following sections will outline the traffic noise impact on the new City of Ottawa building to be constructed at 3505 Prince of Wales Drive.

3.1 City of Ottawa Environmental Noise Guidelines for Traffic Noise (Road & Rail)

This assessment uses the City of Ottawa - Environmental Noise Control Guidelines (ENCG), dated January 2016, to assess and mitigate noise from roads, transit ways, railways and aircraft. The maximum road and rail noise levels for indoor and outdoor living areas are taken from Table 2.2a, 2.2b and 2.2c of the ENCG and summarized in Table 3.1 below.

Item	Type of Space	Time Period	Required Leq (dBA)	
			Road	Rail
Indoor Living Areas	Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	07:00 – 23:00	45	40
	Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	23:00 – 07:00	45	40
	Sleeping quarters	07:00 – 23:00	45	40
		23:00 – 07:00	40	35
	General offices, reception areas, retail stores, etc.	16 hours between 07:00 – 23:00	50	45
	Theatres, places of worship, libraries, individual or semi-private offices, conference rooms, reading rooms, etc.	16 hours between 07:00 – 23:00	45	40
	Sleeping quarters of hotels/motels	8 hours between 23:00 – 07:00	45	40
	Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	8 hours between 23:00 – 07:00	40	35
Outdoor Living Areas	Backyards (single homes min 56m2, semi-detached min 46m2, row housing min 37m2) , balconies (min 4m depth), and common outdoor living areas for multi-storey apartment buildings or condos.	16 hour, 07:00 – 23:00	55	

Table 3.1 – Criteria for Indoor Living Areas and Outdoor Living Areas Road and Rail Noise Levels

The ENCG states that noise control studies are to be prepared when the noise sensitive development is within the following setback distances from the road, highway and railway noise sources:

- 100m from an arterial road or a major collector, light rail corridor or bus rapid transitway
- 250m from an existing or proposed highway
- 300m from a proposed or existing rail corridor or secondary main railway line
- 500m from a 400-series provincial highway or principle main railway line

Based on the requirements, a traffic noise study is required, and the general office and reception areas must meet 50 dBA between 07:00 – 23:00. There are no requirements for office areas at night (23:00-07:00) however it is possible that there will be occupants in the building during these hours and therefore we have completed both a nighttime and daytime analysis with the nighttime limit the same as the daytime limit (50 dBA). Semi private offices require 45 dBA, which we have used in our analysis of a boardroom both during the day and at night. Section 3.2 will detail the traffic noise sources included in the analysis and Section 3.3 will state the points of reception chosen for the new building.

No rail or aircraft noise sources are required to be part of the traffic noise study.

3.2 Traffic Noise Sources

The only traffic noise source within range is Prince of Wales Drive. All other collectors and arterials are greater than 100m away from the building. Two points of reception (POR) have been chosen on the new building at the plane of window (POW) on Level 1, one in a boardroom and one in the lobby. These represent a worst case scenario in terms of noise. Each POR is approximately 45m from Prince of Wales Drive. See the site plan in Section 1.1. Figure 3.1 shows the new building and Prince of Wales Drive and the distance between. Table 3.2 below summarizes the road parameters which were used in this analysis.

Road	Road Class	Posted Speed	AADT Vehicles/Day	Day/Night Split (%)	Medium Trucks (%)	Heavy Trucks (%)
Prince of Wales Drive	4UAD	80 km/hr	49,543*	92/8	7	5

Table 3.2 – Summary of Major Road Noise Source

*It should be noted that the figure used for AADT data was taken from the City of Ottawa Traffic Count Intersection Volumes from 2018 for the nearby intersection of Prince of Wales and Strandherd Drive as this is more representative of the traffic along Prince of Wales Drive.

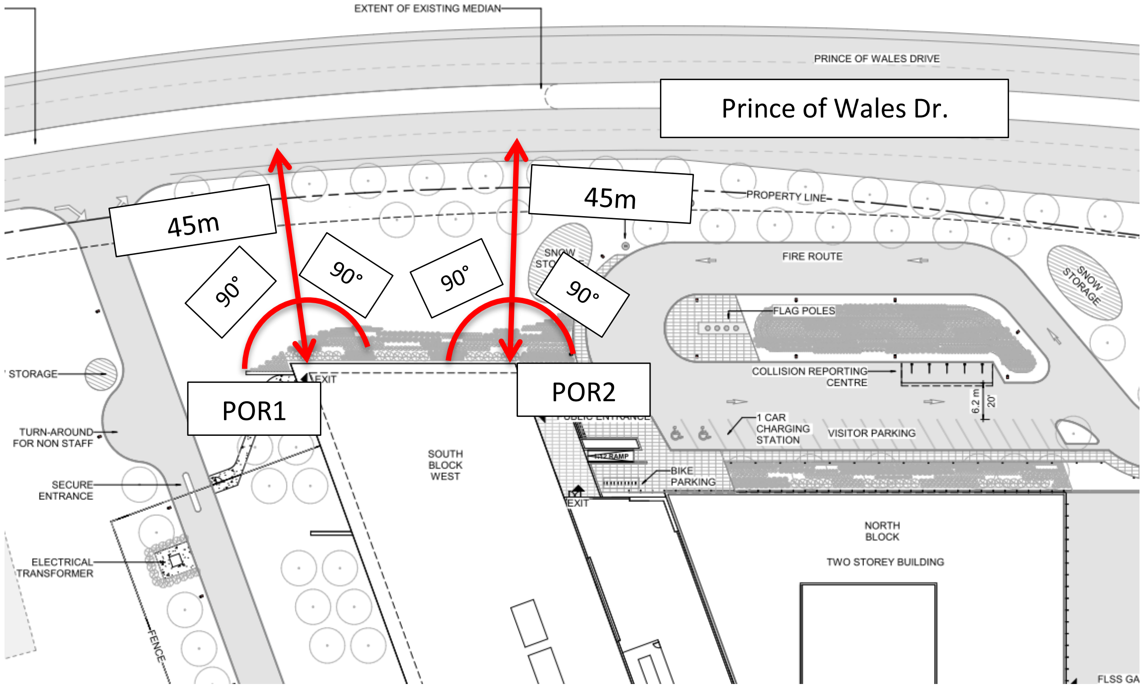


Figure 3.1 – Points of reception at plane of window (POW) showing distances, angles and locations of relevant road noise sources.

3.3 Points of Reception

To determine the worst case noise impact on the façade of the building, we have chosen the closest two rooms (Boardroom as POR5 and Lobby as POR6) which are located on Level 1. POR heights are shown in figure 3.2 on a section of the building elevation. Figure 3.3 & 3.4 on the next page show the two rooms. These are the worst case scenario locations for any location within the new building due to their proximity to Prince of Wales Drive. Table 3.2 below summarizes receiver heights and distances.

Receiver	Height (m)	Distance from Source (m)	Angle to source segment from POR (left)	Angle to source segment from POR (right)
POR5	5	45	90°	90°
POR6	5	45	90°	90°

Table 3.2 – Table of receiver height and distance from noise source.

The exterior wall area includes two façade of the building which is composed of both glazing and an exterior wall assembly for the boardroom POR and glazing only for the lobby POR.

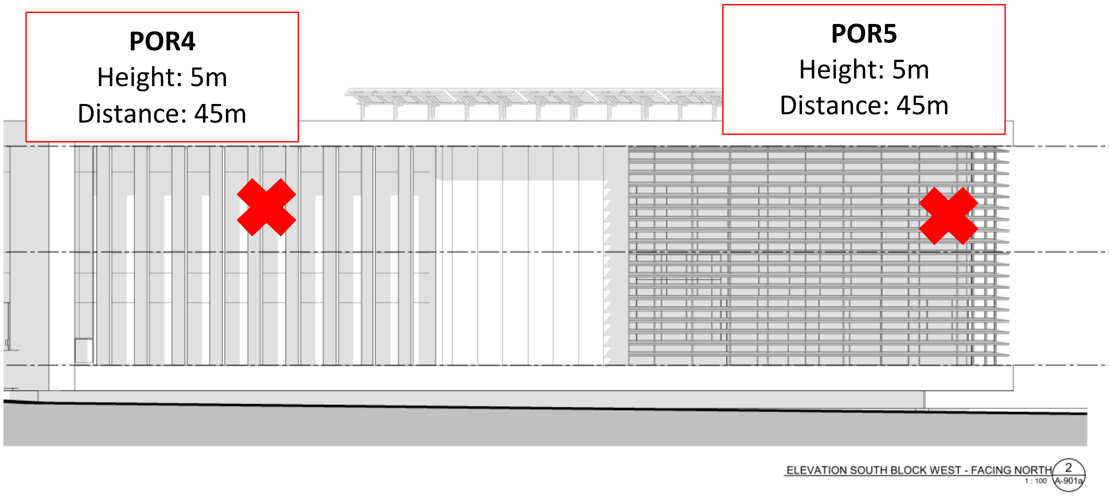


Figure 3.2 – Elevation of west façade of new building showing heights of the points of reception and distance to Prince of Wales Drive.

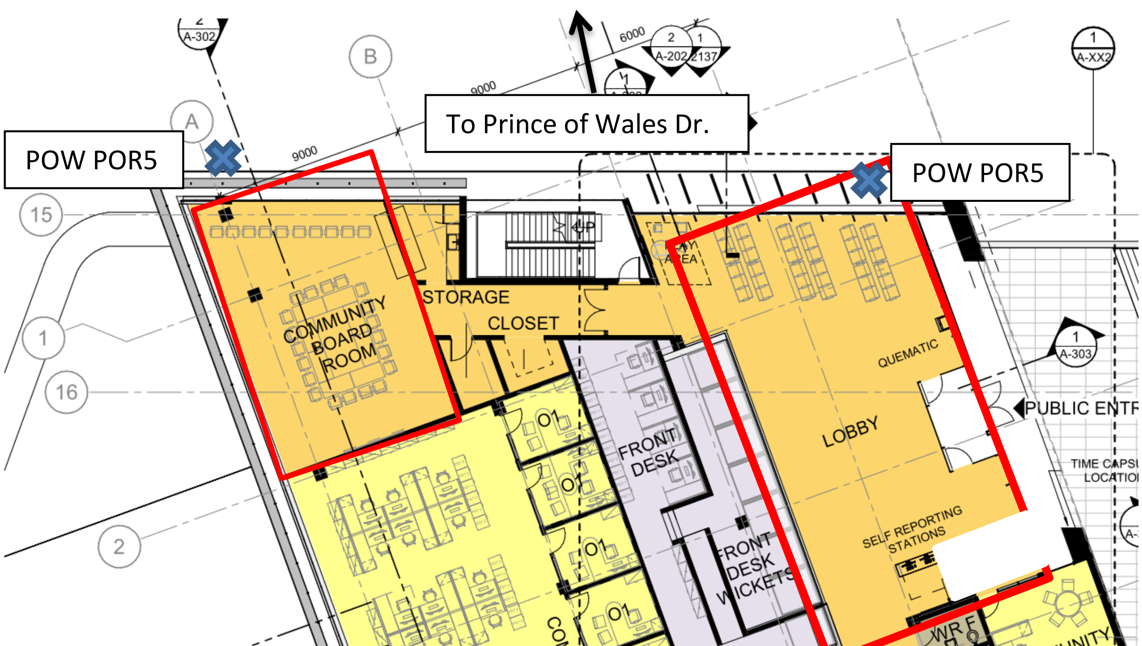


Figure 3.3 – Floor Plan of Level 2 showing the Plane of Window Point of Reception POR5 and POR6.

3.4 Methodology Used in Traffic Noise Impact Calculation

In order to calculate the road noise impact at the proposed development, we utilized the same software as for our environmental noise modelling, Cadna/A. We have previously used this software for traffic noise studies with submission to the City and have demonstrated that differences between traffic noise levels in Cadna/A and STAMSON are minimal. Similar to STAMSON, this program allows us to input variables of a road such as traffic volume, speed, day and night traffic splits and topography to determine the noise impact at a point of reception.

According to the ENCG, when noise levels could exceed 55 dBA at the Plane of Window (POW) of an office area (day) the exterior cladding system of the building envelope must be acoustically designed to ensure the indoor noise criteria is achieved. The City of Ottawa recognizes the Acoustic Insulation Factor (AIF[1]) method as an appropriate analysis technique.

3.4.1 Traffic Noise Analysis Parameters

The parameters used in Cadna/A to assess the noise impact at POR5 and POR6 are indicated in Table 3.3 below. These are used in conjunction with the parameters for road traffic volume given in Table 3.2.

Parameter	Values Used
Roadway	Prince of Wales Dr.
Time Period	16h Day/8h Night
Topography	Flat/gentle slope no barrier
Rows of Houses	0
Intermediate Surface	Reflective
Receiver Height (m)	POR5: 5m; POR6: 5m
Source Receiver Distance (m)	POR5: 45m; POR6: 45m

Table 3.3 – Parameters used in the Cadna/A traffic noise model

We have assessed both daytime and nighttime levels for POR5 & POR6 as this is an office building where occupants could be working overnight.

3.4.2 Building Component Assessment (AIF Analysis) Procedure

According to the ENCG, when noise levels could exceed 55 dBA at the Plane of Window (POW) of an office area (day) the exterior cladding system of the building envelope must be acoustically designed to ensure the indoor noise criteria is achieved. The City of Ottawa recognizes the Acoustic Insulation Factor (AIF[1]) method as an appropriate analysis technique.

To comply with the City of Ottawa policies, the building envelope will require a minimum AIF rating to provide the indoor noise level required for general office area (lobby) and semi-private offices (boardroom) dwellings as described below.

The City of Ottawa's ENCG outlines the following maximum indoor Leq limits:

- maximum daytime indoor L_{eq} for general office space or reception areas should be 50 dBA
- maximum daytime indoor L_{eq} for individual or semi-private offices should be 45 dBA

For the overall exterior wall of any room, the required AIF for road and rail transportation noise is:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 2dB (1)

When the exterior is comprised of components, then the AIF required of each component is determined by the following equation[1]:

Required AIF = Outside L_{eq} - Indoor L_{eq} (Req) + 10 $\log_{10}$ (Number of Components) + 2dB (2)

The required AIF is based on the Outside L_{eq}, Indoor L_{eq} required and the total number of exterior façade components. The AIF method allows for the number of components to be reduced if any component significantly exceeds the required AIF[1]:

“If the AIF of any component exceeds the required AIF by 10 or more, the calculation should be repeated for the other components with the ‘total number of components’ reduced by one. This reduction in the number of components lowers the required AIF for the others.”

[1] J.D. Quirt, Building Research Note: Acoustic Insulation Factor: A Rating for the Insulation of Buildings against Outdoor Noise, National Rearch Council [Revised June 1980]

3.5 Surface Transportation Noise Levels

Table 3.4 shows the predicted sound pressure levels at the points of reception from the results of the Cadna/A noise software calculation.

Noise Source	POR5 (dBA)		POR6 (dBA)	
	Day	Night	Day	Night
Prince of Wales Dr.	72	64	72	64

Table 3.4 – Predicted Traffic Noise at the Points of Reception**.**

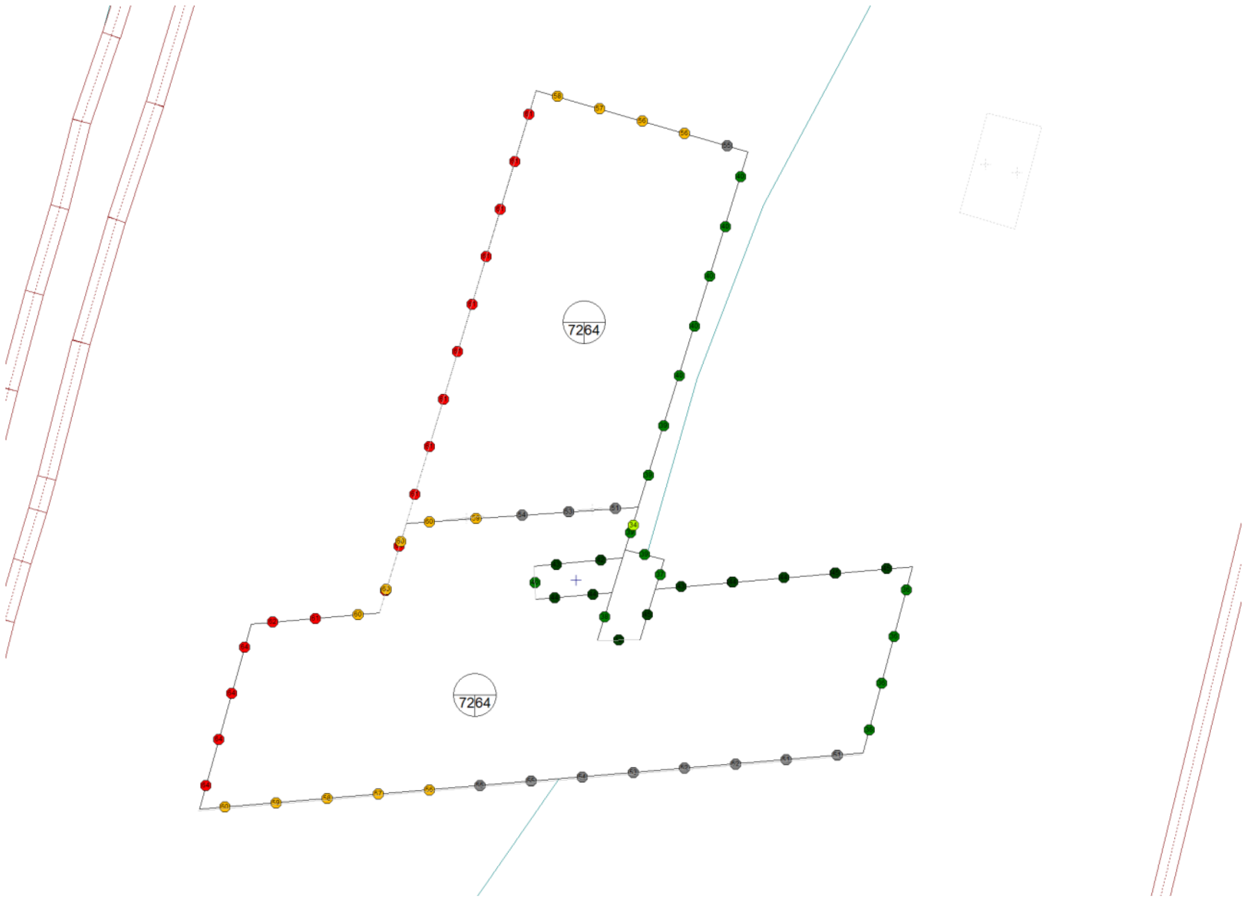


Figure 3.4 – Building evaluation showing traffic noise levels along the perimeter of the building and daytime and nighttime sound levels.

We have calculated the predicted noise level caused by traffic using Cadna/A and have shown that a 16h L_{eq} at POR5 and POR6 is 72 dBA for both. The 8h L_{eq} at night was calculated to be 64 dBA for each POR. We checked these figures in STAMSON to ensure they were representative and obtained 71 dBA during the day and 63 dBA at night, therefore our noise levels in Cadna/A correlate well. The calculated daytime levels account for a worst case scenario in terms of traffic noise. As the levels during the day are above 55 dBA the following is required:

1) An evaluation of exterior building components using the AIF method is undertaken in Section 8 in order to verify that building components will achieve the required daytime indoor sound level of 45 dBA for the boardroom space and indoor sound level of 50 dBA for the lobby space.
2) Addition of a Warning Clause to the development agreement. The ENGC requires a Warning Clause whenever noise could meet or exceed 55 dBA 16 hour Leq at the Outdoor Living Area or Plane of Window of any living or sleeping area, in this case including the lobby and boardroom, prior to any noise mitigation. General Warning Clause guidelines are provided in Section 3.7.

3.6 Exterior Building Component Analysis (AIF Method)

In this section, we determine if the building complies with the City of Ottawa's ENCG indoor noise requirements based on the existing or proposed wall and window construction. We compare the required minimum façade AIF to the estimated AIF of the currently selected façade materials.

3.6.1 Building Components

The current design of the relevant building's façade is made up of 2 different components at the boardroom:

1) Exterior wall
2) Glazing

And one component for the lobby:

1) Glazing

The existing exterior wall composition of the building façade is given on Drawing A-001 of the architectural plans and is shown in Table 3.5. This wall type is sufficiently similar to wall type EW5 described in the Canada Mortgage and Housing Corporation (CMHC) document "Road and Rail Noise: Effects on Housing". Table 3.5 shows a comparison of these wall compositions.

Exterior Wall Assembly (W2)	**Wall Type EW5 from CMHC Road and Rail Noise**
Face brick (100mmx100mmx600mm) 25mm airspace Semi rigid insulation Continuous Vapour Barrier 16mm Sheathing 152mm steel studs 16mm gypsum wall board	100mm Brick Veneer 25mm Air Space Sheathing 38 by 89mm studs Studs @with 50mm of Batt insulation or thicker Vapour barrier 12.75mm gypsum board

Table 3.5 – Comparison of new classroom addition building exterior wall and equivalent wall from CMHC, Road and Rail Noise: Effects on Housing.

There are currently no glazing assemblies indicated in the architectural drawings and therefore we assume a double pane window that meets minimum OBC requirements such as the following example:

Basic Window Assembly
4mm glazing 13mm interplane spacing 4mm glazing

Table 3.6 – Possible Window Assembly used in Calculations

The calculation of AIF for each building component depends on the ratio of the area of a given component on the exterior to the total floor area of the corresponding interior room. Using plan view and elevation drawings, we have determined these dimensions for the boardroom and the lobby for which we determined the noise impact at each POR. The areas of the exterior wall components and ratios to the floor are given in Table 3.7 and 3.8. Sections of the exterior walls showing the heights of the wall components in the boardroom and lobby are shown in Figure 3.5.

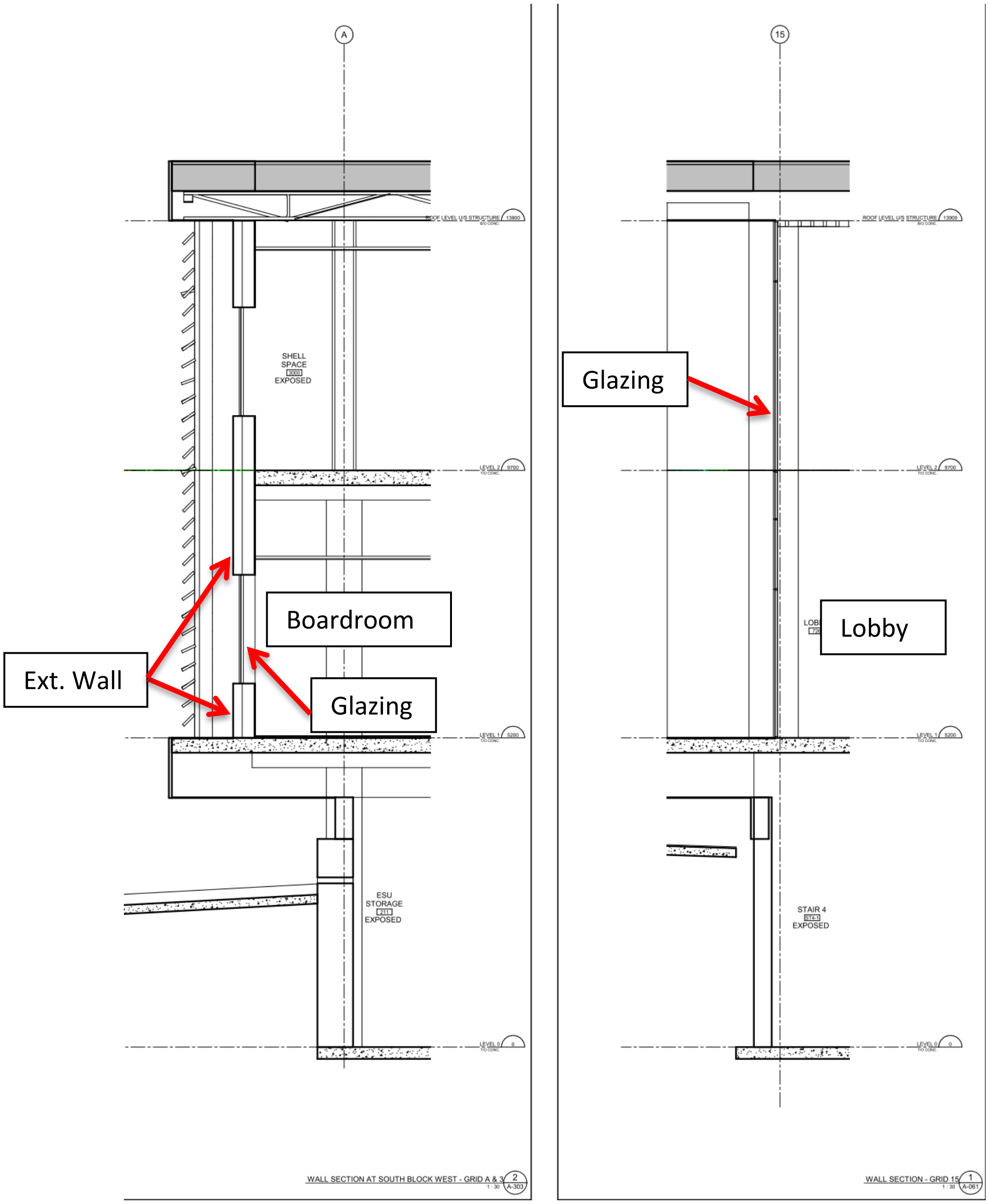


Figure 3.5 – Sections showing exterior wall and glazing sections for each room analyzed.

3.6.2 AIF Calculations

Below in Table 3.7 & 3.8 we provide the results of our AIF calculations based on the procedure given in Section 3.4.2 and the building component information given in section 3.6.1 and dimensions from the plans for each component at all PORs. Component AIFs are determined based on component area ratio to floor area given in CMHC "Road and Rail Noise: Effects on Housing" Tables 6.2 and 6.3.

	POR5 - 2 Component Façade												
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11	Column 12	Column 13
	Room Floor Area (m2)	Number of Components	Component Number	Component Type	Component Area (m2)	Component Area ratio to Floor Area (%)	Outside Leq	Required Indoor Leq	Initial Required AIF	Component AIF	Comp1 AIF > Init AIF +10	Final Required AIF	Acceptable Component AIF
Row 1	98.9	2	1	Exterior Wall	54.2	55%	72	45	32	50	Yes	29	**Yes**
Row 2	98.9	2	2	Window	40.7	41%	72	45	32	29	Yes	29	**Yes**

Table 3.7 – POR5 AIF parameters used in calculations, resulting required AIF and component AIF, and statement if component AIF is acceptable.

	POR6 - 1 Component Façade												
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11	Column 12	Column 13
	Room Floor Area (m2)	Number of Components	Component Number	Component Type	Component Area (m2)	Component Area ratio to Floor Area (%)	Outside Leq	Required Indoor Leq	Initial Required AIF	Component AIF	Comp1 AIF > Init AIF +10	Final Required AIF	Acceptable Component AIF
Row 1	203.7	1	1	Glazing	285.4	140%	72	50	24	26	N/A	24	**Yes**

Table 3.8 – POR6 AIF parameters used in calculations, resulting required AIF and component AIF, and statement if component AIF is acceptable.

As can be seen in Table 3.7 and 3.8, the assumed glazing assembly (4mm pane + 13mm airspace + 4mm pane) is the limiting component of the assembly. To meet the required AIF, the Component AIF (Column 10) must meet the Final Required AIF (Column 12). In both cases, this requirement is met. AIF 29 translates to an STC of STC 31, and therefore as long as the assembly used meets this requirement, indoor noise levels will be met.

3.7 Warning Clauses

Since the predicted noise level from surface transportation exceeds 55 dBA, a generic warning clause must be added to the development agreement.

The City of Ottawa requires a Warning Clause whenever noise could meet or exceed 55 dBA 16 hour Leq at the Outdoor Living Area or Plane of Window of any living or sleeping area prior to any noise mitigation.

Table 3.9 provides the types of warning clauses and example text to be adapted into warning clauses. These warning clauses should be taken as <u>*example only*</u> and are taken from Appendix A of the ENCG which also states:
"*A warning clause is not considered a form of noise mitigation. It is not acceptable therefore to use warning clauses in place of physical noise control measures to identify an excess over the MOE or City noise limits*."

TYPE	Example Text	Notes
Generic	Purchasers/tenants are advised that sound levels due to increasing road/rail/Light Rail/transit way traffic may occasionally interfere with some outdoor activities as the sound levels may exceed the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation this development has been designed so as to provide an indoor environment that is within provincial guidelines. Measures for sound attenuation include: • multi-pane glass; • brick veneer; • concrete panels;	The generic warning clause outlines that MOE sound levels may be exceeded but the indoor environment is within guidelines. Mitigation measures are described including urban design features. Mention is also made of landscaping to screen the development visually from the source of noise.
Extensive mitigation of indoor and outdoor amenity area	"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 the Environment. To help address the need for sound attenuation this development may include: • multi-pane glass; • brick veneer; • construction of a solid fence in backyard area To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features. This dwelling unit has also been designed with the provision	The warning clause makes reference to MOE sound levels being exceeded from time to time and that there are sound attenuation features and landscaping within the development that should be maintained.

	for adding central air conditioning at the occupant's discretion. Installation of central air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment.	
No outdoor amenity area	Purchasers/tenants are advised that sound levels due to increasing road/rail/Light Rail/transitway traffic will interfere with outdoor activities as the sound levels exceed the sound level limits of the City and the Ministry of the Environment. To help address the need for sound attenuation this development may includes • multi-pane glass; • brick veneer; • construction of a solid fence in backyard area To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features. This dwelling unit has been supplied with a central air conditioning system and other measures 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 City and the Ministry of the Environment.	This warning clause notes that only an indoor environment is being provided for.

Table 3.9 – Warning Clause Types and Example Text from the City of Ottawa (from ENCG Table A1)

3.8 Traffic Noise Assessment Summary

Exterior Walls

Face brick (100mmx100mmx600mm)
25mm airspace
Semi rigid insulation
Continuous Vapour Barrier
16mm Sheathing
152mm steel studs
16mm gypsum wall board

The AIF value for the exterior wall exceeds the requirements and no changes are required.

Exterior Glazing

Recommended window assemblies for the proposed double pane glazing assembly are given in Section 3.6.1. Provided that this assembly or an equivalent STC 31 assembly is used, indoor noise level requirements will be met.

In addition, as the predicted noise level from surface transportation exceeds 55 dBA, a generic warning clause must be added to the development agreement.

4.0 Conclusion

We have reviewed the sound pressure levels in our 3D acoustical model of the new mechanical and electrical equipment at the new City of Ottawa building located at 3505 Prince of Wales Drive. We have found that given the mechanical equipment layout, the noise levels do not exceed the City of Ottawa Environmental Noise Control Guidelines limit of 50 dBA during the day or 45 dBA at night to neighbouring properties. It should be noted however that equipment selections are still being finalized and that we have used representative data for mechanical intake and exhaust louvres and the cooling tower so as to be able to obtain an idea of potential noise issues to the surrounding area. Provided that noise levels from Table 2.1 are not exceeded for mechanical equipment, no noise issues are anticipated however once equipment selections are finalized, it is recommended that our calculations are revised to ensure this is still the case. For emergency equipment (generators) we have recommended silencers for the gas exhaust as well as additional mitigation measures for the intake and exhaust. Provided that these recommendations are followed, the sound levels at each POR will be below the 55 dBA MOE limit for emergency equipment.

The traffic noise from Prince of Wales Drive near the new building was also analyzed. It was found that the traffic noise from this source was greater than 55 dBA at the nearest plane of window point of the development and warranted an AIF analysis of the exterior building components. This analysis showed that the planned exterior wall assembly for the boardroom and lobby was acceptable and minimum glazing requirements are given in Section 3.6.1. No changes are required in order to meet City of Ottawa ENCG 2016 indoor noise levels.

Should you have any comments or questions regarding this report, please do not hesitate to contact us.

Sincerely,

Patrick Richard, M.Sc.E.
Acoustic Consultant

Approved By:

LICENSED PROFESSIONAL ENGINEER
D. E. BUCHAN
MAY 15/2019
PROVINCE OF ONTARIO

Donald Buchan, P.Eng
Principal
Buchan Lawton Parent Ltd.

APPENDIX

Noise Source Sound Data

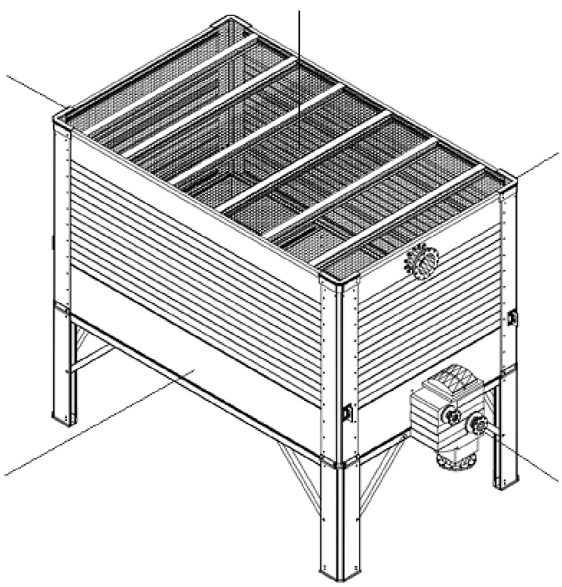
SOUND REPORT

Project Name: Algonquin (Sound)
Tower Series TTXL
Tower Model 121950
VFD Operation 60Hz
State/Province:
Country:
Date: 04/15/2019

TOP		
	5ft	**50ft**
63Hz	76	66
125Hz	86	85
250Hz	83	73
500Hz	81	76
1kHz	76	69
2kHz	69	62
4kHz	63	57
8kHz	50	43
dBA	83	74

END		
	5ft	**50ft**
63Hz	79	68
125Hz	87	79
250Hz	91	79
500Hz	90	73
1kHz	87	71
2kHz	82	66
4kHz	76	60
8kHz	67	51
dBA	91	77

SIDE		
	5ft	**50ft**
63Hz	76	68
125Hz	86	78
250Hz	89	78
500Hz	87	73
1kHz	86	69
2kHz	81	63
4kHz	74	58
8kHz	66	47
dBA	90	75



SIDE		
	5ft	**50ft**
63Hz	76	68
125Hz	86	78
250Hz	89	78
500Hz	87	73
1kHz	86	69
2kHz	81	63
4kHz	74	58
8kHz	66	47
dBA	90	75

END		
	5ft	**50ft**
63Hz	79	68
125Hz	87	79
250Hz	91	79
500Hz	90	73
1kHz	87	71
2kHz	82	66
4kHz	76	60
8kHz	67	51
dBA	91	77

	PWL	**SPL**	
	60Hz	**5ft**	**50ft**
63Hz	99	87	67
125Hz	112	100	80
250Hz	110	98	78
500Hz	105	93	73
1kHz	102	90	70
2kHz	96	84	64
4kHz	91	79	59
8kHz	81	69	49
dBA		95.5	75.5

Representative Cooling Tower data

Sound data

1250DQGAE

60 Hz

Sound pressure level @ 7 meters, dB(A)

See Notes 1-6 listed below

Configuration		Position (Note 1)								8 position average
		1	2	3	4	5	6	7	8	
Standard – Unhoused high ambient cooling system	Infinite exhaust	91	94	94	96	98	97	95	95	95
Standard – Unhoused enhanced high ambient cooling system	Infinite exhaust	94	95	94	95	94	94	95	94	94
Standard – Unhoused remote cooled	Infinite exhaust	89	91	91	89	91	90	92	90	90

Used in conjunction with generator intake/exhaust louvre measurements

Sound power level, dB(A)

See Notes 2-4, 7, 8 listed below

Configuration		Octave band center frequency (Hz)									Overall sound power level
		31.5	63	125	250	500	1000	2000	4000	8000	
Standard – Unhoused high ambient cooling system	Infinite exhaust	70	90	109	115	121	120	116	112	110	125
Standard – Unhoused enhanced high ambient cooling system	Infinite exhaust	69	85	104	113	118	117	113	109	108	122
Standard – Unhoused remote cooled	Infinite exhaust	67	82	99	107	112	113	112	107	107	118

Exhaust sound power level, dB(A)

See Notes 2, 9 listed below

Open exhaust (no muffler) @ rated load	Octave band center frequency (Hz)									Overall sound power level
	31.5	63	125	250	500	1000	2000	4000	8000	
	72	96	119	121	126	130	128	128	126	135

Note:

1. Position 1 faces the generator front per ISO 8528-10. The positions proceed around the generator set in a counter-clockwise direction in 45° increments. All positions are at 7 m (23 ft) from the surface of the generator set and 1.2 m (48”) from floor level.
2. Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
3. Data based on full rated load. Sound data with remote-cooled generator sets are based on rated loads without cooling fan noise.
4. Sound data for generator set with infinite exhaust do not include exhaust noise.
5. Sound Pressure Levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
6. Reference sound pressure is 20 μPa.
7. Sound power levels per ISO 3744 and ISO 8528-10, as applicable.
8. Reference power = 1 pw (10^{-12} W)
9. Exhaust sound power levels are per ISO 6798, as applicable.

CRITICAL PLUS CYLINDRICAL SILENCERS

25 to 35 dBA Noise Reduction

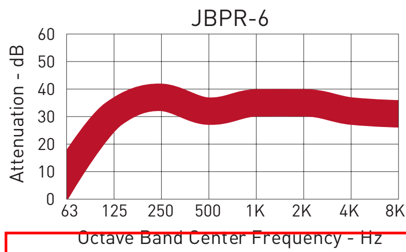
SILENCER SELECTION

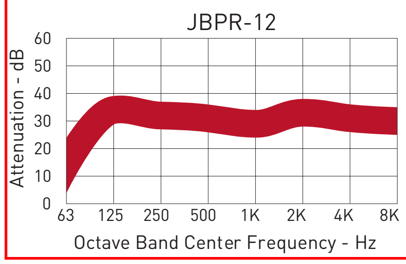
For immediate assistance to select the appropriate silencer that best suits your application's acoustical and backpressure requirements contact Silex Innovations. Or, use our exclusive silencer sizing and selection program, found at www.silex.com.

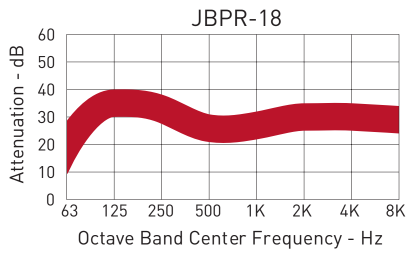
PERFORMANCE & MATERIALS

The critical plus grade series are combination silencers. More effective at higher frequencies than the JB series, all of the silencers are manufactured from light to heavy gauge steel and finished with high temperature black paint. A drain is included as a standard component on the silencer.

TYPICAL ATTENUATION CURVE







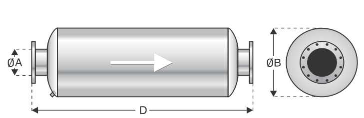
DIMENSIONS

Model	ØA in(mm)	ØB in(mm)	C in(mm)	D in(mm)	F** in(mm)	G in(mm)	H in(mm)	Wgt lb(kg)
JBPR-1.5	1.5	9(229)	24(610)	30(762)	4(102)	7.5(191)	27(686)	28(13)
JBPR-2	2	9(229)	24(610)	30(762)	4.5(114)	7.5(191)	27(686)	31(14)
JBPR-2.5	2.5	10(254)	28(711)	34(864)	5(127)	8(203)	31(787)	42(19)
JBPR-3	3	12(305)	32(813)	38(660)	5.5(140)	9(229)	35(889)	57(26)
JBPR-3.5	3.5	14(356)	36(914)	42(1067)	6(152)	10(254)	39(991)	76(34)
JBPR-4	4	14(356)	40(1016)	48(1219)	6(152)	11(279)	44(1118)	92(42)
JBPR-5	5	16(406)	49(1245)	57(1448)	7(178)	12(305)	53(1346)	134(61)
JBPR-6	6	18(457)	55(1397)	63(1600)	8(203)	13(330)	59(1499)	177(80)
JBPR-8	8	22(559)	66(1676)	74(1880)	9.5(241)	15(381)	70(1778)	257(117)
JBPR-10	10	26(660)	81(2057)	89(2261)	11.5(292)	17(432)	85(2159)	422(191)
JBPR-12	12	30(762)	94(2388)	102(2591)	13(330)	19(483)	98(2489)	568(258)
JBPR-14	14	36(914)	99(2515)	109(2769)	15.5(394)	23(584)	104(2642)	711(323)
JBPR-16	16	40(1016)	109(2769)	119(3023)	16.5(419)	25(635)	114(2896)	1056(479)
JBPR-18	18	45(1143)	117(2972)	127(3226)	18(457)	27.5(699)	122(3099)	1297(588)
JBPR-20	20	50(1270)	127(3226)	137(3480)	20.5(521)	30(762)	132(3353)	1811(821)
JBPR-22	22	54(1372)	139(3531)	149(3785)	22.5(572)	32(813)	144(3658)	2094(950)
JBPR-24	24	60(1524)	152(3861)	162(4115)	24(610)	35(889)	157(3988)	2507(1137)
JBPR-26	26	64(1626)	173(4394)	183(4648)	25.5(648)	37(940)	178(4521)	2995(1359)
JBPR-28	28	68(1727)	190(4826)	200(5080)	26.5(673)	39(991)	195(4953)	3526(1599)
JBPR-30	30	72(1829)	206(5232)	216(5486)	28(711)	41(1041)	211(5359)	4051(1838)

Exposed insulation inside.
**For F dimension other than that specified, please contact Silex Innovations.
Available in sizes up to 60" inlet.

TYPICAL ORIENTATIONS

ST



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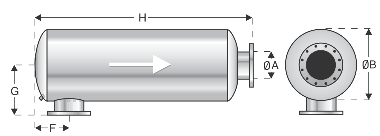

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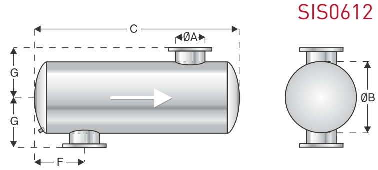
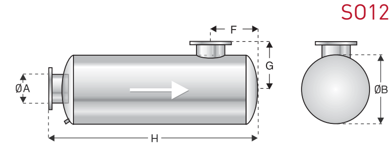


SO12



OPTIONS

- Aluminized steel, 304L or 316L stainless steel
- Dual inlet or custom inlet / outlet configurations
- Thermal insulation blankets to suit all configurations
- Mounting brackets, gussets and lifting lugs

Metric dimensions rounded to nearest mm. Dimensions and weights are nominal and may vary slightly in production models. On silencers 4" and larger the inlet and outlet are flanged, manufactured from minimum ½" thick plate and drilled to ANSI class 150.
The default material used is aluminized steel, however NGP reserves the right to substitute to carbon steel due to material availability, gauge and size limitations.

ADDENDUM 1

City of Ottawa and Ottawa International Airport Authority
Comments and Responses

City of Ottawa Technical Circulation Comments – Site Plan Control Application: 3505 Prince of Wales Drive, July 26, 2019.

"Regardless of the site not being within the AVDZ, given its proximity to take-off / approach surface 07R 25 L, sound as result of aircraft operations will be heard at varying levels. We suggest the noise study be revised to consider the impact of aircraft noise and recommend where necessary mitigation measures for any noise sensitive spaces."

> CPT Response to the City of Ottawa:
> *"OPS does not have sensitive equipment that would be impacted by aircraft noise; in fact we have an office at the airport itself and have had no issues with the use of our radios or other OPS equipment. Because the property is outside of the AVDZ zone and our administrative functions in the building are typical to a generic office environment we do not feel this aircraft noise study would be of benefit to this project."*
>
> SOTA Response:
> "As the site location is approximately 1.75km from the least restrictive aircraft Noise Exposure Forecast (NEF 25), we do not believe that an aircraft noise study is required. There is also no metric for aircraft noise calculation when the site is outside NEF zones. This would require significantly overestimating the noise generated by aircrafts."

"*The noise study has identified the site as Class 1. However, the site appears to fall under Class 2. Please provide clarification as to why a Class 1 identification was selected over Class 2."*

> Section 2.1 on Page 7 of this report is to be changed from Class 1 to Class 2. Therefore, the daytime (7:00-19:00) limit remains at 50 dBA, the nighttime (23:00-7:00) remains at 45 dBA and the evening (19:00-23:00) are now 45 dBA, as opposed to 50 dBA for a Class 1 area. We have accounted for a worst case scenario that all equipment would be in operation during the day and at night (excluding generators) as per NPC-300 and City of Ottawa guidelines and therefore the maximum limit of 45 dBA in our analysis remains unchanged. The 55 dBA limit for emergency equipment remains the same, as generators will be tested during daytime hours, therefore the limit remains 5 dB above the normal daytime limit (50 dBA).

"The noise study shall explain how the locations of the PORs and distances from the noise sources to the PORs were obtained, as related to the Cadna/A noise mapping model."

> The locations of PORs were chosen based on their proximity to the proposed new building. POR1 was the worst case POR for all residences to the north, POR2 is the closest noise sensitive location to the east and POR3 is the closest noise sensitive location to the south. Distances of noise sources to the PORs were obtained by importing a map using OpenStreetMap which contains information including roads, buildings and terrain and then building our noise model of the building using site plan, architectural and mechanical drawings within the imported map. The distances may not be exactly perfect, but any difference should be minimal and not significantly affect the results.