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Proposed Commercial Building
Site 8C Murray Rose Avenue, Sydney Olympic Park
Noise & Vibration
Development Approval Phase

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Site 8C Murray Rose Avenue, Sydney Olympic Park

Noise & Vibration

Development Approval Phase

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DOCUMENT CONTROL

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd has been engaged by FDC Construction & Fitout Pty Ltd to provide specialist consulting services in relation to noise and vibration associated with the development of a six storey commercial office building at Site 8C Murray Rose Avenue, Sydney Olympic Park.

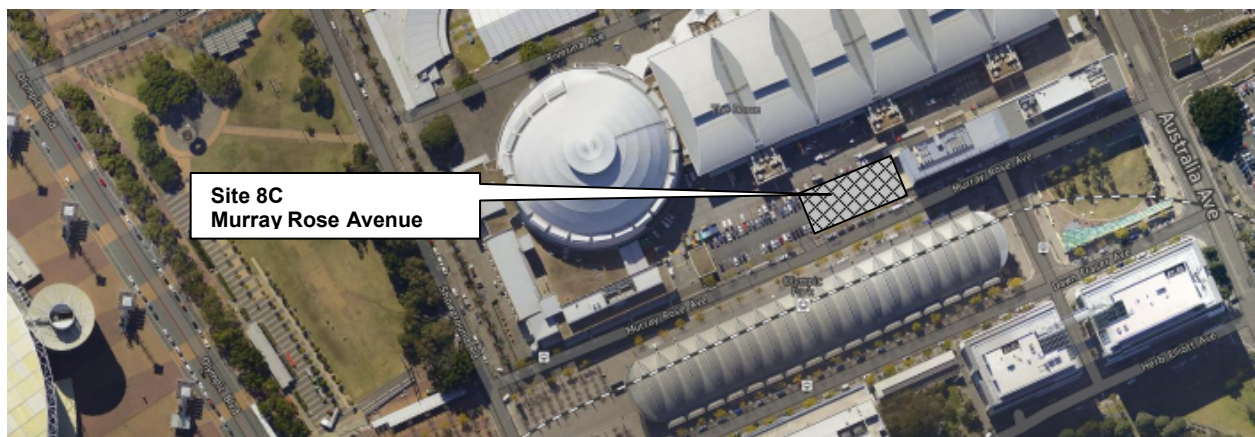
The proposed commercial office building will be designed to achieve a high level of sustainability by targeting 5 Star Green Star Office Design V3. To encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level, up to two points are awarded where it is demonstrated that for 95% of the building NLA, ambient internal noise levels are in accordance with AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.

This report presents the results of an assessment of the proposed building design in regard to the IEQ-12 requirements of the Green Star – Office as Built V3 Technical Manual and Sydney Olympic Park Authority (SOPA) and other regulatory requirements.

2 PROJECT DESCRIPTION

The proposed commercial building is to be constructed at Site 8C Murray Rose Avenue, Sydney Olympic Park. The site forms part of the Jacaranda Square and Sydney Olympic Park Railway Station precinct and was previously utilised for carparking on the southern side of the Exhibition Complex and Ross, Binnie and Buring Pavilions at the Sydney Showground. The site is located approximately 38 m north of the Olympic Park rail line and approximately 450 m to the east of ANZ Stadium. The Project site is shown in **Figure 1**.

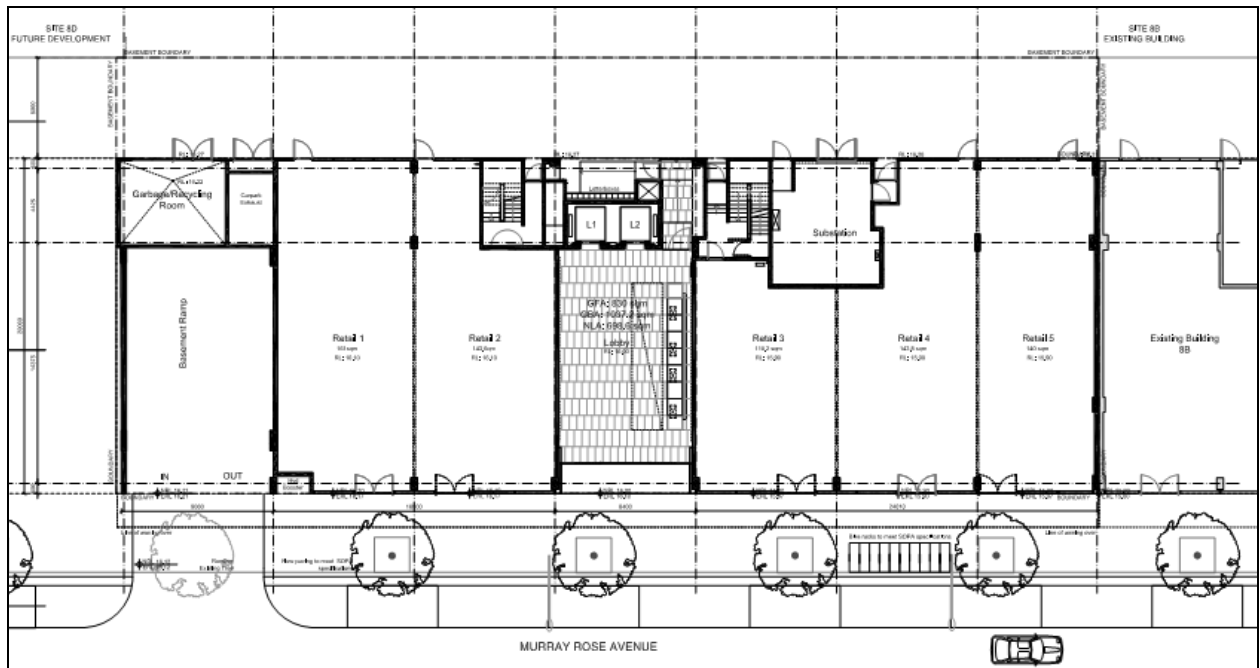
Figure 1 Project Site



Aerial image courtesy of Nearmap

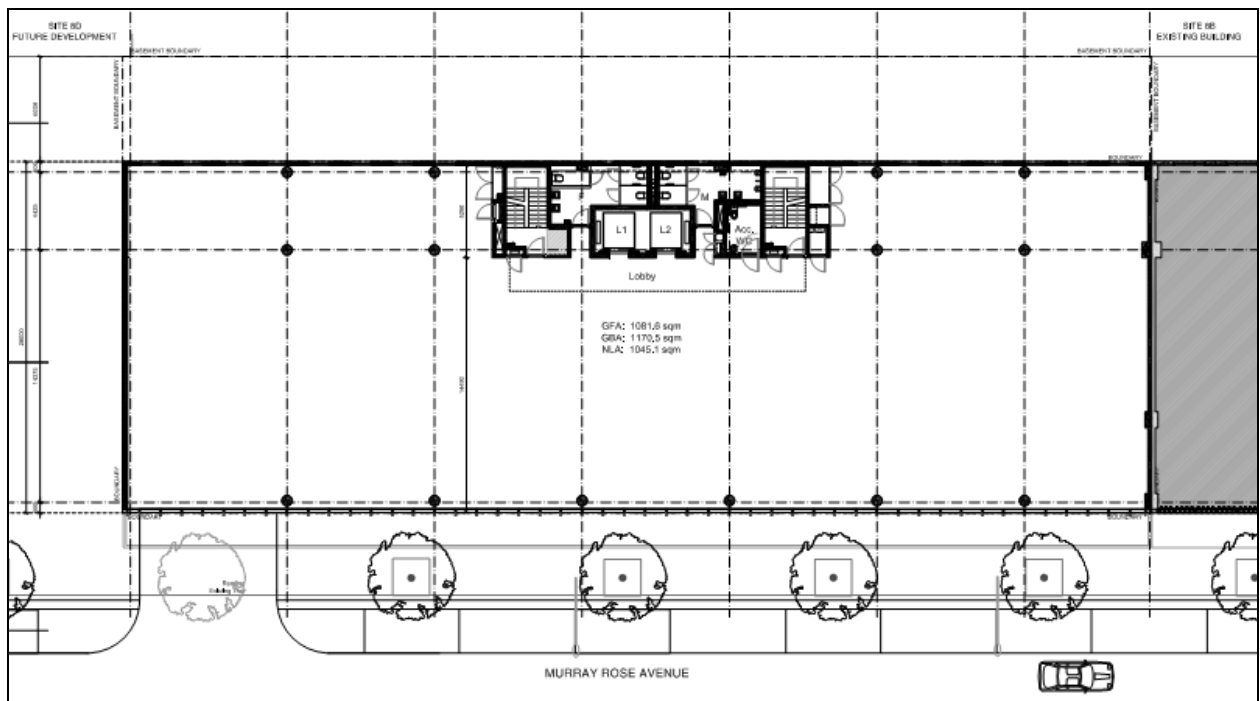
The Project building will be six storeys in height and provide two basement carparking levels, lobby and retail tenancies at ground level, five floors of general office space and a rooftop plantroom. The ground floor plan, typical floor plan and roof plant plan are shown in **Figure 2**, **Figure 3** and **Figure 4**.

Figure 2 Ground Floor Plan



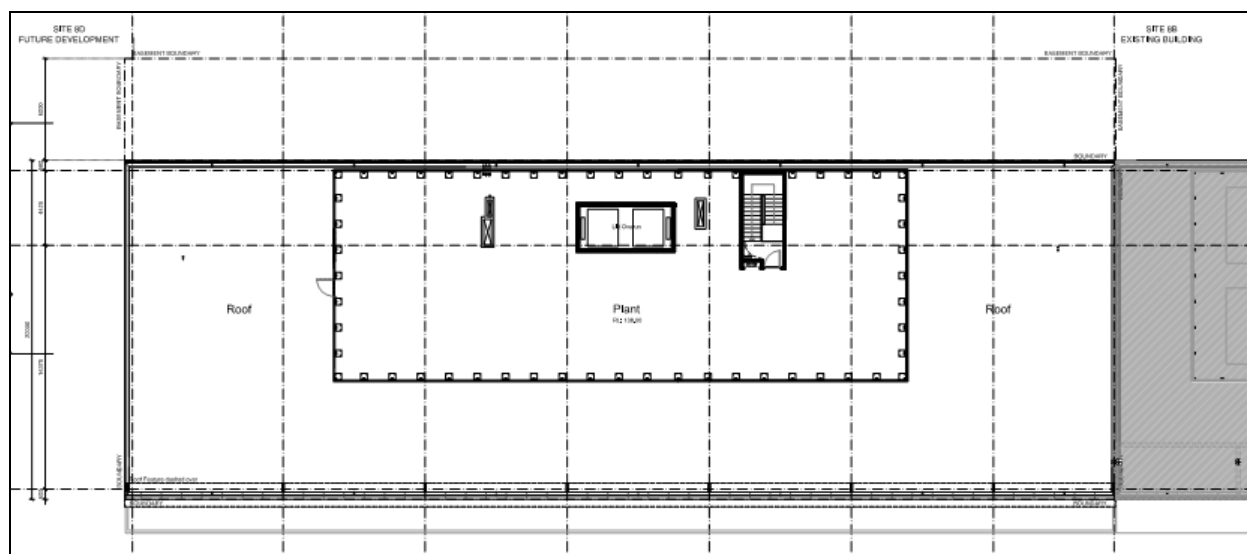
Drawing courtesy of FDC Construction & Fitout Pty Ltd

Figure 3 Typical Office Floor Layout



Drawing courtesy of FDC Construction & Fitout Pty Ltd

Figure 4 Roof/Plant Level Plan



Drawing courtesy of FDC Construction & Fitout Pty Ltd

The northern and southern facades of the building will typically comprise a cladding system featuring double glazing. The northern facade will incorporate a combination of precast panels with double glazed infill panels. The southern facade will comprise clear floor to ceiling double glazing. The walls on the eastern and western ends of the building will be of concrete blockwork construction.

The typical office floor plan will provide approximately 1045.1 m² Nett Lettable Area (NLA). The floor plan design aims at providing flexibility for future tenants. The building core is located centrally on the northern facade of the building.

3 DESIGN CRITERIA

3.1 Internal Noise Environment

The building must conform to the design objectives and development controls of the Sydney Olympic Park Authority.

The proposed commercial office building design will be targeting 5 Star Green Star Office Design V3. To encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level up to two points are awarded where it is demonstrated that for 95% of the building NLA, the building achieves the 'Satisfactory' ambient internal noise levels in accordance with AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors* as follows:

Building Services Design

- One point is awarded where, within the entire base building general office space, noise from the building services does not exceed an LAeq of 40 dBA.

Overall Building

- One point is awarded where within the base building office space, the sound level does not exceed an LAeq of 40 dBA.

In the evaluation of the overall noise level within the base building office space consideration must also be given to the potential for regenerated noise from rail movements on the underground Sydney Olympic Park rail line. Vibration generated by rail movements can travel through the ground and into the building structure where it can then re-radiate within the building as airborne noise. Levels of regenerated noise from rail movements must be at least 10 dB below the design criterion for airborne noise intrusion.

In addition we understand the following **Sound Performance Standard** is required by SOPA:

Sound Performance Standard means the design and construction of the Facility is capable of delivering a sound performance standard of not more than an average of all the readings taken from different places within the facility of 40_{L10} dB(A) (determined when the building is vacant and air conditioning plant is not operational) inside the Facility assuming that at the time the relevant readings inside the building are taken, noise sourced outside the Facility from land the subject of the RAS Lease and including land known as the Carnival site (being identified as part lot 1000, DP 1127564 on Australia Avenue east of the RAS exhibition halls and known as car park P6) is not more than 80_{L10} dB(A).

The intent of the SOPA requirement appears to ensure that noise emissions from the Sydney Showground, principally occurring during the staging of the Sydney Royal Easter Show, will not exceed an LA_{10} of 40 dBA within the proposed future office space. This requirement is consistent with IEQ 12 given that the equivalent LA_{eq} would be in the order of 37 dBA. Furthermore, to meet the Green Star IEQ requirement of an overall building noise level not exceeding LA_{eq} 40 dBA, the level of external noise intrusion and building services noise must each be designed to achieve an LA_{eq} of 37 dBA in order that the overall cumulative noise level (external noise ingress + building services noise) does not exceed LA_{eq} 40 dBA.

3.2 Environmental Noise Emissions

Environmental emissions from the Project should be designed to comply with the requirements of the NSW Environment Protection Authority's *Industrial Noise Policy* (INP).

The INP criteria for industrial (eg mechanical plant and equipment) noise sources have two components:

- Controlling the *intrusive* noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level *amenity* for particular land uses for residents and sensitive receivers in other land uses.

Intrusiveness Criterion

In setting an "Intrusive" noise goal, a statistically rigorous estimate of the ambient (background) LA_{90} noise level, termed the Rating Background Level (RBL), needs to be established at the nearest sensitive residential receivers. An "RBL plus 5 dBA" criterion is then applied to the 15-minute LA_{eq} noise emissions of the noise source in question at the receivers of interest (normally at their property boundary).

Intrusive Design Goal: $LA_{eq}(15\text{minute}) \leq \text{RBL} + 5 \text{ dBA}$

The "Intrusive" noise goal is only applicable to residential receivers.

Amenity Criterion

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. If present, the existing noise level from industry is generally measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. In order to determine the amenity noise goal, the maximum ambient LAeq noise levels within an area should not normally exceed the acceptable noise levels specified in **Table 1**. Where existing LAeq noise levels approach or exceed the acceptable noise levels given in **Table 1**, LAeq noise design goals are set below the existing LAeq levels in order to limit any further increase or “creep” in the ambient levels.

An extract from the NSW INP that relates to the amenity criteria recommended for the commercial receivers surrounding the Project site is given in **Table 1**.

Table 1 Amenity Criteria – Commercial Receivers

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq ¹ Noise Level	
			Acceptable	Recommended Maximum
Commercial premises	All	When in use	65 dBA	70 dBA

Notes:

- 1 The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
- 2 For Monday to Saturday, Daytime 7.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm – 7.00 am.
- 3 On Sundays and Public Holidays, Daytime 8.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm – 8.00 am.

4 PRELIMINARY ACOUSTICAL DESIGN EVALUATION

4.1 Ground-borne Noise from Olympic Park Rail Line

The prediction of ground-borne noise levels within a building can be performed using measured vibration levels taken at the footings of the proposed structure. To conduct this exercise, the following formula, as taken from the *Association of Noise Consultants - Measurement & Assessment of Groundborne Noise & Vibration Guidelines 2001*, has been implemented:

$$L_p = L_v - 27 \text{ dB} \quad \text{where:} \quad \begin{array}{l} L_p = \text{RMS noise level during a train passby event} \\ L_v = \text{RMS vibration velocity level of the floor} \end{array}$$

Vibration levels were previously measured on the adjacent Site 8B. Measurements of around 15 individual train passbys on the Sydney Olympic Park Rail Line were conducted at the proposed location of the footings of the commercial building to be constructed on the site. The measurements were carried out on 18 October 2010 between the approximate hours of 10:30 am and 1:30 pm, at two locations representative of the southern facade of the building (facing Olympic Park station). Measurements which were unduly affected by other sources of vibration in the area (ie vehicular movements on adjacent roads, pedestrians walking past the measurement site, etc) were considered erroneous and excluded from the data set.

To calculate ground-borne noise within the building the 95th percentile vibration data measured at the proposed footing location was used in combination with the above formula. It should be noted that ground-borne noise levels are only considered significant below frequencies of 315Hz. The overall ground-borne noise level was therefore calculated over the 5 Hz – 315 Hz range.

Table 2 Predicted Structure-borne Noise Level Associated with Train Passbys

Location	Predicted 95 th Percentile Ground-borne Noise Level (dBA)
Footings at southern facade of the commercial building at Site 8B	23

The results in **Table 2** indicate that the predicted 95th percentile ground-borne noise level from train passbys within the building on Site 8B would be in the region of 23 dBA. Given the proposed commercial building on Site 8C will be located a similar distance from the rail line, vibration levels at the footings on the future southern facade are expected to be similar to the previous measurement results. The predicted 95th percentile ground-borne noise level from train passbys within the building on Site 8C are determined to be around 23 dBA.

4.2 Airborne Noise Intrusion – Glazing Design

Ambient noise levels in the Sydney Olympic Park environs are generally lower than those typically experienced in commercial urban areas due to the decentralised nature of the precinct and the subsequent low traffic volumes.

4.2.1 Southern Facade

The southern facade of the future building will not be exposed to significant levels of noise. The highest levels likely to impinge on the facade at this location would be generated by intermittent traffic on Murray Rose Avenue.

The southern facade of the proposed building will comprise double glazing. The selection of the double glazed system employed will be based upon thermal considerations and as such will incorporate a fairly narrow airspace (usually around 12 mm to 25 mm) between the internal and external glazing. Given the area of glazing involved, the glass thickness is unlikely to be less than 6 mm. The demonstrated acoustical performance of a typical commercial system employing 6mm glass panels separated by a 12 mm airspace is around R_w 29. This system will enable the satisfactory noise level of 40 dBA (L_{Aeq}) for general office space, recommended by AS/NZS 2107:2000, to be comfortably achieved.

It is recommended that the external and internal panels of the double glazed system are of dissimilar thickness to avoid a coincidence dip at higher frequencies.

4.2.2 Northern Facade

The maximum noise exposure of the northern facade will occur during the period of the Sydney Royal Easter Show. The SOPA Sound Performance Standard addresses this scenario. In accordance with SOPA's requirement, with an L_{A10} noise level of 80 dBA at the boundary of the Carnival site (carpark P6), the noise level impinging upon the northern facade of the proposed building, a distance of approximately 200 m to the west is predicted to be around 43 dBA. Assuming double glazed units comprising internal and external panels of 6 mm glass separated by a 12 mm airspace and minimum tested performance of R_w 29, the predicted noise level within the office space due to airborne noise ingress from the Carnival site is likely to be around 20 dBA. The actual resulting internal noise level will be dependent upon the surface finishes within the office space and the amount of absorption provided by the ceiling tiles and carpet.

The actual ambient L_{A10} noise level at the northern facade of the proposed building is likely to be higher than 43 dBA due to the influence of general ambient noise from the Showground during the staging of the Sydney Royal Easter Show however typical commercial double glazing will enable the requirements of IEQ 12 and AS/NZS 2107:2000 to be comfortably achieved within the general office space.

It is recommended that the external and internal panels of the double glazed system are of dissimilar thickness to avoid a coincidence dip at higher frequencies.

4.3 Building Services Noise

The mechanical design for typical office floors utilises Mitsubishi Electric's City Multi YHM-A range. This range caters to large scale Variable Refrigerant Flow (VRF) systems.

The indoor units selected comprise the PEFY-PVMA type, ranging from 3.6 kW to 14 kW cooling capacity. The manufacturer's data reports measured sound pressure levels at 1.5 m varying between 34 dBA (on high) for the smaller 3.6 kW units to 44 dBA (on high) for a 14 kW unit.

The outdoor units comprise, typically, an R2 Series Heat Recovery Unit with a manufacturer's measured sound pressure level for a 14 kW unit of 64 dBA. No distance is given for this level but we would assume it to have been measured at between 1 and 3 m.

The plant is expected to operate during daytime hours only (that is, generally not beyond 6.00 pm).

4.3.1 Internal Noise Levels

The typical floor layout shows outside air fans (64 dBA) and toilet exhaust fans (59 dBA) with internally lined ducted inlets and outlets and substantial duct runs before the outside air ducting reaches any indoor VRF unit.

The fans themselves are located above ancillary space, not above office space, so breakout noise transmission through the ceiling will not be an issue.

In terms of satisfying the Green Star requirements, the items of significance are the indoor VRF units. The inlets and outlets to each unit are ducted using internally insulated flexible ductwork. Return air to the units will be via the ceiling plenum. Calculations conducted using the worst case unit, the PEFY-P125VMA on high, indicate that the 40 dBA criterion will be achieved in the immediate office area beneath the unit. A typical acoustical tile suspended ceiling has been assumed.

Ductborne noise transmission via the supply air ductwork from these typical units will achieve acceptable levels provided duct velocities are controlled to prevent excessive noise regeneration. The mechanical services planning should comply with the velocities recommended in **Table 3**.

Table 3 Maximum Acceptable Duct Velocites m/s

Criterion	Main Duct ²	Branch Duct ³	Run-out Duct ⁴
Insulated Duct ¹			
NR 30 – 39 dBA	6.8	5.0	3.5 (2.6) ⁵
NR 35 – 43 dBA	8.0	6.0	4.3 (3.2) ⁵
Un-Insulated Duct			
NR 30 – 39 dBA	5.6	4.2	2.8 (2.1) ⁵
NR 35 – 43 dBA	6.8	5.0	3.5 (2.6) ⁵

1 Internally insulated - minimum 25 mm fibreglass or rockwool.

2 Main Ducts - ducts within the criteria space followed by at least one elbow and run-out ducting.

3 Branch Ducts – ducts connected directly to the run-out ducting.

4 Run-out Ducts – ducts connected directly to the terminal register, or within five duct diameters of the register.

5 Recommended duct velocity for flexible ducting.

Selection of suitable air velocity for flexible ducting will vary according to duct construction. As a guide, use run out duct velocity reduced by 25% (shown in brackets in **Table 3**).

Noise emissions from hydraulic services, lift operation or any other building services, with the exception of the mechanical ventilation systems, will not contribute significantly to the LAeq(15minute) noise level within general office space. The levels of noise generated by these services will not be sufficient to affect the cumulative level of ambient noise within the general office space.

4.3.2 Environmental Noise Emissions

Noise emissions from carpark exhaust systems, roof top plant room etc shall not exceed 65 dBA at adjacent commercial premises and at the boundary of the site.

Based upon the manufacturer's data for the outdoor heat recovery units, environmental noise emissions from these units will comply with the INP requirements.

From review of the fan schedule it would appear that all the fans proposed will likely meet INP noise emissions limits.

The mechanical plant associated with the development must be reviewed by an appropriately qualified acoustic consultant at the detailed design stage when final plant selections have been made and mechanical layout is complete.

5 CONCLUSION AND RECOMMENDATIONS

SLR Consulting Australia Pty Ltd has conducted a Development Approval Phase review of noise and vibration issues associated with the construction of a six storey commercial office building at Site 8C Murray Rose Avenue, Sydney Olympic Park. This assessment has been carried out in accordance with NSW regulatory requirements and this report is to form part of a Development Application in support of the proposed development.

This report presents the results of an assessment of the proposed development in relation to the requirements of the Green Star – Office as Built V3 Technical Manual in regard to IEQ-12 Internal Noise Levels and the two credit points potentially awarded and the SOPA requirements in relation to acceptable internal noise levels.

The scope of the assessment involved review of the survey results of groundborne vibration levels previously measured on the adjacent Site 8B due to rail movements on the nearby underground rail line, establishment of assessment criteria for noise ingress to future general office space and noise emissions from the proposed building; an assessment of noise intrusion to future office space given calculated levels of regenerated noise and the calculated levels of ambient noise at the northern and southern facades relative to appropriate criteria; and, recommendations for glazing systems capable of achieving the internal noise levels required. Criteria for environmental noise emissions from the building itself are also given. The findings are as follows:

Internal Noise Levels

- Levels of regenerated noise due to rail movements on the nearby underground rail line will enable the design criteria for internal noise to be achieved.
- Compliance with IEQ-12 and SOPA requirements for internal noise levels can be achieved with double glazing on the northern and southern facades. The double glazing used should comprise, at a minimum, external and internal panels of 6 mm glass separated by a 12 mm airspace. It is acoustically preferable for the external and the internal glazing to be of different thicknesses, for example 6 mm and 10 mm glass, rather than comprising panes of the same thickness (eg 6mm and 6 mm).
- Compliance with project specific noise goals can be achieved by the building services design with the incorporation of appropriate acoustical treatments. Noise emissions to office space must be reviewed when the mechanical design has been finalised.

Environmental Noise Emissions

Environmental noise emissions from mechanical services should be designed so that operational levels do not exceed an LAeq of 65 dBA at the boundary of the site and adjoining commercial premises in accordance with INP requirements. This design goal can be achieved with the implementation of appropriate noise controls. Noise emissions to the external environment must be reviewed when the mechanical design has been finalised.