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Noise Impact Assessment

Reference: 220041

Prepared for: GL Investment Co PTY LTD ATF/GL No. 1 Trust

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Contents

Appendices

Index of Figures

Index of Tables

1 Executive summary

The proposed development being reported on is as issued under application number 4972-2011, Four Points by Sheraton Hotel Expansion, Lots 101 and 102 DP1009697, 161 Sussex Street, Sydney, by GL Investment Co PTY LTD ATF/GL No. 1 Trust.

In particular this report outlines responses to the following items in the DGR;

7. Noise

- Identify the main noise generating sources and activities at all stages of construction and during operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land
- Demonstrate that the development is of a type that is not sensitive to traffic noise or vehicle emissions, is appropriately located and designed or includes measures to ameliorate potential noise or vehicle emission impact
- Detail noise strategies which incorporate the mitigation of road traffic noise from the Western Distributer by the use of durable materials

This preliminary noise report details the comments and recommendations which include the following:

- Existing ambient and background noise levels were measured as mentioned below, which are used as a baseline in setting appropriate noise criteria to assess the impact of the surrounding on the development (details in Section 6).

Location	Time period	Ambient Noise Level LAeq dBA	Background Noise Level LA90 dBA
Sussex Street	Day	71	63
	Night	69	58
M4 Western Distributor Freeway	Day	77	73

Table 1 **|** Summary of attended noise measurements (All levels are in dBA)

- Section 7.1 of this report predicts the noise impact from the main noise generating construction activities for the project. Below is the construction noise criteria (Management Level) for proposed construction activities related to the hotel redevelopment.

Time Period	Management Level LAeq 15min
Recommended standard hours	71 dBA
Outside recommended standard hours	63 dBA

Table 2 **|** Construction noise criteria (LAeq 15min)

- Section 7.3 establishes the Operational noise criteria (project specific noise levels) mentioned below for the proposed hotel redevelopment.

Receiver Type	Project Specific Noise Level dBA
Residential	59 dBA
Commercial	59 dBA

Table 3 **|** Operational noise criteria (dBA)

- Section 7.4 through an example of external façade design demonstrates a strategy to reasonably mitigate noise impact from the traffic moving on M4 Western Distributor Freeway and other roads. Detailed noise mitigation strategies will be discussed in the succeeding acoustic design report.
- Identified potential noise sensitive receivers in close proximity of the site mentioned in Section 6.2 of this report.
- Based on preliminary assessment of the construction activities, some of the activities or combined noise levels from more than 1 equipment/mobile plant may marginally exceed the criterion dependent on the proximity to the nearest sensitive receiver and time of work. Construction noise management measures as per Section 7.2 should therefore be implemented.
- Based on the preliminary noise assessment, operational external noise level will comply with the NSW INP operational noise criteria.
- The key issue with the project remains the ongoing resolution of the design in consultation with the relevant infrastructure authority and stakeholder bodies.

2 Introduction

Aurecon has been engaged by GL Investment Co PTY LTD ATF/GL No. 1 Trust to provide an acoustic assessment along with other engineering services for the development application being submitted for their hotel redevelopment located at 161 Sussex Street in the Central Business District (CBD), Sydney.

This preliminary report responds to the relevant sections of the Director General's Environmental Assessment Requirements (DGR) issued on 9th February 2012 and provides the acoustic criteria which will form the basis of the acoustic design for the proposed redevelopment of the hotel.

This report has been prepared in accordance with the following documents:

- NSW Office of Environment & Heritage (OEH) *Industrial Noise Policy (INP):* DGR reference no. 7.
- Australian Standard AS/NZS 2107:2000 "*Recommended Design Sound Levels and Reverberation Time for Building Interiors*".
- Department of Planning Publication '*Development Near Rail Corridors & Busy Roads – Interim Guidelines' 2008:* DGR reference no. 7.
- Office of Environment & Heritage (OEH) *Interim Construction Noise Guideline (ICNG) 2009:* DGR reference no. 7.
- *National Construction Code (NCC) 2011*.

3 Proposed site

3.1 Site description

The proposed hotel redevelopment is located at 161 Sussex Street, Sydney, NSW. The site is located on the edge of the Sydney Central Business District, to the west of Sussex Street with the King Street and flyover extensions to the north plus west and the Market Street flyover to the south. Figure 1 below shows the location of the existing and proposed hotel in context to the Sussex Street and King Street flyover. The land usage of the surrounding area is mostly a mixture of commercial and office buildings plus a few residential receivers including the existing section of Four Points at Sheraton – the nearest sensitive receiver.

The Hotel is within the Darling Harbour precinct, which is identified as a State Significant Site. As the proposed development will have a capital investment value of more than $10 million it is declared to be a State Significant Development.

The overall design and functional intention of the Hotel Expansion Project is to:

- Increase the quantum of hotel accommodation in Darling Harbour;
- Significantly improve convention facilities;
- Remedy the current functionality of the hotel (both front and back of house areas);
- Improve the experience of the hotel and convention facilities for patrons; and
- Augment the hotel/convention facilities with new commercial office tenancies on the site

The Hotel Expansion project will provide the following outcomes:

- Twenty five (25) Storey Tower – consisting of :
  231 new Hotel Rooms and Suites in the lower 14 levels
  Commercial Office Space for the 7 levels above the Hotel levels;
- Convention space with associated Pre Function Areas;
- New Meeting Rooms, acting as breakout venues serving the Convention/ Ballroom Functions
- New breakout areas and dining venues to accommodate the increase hotel accommodation
- New / Upgrade Back of House areas to serve these new convention / ballroom venues;
- An activated of Slip Street and re-activated Corn Exchange Building;
- A heritage interpretation strategy to re-inforce the historical fabric of the site (trade and maritime uses);
- A direct, safe through site link to Darling Harbour;

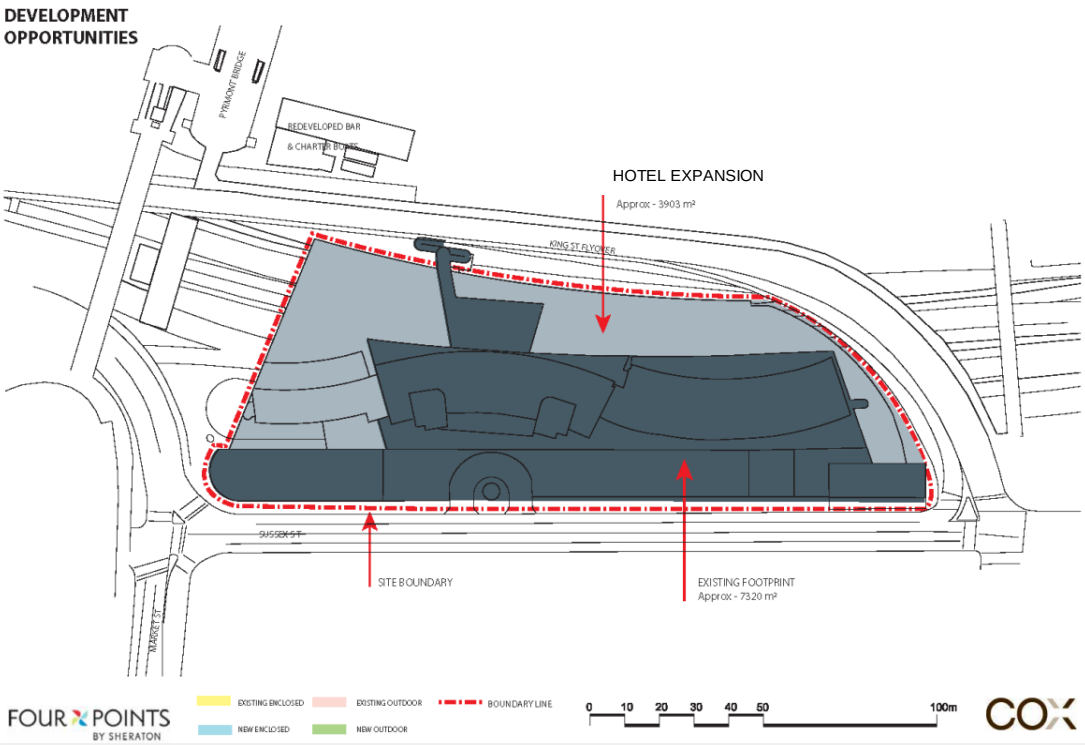

Figure 1 | Four Points Sheraton Hotel layout

4 Key design considerations

4.1 Noise and vibration impact of the project on the environment

Below is the scope of work from potential noise impact on the community from the project during construction stage:

- Identify sensitive land uses surrounding the site.
- Construction activities from the site (i.e. vehicle movements, loading and unloading, etc.) impacting on the surrounding properties.
- Recommend standard hours for construction work.
- Sleep disturbance considerations for the neighbouring residents from the night time construction work (if any).
- Application of feasible mitigation measures to minimise noise impacts.

Potential noise impacts on the community from the operation of the project are expected to be predominantly from the following:

- Mechanical plant and services equipment associated with the proposed facility
- Activities from the site (i.e. vehicle movements, loading and unloading, etc.)
- Music noise emissions from function and bar areas

4.2 External noise and vibration affecting the development

Environmental noise and vibration sources that may affect the proposed development are following:

- Traffic noise from King Street, M4 Western Distributor Freeway, Sussex Street transmitting through the external façade of the building.
- Noise from the nearby Darling Harbour ships noise (e.g. horn, engine noise, etc.).
- Address the amenity of the active slip street to meet the requirements as agreed with the SHFA.
- Mechanical plant and services from adjacent properties.
- Vibration and ground borne noise from the Monorail services.

4.3 Internal noise considerations

Internal acoustic issues within the hotel building that are to be considered in the acoustic design are following:

- Music noise transmission from function rooms to other areas
- Noise transfer between adjacent function areas.
- Internal background noise levels from services.
- Noise from plumbing into guest rooms, etc.
- Footfall noise floor to floors below.
- Noise transfer between adjacent hotel rooms
- Australian National Construction Code (NCC) legislative requirements.

5 Acoustic criteria

5.1 Noise emission criteria

The noise emissions from the development due to building services are addressed following the guideline in the Office of Environment & Heritage (OEH) Industrial Noise Policy.

5.1.1 NSW Industrial Noise Policy

The recommended noise levels emitted from industrial sources in NSW are outlined in the *NSW Industrial Noise Policy*. Intrusiveness and amenity criteria are determined based on type of receiver and existing ambient and background noise environment. The **intrusiveness** noise criterion requires that the $L_{Aeq\ 15minute}$ for the noise source, measured at the most sensitive receiver under worst-case conditions should not exceed the RBL by more than 5dB:

$$L_{Aeq,\ 15\ minute} \leq \textit{rating background level} + 5\ dB$$

Note: Rating background level (RBL) being defined as the median value of the measured $L_{A90,\ 15\ minute}$ for the assessment period

The **amenity criterion** is based on the ambient noise level at the receiver. Noise criteria for the protection of amenity are given for various types of receiver and different times of the day. The amenity criterion is set so that the L_{Aeq} noise level from the industrial noise source does not increase the total industrial noise levels at the receiver above the Acceptable Noise Levels (ANL) for that receiver. The criteria relate only to industrial type noise and do not include road, rail or community noise. The criteria are set based on how close the existing L_{Aeq} industrial noise levels are to the ANP, using the adjustment factors given in Table 2.2 of the INP to account for existing level for industrial noise. Amenity noise criteria from industrial noise sources for the type of noise sensitive receivers encountered during this assessment are shown in Table 4 below.

Recommended noise levels from industrial sources				
Type of Receiver	Indicative noise amenity area	Time of Day	Recommended LAeq Noise Level (dBA)	
			Acceptable	Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial	All	When in use	65	70

Table 4 **|** Recommended noise levels from industrial sources

The Acceptable Noise Level (ANL) from Table 4 is compared to the measured ambient noise level from which amenity criterion is determined by a set of conditions outlined in the Industrial Noise Policy.

The design criterion is taken to be the most stringent (lower) of the intrusive criterion and amenity criterion for all receivers

Times of day as defined in the NSW INP:

- Day – 7 am to 6 pm (8 am to 6 pm Sundays and public holidays)
- Evening – 6 pm to 10 pm
- Night – 10 pm to 7 am (10 pm to 8 am Sundays and public holidays)

5.2 Internal noise criteria

A number of documents were taken into account when determining suitable criteria for the proposed development. These documents include:

1. Australian Standard AS/NZS 2107:2000 "Recommended Design Sound Levels and Reverberation Time for Building Interiors".
2. Department of Planning Publication "Development Near Rail Corridors & Busy Roads – Interim Guidelines" 2008.

Among these documents, the most stringent criteria is set out in the City of Sydney Council's DCP.

5.2.1 AS/NZS 2107:2000

Typically, the recommended internal noise level L_{Aeq} for fully furnished spaces should meet the criteria presented in *Australian/ New Zealand Standard: Recommended design sound levels and reverberation times for building interiors AS/NZS 2107:2000*. Note that the designs for internal noise levels detailed in AS2107 are applicable only for steady state or quasi-steady state noise sources.

Type of occupancy/activity		Recommended L_{Aeq} Noise Level (dBA)	
		Satisfactory	Maximum
Hotel			
Conference areas -			
- Without sound reinforcement	Up to 50 persons	35	40
	From 50 - 250 persons	30	35
- With sound reinforcement		35	45
Dining rooms		40	45
Foyers and recreation areas		45	50
Kitchen, laundry and maintenance areas		45	55
Sleeping areas-	Hotels near major roads	35	40
Washroom and toilets		45	55

Table 5 **|** Recommended LAeq noise levels from AS2107:2000

5.2.2 Development near Rail Corridors and Busy Roads

The Development of Planning (NSW government) document "*Development Near Rail Corridor and Busy Roads – Interim Guideline*" sets the criteria for noise in a residential building from a busy road summarized below. The proposed guest rooms in the hotel would be considered similar to a bedroom of a residential building for the purpose of allocating noise criteria.

"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LA_{eq} levels are not exceeded:

- in any bedroom in the building : **35**db(A) at any time 10pm – 7am
- anywhere else in the building (other than a garage, kitchen, bathroom or hallway): **40**dB (A) at any time".

5.2.3 WHO Guideline

In addition to the above, the World Health Organization (WHO) Guidelines for Community Noise (1999) and the OEH it is recommended that:

- Where the noise is continuous, the sound pressure level indoors should not exceed Leq 30dBA.
- Limit the maximum internal noise levels to Lmax 45dBA.
- Internal noise levels below Lmax 50-55 dBA are unlikely to cause awakening reactions.

One or two noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly.

Summary:

Type of occupancy/activity		Satisfactory Recommended L_{Aeq} Noise Level (dBA)	Document referred
Hotel			
Sleeping areas	Hotels near major roads	35	AS/NZS 2107:2000
Dining rooms		40	
Foyers and recreation areas		45	
Kitchen, laundry and maintenance areas		45	
Washroom and toilets		45	
Conference areas -			
- Without sound reinforcement	Up to 50 persons	35	
	From 50 - 250 persons	30	
- With sound reinforcement		35	

Table 6 **|** Summary of the internal noise criteria

5.3 Internal sound insulation criteria

As a minimum requirement, walls and floors and separation of services shall comply with the National Construction Code (NCC) 2011.

5.3.1 NCC 2011

The acoustic provisions for inter-tenancy walls in Class 3[1] building are outlined in the National Construction Code (NCC) and the following is an extract from the NCC:

F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

i. have the required value for weighted sound reduction index (Rw) or weighted sound reduction index with spectrum adaptation term (Rw + Ctr) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or
ii. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

(a) A floor in a building required to have an impact sound insulation rating must –

i. have the required value for weighted normalised impact sound pressure level with spectrum adaptation term (Ln,w + CI) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or
ii. comply with Specification F5.2.

(b) A wall in a building required to have an impact sound insulation rating must –

i. for a Class 2 or 3 building be of discontinuous construction.

[1] As per NCC Class 3 building - a residential building for a number of persons such as a large scale boarding house, guest house, hostel, the residential part of a hotel, motel ,school, etc.)

(c) For the purposes of this Part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F5.4 Sound insulation rating of floors

A floor in a Class 2 or 3 building must have an Rw + Ctr (airborne) not less than 50 and an Ln,w + Cl (impact) not more than 62 if it separates –

i. sole-occupancy units; or
ii. a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

F5.5 Sound insulation rating of walls

(a) A wall in a Class 2 or 3 building must –

i. have an Rw + Ctr (airborne) not less than 50, if it separates sole-occupancy units; and
ii. have an Rw (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and
iii. comply with F5.3(b) if it separates:
   A. a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or
   B. a sole-occupancy unit from a plant room or lift shaft.

(b) A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an Rw not less than 30.

(c) Where a wall is required to have sound insulation has a floor above, the wall must continue to –

i. the underside of the floor above; or
ii. a ceiling that provides the sound insulation required for the wall.

(d) Where a wall required to have sound insulation has a roof above, the wall must continue to –

i. the underside of the floor above; or
ii. a ceiling that provides the sound insulation required for the wall.

5.3.2 Typical recommended design criteria for inter tenancy walls and floors

Type of occupancy		Recommended criteria	Document referred
Occupancy 1	Occupancy 2		
Sole occupancy unit	Sole occupancy unit	FLOOR >50 R_w + Ctr (Airborne) < 62 $L_{n,w}$ + Cl (Impact) WALLS >50 R_w+Ctr	NCC 2011
	Plant room		
	Lift shaft		
	Stairway		
	Public corridor		
	Public lobby		
Sole occupancy unit	Bathroom	Discontinuous wall having ≥20mm cavity between 2 leaves.	
	Sanitary compartment		
	Laundry		
	Kitchen		
	Plant room		
	Lift shaft		
Sole occupancy unit	Stairway	DOOR >30 R_w	
	Public corridor		
	Public lobby		

Table 7 **|** Typical recommended design criteria for inter tenancy walls/ floors

5.4 Construction noise criteria

The guidelines for control of construction noise as outlined in AS2436-2010: *Guide to noise and vibration control on construction, demolition and maintenance sites* shall be applied where appropriate.

5.4.1 NSW OEH Construction Noise Guidelines

This Interim Construction Noise Guideline ICNG (the Guideline) has been developed by a number of agencies including the Environmental Protection Authority NSW (EPA, then the Department of Environment and Climate Change), NSW Department of Planning and Infrastructure, Roads and Maritime Services, NSW (RMS), Work Cover NSW and NSW Health together with the Local Government and Shires Associations of NSW.

5.4.1.1 Recommended standard hours

The recommended standard hours identified in the Interim Construction Noise Guideline are shown in Table 8. There are some situations where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Work Type	Recommended standard hours of work
Normal construction	Monday to Friday 7am to 6pm
	Saturday 8am to 1pm
	No work on Sundays or public holidays

Table 8 **|** Recommended standard hours for construction work

5.4.1.2 Airborne noise for residences

People's reaction to noise from construction will depend on the time of day that works are undertaken. Night time works has the potential to disturb sleep. Noise from work on evenings, Saturday afternoons, Sundays and public holidays can also interrupt leisure activities.

Table 9 sets out management levels for noise at residences and how they are to be applied. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

In Table 9 (reproduced from Table 2 Section 4.1.1 of the ICNG 2009) the rating background level (RBL) is used when determining the management level for the works that are likely to affect an individual or sensitive land use for more than three (3) weeks in total. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Interim Construction Noise Guideline		
Time of day	**Management level LAeq (15 min) ***	**How to apply**
Recommended standard hours: Monday to Friday (7 am to 6 pm) Saturday (8 am to 1 pm) No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB (A) above the noise affected level, the proponent should negotiate with the community.

Table 9 **|** OEH ICNG management level at residence using quantitative assessment

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence. The difference between internal noise levels and external noise levels is around 10dB with windows open for adequate ventilation.

5.4.1.3 Other sensitive land uses

Table 10 below (reproduced from table 3 Section 4.1.2 of the ICNG 2009) sets out the noise management levels for various sensitive land use developments.

Land Use	Management level, LAeq(15min) (applies when property is being used)
Classrooms at schools and other educational institutions	Internal noise level (45 dBA)
Hospital wards and operating theatres	Internal noise level (45 dBA)
Places of worship	Internal noise level (45 dBA)
Active recreation areas	External noise level (65 dBA)
Passive recreation areas	External noise level (60 dBA)
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107:2000 for specific uses.

Table 10 **|** OEH ICNG Construction noise criteria at other sensitive land uses

5.5 Vibration

The two standards that will be consulted in determining the vibration impact on the proposed building from the neighbouring road/ rail traffic and construction activities are given below:

- Office of Environment & Heritage OEH *Assessing Vibration: A Technical Guideline* February 2006. This documents draws similar background references as ISO 2631.1-1997, *Mechanical vibration and shock- Evaluation of human exposure to whole body vibration – Part 1; General requirements*, and ISO 2631.2-1989, *Evaluation of human exposure to whole body vibration - Part 2; Continuous and shock induced vibration in buildings (1-80Hz)*
- German Standard DIN 4150-3 *Structural Vibration Part-3 – Effects of vibration on structures*.

5.5.1 Human comfort

The OEH has developed a document, '*Assessing vibration: A Technical Guideline*' in February 2006 to aid in protecting people from vibration levels above preferred and maximum values felt inside buildings. The guideline does not however address vibration induced damage to structures or building contents or structure-borne noise effects.
Vibration and its associated effects with regards to human comfort are usually classified as continuous, impulsive or intermittent as follows:

- Continuous vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms (Root Mean Square) acceleration values presented in the guideline;
- Impulsive vibration is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration. It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds. Impulsive vibration is assessed on the basis of weighted rms acceleration values presented in the guideline; and
- Intermittent vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. It may originate from impulse sources or repetitive sources or sources which operate intermittently, but which would produce continuous vibration. This type of vibration is assessed on the basis of vibration dose value.

5.5.1.1 Continuous and impulsive vibration

The maximum allowable magnitudes of building vibration provided in the Technical Guideline with respect to human response are shown in and below.

Time of Space Occupancy	Time of Day	Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration 1-80Hz (m/s^2)			
		Z-axis		X-Y axis	
		Preferred	Maximum	Preferred	Maximum
Residential (Continuous)	Day	0.010	0.020	0.0071	0.014
	Night	0.007	0.014	0.005	0.010
Residential (Impulsive)	Day	0.30	0.60	0.21	0.42
	Night	0.10	0.20	0.071	0.14

Table 11 **|** Human Comfort Vibration Limits for Continuous/ impulsive acceleration (1Hz-80Hz)

* Daytime is 07:00am to 10:00pm and night time is 10:00pm to 07:00am

Time of Space Occupancy	Time of Day	Preferred and maximum weighted rms values for continuous and impulsive vibration velocity 1-80Hz (mm/s)			
		rms velocity dB re 10^{-9}mm/s (mm/s)		Peak velocity (mm/s)	
		Preferred	Maximum	Preferred	Maximum
Residential (Continuous)	Day	0.20	0.40	0.28	0.56
	Night	0.14	0.28	0.20	0.40
Residential (Impulsive)	Day	6.0	12.0	8.6	17.0
	Night	2.0	4.0	2.8	5.6

Table 12 **|** Human Comfort Vibration Limits for Continuous/ impulsive velocity (1Hz-80Hz)

* Daytime is 07:00am to 10:00pm and night time is 10:00pm to 07:00am

5.5.1.2 Intermittent vibration

Disturbance caused by vibration will depend on its duration as well as its magnitude. This method involves the calculation of a Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of bursts of intermittent vibration. Various studies have shown that VDV assessment methods far more accurately assess the level of disturbance than methods which assess the vibration magnitude only.

The VDV is the fourth root of the integral of the fourth power of vibration with respect to time. The VDV represents an 'amount' of vibration. In assessing the VDVs, criteria detailed in BS6472:1992 'Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80Hz)' are used, however the base values and multiples are converted into VDVs assuming constant levels over a 15 hour day and a 9 hour night. The resulting VDV criteria are shown in Table 13.

Location	Time Period	Low Probability of Disturbance VDV
Residential (Intermittent)	Day (7:00am – 10:00pm)	0.2 - 0.4
	Night (10:00pm – 7:00am)	0.13 - 0.26

Table 13 **|** Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

5.5.2 Structural damage

The German Standard DIN4150-3 *Structural Vibration Part 3 – Effects of vibration on structures* is used to measure and evaluate the effects of vibration on structures designed primarily for static loading.

5.5.2.1 Short term vibration

Vibration impact is classified under two broad categories as per DIN4150-3, short term and long term. Short term vibrations are those which do not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated. Long term vibrations are all other types of vibrations which are not covered in the definition of short term vibration category. Below is the table outlining the vibration velocity guideline used to evaluate the effects of short term vibration on residential properties.

Type of Structure	Guideline values for velocity in mm/s			
	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	**10 Hz to 50 Hz**	**50 Hz to 100 Hz**	
Dwellings and building of similar design and/or occupancy	5	5 to 15	15 to 20	15

Table **14** | Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

At frequencies above 100Hz, the values given in column 50Hz to 100 Hz in the table above may be used as minimum values.

The levels in **Table** 14 have been established by the Standard such that no damage will occur up to the limits. The levels are considered conservative, i.e. vibration levels that exceed the limits will not necessarily translate into structural damage. The Standard defines damage to include cracks forming in plastered surfaces of walls, existing cracks in a building becoming enlarged, and separation of lightweight walls from load bearing walls. Most commonly specified “safe” structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

5.5.2.2 Long term vibration

Table below gives the guideline values for the highest value of the two horizontal components measured in the top floor. If a building is subjected to harmonic vibration, then the maximum values can also occur in floors other than the top floor, or in the foundation. The values given in table also apply in these cases.

Type of Structure	Guideline values for velocity in mm/s of vibration in horizontal plane of highest floor, at all frequencies.
Dwellings and building of similar design and/or occupancy	5

Table 15 **|** Guideline values for vibration velocity to be used when evaluating the effects of long-term vibration on structures

6 Noise survey

6.1 Purpose of the noise survey

Noise survey involving attended monitoring has been conducted around the site. The purpose of the noise survey was to:

- Identify existing ambient noise levels, as a baseline in setting appropriate noise criteria to assess the impact of the surrounding on the development.
- Identify the existing background noise levels to be used in setting appropriate construction noise criteria and project specific noise criteria.
- Identify sources and levels of noise that are most likely to affect the development.
- Identify potential noise sensitive receivers in the vicinity.

6.2 Noise sensitive receivers

The noise sensitive residential receivers in close proximity to the site are at 365 Kent Street, 18 King street, 27 King street, 200 Sussex Street (Shelbourne Hotel) NSW, eastern side of the existing Four Points Hotel along Sussex Street. Noise sensitive commercial receivers in close proximity are the buildings between 2 -140 Sussex Street, eastern side of the existing Four Points Hotel. Location of sensitive receivers could be found in Figure 2**.**

6.3 Instrumentation

Table 16 shows the equipment used for all the measurements performed on site. On site calibration of the sound level meter was conducted immediately prior to and following measurements. Changes in the calibration were observed to be ≤ 0.4dB for all instrumentation used.

Equipment	Make	Model	Serial No.	Type	Last Calibration	Calibration Due
Sound Level Meter	LD	831	0001595	1	26.08.10	26.08.12
Calibrator	LD	CAL200	6345	-	26.08.11	26.08.12

Table 16 **|** Sound Pressure Level measurement equipments

Attended noise measurements (15 minute) were conducted on 28/05/2012 at various locations. The background and ambient noise measurements were conducted using a Larson Davis 831 Type 1 sound level meter which was set to 'A' frequency weighting, 'F' time weighting, and was fitted with an approved windshield. Measurements were typically taken at a height of 1.2 metres and at least 3.5 metre from any reflecting surface other than the ground. The measurement period at each location consisted of 15 minutes. A Larson Davis CAL200 was utilised to calibrate all sound level meters before and after each series of measurements with no significant calibration drift noted. Measurements were typically taken in accordance with the Australian Standard AS 1055 1997: Acoustics – Description and measurement of environmental noise.

6.3.1 Results

Figure below shows the location of the attended measurements and sensitive residential receivers in context to the existing Four Points Hotel.

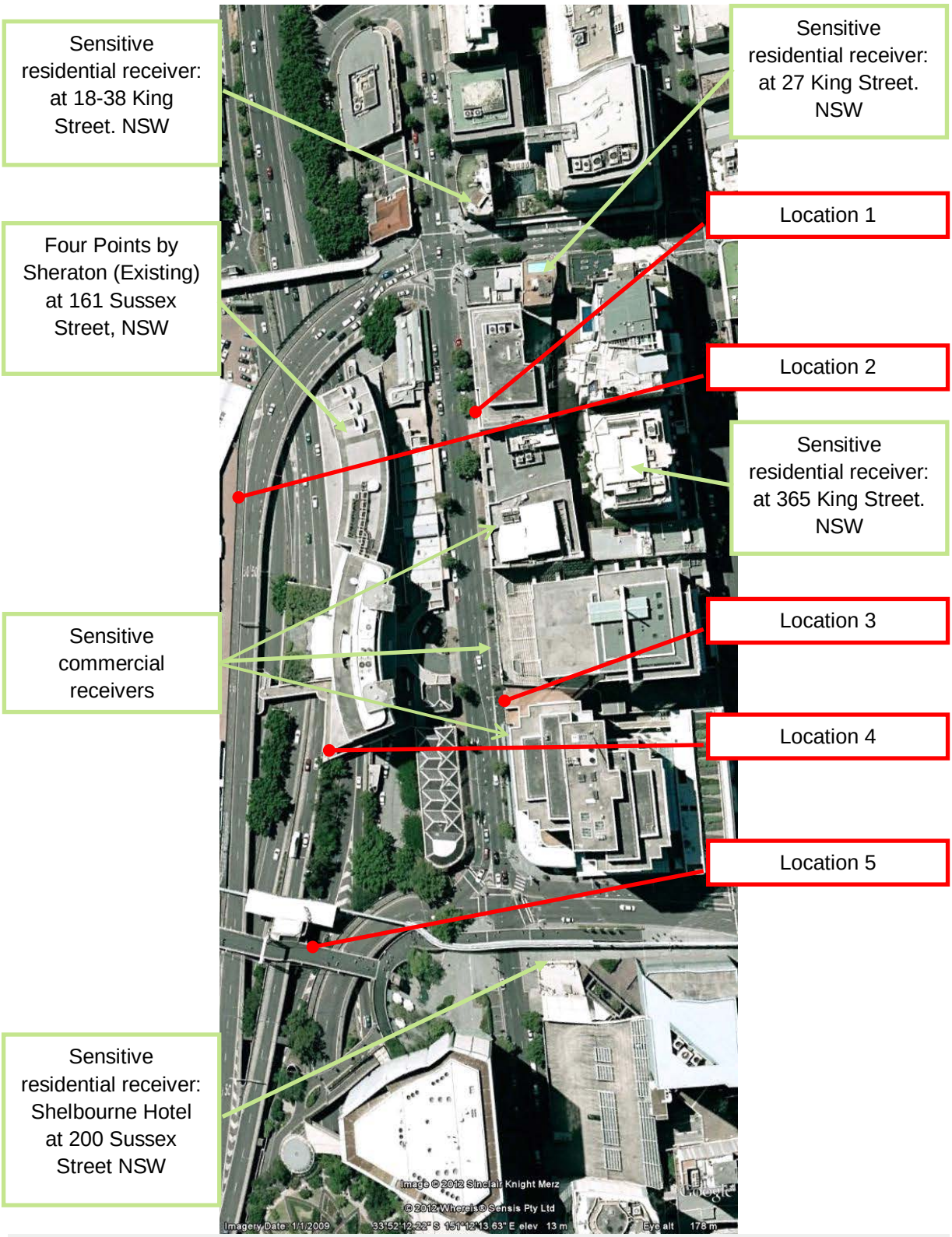

Figure 2 | Measurement locations and noise sensitive receivers

Below are the results of the attended noise measurements conducted on 28/05/2012.

Location	Date/Time of measurement	Time period	LAeq dBA	LA90 dBA[2]	Noise Description
Location 1	28/05/12 – 02:51pm	Day	69	61	Noise contribution predominantly from traffic on Sussex Street and M4 Western Distributor Freeway, King Street
	28/05/12 – 05:16pm	Day	71	63	
	28/05/12 – 10:49pm	Night	69	58	
Location 2	28/05/12 – 03:10pm	Day	72	68	Noise contribution predominantly from traffic on M4 Western Distributor Freeway and Harbour Street
Location 3	28/05/12 – 11:06pm	Night	69	58	Noise contribution predominantly from traffic on Sussex Street and Market Street
Location 4	28/05/12 – 03:53pm	Day	77	73	Noise contribution predominantly from traffic on M4 Western Distributor Freeway, Harbour Street and King Street
	28/05/12 – 04:57pm	Day	76	74	
Location 5	28/05/12 – 03:30pm	Day	74	72	

Table **17** | Summary of attended noise measurements (All levels are in dBA)

[2] Note: Rating background level (RBL) being defined as the value of the measured LA90, 15 minute for the assessment period

7 Preliminary assessment

7.1 Noise assessment - Construction

This section deals with the assessment of the construction/demolition noise from the proposed construction activities at the 161 Sussex Street redevelopment as per the Interim Construction Noise Guideline. Below are the assumptions taken into consideration.

- Standard hours of work during construction for the project has been assumed as Monday to Friday (7am to 6pm); Saturday (8am to 1pm) and no work on Sundays or Public holiday. All work other than the above mentioned time period including night time activities are considered to the work outside the recommended standard hours. Separate Management Levels (Construction noise criteria) have been adopted for these two time periods as mentioned in Table 18 below.
- Lowest Rating Background Level (RBL) as described in the NSW INP at the nearest sensitive receivers was measured as 61 dBA during the day time period (Location 1) and 58dBA during the night time period (Location 1). Refer to Table 17 for measured RBL.
- Below are the Management Levels (LAeq 15min) suitable for all nearest residential properties on the Sussex Street for the proposed construction activities at 161 Sussex Street Redevelopment based on the procedure mentioned in Table 9 referenced from OEH ICNG.

Time Period	Management Level LAeq 15min
Recommended standard hours	RBL (61) +10 = 71 dBA
Outside recommended standard hours	RBL (58) + 5 = 63 dBA

Table 18 **|** Construction Noise criteria/ Management Level (LAeq 15min)

- Entire construction activities will be conducted for more than three (3) weeks.
- Typical construction activities would consist (but not limited to) of the following:
  - Loading and unloading during the construction of tower building.
  - Movement of mobile plants (large trucks, etc.) in and out of the construction site.
  - Lifting of heavy materials (e.g. reinforcements, formwork, etc.) with fixed tower cranes.
  - Drilling of foundation/piles with special rigs.
  - Earthworks.
  - Demolition of existing structures.
  - Typical distance of the construction equipment and mobile plants till the nearest sensitive receivers are in the range of 20 - 90m.
- List of typical construction equipment and mobile plants to be used during the proposed construction are given below along with their sound power levels. This information has been

referenced from *AS2436-2000 Guide to noise and vibration control on construction demolition and maintenance sites*.

Mobile Plant/ Equipment	Sound Power Levels (Typical mid –point SWL dBA)
Excavator	107
Rollers	108
Dump Trucks	104
Aggregate Spreaders	95
Crane (mobile)	104
Crane (tower)	105
Pilling (bored)	111

Table 19 **|** Sound Power Levels of Mobile Plants

7.1.1 Equipment noise

Table below lists the typical construction plant and equipment and the sound pressure levels at various distances.

Mobile Plant/ Equipment	Sound Pressure Levels (SPL dBA at 20m)	Sound Pressure Levels (SPL dBA at 50m)	Sound Pressure Levels (SPL dBA at 100m)
Excavator	73	64	56
Rollers	74	65	57
Dump Trucks	70	61	53
Aggregate Spreaders	61	52	44
Crane (mobile)	70	61	53
Crane (tower)	71	62	54
Pilling (bored)	77	68	60

Table 20 **|** Sound Pressure Level of equipment/ mobile plants at various distances

The sound pressure levels at the boundary of the sensitive receivers are dependent on the sound power level of the equipment/ mobile plant and the distance between the source – receiver. There has been no consideration given to the barrier attenuation (noise reduction due to breaking of the line of sight of source – receiver for calculating the sound pressure level.

7.1.2 Construction noise assessment - Conclusion

Based on the preliminary assessment of the construction activities, some of the activities or combined noise levels from more than 1 equipment/mobile plant may marginally exceed the criterion dependent on the proximity to the nearest sensitive receiver and time of work. Construction noise management measures as per Section 7.2 should therefore be implemented. Further, attended noise measurements during the construction phase could be undertaken to assess the noise levels against the construction noise criteria.

Above assessment is based on preliminary attended measurements conducted at the site, assumed construction equipments and distances of source-receivers. A detailed analysis of noise impact will be conducted at a later stage after acquiring precise information about the construction activities.

7.2 Construction noise management measures

Below are some of the general noise management measures that could be employed for minimising construction noise and vibration at the nearest sensitive receivers. Work practices that minimise noise levels on site and provide for proper communication with the community are generally the most effective at managing noise.

7.2.1 Transmission path

- To reduce the line-of-sight noise transmission to residences or other sensitive land uses employ temporary barriers.
- Temporary noise barriers can be constructed from hoarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels at the site boundary. Stockpiles, shipping containers and site office transportables can be effective barriers.
- Erect temporary noise barriers before work commences to reduce noise from works as soon as possible.
- Where high-rise dwellings adjoin the construction site, the height of a barrier may not be sufficient to effectively shield the upper levels of the residential building from construction noise. Check whether this is a consideration for the project and examine alternative means of mitigation where needed.
- Consult with most affected neighbours about how effective the proposed noise mitigation measures will be in addressing their concerns.

7.2.2 Plant and Equipment

7.2.2.1 Use Quieter Methods

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.

7.2.2.2 Use Quieter Equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting less noisy plant.
- Pneumatic equipment is traditionally a problem – select supersilenced compressors, silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.

7.2.3 On Site

Acoustic Barriers and acoustic sheds are most suited to long term fixed works, as in these cases the associated cost is typically outweighed by the overall time savings.

7.2.3.1 Location of Equipment

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.
- Locate site vehicle entrances away from residences and other sensitive land uses.
- Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.

7.2.3.2 Maximise shielding

- Reuse existing structures rather than demolish and reconstruct.
- Use temporary site buildings and materials stockpiles as noise barriers.
- Schedule construction of permanent walls so that they can be used as early as possible as noise barriers.
- Use natural landform as a noise barrier - place fixed equipment in cuttings, or behind earth berms.
- Note large reflecting surfaces on and off site that might increase noise levels, and avoid placing noise-producing equipment in locations where reflected noise will increase noise exposure or reduce the effectiveness of mitigation measures.

7.3 Noise assessment - Operational

Based on the attended noise data, the background, amenity, intrusiveness criteria and Project Specific Levels (Operational noise criteria) are shown in Table 21 below as per the NSW INP. All values are rounded to the nearest 1 dB. The nearest residential properties are adjacent to Sussex Street with most of the noise contribution from the traffic moving on the Sussex Street and M4 Western Distributor Freeway. Our calculation has considered the worst-case scenario (night time) for the entire day. Attended noise levels at Location 1 have been used to calculate Project Specific Noise Criteria for residential properties. For the purpose of this assessment, a short term noise survey is deemed to be appropriate in accordance with NSW INP. Recommended acceptable noise level in table below for residential (45dBA) and commercial (65dBA) has been referenced from Table 4 (Recommended noise levels from industrial sources)

Receiver Type	Period	Existing LAeq dBA	Existing RBL dBA	Recommended Acceptable LAeq dBA	Amenity Criteria dBA	Intrusive Criteria dBA	Project Specific Level dBA [C]
Residential	Night	69	58	45	59[B]	63	59[A]
Commercial	When in use	69	61	65	59[B]	66	59[A]

Table 21 **|** Amenity/ Intrusive Criteria and Project specific Noise levels

[A]: Based on Amenity Criterion

[B]: Existing level unlikely to decrease in future

[C] Note: Project specific noise levels are applicable to the new mechanical equipment/ plant to be installed within the hotel property and not for the existing mechanical equipment.

Operational noise criterion for the Hotel redevelopment is given below:

Receiver Type	Project Specific Noise Level dBA
Residential	59 dBA
Commercial	59 dBA

Table 22 **|** Operational noise criteria (dBA)

7.3.1 Noise emission

This section deals with preliminary noise emission calculation based on the mechanical design of the proposed hotel redevelopment. Worst case scenarios have been taken into consideration which are plant room at level 15 having 8 Air Handling Units (AHU) and plant room at level 22 having four (4) Cooling towers, two (2) pressurized fans, two (2) hot water boilers, four (4) condenser water pumps and two (2) heating water pumps. Table below demonstrates the external noise emissions from the mechanical plant rooms.

Plant room level	Combined Sound Power Level from all the mechanical plants (dBA)	External noise level at 1m distance from the façade (dBA)	Operational external noise criteria (dBA)	Compliance
Level 15	98	<40dBA	59	Yes
Level 22	99	<40dBA	59	Yes

Table 23 **|** Operational external noise emission calculation (dBA)

Below are the assumptions made for predicting the external noise emissions:

- Typical plant room dimensions taken as 30m (Length) x 30m (width) x 4m (Height).
- Sound Power Level of a typical Air Handling Unit (AHU) has been considered as 89 dBA.
- Sound Power Level of a typical Cooling Tower (CT) has been considered as 93 dBA.
- Reverberation time inside the meeting room based on the amount of absorptive material on the internal surface areas has been taken as 1sec.
- No operable windows are permitted on plant room facades.
- External façade wall for both the plant rooms have been considered as 300mm solid brick wall.

7.3.2 Operational noise assessment - Conclusion

Based on the preliminary noise assessment operational external noise level will comply with the NSW INP operational noise criteria.

Above assessment is based on preliminary attended measurements conducted at the site, assumed sound power levels of mechanical plants/ equipments and typical external façade design for plant rooms. A detailed analysis of noise impact will be conducted at a later stage after acquiring precise information about the construction activities.

7.4 Façade design

Based on the attended measurements near the site, the maximum ambient noise levels that were recorded were 77 dBA during the day time period at the western face of the existing Four Points Hotel (refer to figure 2 for exact position of measurement location). Satisfactory recommended noise level (LAeq) inside the meeting room/conference room with sound reinforcements as per the AS2107:2000 is 35-45 dBA (refer Table 24). Meetings room/ conference rooms are planned at the ground and

mezzanine level compared to the guest rooms which are planned at higher floor levels as per the preliminary design supplied by the architect. Calculation below takes into consideration the worst case scenario of meeting room/ conference room which are nearest to the noise source (i.e. traffic on road) as per the preliminary design. General sound reduction properties of the external façade to ensure sufficient internal ambient noise levels as per the Australian and international standards are also discussed below.

Description	Octave band centre frequency (Hz)								Total	
	63	125	250	500	1000	2000	4000	8000	dB	dBA
External ambient noise levels (dBA)	52	57	63	68	74	70	58	47	82	77
Façade transmission loss (6mm glass+12mm airgap + 12.76mm laminated glass)	26	26	28	38	47	43	51	51	-	-
Internal ambient noise level (Meeting room dBA)	26	32	35	31	28	28	8	0	54	38

Table 24 **|** Façade transmission loss calculation

Below are the assumptions made for predicting the meeting room internal noise level:

- Typical meeting room dimensions taken as 15m (Length) x 12m (width) x 3m (Height)
- Reverberation time inside the meeting room based on the amount of absorptive material on the internal surface areas has been taken as 0.5sec.
- External ambient noise levels is assumed to be diffused in nature and surrounding the entire hotel façade with no disparity.
- Meeting room western wall is assumed to be facing the M4 Western Distributor Freeway with its 40% western wall surface comprising of double glazed fixed window.
- No operable windows is permitted on these facades.

Below are some of the properties for external façade treatments that would achieve the required internal noise levels:

- Sound Reduction Index (SRI) for the solid areas external façade Rw>50
- Minimum transmission loss characteristic of the external façade is given in Table 24.
- External ambient noise levels at the ground level of the proposed hotel will be higher than the external ambient noise levels at higher floor level because of the distance attenuation from the primary noise sources, which are the traffic moving on the roads. Thus based on our professional experience Sound Reduction Index (SRI) for the external façade at higher floors would be less than the SRI of the external façade at lower floors. Detailed analysis of the SRI for the external façade at different levels would be conducted at a later stage of the project.

7.4.1 Façade design - Conclusion

Above example reiterates that an external façade of double glazed fixed window with the transmission loss given in Table 24 and Sound Reduction Index Rw of >50 for a meeting room could achieve internal noise levels (LAeq) of <40 dBA which would comply with *Australian Standard AS2107:2000*.

8 Conclusion & recommendations

Aurecon has completed a noise impact assessment to determine the noise contribution from the operational and construction phase for the development application being submitted for the hotel redevelopment at 161 Sussex Street, Sydney by GL Investment Co PTY LTD ATF/GL No. 1. This preliminary assessment report details our comments and recommendations, which include the following:

- Established internal and external noise criteria based on Australian Standards and other relevant Legislative requirements mentioned in Section 5.
- Measured existing ambient and background noise level mentioned below, which are used as baseline in setting appropriate noise criteria to assess the impact of the surrounding on the development (Section 6).

Location	Time period	Ambient Noise Level LAeq dBA	Background Noise Level LA90 dBA
Sussex Street	Day	71	63
	Night	69	58
M4 Western Distributor Freeway	Day	77	73

Table 25 **|** Summary of attended noise measurements (All levels are in dBA)

- Established construction noise criteria (Management Level) for proposed construction activities related to the hotel redevelopment (details in Section 7.1).

Time Period	Management Level LAeq 15min
Recommended standard hours	71 dBA
Outside recommended standard hours	63 dBA

Table 26 **|** Construction noise criteria (LAeq 15min)

- Established operational noise criteria (Project Specific Noise Level) for the proposed hotel redevelopment (details in Section 7.3).

Receiver Type	Project Specific Noise Level dBA
Residential	59 dBA
Commercial	59 dBA

Table 27 **|** Operational noise criteria (dBA)

- Identified potential noise sensitive receivers in close proximity of the site mentioned in Section 6.2 of this report.
- Based on preliminary assessment of the construction activities, some of the activities or combined noise levels from more than 1 equipment/mobile plant may marginally exceed the criterion dependent on the proximity to the nearest sensitive receiver and time of work. Construction noise management measures as per Section 7.2 should therefore be implemented.
- Based on the preliminary noise assessment, operational external noise level will comply with the NSW INP operational noise criteria.

Appendix A
Glossary of terms

Decibel, dB:
Unit of acoustic measurement. Measurements of power, pressure and intensity. Expressed in dB relative to standard reference levels.

Sound Pressure Level (Lp) – Sound or noise is the sensation produced at the ear by very small fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range (from 20 microPascals to 60 Pascals). A scale that compresses this range to a more manageable size and that is best matched to subjective response is the logarithmic scale, rather than a linear scale.

Sound Pressure Level (Lp) is defined as:

$$L_P = 10\log_{10}\left(\frac{p^2}{p_{ref}^2}\right)dB$$

In the above equation, p is the sound pressure fluctuation (above or below atmospheric pressure), and p_{ref} is 20 microPascals (2×10^{-5} Pa), the approximate threshold of hearing. To avoid a scale which is too compressed, a factor of 10 is included, giving rise to the decibel, or dB for short.

Sound Power Level, LW (dB), of a source:
10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 Pico Watt. Sound power level cannot be directly measured using a microphone. Sound power level does not change with distance. The sound power level of a machine may vary depending on the actual operating load.

A-Weighted Decibel (dB(A)) & Loudness – The overall level of a sound is usually expressed as dB(A), instead of dB. The sound is measured using an A-weighted filter, which is incorporated into the sound level meter. The filter is used to approximate the response of the human ear. It reduces the significance of lower frequencies and very high frequencies, thereby increasing the importance of mid-frequencies (500Hz to 4kHz), and being a good measure of the “loudness” of a sound.

A change of 1 to 2dB(A) is difficult to detect, whilst a change of 3 to 5dB(A) corresponds to a small but noticeable change. A 10dB(A) change corresponds to a doubling or halving in apparent loudness.

C-Weighted Decibel (dB(C)) – In some circumstances, the sound pressure level is expressed as C-Weighted decibels, instead of the more common A-Weighted. The C-Weighting filter is designed to replicate the response of the human ear above 85 dB, and places a greater weighting on low frequency noise.

L_{Aeq} is the time averaged A-weighted sound pressure level for the interval, as defined in AS1055.1. It is generally described as the equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.

L_{Ceq} is the time averaged C-weighted sound pressure level for a time interval, as defined in AS1055.1. It is generally described as the equivalent continuous C-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.

L_{An} is the sound level, which, for a specified time interval, in relation to an investigation of a noise, means the A-weighted sound pressure level that is equalled or exceeded for n% of the interval. Commonly used percentages are 1, 10, 90 & 99%.

L_{Cpk} is the peak C-weighted sound pressure level for a time interval.

$L_{Cmax,T}$ is the average maximum C-weighted sound pressure level, which, for the specified time interval, means the C-weighted sound pressure level during the interval obtained by using the fast time weighting and arithmetically averaging the maximum sound levels of the noise during the interval. Under certain conditions the 10th percentile noise level, $L_{C10,T}$, can represent the average maximum C-weighted sound pressure level.

Octave frequency bands allow a representation of the spectrum associated with a particular noise. They are an octave wide, meaning that the highest frequency in the band is just twice the lowest frequency, with all intermediate frequencies included and all other frequencies excluded. Each octave band is described by its centre frequency.

Maximum Exposure Time (Hours) is the maximum possible time a person can be safely exposed to a specific noise level (L_{Aeq}).

Ambient Sound:
Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.

Background noise:
The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed.

Percentile Level - L_{90}, L_{10}, etc.:
A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, e.g. L90 is the level which is exceeded for 90% of a measurement period. L_{90} is commonly referred to as the "background" sound level.

$L_{AEQ,T}$:
Equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.

Rating Background Level – RBL:

Method for determining the existing background noise level which involves calculating the tenth percentile from the LA90 measurements. This value gives the Assessment Background Noise Level (ABL). Rating Background Level is the median of the overall ABL.

R_w – Weighted Sound Reduction Index:
A new single number quantity for airborne sound insulation rating which replaces STC. STC has been traditionally used for the classification of partitions and to define acoustical requirements in the Building Code of Australia.

For majority of partitions, the value for R_w will be similar to the value for STC. Partitions with particularly poor performance at 100Hz may have lower values for R_w than for STC. Conversely, partitions with poor performance at 4kHz may have higher values for R_w than for STC.

C_{tr} – Adaptation factor:
C_{tr} is a spectrum adaptation factor which has been chosen in the BCA to take into account lower frequency level sounds. For an airborne sound insulation, the C_{tr} factor and the R_w of building element will need to be considered. C_{tr} is a negative number which means that $R_w + C_{tr}$ of a building element will be less than the R_w of the building element. For example a wall system may have an R_w of 55 but would have an $R_w + C_{tr}$ of 50 if the C_{tr} value was –5.

Weighted Standardised Level Difference, $D_{nT,w}$:
A term used in combination with C_{tr} to describe the airborne sound insulation rating of a building element when tested on site. A higher $D_{nT,w}$ means a higher difference between the sound levels in the originating (source) room and the receiving room and thus a higher standard of insulation. The higher the $D_{ntw} + C_{tr}$ of a building element, the better the performance of the building element in terms of airborne sound insulation.

Weighted Normalised Impact Sound Level, $L'_{n,w}$:
A term used to describe the impact sound insulation of the floor. In the BCA, the use of parameter $L'_{n,w}$ plus spectrum adaptation term C_I will be used to quantify the floor impact sound insulation ratings. The lower the $L'_{n,w} + C_I$ of a floor, the better the performance of the floor in terms of impact sound insulation.

Weighted Standardised Impact Sound Level, $L_{nT,w}$:
A term used in combination with a spectrum adaptation CI to describe the impact sound insulation rating of a floor when tested on site. Similar to the L'n,w, it measures adequateness of a floor in controlling impact sound.

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