

PLANS AND DOCUMENTS
referred to in the PDA APPROVAL

21 MAY 2013

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Report

NOISE ASSESSMENT

**Sullivan Nicolaides Pathology Headquarters
Sonic HealthCare Ltd c/- NPL Property Services**

CONFIDENTIAL

Revision: 2.0 - FINAL
Issued: 8 February 2013



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1. EXECUTIVE SUMMARY

1.1. Purpose

The purpose of this report is to provide an acoustic assessment for the proposed Sullivan Nicolaides Pathology (SNP) headquarters to satisfy the requirements of the Urban Land Development Authority (ULDA) so that an acceptable noise environment is achieved. NDY's assessment involved:

- Inspection of the site and surrounding environment,
- Measurement of existing noise levels,
- Analysis of the clients architectural drawings and assessment of potential noise emissions,
- Determination of appropriate noise control measures, and
- Preparation of this report.

1.2. Major Recommendations

NDY has conducted a noise assessment for the proposed Sullivan Nicolaides building at Lot 5 Hurworth Street, Bowen Hills. Potential sources of noise intrusion and emission have been assessed. A summary of recommendations is listed below:

Control of Road Traffic Noise Intrusion: Acoustic treatment will be required to the facade for purposes of maintaining road traffic noise intrusion to levels in accordance with AS/NZS2107. NDY recommends the following minimum acoustic ratings in terms of the weighted sound reduction index, R_w :

- **Facade Walls** - R_w40 We expect that this can be achieved by a curtain wall system with internal stud work and plasterboard lining with thermal insulation batts installed within the wall cavity.
- **External Glazing** - R_w32 . An example construction is 6mm float / 12mm air gap / 6mm float or 6.38mm laminated glass.
- **Roof/Ceiling** - R_w39 . An example construction is 0.48mm metal deck roofing with fibreglass Anticon insulation blanket underneath, 500mm air cavity, and mineral fibre ceiling tiles.
- **Skylights** – R_w39 . An example construction is translucent roof sheeting, minimum 1m cavity, and 6.38mm laminated glass at ceiling level. The walls of the skylight riser would need to be acoustically rated, eg 1 layer 13mm plasterboard and be sealed air tight to avoid noise break-in into the ceiling cavity.

Conversation Noise on Balconies: Noise emissions (conversation noise) from the various proposed balconies and external spaces is expected to be acceptable.

Car park noise: Car parking noise is expected to comply with the environmental noise criteria with the exception of car passby and door slam during the night time period (10pm to 7am) within the visitor carpark. Therefore it is recommended that the use of the visitor carpark be avoided during the night time (10pm to 7am) period. Noise emissions from the remaining parking areas are expected to be acceptable during all periods.

Loading Area Noise: Noise emissions from general loading and unloading activities are expected to be acceptable during all periods. As currently documented, it is required that all loading be conducted in the under-croft area.



Mechanical Plant: Acoustic requirements for mechanical plant have been listed in 7.4 of this report. Requirements include meeting the specified sound powers, shielding of Cooling Tower plant by an acoustic screen and in duct attenuation for car park ventilation fans.

Construction Noise: Construction phase noise emissions will be managed through the Construction Noise Management Plan (CNMP) listed in Section 8. It would remain the responsibility of the Principal Contractor to implement and comply with the CNMP such that noise emissions are minimised as far as practical. Part of the proposed plan would involve noise and vibration logging during the critical construction stages.

In summary we expect that noise emissions from the proposed Sullivan Nicolaides Pathology Headquarters are able to be controlled to an acceptable level by implementing the recommendations in this report.



2. BACKGROUND

2.1. Information Sources

- [1] Australian Standard AS 1055:2000; Acoustics - Description and Measurement of Environmental Noise.
- [2] Australian Standard AS/NZS 2107:2000; Acoustics – Recommended design sound levels and reverberation times for building interiors.
- [3] Australian Standard AS 2021:2000; Acoustics – Aircraft noise intrusion – Building siting and construction.
- [4] Australian Standard AS 2436:2010; Acoustics – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance sites.
- [5] Australian Standard AS3671-1989; Acoustics - Road traffic noise intrusion - Building siting and construction.
- [6] Environmental Protection (Noise) Policy 2008. Reprinted as in force on 1 January 2012.
- [7] Environmental Protection Act 1994. Reprinted as in force on 1 January 2012.
- [8] Queensland Development Code
- [9] Noise Impact Assessment Planning Scheme Policy (NIAPSP) from Brisbane City Council's City Plan 2000.
- [10] WHO Sleep Disturbance Criteria
- [11] Architectural Layout Drawings by Nettleton Tribe, received 13/01/2013
- [12] Site survey plan drawing Number S3761-A1 dated 15/01/2012 by DTS
- [13] Bowen Hills Urban Development Area Development Scheme, Effective 3 July 2009 (Amended 1 April 2010)

2.2. Revision History

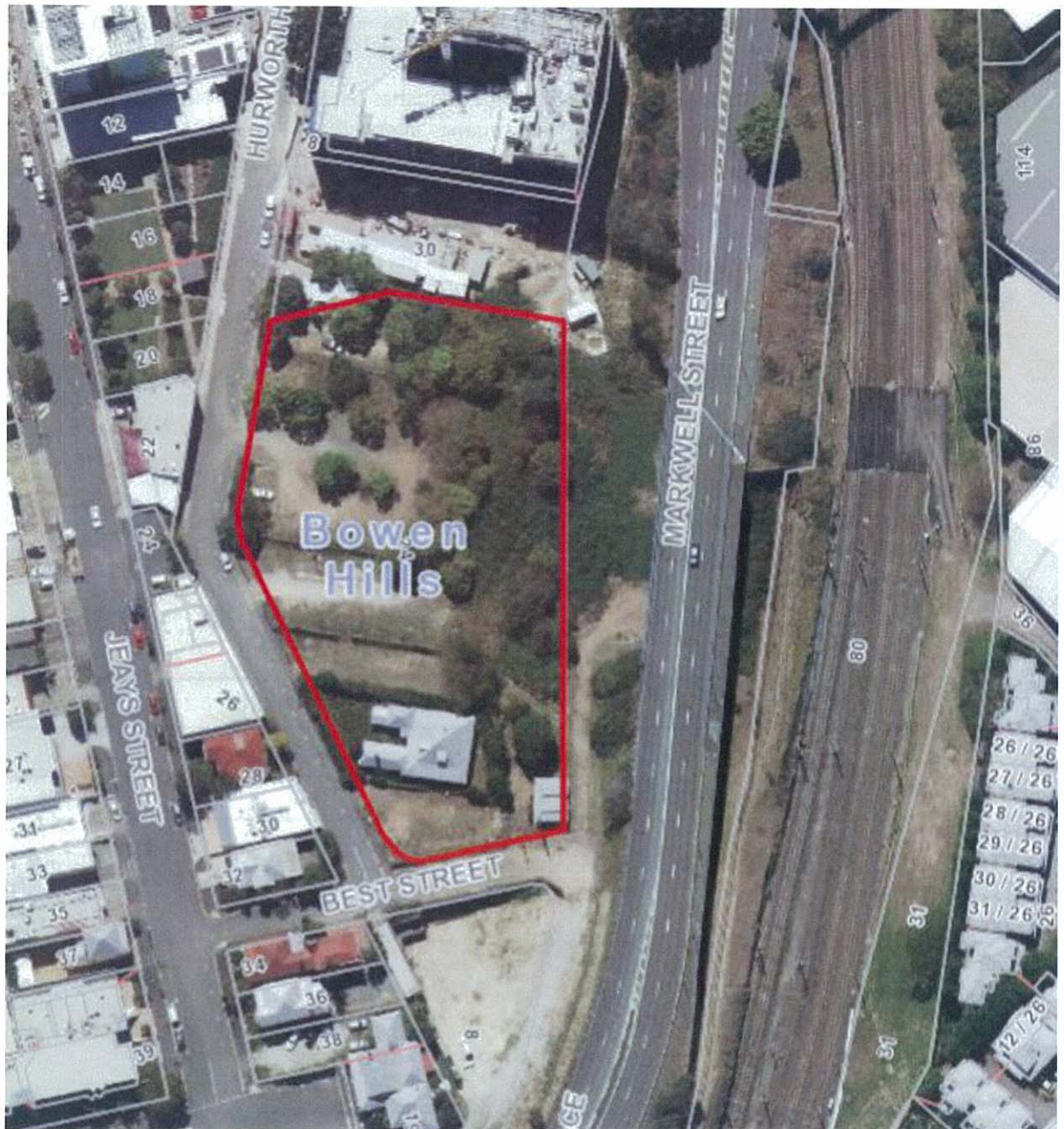
	Date Issued	Comment
1	29 January 2013	Draft for Comment
2	8 February 2013	Final

3. SITE DESCRIPTION

3.1. Site and Surrounding Uses

The proposed Sullivan Nicolaides site is located at Hurworth Street, Bowen Hills. The real property description is Lot 5 on SP213464. The site boundary is as designated below in Figure 3-1.

Figure 3-1 Site Location and surrounding uses



The following information was observed regarding the uses around the site:

- **North** – Vacant lot, then 7 storey residential building at 8 Hurworth Street. Also, 3 storey residential building at 12 Jeans St and 10 storey residential building at 6 Jeans Street.



- **East** – Markwell Street, Rail Corridor and then two storey residential townhouses in Rosetta Street.
- **South** – Vacant site at 8 Best St which is zoned high density residential for up to 12 storey residential development. Two storey commercial buildings in Mallon Street. Short term accommodation at 19 Mallon Street (boarding house).
- **West** – Two storey commercial buildings in Jeays Street. Based on the council zoning these land parcels are zoned high density residential for up to 12 storey residential development. We believe that any future buildings are unlikely to be that tall, due to the land size, however have conservatively considered this to be the worst case.

3.2. Proposed Development

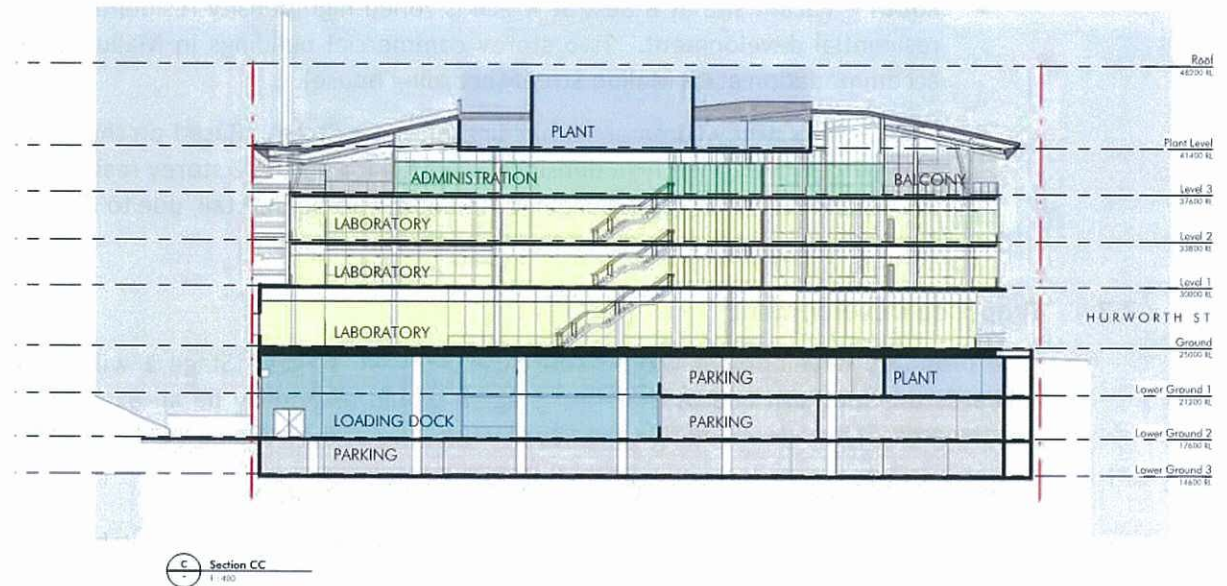
The proposed development will be constructed in two stages. Stage 1 will be constructed first towards the southern end of the site. Stage 2 would essentially be an extension of the building northwards. It is understood that the floor by floor use of the building will be as follows:

- Lower Ground 3 – Car parking, water pumps, storage space.
- Lower Ground 2 – Car parking, switch room, substation, main switchboard, courier office, loading dock, and store.
- Lower Ground 3 – car parking, workshop, store, fire pumps, hydraulic water tanks, chemical store.
- Ground Floor – Laboratory (both Stage 1 and Stage 2).
- Level 1 – Laboratory (both Stage 1 and Stage 2).
- Level 2 – Laboratory (both Stage 1 and Stage 2).
- Level 3 – Administration Areas (both Stage 1 and Stage 2).
- Roof – Stage 1 - Enclosed Chiller Plantroom, Lab Exhaust, Cooling Towers plant deck, enclosed backup generator plantroom, enclosed air handling plantroom. Stage 2 – Enclosed air handling plantroom.

A section view through the building is shown below.



Figure 3-2 Section through the proposed building



Potential noise emissions from development will be assessed in this report.



4. EXISTING NOISE LEVELS

Noise monitoring was conducted to quantify the existing ambient noise environment in the local area. Noise measurements were taken in accordance with AS 1055-1997 *Acoustics Description and Measurement of Environmental Noise*. Refer to Appendix A for instrumentation details.

4.1. Ambient Noise Level Survey

A Noise Logger was located on the site which is currently vacant. The purpose was to quantify the existing ambient noise levels. Noise statistics were recorded in 15 minute blocks over the period of Friday 30th November to Monday 10th December 2012. Key noise level parameters are summarised in Table 4-1.

Table 4-1 Noise Logging Results

Noise Descriptor	Period	Representative Noise Levels, dB(A)
L _{Aeq,24hrs}	24 hours	54
L _{Aeq,1hrs}	Maximum 1 hour	59
L _{A10}	average day time – 7am to 6pm	57
L _{A10}	average evening - 6pm to 10pm	54
L _{A10}	average night time - 10pm to 7am	50
L _{A90}	average day time – 7am to 6pm	50
L _{A90}	average evening time - 6pm to 10pm	48
L _{A90}	average night time - 10pm to 7am	43

The recorded noise sources were consistent with that of a busy inner suburb and the background comprised mainly road traffic along Markwell Street. Refer to Appendix A for a graph of the measured noise levels.

4.2. Attended Noise Monitoring

A short term attended noise measurement was conducted at the most noise exposed corner of the site adjacent Markwell Street. The noise measurement was conducted in accordance with Australian Standard AS1055:1997. Measurement equipment is listed in Appendix A, Section A-2. Weather conditions during the survey were fine and calm. The measurement was conducted from 2pm to 2.15pm on the 30th November 2012. A comparison was made back to the unattended logger shown in Table 4-2 for purposes of establishing the variance in sound level across the site.



Table 4-2 Attended measurement versus logger location 2.00 to 2.15pm 30/11/12

Noise Descriptor	Location L2 - Attended Noise Logger dB(A)	Location L1 - Unattended Noise logger dB(A)	Difference, dB
L _{Amax}	70	68	2
L _{A1}	66	64	3
L _{A10}	61	58	3
L _{Aeq}	58	55	3
L _{A90}	51	50	1
L _{Amin}	48	48	0



5. NOISE CRITERIA

The noise criteria applied to the site is generally in accordance with the Bowen Hills Urban Development Area Development Scheme, (July 2009). Where the design, siting and layout of development must address noise impacts and where necessary incorporate appropriate noise mitigation measures. Also, the development is to achieve acceptable noise levels for noise sensitive uses in affected areas.

Noise emissions from the re-developed building will be assessed against the following noise criteria.

5.1. Intermittent Noise Emission

For the assessment of intermittent noise during the daytime and evening periods we have adopted Brisbane City Council's Comparison of Like Parameters criterion. The L_{A10} noise parameter has been deemed the most appropriate to assess the impact of intermittent noise emissions such as loading area, truck passby and car parking events onto nearby residences. Noise data obtained during NDY's logging period has been used to determine the arithmetic average ambient L_{A10} noise level as per Table 4-1.

Therefore the following site specific intermittent noise limits apply at residential receivers surrounding the site.

Table 5-1 Noise Limits at Residential Receivers for Intermittent Noise

Period	Time	Noise Limits at a Noise Sensitive Place Measured as the Adjusted Maximum Sound Pressure Level
Residential Receiver		
Daytime	7am – 6pm	$72\text{dB(A)} + 3\text{dB(A)} = 75\text{dB(A)} L_{A\text{max}}$ $57\text{dB(A)} + 3\text{dB(A)} = 60\text{dB(A)} L_{A10}$
Evening	6pm – 10pm	$69\text{dB(A)} + 3\text{dB(A)} = 72\text{dB(A)} L_{A\text{max}}$ $54\text{dB(A)} + 3\text{dB(A)} = 57\text{dB(A)} L_{A10}$

5.2. Sleep Disturbance Criteria

Sleep awakening criteria may be used to assess the impact of noise sources operational during the night period (10pm – 7am) that are neither steady nor quasi-steady.

Research adopted by the World Health Organisation (WHO), concludes that for short duration variable noise sources the onset of sleep disturbance commences at internal $L_{A\text{max}}$ noise levels of 45 dB(A). Applying a correction of 5dB(A) for an open windows this equates to a level at the facade of 50dB(A).

Therefore the following site specific intermittent noise limits apply at residential receivers surrounding the site during the night time period.

**Table 5-2 Sleep Disturbance Noise Limits at Residential Receivers**

Period	Time	Noise Limits at a Noise Sensitive Place Measured as the Adjusted Maximum Sound Pressure Level
Night time	10pm – 7am	50dB(A) L_{Amax}

5.3. Mechanical Plant Noise

All mechanical plant is required to be controlled to acceptable noise levels at neighbouring noise sensitive receivers. The noise criteria listed within this section has been used to address the noise impact of the mechanical plant onto nearby noise sensitive receivers, such that acceptable noise levels are achieved.

5.3.1. BCC City Plan plant limits

BCC noise limits for mechanical plant may be calculated by using AS/NZS 2107:2000 that recommends appropriate indoor noise levels.

The noise impact of mechanical plant is to be considered for nearby residential dwellings. From AS/NZS 2107: 2000 the internal daytime and evening limit is 45dB(A) (living areas), and the night time limit is 40dB(A) (sleeping areas). For the adjoining residential premises, an attenuation factor, C, of 5dB(A) is used to represent the noise loss between inside and outside the residence. This results in an external noise limit of 50dB(A) in the daytime and evening, and 45dB(A) at night when measured outside the adjoining residence. Therefore to achieve compliance with Council's NIAPSP the recommended assessment limits are as follows.

Table 5-3 BCC assessment limits for air conditioning plant

Period	Time	Required Noise Limit. $L_{Amax,adj}$
Residential Receiver		
Daytime and Evening	7am – 10pm	50dB(A)
Night time	10pm – 7am	45dB(A)

Note: The limits are set as $L_{Amax,adj}$ to allow for tonal or impulsive noise characteristics.

5.3.2. Environmental Protection Act derived 'Background +3/+5' Criteria

Using the EPA noise criteria, the noise limits are calculated as shown in Table 5-4. The background noise levels measured at the noise logging location are considered representative of the site and surrounding area and have therefore been used to provide a basis for assessment purposes.

**Table 5-4 EPA Derived Noise Limits for Residential Receivers**

Period	Time	Noise Limits at a Noise Sensitive Place Measured as the Adjusted Maximum Sound Pressure Level $L_{Amax,adj}$
Residential Receiver		
Daytime	7am – 6pm	50dB(A) + 5dB(A) = 55dB(A)
Evening	6pm – 10pm	48dB(A) + 5dB(A) = 53dB(A)
Night time	10pm – 7am	43dB(A) + 3dB(A) = 46dB(A)

5.3.3. Proposed Noise Limits

The above listed noise limits are a overall measured limit which includes existing background noise sources. Based on Sections 5.3.1 and 5.3.2 we have selected the most conservative criteria, refer Table 5-5.

Table 5-5: Proposed Noise Limits for Mechanical Plant

Assessment Location and Period	Required Assessment Limit $L_{Amax,adj}$ dB(A)
Daytime and Evening	50dB(A)
Night time	45dB(A)

Notes:

1. Daytime and evening background noise levels may be too high to accurately assess plant noise at the receiver location
2. Limits include penalties for tonality & impulsiveness
3. All plant operating under worst-case conditions
4. Assessed outside nearest affected receiver(s)

5.4. Continuous (Non Time Varying) Internal Noise Levels

AS 2107-2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors' sets out the design noise criteria for steady state noise such as noise emission from air-conditioning systems and road traffic depending on the type/use of different rooms. Recommendations for each space in terms of an averaged A-weighted sound pressure level (L_{Aeq}) have been referenced from Table 1 of AS2107:2000 and summarised in Table 5-6.

Table 5-6: Background Noise Design Criteria

Type of Occupancy / Activity	Recommended Design Sound Level, L_{Aeq} dB(A)		Recommended reverberation time RT_{60} (s)
	Satisfactory	Maximum	
Administration and Private Offices	35	40	0.6 to 0.8
General Offices	40	45	0.4 to 0.6
Kitchens, sterilizing and service areas	50	55	0.6 to 0.8
Parking Stations (carpark areas)	55	65	-
Laboratories	45	50	0.4 to 0.7
Toilets	45	55	-

AS/NZS2107: 2000 also sets out the design criteria for reverberation times within occupied spaces. The reverberation time defines the time taken for sound to decay within a space and thus the degree of speech intelligibility.

5.5. Construction Noise and Vibration Criteria

5.5.1. Noise Criteria

In Queensland, construction activities should be conducted in accordance with general building work hours as described under Section 440R – “Building Work” of the *QLD Environmental Protection Act 1994*. Under the regulation, no audible noise is permitted at the following times:

- 6.30 pm to 6.30 am – Monday to Saturday; and
- Sundays and public holidays.

The time restrictions are designed to strike a balance between protecting noise amenity and the need to start construction activities early in the morning

There are no numerical noise limits for construction noise in Queensland.

5.5.2. Vibration Criteria

Vibration propagating through rock and soil may be transmitted from the construction activity to the nearest noise sensitive receivers in the form of structural vibration energy. The effects of ground-borne vibration include movement felt through building floors, low frequency rumbling sounds or regenerated noise, and in extreme circumstances rattling of windows and shaking of items on shelves or wall hangings.

BCC’s City Plan Noise Policy nominates the following two vibration criteria:

- Cosmetic damage British Standard BS7385.2 1993.
- Human comfort limits Australian Standard AS2670.2-1990.



If vibration levels comply with the human comfort limits (AS2670.2-1990), they are also expected to comply with the less stringent criteria based on cosmetic damage British Standard BS7385.2 1993.

6. NOISE INTRUSION ASSESSMENT

6.1. Road Traffic Noise

Noise levels were measured with a handheld B&K2270 sound level meter at an un-shielded location at the corner of the site closest Markwell Street as listed in Section 4.2. The L_{Aeq} at this location was established to be 3dB(A) higher than at the unattended logger location. The highest $L_{Aeq,1hour}$ at the unattended logger location was 59dB(A) which means that the highest $L_{Aeq,1hour}$ at the most exposed corner could be expected to be 62dB(A). To estimate future traffic noise levels based on a 10 year horizon we have allowed for growth rate of 4% per annum which is in line growth rates normally applied for Brisbane. This equates to a 2dB(A) increase in the L_{Aeq} noise levels over the next 10 years, or a ultimate noise level of 64dB(A), rounded to 65dB(A) $L_{Aeq,1hour}$.

Acoustic treatment will be required to the facade, in particular to the glazing which is typically the weakest element on any facade. We have recommended the external facade sound isolation requirements as listed below.

Facade Walls

NDY recommends that a minimum acoustic rating of Rw40 be achieved between the office/laboratory areas and outside. We expect that this can be achieved by a curtain wall system with internal stud work and plasterboard lining with thermal insulation batts installed within the wall cavity.

External Glazing

Acoustically rated glazing is required to control external road traffic noise intrusion from Markwell Street to acceptable levels within the office and laboratory areas. Facade Glazing system must achieve a minimum acoustic rating of Rw32. Example systems an insulating glass unit, 6mm float / 12mm air gap / 6mm float, or a single layer of 6.38mm laminated glass.

Roof/Ceiling

NDY recommend that the roof/ceiling system achieve a minimum acoustic rating of Rw39. An example construction is 0.48mm metal deck roofing with fibreglass Anticon insulation blanket underneath, 500mm air cavity, and mineral fibre ceiling tiles.

Skylights

We note that one skylight is proposed for the Concourse area. These can potentially represent a significant weakness for noise intrusion. Construction details are unknown at this stage. We recommend the following construction as acceptable: translucent roof sheeting, minimum 1m cavity, and 6.38mm laminated glass at ceiling level. The walls of the skylight riser would need to be acoustically rated, eg 1 layer 13mm plasterboard and be sealed air tight to avoid noise break-in into the ceiling cavity.

An example calculations have been provided in Appendix B, Figure B-1.

7. NOISE EMISSION ASSESSMENT

Noise emissions from the proposed site are assessed in the following sub-sections.

The closest potential noise sensitive receivers (NSR's) in each direction are as follows:

- NSR (north) - 8 Hurworth St – existing 7 storey residential apartment building
- NSR (south) – 8 Best St – assumed potential future 12 storey residential apartment building
- NSR (west) – 24 Jeays St - assumed potential future 12 storey residential apartment building
- NSR (east) – 28/26 Rosetta St – existing two storey townhouses

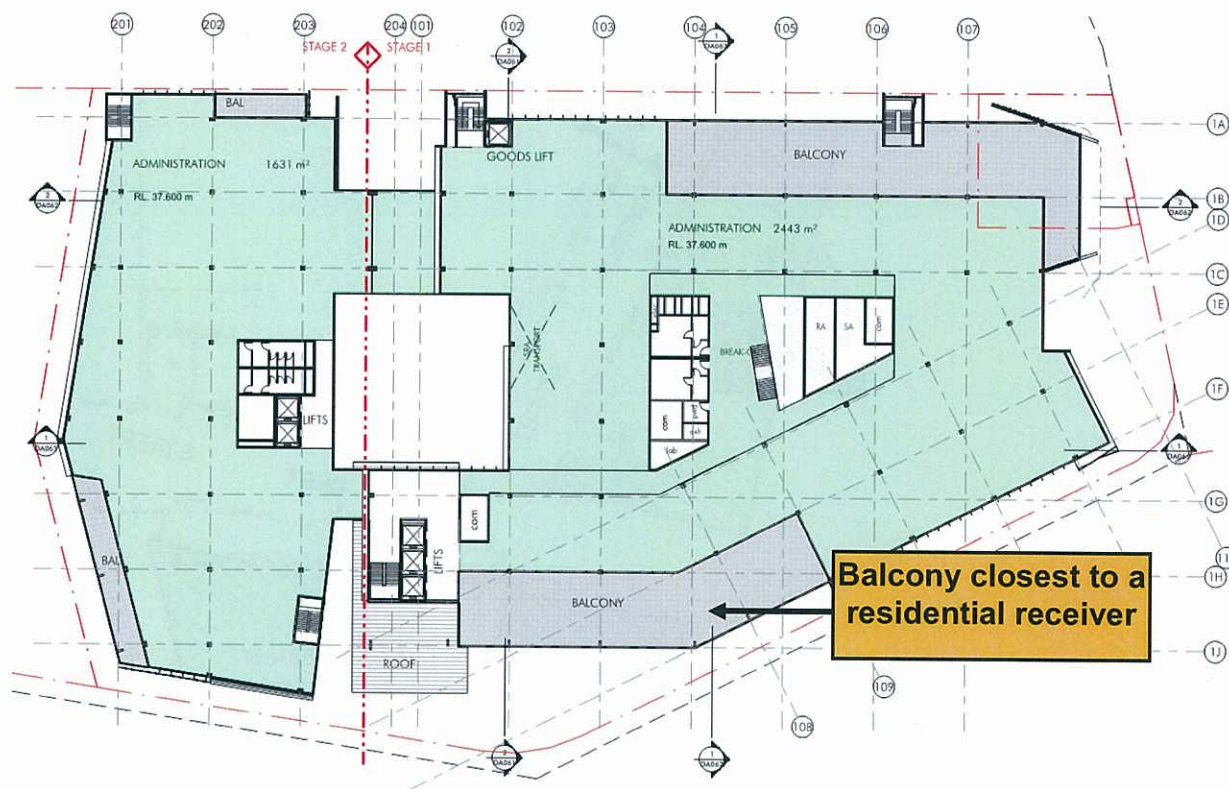
The above properties are the closest residential uses to the SNP development and will be used as the primary calculation points. Other properties are of commercial use, or if residential, are further away and therefore the impact is expected to be less than presented.

7.1. Conversation Noise on Outdoor Balcony areas

The Architectural Drawings show outdoor balcony and terrace areas which may potentially be used for staff lunch or breakout areas. There are three areas identified on each of Level 1 and 2, and 4 areas identified on Level 3.

Refer to Figure 7-1 for the layout of Level 3 and the location of the anticipated closest balcony to the nearest noise sensitive receiver.

Figure 7-1 Location of balconies on Level 3



Typical noise events on the balcony areas are expected to include staff conversations. Expected sound power levels for these events are listed in Table 7-1.

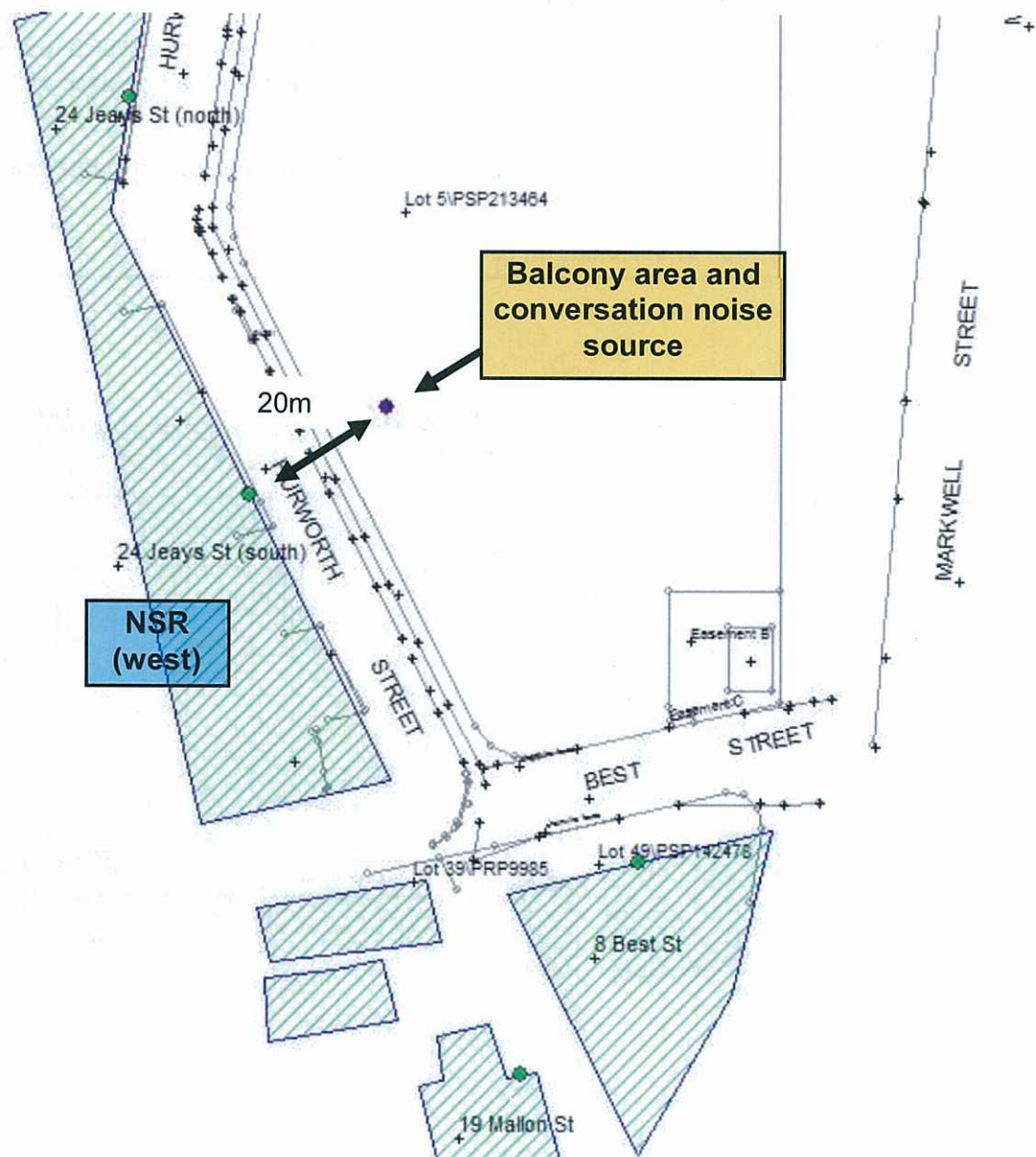


Table 7-1 Conversation Sound Power Levels

Noise Source	Sound Power Level dB(A)	Penalty, dB(A)
Modest Conversation on outdoor area, 25 people	76dB(A)	N/A

The worst affected noise sensitive receiver is expected to be the potential future residential development house at 24 Jeays Street to the west. Noise calculations were carried out using SoundPLAN software version 7.1. Using SoundPLAN a three-dimensional model of terrain, buildings, noise sources and receiver was created. The program uses receiver based ray tracing algorithms and includes 3D topographical effects. A screenshot of the model is shown below.

Figure 7-2 Model of conversation noise to the surrounding noise sensitive receivers



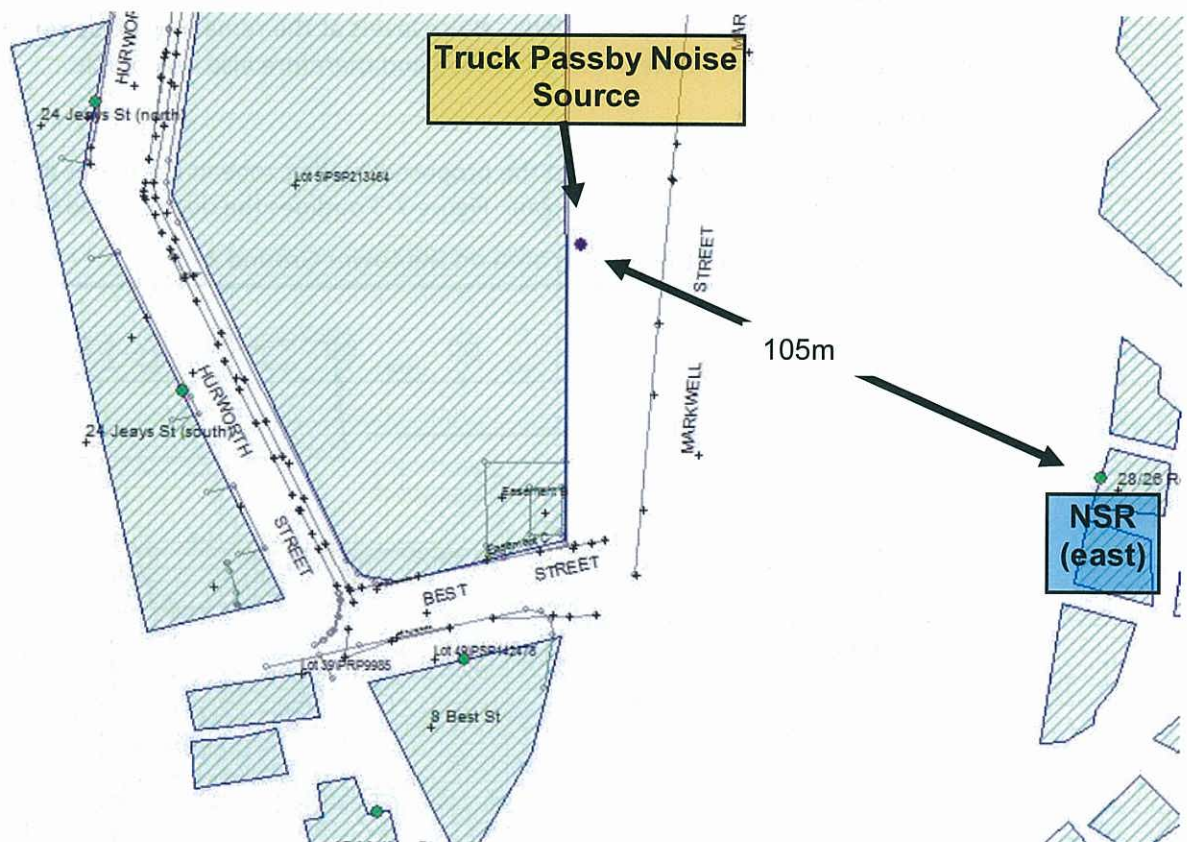
Loading/unloading activities inside this under-croft area are expected to be well attenuated by the concrete building structure and therefore only truck movements in the outdoor entry need be assessed. Noise levels were obtained from NDY's database from similar assessments.

Table 7-3 Loading Bay sound power levels

Noise Source	Sound Power Level dB(A)	Penalty, dB(A)
Truck Movements	93	none

Noise calculations were carried out using SoundPLAN software version 7.1. Using SoundPLAN a three-dimensional model of terrain, buildings, noise sources and receiver was created. The program uses receiver based ray tracing algorithms and includes 3D topographical effects. A screenshot of the model is shown below.

Figure 7-4 Three-dimensional Model of proposed buildings and surrounds



The 'Comparison of Like Parameters' criterion will be used to assess noise emissions during the daytime and evening hours. Sleep disturbance criteria will be used to assess night time noise events. Refer to Table 5-1 and Table 5-2 for intermittent noise criteria specific to this site. Truck events were assessed against the L_{A10} parameter. NDY has calculated noise emissions at the closest receivers, refer to the table below for calculations.

**Table 7-4 Noise Emission results at worst affected residential receivers**

Description	Receiver	Noise Level, dB(A)	Complies with 60dB(A) Day time criteria?	Complies with 57dB(A) Evening criteria?	Complies with 50dB(A) Night time criteria?
Truck Passby	24 Jeays St	28	Yes	Yes	Yes
	8 Best St	30	Yes	Yes	Yes
	8 Hurworth St	23	Yes	Yes	Yes
	28/26 Rosetta St	42	Yes	Yes	Yes

Based on NDY's predictions to the worst affected NSR's, truck based deliveries and unloading activities are expected to be acceptable during all time periods.

As currently documented, it is required that all loading be conducted in the under-croft area.

7.3. Car Park Noise

Short-term noise events from onsite vehicles and car park activities can potentially affect nearby noise sensitive receivers. Typical car parking noise events that may affect neighbouring properties include:

- Door Slam
- Car movement on entry ramp and within carpark

The majority of the car parking will be located underground and therefore noise levels from door slam are expected to be well attenuated by the building structure. The exception is the 11 bay visitor carpark located in the undercroft area off Hurworth/Best Street.

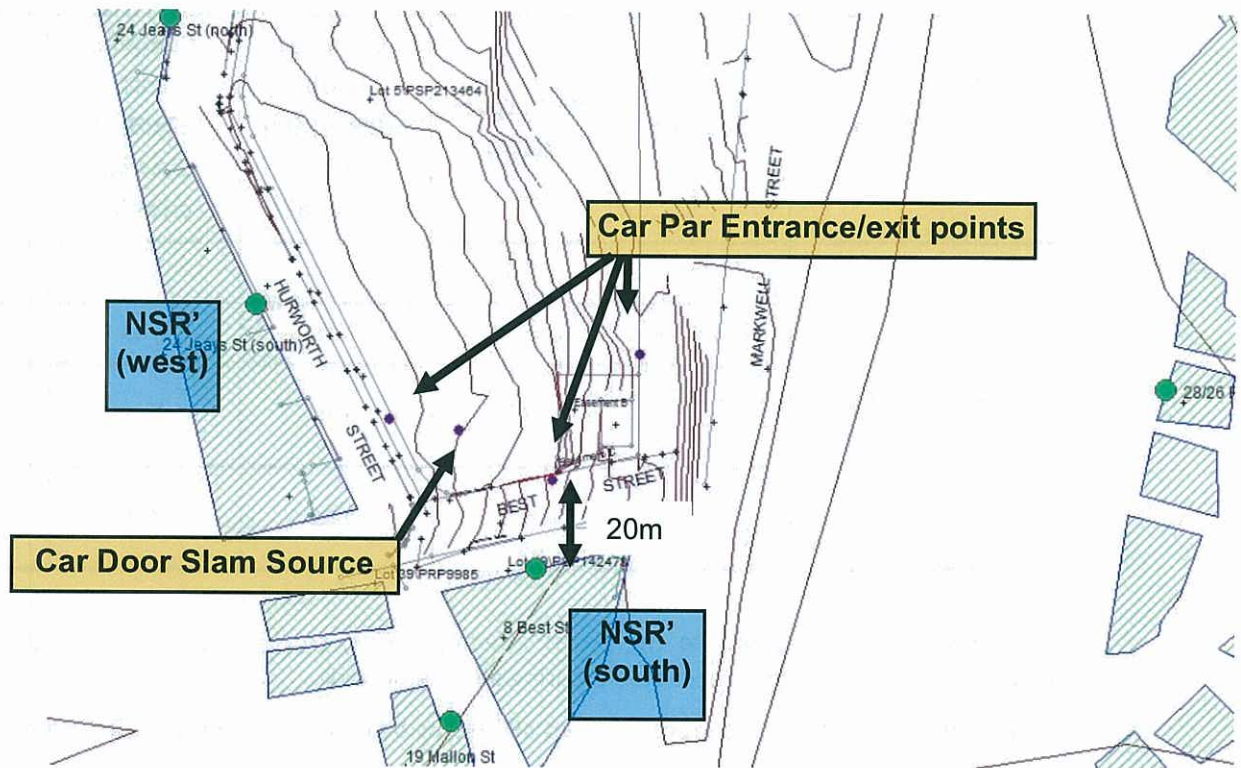
Car passby noise emissions will be assessed at each entrance/exist point and car door slam assessed for the visitor car park. Expected sound power levels for these events are listed in Table 7-5 below.

Table 7-5 Car Park sound power levels

Noise Source	Sound Power Level dB(A)	Penalty, dB(A)
Car passby @ 5km/h	88	none
Car door slam	89	+5 impulsive penalty

Car entry and exit points are located towards the southern end of the development, on the east, south and west boundaries. For the purpose of this assessment a car passby noise source has been placed at each of these points. Refer to Figure 7-5 for the location of the car park entrance in relation to the nearest noise sensitive receivers.

Figure 7-5 Location of Car Noise Sources



The 'Comparison of Like Parameters' criterion will be used to assess noise emissions during the daytime and evening hours. Sleep disturbance criteria will be used to assess night time car park noise events. Refer to Table 5-1 and Table 5-2 for intermittent noise criteria specific to this site. Car passby events were assessed against the L_{A10} parameter, and door slam against the L_{Amax} parameter. NDY has calculated noise emissions at the closest receivers, refer to the tables below for calculations.

Table 7-6 Car Passby noise emission to nearest residential receivers, L_{A10}

Description	Receiver	Noise Level, dB(A)	Complies with 60dB(A) Day time criteria?	Complies with 57dB(A) Evening criteria?	Complies with 50dB(A) Night time criteria?
Car Passby	24 Jeays St	53	Yes	Yes	No
	8 Best St	56	Yes	Yes	No
	8 Hurworth St	23	Yes	Yes	Yes
	28/26 Rosetta St	34	Yes	Yes	Yes



Table 7-7 Car door slam noise emission to nearest residential receivers, L_{Amax}

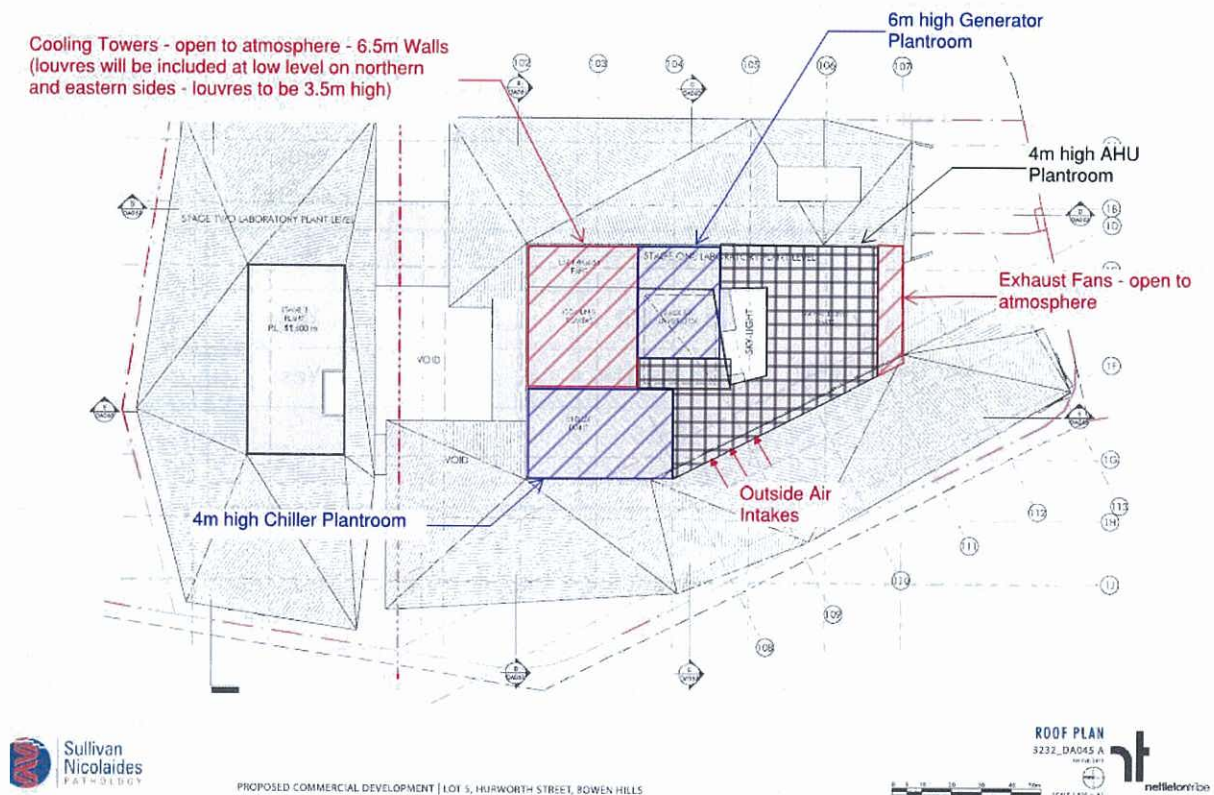
Description	Receiver	Noise Level, dB(A)	Complies with 75dB(A) Day time criteria?	Complies with 72dB(A) Evening criteria?	Complies with 50dB(A) Night time criteria?
Car Door Slam	24 Jeays St	53	Yes	Yes	No
	8 Best St	56	Yes	Yes	No
	8 Hurworth	43	Yes	Yes	Yes
	28/26 Rosetta St	39	Yes	Yes	Yes

Based on NDY's analysis car parking noise is expected to comply with the environmental noise criteria as per Table 5-1 with the exception of car passby and door slam during the night time period (10pm to 7am). The origin of the exceedance is the visitor carpark. Therefore it should be conditioned that use of the visitor carpark be avoided during the night time (10pm to 7am) period. Noise emissions from the remaining parking areas are expected to be acceptable during all periods.

7.4. Mechanical Plant Noise

The mechanical plant has potential to affect surrounding Noise Sensitive Receivers (NSR's) if not adequately attenuated. Mechanical plant should be designed such that the combined noise emissions as measured at the nearest noise sensitive receiver do not exceed the site specific assessment limits presented in Table 5-5 of this report. We understand that the major mechanical plant is to be positioned in the following zones.

Figure 7-6 Location of Mechanical Plant Items



Noise emissions from the following major plant items will be assessed in this report:

- 4 x Cooling Towers on rooftop platform.
- 6 x duct mounted Carpark ventilation fans at low level.
- 1 x Kitchen Exhaust fan mounted on the rooftop.
- 10 x Laboratory exhaust fans, mounted on rooftop.

The remaining plant items are to be either 10dB(A) quieter than the above or well attenuated by the building structure and therefore pose less risk.

For the above listed major plant items, Table 7-8 lists the preliminary sound powers advised by the Mechanical Services Engineer. These sound powers will be used for analysis purposes.

Two scenarios have been analysed, a day scenario when typically all plant is operating and a night scenario when a reduced amount of plant is operating because the building is unoccupied.

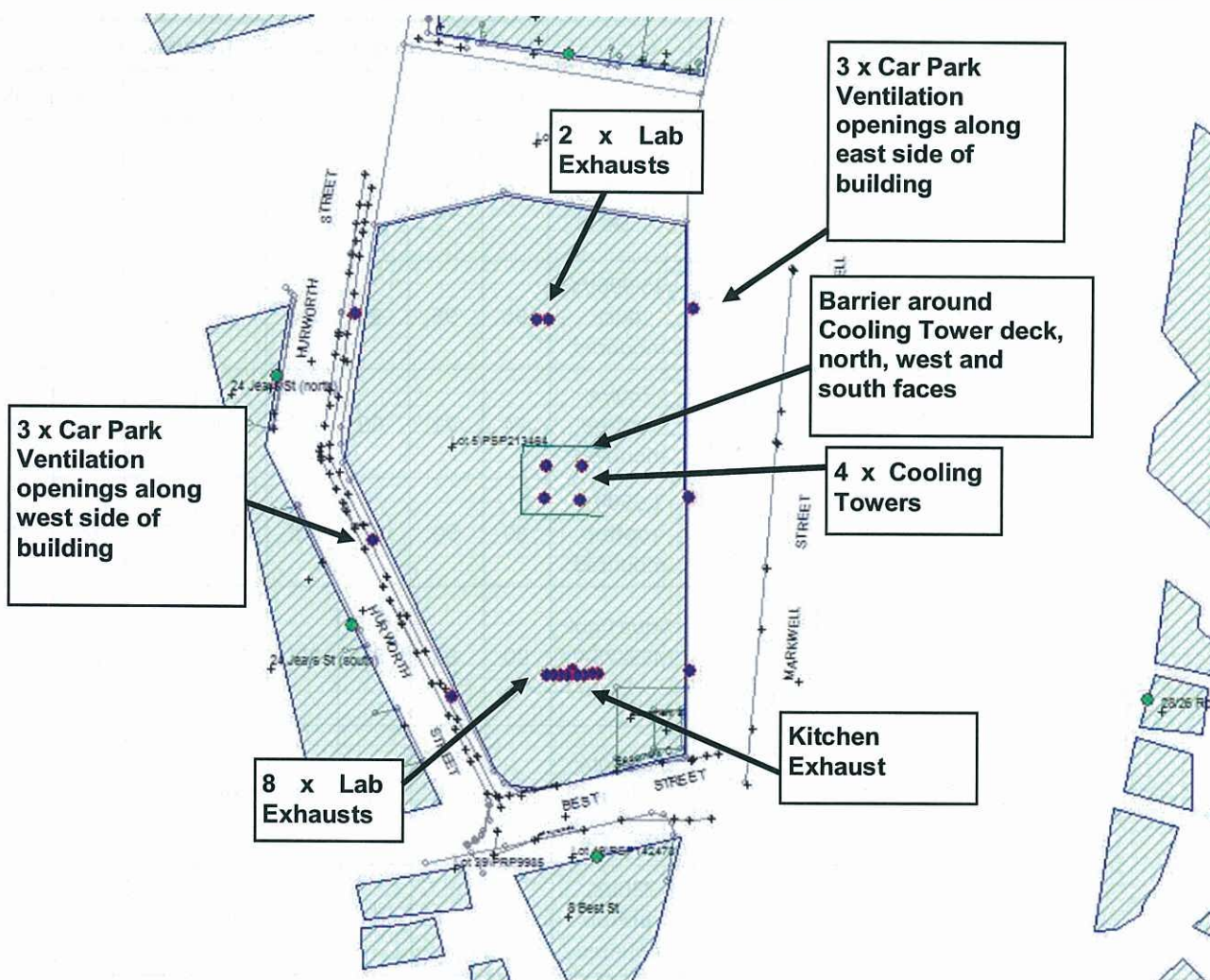


Table 7-8 Major Mechanical Plant Sound Powers

Scenario	# of items	Source	Details	Octave band centre frequency (Hz)								dB(A)
				63	125	250	500	1k	2k	4k	8k	
Day & Evening (7am to 10pm)	4	Cooling Tower at 100% load	Aqua Cool MSS225AL S4	99	95	92	89	90	87	86	85	95
	6	Car Park Fans	25,000l/s duct mounted	96	96	98	96	96	93	89	86	100
	10	Lab Exhausts	730l/s, rooftop mounted	74	71	66	59	59	55	55	50	65
	1	Kitchen Exhaust	1,950l/s, rooftop mounted	89	90	85	75	73	71	69	69	81
Night (10pm to 7am)	2	Cooling Tower at 75% load	Aqua Cool MSS225AL S4	90	86	83	80	85	83	84	84	91
	6	Car Park Fans at 50% load	25,000l/s duct mounted	86	86	88	86	86	83	79	76	90
	4	Lab Exhausts	730l/s, rooftop mounted	74	71	66	59	59	55	55	50	65

NDY has modelled the environmental noise emissions from these items based on the proposed location and documented acoustic treatments (where applicable). For the car park exhaust the effect of in-duct acoustic treatment has been considered. Refer to the recommendations made in Section 7.4.2. Resultant sound powers at the SNP facade are listed in Appendix B, Figure B-3. These were the modelling inputs. The modelled location of the plant items is shown in Figure 7-7.

Figure 7-7 Location of Major Mechanical Plant Noise Emission Sources



The Mechanical Plant Noise Criteria be used to assess noise emissions. Refer to Table 5-5 for the nominated design criteria. Noise emissions were calculated at the nearest residential dwellings in each direction. Results are shown in Table 7-9.



Table 7-9 Major Mechanical Plant Predictions to Nearest Noise Sensitive Receivers

Description	Receiver	Noise Level, dB(A)	Complies with 50dB(A) Day and evening time criteria?	Complies with 45dB(A) Night time criteria?
Mechanical Plant Daytime/evening scenario (7am to 10pm)	24 Jeays St	50	Yes	N/A
	8 Best St	44	Yes	
	28/26 Rosetta St	39	Yes	
	8 Hurworth St	35	Yes	
Mechanical Plant Night time scenario (10pm to 7am)	24 Jeays St	42	N/A	Yes
	8 Best St	36		Yes
	28/26 Rosetta St	27		Yes
	8 Hurworth St	26		Yes

Predicted mechanical plant noise emissions comply with both the day/evening and night time assessment criteria listed in Table 5-5. Predictions of the individual plant component noise levels are shown in Figure B-4 to Figure B-7 in Appendix B. An example of the detailed calculation results demonstrating the various distances and attenuations are shown in Figure B-8.

The following recommendations are made for mechanical plant located on site such that the above noise levels can be achieved.

7.4.1. Cooling Towers

Cooling Towers are to be located on an external deck at Roof Level RL41.4. Based on the component noise level predictions presented in Figure B-4 in Appendix B the Cooling Towers are the largest source of plant noise from the site. The following acoustic treatment is required:

- A total of four induced draft Cooling Towers are to be installed.
- A screen is required around the cooling Tower Deck to the following specification:
 - North face – Solid acoustic screen with acoustic louvers positioned within the lower half of the barrier only such that the CT fans remain shielded by the solid upper section.
 - East face – Standard weather louvers. We recommend the top section be solid acoustic screen or blanked off to provide additional fan noise attenuation however this is not strictly mandatory.
 - West face – Solid acoustic screen to full height with no openings.
 - South face – Solid acoustic screen to full height with no openings.

The screen is to extend beyond the Cooling Towers approximately 1m above the top of the cooling tower. The presently selected Cooling Towers are 5.6m high, therefore the barrier is to be 6.6m high. The acoustic screen is required to be impervious from the deck level to the required height and contain no gaps in the fence that would allow the passage of sound. It is required that the screen achieve a minimum surface density of

12.5 kg/m². Suitable materials include 9mm fibrous cement sheeting. To ensure optimum performance of the barrier, it should be constructed so that any short-term deterioration does not adversely affect its performance.

- Where acoustic louvers are called up they shall achieve the following minimum acoustic performance.

Table 7-10 Cooling Tower Acoustic Louvre, Noise Reduction requirements, dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Acoustic Louvre	11	16	18	21	27	25	26	26

- Each of the four Cooling Towers are to be fitted with the factory Low Noise package and must meet the specified sound power level in requirements listed below:

Table 7-11 Cooling Tower Maximum Allowable Sound Power Level (each), dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Cooling Tower	99	95	92	89	90	87	83	85

7.4.2. Car Park Ventilation Fans

Three car park supply fans (CPSFs) and three car park exhaust fans (CPEF's) are to be located in dedicated plant room spaces in the various lower ground levels. The following acoustic treatment is required:

- Equipment shall comply with the specified sound powers in requirements listed below.

Table 7-12 Car Park Ventilation Fans Maximum allowable sound Power Level (each), dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Car Park Ventilation Fan	99	95	92	89	90	87	83	85

- In the event that the above sound spectrum cannot be achieved, then additional attenuation measures need to be installed to compensate.
- Positioned within the ductwork on the environment side of the fan, install a 2m length of 50mm thick internally lined duct or internally lined plenum, in addition to at least one internally lined elbow.
- An attenuator is required on the environment of each fan, each meeting the following specified insertion loss requirement.

**Table 7-13 Car park supply/exhaust Fan attenuator, insertion loss requirements, dB**

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Car Park Fan Attenuator	9	18	28	35	40	40	32	32

7.4.3. Kitchen Exhaust Fan

The Kitchen Exhaust Fan (KEF) requires the following acoustic treatment:

- No more than one kitchen exhaust fan be installed, unless a supplementary assessment is conducted.
- Equipment shall comply with the specified sound powers in requirements

Table 7-14 Kitchen Exhaust Maximum Allowable Sound Power Level, dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Kitchen Exhaust Fan	89	90	85	75	73	71	69	69

- If the above sound power level cannot be achieved then additional attenuation shall be incorporated to compensate.
- Fan to be positioned farther than 5m from the edge of the roof.
- The exhaust fan can be rooftop mounted.

7.4.4. Laboratory Exhaust Fans

The Laboratory Exhaust Fans require the following acoustic treatment:

- No more than 10 Laboratory exhausts fan can be installed unless a supplementary assessment is conducted.
- Fans to be positioned farther than 5m from the edge of the roof.
- Equipment shall comply with the specified sound powers in requirements

Table 7-15 Laboratory Exhaust Maximum Allowable Sound Power Level, dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Laboratory Exhaust Fan	74	71	66	59	59	55	55	50

- If the above sound power level cannot be achieved then additional attenuation shall be incorporated to compensate.
- The exhaust fan can be rooftop mounted.



7.4.5. Chillers

We understand that 4 Chillers are proposed to be installed in a roof level plantroom. The Chillers require the following acoustic treatment:

- It is recommended that equipment shall comply with the following specified sound powers

Table 7-16 Chillers Maximum Allowable Sound Power Level, dB

Unit	Octave band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Chiller	81	84	85	97	89	88	82	70

- Based on the above recommended sound power the Chillers are to be enclosed in a dedicated plantroom having the following minimum acoustic ratings
 - Walls Rw45
 - Roof/Ceiling Rw40
 - Floor Slab Rw60
- No un-attenuated openings to the outside.
- Chillers are to be suitably vibration isolated to prevent structure borne noise.

7.4.6. Standby Generator

Two stand-by power generators are to be housed in a dedicated sound rated plantroom constructed of blockwork. A preliminary allowance should be made for 2.4m long intake and discharge attenuators, and dual stage exhaust mufflers.

7.4.7. Air Handling Plant

Air handling plant is to be enclosed within the rooftop plantroom. Outside air is to be drawn through internally lined ductwork and any unused sections of the intake louver blanked off with 1.2mm thick galvanised steel sheet or 6mm fibrous cement sheeting.

7.4.8. General

A summary of general recommendations for Mechanical Plant is as follows:

- The combined noise emissions from all Mechanical plant should be designed such that the combined noise emissions as measured at the nearest noise sensitive receiver do not exceed the site specific limits presented in Table 5-5 of this report.
- We expect that fans delivering over 800l/s may be required to be positioned “in-duct” with provisions for attenuators either side of the fan.
- Fans less than 800l/s may be centrifugal rooftop type but should be located away from the edge of the roof so as to maximise acoustic shielding from the roof.
- Individual Split system type units should not to exceed 60dB(A) at 1m.
- Achieve no direct line of sight between major plant items and the nearest noise sensitive receivers.



- The extraction systems are to be constructed such that the outlet is either shielded from the noise sensitive premises and/or is pointing in a direction at least 90 degrees away from the nearest residences.
- Where any of the above equipment is tonal, then a 5dB(A) penalty would be applied.

The above are guidelines only and acoustic design input will be required during the detailed design phase that mechanical plant noise is able to be controlled to acceptable levels at surrounding sensitive receivers. Upon commissioning of the building it will be the Mechanical Contractor's responsibility to submit confirmation that noise emissions from the installed plant comply with the noise limits listed in Table 5-5 of this report, refer project verification requirements in Section 9 of this report.



8. CONSTRUCTION NOISE MANAGEMENT PLAN

The following environmental noise management plan is recommended for the construction phase of the project.

8.1. Construction Phase

The following Construction Noise Management Plan (CNMP) will apply to the Sullivan Nicolaides Pathology, Hurworth Street development during the construction phase.

8.1.1. Summary of Impacts

The construction of the building will potentially create noise and vibration impacts. Many construction activities and work practices result in high noise levels, however impacts shall be minimal if work is conducted during reasonable hours.

8.1.2. Objective

To minimise the generation of noise and vibration emissions during the construction of the development and to mitigate any adverse acoustic impacts.

8.1.3. Legislative Basis

Ensure that noise from the development complies with the requirements of the Environmental Protection (Noise) Policy 2008.

8.1.4. Performance Criteria

The following noise minimising practices from AS2436-2010: *Guide to Noise and Vibration Control on Construction, Maintenance and Demolition Sites* are suggested:

- Where reasonably practicable, noisy plant or processes should be replaced by quieter alternatives;
- Plant should always be used in accordance with the manufacturer's instructions;
- Care should be taken to site noisy equipment away from noise-sensitive areas;
- Where possible, loading and unloading should also be carried out away from noise-sensitive areas;
- Plant known to emit noise strongly in one direction should, where possible, be orientated so that the noise is directed away from noise-sensitive areas;
- Machines which are used intermittently such as cranes, dozers, grades, backhoes, bobcats, loaders, etc, should be shut down in the intervening periods between work or throttled down to a minimum;
- Where machines are fitted with engine covers, these should be kept closed when the machine is in use;
- Regular and effective maintenance of stationary and mobile equipment including off-site vehicles is essential and will do much to keep noise levels near to that of new machinery;
- Effective muffling devices should be fitted to all machines.

The following measures should be carried out:



- Construction work is to be carried out in accordance with Section 4 of AS2436. This relates to Project Planning and Supervision and the management of noise and vibration related noise sources;
- Equipment used on the construction site is to be the quietest reasonably available;
- Adhere to specified construction hours from Section 440R – “Building Work” of the QLD *Environmental Protection Act 1994*, namely 6.30 am to 6.30 pm – Monday to Saturday. Any activities conducted outside the recommended hours will require notifying nearby affected sensitive receivers;
- Ground Vibration emissions to nearby sensitive receivers shall comply with the cosmetic damage criteria listed in British Standard BS7385.2 1993.
- Maintain up to date records on site of all noise complaints in the ‘Environmental Incidents and Complaints Register’;
- Should a noise complaints arise, noise monitoring or measurements may be required to determine the level of noise and decide on any ameliorative measures;
- Follow up justified complaints with a telephone call explaining the reason for the noise or vibration incident and the action taken;
- Maintain up to date records on site of all significant noise or vibration incidents in the ‘Environmental Incidents and Complaints Register’;
- Report to the Administering Authority, as soon as practicable, any significant incident which may give rise to complaint;
- Conduct internal, informal monthly audits on site of work practices and condition of equipment;
- All staff are to be trained to provide the standard of noise care expected in accordance with this CNMP;
- All site equipment is to be maintained on a regular basis.

8.1.5. Monitoring

The construction supervisor will carry out or delegate the following monitoring activities:

- Noise monitoring shall be conducted at residences from where complaints arise for purposes of establishing the severity of the impact and to identify the problem events.
- Ground vibration monitoring shall be conducted for critical stages of construction including the demolition and piling stages, and in instances where complaints arise.

8.1.6. Reporting

The reporting requirements for the CNMP during construction are as follows:

- Recording of any complaints regarding noise or vibration in a Complaints and Incidents Register;
- Recording of any negative noise or vibration impact incidents in a Complaints and Incidents Register;
- Additional noise reports may arise if noise monitoring is conducted.

8.1.7. Corrective Actions

Exceedance of the noise and vibration goals shall instigate the following actions:

- Meetings between the complainant and Project Community Liaison representative;
- Manned measurement of noise levels to determine activity causing excessive noise emission levels;
- Manned measurement of vibration levels to determine activity causing excessive vibration emission levels;
- If necessary, specialist consultants will be employed to determine adequate amelioration strategies.

9. VERIFICATION

The following measures are required to confirm compliance with this report.

- During construction, site inspections and supervision by a member firm of the Association of Australian Acoustic Consultants or Member of the Australian Acoustical Society, to confirm that the construction is in accordance with this acoustic report. For any variations or modifications, submit a professional letter of opinion, which certifies, on the basis of supporting technical data and risk management that the installed construction will provide the specified performance.
- Monitoring and Reporting of noise and vibration impacts as required in the CNMP.
- Prior to completion of the project it will be the mechanical contractor's responsibility to submit confirmation that noise emissions from the installed plant comply with the noise limits listed in Table 5-5 of this report. Acoustic testing shall be undertaken over a sufficiently representative period; we expect that 15 minutes during both day and night periods would be sufficient for continuous noises. Testing and reporting shall be undertaken by a member firm of the Association of Australian Acoustic Consultants or Member of the Australian Acoustical Society.

10. SUMMARY OF RECOMMENDATIONS

Based on our assessment the acoustic recommendations relating to this project have been summarised below:

Control of Road Traffic Noise Intrusion: Acoustic treatment will be required to the facade for purposes of maintaining road traffic noise intrusion to levels in accordance with AS/NZS2107. NDY recommends the following minimum acoustic ratings in terms of the weighted sound reduction index, R_w :

- **Facade Walls** - R_w40 We expect that this can be achieved by a curtain wall system with internal stud work and plasterboard lining with thermal insulation batts installed within the wall cavity.
- **External Glazing**- R_w32 . An example construction is 6mm float / 12mm air gap / 6mm float.
- **Roof/Ceiling** - R_w39 . An example construction is 0.48mm metal deck roofing with fibreglass Anticon insulation blanket underneath, 500mm air cavity, and mineral fibre ceiling tiles.
- **Skylights** – R_w39 . An example construction is translucent roof sheeting, minimum 1m cavity, and 6.38mm laminated glass at ceiling level. The walls of the skylight riser would need to be acoustically rated, eg 1 layer 13mm plasterboard and be sealed air tight to avoid noise break-in into the ceiling cavity.



Conversation Noise on Balconies: Noise emissions (conversation noise) from the various proposed balconies and external spaces is expected to be acceptable.

Car park noise: Car parking noise is expected to comply with the environmental noise criteria with the exception of car passby and door slam during the night time period (10pm to 7am) within the visitor carpark. Therefore it is recommended that the use of the visitor carpark be avoided during the night time (10pm to 7am) period. Noise emissions from the remaining parking areas are expected to be acceptable during all periods.

Loading Area Noise: Noise emissions from general loading and unloading activities are expected to be acceptable during all periods. As currently documented, it is required that all loading be conducted in the under-croft area.

Mechanical Plant: Acoustic requirements for mechanical plant have been listed in 7.4 of this report. Requirements include meeting the specified sound powers, shielding of Cooling Tower plant by an acoustic screen and in duct attenuation for car park ventilation fans.

Construction Noise: Construction phase noise emissions will be managed through the Construction Noise Management Plan (CNMP) listed in Section 8. It would remain the responsibility of the Principal Contractor to implement and comply with the CNMP such that noise emissions are minimised as far as practical. Part of the proposed plan would involve noise and vibration logging during the critical construction stages.

11. CONCLUSION

NDY has conducted a noise assessment for the proposed development of the Sullivan Nicolaides Pathology at Hurworth Street, Bowen Hills. Noise logging results, criteria, modeling and assessment results have been presented within this report. In summary, we expect that noise emissions from the SNP are able to be controlled to an acceptable level by implementing recommendations in this report.



APPENDIX A: NOISE MEASUREMENT RESULTS

A1 Unattended Monitoring

A1 – Unattended Monitoring

The equipment used for noise unattended monitoring was as follows:

Table A-1 Unattended Noise Measurement Equipment

Location	Instrument	Serial Number	Lab Calibration Due	Field Calibration
L1	Rion NL-21 Type 2 Sound Level Meter	01277351	11/04/2014	94.0 dB(A) before 94.1 dB(A) after
All	Bruel and Kjaer Calibrator Type 4231	2656359	23/07/2013	N/A

Logging details are listed below.

**Table A-2 Unattended Noise Logging Details**

Detail	Logger L1 Information
Microphone Height	Approximately 1.2m above the ground.
Microphone Orientation	Pointing vertically upwards
SLM Time Weighting	Fast
SLM Frequency Weighting	A
Measurement Interval Period	15 minutes intervals
Logger location	Approximately 2m from the Hurworth Street Boundary in the Location shown in Figure A-1.
Facade Reflection	No
Date of measurement	30 November to 10 December 2012
Weather during logging period	Data obtained from Brisbane {station 040913 and 040842}, http://www.bom.gov.au/climate/dwo/201212/html/IDCJDW4019.201212.shtml Refer to table below

Table A-3 Weather Data from station 040913 and 040842

Date	Min temp (°C)	Max temp (°C)	Rainfall (mm)	9am wind direction	9am wind speed (km/h)	3pm wind direction	3pm wind speed (km/h)
30/11/2012	20	30.6	0	E	6	NNE	11
1/12/2012	21.2	30.2	0	NW	9	NE	15
2/12/2012	21.6	29.8	0	NNW	7	NE	9
3/12/2012	21.5	30.9	0	NE	9	NNE	11
4/12/2012	21.8	37.9	0	ENE	6	NW	9
5/12/2012	19.1	34.3	0	SW	7	W	22
6/12/2012	19.6	29.4	0	E	7	ENE	15
7/12/2012	20.7	28.1	0	NNE	9	NE	11
8/12/2012	22.3	29.6	0.6	NE	7	ENE	13
9/12/2012	22.3	29.2	0	NNE	6	ENE	11
10/12/2012	22	26.4	0.6	SSW	4	ENE	4

The noise logger locations are shown in Figures A1.

Figure A-1 Logger Location, L1



Noise results are summarised below.



Table A-4 Noise Logging Results

Noise Descriptor	Period	Representative Noise Levels, dB(A)
L _{Aeq,24hrs}	24 hours	54
L _{Aeq,1hrs}	Maximum 1 hour	59
L _{A10,18hrs}	18 hours	55
L _{Amax}	average day time – 7am to 6pm	72
L _{Amax}	average evening - 6pm to 10pm	69
L _{Amax}	average night time - 10pm to 7am	65
L _{A10}	average day time – 7am to 6pm	57
L _{A10}	average evening - 6pm to 10pm	54
L _{A10}	average night time - 10pm to 7am	50
L _{Aeq}	average day time – 7am to 6pm	55
L _{Aeq}	average evening time - 6pm to 10pm	53
L _{Aeq}	average night time - 10pm to 7am	50
L _{A90}	average day time – 7am to 6pm	50
L _{A90}	average evening time - 6pm to 10pm	48
L _{A90}	average night time - 10pm to 7am	43

A graph of the noise logging results in 15minute intervals is shown below