ADP
Consulting : Engineering

SCEGGS Wilkinson House

Noise Impact Assessment
Acoustics Report

Prepared for: Sandrick Project Directions

Project No: SYD1685
Date: 15 October 2021
Revision: 02

ADP Consulting : Engineering

Creating great environments with great people

Project:	SCEGGS Wilkinson House
Location:	215 Forbes Street Darlinghurst NSW 2010
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Project No:	SYD1685
Revision:	02
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Project Team	
Client / Principal	Sandrick Project Directions
Architect	Smart Design Studio
Planner	Urbis

Contents

Appendices

Figures

Tables

1. Introduction

1.1 Document purpose

ADP Consulting Pty Ltd has been retained on behalf of Sandrick Project Directions to undertake acoustics engineering services for the proposed adaptive reuse of Wilkinson House, including alteration and additions located at 215 Forbes St, Darlinghurst.

This report is prepared to provide acoustic design advice for documentation by others and addresses the following:

- Relating to demolition, excavation, and construction:
  - Demolition, excavation, and construction noise and vibration management levels
  - An assessment of the construction noise and vibration levels and quantifies the resulting impacts of the proposed equipment
  - Where required or reasonable and feasible, provide recommendations to ensure that the Noise Management Levels are not breached.
- Relating to operational noise and internal environment:
  - Noise emission criteria and recommendations at the nearby sensitive receivers
  - Recommended internal noise levels of the development
  - Locations of sensitive receivers likely to be affected by demolition, excavation and construction works

The design and construction criteria and acoustic treatment concepts in this report will be built upon by ADP Consulting and the project team through further analysis, recommendations and coordination as the design progresses and is finalised.

It is the responsibility of the relevant contractor to ensure the implementation of the acoustic intent of this document, including compliance with criteria, codes, standards, specification etc.

1.2 Referenced drawings, codes and standards

The following drawings, conditions guidelines, standards, regulatory requirements and other project-specific information has been referenced in preparing this report:

- Smart Design Studio's "For SSDA Submission" architectural drawings, dated 15 October 2021 (Architectural drawings)
- Wilkinson Murray's Construction & Operational Noise Report (Report No. 18180), dated 22 July 2019 (Noise Report)
- Planning Secretary's Environmental Assessment Requirements (SEARs) Matrix (SSD-19989744) SCEGGS Darlinghurst – Adaptive re-use of Wilkinson House, dated June 2021 (SEARs)
- TBH Consultancy's Preliminary Construction Management Plan SCGEGGS – Wilkinson House, dated 10 September 2021 (Preliminary Construction Management Plan)
- AS 2670.2:1990 Evaluation of Human Exposure to Whole-Body Vibration Part 2: Continuous and Shock-Induced Vibration in Buildings (1 to 80 Hz) (AS 2670.2)

- AS/NZS 1668.1:2015 The Use of Ventilation and Air Conditioning in Buildings Part 1: Fire and Smoke Control in Buildings (AS/NZS 1668.1)
- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS 2107)
- Assessing Vibration: A Technical Guideline – NSW Department of Environment and Conservation, dated February 2006 (AVTG)
- BS 6472–1992 – Evaluation of Human Exposure to Whole-Body Vibration in Buildings (1 to 80 Hz) (BS 6472)
- BS 7385.2-1993 Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground-borne Vibration (BS 7385.2:1993)
- NSW EPA's Noise Policy for Industry, dated October 2017 (NPfI)
- Association of Australasian Acoustical Consultants' (AAAC) Guideline for Commercial Building Acoustics, version 1.0, dated June 2017 (GCBA)
- Association of Australasian Acoustical Consultants' (AAAC) Guideline for Educational Facilities, version 2.0, dated January 2018 (GEF)
- Association of Australasian Acoustical Consultants' (AAAC) Guideline for Child Care Centre Acoustic Assessment, version 2.0, dated October 2013 (GfCCC)
- AS 2436:2010 (R2016) Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (AS2436:2010)
- Office of Environment and Heritage – Interim Construction Noise Guidelines, dated July 2009 (ICNG)
- Department for Environment Food and Rural Affairs (United Kingdom) Update of Noise Database for Prediction of Noise on Construction and Open Sites 2005 (DEFRA)
- Sydney Local Environmental Plan 2012, last updated September 10 2021 (LEP)
- Environmental Planning and Assessment (Covid-19 Development – Construction Work Days) Order (No 3) 2021, dated 30 July 2021 (Environmental Planning and Assessment Order (No 3))
- City of Sydney's Construction Site Noise Post in Development Guidelines & Policies, published 11 September 2021(City of Sydney Construction Site Noise Guideline)
- *Prediction of Noise from Small to Medium Sized Crowds* by M.J. Hayne, J.C. Taylor, R.H. Rumble and D.J. Mee, dated 2-4 November 2011

1.3 Project summary

We understand the project is the proposed adaptive reuse of Wilkinson House, including alteration and additions, which is a 1928 building designed by Emile Soderston. SCEGGS has a 20-year masterplan which the adaptive reuse of the Wilkinson building is a part of. The scheme is to adaptively reuse the building to suit their current and future teaching needs.

The Architectural Drawings show that the proposed upgrade to Wilkinson House will consist of:

- Lower ground level, consisting of:
  - 2 Sports GLAs (gym / sports centre)
- Ground level, consisting of:
  - Foyer
  - Staff room for academic support
  - Drama classroom
  - PDHD classroom
  - Three 4-person meeting room
  - One 10-person meeting room
  - Staff bathrooms

- First level, consisting of:
  - 3 general classrooms
  - Staff room for social science
  - Staff lunch room
  - One 8-person meeting room
  - Breakout areas
- Second level, consisting of:
  - 3 general classrooms
  - Staff room for indigenous support
  - Breakout areas
  - Student water closets
- Third level, consisting of:
  - Multipurpose common room
  - Courtyard exposed to roof level through roof opening
  - General classroom
  - Career's office
  - Waiting areas
  - Staff water closets
- Roof level, consisting of:
  - Photo-voltaic panels
  - Oculus exposed to third level

1.3.1 Project Background

We note that a previous concept development application was prepared for the demolition of Wilkinson House on SCEGGs Campus that was not approved, where an operational and construction noise report was prepared by Wilkinson Murray. Acoustic survey data within the Wilkinson Murray report is still relevant for the assessment of this state significant development application (SSDA) and has been documented in Section 2.2.

1.4 Construction Methodology

The construction methodology presented in the Wilkinson House Preliminary Construction Management Plan contains preliminary information on the demolition and construction methodology and expected plant and equipment.

We would like to identify that at the time of writing, best attempts are made to provide accurate information for the demolition, excavation and construction of the site. We note that specific plant and equipment models that will be used have not been selected and estimates have been provided of the proposed equipment outlined in this report. The demolition, excavation and construction programme and plant and equipment presented in this report may be subject to changes at a later stage when a selected contractor is appointed and more accurate information is available.

It is expected that the construction programme will consist of the following:

- Site Establishment (approx. 1 month)
  - Delivery and installation of demountable buildings, erection of hoardings, services etc.
- Demolition (approx. 3 months)
  - Internal walls and slab demolition, piling works and installation of trusses.
- Excavation & Substructure (approx. 2 months)
  - Bulk and detailed excavation, concrete foundation, material handling.
- Construction (approx. 6 months)
  - Structural, building envelope and façade, internal services, and finishes
- Closing Out and Handover (approx. 3 months)
  - Final testing and commissioning.

The preliminary construction management plan states that demolition, excavation and construction works will take place during the following hours:

> 7:30am to 5:30pm Monday to Friday, and

> 7:30am to 3:30pm on Saturday.

We note that these hours are outside recommended standard hours for Saturday as scheduled in the Interim Construction Noise Guideline (ICNG), however, the City of Sydney Construction Site Noise Publication specifically states the following regarding construction hours for areas outside the city centre:

> *work from 7.30am to 5.30pm Monday to Friday and 7.30am to 3.30pm Saturday in other parts of our local government area.*
>
> *not work on Sundays or public holidays anywhere in our local area.*

Therefore, this construction noise and vibration assessment has redefined the recommended standard hours to be as stated above, consistent with the construction hours specified by the council.

1.5 Secretary's Environmental Assessment Requirements (SEARs)

The SEARs relevant to acoustics and the section in which they have been assessed are presented in Table 1.

Table 1 SEARs Conditions addressed in report sections

SEARS Condition	Report Section
Construction	
includes a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation and construction.	**6**
details the proposed construction hours and provide details of, and justification for, instances where it is expected that works would be carried out outside standard construction hours.	**1.4, 3.1**
Operational	
includes a quantitative assessment of the main sources of operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant) and any out of hours community use of school facilities.	**9.5, 8.1**
outlines measures to minimise and mitigate the potential noise impacts on nearby sensitive receivers.	**8**
considers sources of external noise intrusion in proximity to the site (including, road rail and aviation operations) and identifies building performance requirements for the proposed development to achieve appropriate internal amenity standards.	**9.1**
demonstrates that the assessment has been prepared in accordance with polices and guidelines relevant to the context of the site and the nature of the proposed development.	**1.2, 5, 8**

1.6 Site Plan

Figure 1 provides a site map of the proposed redevelopment site location and its surrounds.

Figure 1 Site plan

2. Site investigations and noise environments

2.1 Site investigations

Based on a desktop site survey we have identified the following sensitive receivers as being the nearest noise sensitive premises to the proposed redevelopment:

- Commercial premises, including:
  - William St mixed use commercial, located approximately 40 metres north of the development site
- Residences, including:
  - 184 to 188 Forbes St, located approximately 20 metres east of the development site
  - 152 to 188 Bourke St, located approximately 45 metres west of the development site
  - Thomson Street / Lane residences, located approximately 110 metres south of development site
- St Peter's Church, located approximately 10 metres to the north of the development site, a part of the SCEGGS Campus
- SCEGGS Arts centre, located directly west of site, a part of SCEGGS Campus
- SCEGGS External Sports Court and Gym, located directly south of site, a part of SCEGGS Campus. It is understood that temporary demountable classrooms will be located on the external sports court
- The development itself that includes:
  - Services requiring noise attenuation and vibration isolation to ensure low indoor noise levels in occupied areas and compliance with noise emission regulations
  - An expected standard of amenity compliant with all applicable codes, regulatory requirements, client brief and/or other standards

The heritage-listed properties, as described in the Sydney Local Environment Plan (LEP) closest to the development are:

- SHR00148, LEP I300, St Peters Church & Precinct located at 12m away to the North
- LEP I301, SCEGGS Darlinghurst adjacent to and comprising of the site

2.2 Noise Environment

Unattended logger measurements were presented in Wilkinson Murray's report, which are used in this report for the adaptive re-use of Wilkinson House.

Wilkinson Murray in their Noise Report have presented unattended noise measurements at the following locations (shown in Figure 1):

- **Location L1** – on the northern end of Thornton Street
- **Location L2** – at the back of 184 Forbes Street

  between 14 and 24 September 2018

Background and equivalent continuous sound levels stated in the Noise Report at location L1 and L2 are summarised in Table 2. We note that these measurements are representative of the noise environment as

they were taken in the last 5 years and no major changes to the area and its environment have been made since measurement to justify any changes to these measurements. Additionally, due to lockdown restrictions in the current noise environment, additional measurements would not represent the noise environment as accurately as those outlined in the Noise Report. The sound levels scheduled in Table 2 have been used to determine the criteria presented in Section 3.1 and Section 4.4.

Table 2 Unattended noise measurements at locations L1 and L2, dB(A)

Noise Measurement	**Daytime** (07:00-18:00)	**Evening** (18:00-22:00)	**Night-time** (22:00-07:00)
L1 – Thomson Street			
Repeatable – L_{Aeq}	56	52	49
Rating Background Level (RBL) – L_{A90}	47	45	44
L2 – Forbes Street			
Repeatable – L_{Aeq}	55	55	53
Rating Background Level (RBL) – L_{A90}	50	49	47

3. Construction Noise and Vibration Criteria

This section addresses noise and vibration management levels for the demolition, excavation and construction of Wilkinson House developed in accordance with the ICNG.

3.1 Noise Management Levels

The ICNG provides guidelines for demolition, excavation and construction noise, and outlines procedures if there is exceedance of the NMLs.

Table 3 summarises the ICNG methodology for establishing NMLs for residential receivers, and an outline of the relevant procedure in the case of an exceedance of NMLs.

Table 3 Noise management levels - Construction

Time of Day	Management level, $L_{Aeq\ (15\ min)}$	How to apply
Residences, Recommended Standard Hours* Monday to Friday: 7:30am to 5:30pm Saturday 7:30am to 3:30pm* 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 $L_{Aeq\ (15\ min)}$ 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.

Time of Day	Management level, $L_{Aeq\ (15\ min)}$	How to apply
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.

* We note that these standard hours have been redefined as per the City of Sydney Construction Site Noise Publication

The nearest noise sensitive receivers with the potential to be affected by construction works have been identified in Section 2.1. The Rating Background Levels (RBLs) have been established based on the long-term unattended noise measurements outlined in Section 2.2.

The NMLs for the residential receivers are presented in Table 4, and the NMLs for non-residential noise-sensitive receivers are presented in Table 5.

Table 4 Residential Noise Management Levels

		Noise Management Level $L_{Aeq\ (15\ min)}$ dB(A)	
Time of Day	**Land Use**	**Noise affected**	**Highly noise affected**
Recommended standard hours*: Monday to Friday: 7:30am to 5:30pm Saturday 7:30am to 3:30pm No work on Sundays or public Holidays	**Residential** Thomson St and Bourke St	57	75
	Residential Forbes St and St Peters St	60	75

* We note that these standard hours have been redefined as per the City of Sydney Construction Site Noise Publication

Table 5 Non-Residential Noise Management Levels

Receiver	When to apply	Noise Management Level $L_{Aeq\ (15\ min)}$ dB(A)
Commercial Office	When in use	70 (external)
School Classroom	When in use	45 (internal)
Place of Worship	When in use	45 (internal)
Active Recreation Area	When in use	65 (external)

Receiver	When to apply	Noise Management Level $L_{Aeq\ (15\ min)}$ dB(A)
Passive Recreation Area	When in use	60 (external)

3.2 Vibration Criteria

Vibrations generated from construction works can be assessed in the following categories:

> Human comfort
> Structural damage
> Ground-borne noise

The following section provides 'best practice' guidelines for the different categories of construction vibration.

3.2.1 Human Comfort

Human comfort due to exposure to vibrations is dependent on duration and magnitude. Vibration assessed for human comfort can be classified as continuous, impulsive or intermittent and can enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side), or z-axis (foot to head).

The AVTG refers to BS6472:1992 as being relevant in assessing human comfort.

3.2.1.1 Continuous and Impulsive Vibrations

Allowable magnitudes for continuous and impulsive exposure to building vibration (summarised from Table 2.2 of AVTG) with respect to human response are presented in Table 6.

Table 6 Continuous and impulsive vibration criteria, m/s^2

Location	Time of Construction	Preferred (rms)		Maximum (rms)	
		z-axis	x & y-axis	z-axis	x & y-axis
Continuous vibration					
Residences	Day (7am – 10pm)	0.010	0.0071	0.020	0.014
	Night (10pm – 7am)	0.007	0.005	0.014	0.010
Offices, commercial, educational institutions and places of worship	All times	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Day (7am – 10pm)	0.30	0.21	0.60	0.42
	Night (10pm – 7am)	0.10	0.071	0.20	0.14
Offices, commercial, educational institutions and places of worship	All times	0.64	0.46	1.28	0.92

3.2.1.2 Intermittent Vibrations

The VDV criteria recommended in AVTG are summarised in Table 7. To quantify the cumulative effects of several vibration events based on human exposure due to duration and magnitude, the Vibration Dose Value (VDV) descriptor is used.

Table 7 Acceptable vibration dose values (VDV), $m/s^{1.75}$

Location	Time of Construction	Preferred (rms)	Maximum (rms)
Residences	Day (7am – 10pm)	0.20	0.40
	Night (10pm – 7am)	0.13	0.26
Offices, commercial, educational institutions and places of worship	All times	0.40	0.80

3.2.2 Ground-Borne Noise

Ground-borne noise is generated by vibrations through the ground affecting structures through activities such as rock breaking or excavations. The ICNG states that noise management actions should be implemented (which may include community consultation and respite) when the following levels are exceeded:

- Evening (18:00-22:00) – Internal: $L_{Aeq\ 15min}$ – 40 dB(A)
- Night-time (22:00-07:00) – Internal: $L_{Aeq\ 15min}$ – 35 dB(A)

However, there are no criteria presented in the ICNG for ground-borne noise during the day-time hours (7:00am-6:00pm), when it is expected that construction work will take place. Therefore, we recommend that ground-borne noise levels in the adjacent buildings do not exceed the levels presented in Table 8 during the day-time period. These recommendations are in accordance with the internal noise levels adopted from AS/NZS 2107:2016 for use under construction intrusion noise conditions for consistency.

Table 8 Daytime ground-borne noise criteria

Type of receiver	Type of room	Ground borne noise, $L_{Aeq,\ 15min}$ dB(A)
Residential	Any	45
Commercial, educational institutions and places of worship	General office areas / meeting rooms / Classrooms	45

3.2.3 Structural Damage

3.2.3.1 Non-Heritage Buildings

We propose the use of BS 7385.2:1993 to set structural damage limits during the demolition, excavation, and construction phases.

The vibration limits in buildings associated with cosmetic damage in BS7385.2:1993 are summarised inTable 9. The limits are applicable to measurements at the base of the building in question. Under certain circumstances, such as dynamic magnification due to resonance, the allowable velocities presented in Table 9 may need to be reduced by up to 50%.

Monitoring equipment should be configured in such a way so that alarms are triggered at a level below 7.5mm/s (5mm/s as a trigger level is typically used).

Table 9 Transient vibration guide values for cosmetic damage

Type of Building	**Peak component particle velocity in frequency range of predominant pulse**	
	4Hz to 15Hz	**15Hz and above**
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20 mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
	At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded	

3.2.3.2 Heritage Buildings

The following nearby heritage buildings have been identified from the Local Environment Plan (LEP) with the potential to be affected by the proposed development's construction are:

> St Peters Church and Precinct – Bourke Street, Darlinghurst

> SCEGGS Darlinghurst (including Wilkinson House)

Vibration limits for buildings that are part of these heritage items may need to be revised due to their potentially sensitive nature. As BS 7385.2:1993 does not refer to buildings of a sensitive nature, the more appropriate DIN 4150.3:1999 is proposed. Table 10 summarises vibration limits for the adjacent heritage buildings that are sensitive to vibrations, as outlined in DIN 4150.3:1999.

Table 10 Guideline values for vibration velocity to be used when evaluating the effects of short-term

Type of Building	Peak component particle velocity in frequency range of predominant pulse mm/s			Vibration of horizontal plane of highest floor at all frequencies
	1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	
Structures that, because of their particular sensitivity to vibration, cannot be classified into the types of buildings in section 3.2.3.1 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10 (at frequencies above 100Hz, the values given in this column may be used as minimum values)	8

Monitoring equipment should be configured in such a way so that alarms are triggered at a level below 3mm/s (we recommend 2mm/s as a trigger level in heritage buildings).

4. Operational noise emission criteria

Noise emission restrictions apply to future tenant activity and mechanical plant and equipment systems. These must be planned, designed and installed to include suitable sound attenuation, vibration isolation, and other necessary acoustic treatments.

The NPfI requires that trigger levels be calculated from the intrusiveness and amenity criteria. The NPfI also includes the application of modifying factors for undesirable noise characteristics, up to a maximum of 10dB.

4.1 Noise intrusiveness

The NPfI states that the intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5dB.

Table 11 schedules the noise intrusion level criteria in accordance with the NPfI, calculated with the background noise levels presented in Section 2.2.

4.2 Noise amenity

The NPfI describes methodology to limit the increases in noise levels from the introduction of new noise sources in an area. The NPfI recommends that the maximum ambient noise should not exceed the levels in Table 2.2 of the NPfI.

Table 11 summarises the project amenity noise levels (as described in Table 2.2 of the NPfI).

4.3 Modifying factors

For noise emissions from the proposed development with undesirable characteristics such as; tonality, low frequency, impulsiveness and intermittency, adjustments (as per Fact Sheet C of the NPfI) need to be included. These modifying factors include a 5dB penalty for each undesirable characteristic. A maximum penalty of 10dB for 2 or more undesirable characteristics is to be applied.

It should be noted that during the detailed design / construction phase of the project, if the design team / contractor makes selections of equipment which include one or more of these undesirable noise characteristics, a modifying factor will be applied.

4.4 Noise emission criteria (NPfI)

The project specific trigger levels have been derived using the methodology presented in the NPfI and are scheduled in Table 11 and Table 12. We note that these trigger levels have been derived from the background noise levels measured at Locations L1 and L2 presented in section 2.2.

4.4.1 Noise emission criteria summary

Table 11 Noise emission criteria – Residential

Time of operation	Site specific noise limits				
	Intrusive, $L_{Aeq,15min}$	**Recommended amenity, $L_{Aeq, Period}$**	**Project amenity, $L_{Aeq, Period}$**	**Project amenity, $L_{Aeq, 15min}$**	**Project trigger levels, $L_{Aeq, 15min}$**
Residential – Thomson St and Bourke St					
Day (7am to 6pm)	52	60	55	58	**52**
Evening (6pm to 10pm)	50	50	45	48	**48**
Night (10pm to 7am)	49	45	40	43	**43**
Residential – Forbes St and St Peters St					
Day (7am to 6pm)	55	60	55	58	**55**
Evening (6pm to 10pm)	54	50	45	48	**48**
Night (10pm to 7am)	52	45	40	43	**43**

Table 12 Noise emission criteria – Other Receivers

Receiver	Time of operation	Site specific noise limits			
		Recommended amenity, $L_{Aeq, Period}$	**Project amenity, $L_{Aeq, Period}$**	**Project amenity, $L_{Aeq, 15min}$**	**Project trigger levels, $L_{Aeq, 15min}$**
Commercial	When in use	65	60	63	**63**
School classroom - internal	Noisiest 1-hour period when in use	40*	35*	38*	**38***
Place of worship - internal	When in use	40	35	38	**38**
Active recreation area	When in use	55	50	53	**53**
Passive recreation area	When in use	50	45	48	**48**

*The NPfI states, in Section 2.4, that in cases where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(1hr)}$.

It should be noted that the cumulative noise emission from the operations of the proposed development are to meet the project trigger levels presented in Table 11 and Table 12. Careful planning and coordination with the project design team should be undertaken so that these criteria are complied with.

4.4.2 Transient noise events – sleep disturbance

Night-time noises, which occur infrequently and for short durations of time, have the potential to cause sleep disturbances. Such noise sources may include announcements, internal sports and other activities.

Table 13 presents recommended sleep disturbance criteria based on the NPfI and the measured background noise levels presented in Section 4.4. Noise emission from short duration noise events should be controlled to meet these criteria to reduce the risk of sleep disturbance to residences at night.

Table 13 Noise emission criteria – Transient noise events

Activity	Noise Descriptor	Noise criterion dB(A)
Out of hours school activities	$L_{Aeq,\ 15min}$	49
	L_{Amax}	59

5. Operational internal noise and vibration recommendations

5.1 AS/NZS 2107:2016

Indoor background noise levels in terms of Sound Pressure Level (SPL) and reverberation times (seconds) deemed acceptable to the majority of reasonable occupants are published in AS/NZS 2107. We have summarised the recommended indoor noise levels and reverberation times for the proposed development in Table 14.

These limits apply to continuous sources of noise internal to the proposed development such as plant equipment, lifts, etc.

Please note that this section would apply for:

> mechanical plant and equipment for all spaces

Furthermore, the façade should be designed so that the noise levels presented in Table 14 are complied with.

Table 14 Internal design sound pressure levels and reverberation time recommendations

Type of occupancy	Design SPL, L_{Aeq}, dB(A)	Reverberation Time, seconds
Office areas	40 to 45	0.4 to 0.7
Professional and administrative offices	35 to 40	0.6 to 0.8
Teaching spaces / single classroom	35 to 45	Curve 3*
Corridors and lobbies	< 50	< 0.8
Staff common rooms	40 to 45	< 0.6
Meeting room (small)	40 to 45	< 0.6
Video / audio conference rooms	30 to 40	0.2 to 0.4
Sports hall	< 50	0.9*
Washrooms and toilets	< 55	-

* Specific reverberation time criteria shall be calculated based on the curves in Appendix A of AS/NZS 2017 and the volumes of the spaces

5.2 Fire mode noise conditions

Some building systems only operate in fire mode and during periodic testing, so they do not add to background noise under typical conditions. According to AS/NZS 1668.1:2015, these systems are subject to noise limits, presented in Table 15, relating not to occupant comfort but rather to occupant distress and the intelligibility of emergency commands. Here, the 65 dB(A) limit supports the audibility of fire alarms (min. 75 dB(A) at bedheads per AS 1670.1).

Table 15 Fire mode maximum sound pressure levels

Area type	Maximum SPL, L_{Aeq}, dB(A)
Occupied Area	65
Fire-isolated exit (e.g. fire stair)	80

5.3 Internal vibration requirements

Vibration is the oscillation of an object, structure, or surface at frequencies typically below 20 Hz, which is inaudible but instead can be "felt". **Structure-borne sound** means oscillation at frequencies higher than 20Hz, resulting in audible noise, which is transmitted through rigid building elements and radiated by surfaces.

Human response to building vibration is a complex phenomenon. There is great variability in the vibration tolerance of humans, and as a result, human comfort criteria cannot robustly be defined and quantified. Acceptable values of human exposure to vibration depend on human activity and the character of the vibration, and they are further influenced by individual attitudes, expectations, and perceptibility.

Limits for vibration of the building structure potentially affecting human comfort have been derived from AS 2670.2 and BS 6472, both of which are referenced and discussed practically in the AVTG. These standards propose maximum vibration levels in terms of baseline curves and multiplication factors. For the purpose of minimising the disturbing perceptibility of vibration within the occupied areas of this development, Table 16 specifies appropriate limits for floor vibration in a simplified form.

Table 16 Vibration limits

Type of occupancy	Time	Continuous vibration limits: r.m.s. acceleration (m/s^2) Preferred / maximum	Impulsive vibration limits: r.m.s. acceleration (m/s^2) Preferred / maximum	Intermittent vibration limits: Vibration Dose Value VDV ($m/s^{1.75}$) Preferred / maximum
Offices, schools, educational institutions and places of worship	Day or night	0.020 / 0.040	0.640 / 1.280	0.40 / 0.80

5.4 Noise Levels from Gym Use

We understand that a gym / sports centre is proposed on the basement floor of the development, to be operated by SCEGGS.

Activities in gyms, particularly the dropping of weights, can generate high levels of vibration and structure-borne noise in the underlying building structure. Vibration isolation is therefore necessary to reduce the transfer to adjacent sensitive areas such as residences, particularly when gyms are located adjacent to sensitive areas.

We recommend that any noise and vibration transmitted by gyms within the proposed development is to comply with the internal vibration limits scheduled in Section 5.3, external noise limits scheduled in Section 4.4 and the following internal noise limits:

Table 17 Gym maximum internal noise levels

Adjacent space	**Internal noise criterion, L_{max}, dB(A)** **Day / Evening** (7am to 10pm)
Classrooms and other spaces	Airborne: 45 Structure borne: 40

6. Construction Noise and Vibration Assessment

This section has been prepared to provide acoustic engineering advice for documentation by others and addresses:

> Assessment of the construction noise and vibration levels that quantifies the resulting impacts of proposed and anticipated construction equipment

> Where required or reasonable and feasible, recommendations to ensure Noise Management Levels are not breached.

6.1 Construction Noise Assessment

For the purposes of assessment, the construction equipment expected to be used on site has been collated based on information contained in the Preliminary Construction Management Plan, as well as previous knowledge of the common construction site equipment.

The layout of equipment on site and usage characteristics are subject to change.

6.1.1 Plant and equipment Noise Levels

The noise levels for the expected construction plant and equipment have been determined, based on AS2436 and DEFRA. Variations in noise levels may be observed due to equipment factors such as the size, make/model, level of wear, operator etc.

A schedule of the expected noise levels for plant and equipment that may be used at different stages of the construction is presented in Table 18.

Table 18 Plant equipment sound power levels

Plant Equipment	Mobilisation and operation emissions	Sound Power Level dB(A)
Site Establishment, Demolition, Excavation & Substructure – approximately 5 months duration		
General delivery trucks	Access from St Peters St	101
5-tonne excavator	Operation onsite	101
5-tonne excavator (with hammer attachment)	Operation onsite	117
14-tonne excavator	Operation onsite	103
Handheld pneumatic jackhammer	Operation onsite	116
Handheld demolition saws	Operation onsite	120
Concrete pump (infrequent days)	Operation onsite	107
Concrete vibrator (infrequent days)	Operation onsite	99

Plant Equipment	Mobilisation and operation emissions	Sound Power Level dB(A)
Piling rig	Operation onsite	96
Forklift	Operation onsite	106
Construction – approximately 6 months duration		
General delivery trucks	Access from St Peters St	101
Tower crane	Operation onsite	105
Single hoist (man and materials)	Operation onsite	96
Concrete pump (infrequent days)	Operation onsite	107
Concrete vibrator (infrequent days)	Operation onsite	99
Handheld pneumatic jackhammer	Operation onsite	97
Handheld demolition saws	Operation onsite	120
Handheld drill	Operation onsite	88
Nail gun	Operation onsite	101
Forklift	Operation onsite	106

6.1.2 Predicted Noise Levels

The noise levels from use of indicative construction plant and equipment have been predicted at the nearest noise sensitive receivers (Table 19). The predicted noise levels indicate that there may be exceedances of the ICNG noise affected management levels for residences nearest to the development. The exceedances range between 1 dB and 12 dB and are all below the highly affected noise level for residences.

Table 19 Construction Noise-Level Predictions and Compliance with NMLs

Equipment	Residential – 184 Forbes Street (below Level 5)		Residential - 184 Forbes Street (above Level 5)		Residential – 152 Bourke Street		School Classroom – SCEGGS Art Building		Place of Worship - St Peters Church	
	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies
Site Establishment, Demolition, Excavation & Substructure – approximately 5 months duration										
General delivery trucks	51	Y	58	Y	44	Y	39	Y	35	Y
5-tonne excavator	60	Y	61	N(-1)	53	Y	51	N(-6)	38	Y
5-tonne excavator (with hammer attachment)	67	N(-7)	69	N(-9)	60	N(-3)	58	N(-13)	45	Y
14-tonne excavator	62	N(-2)	63	N(-3)	55	Y	53	N(-8)	40	Y
Handheld demolition saws	70	N(-10)	72	N(-12)	63	N(-6)	61	N(-16)	48	N(-3)
Handheld pneumatic jackhammer	66	N(-6)	68	N(-8)	59	N(-2)	57	N(-12)	44	Y
Piling Rig	46	Y	48	Y	39	Y	37	Y	24	Y
Concrete Pump	66	N(-6)	67	N(-7)	59	N(-2)	57	N(-12)	44	Y
Concrete Vibrator	58	Y	59	Y	51	Y	49	N(-4)	36	Y
Forklift	65	N(-5)	66	N(-6)	58	N(-1)	56	N(-11)	43	Y

Equipment	Residential – 184 Forbes Street (below Level 5)		Residential - 184 Forbes Street (above Level 5)		Residential – 152 Bourke Street		School Classroom – SCEGGS Art Building		Place of Worship - St Peters Church	
	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies	Noise Level	Complies
Wilkinson House Construction – approximately 6 months duration										
General delivery trucks	51	Y	58	Y	44	Y	39	Y	35	Y
Tower crane	59	Y	61	N(-1)	52	Y	50	N(-5)	37	Y
Single hoist (man and materials)	50	Y	52	Y	43	Y	41	Y	28	Y
Concrete pump	66	N(-6)	67	N(-7)	59	N(-2)	57	N(-12)	44	Y
Concrete vibrator	58	Y	59	Y	51	Y	49	N(-4)	36	Y
Handheld pneumatic jackhammer	47	Y	49	Y	40	Y	38	Y	25	Y
Handheld demolition saws	70	N(-10)	72	N(-12)	63	N(-6)	61	N(-16)	48	N(-3)
Handheld drill	47	Y	48	Y	40	Y	38	Y	25	Y
Nail gun	60	Y	61	N(-1)	53	Y	51	N(-6)	38	Y
Forklift	65	N(-5)	66	N(-6)	58	N(-1)	56	N(-11)	43	Y

As part of the assessment, we have assumed a 2.4m plywood screen surrounding the site is acting as an acoustic barrier for noise emission to receivers, as is indicated in the Preliminary Construction Management Plan. This screen has been assumed to reduce the noise level at the receiver by 7 dB. The performance of such a screen on site however may vary, and this level of reduction has used as a conservative estimate.

Receivers in the 184 Forbes Street apartment building on the higher levels have been assessed without the acoustic screen.

Additionally, we have made the following assumptions:

- The use of handheld demolition saws is required intermittently, and typically only run for 2 minutes at a time during the excavation and mostly internally during construction phases. These activities are limited in use over relatively short durations and hence we recommend that the methodology regarding time intervals presented in the ICNG are used.
- The tower crane and single hoist are used intermittently and only for approximately 5 minutes intervals in a 15-minute period.
- The use of the 5 hammer and saw attachments will be also restricted to intermittent 2 minute periods

- General delivery trucks will access the site from St Peters Street and are not to idle their engines outside the site
- As the façade construction at nearby St Peters Church Precinct and SCEGGS Campus receivers are not known, the internal noise levels have been determined as being through a fully enclosed façade, resulting in a conservative transmission loss of approximately 22dB.

7. Construction Noise and Vibration Recommendations

7.1 Construction Noise Recommendations

Our construction noise assessment presented in Section 6.1 indicates that exceedances of the noise affected NML for residences of up to 12 dB due to the noise from construction activities are likely. As stated in the ICNG, an exceedance of the noise affected NML requires that:

> *"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."*

7.1.1 Exceedance of Noise Affected NML

Where it is expected that an exceedance of the Noise Affected NML will occur at noise-sensitive receivers, the following useful means have been identified to assist in managing the noise impact of such activities:

- Community notification
- Plant operation
- Worker conduct
- Complaint handling

These techniques are explained in more detail below.

7.1.1.1 Community Notification

Community notification is an effective method for decreasing the impact of construction noise, below are some techniques for notifying sensitive receivers:

- Contact potentially noise affected neighbours at the earliest possible time before any site work begins.
- Describe any noise controls, such as, walls to be built first that will reduce noise, temporary noise walls, or use of silenced equipment.
- Keep neighbours up to date on progress.
- Provide contact details on a site board at the front of the site and maintain a complaint register suited to the scale of works.
- Provide a copy of the noise management plan, if available, to potentially noise affected neighbours.
- Inform nearby sensitive receivers of any potential exceedances in NMLs before the commencement of noisy activities via letterbox drop with the nature, time and duration of the activity.

7.1.1.2 Plant Operation

For activities with marginal exceedances of the NMLs (i.e. up to 5dB(A)), careful selection and maintenance of plant equipment will ensure that disruptions to adjacent receivers are minimised.

The following are some techniques for quiet and efficient plant operation:

- Where practical, undertake the noisiest works during the recommended standard hours.

- Turn off plant at times that it is not being used.
- Examine, and implement where feasible and reasonable, alternative work practices which generate less air-borne and ground-borne noise – for example:
  - use electric equipment instead of diesel or petrol-powered equipment
  - use sawing methods that reduce ground-borne noise
- Examine, and implement where feasible and reasonable, the use of silenced equipment and noise shielding around stationary plant (such as generators).
- Ensure plant is regularly maintained, and repair or replace equipment that becomes noisy.
- Arrange the work site to minimise the use of movement alarms on vehicles and mobile plant.
- Locate noisy plant away from potentially noise affected neighbours or behind barriers, such as sheds or walls.
- Ensure that the site foreman or representative is trained in taking noise measurements and logs noisy activities during construction at the closest affected receivers and on site.

7.1.1.3 Equipment Selection

Equipment mitigation measures (developed from AS2436) may be considered to reduce noise emission from construction equipment that causes significant noise emission (12dB exceedance of Noise Affected NML) from the site, they are presented in Table 20.

Table 20 Remedies for noisy equipment

Equipment Plant	Possible Remedies
Handheld Pneumatic Jack Hammer Handheld Demolition Saws	Tool muffler or silencer Dampened bit Enclosure barrier Maintain saw sharpness
5-tonne excavator (with hammer attachment)	Engine exhaust silencer Portable acoustic enclosure Tool muffler or silencer Dampened bit
Concrete pump	Enclosure barrier where feasible and reasonable Letterbox dropping for dates of pouring Acoustic silencer on engine

7.1.1.4 Worker Conduct

Workers should also be involved in noise mitigation through the following methods:

- Avoid dropping materials from a height.
- Talk to workers about noise from the works at the sensitive receivers and how it can be reduced.
- Use radios and stereos indoors rather than outdoors.

7.1.1.5 Complaint Handling

The following recommendations should be put in place to respond to complaints:

- Site staff with the displayed complaints phone number will be informed of current and upcoming works and the relevant contacts for these works
- Handle complaints in a prompt and responsive manner
- Once a complaint is received, noise measurements will be taken by suitably trained site staff and action taken accordingly
- Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, actions additional to those described above to minimise noise output

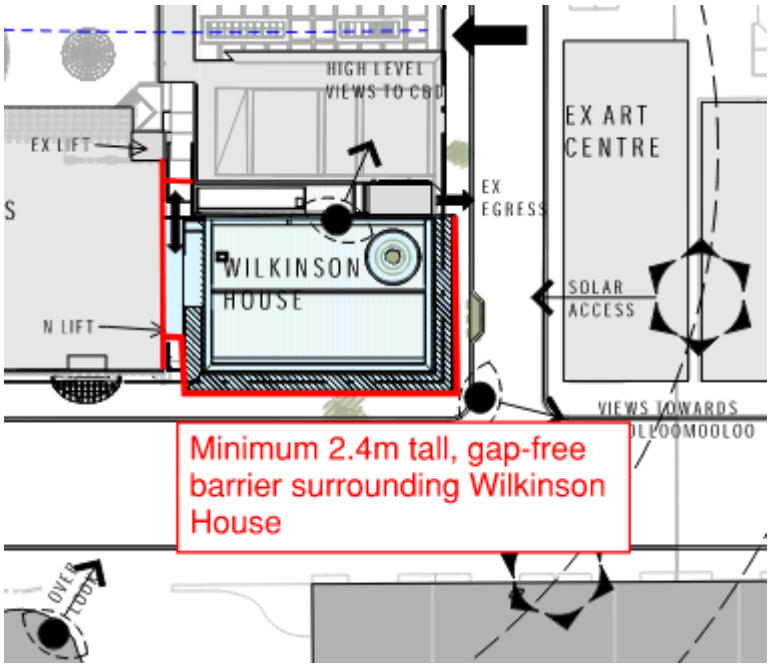
7.1.2 Barriers

The preliminary construction management plan states that a 2.4m plywood barrier will be installed around the perimeter to reduce the noise emission of equipment on site. Using this technique, the following reductions can be expected:

- **0-15 dB reduction:** This may be achieved with the use of barrier or hoarding strategically placed around noisy equipment, such as hand-held pneumatic jackhammers and hand-held demolition saws or around the site perimeter. Note that construction materials of barriers or hoardings achieve different results based on material used height and relative distances between barrier and noise source or sensitive receiver.

We have conservatively estimated the performance of the plywood barrier to lead to a 7dB reduction. Figure 2 presents the required locations of the barrier to effectively reduce noise levels at nearby receivers.

Figure 2 Acoustic Barrier Indicative Location



7.2 Construction Vibration Recommendations

The amount and nature of vibration emanating from the construction works has the potential to affect nearby receivers. It is the contractor's responsibility to ensure that the vibration levels do not exceed the criteria in Section 3.2 of this report.

7.2.1 Vibration Buffer Distances

During demolition, excavation and construction, the contractor is to ensure that vibration levels are within the guidelines presented in Section 3.2 of this report.

The amount of vibration in a building is difficult to estimate due to the large number of factors involved in vibration transmission. However, a buffer distance can be used to indicate safe distances of activities from adjacent buildings to meet vibration criteria. Indicative best-practice buffer distances have been scheduled and are presented in Table 21. It is important to note, that at this stage, the equipment for construction have not been finalised and the buffer distances are intended as a guide for the contractor.

Table 21 Vibration buffer distances, day period

Criterion	Descriptor		Handheld jack-hammer	Rock-breaker			Rotary cutter
				Light (300kg)	Medium (900kg)	Heavy (1600kg)	
Tactile vibration – residential	VDV & rms	Continuous	10m	25m	35m	55m	5m
		Impulsive	< 1m	1m	5m	20m	< 1m
Tactile vibration – commercial	VDV & rms	Continuous	5m	10m	20m	40m	2m
		Impulsive	< 1m	< 1m	5m	15m	< 1m
Cosmetic damage	Peak particle velocity		< 1m	2m	7m	22m	< 1m

7.2.2 Dilapidation Reports

We recommend that dilapidation reports be prepared on the adjacent and surrounding buildings. This should be done to achieve an understanding of the structural integrity of the buildings in question, and to assess any impacts that vibration from construction activities may have on nearby receivers.

In particular, the structural integrity of the St Peters Church Precinct should be investigated.

7.2.3 Vibration Monitoring

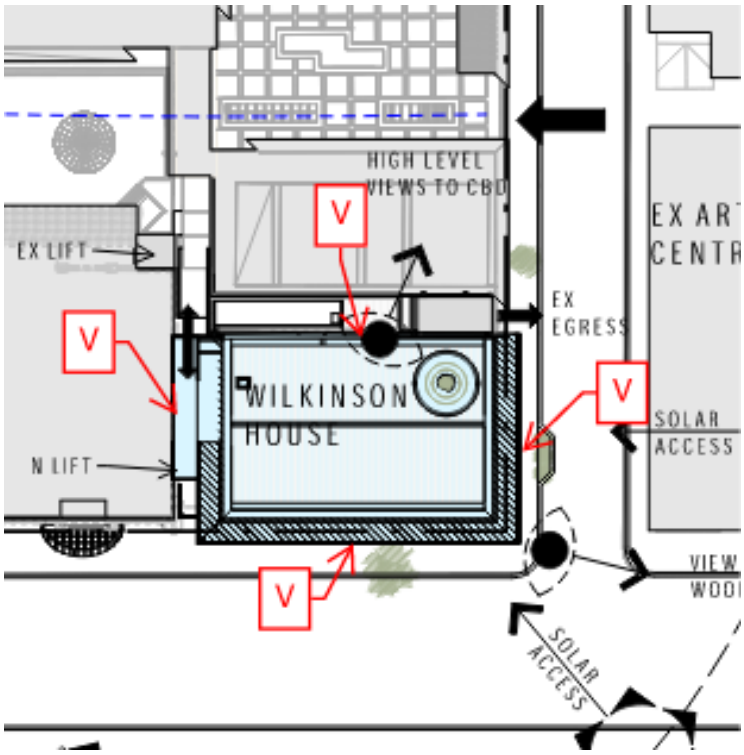
Vibration buffer distances scheduled in section 7.2.1 indicate that the proposed construction activities associated with heavy equipment may exceed the Vibration Criteria in Section 3.2. In these instances, we recommend that vibration monitoring equipment be used to ensure that the vibration limits are not exceeded (particularly during excavation and piling works).

> It is recommended that vibration loggers be installed on each side of Wilkinson house at the base of the building to monitor vibration to the retained façade and to other SCEGGS buildings

The vibration monitors should be set up that the locations shown in Figure 3 and to inform site staff of breaches to the limits as described in Section 3.2. The monitors may be relocated to a different monitoring

location depending on the proximity of the nearest vibration intensive excavation activity. As further information is provided by the structural engineers, particularly on retention of the Wilkinson House Façade, these monitoring locations and methodology may be revised.

Figure 3 Indicative Locations for Vibration Monitors (marked as V)



It is also recommended that, where practicable, alternative methods be employed to reduce the impacts of demolition / construction, i.e. using saws instead of jackhammers near adjacent structures where vibrations are easily transferable, such as in bedrock.

Monitoring equipment should be configured in such a way so that alarms are triggered at a level below the values described in Section 0 (2mm/s for heritage buildings, 5mm/s for non-heritage).

8. Operational noise assessment

8.1 Noise Emissions

8.1.1 School Function assessment

In order to address the SEARS, operational noise from the proposed adaptive reuse of Wilkinson House. The basement floor gym / sports centre, the internal classrooms, the roof terrace and the announcement system have been identified as potential sources of noise. The major sensitive receiver that may be affected by venue noise are the residences at 184 Forbes Street.

Based on source noise levels measured on other similar projects, maximum predicted sound power levels for function room noise have been scheduled in Table 22. We have also used the methodology in the Acoustics Australia paper number 133 presented at the Acoustics Australia on 2-4 November 2011, *Prediction of Noise from Small to Medium Sized Crowds* by M.J. Hayne, J.C. Taylor, R.H. Rumble and D.J. Mee to calculate the sound power levels for medium sized crowds. Children crowd noise levels have been taken from the GfCCC.

Table 22 School activity sound power levels

School Activity	Sound Power Level, dB(A)	
	L_{Aeq}	L_{Amax}
Basketball – 16 Playing 14 Watching	97	101
25 Children playing – indoor classroom	91	98
30 person crowd – outdoor community event	86	97

Furthermore, in order to determine receiver noise levels, the school activities have been compared to the project specific trigger noise levels presented in section 4.4. This assessment is based on Wilkinson House's typical school operational hours described below. In addition, SCEGGS have provided expected after school hour uses for Wilkinson House, including after hour use for Sports Centre and Roof Terrace. We have made the following assumptions for operation typical and after hour use:

- Wilkinson Classrooms typical operation:
  - operation will take place internally with the option for doors open
  - could operate between 7:30am and 5:00pm Monday to Friday
- Sports Centre typical operation:
  - events will take place internally with doors closed
  - could operate 6:45am to 8:20am and 6:00pm to 9:00pm Monday to Friday and 7am to 4:30pm on Saturday
- Roof terrace typical operation:
  - could operate between 7:30am and 5:00pm Monday to Friday
  - Roof terrace is mostly covered and offers some degree of shielding

- Roof Terrace after hours use:
  - Will operate between 5:00pm and 9:30pm
  - Will not play amplified music
  - A maximum of 30 people will be in attendance.
  - Roof terrace is mostly covered and offers some degree of shielding
- The most stringent criteria have been used for each noise emission scenario
  - Nearby sensitive receivers, criteria presented in Section 4.4
  - Internal design sound levels in classrooms presented in Section 5.1
- Building construction as stated in section 9.1

We note that staff will be expected to be on site from 6am to 9pm, however staff are not expected to have an impact on the local noise environment.

The calculated noise levels at each receiver for different times are presented in Table 23.

Table 23 Noise emission assessment for school functions

Receiver location	Time of day	Receiver noise levels, dB(A)	Criteria, dB(A)	Compliance
Residences - Forbes St	Day	47	55	Yes
	Evening	43	48	Yes
	Night (6:45am to 7:00am)	29	43	Yes
Residences - 152 Bourke St	Day	44	52	Yes
	Evening	42	48	Yes
	Night (6:45am to 7:00am)	23	43	Yes
Commercial - 165 William St	When in use	43	63	Yes
St Peter's Church – internal	When in use	35	38	Yes
L2 Classroom - internal	When in use	29	38	Yes

8.1.2 Mechanical plant and equipment emission

Preliminary plant and equipment specifications have been provided by the mechanical engineer. Based on the Architectural Drawings and Building Services Mark-up, we understand that external plant (3 condenser units) will be located on the north-western rooftop plant area of the Joan Freeman science, art and technology building. Our calculations have made provisions for noise emissions from this location to nearby sensitive receivers.

We have made the following assumptions in our calculations:

- Each outdoor condenser is to have a maximum sound power level of 84 dB(A)

> Classrooms will be mechanically ventilated and not require open windows for ventilation
> We understand the condenser units will be operating under the following operating conditions:
  - Day and Evening: 100% of units in operation
  - Night: if operating, operate in night-time mode (-6dB correction)

The calculated noise levels at the most sensitive receivers have been provided in Table 24.

Table 24 Mechanical noise emission levels at closest sensitive receivers

Receiver location	Time of day	Receiver noise levels, dB(A)	Criteria, dB(A)	Compliance
Residences - Forbes St Apartments	Day	45	55	Yes
	Evening	45	48	Yes
	Night	39	43	Yes
Residences - 152 Bourke St	Day	40	52	Yes
	Evening	40	48	Yes
	Night	34	43	Yes
Commercial - 165 William St	When in use	45	63	Yes
St Peter's Church	When in use	33	38	Yes
L2 Classroom - internal	When in use	35	38	Yes
Playground	When in use	48	53	Yes
Roof terrace	When in use	53	53	Yes

Table 24 presents noise levels at the worst affected locations of different receiver types. We note that compliance at this location would mean compliance at other locations described in Section 2.1.

9. Operational Noise Recommendations

9.1 Noise intrusion

External noise measurements scheduled in Section 2.2 and predicted internal noise generation have been used to determine the acoustic performance of the façade at Wilkinson House. These recommendations have been made to meet:

> Operational noise emission criteria presented in Section 4.4

> Internal design sound levels in classrooms presented in Section 5.1

9.1.1 Glazing recommendations

Recommended minimum glazing system performance is presented in Table 25.

Table 25 Minimum glazing performance requirements

Indicative glazing construction	Minimum glazing octave band insertion loss – dB, Hz								
	63	125	250	500	1k	2k	4k	8k	R_w
6mm monolithic	12	18	23	26	29	27	29	29	**28**
6mm monolithic / 12mm airgap / 6mm monolithic glass	15	22	22	30	32	32	38	44	**32**

We understand that these glazing recommendations will be refined at a later stage and the following considerations will need to be accounted for. These include:

> Selection of glazing supplier (framing systems and ultimately acoustic performance of the glazing system as a whole)

> If required, reassess noise intrusion based on glazing sizes and any changes made

> Structural requirements

> Thermal requirements

9.1.2 External wall recommendations

To assist in reducing noise intrusion, the wall construction will need to be made up of concrete or brick veneer with a minimum acoustic performance of R_w 50.

9.2 Internal Floor recommendations

To assist in reducing noise intrusion and structure borne noise between levels, the floor construction will need to have a minimum airborne acoustic performance of Rw 50 and impact noise performance of Lnw62.

9.3 School Bells and Announcement System Recommendations

We understand that there is a school bell and internal announcement system proposed for the adaptive re-use of the Wilkinson House. At the time of writing the position and number of speakers has not been finalised. It is anticipated that the speaker and bell systems will have adjustable sound levels, and we therefore recommend the following:

- Directional speakers should be angled downwards
- External speakers should be orientated away from nearest residential receivers
- Utilise a large number of low powered speakers as opposed to a few high-powered speakers
- The internal sound pressure level in habitable areas due to the speakers should not exceed 85dB(A) at 3 metres

9.4 Lift recommendations

The contractor is to ensure the following items are complied with:

- The noise generated by the lift operation is to be 5dB(A) below the lower levels presented in Section 5.1
- Noise levels inside the lift car are not to exceed 55dB(A) under the following circumstances:
  - Door opening and closing
  - Accelerating and decelerating
- Noise levels inside the lift car are not to exceed 50dB(A) when running at constant speed
- Lift guide alignment should be accurate enough such as to not give rise to increased levels of noise during operation

9.5 Mechanical plant and equipment recommendations

At time of writing, plant and equipment selection is yet to be finalised. It is anticipated that provision has been included in the current scheme to incorporate standard acoustic treatment, such as silencers, barriers, acoustically lined ductwork, acoustic louvres, etc. to meet the noise emission requirements of Section 4.4.

Generally, the following allowances should be made for in the design:

- Support points for major plant items should be structurally rigid. Mid span areas of floor slab should be avoided where practical. Ideally columns, thick structural slabs or very strong beams should be provided in such cases
- At least 190mm concrete slabs and precast/in-situ concrete walls surrounding plant
- Vibration isolators for equipment rotating plant and machinery located in plant rooms with >90% isolation efficiency
- Plant complete with associated motor and drive assemblies should be mounted on rigid integral steel chassis or concrete inertia blocks
- All penetrations to plant rooms should be properly dimensioned, packed and sealed
- Main services ducts and pipes to have their own individual penetrations, with suitable spacing to allow good sealing
- Allowance for acoustic attenuation treatments e.g. internal lining to air inlets and discharges to meet external noise emission criteria

- For major equipment such as chillers and cooling towers, allow for local stiffening of the plant room floor
- Speed controllers, if used, should be of good quality and compatible with the motor model. Poor quality controllers can result in significant increase in motor noise, as much as 10dB(A), with an offensive characteristic such as high frequency tone
- Selection of low noise fans, allowance for smooth airflow conditions in ductwork, use of attenuators and lined duct work while minimising regenerated noise at bends, take-offs and transitions
- Selection of plant and acoustic measures such as lined ductwork, silencers and enclosures, that will ensure that noise emission levels presented in Section 4.4 are complied with.

9.6 Recommended operating conditions

We note that assumptions regarding operation conditions outlined in section 8.1.1 will lead to compliance with:

- Operational noise emission criteria presented in Section 4.4
- Internal design sound levels in classrooms presented in Section 5.1

10. Conclusion

A site survey of the proposed redevelopment site and surrounds at SCEGGS Wilkinson House has been completed to determine existing noise levels for the environment and surrounds for a proposed redevelopment of the site.

Current regulations and standards associated with the development have been reviewed and assessed in accordance with existing site constraints. The construction standards have been provided to satisfy the local council and other relevant standards.

ADP Consulting believe there are no site conditions, statutory or other requirements that would preclude this development from complying with the criteria defined in this report.

The design and construction criteria and acoustic treatment concepts in this report will be built upon by ADP Consulting and the project team through further analysis, recommendations and coordination as the design progresses and is finalised.

ADP
Consulting : Engineering

Appendix A
Glossary of Acoustic Terms

Air-borne sound

The sound emitted directly from a source into the surrounding air, such as speech, television or music.

Ambient sound

Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far. This is normally taken to be the L_{Aeq} value.

Background noise level

The average of the lowest levels of the noise levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources. Usually the L_{A90} value represents the background noise level.

dB(A)

Unit of acoustic measurement weighted to approximate the sensitivity of human hearing to sound frequency.

Decibel scale

The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. Therefore, a 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. It is generally accepted that a 10 dB increase in the sound pressure level corresponds to a perceived doubling in loudness.

Examples of decibel levels of common sounds are as follows:

- 0 dB(A) Threshold of human hearing
- 30 dB(A) A quiet country park
- 40 dB(A) Whisper in a library
- 50 dB(A) Open office space
- 70 dB(A) Inside a car on a freeway
- 80 dB(A) Outboard motor
- 90 dB(A) Heavy truck pass-by
- 100 dB(A) Jackhammer / Subway train
- 110 dB(A) Rock Concert
- 115 dB(A) Limit of sound permitted in industry
- 120 dB(A) 747 take off at 250 metres

Frequency

The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high-pitched sound and a low frequency to a low-pitched sound.

L_{90}, L_{10}, etc

A statistical measurement giving the sound pressure level which is exceeded for the given percentile of a measurement period (i.e. L_{90} is the level which is exceeded for 90 percent of a measurement period). L_{90} is commonly referred to as a basis for measuring the background sound level.

$L_{Aeq,T}$

The 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.

L_{Amax}

The maximum sound pressure level measured over the measurement period.

L_{Amin}

The minimum sound pressure level measured over the measurement period.

Day

Referred to as the period between 7am and 6pm for Monday to Saturday and 8am to 6pm for Sundays and Public Holidays.

Evening

Referred to as the period between 6pm and 10pm for Monday to Sunday and Public Holidays.

Night

Referred to as the period between 10pm and 7am for Monday to Saturday and 10pm to 8am for Sundays and Public Holidays.

Assessment background level (ABL)

The overall background noise level on each day, evening and night periods for each day of the noise monitoring.

Rating background level (RBL)

The overall background level on each day, evening and night periods for the entire length of noise monitoring.

Reverberation

The persistence, after emission by the source has stopped, of a sound field in an enclosure.

Sound isolation

A reference to the degree of acoustical separation between two spaces. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term 'sound isolation' does not specify any grade or performance quality and requires the units to be specified for any contractual condition.

Sound pressure level, L_p, dB of a sound

A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the R.M.S. sound pressure to the reference sound pressure of 20 micro Pascals.

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