

Arup**Acoustics**

Thiess Pty Ltd

**Royal North Shore
Hospital
Redevelopment**

Acoustic Statement of
Commitments

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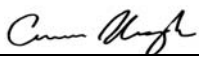
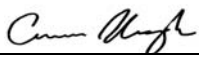


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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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1 Introduction

The proposed development is for the construction of a new Acute Hospital, Community Health Facility, multi-level car park and associated works on land known as the 'Royal North Shore Hospital Redevelopment', (RNSH), and is to be administered as a Project Application under Part 3A of the Environmental Planning and Assessment Act 1979, (the Act). The Project is referred to as MP 08_0172.

In summary, the proposed scope of works includes:

- Acute Hospital building.
- Community Health Facility.
- Multi-level car park for 576 vehicles.
- Refurbishment/alterations to the Douglas Building.
- Pedestrian bridge linking new Hospital and Douglas Building.
- New roads associated with the development of the Acute Hospital building, Community Health Facility and car park.
- At grade parking and the temporary use of land for parking purposes during construction.
- Public Domain works including footpaths, lighting and street tree planting.
- Demolition of Buildings 1, 2, 10 and part 19 (demolition of all other buildings requiring demolition has already been approved)
- Landscaping.
- Civil works including storm water and drainage infrastructure, new roads and utilities.

This Report has been prepared to address those matters related to acoustics and the assessment of MP 08_0172. Refer to 'Background' discussion below.

2 Background

2.1 Concept Plan

A Concept Plan Approval was issued by the Minister for Planning on 9 February 2007, (Major Project Application No. 06_0051), which gave concept approval for the following hospital related components:

- Subdivision of the site into a hospital precinct and other development precincts.
- A maximum floor area of 178,370m² across the development precincts (maximum FSR are prescribed for each precinct)
- Minimum and maximum FSR for the various components of the proposal including residential, employment generating uses, nurses accommodation etc.
- The conceptual road design.
- Urban design, landscaping, open space and heritage concepts.
- Maximum heights.
- Car parking provision to be in accordance with Willoughby Council DCP.
- Improved servicing of the site.
- Staged re-opening of Westbourne Street to through traffic.

Project Application Approval was given for demolition works and site preparatory works to ground level.

On 31 January 2008, the Concept Plan and Project Application Approval was modified in so far as amendments being to conditions related to agreements with public transport providers and with respect to the scheduling of a Traffic Management and Accessibility Plan (TMAP) (Conditions M9.1 and M10.1).

The Concept Plan and Project Application was further modified on 7 April 2008. The modification allowed for the erection temporary buildings and imposed relevant conditions.

2.2 Project Application

Further to the Concept Approval for the whole RNSH site, and along with it the identification of development precincts within the site, on 19 August 2008 a request was made to the Minister to declare the core medical precinct as "Critical Infrastructure Project", under Clause 6 of SEPP Major Projects 2005 (the SEPP), to permit the lodgement of a Project Application, under Part 3A of the Act.

The application was accompanied by a Preliminary Environmental Assessment, (PEA), for development within the core medical precinct and a request for any relevant Director-General's environmental assessment requirements (DGR's).

On 30 September 2008, the DGR's were issued by the NSW Department of Planning, under s.75F of the Act. The project has been declared a Major Project Application, (MP 08-0172).

3 Acoustic Considerations

3.1 Noise and Vibration Impact of the Development on the Environment

Noise impacts on the community from the development when operational are expected to be primarily from the plant and services equipment associated with the new facilities.

This issue will be address in this report.

3.2 External Noise and Vibration Affecting the Development

Environmental noise and vibration sources which may affect the development once operational are:

- Plant and services noise from adjacent properties
- Traffic, train, helicopter and pedestrian noise

Many of these issues are resolved with adequate façade glazing and building envelope construction in the detailed design stage. Traffic and rail vibration is unlikely to be an issue and vibration mitigation controls should not be needed.

During detail design an assessment of intrusive traffic noise levels will be undertaken however, it is expected that internal traffic noise levels will comply with the appropriate Australian Standard or project noise level.

3.3 Internal Noise and Vibration Impacts on the Development

Occupants of the proposed development may be affected by noise and vibration generated within the development itself. Potential noise impacts are expected to be from:

- Mechanical plant and services equipment associated with the development. Mechanical services noise will be transmitted via the structure and through the development.
- Emergency generators
- Vertical inter-office or inter-ward noise via the lift shaft and risers.
- Car movements to and from parking areas
- Deliveries and collections from loading bays

These issues will be resolved during the design development stage of the buildings.

3.4 Construction Noise and Vibration Impacts on the Surroundings

Construction noise and vibration impacts are expected to be associated with:

- High-impact construction methods, such as piling
- Noisy construction equipment
- Construction-related traffic.

Where feasible, construction methods and equipment will be selected such that noise and vibration levels in surrounding areas meet the relevant criteria for human comfort and building damage. Hours of work will be restricted as appropriate.

Construction methodology and equipment will be selected to meet the DECC requirements.

3.5 Noise and Vibration Sources likely to affect the Development

The proposed development must be protected from excessive noise break-in from external noise sources.

Potential noise sources that may adversely affect the development include traffic noise from the Pacific Highway, trains on the North Shore Railway Line, helicopters and ambulances servicing the hospital.

During design phase an assessment of intrusive transportation noise levels will be undertaken however, it is expected that internal noise levels will comply with the appropriate Australian Standard or project noise level.

4 Acoustic Design Criteria

Acoustic design criteria are presented for:

- Noise breakout to the community, from mechanical services associated with the development
- Internal noise levels including external noise break-in to the buildings, and
- Design criteria are based on relevant Australian Standards, codes, policies and control plans, including:
 - *NSW Industrial Noise Policy*, Environmental Protection Authority (EPA INP), January 2000
 - *AS 1055.2 – 1997: Acoustics – Description and measurement of environmental noise. Part 2: Application to specific situations*
 - *AS/NZS 2107-2000, Acoustics- Recommended design sound levels and reverberation times for building interiors*, Standards Association of Australia

4.1 Design Criteria for Control of Noise and Vibration Breakout

Noise and vibration breakout from activities on the site will be controlled to limit disruption and disturbance to buildings in and around the site. Limitations on noise levels generated within the Royal North Shore Hospital Development shall be derived from advice and guidance provided in the EPA INP and AS 1055. The EPA INP is applicable to noise generated by plant and services associated with the development. The noise criteria adopted for this project will be the most onerous of the EPA INP intrusiveness and the amenity criteria, and the AS 1055 environmental noise criteria.

Unattended background noise measurements will be carried out on site during the design phase of the development and are necessary to refine the applicable noise criteria.

4.2 AS 1055 Criteria for Environmental Noise

AS 1055.2 provides guidelines for setting noise limits for environmental noise for alternative 'neighbourhoods'. Although the standard clearly states that, wherever possible, values of existing ambient background noise shall be measured, the suggested limits are a useful reference when considering appropriate environmental noise limits for any area.

4.3 Industrial Noise Policy Criteria for Environmental Noise

The New South Wales environmental noise policy relating to industrial noise is the *New South Wales Environment Protection Authority Industrial Noise Policy* (INP), dated January 2000. Noise emission from plant and equipment on the subject site is required to comply with the noise limits assessed in accordance with the INP.

The objective of the INP is to protect residential areas from noise generated by commercial, industrial or trade premises. Noise limits are set based on land use in the area and existing background noise levels. Compliance is achieved if the adjusted L_{eq} noise level at any residence affected by noise from the facility is below the noise limit. The adjusted L_{eq} is determined by applying corrections for such noise characteristics as duration, intermittency, tonality, and impulsiveness.

The assessment of noise emission under INP is based on the calculation of a noise limit at a receiver position, taking into account the land-use in the surrounding area and the background noise level.

Once a noise limit is established, the noise emission for new equipment is measured or predicted. Should the noise level be in excess of the noise limit then remedial action is required.

INP separates the day into three different time periods – day, evening and night. These time periods are detailed in Table 1.

Period	Day of Week	Time period
Day	Monday-Saturday	0700-1800hrs
	Sunday, Public Holidays	0800-1800hrs
Evening	Monday-Sunday	1800-2200hrs
Night	Monday-Saturday	2200-0700hrs
	Sunday, Public Holidays	2200-0800hrs

Table 1 – INP Time Periods

The INP provides guidance on acceptable noise levels from the introduction of new industrial noise sources to an area. The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residential properties.
- Maintaining noise level amenity for particular land uses such as residences and hospital buildings etc.

Both of these components suggest noise criteria that should not be exceeded in order to avoid any adverse noise impacts on the affected areas. Both criteria should be taken into account when assessing the noise impact of industrial source(s) associated with the proposed development, and where the intrusiveness and the amenity criterion differ, the lower of the noise criteria should be adopted as the project-specific noise criterion.

4.4 Design Criteria for Control of External Noise

Background noise levels and reverberation times within the development will be controlled with reference to the applicable criteria from AS 2107. Due consideration will also be given to achieving acoustic conditions suitable for speech communication and freedom from disturbance arising from transient sounds. This includes provision in the design of the building envelopes and mechanical services plant.

The ingress of noise from road traffic will be dealt with by controlling the noise levels to an appropriate tolerance above the background levels. Careful consideration will be given to the proposed use of these spaces to ensure compatibility with the noise climate.

Internal vibration levels from mechanical services plant near and in the development will be controlled to meet AS 2670.2 -1990¹. Internal noise levels resulting from vibration transmission, such as reradiated structureborne noise, will be limited to the most stringent criteria given in AS 2107 or accepted practice for structureborne noise.

4.5 Australian Standard AS2107-2000

AS2107 recommends design sound levels for various types of building. The limits apply to “steady-state or quasi-steady-state sounds, such as noise from air conditioning systems.”

¹ AS 2670.2-1990: Evaluation of human exposure to whole-body vibration – Continuous and shock – induced vibration in buildings (1 to 80 Hz)

4.6 Design Criteria for Control of Internal Noise

AS 2107 provides guidance for design background noise levels for various types of occupancy. The limits apply to steady-state or quasi steady-state sounds such as noise from air conditioning systems, and are given as overall dB(A) limits for many types of room.

Target noise limits for steady-state (i.e. L_{Aeq}) noise generated by building services and noise break-in from external sources have been determined by a combination of guidance from AS 2107 and experience from similar projects. Table below outlines noise level targets for the various spaces to be achieved by all services running normally and together plus external noise break-in.

AS 2107 – 2000 recommends design sound levels for various types of building. The limits apply to “*steady-state or quasi-steady-state sounds, such as noise from air conditioning systems.*” The method of measurement of indoor sound levels must be carried out in accordance with AS 2107.

4.7 Design Criteria for Control of External Noise

Background noise levels and reverberation times within the development will be controlled with reference to the applicable criteria from AS 2107. Due consideration will also be given to achieving acoustic conditions suitable for speech communication and freedom from disturbance arising from transient sounds. This includes provision in the design of the building envelopes and mechanical services plant.

The ingress of noise from road and rail traffic will be dealt with by controlling the noise levels to an appropriate tolerance above the background levels. Careful consideration will be given to the proposed use of these spaces to ensure compatibility with the noise climate.

The building envelope, including façade glazing, should ensure that external noise, in particular noise be controlled to limit intrusive noise levels to an appropriate level.

Noise associated in building services should be designed to comply with the criteria given presented in AS 2107-2000

4.8 Criteria for Traffic Noise

Noise criteria for traffic movements resulting from the Royal North Shore Hospital were developed from the Environmental Criteria for Road Traffic Noise (ECRTN).

In accordance with the INP, road traffic noise from vehicles while on site is characterised as industrial noise, and therefore vehicle movements on site are subject to the noise criteria discussed in Section 4.3.

Road traffic noise from vehicles from Royal North Shore Hospital operating on public roads is subject to the ECRTN noise criteria. The ECRTN provides several categories for type of development and appropriate noise planning targets are given for each type of development.

The ECRTN noise criteria are planning goals for new development and as such are not legislative requirements which must be met by new developments. Rather, these criteria should be used as design goals for the development; however the ECRTN recognises that “the criteria are applied as targets, but recognise that there will be situations where planning strategies are not feasible”.

Royal North Shore Hospital is best characterised as a development of Type 7 – *Land use developments with potential to create additional traffic on collector roads.*

5 Guidelines for meeting Noise and Vibration criteria

The following methods will be adopted to ensure that the acoustic design targets presented in Section 4 will be achieved.

5.1 Noise Impacts from Development on the Community

5.1.1 General

The following areas are expected to generate environmental noise:

- Mechanical services noise normal mode
- Mechanical services from fix emergency plant.

The sections below take consideration of the noise generating activities associated with the areas listed above.

Nearest noise sensitive receivers are residential properties located on the Pacific Highway and Herbert Street, St Leonards.

5.1.2 Mechanical Services Plant

The operation of mechanical services plant (chillers, air handling plant etc) associated with the development may generate significant levels of noise. During the design phase plant design and selection will ensure that mechanical noise levels to not adversely affect the nearby community.

However, all items of mechanical services plant will be assessed against the operational criteria and all necessary remediation measures such as selection of plant, vibration isolators, attenuators, lined plena, enclosures and suitable orientation of exhaust and inlet louvres etc. will be applied as required to comply with the *NSW Environmental Protection Agency Industrial Noise Policy*.

5.2 External Noise Impacts on the Development

5.2.1 General

This area is in the heart of St Leonards, and is a lively and vibrant area during the day and at times the night. It is likely that in the vicinity of the subject site background noise levels will be dominated by traffic noise. Ambient noise levels will rarely drops below 50 dB(A) at the quietest times of the night.

This noise level in the community will be dominated by road traffic noise and distant mechanical noise.

The building façades will be designed to achieve the criteria for the 'windows closed' scenario. The 'windows open' criteria are to be reviewed if required however it is likely to be exceeded given the existing noise environment, particularly to the lower levels from nearby traffic.

5.2.2 Road Traffic

Noise generated by traffic, is the dominant source of noise throughout the daytime. This has the potential to affect the inside environment of the development. To ensure compliance with the AS2107:2000, close attention should be paid to the necessary noise insulation performance of the façade and glazing.

Appropriate noise mitigation methods will be implemented, such as absorptive finishes to reduce reverberant noise build-up, and careful design of noise control treatment.

5.2.3 Mechanical Plant

Plant noise from neighbouring properties is unlikely to be an issue since the building envelope will be protected from higher noise sources than are anticipated from plant.

However, outdoor roof-top mechanical services in adjacent buildings of the facility may contribute to noise at high levels, where traffic noise is lower. During the design phase mechanical noise from within the development will be reviewed to ensure that it does not adversely affect occupants within the hospital grounds.

5.2.4 Loading Bay

Truck access to the loading bays within the hospital grounds shall be reviewed to ensure that truck noise is minimised to occupants of the hospital.

6 Summary of the proposed noise criteria

6.1 Internal Design Criteria

6.1.1 Background Noise Levels

Australian Standard AS2107² provides recommended satisfactory and maximum internal noise levels and reverberation times for various types of building occupancy. The AS2107 internal noise levels apply to steady-state background noise within the building occupancy, such as mechanical services noise.

Internal noise levels will be designed to achieve the recommended AS2107 levels.

6.1.2 Reverberance

AS2107 also provides recommended values for the mid-frequency internal reverberation times (RT) for various spaces.

The room acoustics of the development will be designed to achieve the recommended RT values from AS2107.

6.1.3 Building Envelope

The building envelope will be designed to achieve the recommended internal levels given in the Environmental Criteria for Road Traffic Noise (ECRTN³) and achieve the AS2107 background noise levels. The building design will also be made with reference to AS3671⁴ and AS2021⁵.

6.1.4 Internal Sound Insulation

Internal sound insulation within the development will be designed to comply with the requirements of the Building Code of Australia (BCA), and to achieve an appropriate degree of acoustic separation and speech privacy between internal spaces. Arup Acoustics' previous experience and the guidance of AS2822⁶ will be applied in the design of internal partitions.

6.2 Construction/Demolition Noise

The NSW EPA (now known as DECC) Environmental Noise Control Manual (ENCM) Chapter 171 outlines the construction/demolition noise limits. However, there has recently been a review of this document and for this project it is proposed to use the new DECC *Draft Construction Noise Guideline* (2008).

6.3 Helicopter Noise

No current DECC criteria for aircraft noise are available for assessment of helicopter noise from the development. Previous assessments in the Land and Environment Court of NSW have applied noise criteria obtained from AirServices Australia.

Helicopter noise from the development will be assessed against the guidelines given in the AirServices Australia *Principles and Procedures* guideline⁷ and the *Fly Neighbourly Guide*

6.4 Mechanical Plant Noise

Willoughby Council does not set numerical criteria for noise emission from developments in the *Willoughby Development Control Plan 2006*. Therefore, industrial noise criteria for the

² Australian Standard AS2107 (2000) *Acoustics – recommended design sound levels and reverberation times for building interiors*

³ NSW EPA (1999) *Environmental Criteria for Road Traffic Noise*

⁴ Australian Standard AS3671 (1989) – *Acoustics – Road traffic noise intrusion – Building siting and construction*

⁵ Australian Standard AS2021 (2000) – *Acoustics – Aircraft noise intrusion – Building siting and construction*

⁶ Australian Standard AS2822 (1985) – *Acoustics – Methods of assessing and predicting speech privacy and speech intelligibility*

⁷ AirServices Australia (2002) *Environmental Principles and Procedures for Minimising the Impact of Aircraft Noise*, Environment Branch

development will be assessed against the Department of Environment and Climate Change (DECC) guidance.

The New South Wales environmental noise policy relating to industrial noise is the *New South Wales Environment Protection Authority Industrial Noise Policy* (INP)⁸, dated January 2000. Noise emission from plant and equipment on the subject site will be assessed against the noise limits given in the INP.

6.5 Traffic Noise

6.5.1 On-Site

Traffic noise from movements on-site (including noise from loading docks and car parking areas) will be assessed against the Industrial Noise Policy criteria, in accordance with the guidance of the DECC.

6.5.2 Off-Site

Traffic noise from traffic generated from the development travelling on public roads will be assessed against the Environmental Criteria for Road Traffic Noise (ECRTN). The Royal North Shore Hospital project is best characterised as a development of Type 7 – *Land use developments with potential to create additional traffic on freeways/arterial roads*.

6.6 Sleep Disturbance

Sleep Disturbance shall be assessed in accordance with the procedure given in Appendix B of the ECRTN. A review shall also be undertaken with World Health Organisation (WHO) best practise.

6.7 Fixed Emergency Equipment

Fixed mechanical emergency equipment located at the Royal North Shore Hospital will be assessed against the criteria given in Chapter 151 of the EPA Environmental Noise Control Manual (ENCM, 1994).

6.8 Vibration

Construction/demolition and operational vibration from the development will be assessed against the provisions of the DECC *Assessing Vibration*⁹ guideline.

⁸ NSW EPA (2000) *Industrial Noise Policy*
⁹ NSW DECC (2006) *Assessing Vibration – A Technical Guideline*

7 Audio Visual

7.1 Communication

Audio Visual systems are about assisting in the communication of an aural or visual message. In many instances where that aural or visual message is being relayed remotely or to a group of people, some form of enhancement of that message is required. For instance; speech reinforcement in large spaces; image reinforcement to large groups of people; video conferencing to remote sites.

Whilst enhancing an aural or visual message, it is important to keep that message true to the original. Speech should be clear and intelligible whilst not being so loud as to be a strain to listen to. Images of people should be clear and of realistic proportions so as to maintain a sense of realistic scale rather than create an imposing or diminutive image of that person. A loss of purity in the aural or visual image can potentially lead to a misinterpretation or misunderstanding of that message.

Audio Visual designers use the principal of clarity in communication as a driving factor behind all design.

7.2 Consultation

Consultation is the most important step in the process of understanding the requirements of an Audio Visual system. This process includes;

- review and auditing existing audio visual systems (where applicable)
- reviewing and auditing the operation of existing audio visual systems (where applicable)
- consultation on the functional and operational requirements of existing audio visual systems
- consultation on the anticipated functionality and operational requirements of new audio visual systems
- presentation of options for a range of solutions that will meet functional and operational requirements with clear recommendations

Arup's Audio Visual consultants strive to understand all the above in order to help in the delivery of an optimal audio visual solution.