INNER WEST

Appendix 7 – Aircraft Noise Assessment

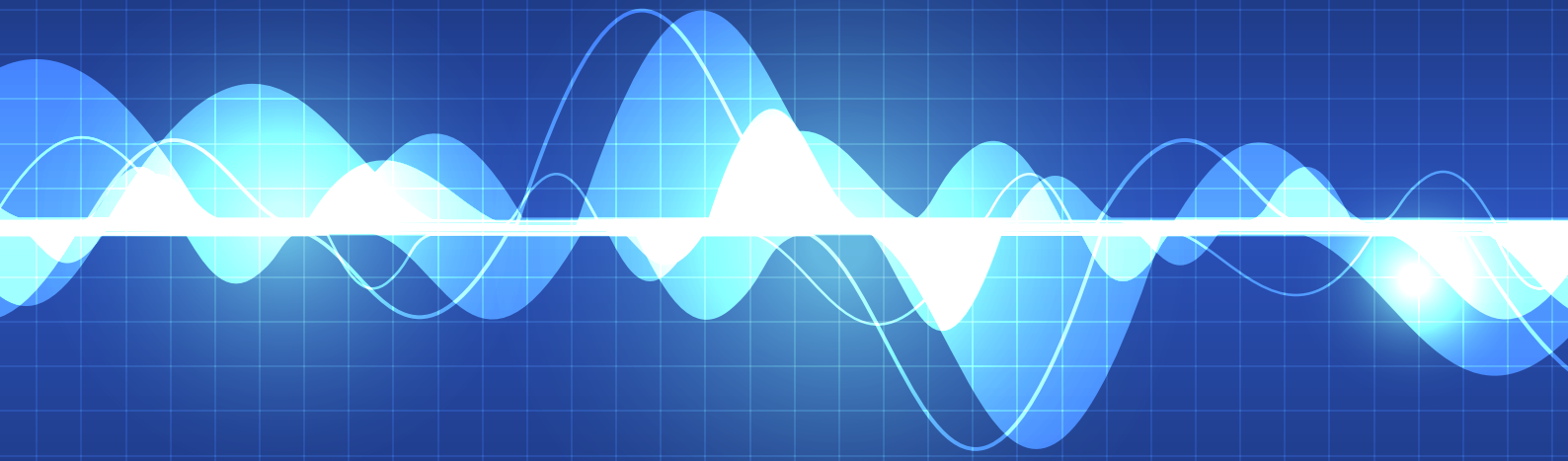
FOR EXHIBITION

November 2023

Leichhardt Precinct

Aircraft Noise Impact Assessment

Prepared for Inner West Council
March 2021



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Leichhardt Precinct

Aircraft Noise Impact Assessment

Report Number

J210019 RP1

Client

Inner West Council

Date

30 March 2021

Version

v4 Final

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30 March 2021

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30 March 2021

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1 Introduction

EMM Consulting Pty limited (EMM) has been engaged by Inner West Council to prepare an aircraft noise impact assessment for the proposed residential intensification within part of the Parramatta Road Corridor Urban Transformation Strategy (PRCUTS), Leichhardt Precinct affected by the ANEF 25-30 and centred around Norton Street, Leichhardt, NSW.

Noise impacts have been addressed for aircraft utilising the Sydney Airport in accordance with the following:

- Ministerial Direction 3.5 - *Development Near Regulated Airports and Defence Airfields*;
- Leichhardt Precinct Draft Structure Plan;
- AS 2021 - 2015 Acoustics - Aircraft noise intrusion – Building, siting and construction;
- Sydney Airport Master Plan 2033 (2014); and
- Sydney Airport ANEF 2039, published in the Sydney Airport Master Plan 2039 dated April 2019.

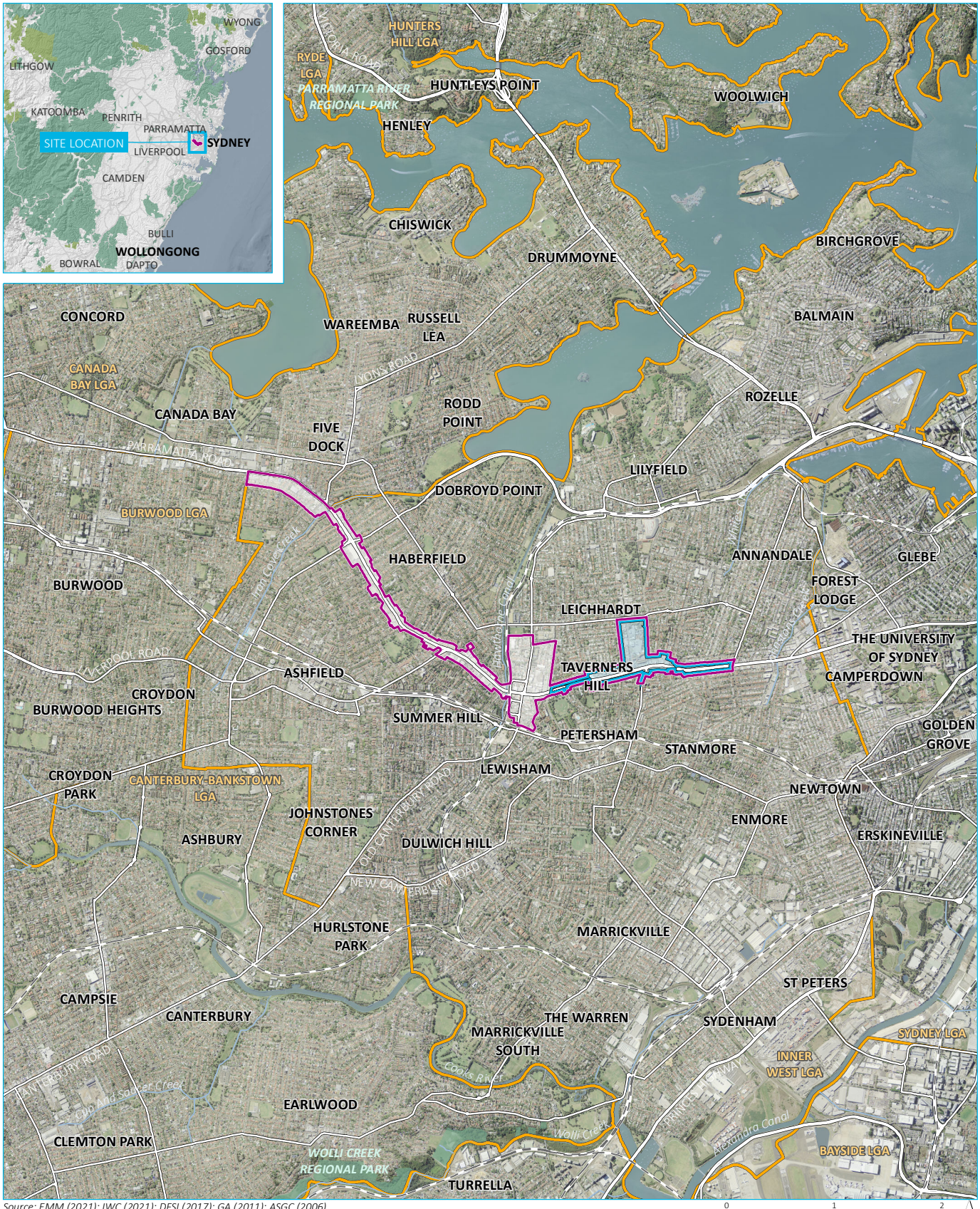
The Sydney Airport Master Plan 2039 and accompanying ANEF 2039 were approved in April 2019. Acoustic treatments have been described as part of this report to satisfy the requirements of AS2021-2015 and the planning authority.

1.1 Study area

The study area forms part of the Parramatta Road Corridor Urban Transformation Strategy (PRCUTS) and identified as the Leichhardt Precinct. The precinct is centred on Parramatta Road and extends from Johnston Street, Annandale (east) to Flood Street, Taverners Hill (west), and north on the alignment of Norton Street to Marion Street, Leichhardt. As a component of the PRCUTS, the Leichhardt precinct has been identified as an area where an increase of residential densities is proposed.

The precinct is exposed to Sydney (Kingsford-Smith) Airport (SYD) flight operations and is the principal acoustic consideration for potential redevelopment of the precinct. The main exposure will be aircraft approaches on runway end 16R and departure events on runway end 34L comprising the main north-south runway. Whilst this report is to focus on aircraft noise exposure, areas of the precinct fronting Parramatta Road would also be exposed to high traffic noise levels to be assessed against the noise criteria outlined in State Environmental Planning Policy (Infrastructure) 2007.

The study area and surrounding precinct context is shown in Figure 1.1.



Source: EMM (2021); IWC (2021); DFSI (2017); GA (2011); ASGC (2006)

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KEY

- PRCUTS
- Leichhardt precinct
- Rail line
- Major road
- Watercourse/drainage line
- Waterbody
- NPWS reserve
- State forest
- Local government area

Study area - Leichhardt Precinct

Inner West Council
Aircraft Noise Impact Assessment
Figure 1.1

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2 Regulatory context

2.1 Ministerial Direction 3.5

Ministerial Direction 3.5 - Development Near Regulated Airports and Defence Airfields and AS 2021:2015 Acoustic-Aircraft Noise Intrusion – Building siting and construction recommends appropriate controls for development to achieve the aircraft noise reduction requirements (ANR), specifically the objectives of the direction are:

a) to ensure the effective and safe operation of regulated airports and defence airfields;

b) to ensure that their operation is not compromised by development that constitutes an obstruction, hazard or potential hazard to aircraft flying in the vicinity; and

c) to ensure development, if situated on noise sensitive land, incorporates appropriate mitigation measures so that the development is not adversely affected by aircraft noise.

In terms of the requirements for a planning authority, the direction states:

7. A planning proposal must include a provision to ensure that development meets *Australian Standard 2021 – 2015, Acoustic- Aircraft Noise Intrusion – Building siting and construction* with respect to interior noise levels, if the proposal seeks to rezone land:

   a) for residential purposes or to increase residential densities in areas where the ANEF is between 20 and 25; or

   b) for hotels, motels, offices or public buildings where the ANEF is between 25 and 30; or

   c) for commercial or industrial purposes where the ANEF is above 30.

Furthermore, the Ministerial Direction also states (in part):

9. A planning proposal may be inconsistent with the terms of this direction only if the relevant planning authority can satisfy the Secretary of the Department of Planning and Environment (or an officer of the Department nominated by the Secretary) that the provisions of the planning proposal that are inconsistent are:

   a) justified by a strategy which:

      i) gives consideration to the objectives of this direction;

      ii) identifies the land which is the subject of the planning proposal (if the planning proposal relates to a particular site or sites); and

      iii) is approved by the Secretary of the Department of Planning and Environment; or

   b) justified by a study prepared in support of the planning proposal which gives consideration to the objectives of this direction; or

   c) in accordance with the relevant Regional Plan prepared by the Department of Planning and Environment which gives consideration to the objectives of this direction; or is of minor significance.

Inner West Council is applying the residential densities recommended for the Leichhardt Precinct in PRCUTS which is given statutory weight by a Ministerial Direction 9.1 of the Environmental Planning and Assessment Act 1979. This report is the strategy for Inner West Council to demonstrate that increased densities of residential development can be accommodated despite noise exposure from aircraft.

2.2 Australian Standard AS 2021-2015

The fundamental tool used for building site acoustic planning purposes around aerodromes is Australian Standard *AS 2021 - 2015 Acoustics - Aircraft noise intrusion - Building siting and construction*. This is the fifth edition in this standard with the original published in 1977 and it replaces the prior edition which was published in 2000. The fundamental principles for land use planning did not change between the 2000 and 2015 versions. AS 2021 states:

> The aircraft Noise Exposure Forecast (NEF) technique was first developed in the United States of America in the late 1960s. It was subsequently redefined in Australia in 1982. The NEF system is a scientifically based computational procedure for determining aircraft noise exposure levels around aerodromes. It can be used for assessing average community response to aircraft noise and for land use planning around aerodromes. In the Australian NEF system, noise exposure levels are calculated in Australian Noise Exposure Forecast (ANEF) units, which take into account the following features of aircraft noise:
>
> (a) The intensity, duration, tonal content and spectrum of audible frequencies of the noise of aircraft take offs, approaches to landing, and reverse thrust after landing (for practical reasons, noise generated on the aerodrome from aircraft taxiing and engine running during ground maintenance is not included).
>
> (b) The forecast frequency of aircraft types and movements on the various flight paths, including flight paths used for circuit training.
>
> (c) The average daily distribution of aircraft arrivals and departures in both daytime and night-time (daytime defined as 0700 hours to 1900 hours, and night-time defined as 1900 hours to 0700 hours).
>
> ANEF charts are provided for most aerodromes throughout Australia. The charts are simply plans of the aerodrome and the surrounding localities on which noise exposure contours of 20, 25, 30, 35 and 40 ANEF units have been drawn. These contours indicate land areas around an aerodrome which are exposed to aircraft noise of certain levels as defined by Clause 1.5.6; the higher the ANEF value the greater the noise exposure.
>
> In the areas outside 20 ANEF, noise from sources other than aircraft tends to predominate over aircraft noise, although individual reactions to aircraft noise may differ markedly. Within the area from 20 ANEF to 25 ANEF, aircraft noise exposure starts to emerge as an environmental problem, while above 25 ANEF the noise exposure becomes progressively more severe.
>
> The land use compatibility recommendations made in this Standard relate to the above ANEF contours.

Other useful context from AS 2021-2015 includes:

> Prior to 1982, Australian land use recommendations were essentially similar to the criteria used in the U.S. NEF system. However, with the availability of an Australian dose/response function derived from the NAL social survey, the U.S. criteria were revised to take into account the general reaction of Australian communities to aircraft noise.
>
> In essence, this revision was limited to a firmer definition of the criterion for residential land use compatibility. In the NEF system as originally adopted in Australia, the U.S. criterion of 30 NEF was adhered to, but, in accordance with a recommendation of the House of Representatives Select Committee on Aircraft Noise made in 1970, cautious restraint was urged to be applied by land zoning authorities when applying the system to Australian conditions. Where possible, the 25 NEF contour was used rather than the 30 NEF as a conservative safeguard until the system was validated in Australia.
>
> The NAL Report provided substantial evidence to support the use of 25 ANEF as the appropriate criterion for residential land usage. The 25 ANEF as a residential land usage criterion was recommended in 1985 by the House of Representatives Select Committee on Aircraft Noise, and subsequently adopted as policy by the Commonwealth Government.

The only qualification which arises from the findings of the NAL Report is that some people will find that the noise exposure at 25 ANEF is still unacceptable (refer to Figure A1 for the percentage of people affected in the 20 ANEF to 25 ANEF zone). Accordingly, the issuing authorities enter the 20 ANEF contour on all ANEF charts. It is to be stressed, however, that the actual location of the 20 ANEF contour is difficult to define accurately, because of variations in aircraft flight paths, pilot operating techniques, and the effect of meteorological conditions on noise propagation. For that reason, the 20 ANEF contour is shown as a broken line on ANEF charts.

2.2.1 Site acceptability

The Standard considers whether a building site is 'acceptable', 'conditionally acceptable' or 'unacceptable' on acoustic grounds. To do this, an Australian Noise Exposure Forecast (ANEF) noise contour map is needed, which shows the aerodrome's noise footprint on the surrounding environment. The ANEF map is a function of noise levels from various aircraft that are forecast to use the airport and the number of aircraft movements. The ANEF values are used for land use planning around Airports in Australia. Most councils around the airport adopt this approach, and in the absence of such guidance in local or state policies, advice in AS 2021 is the most authoritative available.

The Australian Standard recommends an initial screening approach to determine the acceptability of a site for nominated land uses. Table 2.1 provides a reproduction of Table 2.1 from AS 2021 and the associated notes that follow the table.

Table 2.1 Building site acceptability based on ANEF zones (AS 2021)

Building Type	ANEF Zone of site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Notes:
1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside but near to the 20 ANEF contour.
2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate (see also Figure A1 of Appendix A).
3. There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases, Table 2.1 should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3.
4. This Standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required ANR determined according to Clause 3.2. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.
5. In no case should new development take place in green field sites deemed unacceptable because such development may impact airport operations.

AS 2021 defines the terms in Table 2.1 as follows:

Acceptable

> *If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of Table 2.1).*

Conditionally acceptable

> *If from Table 2.1, the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedure of Clauses 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3 (See Notes 1 and 3 of Table 2.1).*

If an area is found to be 'conditionally acceptable' this typically means that any proposed buildings could require an improved level of building fabric above standard or light-weight materials to achieve internal noise goals set by AS 2021.

Unacceptable

> *If, from Table 2.1 the building site is classified as 'unacceptable', construction of the proposed building should not normally be considered. Where in the community interest redevelopment is to occur in such areas, e.g. a hotel in the immediate vicinity of an aerodrome, refer to the notes to Table 2.1.*

Note 4 of Table 2.1 outlines that the Standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable. This Note 4 in the Standard supports the potential for increased densities of residential development and the intent of the PRCUTS for the Parramatta Road corridor. This Report is to demonstrate that buildings within this zone can be constructed to meet the required ANR determined in accordance with AS 2021, and therefore satisfy the requirement under paragraph 7 of the Ministerial Direction 3.5 to meet the interior noise levels of AS 2021.

2.2.2 Requirements for construction

If buildings are constructed in 'conditionally acceptable' areas, AS 2021 sets out required internal noise levels, based on L_{ASmax} values from the loudest operating aircraft type.

A procedure is described in AS 2021 for determining the required performance of building elements to meet these levels, but this is not a requirement of the Standard and in this study is replaced with a more accurate method – measurements to determine external noise levels, and accurate frequency-based calculations to determine resulting internal levels.

2.2.3 Maximum noise levels

For this precinct there are areas which are located within contours equal to or exceeding ANEF 25. As such, it is necessary to quantify the typical L_{ASmax} noise level from aircraft. The representativeness of noise data should reflect typical events at the aerodrome, which can be ambiguous in some cases, particularly when trying to estimate future operations and associated impacts. For Sydney Airport this is relatively straightforward because of its well-established flight path, movements, runways and aircraft types.

For aerodromes with a relatively high number of movements (defined as an airport), AS 2021 suggests that data tabulated in the standard be supplemented by site-specific field measurements. Where a site is 'conditionally acceptable', AS 2021 recommends that buildings be designed to achieve internal noise levels no greater than identified maximum values from aircraft.

Table 2.2 reproduces recommended internal maximum noise levels for various spaces as categorised in AS 2021. These are the L_{ASmax} or maximum noise inside buildings. The spaces with the most onerous criteria are theatres, cinemas and recording studios, although these are often designed and constructed with highly noise attenuating building elements.

For residential buildings, it is necessary to consider aircraft noise levels of greater than L_{ASmax} 60 dB as an external level of 60 dB is typically reduced to 50 dB inside, even with a partially open window or door. This satisfies the strictest residential criterion which applies to sleeping areas and dedicated lounges.

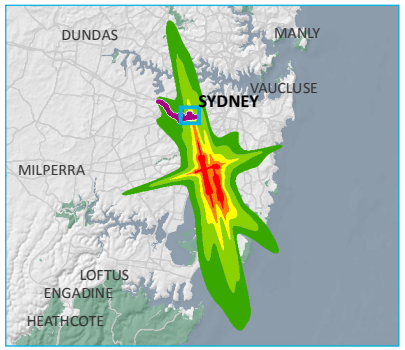
Table 2.2 Indoor design sound levels

Building type and activity	Indoor L_{ASmax} Design Sound Level, dB
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathroom, toilets, laundries	60
Hotels, motels, hostels	
Relaxing, sleeping	55
Social activities	70
Service activities	75

3 Precinct ANEF exposure

For the purposes of site suitability, determining planning constraints and identifying noise exposure for the precinct, EMM has reviewed the Sydney Airport's ANEF 2039 map dated 20 August 2018 and approved in April 2019.

A projection of the ANEF 2039 over the precinct (Figure 3.1) confirms the central portion is within the 25-30 ANEF zone and comprises an area of approximately 195,000 m^2 or more than 50% of the precinct.



KEY

- PRCUTS
- Leichhardt precinct
- Rail line
- Major road
- Watercourse/drainage line
- NPWS reserve (refer to inset)

Sydney Airport ANEF 2039

- ANEF15
- ANEF20
- ANEF25
- ANEF30
- ANEF35

Source: EMM (2021); IWC (2021); DFSI (2021, 2017); GA (2011); ASGC (2006)

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Leichhardt Precinct and Sydney Airport ANEF 2039

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Figure 3.1

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4 Additional discussion

4.1 Sydney Airport Masterplan

Sydney Airport Master Plan (SAMP) 2039 assists in understanding the future operations and related changes in impacts from aircraft noise. Whilst Sydney Airport Master Plan 2033 also provides additional relevant commentary on aircraft fleets and resultant aircraft flyover noise levels.

For example, it is stated that airlines expected to see continued increases in seating density across the industry. Further, Qantas "...intends to replace B767s with the 20-25% larger A330s", Qantas has also phased out use of B747 aircraft. Airline fleet renewal and modernisation programs continue, in many cases, to progressively introduce into service new generation, quieter aircraft (for example the Boeing B787, B737Max, Airbus A350, A320neo) in place of ageing, noisier aircraft (like the Boeing B747, B767 and Airbus A340) which are being retired.

At Section 14.2.1, page 179 (SAMP 2033), the plan states:

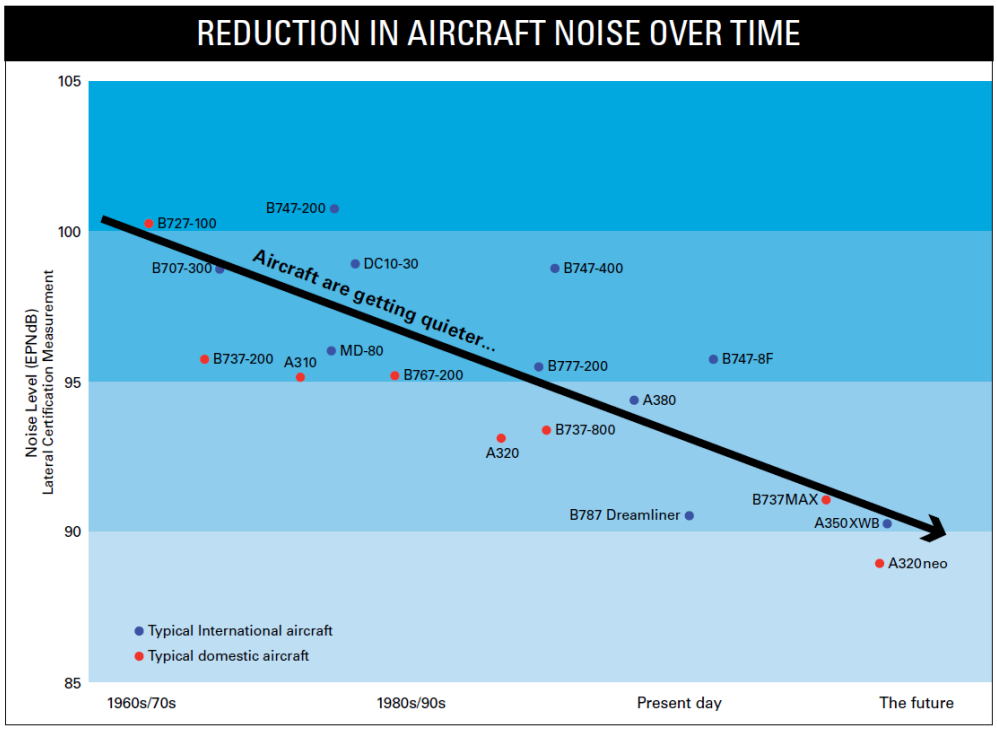
> Sydney Airport welcomes the introduction of the new generation of quieter aircraft like the Airbus A380, Boeing B777, B787 Dreamliner and B747-8F. It is expected that other new generation quieter aircraft like the A350XWB, B737 MAX and A320neo will be introduced within the planning period of this Master Plan.
>
> Sydney Airport's past, present and future investment in infrastructure to accommodate these new generation aircraft is designed to ensure residents living close to the airport or under flight paths will continue to benefit from their introduction. For example, to accommodate the A380, which is both larger and much quieter than the older aircraft type it is replacing, Sydney Airport has invested significantly to upgrade infrastructure.

Whilst Section 15.6.1, page 231 (SAMP 2039) discusses the critical reduction at source and outlines the following for Sydney airport:

- In 2018, 21 airlines are operating next generation aircraft which represents: – 25 percent of all scheduled international movements – 452 next generation movements per week – Average seat configuration of 383 seats – 33 percent higher than the overall international average;
- Since 2010, legacy four engine aircraft (B747/ A340) numbers have reduced by 68 percent, from an average of 38 movements per day to under 15 movements per day;
- In 2017, SYD was the 11th busiest airport in the world for next generation aircraft movements, and 9th in terms of seats; and

Figure 14.2 of the Master Plan 2033 demonstrated the above and depicts how improved technology has resulted in quieter aircraft (reproduced as Figure 4.1). The expectation as shown is to continue the trend of reduced aircraft noise emissions into the future.

Whilst Figure 15.2 of the Master Plan 2039 outlines the current fleet mix for Sydney Airport (reproduced as Figure 4.2) and demonstrate airline fleet renewal and modernisation programs continue, in many cases, to progressively introduce into service new generation, quieter aircraft (for example the Boeing B787, B737Max, Airbus A350, A320neo) in place of ageing, noisier aircraft (like the Boeing B747, B767 and Airbus A340) which are being retired.



Source: Sydney Airport Master Plan 2033 (2014)

Figure 4.1 Reduction in aircraft noise over time

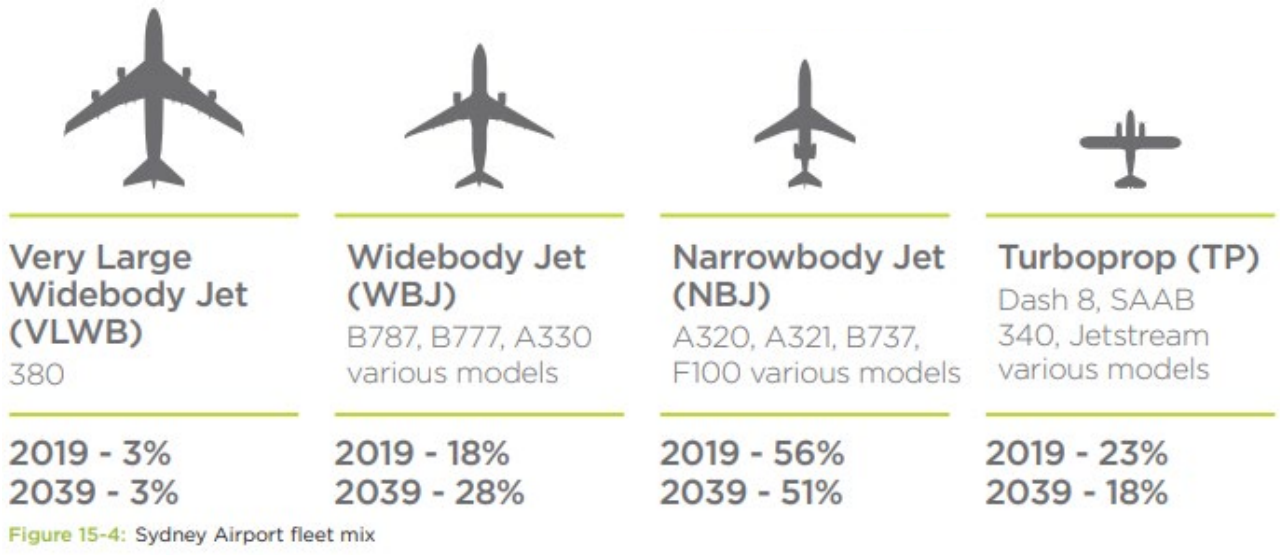


Figure 4.2 Sydney Airport fleet mix

At page 182, SAMP 2033 states:

> In 2008, Airservices Australia released a report showing that an Airbus A380 departing from or arriving at Sydney Airport is between 2.1 and 6.7 decibels quieter than the 747-400, the older aircraft type it typically replaces.
>
> Airservices Australia indicates in its report that “a three decibel reduction is regarded as a halving of an aircraft’s noise energy".

Refer to Figure 4.3 demonstrating the above via actual measured noise reductions from comparable aircraft, as reported in the SAMP 2033 at Table 14.6. The A380 has a smaller noise footprint on take-off and landing and hence reduces the impact of aircraft on the community. The reductions in L_{ASmax} noise are significant both in terms of occupant experience and implementation of noise controls for buildings.

Location of NMT	Aircraft type	Arriving or departing	Average LA max [dB(A)]	Reduction in decibels	Reduction in noise energy
Sydenham	A380	Departing	87.7	- 4.4	- 64%
	B747-400	Departing	92.1		
	A380	Arriving	93.9	- 2.6	- 45%
	B747-400	Arriving	96.5		
Leichhardt	A380	Departing	81.7	- 3.9	- 59%
	B747-400	Departing	85.6		
	A380	Arriving	84.4	- 2.1	- 38%
	B747-400	Arriving	86.5		
Annandale	A380	Departing	71.5	- 5.5	- 72%
	B747-400	Departing	77.0		
St Peters	A380	Departing	73.6	- 6.7	- 79%
	B747-400	Departing	80.3		
Croydon	A380	Departing	76.7	- 2.3	- 41%
	B747-400	Departing	79.0		

Source: Airservices Australia

Source: Sydney Airport Master Plan 2033 (2014)

Figure 4.3 Noise monitoring around Sydney Airport

At page 182, the SAMP 2033 states:

> In July 2012, Virgin Australia announced an agreement with Boeing to order 23 of its new generation 737 MAX aircraft, the first airline in Australia to do so. Boeing has said that the noise footprint of this aircraft is 40% smaller than today’s B737s."
>
> The B787 Dreamliner began flying to Sydney in August 2013. Qantas has selected the B787 Dreamliner as the cornerstone of its domestic and international fleet renewal program. Under the fleet plan, the Qantas Group has orders for 15 Boeing 787 aircraft, with the first aircraft having arrived in the second half of 2013. Qantas has options and purchase rights for a further 50, available for delivery from 2016. Powered by General Electric’s GEnx engines, Qantas indicates that it has a 50% smaller noise footprint. The B787 will, over time, replace older aircraft like the B767-300. Cathay Pacific already flies the new generation B747-8F freighter to Sydney and has said that its noise footprint is 30% smaller than the older freight aircraft type it replaced.

In summary, the long term expectations are reductions in aircraft noise levels from overflight events.

5 Inner West development

The proposed intensification of residential development in the Leichhardt precinct within the 25-30 ANEF is not unique within the Inner West Local Government Area (LGA). A number of sites within St Peters, Marrickville and Leichhardt have successfully demonstrated that residential development can be designed and constructed to satisfy the requirements of AS 2021. A few examples are provided below for discussion, reference and precedent purposes.

5.1 63 Grove Street, St Peters

A web search confirmed that 63 Grove Street was purchased as an industrial site in 2004 with a site area of approximately 7,339m^2. A rezoning application (DA200500749) was submitted to Marrickville Council in 2005 to rezone the land from industrial and subdivide the site to create a 34 lot residential subdivision with construction of two storey dwellings on each lot and was approved on 28/6/2010. A historical review of aerial photography (Google Earth) confirms that site was industrial in 2009. Subsequently the site was cleared, and construction of the residential development and internal roads completed in 2013/14 confirming approval of both the rezoning application and development for residential use.

Considering the timing of the application in 2005, the relevant ANEF to be applied to the development would have likely been ANEF 2023/24. A review of ANEF 2023/24 confirms that more than 90% of the site at 63 Grove Street was located wholly within the 25-30 ANEF zone. The site would be exposed to a L_{ASmax} noise level of 91 dB or greater.

This is an example of Council allowing rezoning of industrial land and subsequent development of new residential dwellings within the ANEF 25-30 contour zone.

5.2 23 Addison Road, Marrickville

The 23 Addison Road, Marrickville property was purchased as an industrial site in 2002 and resold again in 2011, with a site area of approximately 2,094m^2. A development application (DA201300025) was submitted to Marrickville Council in 2013 to demolish the existing improvements and construct a six-storey mixed use development containing a ground floor commercial/retail tenancy and 59 car spaces with residential accommodation above consisting of 21 x 1 bedroom, 33 x 2 bedroom and 6 x 3 bedroom dwellings and widening Fotheringham Street and Stevens Lane. The previous use on the site was industrial. The development was approved on 13 February 2014 and has since been constructed and is occupied.

Considering the timing of the application in 2013, the relevant ANEF to be applied to the development would have likely been ANEF 2033. A review of ANEF 2033 confirms the entire site is located wholly within the 25-30 ANEF zone. A review of the acoustic report submitted with the application has confirmed a calculated L_{ASmax} noise level for the site of 92 dB.

This is an example of Council allowing rezoning of industrial land and subsequent development of new residential dwellings within the ANEF 25-30 contour zone.

5.3 Victoria Road precinct (2015)

EMM developed an aircraft noise strategy for the Victoria Road, Marrickville site in 2015, to determine its suitability to accommodate residential land use. The study adopted the noise data contained in AS 2021, used to produce grid points across and in the vicinity of the site and assigned a representative aircraft noise level to each.

A worst case 90 dB L_{ASmax} noise level was established for the most exposed part of the site, based on the relatively noisier but very infrequent B747-400 aircraft long range departure events (representing approximately 1.5% to 2% of movements on average, and likely reducing in the future).

From this, performance requirements for facade, roof/ceiling and glazing were developed to ensure AS 2021 internal design goals are achieved. Numerous construction options are provided to satisfy minimum building element sound ratings (Rw), however, internal noise criteria can be achieved using multiple design scenarios.

The findings of the 2015 study demonstrated that current building materials can be reasonably applied to achieve internal noise goals set by AS 2021 such that the occupant's amenity is not compromised. The study demonstrated that although the subject site is in an ANEF zone which is susceptible to higher levels of aircraft noise, buildings can be designed to ensure internal levels are insulated appropriately. The noise result internally for potential residences within the Leichhardt precinct, which is located in 25 to 30 ANEF zone, could be the same as that for a site in a 20 to 25 ANEF. The difference being the building fabric requirements.

The findings of the study supported proposed high and medium density residential developments in terms of residential amenity provided the design guidelines, and their objectives, were achieved. We note that meetings with various stakeholders (eg Sydney Airport Corporation Limited representatives) supported the study and ultimately Council adopted the study outcomes via a Development Control Plan (DCP) specific to the precinct. (Marrickville Development Control Plan 2011 - 9.47.15 Schedule 1 – Victoria Road Precinct Aircraft Noise Policy).

5.4 Precinct 75 (2019)

Precinct 75 comprises 67, 73-83 Mary Street, 50-52 Edith Street and 43 Roberts Street, St Peters with frontages to Mary Street (south) and Edith Street (north.

The site has a combined area of approximately 1.333 hectares (13,300 m^2) and accommodated a number of commercial, retail and artistic uses such as The Rice Pantry, iConnect Systems, Smithys PA and Stage Gear, Willie the Boatman, Inartisan, Crank Furniture Co., Andiamo and others.

A Planning Proposal sought amendments to the Local Environmental Plan (LEP) to facilitate a mixed-use development on the site.

EMM completed a review of potential noise constraints for the site (EMM June 2019), primarily focused on aircraft noise exposure utilising ANEF 2039 and L_{ASmax} noise levels for the site in accordance with AS 2021. This was done to determine the suitability to accommodate residential use within the site. The calculation of L_{ASmax} noise exposure for the site confirmed L_{ASmax} noise levels determined in accordance with the procedures of AS2021 to be in order of 86-88dB.

The planning proposal was approved by Department of Planning, Industry and Environment and is now addressed within Marrickville Local Environmental Plan 2011 (Amendment No 18).

5.5 Italian Forum DA 523/94 (1995)

The Italian Forum serves as a precedent to intensification of residential development within the 25-30 ANEF and was approved by Leichhardt Municipal Council on 21 August 1995. An acoustic report (November 1994) was prepared to support the development by Richard Priddle – Consultant in Acoustics and established on site aircraft noise levels consistent with equivalent predictions utilising appropriate aircraft types and methodology of AS 2021. The report went on to recommend acoustic performances of building components consistent with the findings and outcomes of this assessment.

6 Assessment of noise impacts

The following presents the assessment of aircraft noise levels established using the methodology provided in AS2021-2015 with context to the subject precinct and proximity to the Sydney Airport patterns indicated on ANEF 2039.

6.1 Aircraft flyover L_{ASmax} noise levels

To determine the typical maximum L_{ASmax} noise exposure for the precinct and surrounding area, a 100-m-grid was developed and a worst case prediction of a Boeing 747-400 (long haul) departure and arrival on the main north-south runway (16R/34L) was considered. It is well documented that this aircraft type has been adopted in assessments to establish the typical maximum event for the airport for many years. However, the ANEF 2039 map and associated table of aircraft events shows that this aircraft is used very infrequently (ie 1.5-2%). It is also well known that this aircraft is being phased out by local and international airlines. The noise levels from other aircraft types currently in circulation and those likely to replace the 747 are measurably lower (quieter) and hence the maximum noise levels adopted herein are conservative.

A summary of the distance coordinates from the main north-south runway (16R/34L) and calculated L_{ASmax} noise levels for take-off and arrival are summarised in Table 6.1 and presented in Figure 6.1. The calculations utilise the centreline distance for landing (DL) and take-off (DT) in addition to the sideline distance (DS) as defined in AS2021. Corrections were adopted in accordance with the procedures of AS 2021 to account for elevation relative to airport and potential for nine storey buildings within some areas of the precinct.

Table 6.1 Precinct L_{ASmax} noise levels – 747-400 long range

DL (m)	DS (m)	DT (m)	Departure L_{ASmax} dB	Arrival L_{ASmax} dB
4600	0	8400	88	87
4600	100	8400	88	87
4600	200	8400	87	84
4600	300	8400	86	81
4600	400	8400	84	78
4600	500	8400	82	76
4600	600	8400	80	73
4600	700	8400	79	71
4600	800	8400	77	69
4600	900	8400	76	67
4600	1000	8400	74	66
4700	0	8500	88	87
4700	100	8500	87	87
4700	200	8500	87	84
4700	300	8500	85	81

Table 6.1 Precinct L_{ASmax} noise levels – 747-400 long range

DL (m)	DS (m)	DT (m)	Departure L_{ASmax} dB	Arrival L_{ASmax} dB
4700	400	8500	84	78
4700	500	8500	82	76
4700	600	8500	80	73
4700	700	8500	79	71
4700	800	8500	77	69
4700	900	8500	76	67
4700	1000	8500	74	66
4800	0	8600	88	87
4800	100	8600	87	86
4800	200	8600	87	84
4800	300	8600	85	81
4800	400	8600	84	78
4800	500	8600	82	76
4800	600	8600	80	73
4800	700	8600	79	71
4800	800	8600	77	69
4800	900	8600	76	67
4800	1000	8600	74	66
4900	0	8700	88	87
4900	100	8700	87	86
4900	200	8700	87	84
4900	300	8700	85	81
4900	400	8700	84	78
4900	500	8700	82	76
4900	600	8700	80	73
4900	700	8700	79	71
4900	800	8700	77	69
4900	900	8700	76	67
4900	1000	8700	74	66
5000	0	8800	88	87
5000	100	8800	87	86
5000	200	8800	87	84

Table 6.1 Precinct L_{ASmax} noise levels – 747-400 long range

DL (m)	DS (m)	DT (m)	Departure L_{ASmax} dB	Arrival L_{ASmax} dB
5000	300	8800	85	81
5000	400	8800	84	78
5000	500	8800	82	76
5000	600	8800	80	73
5000	700	8800	79	71
5000	800	8800	77	69
5000	900	8800	76	67
5000	1000	8800	74	66
5100	0	8900	88	86
5100	100	8900	87	85
5100	200	8900	87	84
5100	300	8900	85	81
5100	400	8900	84	78
5100	500	8900	82	76
5100	600	8900	80	74
5100	700	8900	79	71
5100	800	8900	77	69
5100	900	8900	76	68
5100	1000	8900	74	66
5200	0	9000	87	86
5200	100	9000	87	85
5200	200	9000	86	84
5200	300	9000	85	81
5200	400	9000	84	78
5200	500	9000	82	76
5200	600	9000	80	74
5200	700	9000	79	71
5200	800	9000	77	69
5200	900	9000	76	68
5200	1000	9000	74	66
5300	0	9100	87	86
5300	100	9100	87	85

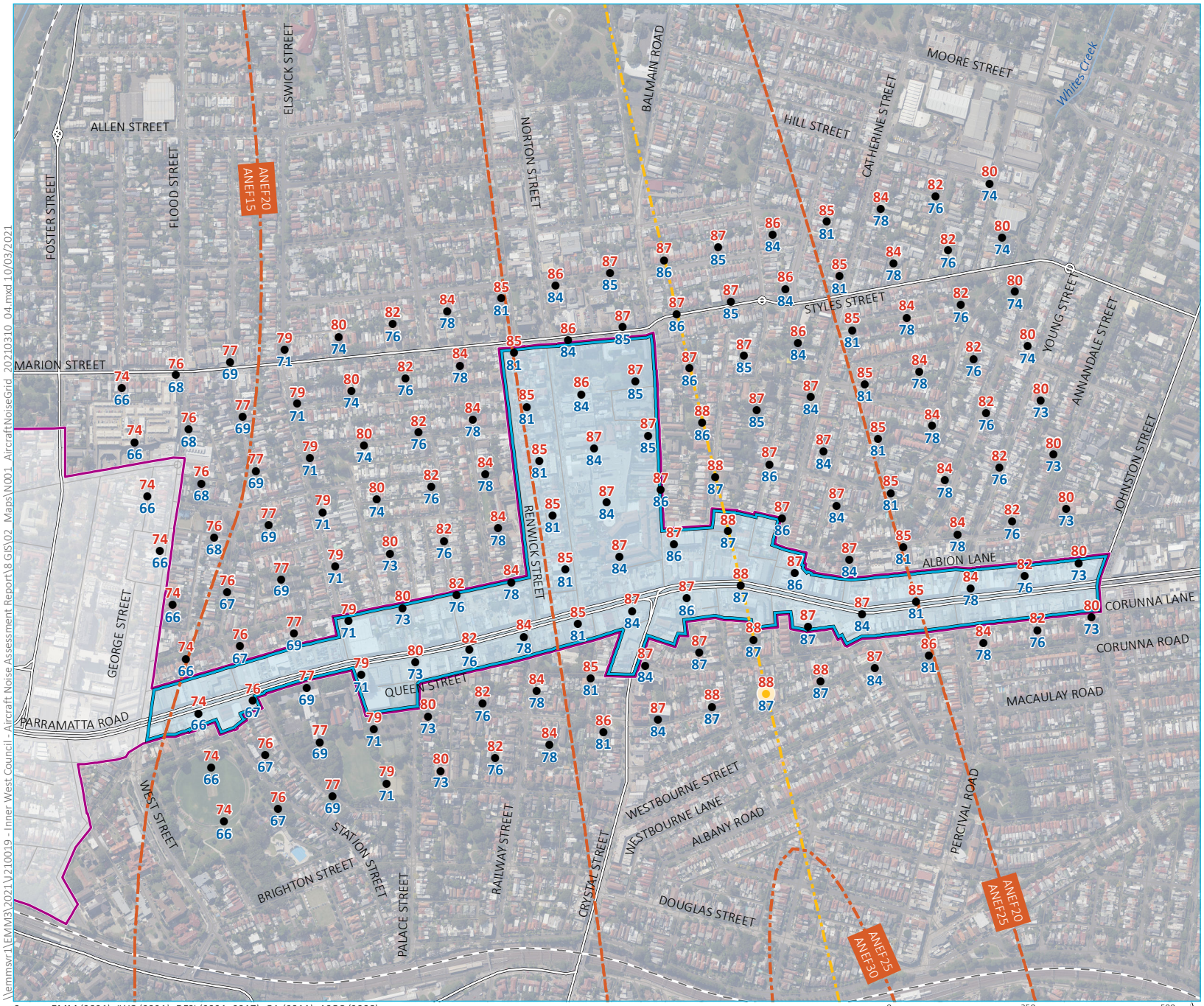
Table 6.1 Precinct L_{ASmax} noise levels – 747-400 long range

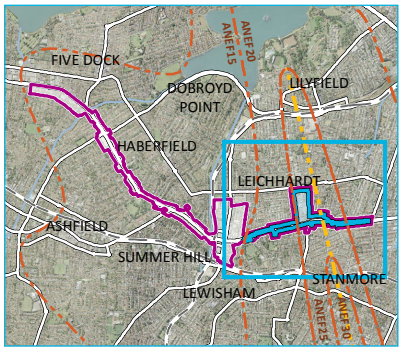
DL (m)	DS (m)	DT (m)	Departure L_{ASmax} dB	Arrival L_{ASmax} dB
5300	200	9100	86	84
5300	300	9100	85	81
5300	400	9100	84	78
5300	500	9100	82	76
5300	600	9100	80	74
5300	700	9100	79	71
5300	800	9100	77	69
5300	900	9100	76	68
5300	1000	9100	74	66
5400	0	9200	87	86
5400	100	9200	87	85
5400	200	9200	86	84
5400	300	9200	85	81
5400	400	9200	84	78
5400	500	9200	82	76
5400	600	9200	80	74
5400	700	9200	79	71
5400	800	9200	77	69
5400	900	9200	76	68
5400	1000	9200	74	66

Notes: 1. L_{ASmax} noise levels in accordance with AS2021-2015

A review of Table 6.1 and Figure 6.1 confirm that the precinct is exposed to L_{ASmax} noise levels from departing 747-400 (long range) aircraft of 74-88 dB whilst arrivals result in levels of 66-87 dB.

Review of Figure 6.1 confirms that L_{ASmax} noise levels from departing aircraft within the ANEF 25-30 within the Leichhardt precinct range from 85-88 dB, whilst L_{ASmax} noise levels within the ANEF 20-25 range up to 85 dB. The 3 dB difference is not significant and the level of 88 dB only occurs on a discrete portion of the site directly in line with the main north-south runway with a typical level difference of 2dB.





KEY

- PRCUTS
- Leichhardt precinct
- ANEF 2039 contour
- Runway line continuation
- Aircraft noise grid - origin
- Aircraft noise grid
- Rail line
- Major road
- Minor road
- Watercourse/drainage line

Site L_{ASmax} noise levels - Boeing 747-400 (long range)

Inner West Council
Aircraft Noise Impact Assessment
Figure 6.1

Source: EMM (2021); IWC (2021); DFSI (2021, 2017); GA (2011); ASGC (2006)

0 250 500 m
GDA 1994 MGA Zone 56

N

EMM creating opportunities

\\emmsvr1\EMM3\2021\V210019 - Inner West Council - Aircraft Noise Assessment Report\8 GIS\02 Maps\N001 AircraftNoiseGrid 20210310 04.mxd 10/03/2021

6.2 Aircraft noise reduction (ANR) requirements

AS 2021 provides the methodology adopted for calculating the aircraft noise reduction (ANR) values for building elements potentially constructed within the precinct.

The spectral or 1/1 octave band frequency components of aircraft noise are important in the determination of ANR for each building element, particularly when an ANR of 30 or more is required.

The overall ANR of a building is simply the external aircraft noise level (eg 74 to 88 dB in this case) less the AS 2021 internal noise goal (eg 50 dB for sleep areas and dedicated lounges of residences). A maximum ANR of 38 dB (ie 88-50) is applicable to the precinct whilst the minimum applicable would be an ANR of 24 dB (ie 74-50).

The aircraft noise attenuation required of each component is determined from the equation:

$ANAc = ANR + 10 \log10 [(Sc/Sf) \acute{} (3/h) \acute{} 8TN] - Kc$

where:

Sc/Sf is the surface area ratio of the component (c) element to that of the floor (f)

h is the room height

T is the room's reverberation time

N is the number of components present in the external envelope of the room or space

Kc is the orientation effect (as defined in AS 2021)

This detailed assessment is completed by the proponent or developer during the Development Application or Construction Certificate phase of a development and based on detailed architectural drawings to demonstrates that the construction of the building can satisfy the requirements of AS 2021.

6.3 Conceptual building construction options

The purpose of this section is not to provide design advice to potential applicants and developers within the Leichhardt Precinct, but rather demonstrate typical and readily available constructions that can be adopted for development within the high noise exposure zones (25-30 ANEF) identified to achieve the internal noise level requirements of AS 2021 due to noise generated by aircraft flyovers.

Each development will have its own specific design and construction characteristics including wall constructions, roof constructions, size of windows and doors, internal surface finishes, etc. It would be the responsibility of each applicant or developer to demonstrate that they can achieve the requirements of AS 2021.

Table 6.2 and Table 6.3 present the potential building material solutions for each element of the facade that would satisfy the criteria outlined in Table 2.2. These are in-principle options and there are a range of solutions that would satisfy the requirements for increased density of residential development within the 25-30 ANEF. The glazing specifications are nominal only and windows, doors and skylight should be specified and selected to achieve the minimum acoustic requirement. For the purpose of the assessment, the required acoustic ratings in weighted noise reduction (Rw) are typically equivalent to the ANR +6dB.

6.4 Acoustic constructions

The conceptual glazing and façade constructions for residential development within the study area are presented in Table 6.2 and Table 6.3. These are for the areas of the precinct exposed to the highest level of aircraft noise and hence other areas within the precinct could adopt reduced acoustic performance options.

Table 6.2 Minimum glazing constructions

Location within building	Construction	Acoustic Rating R_w
Bedrooms and dedicated lounges	6.38 mm / 100-150 mm / 5 mm	43-45
Other habitable spaces	10.38 mm / 12-40 mm / 6 mm	38-40
Bathrooms, toilets, laundries	10.38 mm laminated	33-35

Indicative façade/roof constructions to satisfy noise intrusion requirements are provided in Table 6.3. Light weight options are provided in addition to typical brick-veneer and masonry construction to demonstrate that a range of construction can be used to meet minimum requirements. To that end, it would be prudent to adopt a façade inclusive of masonry in such areas of Sydney where aircraft noise is known to exist.

Table 6.3 Minimum façade/roof constructions

Type	Construction	Acoustic Rating R_w
Light-weight facade	9 mm fibre cement sheeting externally, 92 mm metal stud, 2 x 13 mm standard plasterboard internally with R2 insulation in wall cavity (including infill panels above windows doors)	48
Brick veneer facade	9mm fibre cement sheeting, 92 mm deep 92 mm metal stud, 1 x 13 mm standard plasterboard internally with R2 insulation in wall cavity (including infill panels above windows doors)	50
Masonry facade	Core-filled concrete blockwork, cavity brick, precast concrete or cast in-situ concrete walls.	>50
Masonry roof	Precast concrete or cast in-situ concrete roof.	>50

6.5 Façade penetrations

Façade penetrations are to be acoustically treated to maintain the acoustic integrity of the façade element in which they are located. This may include fire sprinkler penetrations, outside air louvres and exhaust louvres.

It is noted that the above constructions are would not be dissimilar to those required for residential buildings within the ANEF 20-25 zone exposed to L_{ASmax} noise levels of 82-85 dB with double glazing still anticipated.

7 Conclusion

The study area forms part of the Parramatta Road Corridor Urban Transformation Strategy (PRCUTS) and is identified as the Leichhardt Precinct. The precinct is centred on Parramatta Road and extends from Johnston Street, Annandale (east) to Flood Street, Taverners Hill (west), and north on the alignment of Norton Street to Marion Street, Leichhardt. As a component of the PRCUTS, the Leichhardt precinct has been identified for increased residential densities.

EMM has completed a review of potential noise constraints for the precinct, primarily focused on aircraft noise exposure utilising ANEF 2039 and L_{ASmax} noise levels in accordance with AS 2021. This was done to determine the suitability to accommodate residential use within the precinct. With regard to the precinct suitability for residential use, the following has been discussed:

- The calculation of L_{ASmax} noise levels determined in accordance with the procedures of AS2021 confirmed that the precinct is exposed to L_{ASmax} noise levels of between 74 dB to 88 dB from aircraft departures;
- Aircraft noise exposure is not dissimilar to approved and constructed medium and high density developments within the Victoria Road precinct in Marrickville and Precinct 75 in St Peters, as well as other smaller land use changes of recent times in the area;
- Sydney Airport Masterplan 2039 and additional reference information from SAMP 2033 identified the trend for a reduction in aircraft noise levels as a result of decommissioning of older aircraft and prevalence of new generation of aircraft;
- Review of L_{ASmax} noise levels for ANEF 25-30 compared to ANEF 20-25 confirmed a typical difference of only 2dB and would not materially alter the required building construction; and
- Based on the review of the information and details discussed in this report, we are of the opinion that notwithstanding that a portion of the precinct is located within the 25-30 ANEF zone, any residential buildings could be designed and constructed to satisfy the internal design levels of AS 2021 in all areas of the precinct.

Consistent with the planning approach for Precinct 75, it is recommended that an LEP amendment affecting the Leichhardt precinct to ensure that the requirements for noise controls (in accordance with the procedures of AS 2021) and any potential impacts from aircraft noise intrusion are addressed. Developers may exclude older generation aircraft referenced in AS2021-2015 from noise assessments, where this can be clearly justified through a series of documented on site measurements and revised or updated operational data from Air Services Australia (ASA) for aircraft movements at Sydney Kingsford Smith Airport that those older generation aircraft are no longer part of normal airport operations. This information is often found in the latest revision of an aerodrome's ANEF charts that usually include a table of aircraft types used to develop the ANEF, as endorsed by ASA.

It would be the responsibility of any proponent or developer within the Leichhardt Precinct to review acoustics and finalise treatments as part of the detailed design phase to ensure compliance with the internal noise requirements established in accordance with AS 2021.

It is the opinion of EMM that the precinct is acceptable for increased residential development. EMM has provided readily available indicative construction options and requirements which demonstrate that residential development can comply with the aircraft noise objectives and as such satisfy the requirements of Ministerial Direction 3.5. EMM have also identified precedent of use with examples of previous approvals to residential development within the ANEF 25-30 contour.