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IKEA TEMPE

AIRCRAFT NOISE INTRUSION ASSESSMENT

TD691-01F02 (REV 1) AIRCRAFT NOISE ASSESSMENT

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Prepared for:

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1 INTRODUCTION

This report presents an assessment of aircraft noise intrusion, which potentially affects the proposed commercial development of the Ikea Tempe Store located on the corner of the Princes Highway and Bellevue Street, Tempe.

The site is located less than 1km north-east of Sydney's Kingsford Smith Airport and is located within the ANEF 30-40 contours.

This report recommends noise attenuation measures so that internal noise levels from aircraft operations comply with Australian Standard AS2021 – 2000.

Before committing to any form of construction or committing to any contractor, advice should be sought from an acoustic consultant to ensure that the forms of construction selected comply with the criteria nominated in this report.

Site inspections during construction are recommended, followed by compliance testing once the dwelling is commissioned. This will allow an approach based on risk minimisation to ensure that the design complies with acceptable noise limits.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 AIRCRAFT NOISE

The current ANEF map for Kingsford Smith Airport is the ANEF 2023/24, approved by the Federal Minister for Transport and Regional Services in March 2004

The applicable noise exposure zones obtained from the ANEF contours are summarised in

.

Table 1 - LOCATION OF SITE RELATIVE TO AIRCRAFT NOISE EXPOSURE CHARTS

Assessment Chart	Location	ANEF Zone
ANEF 2023/24	Ikea	30-35

According the ANEF map, both developments on the property lie within the **Conditionally Acceptable** zone nominated in Australian Standards AS2021-2000 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction".

2.1 Measured Aircraft Noise Levels

Aircraft noise levels were measured at the subject development site. The predominant operations involved take-offs on Runway 34L and arrivals on Runway 16R, the main north-south runway. The site is also affected by take-offs on Runway 34R and arrivals on Runway 16L, the third runway.

2.2 Predicted Aircraft Noise Levels

Aircraft noise exposure levels were calculated for the development site based on Australian Standard AS2021-2000.

To determine resultant aircraft noise levels the following factors were considered as specified in the Standard;

1. The site's position relative to each runway, including take off and landing distances and runway centre line offsets;

2. Elevation of the site compared with the elevation of the runways; and,

3. Type of aircraft and associated maximum noise level during take off and landing.

Using these factors, the resultant maximum noise levels were determined for each aircraft type. This calculation is not based on ANEF contours but on the location of the site relative to the runways.

The operation of runways 16L and 16R for arrivals and 34R and 34L for departures from Kingsford Smith Airport mostly impacts the proposed development site. This includes operation Modes 8, 9 and 10.

In accordance with clause 3.1.4 of the Standard, *"where there is evidence that the particular aircraft type and movement which produced that noise level do not constitute a typical operation, then the noise level can be ignored and the next lowest noise level selected"*.

Aircraft noise movement statistics were obtained for the year 2007 and 2008 to date from noise monitoring terminals in Sydney published by Air Services Australia. In accordance with clause 3.1.4, the upper 5% of movements are assumed to *"not constitute a typical operation"* and were excluded.

As the development site is so large, Two assessment locations were used to assess aircraft noise intrusion. The table below shows the maximum design noise level at the each of the assessment points at subject site.

Table 2– MAXIMUM NOISE LEVELS AT ASSESSMENT LOCATION AS PER AS2021

Assessment Location	Aircraft Type	Mode of Operation	Maximum Noise Levels dB(A)
1 – Ikea showroom, market hall and offices	Boeing 747-400	Departure (Runway 34L)	89
2 – Ikea warehouse/ self serve furniture	Boeing 747-400	Departure (Runway 34L)	90

3 EXTERNAL FACADE REQUIREMENTS

3.1 Design in Accordance with AS2021-2000

The external noise levels are used to calculate the expected internal noise level by taking into account the sound attenuation provided by the building facades. Where internal noise levels exceed the criteria nominated in AS2021-2000, noise mitigation can be implemented using well-established noise control methods. (i.e. extra thickness or double glazing, acoustically rated doors and seals, treatment to the walls and ceiling etc)

Calculations for the required R_w ratings of external partitions were performed in accordance with Appendix E and Appendix F of Australian Standard AS2021-2000. The resulting R_w rating required for each element, in principle, is presented in the Appendix C and summarised in

below.

Table 3– SUMMARY OF REQUIRED ACOUSTIC TREATMENT AT IKEA TEMPE

Area	Facade	Required Rw Rating	Possible Construction
Ikea Store			
Ikea Showroom (upper ground floor)	Walls	Rw 19	Lightweight sandwich panels (Bondor)
	Windows	Rw 19	Standard 6mm float glass
	Roof/ Ceiling	Rw 31	Metal deck roof with sarking and insulation underneath with a plasterboard lining.
Ikea Warehouse/ self service furniture	Walls	Rw 17	Lightweight sandwich panels (Bondor)
	Windows	Rw 17	Standard 4mm float glass
	Roof/ Ceiling	Rw 35	Metal deck roof with sarking and insulation underneath with a plasterboard lining.
Ikea Market Hall (ground floor)	Walls	Rw 21	Lightweight sandwich panels (Bondor)
	Windows	Rw 21	Standard 6mm float glass
Ikea Office Area			
Private offices	Walls	Rw 34	Lightweight sandwich panels (Bondor) with studwork spaced off the panels. One layer of plasterboard fixed to the studwork. Insulation in the wall cavity
	Windows	Rw 34	10.38mm laminated glass
	Roof/ Ceiling	Rw 37	Metal deck roof with sarking and insulation underneath. A suspended ceiling consisting of 1 layer of plasterboard. Glasswool insulation installed in the ceiling cavity
Open offices	Walls	Rw 30	Lightweight sandwich panels (Bondor) with studwork spaced off the panels. Plasterboard fixed to the studwork
	Windows	Rw 30	6.38mm laminated glass
	Roof/ Ceiling	Rw 41	Metal deck roof with sarking and insulation underneath. A suspended ceiling consisting of 1 layer of plasterboard. Glasswool insulation installed in the ceiling cavity

It should be noted that the methods used for determining the required R_w rating for each element in AS2021 assumes that equal noise energy is transmitted through the building components.

This is not always true in practice because walls (and sometimes roofs) generally achieve a higher R_w rating than windows. Taking into account the higher R_w rating for these other elements, the required R_w rating for glazed elements can be reduced. The proposed construction of elements shall be assessed in detail at the detailed design stage of the project.

Before committing to any form of construction or committing to any contractor, advice should be sought from an acoustic consultant to ensure that the forms of construction selected comply with the criteria nominated in this report.

3.2 Construction Supervision

Site inspections during construction are recommended, followed by compliance testing once the dwelling is commissioned. This will allow an approach based on risk minimisation to ensure that the design complies with acceptable noise limits.

4 CONCLUSION

Renzo Tonin & Associates have completed an acoustic assessment of aircraft noise potentially affecting the proposed commercial development: Ikea, Tempe.

Criteria applicable to aircraft noise intrusion have been presented. The impact of aircraft using Kingsford Smith Airport has been assessed.

The internal noise levels due to aircraft noise at the proposed development can be reduced to that required by Australian Standard 2021-2000 by the application of standard noise control measures.

In-principle building material selections are recommended in Appendix C and Table 3 of this report to control noise so that internal noise levels within the development comply with the criterion specified in the Standard.

It is recommended that an acoustic consultant be retained to recommend the final construction details, to supervise the works and to provide a final compliance report.

APPENDIX A - CRITERIA AND DESIGN METHODOLOGY

A.1 Aircraft Noise Zoning

Table 2.1 of Australian Standard AS2021-2000 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction" provides zoning information for sites subjected to aircraft noise. The table lists three ANEF Zones, namely, Acceptable, Conditionally Acceptable and Unacceptable, and recommends suitable ANEF levels for different types of buildings.

Table 4– BUILDING SITE ACCEPTABILITY BASED ON ANEF ZONES (TABLE 2.1AS2021)

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		

Note: within 20 ANEF to 25 ANEF, some people may find that 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.

In **Acceptable** zones there is usually no need for the building construction to provide protection specifically against aircraft noise.

In **Conditionally Acceptable** zones the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedures of Clause 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.

In **Unacceptable** zones – construction of the proposed development should not normally be considered.

A.2 Aircraft Noise Internal Criteria for Commercial Development

Australian Standard AS2021-2000 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction" recommends the following internal design noise levels for commercial development:

Table 5– INTERNAL DESIGN SSOUND LEVELS dB(A)

Occupancy	Max Noise Level, Lmax dB(A)
Commercial Buildings	
Private offices, conference rooms	55
Drafting, open offices	65
Typing, data processing	70
Shops, supermarkets, showrooms	75
Industrial Buildings	
Inspection, analysis, precision work	75
Light machinery, assembly, bench work	80
Heavy machinery, warehouse, maintenance	85

Notes:

The above internal sound design levels are the maximum levels from an aircraft flyover which, when heard inside the specified area by the average listener, will be judged as not intrusive or annoying by that listener while carrying out the specified activity. Owing to the variability of subjective responses to aircraft noise, these figures will not provide sufficiently low interior noise levels for occupants who have a particular sensitivity to aircraft noise.

Some of these levels, because of the short duration of individual aircraft flyovers, exceed some other criteria published by Standards Australia for indoor background noise levels (See AS 2107).

APPENDIX B - GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather — Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

Ambient Noise — The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.

Assessment Period — The period in a day over which assessments are made.

Assessment Point — A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.

Background Noise — Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the $\mathbf{L_{90}}$ noise level (see below).

Decibel [dB] — The units that sound is measured in. The following are examples of the decibel readings of every day sounds:

0dB The faintest sound we can hear

30dB A quiet library or in a quiet location in the country

45dB Typical office space. Ambience in the city at night

60dB Martin Place at lunch time

70dB The sound of a car passing on the street

80dB Loud music played at home

90dB The sound of a truck passing on the street

100dB The sound of a rock band

115dB Limit of sound permitted in industry

120dB Deafening

dB(A): A-weighted decibels The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.

Frequency Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.

Impulsive noise Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.

Intermittent noise The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.

L_{max} The maximum sound pressure level measured over a given period.

L_{10} The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L_{90} The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).

L_{eq} The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.

Reflection Sound wave changed in direction of propagation due to a solid object obscuring its path.

R_w	'Weighted Sound Reduction Index'. A method of rating the airborne sound insulation of a partition, based on sound insulation measurements in one-third octave bands from 100 Hz to 3.15 kHz. A standard-shape curve is fitted to the data, and the nominal sound insulation at 500 Hz defines the weighted index. R_w is a laboratory measurement.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX C - CALCULATION SHEETS – AS2021:2000

Building classification	Commercial buildings

Room 1 description		ikea showroom				
Room 1 Type		Shops, supermarkets, showrooms				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	7125	31.0	36.0	Metal deck roof with sarking & insulation, lined with 1 layer plasterboard
north wall	Theta (θ_1) =	0	428	18.6	23.6	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
east wall	Theta (θ_2) =	0	338	17.6	22.6	Lightweight sandwich panels (Bondor)/6mm standard float glass
west wall	Theta (θ_3) =	>90	338	11.0	16.0	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	7125	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		1				
Noise Limit		75				

Room 2 description		offices				
Room 2 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	1800	40.7	45.7	Metal deck roof with sarking & insulation, suspended ceiling 1 layer plasterboard
north wall	Theta (θ_1) =	0	180	30.6	35.6	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
west wall	Theta (θ_2) =	>90	90	21.0	26.0	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
south wall	Theta (θ_3) =	90	180	24.0	29.0	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
east wall	Theta (θ_4) =	0	90	27.5	32.5	
Floor		Floor fully shielded	1800	-	-	
h (height of ceiling) [m]		9				
T (Reverb Time) [sec]		1.5				
Noise Limit		65				

Room 3 description		Ikea market hall				
Room 3 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof		-	-	
north wall	Theta (θ_1) =	-	427.5	20.8	25.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
east wall	Theta (θ_2) =	-	337.5	19.8	24.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
west wall	Theta (θ_3) =	>90	337.5	19.8	24.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	7125	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		1				
Noise Limit		65				

Room 4 description		private offices				
Room 4 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	16	36.7	41.7	Metal deck roof with suspended ceiling and insulation
north wall	Theta (θ_1) =	0	9	34.1	39.1	Bondor panel & studwork with one layer of plasterboard
east wall	Theta (θ_2) =	0	9	34.1	39.1	
	Theta (θ_3) =	-		-	-	
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	16	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		0.5				
Noise Limit		65				

Building classification	Commercial buildings

Room 1 description		ikea showroom				
Room 1 Type		Shops, supermarkets, showrooms				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	7125	31.0	36.0	Metal deck roof with sarking & insulation, lined with 1 layer plasterboard
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east wall	Theta (θ_2) =	0	338	17.6	22.6	Lightweight sandwich panels (Bondor)/6mm standard float glass
west wall	Theta (θ_3) =	>90	338	11.0	16.0	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	7125	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		1				
Noise Limit		75				

Room 2 description		offices				
Room 2 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	1800	40.7	45.7	Metal deck roof with sarking & insulation, suspended ceiling 1 layer plasterboard
north wall	Theta (θ_1) =	0	180	30.6	35.6	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
west wall	Theta (θ_2) =	>90	90	21.0	26.0	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
south wall	Theta (θ_3) =	90	180	24.0	29.0	Lightweight sandwich panels (Bondor)/ 6.38 laminated glass
east wall	Theta (θ_4) =	0	90	27.5	32.5	
Floor		Floor fully shielded	1800	-	-	
h (height of ceiling) [m]		9				
T (Reverb Time) [sec]		1.5				
Noise Limit		65				

Room 3 description		Ikea market hall				
Room 3 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof		-	-	
north wall	Theta (θ_1) =	-	427.5	20.8	25.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
east wall	Theta (θ_2) =	-	337.5	19.8	24.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
west wall	Theta (θ_3) =	>90	337.5	19.8	24.8	Lightweight sandwich panels (Bondor)/ 6mm standard float glass
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	7125	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		1				
Noise Limit		65				

Room 4 description		private offices				
Room 4 Type		Drafting, open offices				
Component description			Area (m^2)	ANAc	Rw	Possible Construction
Roof		Any other Roof	16	36.7	41.7	Metal deck roof with suspended ceiling and insulation
north wall	Theta (θ_1) =	0	9	34.1	39.1	Bondor panel & studwork with one layer of plasterboard
east wall	Theta (θ_2) =	0	9	34.1	39.1	
	Theta (θ_3) =	-		-	-	
	Theta (θ_4) =	-		-	-	
Floor		Floor fully shielded	16	-	-	
h (height of ceiling) [m]		4.5				
T (Reverb Time) [sec]		0.5				
Noise Limit		65				