



WAGGA WAGGA AIRPORT AIRCRAFT NOISE MODELLING REVIEW

CITY OF WAGGA WAGGA

6 October 2022

Table of Contents

1.	INTRODUCTION	4
2.	BACKGROUND	4
3.	RUNWAY DEVELOPMENT SCENARIOS	5
4.	AIRPORT FORECAST	6
4.1	REGULAR PUBLIC TRANSPORT (RPT).....	7
4.2	GENERAL AVIATION.....	8
4.3	MILITARY.....	11
4.4	HELICOPTERS	11
5.	FLIGHT TRACKS AND TRAFFIC ALLOCATION	12
5.1	FIXED WING	12
5.2	HELICOPTERS	15
6.	ANEC AND N-ABOVE NOISE CONTOURS.....	16
7.	LIMITATIONS	19
8.	FURTHER WORK	19
	APPENDIX A: MP2010 ANEF VS ANEC FORECAST COMPARISON.....	20
	APPENDIX B: NASF GUIDELINE A.....	22

Tables

TABLE 1: RUNWAYS FOR MODELLED SCENARIOS	5
TABLE 2: RPT AIRCRAFT MOVEMENTS ANEF VS ANEC	8
TABLE 3: AIRLINE TRAINING ACADEMY MOVEMENTS ANEF VS ANEC	8
TABLE 4: LOCAL FLIGHT TRAINING SCHOOL FORECAST MOVEMENTS BY AIRCRAFT GROUP.....	9
TABLE 5: ITINERANT FLIGHT TRAINING MOVEMENT FORECAST	9
TABLE 6: CHARTER AND EXECUTIVE MOVEMENT FORECAST	10
TABLE 7: MRO MOVEMENT FORECAST	10

TABLE 8: EMERGENCY SERVICES MOVEMENT FORECAST11

TABLE 9: FIXED WING AIRCRAFT ALLOCATION BY TRACK TYPE15

Figures

FIGURE 1: RUNWAYS AND THRESHOLDS6

FIGURE 2: ANEC VS MP2010 ANEF MOVEMENTS BY CATEGORY7

FIGURE 3: ANEC1 NOISE MODEL FIXED WING ARRIVAL, DEPARTURE AND OVERFLIGHT TRACKS14

FIGURE 4: ANEC1 NOISE MODEL FIXED WING TRAINING CIRCUIT TRACKS14

FIGURE 5: ANEC1 FLIGHT TRACKS AND NOISE CONTOURS17

FIGURE 6: ANEC2 FLIGHT TRACKS AND NOISE CONTOURS17

FIGURE 7: ANEC3 FLIGHT TRACKS AND NOISE CONTOURS18

FIGURE 8: EXISTING ANEF VS ANECS COMPARISON18

Revision	Date	Description	Author	Verifier	Approver
0	31/08/2022	First Draft for WWCC comment	BJH	---	BJH
1	20/09/2022	Revised Draft for WWCC comment	BJH	---	BJH
2	28/09/2022	Final Draft	BJH	BMW	BJH
3	06/10/2022	Final	BJH	BMW	BJH

1. INTRODUCTION

REHBEIN Airport Consulting was engaged by Wagga Wagga City Council (Council) to undertake aircraft noise modelling and development of an Australian Noise Exposure Concept (ANEC) with associated N-above contours.

The objective of the modelling is to determine whether the current Australian Noise Exposure Forecast (ANEF) mapping developed for the Wagga Wagga Airport Master Plan 2010 (MP2010) remains appropriate, pending a full update of the Master Plan for which the timing is not currently known.

Note: The MP2010 Ultimate Capacity ANEF is termed an ANEF because it was endorsed by Airservices Australia for technical accuracy. Only one ANEF chart can be endorsed at any time. In this study the corresponding estimated noise contours are termed an Australian Noise Exposure Concept (ANEC) because they have not been endorsed by Airservices to become an ANEF.

The scope for this review was agreed in stages, as follows:

- Stage 1 – Airport Forecast
 - Establish current aircraft movements by type, operation, runway, arrivals, departures and training, and day/night use;
 - Confirm current runway usage with the Bureau of Meteorology wind speed and direction and/or aircraft movement record data;
 - Determine the airport capacity (total aircraft movement numbers by category or operation) in consultation with Wagga Wagga Airport and City Council representatives that is consistent with the Airport's vision and objectives. This will be by reference to the ultimate capacity forecast included in the Wagga Wagga Airport Master Plan 2010 and adjusted in discussion with Council;
 - Agree distribution of aircraft types by category;
 - Develop existing and possible future flight paths for modelling purposes; and
 - Provide draft technical report with noise model input and assumptions to Wagga Wagga City Council for confirmation.
- Stage 2 – Develop the ANEC
 - Model the agreed inputs and assumptions to construct ANEC contours in the FAA Integrated Noise Model (INM) versions 7.0d;
 - Resultant ANEC contours and N-Above contours (N60, N65 and N70) to be reviewed and confirmed with Wagga Wagga City Council and compared against the 2010 endorsed ANEF; and
 - Review contours and input assumptions. Adjust assumptions and remodel in INM as agreed with Wagga Wagga City Council.

This report provides background, detail on assumptions and results from the review. Limitations of the modelling process and further work required are discussed.

2. BACKGROUND

An Ultimate Capacity Australian Noise Exposure Forecast (ANEF) was prepared as part of the 2010 Wagga Wagga Airport Master Plan (MP2010), which remains the adopted airport Master Plan.

The Ultimate Capacity ANEF for Wagga Wagga Airport is based on the proposal within the MP2010 to eventually construct a parallel runway dedicated to light aircraft movements, in particular intensive circuit training activity. The MP2010 forecast for medium (expected) growth out to 2029/30 was applied in the ANEF for all aircraft except civil and military light aircraft training movements, which were increased to reflect the ultimate runway capacity.

The use of an ultimate capacity approach at the time was justified on the basis that an ANEF is intended to protect the public from unacceptable impacts of aircraft noise in the long-term. However, by assuming the development of additional runway infrastructure, the ANEF produced may not reflect the noise exposure outcomes that might be predicted if the MP2010 infrastructure is not fully provided. In most cases, these

outcomes would be expected to cover a smaller footprint than the Ultimate Capacity ANEF. However, due to differences in airspace operation that can be expected with and without the additional MP2010 runway infrastructure, this may change the footprint into a different shape as aircraft will operate in a different pattern. Pending the development and adoption of an updated airport Master Plan, Council is seeking to understand the aircraft overflight and noise impact implications of additional scenarios representing different runway development outcomes.

The MP2010 Ultimate Capacity ANEF is termed an ANEF because it was endorsed by Airservices Australia for technical accuracy. Only one ANEF chart can be endorsed at any time. In this study the corresponding estimated noise contours are termed an Australian Noise Exposure Concept (ANEC) because they have not been endorsed by Airservices to become an ANEF.

3. RUNWAY DEVELOPMENT SCENARIOS

Three additional scenarios are considered for runway development. These do not include a parallel runway (the impact of which is accounted for in the MP2010 ANEF) and only consider the existing Runway 05/23 infrastructure and the possible extensions to the existing runway envisaged in the MP2010. The scenarios are:

- **ANEC1** – Retention of the existing Runway 05/23 extent only, and no development of parallel runway;
- **ANEC2** – Extension of the existing Runway 05/23 to the north-east, to the extent envisaged in the MP2010, and no parallel runway; and
- **ANEC3** – Extension of the existing Runway 05/23 to the south-west, to the extent envisaged in the MP2010, and no parallel runway.

These scenarios are also considered, in combination, to encompass the noise footprint associated with the aircraft movement forecasts discussed below, operating from Runway 05/23 extended in both directions. None of the scenarios in this review include a parallel runway.

The runways used in the model for each scenario are as indicated in **Table 1** and **Figure 1**.

Table 1: Runways for Modelled Scenarios

SCENARIO	05 THRESHOLD	23 THRESHOLD
ANEC1	05 (existing)	23 (existing)
ANEC2	05E (existing)	23U (extended to NE)
ANEC3	05U (extended to SW)	23E (existing)

The MP2010 ANEF scenario is not included in this review. However it should be noted that scenario remains a possible outcome and the land uses should continue to be protected until the ANEF is revised at some point (in conjunction with a Master Plan update).

Figure 1: Runways and Thresholds



4. AIRPORT FORECAST

The forecasts of aircraft movements on which the existing Ultimate Capacity ANEF is based were reviewed for continued relevance, taking into account actual traffic development since 2010. The same traffic growth assumptions are applied to all three (3) runway development scenarios described in [Section 3](#).

Notwithstanding that traffic growth has so far not eventuated as originally forecast, the ultimate capacity approach to land use planning remains valid. Therefore, even though this review seeks to evaluate the effect of different runway infrastructure than that envisaged in the MP2010, the general principle of adopting ultimate capacity forecasts (insofar as they could be accommodated on a single runway) continues to be applicable.

The same overall approach to developing the ultimate capacity forecasts that was used for the MP2010 ANEF was also applied to the ANECs in this review. The steps for the MP2010 ANEF and the ANEC forecasts are as follows:

- Develop forecasts by traffic category for a given future year, applying growth assumptions appropriate to each category. For the MP2010, this forecast was for financial year 2029/30. For the ANEC, recognising the actual pace of growth in traffic since 2010, the forecast is for 2050.
- Determine the ultimate practical movement capacity of the runway infrastructure applicable to the scenario. For the MP2010 ANEF this was established to be around 350,000 total movements. For the ANEC, with only the single runway, it was established to be around 190,000 total movements.
- Extend the 'future year' forecasts to give the total movements equivalent to the ultimate practical capacity. In the MP2010 this was done by expanding flight training movements only, and leaving other

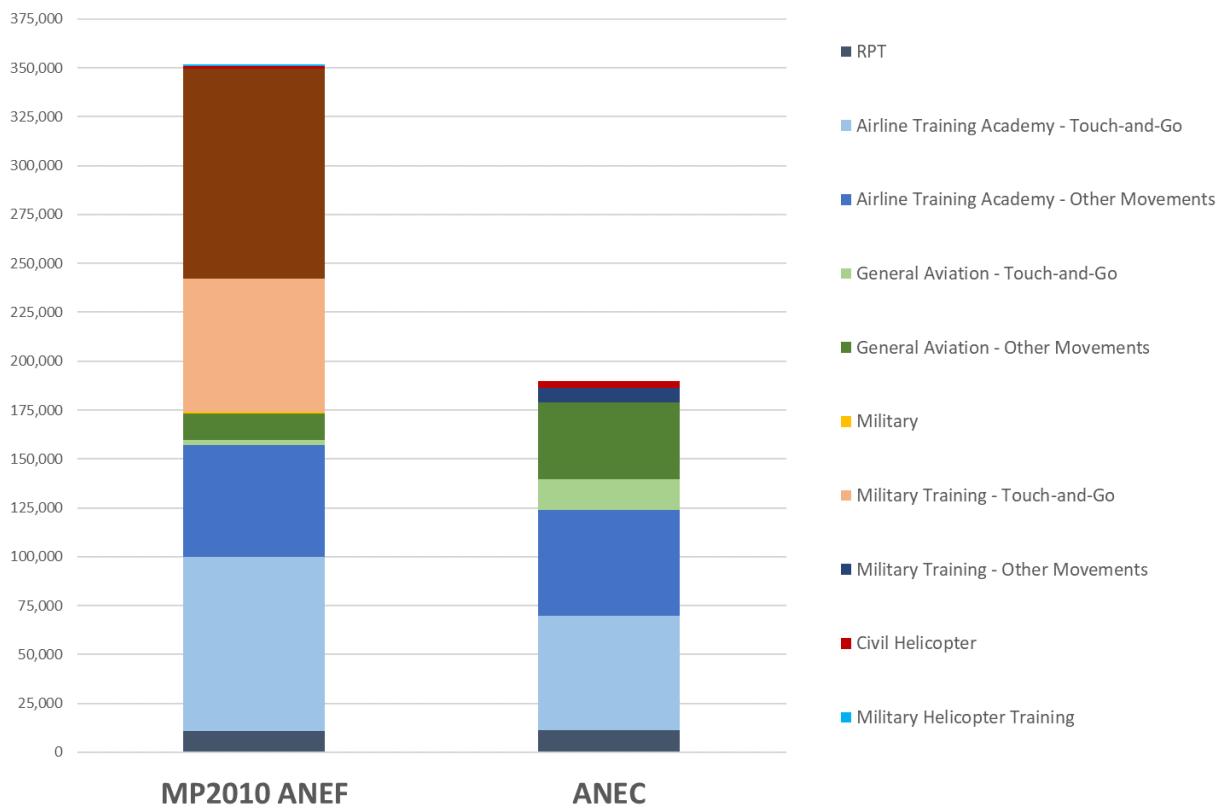
categories at the 2029/30 forecast level. For the ANEC it has been done by expanding all categories pro-rata.

Forecasts were reviewed with WWCC Airport Manager at meetings on 15 June 2021, 1 July 2021 and 15 July 2021.

In reviewing the forecasts, reference has been made to historical aircraft movement data collected by and on behalf of Council from 2017-2019. For some of the categories adopted in the MP2010 Ultimate Capacity ANEF the forecasts have been refined to reflect updated assumptions about traffic demand, representative aircraft types and distribution of operations. General Aviation traffic, previously forecast as a whole category, has been split into different market segments to enable each to be considered in more detail.

A comparison table of the breakdown of forecast movements of different categories included in the MP2010 ANEF and the ANEC runway development scenarios used in this review, is provided at [Appendix A](#). This is illustrated graphically in [Figure 2](#).

Figure 2: ANEC vs MP2010 ANEF Movements by Category



4.1 REGULAR PUBLIC TRANSPORT (RPT)

The future synthetic passenger flight schedule used for the MP2010 medium-growth forecast (2029/30 expected-value) was developed to carry the same annual passenger traffic of approximately 516,000 passengers on 11,336 movements. Aircraft types were adjusted to a more representative selection of types, covering 48-100 seats, based on available aircraft in the INM model and those currently operating in Australia to similar regional destinations (ATR42, Bombardier Dash 8-Q400, Fokker F70 and F100). Older, noisier, Boeing 737-400 aircraft, which would no longer be expected to operate passenger services, were removed. [Table 2](#) illustrates the changes in assumptions between the Ultimate Capacity ANEF and the ANECs.

It is acknowledged that traffic growth from 2010-2021 mean that reaching this level of RPT traffic is likely now an ultimate capacity assumption, rather than at 2030 or perhaps even 2050. However, future growth of

Wagga Wagga as a regional centre mean it is not beyond the realm of possibility that such traffic would eventually be achieved.

Table 2: RPT Aircraft Movements ANEF vs ANEC

ENDORSED ULTIMATE CAPACITY ANEF		REVISED ASSUMPTION FOR ANEC	
Aircraft Type	Annual Movements	Aircraft Type	Annual Movements
737400	624	F100	832
EMB190	832	F70	1,040
DHC840	2,600	DHC840	3,224
DHC830	5,616	ATR42	6,240
SF340	1,248		
TOTAL	10,920	TOTAL	11,336

4.2 GENERAL AVIATION

4.2.1 AIRLINE TRAINING ACADEMY MOVEMENTS

The MP2010 included civil flying training movements associated with AAPA estimated to generate approximately 30,000 movements at the academy’s planned capacity of 200 students per year. Current (historical average 2017-2019) annual movements are recorded as 20,480. At a reported operating level of around two-third of total capacity, this is consistent with the MP2010 estimate of 30,000 annual movements for AAPA.

The MP2010 assumed that AAPA would reach capacity by 2014/15, however evidence now shows the pace of growth has been slower. Nevertheless, Council’s aspirations for Wagga Wagga to develop as an aviation training hub remain. Therefore, the two additional flight training academies envisaged in the MP2010 may still develop, with the timeframe for this now more likely to be at 2050 than at 2029/30. Hence, for this review, the forecast level of 90,000 training academy movements has been moved out to 2050.

The total training movements in the MP2010 were increased to utilise the full parallel-runway capacity estimate of 350,000 movements. Without the parallel runway the single runway practical capacity is now assumed (by reference to FAA Advisory circular 150/5060-5) to be 190,000 movements. After adjusting the remaining aircraft movement forecast categories (as described below), the ultimate capacity flight training academy movement capacity is 112,772 movements. This is a reduction from 146,273 movements accommodated in the Master Plan as shown in [Table 3](#).

The proportion of single and twin-engine aircraft has been adjusted to reflect historical AAPA usage instead of the assumed 75%/25% split assumed in the Master Plan.

Table 3: Airline Training Academy Movements ANEF vs ANEC

CATEGORY	ENDORSED ULTIMATE CAPACITY ANEF			REVISED ASSUMPTION FOR ANEC		
	Total Annual Movements	Aircraft Type	% by Type	Total Annual Movements	Aircraft Type	% by Type
Airline Training Academy Arrival/Departure	57,153	Single	25.0%	94,728	Single	84.0%
		Twin	75.0%		Twin	16.0%
Airline Training Academy Circuit Training	89,120	Single	25.0%	18,044	Single	84.0%
		Twin	75.0%		Twin	16.0%

CATEGORY	ENDORSED ULTIMATE CAPACITY ANEF			REVISED ASSUMPTION FOR ANEC		
TOTAL	146,273			112,722		

4.2.2 LOCAL FLIGHT TRAINING SCHOOL MOVEMENTS

In addition to AAPA, there are also flight training movements carried out by other training providers based at Wagga Wagga. In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. Analysis of historical usage data for the current operators indicates a typical split of aircraft groups and current movement levels for each as shown in **Table 4**.

Table 4: Local Flight Training School Forecast Movements by Aircraft Group

AIRCRAFT GROUP	EXISTING MOVEMENTS	GROWTH ASSUMPTION	2050 FORECAST MOVEMENTS	ULTIMATE PRACTICAL CAPACITY FORECAST MOVEMENTS
Light Sports Aircraft	5,400	3% p.a. for 30 years	13,107	16,423
Single Engine Piston	210	8% p.a. for 30 years (high growth from a low base)	2,113	2,648
Twin Engine Piston	470	2% p.a. for 30 years	851	1,066
Single Engine Turboprop	160	2% p.a. for 30 years	290	363
TOTAL	6,240	Approx 3.3% p.a. average	16,361	20,501

4.2.3 ITINERANT FLIGHT TRAINING MOVEMENTS

Presently, there are approximately 2,625 movements by flight training organisations which are based remote to Wagga Wagga. In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. Growth in these movements is expected to continue but at a relatively low rate of 2% p.a. as the attraction of the airport as a training destination may reduce as local traffic increases and the airspace becomes busier. The presence of the ILS will be a draw for training activity. A total of 5,958 annual movements in this category are forecast at ultimate practical capacity. Analysis of the historical usage data has provided an approximate split of aircraft by group as show in **Table 5**.

Table 5: Itinerant Flight Training Movement Forecast

AIRCRAFT GROUP	ULTIMATE PRACTICAL CAPACITY FORECAST MOVEMENTS	% OF TOTAL BY GROUP
Single Engine Piston	5,243	88%
Single Engine Turboprop	179	3%
Twin Engine Piston	179	3%
Twin Engine Turboprop	298	5%
Jets	60	1%
TOTAL Itinerant Training	5,958	100%

4.2.4 PRIVATE FLYING

There are currently 3,000 annual private aviation movements and this sector is assumed to grow by an average of 2% per year to reach 5,434 movements in 2050 and 6,900 annual movements at ultimate practical capacity. In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. Existing data shows 96% of the movements are single engine piston aircraft such as the Cessna 172 family. In future it is assumed this or a similar aircraft will dominate traffic in this sector.

4.2.5 CHARTER / EXECUTIVE

Historical charter movements averaged 2,200 per year across 2017-2019. In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. Growth is assumed at 3% p.a. for 30 years to give 5,340 forecast movements in 2050 increasing to 6,691 annual movements at ultimate practical capacity. The forecast split of movements by aircraft group is shown in **Table 6**, based on the historical split with the addition of occasional (1 per fortnight) visits by larger jet aircraft.

Table 6: Charter and Executive Movement Forecast

AIRCRAFT GROUP	ULTIMATE PRACTICAL CAPACITY FORECAST MOVEMENTS	% OF TOTAL BY GROUP
Single Piston (Cessna 182)	3,813	57%
Single Turboprop (Cessna 208)	2,208	33%
Twin Turboprop (Beech KingAir)	201	3%
Executive Jet (Gulfstream V)	416	7%
Large Business Jet (BBJ/B737-700)	52	

4.2.6 MAINTENANCE, REPAIR AND OVERHAUL

Current movements for maintenance, repair and overhaul (MRO) are estimated at 1,525, based on Reginal Express line maintenance and Douglas Aerospace activity. In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. The MP2010 concept envisages considerable development of aviation support business including MRO. This assumption is supported by the continued presence of the Regional Express line maintenance base and the establishment of Douglas Aerospace on airport following the MP2010.

A potential five-fold growth over 30-years (equivalent to 5-6% p.a. on average) is assumed to generate 2050 movement forecasts of 7,625. This increases to 9,554 movements per year at ultimate practical capacity. A range of aircraft sizes are anticipated, including 19-seat turboprop, medium business jets and small narrowbody type such as the B717-200 (or similar replacement). An even split of movements by aircraft group is assumed as given in **Table 7**.

Table 7: MRO Movement Forecast

AIRCRAFT GROUP	ULTIMATE PRACTICAL CAPACITY FORECAST MOVEMENTS	% OF TOTAL BY GROUP
Commuter turboprop (Beech 1900D)	2,389	25%
Medium Business Jet (Bombardier Challenger 600 Series)	2,389	25%
Medium Business Jet (Falcon 900)	2,389	25%
Small Narrow Body Jet (B717-200)	2,389	25%

4.2.7 EMERGENCY SERVICES

Historical average emergency services aircraft movements are 2,100 per year, on average based on 2017-2019 aircraft movement records. These comprise aeromedical (turboprop and jet) aerial firefighting and police movements in the proportions shown in [Table 8](#). In the MP2010 these were included in the General Aviation category but have been separated out for more detailed analysis in this review. A possible doubling in emergency service movements over 30 years is assumed (approximately 2.5% growth per year) to give a 2050 movement forecast of 4,200 and an ultimate practical capacity forecast total of 6,809.

Table 8: Emergency Services Movement Forecast

CATEGORY	AIRCRAFT	ULTIMATE PRACTICAL CAPACITY FORECAST MOVEMENTS	% OF TOTAL BY GROUP
Aeromedical Turboprop	Beech King Air 300	3,842	73%
Aeromedical Jet	Cessna 510	263	5%
Firefighting	Air Tractor 802F	1,053	20%
Police	Cessna 208	105	2%

4.3 MILITARY

A large number of military training movements (175,530) was included in the MP2010, on the basis that Wagga Wagga Airport might attract the military Basic Flying Training contract, commencing around 2018, or some other form of military flying training. The Basic Flying Training contract was subsequently located at RAAF East Sale in Victoria and is not expected to relocate for at least 20 years. While there is the possibility of future military training at Wagga Wagga, without the additional runway capacity associated with the parallel runway, it would only be possible if the movements associated with it displaced some of the civilian flying training movements.

The military flying training movements assumed in this noise contour review have therefore been substantially reduced. The existing movements are based on the current reported level of activity which consists of 25 sorties per day, 5 days per week for 6 weeks of the year, resulting in 1,500 movements annually. Over the 30 years to 2050, a doubling in the number of visiting aircraft and a doubling in the frequency from six to 12 weeks is assumed. This results in a 2050 forecast of 6,000 movements and a revised ultimate practical capacity forecast of 7,518 annual movements, significantly reduced from the MP2010.

Military non-training movements are largely by civil transport aircraft such as business jet and twin turboprops and are included in the charter category. A small number (90) C130 Hercules movements have been included based on existing movements (36) doubled over 30 years and then extended to ultimate practical capacity.

4.4 HELICOPTERS

Only a small number (490) of military helicopter training movements were included in the MP2010 Ultimate Capacity ANEF. This was based on consultation with Defence who at the time foresaw no significant change to the level of use of the airport by military helicopters. However, the deployment of helicopters for training, which occurs to the south of Runway 05 and west of Runway 30, has increased from one six-week block to three six-week blocks. These training activities affect the fixed wing circuit pattern as described in [Section 5.1](#) below. However, for the purposes of this noise modelling review, these operations have not been included as they take place well away from residential areas.

Civil helicopter movements were assumed to grow from existing (2017-2019) level of 700 movements at 3% per year for 30 years to give a 2050 forecast of 2,800 movements increasing to 3,508 movements at ultimate practical capacity.

Helicopter operations have been assigned equally to four common light-to medium utility types available in the model software:

- Bell 206B3

- Eurocopter AS350;
- Robinson R22; and
- Schweizer S300.

5. FLIGHT TRACKS AND TRAFFIC ALLOCATION

Flight tracks for the single-runway configuration adopted for all ANEC scenarios will vary from those included in the Ultimate Capacity ANEF. This is because of the conventions adopted at aerodromes for the safe operation of aircraft in accordance with Civil Aviation Safety Authority rules i.e. airspace operations. This will place more circuit operations to the north of the runway with a single runway than would be the case if circuit operations were concentrated on a southern parallel runway 05R/23L.

The flight tracks that would operate in the single-runway runway development scenarios tested as part of this review would more closely reflect the existing aircraft flight paths. The flight tracks to be adopted for modelling purposes were developed by reference to the following:

- Circuit traffic pattern and spread of similar aircraft at other airports;
- Training area location for arrivals and departures from/to the training area as notified in the AIP-ERSA (270DEG to 030DEG up to 30 NM from the airport); and
- Straight-in / straight-out tracks for other arrivals and departures were considered representative of operations within the extent of the identified contours;

The flight tracks modelled were agreed as representative of the way the airport and airspace currently operate, and would be expected to operate under the runway development scenarios considered, at meetings with the WWCC Airport Manager on 15 and 29 July 2021.

5.1 FIXED WING

5.1.1 TRACK GROUPS

Flight tracks for the modelling review were developed for ANEC1 (existing runway configuration) in discussion with the Wagga Wagga Airport Manager and agreed to reflect the current and expected future operation of the runway. Flight tracks for the extended runway were then adjusted for ANEC2 and ANEC3 to reflect the respective runway extensions and therefore the shifted start of take-off and touchdown points that would apply.

Fixed wing tracks have been simplified from those adopted in the MP2010 Ultimate Capacity ANEF for the purposes of this review (a more detailed set of tracks may be required/appropriate if the ANECs generated are to be translated into an endorsed ANEF). Four (4) sets of tracks for fixed wing aircraft movement have been adopted to represent most forecast operations. These are:

- Straight-in/straight-out arrival and departure tracks, for aircraft coming from or going to other airports (including RPT, charter, MRO, charter/executive, military (non-training) and a portion of itinerant flight training use);
- Arrival/departure tracks from and to the training area airspace which is located to the northwest of the airport;
- Training circuit tracks for circuit operations on Runway 05/23 as follows:
 - Left-hand (normal) circuits on Runway 05;
 - Right-hand circuits on Runway 05 when military helicopter training is taking place to the south of Runway 05 and west of Runway 30;
 - Left-hand (normal) circuits on Runway 23; and
- An overflight track for practice approaches to Runway 23 ILS which do not touch down on the runway but break off and execute a missed approach.
- The tracks used for arriving, departing and overflight aircraft in ANEC1 are illustrated in [Figure 3](#). The tracks used for the various training circuit operations in ANEC1 are illustrated in [Figure 4](#). The

proportion of fixed wing operations to each group of tracks is given in **Figure 4: ANEC1 Noise Model Fixed Wing Training Circuit Tracks**

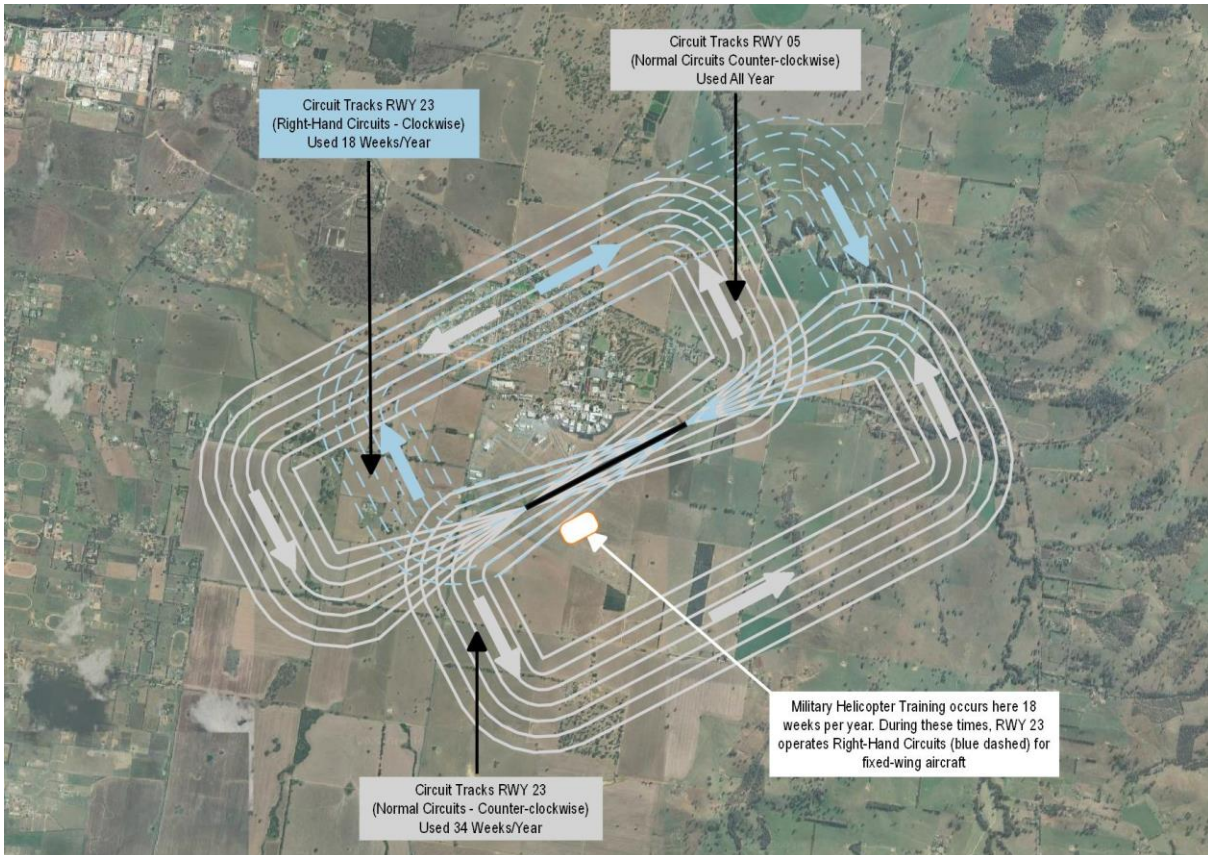


Table 9.

Figure 3: ANEC1 Noise Model Fixed Wing Arrival, Departure and Overflight Tracks

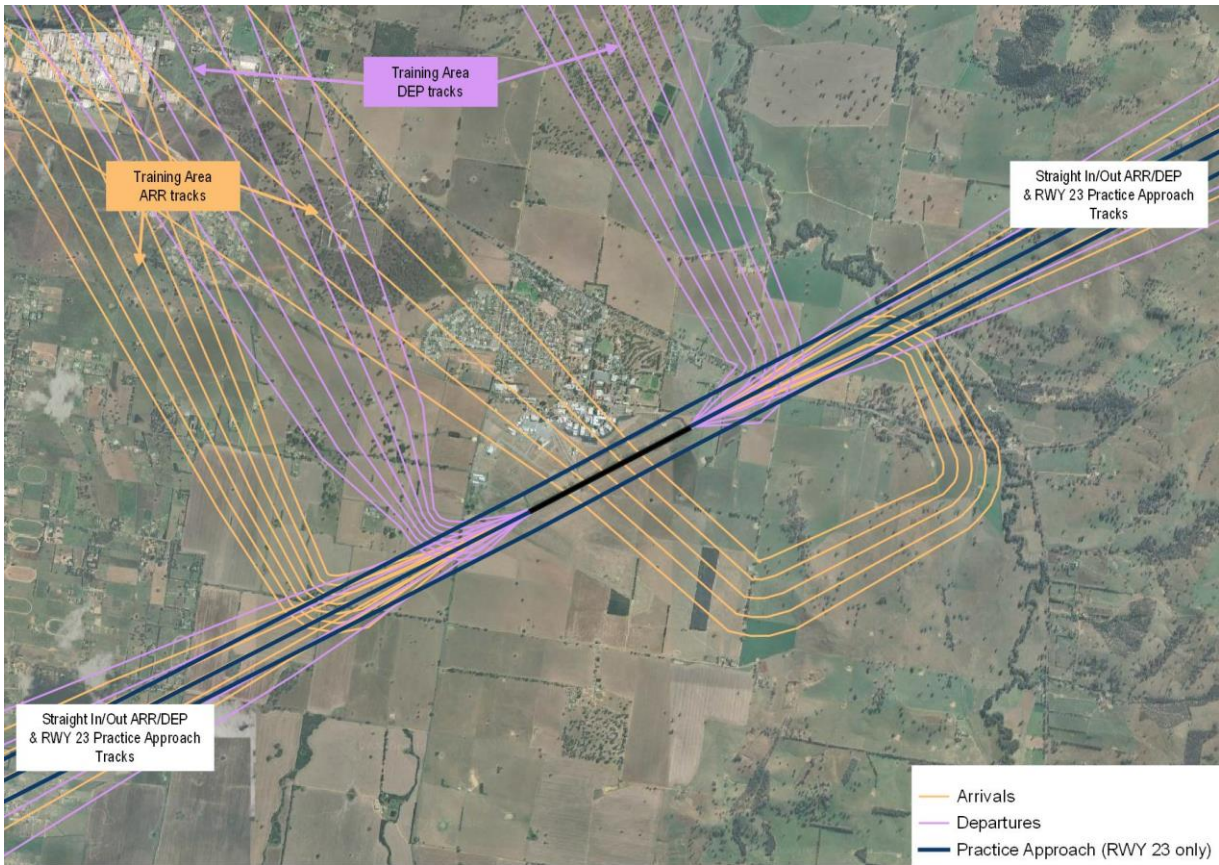


Figure 4: ANEC1 Noise Model Fixed Wing Training Circuit Tracks

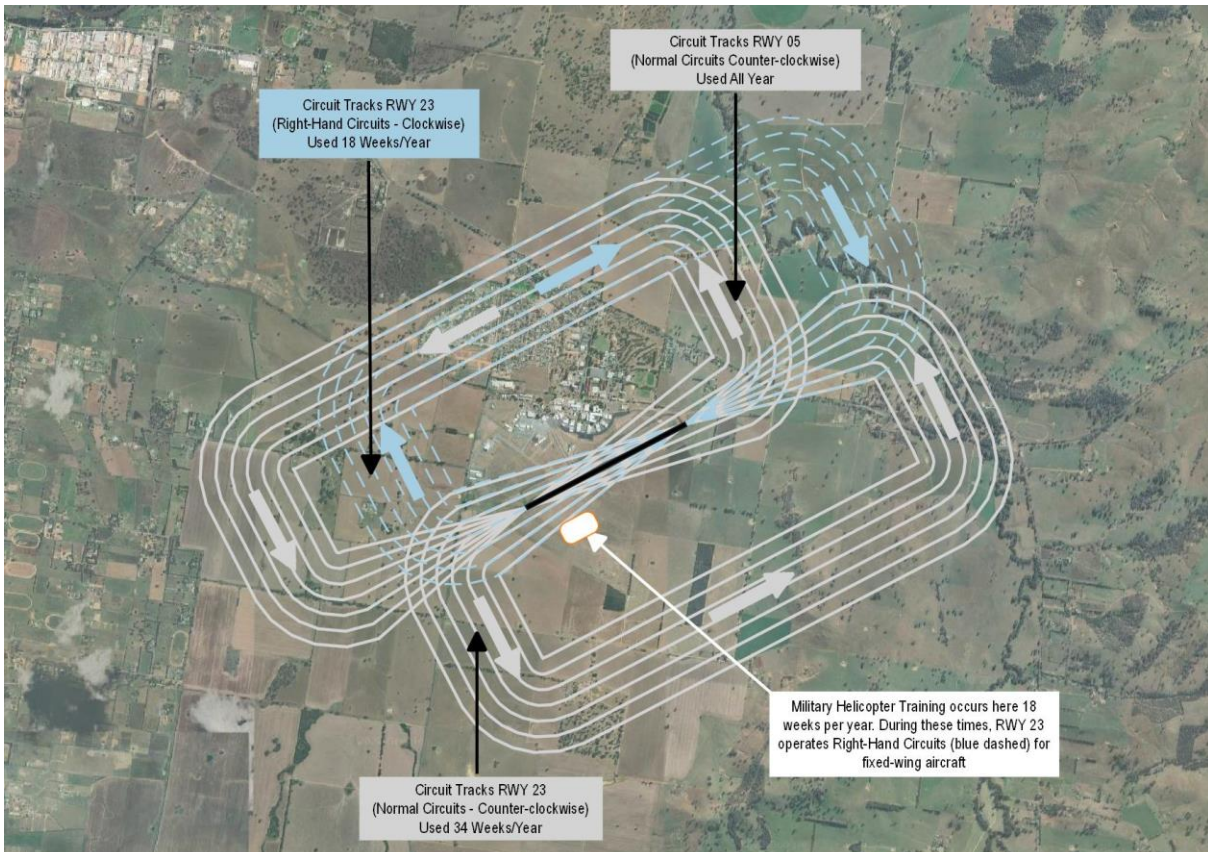


Table 9: Fixed Wing Aircraft Allocation by Track Type

CATEGORY	AIRCRAFT GROUP	STRAIGHT IN/OUT ARR/DEP	TRAINING AREA ARR/DEP	CIRCUITS	PRACTICE APPROACH
RPT	All	100%	-	-	-
Airline Academy	All	-	38%	52%	10%
Local Flight School	All	-	38%	52%	10%
Itinerant Flight Training	Single Piston Single Turboprop Twin Piston	30%	30%	40%	-
	Twin Turboprop Jets	100%	-	-	-
Private Flying	All	30%	30%	40%	-
Charter/Executive	All	100%	-	-	-
MRO	All	100%	-	-	-
Emergency	All	100%	-	-	-
Military	All	100%	-	-	-

5.1.2 RUNWAY USAGE

For fixed-wing operations, based on analysis of aircraft movement records collected on behalf of WWCC for July 2020 to August 2021, the following allocation of fixed wing aircraft to each runway have been adopted:

- Runway 05 – 57% of operations
- Runway 23 – 43% of operations

This allocation varies slightly from the MP2010 Ultimate Capacity ANEF which allocates the fixed wing movements equally in each direction. No fixed wing movements were allocated to Runway 12/30. This is consistent with the ANEF, in which it is assumed to be closed.

5.1.3 TIME OF DAY

90% of fixed-wing operations are assumed to occur between 7.00 and 19.00 and 10% to occur between 19.00 and 07.00. This assumption is consistent with the ANEF (90.3% and 9.7%) and is supported by analysis of historical aircraft movements between 2017 and 2019.

5.2 HELICOPTERS

5.2.1 TRACKS

Helicopter tracks were assumed similar to those in the MP2010 Ultimate Capacity ANEF, with helicopters arriving and departing in line with the (existing) runways. Helicopter are assumed to approach/depart to the intersection of the existing runways, rather than the existing 05 threshold as in the MP2010 Ultimate Capacity ANEF. In reality helicopters will generally approach and depart directly from their parking location, when safe to do so. An even distribution of movements by direction is assumed, consistent with the MP2010 Ultimate Capacity ANEF. A small amount of dispersion has been applied to the helicopter tracks to better reflect the likely reality, compared with the single concentrated track for each direction used in the MP2010 Ultimate Capacity ANEF.

5.2.2 TIME OF DAY

100% of rotary-wing operations are assumed to occur between 7.00 and 19.00. This assumption is consistent with the MP2010 Ultimate Capacity ANEF.

6. ANEC AND N-ABOVE NOISE CONTOURS

ANEC and N-above noise contours have been estimated for each scenario. This has been done using the FAA's Integrated Noise Model (INM) software version 7.0d, for consistency with the endorsed ANEF prepared in 2010 (see [Section 7](#) and [Section 8](#) for discussion of limitations and further work that may be required).

The established Australian Noise Exposure Forecast (ANEF) System and the Australian Standard AS 2021-2015 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction (AS2021)* have been recognised by a number of jurisdictions in their land use planning regimes. The ANEC contours presented in [Figure 5](#) through [Figure 7](#) can be used to estimate where the various ANEF zones would occur under each scenario. These ANEC contours generally sit within the endorsed ANEF 20 contour, with the exception of an area to the west of Elizabeth Avenue. The existing ANEF is shown (dashed) relative to the three ANEC scenarios in [Figure 8](#). The increase in extent in this area is mainly due to the changes in flight tracks used, which better reflect those associated with the single runway operations, compared to those adopted for the MP2010 Ultimate Capacity ANEF which assume parallel runways.

However, since the MP2010 Ultimate Capacity ANEF was prepared, AS2021 was updated (in 2015) and now recognises that the 20 ANEF and 25 ANEF zones do not capture all high noise affected areas around an airport, and the ANEF contours are not necessarily an indicator of the full spread of noise impacts, particularly for residents newly exposed to aircraft noise. The National Airports Safeguarding Framework Guideline A *Measures for Managing Impacts of Aircraft Noise* (NASF Guideline A – attached at [Appendix B](#)) adopts a range of noise measures and tool in conjunction with the ANEF system. These include Number Above (N) noise metrics which in Australia are typically calculated at the 60, 65 and 70 dB(A) levels. These are also presented on [Figure 5](#) through [Figure 7](#) at the thresholds which have been quantified by the National Airports Safeguarding Advisory Group (NASAG) as described in the Attachment to NASF Guideline A, for an average 24-hour period.

Figure 5: ANEC1 Flight Tracks and Noise Contours

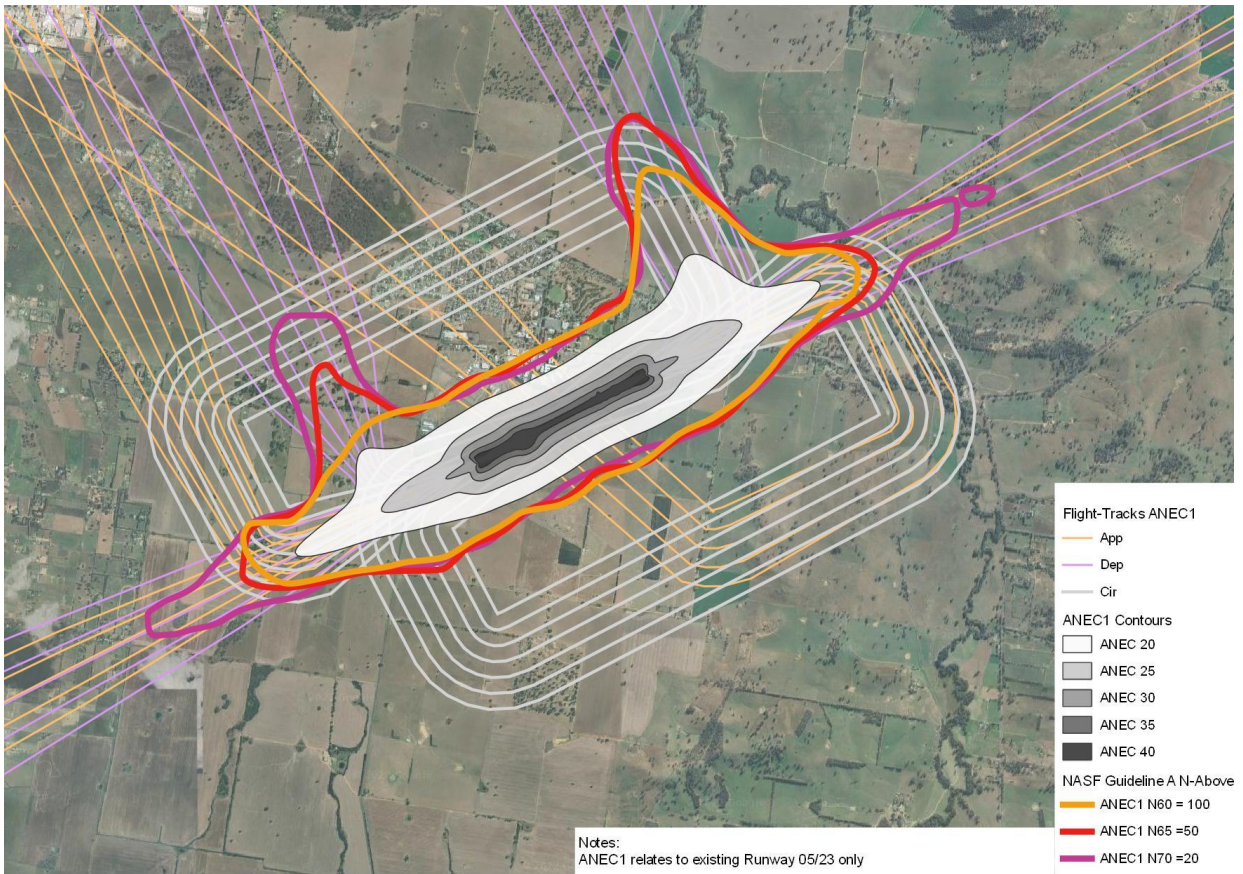


Figure 6: ANEC2 Flight Tracks and Noise Contours

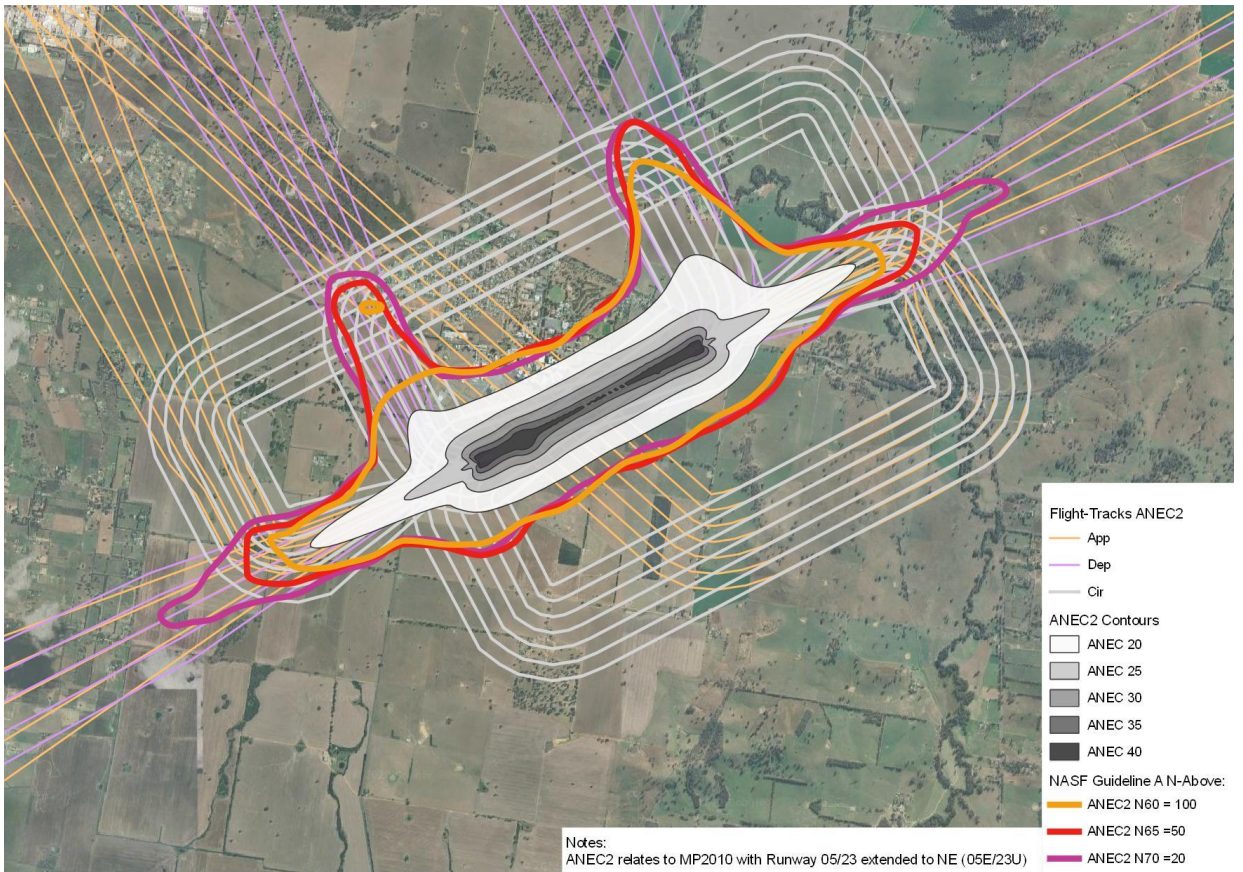


Figure 7: ANEC3 Flight Tracks and Noise Contours

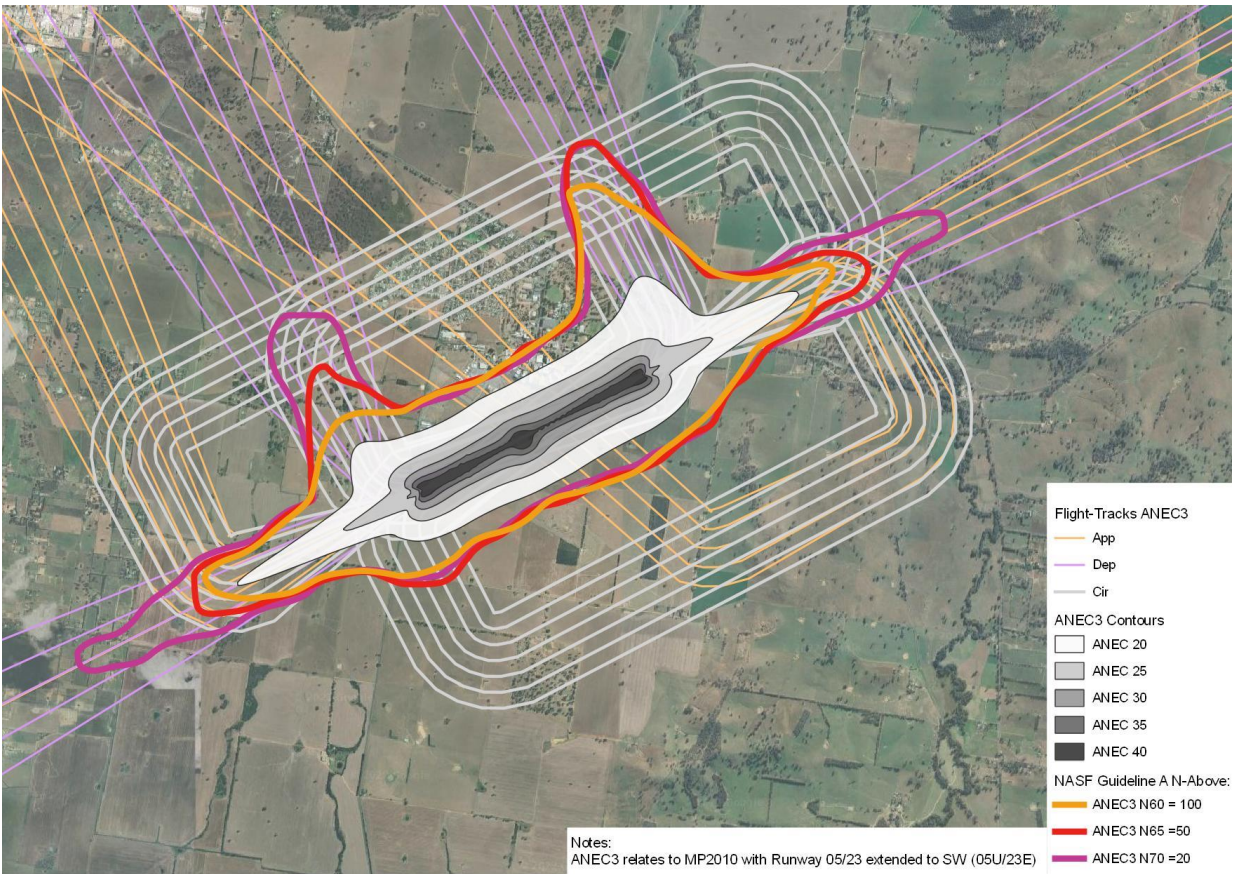
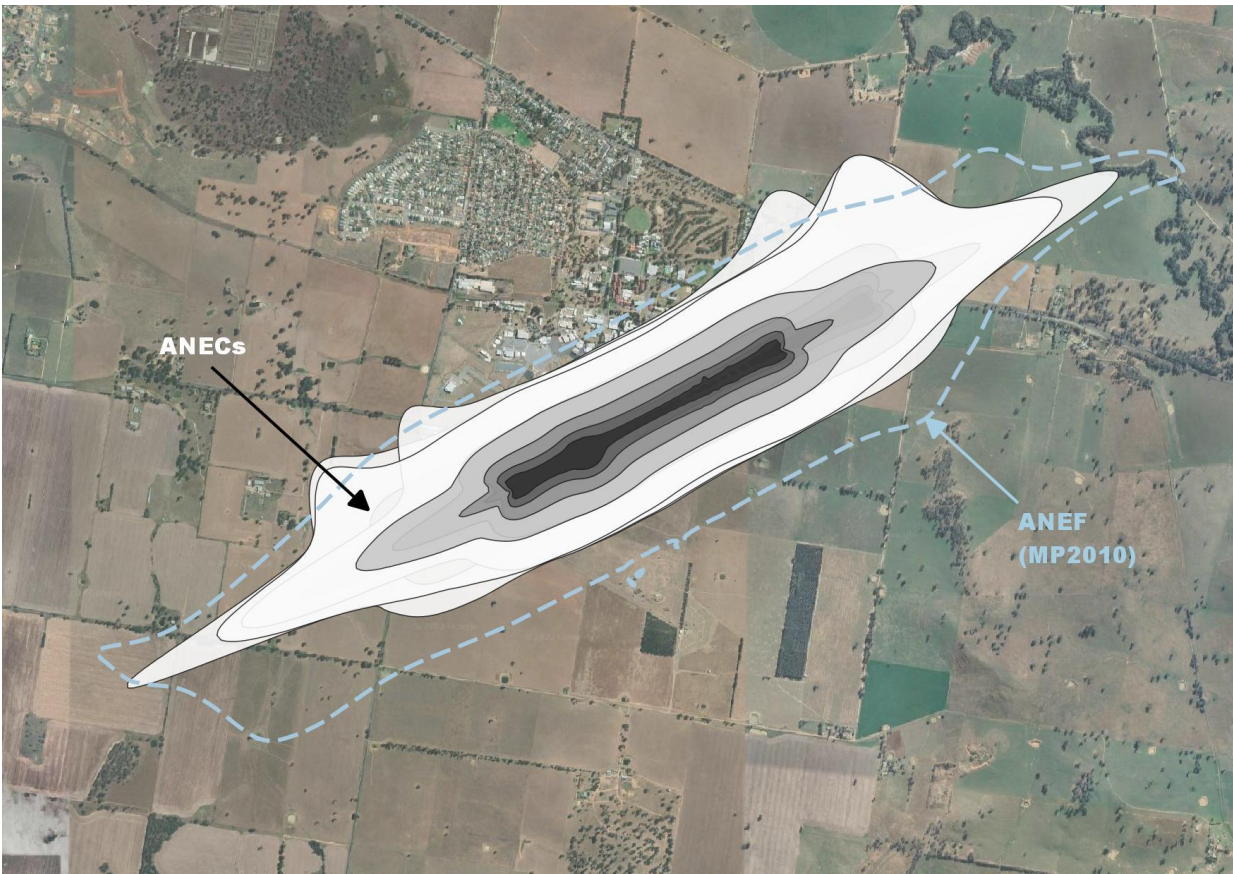


Figure 8: Existing ANEF vs ANECs Comparison



7. LIMITATIONS

The ANEC and N-above noise contours for this review have been generated using the FAA's Integrated Noise Model (INM) software version 7.0d, for consistency and comparison with the endorsed ANEF prepared in 2010. While suitable to identify areas which can be expected to be subject to high levels of aircraft noise under the identified additional scenarios, it should be noted that the use of INM is no longer accepted by Airservices Australia for technical endorsement of ANEFs. ANEFs for technical endorsement now need to be prepared in the FAA's Aviation Environmental Design Tool (AEDT) version 3e.

Noise contours calculated in AEDT are generally similar to those produced by INM, for the same input assumptions. However due to differences in the calculation methods the extent of some contours can vary slightly between the two models.

In addition to the modelling software used, aircraft noise contours can be affected by a number of input assumptions, including the ambient atmospheric conditions selected.

8. FURTHER WORK

Council could consider updating the current endorsed ANEF to include the additional scenarios in a 'composite' contour. Further refinement of the modelling (including conversion to AEDT) would likely be required to achieve technical endorsement by Airservices Australia and this may adjust the contours.

The process of obtaining endorsement would require considerable effort, including obtaining full stakeholder review and agreement to all modelling inputs. The process is likely to take around six months. As there can only be one ANEF published at any time for an airport, Council should consider whether this work is worthwhile pending expected update of the Airport Master Plan.

APPENDIX A: MP2010 ANEF VS ANEC FORECAST COMPARISON

MP2010 ANEF					REVISED ANEC FORECASTS								
Category			Mvmts	% of Total	Category			Mvmts	% of Total				
RPT			10,920	3.1%	RPT			11,336	6.0%				
Civil Aviation Training	146,273	41.6%	Touch-and-Go	89,120	25.3%	Airline Training Academy	112,771	59.4%	Touch-and-Go	58,641	30.9%		
			Other Movements	57,153	16.3%				Other Movements	54,130	28.5%		
General Aviation	16,067	4.6%	Touch-and-Go	2,383	0.7%	Local Flight Training School	20,500	10.8%	54,775	28.8%	Touch-and-Go	15,624	8.2%
						Itinerant Flight Training	5,958	3.1%					
						Private Flying	6,809	3.6%					
			Other Movements	13,693	3.9%	Charter / Executive	6,961	3.5%			Other Movements	39,151	20.6%
						MRO	9,554	5.0%					
						Emergency Services	5,263	2.8%					
Military			780	0.2%	Military			90	0.0%				
Military Training	175,530	49.9%	Touch-and-Go	68,087	19.4%	Military Training	7,518	4.0%	Touch-and-Go	0	0%		
			Other Movements	107,443	30.6%				Other Movements	7,518	4.0%		
Helicopters	1,993	0.6%	Civil Helicopter	1,503	0.4%	Helicopters	3,508	1.8%	Civil Helicopter	3,508	1.8%		
			Military Helicopter Training	490	0.1%				Military Helicopter Training	See Note 1.			
Total	351,572		Touch-and-Go	159,590	45.4%	Total	190,000		Touch-and-Go	74,265	39.1%		
			Other Movements	191,982	54.6%				Other Movements	115,733	60.9%		

- Three (3) blocks of six (6) weeks training are assumed to occur, based on current training patterns, which exceed that assumed in the MP2010. The training will affect use of the Runway 23 circuit direction and has been accounted for in the fixed-wing circuit track allocations. The helicopter training itself has not been modelled in the ANEC.

APPENDIX B: NASF GUIDELINE A

Measures for Managing Impacts of Aircraft Noise

(Note: The latest version of all National Airports Safeguarding Framework guidelines can be found here:

<https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/aviation-safety/aviation-environmental-issues/national-airports-safeguarding-framework/national-airports-safeguarding-framework-principles-and-guidelines>

NATIONAL AIRPORTS SAFEGUARDING FRAMEWORK

MEASURES FOR MANAGING IMPACTS OF AIRCRAFT NOISE

REVISION DATE	VERSION NUMBER	CHANGES MADE	APPROVED BY
Feb 2012	1.1.1	Document Creation	NASAG
Apr 2012	1.1.2	Drafting changes post consultation process	SCOTI
15/7/12	1.1.3	Version control table added.	S. Stone, GM Aviation Environment, DOIT.
November 2016	1.2	Update following completion of AS2021 Review	NASAG/TIC

Purpose of guideline

1. This document provides guidance to Commonwealth, State, Territory and Local Government decision makers to manage the impacts of noise around airports including assessing the suitability of developments.

The document has been developed through the National Airports Safeguarding Advisory Group (NASAG). Why it is important

2. The *Principles for a National Airports Safeguarding Framework* acknowledge the importance of airports to national, state, territory and local economics, transport networks and social capital.
3. Over the long term inappropriate development around airports can result in unnecessary constraints on airport operations and negative impacts on community amenity. These impacts need to be managed in a balanced and transparent way.
4. The established Australian Noise Exposure Forecast (ANEF) System and the Australian Standard AS 2021-2015 *Acoustics – Aircraft Noise Intrusion – Building Siting and Construction* (AS2021) have been recognised by a number of jurisdictions in their land use planning regimes. However, AS2021 recognises that the 20 ANEF and 25 ANEF zones do not capture all high noise affected areas around an airport, and the ANEF contours are not necessarily an indicator of the full spread of noise impacts, particularly for residents newly exposed to aircraft noise.
5. Governments recognise the merits of utilising a range of noise measures and tools in conjunction with the ANEF system to better inform strategic planning and to provide more comprehensive and understandable information on aircraft noise for communities. A brief

overview of other aircraft noise measures and tools for the purposes of public communication is provided in the [Attachment](#).

6. Standards Australia has also developed a handbook (*Acoustics – Guidance on producing information on aircraft noise*) to provide assistance on the preparation of information to describe aircraft noise to the public. Making such information available to the public can assist the individual in making their own decision on what is an acceptable level of aircraft noise in their circumstances.

Roles and responsibilities

7. State/Territory and Local Governments are primarily responsible for land use planning.
8. The Australian Government is responsible for planning control at federally leased airports administered under the *Airports Act 1996* (the Airports Act) and Defence airports under the *Defence Act 1903*. Planning on other airports is undertaken by State, Territory Governments and Local Governments or private operators.
9. Airport lease holders under the Airports Act have the responsibility of publishing as part of the five-yearly Master Plans, endorsed Aircraft Noise Exposure Forecast (ANEF) information. These ANEFs may be standard (up to 20 years) long range (20 year +) or ultimate capacity. The preference for land use planning purposes is to use ultimate capacity or long range forecasts.
10. The Department of Defence prepares ANEFs and related noise information for Defence operated airports and contributes to the ANEF development for joint user airports.

How it should be used

11. Some States/Territories already have planning guidelines or policies in place and this document provides guidance for any reviews of those documents. For those without policies in place, these Guidelines (in addition to the associated Safeguarding Framework) will provide guidance for new policies.
12. In preparing new local or regional Strategic Plans, existing airports should be clearly identified and noise modelling reports made available by the airport owners/operators. The modelling reports will allow the guidelines on noise sensitive developments to be applied in the vicinity of the relevant airports.
13. There is a need to treat future development and existing development differently. Where there is no *major* existing or approved development, there is scope to plan ahead to take account of potential noise disturbance and in particular to minimise the zoning of noise-exposed land for residential development. There may be less scope to avoid noise issues in situations of urban consolidation and infill or redevelopment of brownfield areas, but consideration should be given to the appropriate nature of that development and the balance of public interest. It is recognised that most State and Territory Governments have targets or policies that need to be met to achieve housing and employment area supply.

14. It is recognised that the pattern of flying at military airfield might not readily lend itself to the same suite of frequency based noise measurements. This is because military jets exhibit a pattern of lower frequency but higher individual noise events that may require different measures, such as N80s. These airfields might continue to rely more heavily on the ANEF.
15. This document gives guidance to planning officials when considering the following scenarios:
 - i. rezoning of greenfield areas for noise sensitive uses¹ (i.e. areas that are predominantly rural or non-urban, including specifically identified urban boundary areas around airport sites);
 - ii. rezoning of brown-field areas for noise sensitive uses (i.e. areas that are predominantly urban where changes of land use from industrial, commercial or low-density residential are being considered); and
 - iii. assessment of new developments applications for noise sensitive uses within existing residential areas.

I. Rezoning of greenfield areas to permit noise sensitive uses

16. This section applies where the introduction of new noise-sensitive uses is under consideration in areas that are predominantly rural or non-urban, including specifically identified urban boundary areas. This section does not apply to existing urban areas which have been developed.
17. It is important that consideration be given to the application of the following approach to land use planning:
 - i. no new designations or zoning changes that would provide for noise sensitive developments within a 20 ANEF where that land was previously rural or for non urban purposes (in keeping with AS2021).
 - ii. Zoning for noise-sensitive development be avoided where ultimate capacity or long range noise modelling for the airport indicates either:
 - 20 or more daily events greater than 70 dB(A);
 - 50 or more daily events of greater than 65 dB(A); or
 - 100 events or more daily events of greater than 60 dB(A).
 - iii. Zoning for noise-sensitive development should take into account likely night time movements and their impact on residents' sleeping patterns. For example, where there are more than 6 events predicted between the hours of 11pm to 6am which create a 60 dB(A) or greater noise impact, measures for aircraft noise amelioration and restriction on noise sensitive development may be appropriate.
18. The above approach could be used as additional guidance by strategic planners and weighed along with other relevant strategic considerations.

¹ Noise sensitive uses are residential, education establishments, offices, hospitals, aged care, churches, religious activities, theatres, cinemas, recording studios, court houses, libraries and galleries as specified as a 'noise sensitive developments' in AS2021 (see table 2.1 and 3.3)

II. Rezoning of brownfield areas to permit noise sensitive uses

19. This section applies to urban land that is currently primarily designated for non-noise sensitive uses and is being considered for rezoning, for example, for residential infill or increasing residential densities, such as within a mixed use precinct near a transport corridor.
20. In some instances, areas identified for urban consolidation can also be subject to aircraft noise impacts. In these circumstances, there is a need to balance the need to provide housing, economic growth and strategic planning outcomes against the operational needs of the airports. This approach may identify some adversely impacted parties and it can also identify where benefits outweigh the overall disadvantages.
21. Whilst it would not be appropriate to allow for development that would impact on the operational safety of an airport, there may be circumstances where increasing settlement in existing areas exposed to a significant degree of aircraft noise, would be acceptable given other benefits the site has to offer.
22. Consideration should be given to measures to manage the implications. This could include conditions that require development to be undertaken in a manner that physically reduces noise impacts (e.g. through appropriate construction techniques) and requirements for disclosure processes that ensure future residents are made aware of these impacts prior to purchase.
23. In some circumstances, redevelopment of areas already exposed to aircraft noise can result in a better outcome through better design and construction responses.
24. In locations considered 'marginal' in terms of exposure to aircraft noise, a case-by-case assessment of development proposals could be used.
25. Other relevant aircraft noise information tools (see paragraphs 17 and 29) are available to assist in informing these rezoning considerations.

III. Assessment of new developments applications for noise sensitive uses within existing residential areas

26. This section applies to urban land that is already designated for noise sensitive uses, primarily residential areas where development pre-dates the significant growth of airport traffic experienced following the introduction of jet aircraft in the late 1950s.
27. Whilst it would not be appropriate to allow for development that would impact on the operational safety of an airport, increasing densities or new developments in existing areas exposed to aircraft noise may be acceptable where the site provides other desirable outcomes such as providing housing near transport or meeting urban consolidation targets. In some circumstances, redevelopment of sites already exposed to aircraft noise can result in a better outcome through better design and construction responses.
28. Such development should be undertaken in a manner that physically reduces noise impacts (e.g. through appropriate construction techniques and adherence to AS2021) but also through a disclosure process that ensures future residents are aware of these impacts prior to purchase.

29. Commonwealth, State, Territory, Local Governments and airport operators should support effective disclosure of aircraft noise to prospective residents. This should be considered as broadly as possible but required where ultimate capacity noise modelling for the airport indicates either:

- the area is within the 20 ANEF;
- 20 or more daily events greater than 70 dB(A);
- 50 or more daily events of greater than 65 dB(A);
- 100 events or more daily events of greater than 60 dB(A); or
- 6 or more events of greater than 60 dB(A) between the hours of 11pm and 6 am.

Measures for Airports without an ANEF

30. An ANEF may not be available at all general aviation airports or airports with low frequencies of scheduled flights. Whether or not an ANEF is prepared for these airports, land use planning should take account of flight paths, the nature of activity on airports and/or 'number above' contours if available.

31. A zone of influence around airports could be taken into account, depending on the amount of traffic at the airport. The following zones are approximations and should be used as guidelines only:

- Within 15 km of an international airport, major domestic airport, or major military aerodrome.
- Within 10 km of a domestic airport with regular scheduled public transport services.
- Within 5 km of any other type of aerodrome for which an ANEF chart is unavailable.

32. The approach in paragraph 17 could also be considered as appropriate for use at these airports.

SUPPLEMENTARY AIRCRAFT NOISE METRICS

REVISION DATE	VERSION NUMBER	CHANGES MADE	APPROVED BY
April 2012	1.2.1	Document Creation	SCOTI
15/7/12	1.2.2	Version control table added. Page numbers added.	S. Stone, GM Aviation Environment, DOIT.
November 2016	1.3	Update following completion of AS2021 Review	NASAG/TIC

Background

Over the past three decades the Australian Noise Exposure Forecast (ANEF) system has been used as the primary measure of aircraft noise exposure in the vicinity of airports. The ANEF has been used in four key ways. It has been used to delineate where and what type of development can take place around airports; to determine which buildings have been eligible for insulation around Sydney and Adelaide airports; for technical assessments of airport operating options in Environmental Impact Statement (EIS) processes; and as a tool for providing information to the public on noise exposure patterns around airports.

Experience has shown a range of problems with relying solely on the ANEF as a noise information tool as there are limitations in using the ANEF to describe aircraft noise exposure to laypeople.

While the populations with the highest aircraft noise exposure often live within the 20 ANEF contour, experience shows the majority of noise complaints that are received come from residents living outside the 20 ANEF contour. Traditionally the residents of these areas have been given little information on aircraft noise through the ANEF system other than that the area is considered 'acceptable' for housing. Some people living outside the 20 ANEF contour have been given an expectation of receiving little or indeed no aircraft noise and as a consequence find the levels of noise actually experienced to be unacceptable.

It is not recommended that the ANEF system be replaced as a planning tool. The ANEF system is a well-established and technically complete means of portraying aircraft noise exposure. However, land use planning could be improved through recognition that aircraft noise does not suddenly stop at the 20 ANEF contour.

It is likely that no single standard will be appropriate for all airports but the concepts that follow can readily be adapted to meet local conditions. In particular, there is a need to improve the information used for assessment of proposed noise-sensitive development where residents will be newly exposed to aircraft noise. There is also a need to recognise the particular sensitivities of night-time noise in circumstances where neighbouring residents are not protected by airport curfews. There is a range of research pointing to the negative health impacts of sleep disturbance and the ANEF gives only limited recognition to the impact of night-time aircraft noise.

Why the ANEF?

In 1982, the National Acoustic Laboratories released a major study, *Aircraft Noise in Australia: A Survey of Community Reaction* (the NAL Study), regarding the impacts of aircraft noise on residential communities in Australia. The results were subsequently used in framing relevant Australian Standards and land use planning controls around Australia's airports.

The NAL study was a survey of 3,575 residents around the commercial airports in Sydney, Adelaide, Perth and Melbourne and the Richmond Air Force Base. From responses to a questionnaire, subjective reaction to aircraft noise was measured and correlated with existing and potential objective measures of aircraft noise.

Analysis of the survey showed that the best correlation between community reaction was achieved using a modified version of the existing Noise Exposure Forecast (NEF) which measures average daily sound pressure levels from aircraft. Attitudes towards the aviation industry, personal sensitivity to noise, and fear of aircraft crashing were found to be important in modifying the extent to which a person would be affected by aircraft noise.

The study recommended the methodology establishing the ANEF and suggested that an ANEF value of 20 could be regarded as an 'excessive' amount of aircraft noise. This value has subsequently been enshrined in planning systems and in the relevant *Australian Standard AS 2021-2015 Acoustics – Aircraft noise intrusion – Building siting and construction* as a boundary, beyond which it is acceptable to site noise sensitive land uses such as residential properties.

AS 2021 states 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 and terrain conditions on noise propagation. For that reason, the 20 ANEF contour is shown as a broken line on ANEF plans.

How is the ANEF derived?

The ANEF system is a measure of the aircraft noise exposure levels around aerodromes. It is based on average daily sound pressure levels, which are measured in decibels. Noise exposure levels are calculated in ANEF units, which take into account the following factors of aircraft noise:

- 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);
- the forecast frequency of aircraft types and movements on the various flight paths, including flight paths used for circuit training; and
- 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). Night time movements are represented with a 6 decibel adjustment in the ANEF calculation.

Decibels are a logarithmic unit. This is because the human ear is relatively insensitive to changes in sound pressure level and the decibel scale more helpfully reflects human reaction to sound. So, for example, a 70 decibel sound pressure level represents a ten-fold increase in sound energy compared to a 60 decibel event, but it will be perceived by the human ear to be only about twice as loud.

The following table¹ represents sound levels of a range of common events.

Noise Level dB(A)	Description
120	Threshold of pain
95	Pneumatic drill (un-silenced at 7m distance)
83	Heavy diesel lorry (40 km/h at 7m distance)
81	Modern twin-engine jet (at take-off at 152m distance)
70	Passenger car (60 km/h at 7m distance)
60	Office environment
50	Ordinary conversation
40	Library reading room
35	Quiet bedroom
0	Threshold of hearing

The ANEF measures total noise dose energy so, for example, a 70 decibel aircraft noise event will make the same contribution on the ANEF as 10 sixty decibel events while an 80 decibel event will make the same contribution on the ANEF as 100 sixty decibel events.

There are three different types of aircraft noise contour charts produced using the ANEF system. All three types of charts are prepared using the same computational procedures. The differences arise from the types of data which have been input to produce the maps. The noise exposure contours for each type of map are expressed in increments of five from 15 through to 40 (the higher the ANEF value the greater the forecast noise exposure).

The three categories of ANEF that may be used in an airport master plan under the *Airports Act 1996* are:

Standard ANEF (5-20 years) - this is a forecast of expected aviation noise exposure levels during a specified period of 5-20 years. A standard ANEF includes a forecast of aircraft movement numbers and operating times, aircraft types, flight paths and anticipated use of runways at the aerodrome.

Long Range ANEF (20+ years) - This is a forecast of expected aviation noise exposure levels for a specified period greater than 20 years. Forecasts have regard to present and anticipated future trends and may take account of predicted future aircraft types, movement numbers, flight paths and any changes to runway configurations that are expected to occur within the projected period.

Inclusion of a long-range ANEF in a Master Plan is aimed at assisting the States and Territories with planning decisions around airports by identifying where future incompatible development might occur as a result of exposure to expected future levels of aircraft movements and flight paths.

¹ Source: Noise Mapping Northern Ireland http://www.noiseni.co.uk/index/glossary_of_noise_terms.htm

Ultimate Practical Capacity ANEF - This is a forecast of aviation noise exposure levels that are expected to exist when the airport is developed to its ultimate practical capacity. An estimated date of when the airport is expected to reach its ultimate practical capacity must be stated. Forecasts have regard to present and anticipated future trends and may take account of predicted future aircraft types, movement numbers, flight paths and runway configurations that are expected to occur at the point of the airports ultimate practical capacity.

Limitations of the ANEF

The 1982 NAL study was a landmark study in terms of measuring community reaction to aircraft noise. But experience over the last 30 years has highlighted some limitations to the study's methodology and conclusions that are important to consider.

Firstly, although the study concluded that the ANEF system provided the 'closest fit' in terms of describing the propensity for residents to feel negatively impacted by aircraft noise, the correlation is relatively weak. Only 13 per cent of people's reaction to aircraft noise was related to the objective measure of aircraft noise. Most of the remaining variation in response was explained by factors such as negative attitudes toward the aviation industry or government, fears of aircraft crashes and overall sensitivity to noise.

The NAL Study found that a slightly improved correlation could be achieved by combining the ANEF value with an N70 value (explained on pages 8 and 9), however the computing technology of the day made this calculation unacceptably complex. Major improvements in computing power and reduced costs have made this limitation less relevant today than it was in the early 1980s.

Secondly, the 20 ANEF threshold for acceptability of residential housing was not a conclusion of the NAL study. Rather, the study's authors suggested that an ANEF value of 20 might be regarded as representing an 'excessive' amount of aircraft noise. The study's authors added that questions related to noise regulation and land use planning around airports in Australia can be answered only by translating the present scientific assessment into a socio-political context.

Whether or not areas with this exposure are incompatible with residential zoning is another matter. As scientists, the authors are charged with describing community reaction to aircraft noise. The task of prescribing regulations and standards relating to land-use around airports properly belongs to legislative and planning authorities².

It is important to understand that the NAL study itself attached no particular significance to the 20 ANEF measure. At the 20 ANEF level, it is estimated that approximately 11 per cent of people will be seriously affected by aircraft noise and approximately 45 per cent of people moderately affected by aircraft noise. The figure on the page 5 also shows that at the 15 ANEF level, approximately 8 per cent of people will be seriously affected by aircraft noise and approximately 34 per cent of people moderately affected. The question of how many people should be subject to disturbing levels of aircraft noise through land use planning decisions clearly requires subjective judgements from land use planners as to what is an acceptable number of people expected to experience negative effects of aircraft noise, balanced against other relevant considerations.

AS 2021 makes this point and foreshadows use of additional noise tools for use in land use planning near airports:

Figure 1 shows the dose/response relationship between aircraft noise and community reaction derived from the NAL Report. This figure indicates that significant community reaction may occur for exposures below 20 ANEF. Experience has shown that newly exposed communities may exhibit a higher reaction than that suggested by the curves in [Figure 1]. ANEF values average noise exposure

² NAL Report, p154

over a year and do not take account of variations in noise exposure patterns to which the community reacts on an hourly, daily, weekly or seasonal basis. To address this issue, other parameters such as maximum noise levels and frequency of noise events may be included in noise assessments of airports to supplement ANEF levels³.

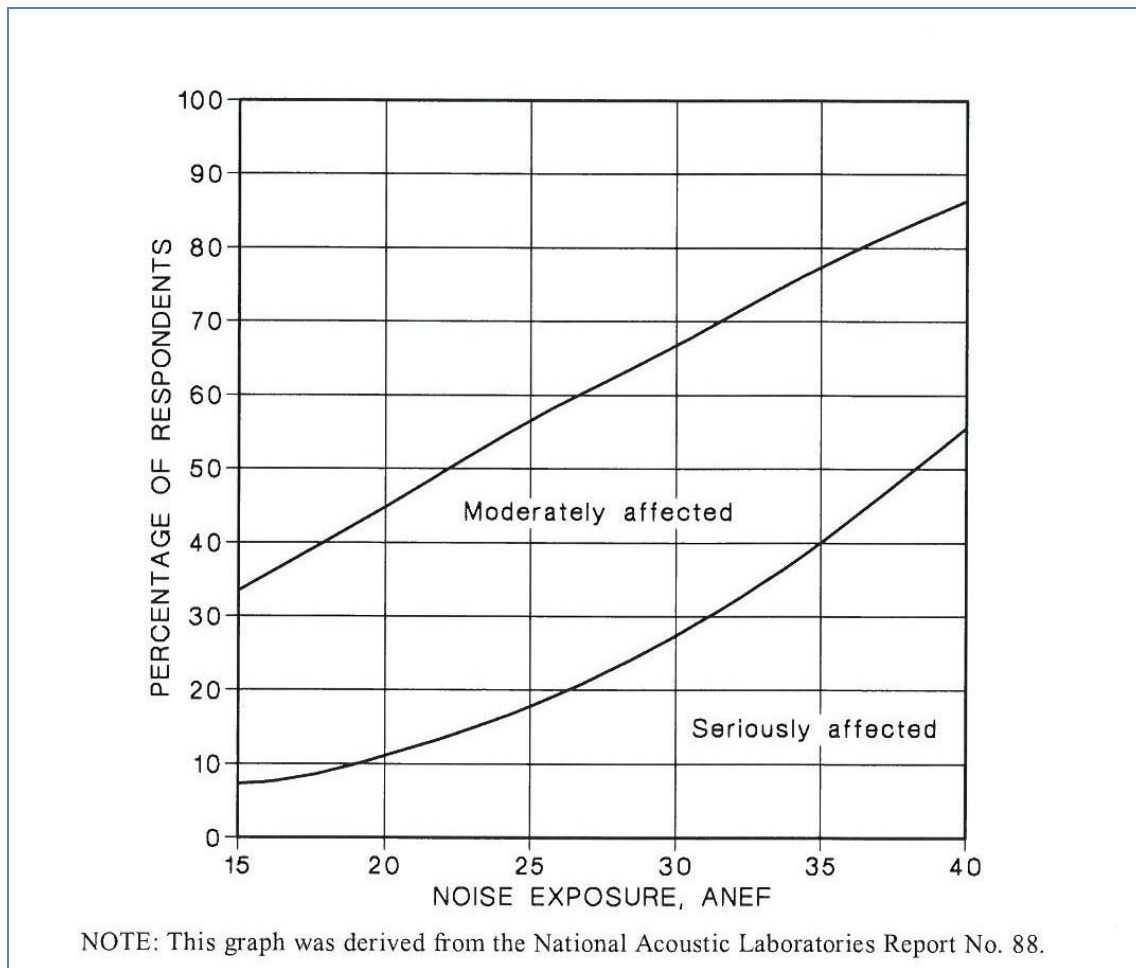


Figure 1: Reaction between noise exposure forecast level and community reaction in residential areas

There is evidence to suggest that an approach to measuring aircraft noise based on the number of aircraft movements may be appropriate as over time individual aircraft events have become quieter, but the frequency of movements has increased.

For example, a 2007 study into Attitudes to Noise from Aviation Sources in England⁴ compared average energy measures with frequency based measures of aircraft noise in two surveys from 1982 and 2005 respectively. The study found that in 1982, there was little relationship between annoyance and aircraft numbers, while in 2005, there was a strong relationship. This coincides with significant changes to both aircraft numbers, which have increased, and individual noise levels, which have decreased.

In Australia also, the mix of aircraft in the airline fleet is considerably different today than it was in 1980 (when the NAL survey was conducted). Modern aircraft are considerably quieter than aircraft of 30 years ago. At the same time, frequency has increased significantly. For example, in Sydney

³ AS2021-2015; Standards Australia, p 140

⁴ ANASE (Attitudes to Noise from Aviation Sources in England) – MVA Consultancy for the Department for Transport in association with John Bates Services, Ian Flindell and RPS, October 2007

there were 138,000 aircraft movements in 1985-86, growing to over 290,000 in 2010-11. The number of aircraft movements also doubled at Brisbane, Canberra, Melbourne and Perth over the same period.

The following sections detail a range of additional aircraft noise metrics that have been developed over the past 15-20 years, many within Australia, to better describe aircraft noise. These measures were first developed in response to the *Senate Select Committee on Aircraft Noise: Falling on Deaf Ears*, which investigated these issues following the opening of the third runway at Sydney Airport in 1994.

The paper concludes with some suggested nominal levels of frequency based aircraft noise measures which could be used by land use planners to action the AS 2021 recommendation to more comprehensively assess the potential impact of aircraft noise on future noise sensitive development.

Supplementary noise information measures

Following the opening of the third runway at Sydney Airport in December 1994, it was recognised that the ANEF, while a useful tool for land use planning, was deficient as a useful tool for describing information about aircraft noise to residents. **Figure 2** shows the poor correlation between the 20 ANEI⁵ contour and the aircraft noise complaints in the Sydney area. In fact, 90 per cent of the complaints at the time were found to have originated outside the 20 ANEI contour.

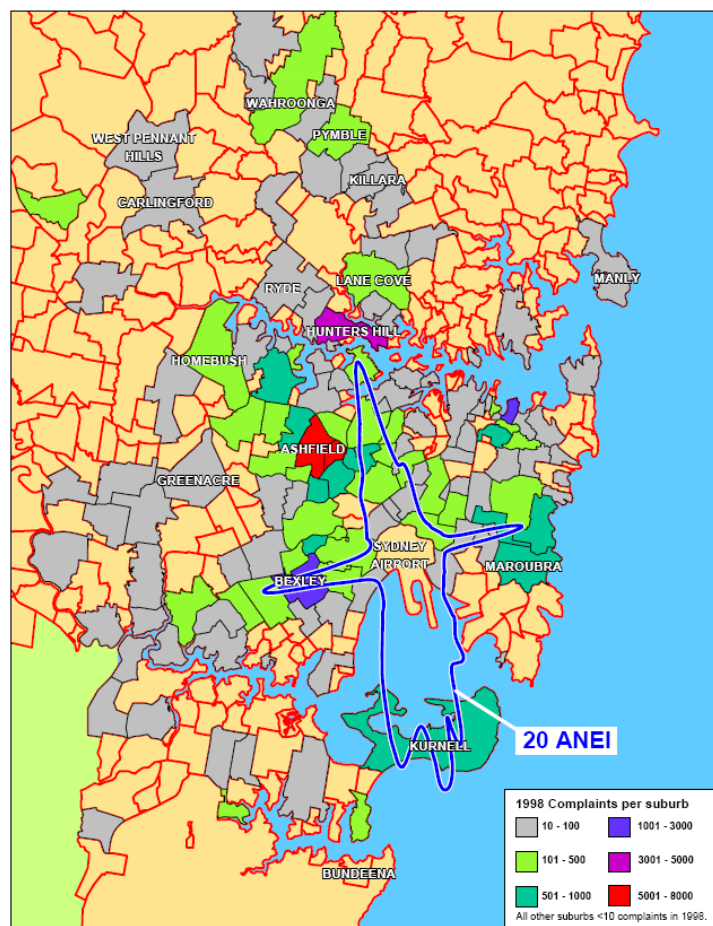


Figure 2: 1998 aircraft noise complaints vs 1998 20 ANEI contour

⁵ The ANEI measures actual historic daily average noise dose whereas the ANEF measures forecast daily average noise dose

One important piece of information frequently sought by members of the public when looking to purchase a house is often the location of the flight paths. The Australian Government Department of Infrastructure and Regional Development, Airservices Australia and many airports have developed the use of flight path information over the last 15 years to provide a more meaningful summary of aircraft flight movements. **Figure 3** illustrates this type of information for Sydney. However, this information is of limited use in land use planning decisions.

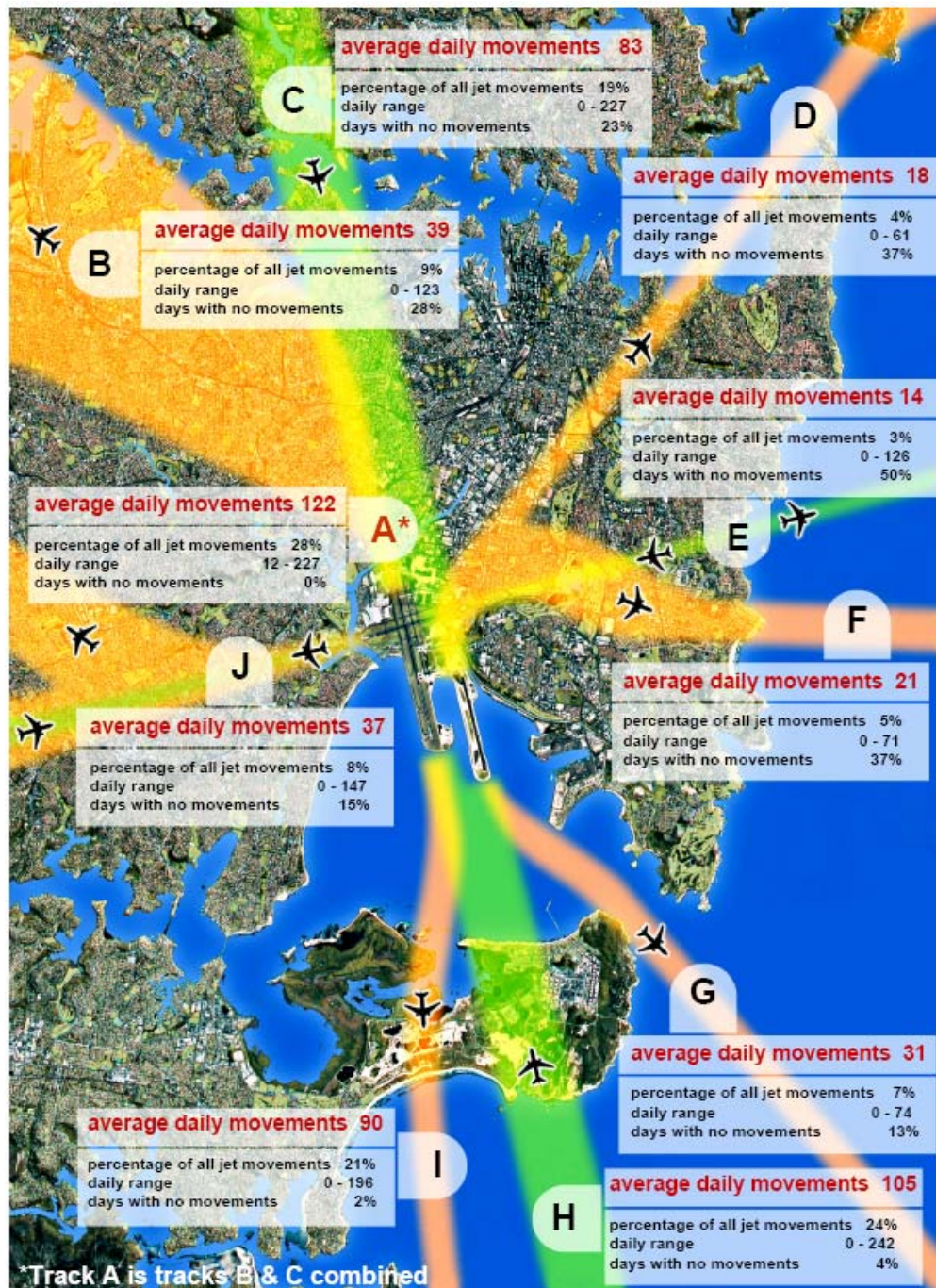


Figure 3: 1998 jet flight path movements – Sydney

While aircraft flight paths are a useful way of presenting information on aircraft activity, they do not include information on the actual noise level of flights. Another useful way of presenting the impact of aircraft noise is to show the noise level of individual flight movements through the use of single event noise contours. **Figure 4** shows an example of a single event contour for a Boeing 767–300 departing from Sydney Airport’s Runway 34R on a particular track. It is possible to give an indication of how many of these flights will occur in a typical day. However, it is also difficult to use the single event contour in a land use planning context as separate diagrams are needed for each aircraft type and each track.

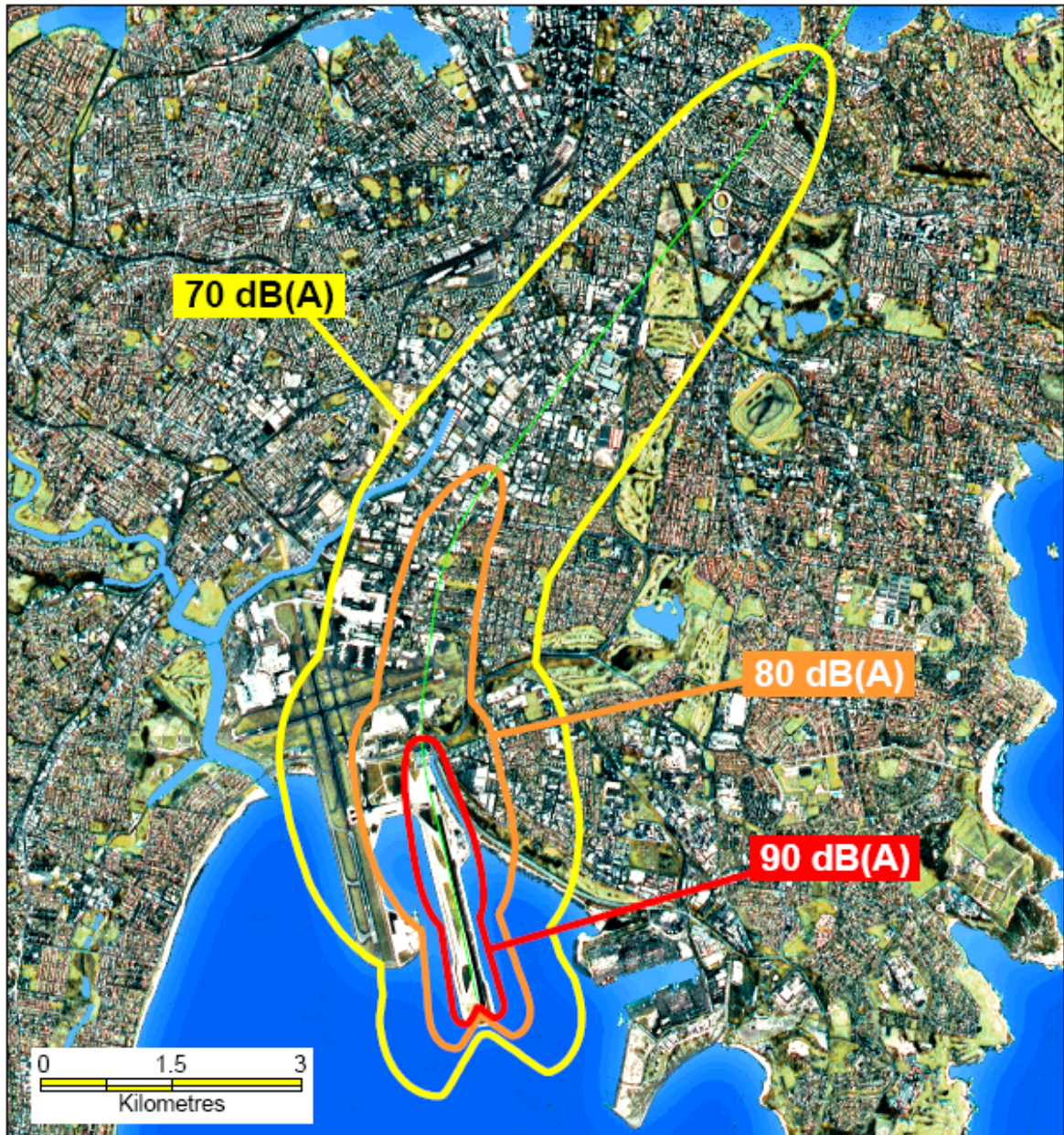


Figure 4: Single event contour

An approach that combines the information in a single event noise contour with the ability to consolidate this information into a description of high noise ‘zones’ is available. Information on the number of noise events is termed the ‘Number Above’ noise metric. In Australia, this is commonly called the N70 (or N65 or N60) where N70 is the number of aircraft noise events louder than 70 dB(A). Thus, residents can be informed in a way that is more intuitive, how many “noisy” events will be experienced within the illustrated zone. 70 dB(A) events have often been used to categorise an event as ‘noisy’ as these correspond to a 60 dB(A) noise level indoors, which can disturb conversation or other indoor activities such as watching television.

Figure 5 shows a typical day N70 contour for Sydney Airport in 1998.

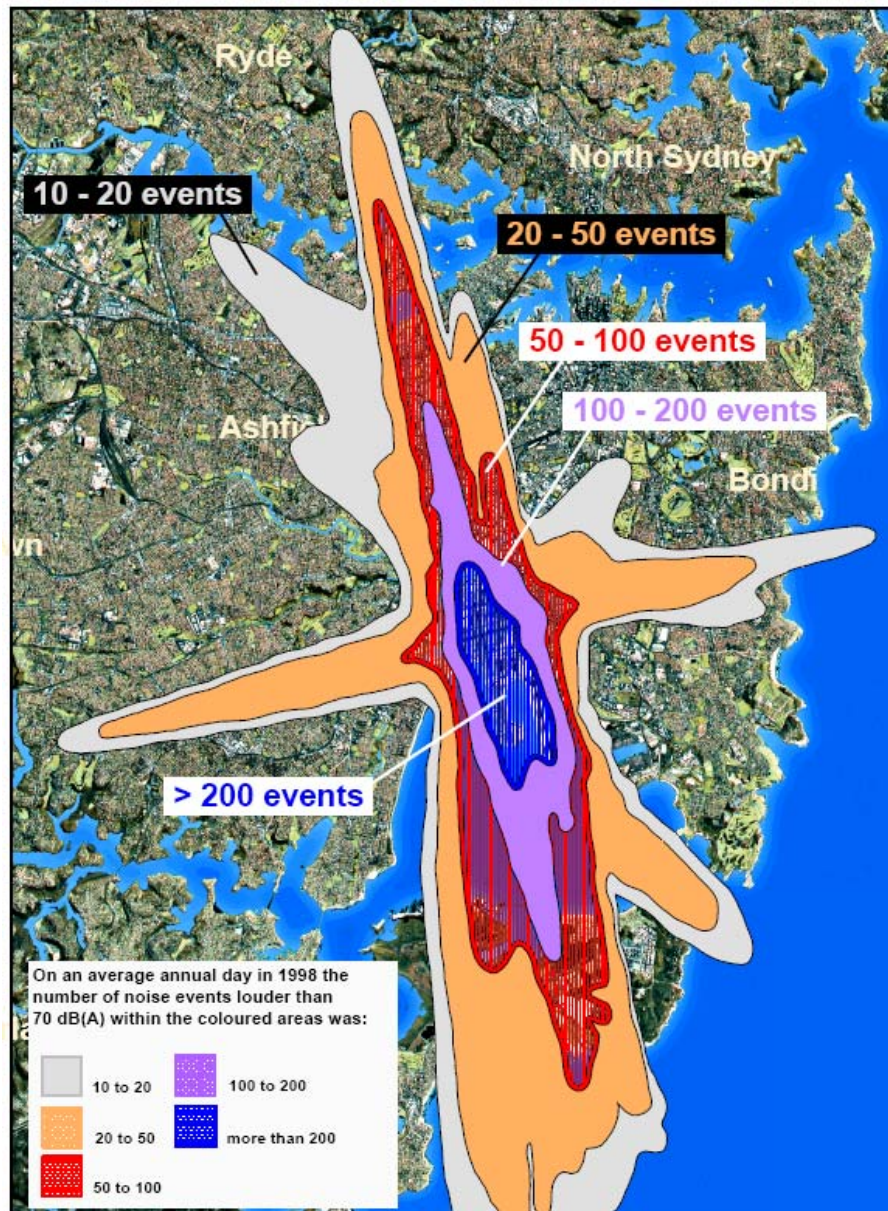


Figure 5: 1998 N70 – average day – Sydney

Case Study of the Applicability of this Concept at Brisbane

The ultimate capacity model from the 2009 Brisbane Airport Master has been used to model the effects of aircraft noise around the Brisbane Airport⁶. The model provides an illustration which complements the ANEF modelling. **Figures 6, 7, and 8** show respectively, the 20 event N70 contour, the 50 event N65 contour and the 100 event N60 contour for the average day when the airport reaches its ultimate operating capacity. These measures recognise the variability in individuals' sensitivity to noise events. In particular, residents who value an outdoor lifestyle or those sensitive to sleep disturbing night-time noise events, may find the N60 measure more relevant to their concerns. The blue baseline area in each map represents the 20 ANEF contour outside of which there are currently no land use planning controls.

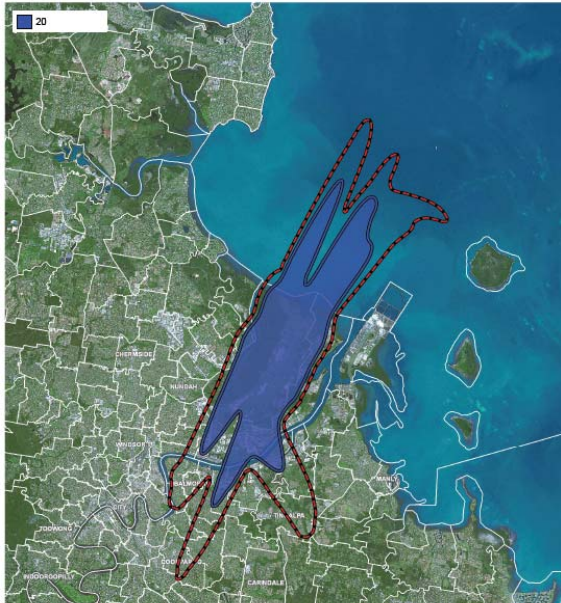


Figure 6: 20 event N70 – ultimate capacity - Brisbane

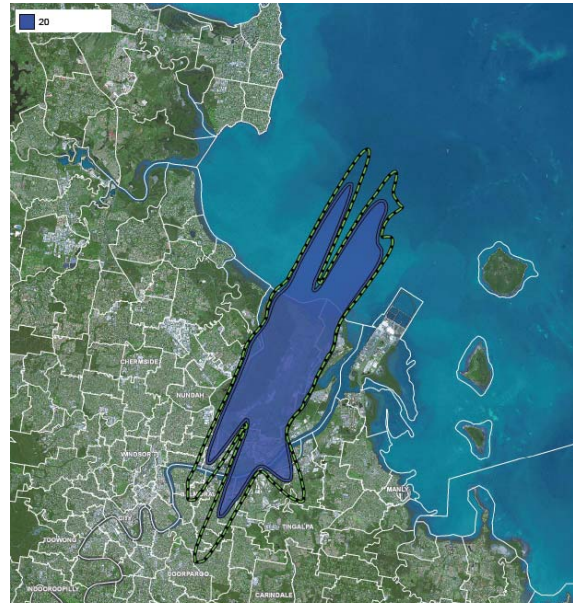


Figure 7: 50 event N65 – ultimate capacity - Brisbane

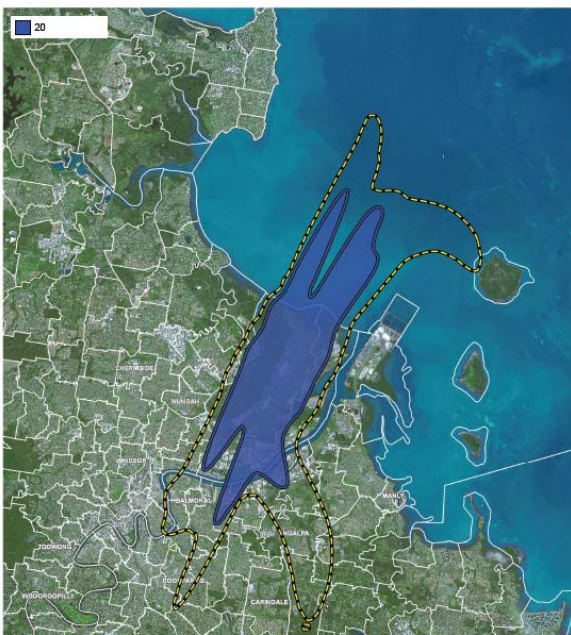


Figure 8: 100 event N60 – ultimate capacity - Brisbane

⁶ Modelling carried out by the then Australian Government Department of Infrastructure and Transport

Night Time Noise

The ANEF provides for weighting of night time noise events to take account of residents' increased sensitivity during evening and sleeping hours. Specifically, sound pressure levels are weighted by 6 dB(A) in the ANEF model for events between 7pm and 7am, effectively treating them as having four times the impact of daytime events. However, this can still under-represent the impact that a relatively small number of moderately noisy events can have during sleeping hours, as the ANEF describes cumulative noise dose rather than disturbance.

The night time (10pm to 6am) noise exposure patterns at Brisbane have been illustrated using N60 contours, at the 3, 6 and 12 event levels, as illustrated in **Figure 9**.

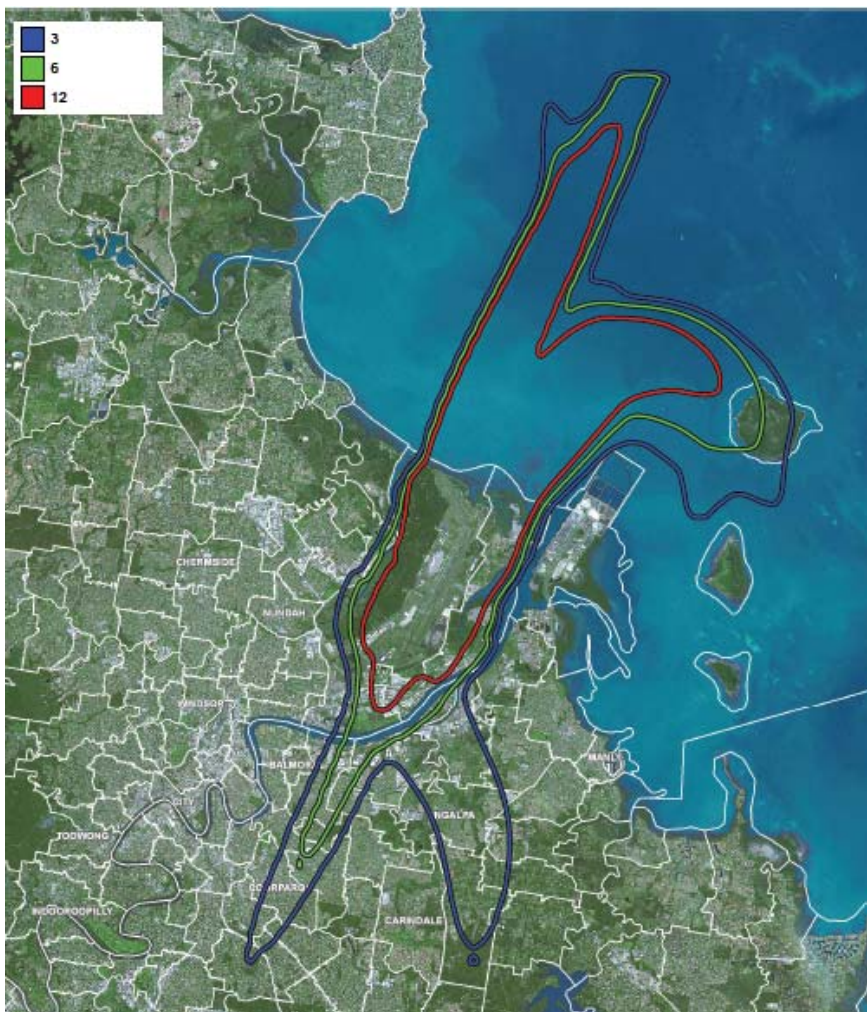


Figure 9: 3, 6 and 12 event N60s, 10pm – 6am – ultimate capacity – Brisbane

Why 20 x N70, 50 x N65, 100 x N60?

The National Airports Safeguarding Advisory Group (NASAG), comprising Commonwealth, State and Territory transport and planning officials, has overseen a process to quantify a range of frequency-based aircraft noise events that may be useful in future land use planning considerations. It has done this recognising that the ANEF has certain limitations and that the existing guidance under AS 2021 highlights the increased sensitivity for residents newly exposed to aircraft noise

Just as aircraft noise does not suddenly stop at the 20 ANEF level, there is no hard and fast line where aircraft noise suddenly changes from being acceptable to being unacceptable at the 20 x N70, 50 x N60 or 100 x N60 levels. Aircraft noise impacts follow a continuum and clearly, noise impacts close to, but outside an identified threshold will be almost indistinguishable to the impacts on the 'the other side of the line'.

Therefore, there is a need for land use planners to take a balanced view of land use planning decisions that recognises aircraft noise does not suddenly stop at a line on a map, no matter how that line has been derived.

That said, frequency based measures of aircraft noise offer an additional information tool for illustrating potential aircraft noise impacts. Different airports exhibit different patterns of activity, so three related parameters are suggested for consideration. Used together, these measures should allow a more comprehensive assessment of noise impacts at most airports.

The 70 decibel (N70) measure has been the most commonly used frequency based aircraft noise measure to date because a 70 decibel outside noise will generally be experienced as a 60 decibel event inside a residence with the windows open. Sixty decibels is the sound level that will disturb a normal conversation or activities such as watching television.

There is also a strong case to consider the impact of 60 decibel aircraft events as worthy of consideration as an additional measure. Firstly, AS 2021 identifies 50 decibels as the level above which noise can be considered intrusive when defining building insulation requirements under AS2021. This inside intrusion would generally be experienced by a 60 decibel outside noise. Secondly, around training airports where there is a high number of moderately noise events, the experience of many residents, evidenced through complaint data and community consultation, shows that there can be significant noise impacts from a high frequency of overflights in the 60 decibel range.

Thirdly, 60 decibels is likely to be more disturbing during sleeping hours. AS 2021 sets an acceptable standard of noise for sleeping areas of 50 decibels. This level of intrusion is likely to result from a 60 decibel outside event.

The 65 decibel threshold is used to present a more comprehensive picture of likely aircraft noise impacts. This recognises the subjectivity of individual responses to aircraft noise and the difficulty in predicting whether individuals will be more sensitive to a moderate frequency of relatively loud events (the N70 measure) or a high frequency of less noisy events (the N60 measure). The N65 is a compromise measure lying between these two levels.

NASAG recognises the valuable role the ANEF plays in assisting land use planners to form an assessment of aircraft noise impacts. But it has long been recognised, including in AS 2021 itself, that the system fails to deal with certain scenarios, particularly the increased sensitivities that residents are likely to experience when newly exposed to aircraft noise.

Use of the 70, 65 and 60 decibel contours allows a balanced and comprehensive view of the impacts residents are likely to experience from aircraft noise. These measures better reflect high-frequency flight paths and known areas of sensitivity at existing airports, and are more easily understood by potential residents and land use planners who are not noise experts.

NASAG also recognises it is not possible, nor desirable to unnecessarily restrict land uses close to airports. The quantum of events nominated for the N70, N65 and N60 event contours respectively, aligns broadly to known areas of sensitivity around existing airports and gives some basis for guidance for areas close to, but outside, existing 20 ANEF contours.

The guidance material also provides assistance for the assessment of impacts from night time aircraft noise events, where a relatively small number of moderately noisy events can cause significant sleep disturbance for residents.

Like the 20 ANEF, there is no 'magical line' at the 20xN70, 50xN65 or 100xN60 contours at which we suddenly see aircraft noise change from being unacceptable to acceptable. These contours represent areas within which land use planners should consider aircraft noise impacts, particularly for new noise-sensitive developments.