



**David Southgate, Director Sydney Environment, Airports
Federal Department of Transport and Regional Services, Australia**

Abstract

In 1994 strident public claims were made that Australia's noise contouring system – the Australian Noise Exposure Forecast (ANEF) System – had failed in predicting the noise exposure patterns from a new runway at Sydney Airport. These claims were essentially endorsed by the findings of a Senate Select Committee in 1995.


Subsequently, the Department released its Discussion Paper 'Expanding Ways to Describe and Assess Aircraft Noise' in March 2000 in an effort to encourage debate on finding better ways to describe aircraft noise exposure patterns to the public and decision makers.

In essence the Department is proposing that conventional equal energy noise contours only be retained for purposes where a 'line' based on community reaction needs to be drawn. For example, when defining eligibility areas in land use planning and insulation schemes.


*It is argued that targeting individual, not community, reaction is the key to successful aircraft noise information. For example, before making a house purchase, an individual needs to be given the type of information which lets them **form their own judgement** on whether the aircraft noise at a particular location is likely to be acceptable.*

This paper focuses on the N70 – it's evolution over recent years in Australia and ways it may be used in the future to increase understanding of aircraft noise exposure patterns.

RELATIONAL INDICATORS

 **Mimicking the way 'ordinary' people talk to each other**

- *flight paths*
- *numbers & times of movements*
- *persistence*
- *loudness of individual events*

 **Verification by the non expert**

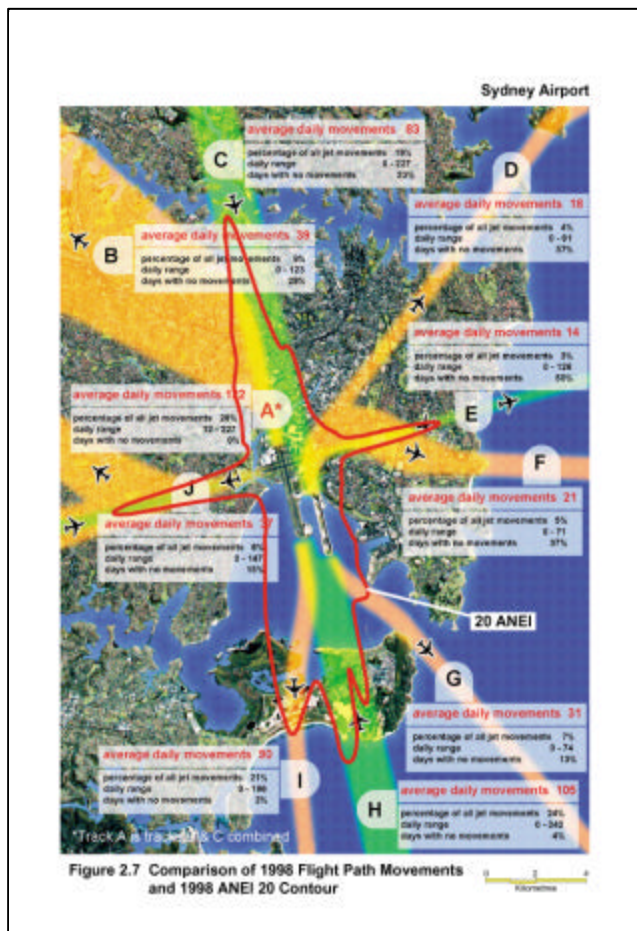
Underlying Principles

One of the fundamental principles of successful communication is 'listen and mimic'. Listen to the language your audience uses when its members discuss an issue amongst themselves and then try to talk with them in the same way.

When members of the public talk to each other, or make a complaint to airports and aviation authorities, about aircraft noise they generally talk in terms of flight paths, the numbers and times of aircraft movements, how long it has been since they have had a break from the noise and the loudness of particular individual events.

The Department has therefore attempted to develop descriptors which present information in this form. Feedback on these 'new' metrics, which we have termed 'relational' indicators, has strongly indicated that the layperson believes these give a much better 'picture' of an airport's noise exposure patterns than conventional equal energy noise contours.

In order to effectively communicate it is also important that the recipients of information can easily verify for themselves the veracity of what they are being told. The 'new' descriptors have clear advantages over conventional metrics in this area.



Forming the Mental Image

The slide above is the first of the Department's relational indicator products and shows a flight path movements chart for Sydney Airport for 1998. Superimposed on this is the ANEF contour for the same period. These represent two different ways of presenting the same information.

Feedback from a very varied audience has indicated that the flight path movements chart gives what they believe is a much more realistic mental 'picture' of the Airport's noise exposure patterns than the ANEF contour.

For many people an airport's noise exposure patterns are visualised as something like a hub (the airport) with radiating spokes (the flight paths). The noise contour does not easily fit with this image.

Given the positive reaction to the flight path movements chart, the Department has produced a second product – the respite chart – using essentially the same flight path image to report on 'breaks' in aircraft noise. Details on respite charts can be obtained from the Department's *Expanding Ways* Discussion Paper.

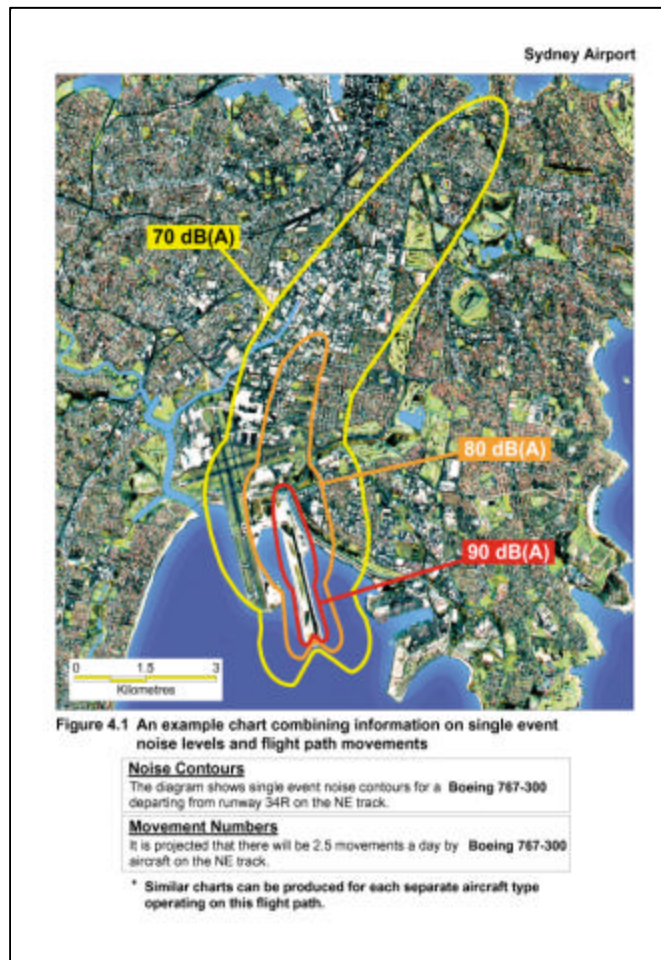


Single Event Contours – The First Step Toward the N70

For many people the flight path and aircraft movement data contained in the flight path movement and respite charts satisfies their aircraft noise information needs. Others are interested in supplementing this with sound pressure level data. However, they are virtually never interested in receiving logarithmically averaged noise data – they are looking for single event noise information.

Throughout the world single event noise contours are commonly included in environmental assessment and information reports. These contours are conventionally placed on a plain background to allow the user to compare the noise footprints of different aircraft types.

In drawing up a plan for re-arranging Sydney airspace in 1996 community representatives pressed for the contours to be overlaid on indicative flight paths so that the information could be given some geographical context. This led to the publication of single event flight path maps of the type shown in the slide above.



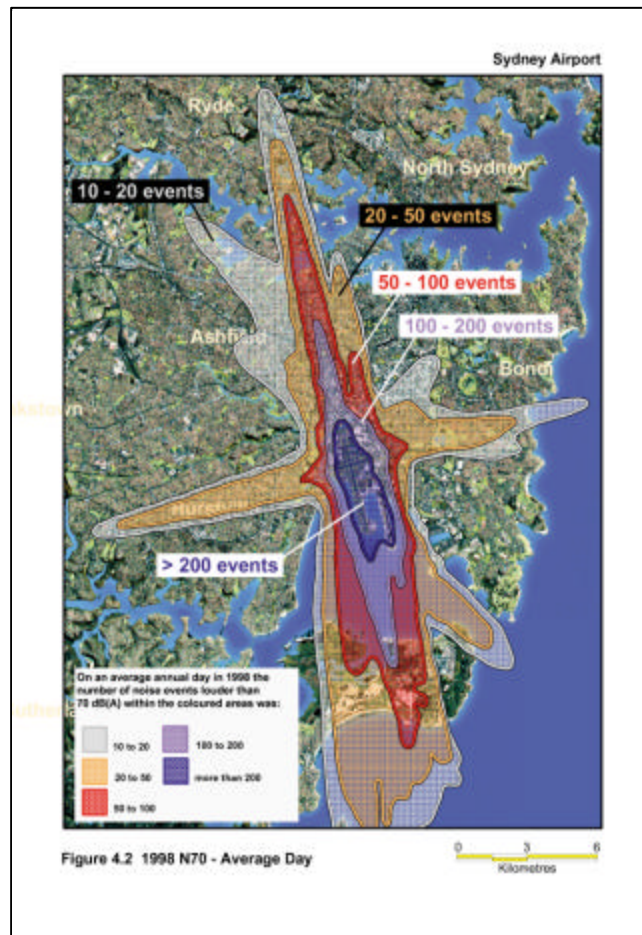
Incorporating Numbers of Movements

A key drawback of the type of presentation shown in the previous slide was that it gave no indication of the number of events on each of the flight paths.

During the process of consultation on the proposals for rearranging Sydney's airspace, a suite of five single event contour maps were prepared in the above format for one specific flight path in response to a request from an elected representative of an area to the north east of Sydney Airport. Each map separately showed single event 70, 80 & 90 dB(A) contours for the five particular aircraft types that it was proposed would use that flight path.

It can be seen that the box at the bottom of the map gives a figure for the projected number of daily movements for the aircraft type involved.

While this presentation proved very useful for one particular flight path it would have clearly been impractical to produce such information for every flight path at the Airport. The search for a way to provide aggregated information of this type led directly to N70 maps being produced.



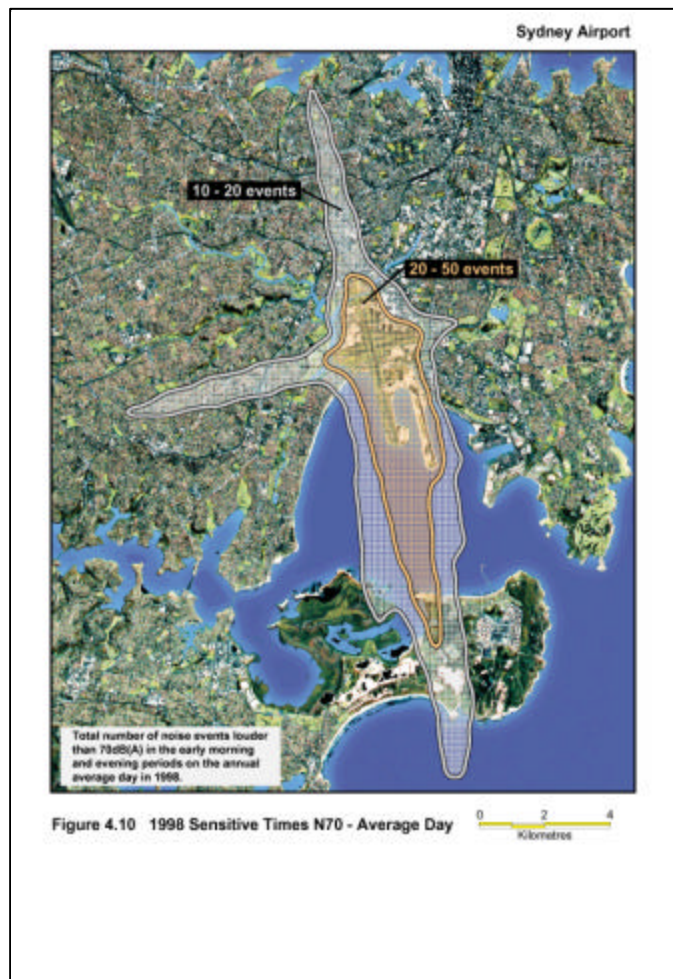
N70 Contour

The figure shows the number of events louder than 70dB(A) on the average day in 1998 at Sydney Airport. The trigger level of 70dB(A) is used as this equates to a noise event likely to disturb conversation and/or listening inside a house with open windows.

The main positive about the N70 is that it reports noise in a way that a person thinks and talks about aircraft noise - by the number of events. It is also an arithmetic contour rather than a logarithmic contour – all other things being equal the N70 will double if the number of movements on a particular flight path doubles.

The downsides of the N70 are that, like other noise contours, it can give the impression that there is no noise beyond the outer contour. It also shares the 'average day' weakness with conventional contours and it does not provide as good a mental image of the noise exposure patterns as flight path based data.

The Number Above metric can equally be used to generated contours for noise levels other than 70 dB(A). For example, preliminary work has indicated that for General Aviation airports, where the noise climate is predominated by very high numbers of movements by relatively quiet aircraft, the N60 gives a good representation of noise exposure patterns.



Beyond Average Day Contours

The N70 is particularly useful for showing noise exposure levels for short time periods. The contour above shows the number of events louder than 70 dB(A) during the noise sensitive early morning and evenings periods at Sydney Airport on the average day in 1998. It can be seen that this gives 'real' information on what occurred during those times.

Conventional metrics such as the DNL and the ANEF, which are essentially based on a 24 hr weighted day, do not lend themselves to an analysis based on partial days.

Similarly N70 contours produced for individual days give a very intelligible picture of the noise exposure patterns. Some examples of single day N70s are shown in the *Expanding Ways* Discussion Paper.

Another example of the versatility of the N70 is shown in Chapter 5 of the Discussion Paper under the title the 'Person-Events Index'. This is a tool based on the N70 which allows a simple and transparent analysis of the noise exposure patterns around an airport.

Comparison of modelled and measured N70's - Sydney Airport

Noise Monitoring Terminal (NMT) Location	1998 N70		Mode 10 N70		Mode 9 N70	
	INM	NMT	INM	NMT	INM	NMT
Bexley	45	41	<10	-	8	-
Penshurst	20	26	<10	1	<10	6
Sydenham	128	109	202	210	105	82
Leichhardt	90	85	190	200	39	35
St Peters	58	74	99	128	55	58
Annandale	27	46	45	88	24	9
Eastlakes	40	32	<10	-	45	17
Coogee	21	24	<10	-	<10	1
Botany	15	23	17	28	<10	5
La Perouse	<10	7	<10	4	<10	1
Kurnell	50	52	<10	3	90	70

1. INM - N70's modelled using the Integrated Noise Model
2. NMT - N70's measured at the Sydney Airport Noise Monitoring Terminals

Validation of N70 Contours

The Department computes its N70 contours indirectly by using INM to produce a detailed TA70 grid and then computing the number of non zero events. Concern has been expressed that since N70 is not produced directly by INM the contours are not validated.

These are understandable concerns and clearly until such time as rigorous validation studies are carried out N70 contours derived indirectly from TA information need to be treated with caution.

Irrespective of this, the table above shows that there is a reasonable correlation between measured and modelled N70s at Sydney Airport. Given that the N70 is a 'yes or no' type metric it is inevitable that there will be specific sites where there are significant differences between measured and modelled data (eg see the comparison at 'Annandale' in the table).

Sydney Airport : Permanent Noise Monitoring Terminals

Average number of events per day at and above 70 dB(A) from

1 July 2000 to 31 July 2000



Penhurst Morning: 4 Daytime: 10 Evening: 8 Weekend: 21	Bexley Morning: 8 Daytime: 11 Evening: 19 Weekend: 39	Eastlakes Morning: 3 Daytime: 43 Evening: 31 Weekend: 75	Coogee Morning: 1 Daytime: 31 Evening: 21 Weekend: 68
Sydenham Morning: 4 Daytime: 168 Evening: 12 Weekend: 148	Leichhardt Morning: 3 Daytime: 104 Evening: 5 Weekend: 81	Kumell Morning: 4 Daytime: 38 Evening: 5 Weekend: 77	Annandale Morning: 0.4 Daytime: 34 Evening: 1 Weekend: 39
	St Peters Morning: 1 Daytime: 67 Evening: 3 Weekend: 83	Botany Morning: 0.4 Daytime: 18 Evening: 0.4 Weekend: 18	

Morning: 06:00 to 07:00 on week days
Evening: 20:00 to 23:00 on week days

Daytime: 07:00 to 20:00 on week days
Weekend: 06:00 to 23:00 on weekends

Using N70s to Report Noise Monitoring

There are networks of noise monitoring terminals around all the major Australian airports. While community pressure has been a key driver in these networks being installed, it has proven very difficult to find ways to report the results of noise monitoring in a way that a layperson finds satisfactory.

The amount of information gathered by a noise monitoring terminal (NMT) is extremely large and summarising this data in a simple way is a daunting task. Over the years many ways of presenting NMT data have been trialled but generally these have not gained wide acceptance. Recently community representatives have requested that reports be based on N70 information.

The above chart is a preliminary version of a measured N70 report for Sydney Airport. It is proposed that future charts will include some indication of exposure patterns on other than the average day (eg worst and best day N70s for the period may be shown).

Presenting measured N70 information allows a member of the public to cross compare between measured and modelled data and thus carry out at least some simple form of validation of published contours. This is not possible with ANEF contours.



Noise Descriptor Software

The Department is currently developing a software package – **TNIP** (Transparent Noise Information Package) – to assist airports and aviation agencies produce the ‘new’ descriptors put forward in the *Expanding Ways* Discussion Paper.





TNIP facilitates the very rapid production of flight path movement and respite charts and measured N70 reports as high quality graphic pdf images. The package also includes a routine for producing N70 grids from INM detailed TA70 grids. A module to provide Person-Events Index (PEI) analyses is now being prepared.

TNIP can be configured for any airport relatively easily. A flight path template which shows the ‘normal’ spread of the airport’s flight paths needs to be prepared using a standard graphics package. This template can be then used for ongoing reporting provided the flight path arrangements do not change. Data files with fields containing information on aircraft type, runways used, dates, times and origin and destination of movements need to be prepared on a routine basis for regular environmental reporting.

TNIP also allows the user to query the database by date and time to produce charts for specific time periods. It is intended that the package will ultimately be configured for the internet so that community members can interrogate an airport’s movements database.

TNIP is freeware and copies can be obtained by emailing the author at david.southgate@dotrs.gov.au.

WHERE TO FROM HERE

-  **Quieter aircraft + more flights = 'numbers game'**
-  **Demands for N60s likely to increase - particularly for GA airports**
-  **N70 in INM**
-  **Communications on CAEP work program**

The Future

In recent years Australia has moved to an almost one hundred per cent high by-pass Chapter 3 fleet. This has been coupled with an environment of increasing numbers of aircraft movements at airports. As a result noise reporting has increasingly become a 'numbers game' and every indication is that this trend will continue. The concept of 'numbers and times' based descriptors appears to be well suited to this environment.

Complaint patterns in recent years indicate that there will be increasing pressure to report noise events down to the N60 level even at major metropolitan airports. Preliminary work indicates that the N60 may well be a useful tool for portraying noise exposure patterns at GA airports.

The Department is keen to see CAEP broaden its work program to encompass examination of ways to improve communicating noise exposure patterns to the public and decision makers.

The concepts discussed in the *Expanding Ways* Paper are not intended to be the final product. Rather they are designed to stimulate ideas on better ways to present a 'real' picture of aircraft noise exposure patterns around airports. It is clear that aircraft noise issues will not be effectively managed while 'experts' and 'non-experts' fail to talk the same language.