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Aircraft Noise Management in New Zealand

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ABSTRACT

New Zealand has a protocol for aircraft noise management that really works and has public acceptance. It is based on the "airnoise boundary" concept, which was conceived by the lead author in 1987, and in 1992 was incorporated into a New Zealand Standard for airport noise management and land use planning. While designed specifically for aircraft noise control around airports, the concept has been successfully utilized also for the management of noise from shipping ports, quarries, transport hubs, and other industries. The protocol is simple: If the industry cannot keep, within its property boundary, all its daily sound emission above the level recommended by the World Health Organization as requisite for the protection of public health, it has to ask the local territorial authority for permission to have a larger area in which to contain the sound. The request is discussed in the public domain and eventually an area of land is designated for this purpose and its boundary – the "airnoise boundary" - defined on a map of the area. The industry is then legally bound to keep all the excess noise within this boundary and a series of noise monitoring stations ensure this is done. In return the land inside the airnoise boundary is subject to strict land use control. Since the airnoise boundary concept was adopted for New Zealand's capital city, Wellington, aircraft noise complaints that in the late 1980s numbered several hundred a year, now number less than 20, while passenger numbers have more than doubled.

1 INTRODUCTION

Native to New Zealand, the kiwi is a flightless bird that has been adopted as the symbol of our nation. It is with some irony then that as a nation of 'kiwis', we have become so dependent on flight. Much of this can be simply put down to our position within the world. Far from, well, anywhere, air travel makes what once were long and tedious journeys to exotic, and not so exotic, locations possible within considerably contracted time frames. There are other reasons as well.

Internally, the geography of our country makes air travel ideal. The land being long, narrow and mountainous, air travel allows quick transit between centres, many hours and even days faster than surface travel modes.

Flight has also been adopted in many aspects of our agricultural industries. The rugged nature of our landscapes has lead to many applications of flight for farmers. Aerial topdressing, access to remote properties and even herding of animals are all possible and common uses of both fixed-wing and rotor aircraft.

So it is not surprising that New Zealanders have been and continue to be pioneering fliers. From Richard Pearse in Timaru, one of the world's first fliers; to the innovative and specialist aerial oversowing and topdressing aircraft manufactured by Pacific Aerospace in Hamilton; to our national airline, Air New Zealand, being recently named the Air Transport World's Airline of the Year; the 'kiwi' is in full flight.

2 FLIGHT AT WELLINGTON

Wellington, the capital of our nation, was certainly not backwards in joining the flock to aviation. In January 1911, from Lyall Bay Beach, Arthur Schaff managed a brief period of flight in his plane, the Vogel I. He managed daylight under the wheels before his first crash (Figure 1), 50 yards two months later with his repaired aircraft, and even greater results with his next plane – the Vogel II – until it went up in flames in 1919.

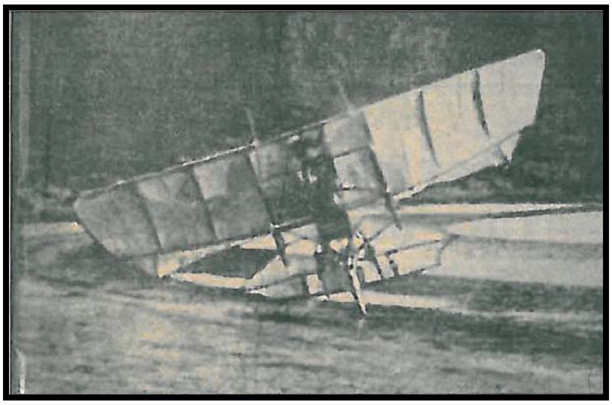

Figure 1 – Arthur Schaff's Vogel I comes to an unceremonious end on the Lyall Bay foreshore. [1]

Whether or not he was the source of inspiration for aviation in Wellington is uncertain, however 17 years following his first flight, the sand dunes behind the site of Mr Schaff's early aviation experiments became Wellington's airfield, and were eventually selected by the Wellington City Council as the place to build Wellington's public aerodrome. Previously described as useless and unsuited to the growing demand for land for residential development in Wellington, the Rongotai Aerodrome opened on the 16th of November 1929.

For the next 25 years, aviation in some respects stagnated at Rongotai. Constrained by short runways and limited facilities, Rongotai quickly became too small for the growing aviation needs of the capital city, with much of the scheduled passenger traffic being relocated to the township of Paraparaumu to the north, and trans-Tasman flights via flying boats from nearby Evans Bay (Figure 2). While there were some highlights, such as the DeHavilland factory opening in 1939 for the production of Tiger Moth training aircraft for pilots off to the War, it seemed that much of Wellington's early aviation impetus was lost.

Figure 2 The inaugural Trans-Tasman Flight 3/10/1950 [2]

However all was by no means lost. With the Government of the time having assumed control of the Aerodrome in 1939 to further the war effort, the strategic positioning of a metropolitan airfield less than 10 kilometres from the seat of Parliament began to get its rightful recognition. Compounded by the fact that Rongotai did not have the runway length to cater for modern aircraft, intense lobbying by various organisations in the late 1940s and early 1950s, most notably the Wellington Chamber of Commerce, started to gain traction. In 1956 construction of Wellington Airport began, incorporating the site of the former Rongotai Aerodrome.

To construct the new airport 180 houses were purchased, a major hill was levelled (Figure 3) and 28 hectares of land were reclaimed mainly to the south but also the north to accommodate a new and much longer runway.

Opening in October 1959, it was barely 10 years before technology again overtook facilities, and in 1972, a further reclamation was undertaken to the south to accommodate the required runway length for the larger DC8 and 707 aircraft. With this extension, Wellington well and truly embraced the jet age.

The 1970s and 1980s saw a large increase in the popularity of air travel, and by 1990, the airport processed 2.5 million passengers on 133,700 flights. [3].

Obviously, with the introduction of jet aircraft came noise, and it was early on in the history of Wellington that noise became an issue. While much of this related to the Airport's proximity to residential houses (Figure 4), there were murmurings of discontent across Wellington, with one particular correspondent to the Dominion newspaper consulting aircraft schedules to gauge which nights he was going to be woken by DC8 trans-Tasman flights. [4]

Figure 3 – Vast earthworks and the dissection of a suburb were required to develop Wellington Airport. The houses in the fore- and backgrounds still exist today.

Figure 4 – Air New Zealand 737 200s operating from Wellington in the late 1970s – adjacent to residential houses. The noise of these aircraft became the catalyst for change and control at Wellington.

In 2009, Wellington Airport processed over 5.2 million passengers on approximately 115,000 flights, showing the continued popularity of air travel in Wellington.

3 AIRCRAFT AND NOISE

Getting an aircraft into the air, and propelling it, requires energy, and a truly efficient energy system has yet to be found. Ancient legend talks of vimañas and flying carpets that moved silently, but although modern man has striven to achieve quiet flight, so far the technology has escaped us. From the very beginning of man's endeavour to achieve powered flight, excessive noise has been evident and complaints inevitable.

New Zealand may well be a small and relatively insignificant country far away from the centres of science and technology, but it can rightly claim ownership of the very first complaints of aircraft noise. Richard Pearse did not suffer legal action but in March 1903 was pelted with rotten vegetables for making an abominable noise and continually crashing his aeroplane into and damaging neighbouring properties.

Figure 5 Richard Pearse’s aeroplane

When aircraft came of age in the 1920s, it was realised that something had to be done about the noise and there were various attempts to solve the problem - as recorded in “The Aeroplane” magazine of the day Figure 6. Unfortunately none were successful.

Figure 6 Steam for Silence [5]

In World War II, the struggle for supremacy took away any thought of reducing the noise from aircraft – indeed at times it was thought the noisier the better. Power and speed were the prime considerations. Larger and more powerful motors were developed, each increase in power resulting in a corresponding increase in noise emission, such that by the end of the War and the introduction of the gas turbine, noise had increased more than a thousand times and was becoming out of control.

Whereas the military might get away with noisy aircraft for the defence of the realm – “The Sound of Security” as it was dubbed – civil aviation, which had readily adopted the gas turbine for its main fleets, had no such excuse and severe annoyance around the world’s major airports led in the 1960s to a number of government surveys of airport noise and the development of special aircraft noise descriptors. Unfortunately, overarching all of this was politics. The descriptors that were developed almost without exception were so obscure and complicated that no one could measure the sound using them with the sound level meters of that time, and hence take action. Of importance to the authorities, whatever they claimed about the noise, no one could prove them wrong. Elaborate noise monitoring systems were set up at the world’s major airports, all purporting to be measuring in terms of the new descriptors, but none could actually do so.

A popular descriptor for an aircraft noise event was the “Perceived Noise Level” (PNL) and such measurements were stated as so many PNdB. From memory, to arrive at a value in PNdB, one had to record the noise event through a sound level meter (such as the Brüel and Kjær 2203) onto a reel to reel tape recorder (usually a Nagra) and analyse the top 10 dB of the recording. This involved first playing the recording through a paper chart recorder to find the location of the top 10 dB on the tape, and then, with a pair of scissors, cutting out that part of the tape and splicing it together with the calibration tone to form a loop which could be run endlessly through the tape recorder in playback mode. This was then played back through the sound level meter with one third octave filters attached, sequentially through each band from 25 Hz to 12.5 kHz making a paper chart trace of each of the 30 one-third-octave bands.

From these traces, the maximum level in each band at half second intervals between the 10 dB down points was read off, and using a table of conversion factors each of the 600 to 700 values changed to a new measure in “Noys”. These were then summed according to a certain formula to give the “Perceived Noisiness” (PN) and finally converted to give the perceived noise level (PNL) using the formula:

$$PNL = 40 + \log_2 PN \quad \text{PNdB} \tag{1}$$

It did not end there. An even more complicated descriptor, the effective perceived noise level, was developed to include a time factor for the duration of the event and a penalty for any prominent tones.

One can see that in the days before computers came of age, undertaking this process in anywhere near real time was impossible. Nevertheless noise monitoring systems were set up purportedly giving the aircraft noise level in PNdB. Of course they couldn’t actually do that, but early on it was discovered that for the aircraft noise of that time, the perceived noise level turned out to be very close to a simple A-frequency weighted maximum sound level plus 13 dB. So that is what the monitoring systems actually used. This was kept secret from airlines, local authorities and government officials alike.

The systems were not very accurate – indeed one major airport near the sea actually used hydrophones to overcome corrosion problems from the salt winds. The monitoring stations were made very visible, and it was noticed at London (Heathrow) Airport that pilots did their very best to keep as far away from the stations as possible on their ordained flight track for fear of heavy fines. Little did they realise that this was all that was intended and, it is believed, no airline there was ever taken to Court for a noise violation.

This, of course, was not the end of the matter, public reaction was judged by each of the major social surveys as a function of some sort of average noise combined with the number of flights per day. From surveys around London (Heathrow) Airport, surveys in which the lead author took part albeit in a junior role, the British Government introduced the Noise and Number Index NNI which was equal to the average daily maximum perceived noise level to which was added fifteen times the logarithm of the number of flights and then 80 subtracted to make the number manageable. Again, the beauty of this is that whatever the value claimed, no one could prove it wrong. Noise contours were drawn around the Airport and sound insulation grants given to those residences within certain contours. The grants were considered sufficient to insulate three rooms and the roof, but the residents were allowed to put the insulation where they chose. A later survey found the majority of residents had remained in the area, i.e., had not moved away because of the noise, but had insulated rooms that faced the adjacent major road leaving those rooms facing the airport and the roof untouched. When asked the reason, almost all said that it was in those rooms that they were most affected by the aircraft noise. No doubt there is a lesson to be learned from this.

Other countries came up with their own descriptors, and it was not until the United States Environmental Protection Agency developed the day-night level (Ldn) that some sense came into aircraft noise exposure descriptors. Nevertheless some countries still retain the obscure descriptors and rely on the relevant civil aviation authority to tell the people how much aircraft noise they are receiving, which of course may be quite different from the actual aircraft sound exposure they receive. The local authorities are then charged with undertaking suitable land use controls to match the needs of the airport, not those of the local residents some of whom may well have been there long before the airport was developed. And this is prevalent in many countries – but not New Zealand

4 THE ROARING EIGHTIES

As aircraft became more and more powerful, and noise emissions increased to unacceptable levels, the Federal Aviation Administration in the United States (FAA) followed shortly after by the International Civil Aviation Organization (ICAO), reacted to encourage aircraft manufacturers to make quieter aeroplanes – there was no consideration of limiting the daily number of flights at airports, which would be anathema. Aircraft noise certification was developed in the early 1970s by the FAA followed shortly afterwards by ICAO who in December 1972 introduced Annex 16 of the Convention on International Civil Aviation and applicable to all civil aviation jet aircraft accepted into service before 6 October 1977. The limits chosen were those considered to be achievable by 75% of the aircraft extant. Aircraft meeting these conditions were said to conform to Chapter 2 of Annex 16.

In June 1976, a reduction in limits was introduced to become effective in October 1977. Aircraft meeting this condition were said to conform to Chapter 3 of Annex 16. Other chapters were introduced for light aircraft, larger propeller types, helicopters and future supersonic aircraft. In its day, this was very farsighted and with ICAO's later endorsing a policy of a "balanced approach to noise management" and stricter noise emission standards – a chapter 4 of Annex 16 was introduced to come into effect in January 2006 – a great improvement in airport environments became possible, but only over a long period of time. Economic considerations often mean international flights have priority when it comes to buying new aircraft to comply with the latest chapter in Annex 16, while the older aircraft, not meeting these requirements, are retained for local air traffic use - and of course there will be many more of these than international flights at most airports.

Many aircraft have a long life – in the Pacific region some Douglas DC 3 aircraft are still in operational service after 70 years of flying – and aircraft noise certification only has an effect on noise exposure levels around local airports if the country concerned adopts Annex 16 as a regulatory instrument in its law. New Zealand was perhaps a little tardy in this, for some of its airlines were still buying chapter 2 aircraft for internal flights in the 1980s and noise exposure levels around its major airports was causing considerable discomfort for local residents.

In 1987 the noise from aircraft using New Zealand's airports had become of great concern and, after personally receiving several hundreds of noise complaints in just a few weeks, the Minister of Health and the Minister of Transport decided to do something about it. Together with the Minister for the Environment they instructed the Principal Scientist in the New Zealand Department of Health to come up with a methodology for controlling noise around New Zealand's airports with the aim of developing a New Zealand Standard that could be adopted as a regulatory instrument. The result was the *airnoise boundary concept* which later formed the basis for New Zealand Standard NZS 6805:1992 "Aircraft noise management and land use planning".

5 THE AIRNOISE BOUNDARY CONCEPT

The concept is quite simple: If an industry cannot keep within its property boundary all the sound energy it emits per day above the amount recommended by the World Health Organization as the maximum permitted in order to protect public health, then it must apply for a larger area in which to contain this sound. After examining the existing land use and any possible noise sensitive activities, the consenting authority, may allow some more area outside the industrial property boundary in which the industry must contain this excess sound energy, but it may or may not be all the noise maker wishes. Once the boundary of this area is set (the airnoise boundary) the industry is obliged to manage its operations so that at no time does the sound outside the boundary exceed the limits set, and strict land use controls are also introduced to protect the health of residents inside the boundary.

In NZS 6805:1992 "Airport noise management and land use planning", the airport authority must first work out the amount of noise it wishes to be allowed to make per day in, say, the next ten year period. This is presented to the local territorial authority in the form of two day/night sound exposure contours around the airport. Note this is sound exposure in pascal-squared-seconds (pasques) not sound exposure level - although the aviation industry has been very hesitant to use pascal-squared-seconds and on more than one occasion has gained permission in the Courts to use the equivalent day/night level.

The two sound exposure contours to be presented are the 100 pasques (approximately 65 Ldn) and the 10 pasques (approximately 55 Ldn) contours and if the airport cannot contain the 100 pasques contour within its own property boundary, it must apply to the local territorial authority for permission to have an area outside its property boundary in which to contain the noise. The application is examined in the public domain where the local people can have input. If the proposed contour covers a noise sensitive activity such as a hospital or school, the contour may be shifted to avoid the area, or the noise sensitive activity may be relocated away from the airport noise (at airport expense.) If agreement cannot be reached, the case is discussed in Court (the Environment Court) and a binding ruling given. A line on the map is then drawn, utilizing natural features or ward boundaries, to enclose the 100 pasque contour and this is called the *airnoise boundary*. A similar line to enclose the 10 pasques contour is then drawn and called the *outer control boundary*. Figures 7, 8 and 9 show one such possible scenario.

From then on, the airport is duty bound to keep all noise in excess of 100 pasques inside the airnoise boundary, and a series of noise monitoring stations ensure this is done. For their part the local territorial authorities must inspect all residences within the airnoise boundary and either buy up the property or provide insulation so that the internal sound level would be similar to that in an area where the outside environmental level met the recommendations of WHO. If any property is likely to receive more than 330 pasques, it should be purchased and the people re-housed. At 1000 pasques there is no question that the noise environment is a hazard to health and no residential building is permitted. Schools and hospitals are not permitted inside the airnoise boundary.

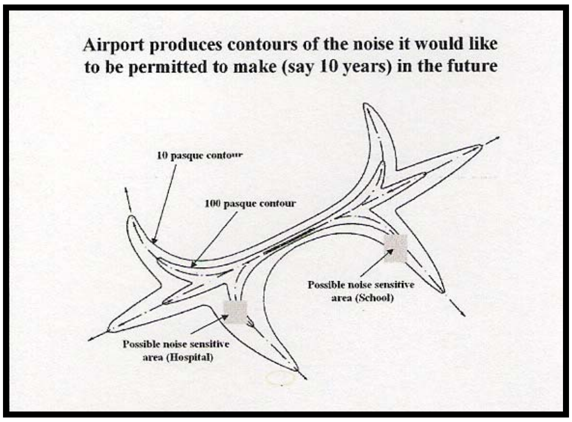

Figure 7 Stage 1 of the process

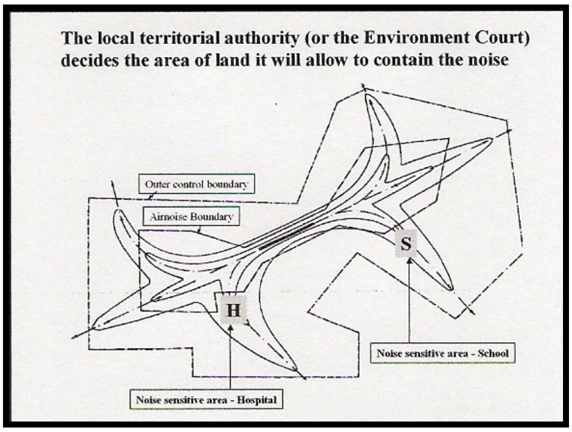

Figure 8 Stage 2 of the process

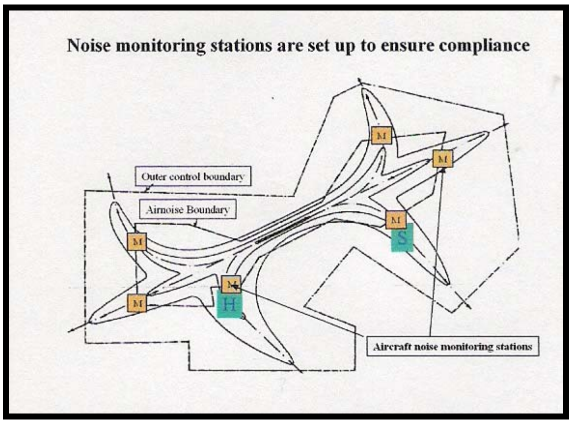

Figure 9 Stage 3 of the process

Strict land use controls are also maintained inside the outer control boundary. Schools and hospitals are proscribed and no new subdivisions allowed. The land use controls are given in Tables 1 and 2. [9]

The pascal-squared second (or pasque) may seem to be an unnecessary new and strange unit to use when it has been customary for everything to do with sound to be measured in decibels, and one may question the introduction of an apparently entirely new measure. The pascal-squared-second is, however, the fundamental unit in acoustics from which all other descriptors are derived – including the decibel (or more correct the "deciBel") . Before the work of Wallis and Holding [6] and the introduction of the computer chip into sound level meters, a measurement of a.c., voltage was all that was possible in the old sound level meter following the work of Harvey Fletcher [7] and his colleagues at the Western Electric Laboratories of the American Telephone and Telegraph Company (AT&T).

Table 1 Noise control inside airnoise boundary

Table 1
RECOMMENDED NOISE CONTROL CRITERIA FOR LAND USE PLANNING INSIDE THE AIRNOISE BOUNDARY

Sound exposure Pa^2s (1)	Recommended control measures	Day/night level Ldn (2)
>100	New residential, schools, hospitals or other noise sensitive uses are prohibited. Steps shall be taken to provide existing residential properties with appropriate acoustic insulation to ensure a satisfactory internal noise environment. Alterations or additions to existing residences or other noise sensitive uses shall be permitted only if fitted with appropriate acoustic insulation.	>65
>350	Consideration should be given to purchasing existing homes, or relocating residents, and rezoning the area to non-residential use only.	>70
>1000	There is a high possibility of adverse health effects. Land shall not be used for residential or other noise sensitive uses.	>75

NOTE –

(1) Night-weighted sound exposure in pascal-squared-seconds or "pasques".

(2) Day/night level (Ldn) values given are approximate for comparison purposes only and do not form the base for the table.

Table 2 Noise control inside outer control boundary

Table 2
RECOMMENDED NOISE CONTROL CRITERIA FOR LAND USE PLANNING INSIDE THE OUTER CONTROL BOUNDARY BUT OUTSIDE THE AIR NOISE BOUNDARY

Sound exposure Pa^2s (1)	Recommended control measures	Day/night level Ldn (2)
>10	New residential, schools, hospitals or other noise sensitive uses should be prohibited unless a district plan permits such uses, subject to a requirement to incorporate appropriate acoustic insulation to ensure a satisfactory internal noise environment. Alterations or additions to existing residences or other noise sensitive uses should be fitted with appropriate acoustic insulation and encouragement should be given to ensure a satisfactory internal environment throughout the rest of the building.	>55

NOTE –

(1) Night-weighted sound exposure in pascal-squared-seconds or "pasques".

(2) Day/night level (Ldn) values given are approximate for comparison purposes only and do not form the base for the table.

Acoustics was only a small facet of Western Electric's work and the development of acoustical measurements occurred on the back of electrical developments. The Laboratory had been engaged for many years in the development of a means to measure an a.c., voltage. This was not easy and the Laboratory had to utilize a root mean square in order to always achieve a positive value for the moving coil meters then in use. In those days the unit for resistance was 1 mile of standard cable, which varied with frequency and temperature, and for measurement of a.c. power to make it independent of frequency and temperature, it was convenient to use a power (or logarithmic) series for its description based on the power developed by a one volt sinusoid across a mile of standard cable.

This measure initially was called the "Transmission Unit" TU [8] but when the Laboratory was renamed "Bell Labs" in 1926, the measure was renamed the "Bel", and acoustics inherited the "deciBel", a logarithmic ratio which is a really awkward thing to use, but beloved of rule makers and acoustical consultants – perhaps because so few people understand it and can work with it.

The order for simplicity

The directive given by the government ministers was to make the methodology simple and transparent so that territorial authority officers and local residents alike could easily understand it and police it, and using the decibel makes everything far too complicated, as shown below:

An example using decibels:

Suppose an airport has two airlines operating from it, and at the airnoise boundary the sound exposure is not to exceed 64.6 Ldn. Airline A is allotted 48% of this and Airline B 30%. Each aircraft of Airline A produces a sound exposure level (L_{AE}) of 100 dB and each aircraft of Airline B produces a sound exposure level (L_{AE}) of 91 dB. How many flights is each airline permitted during the day and during the night?

The day/night level Ldn is defined as:

$$Ldn = 10lg((1/24)(15(10^{(LAeq,d/10)})+9(10^{((LAeq,n+10)/10)}))) \quad (2)$$

$L_{Aeq,d}$ is the time average level during the day, defined as:

$$L_{Aeq,d} = 10lg((1/T)\int_{07:00}^{22:00}(p/p_0)^2dt) \quad (3)$$

$L_{Aeq,n}$ is the time average level during the night, defined as:

$$L_{Aeq,n} = 10lg((1/T)\int_{22:00}^{07:00}(p/p_0)^2dt) \quad (4)$$

and
p_0 is the reference value of 20μPa,
t is the integrating time in seconds and
T the time period, also in seconds

The sound exposure level of a noise event L_{AE} is defined as:

$$L_{AE} = 10lg(\int_0^T(p/p_0)^2dt) \quad (5)$$

where
p_0 is the reference value of 20μPa,
t is the integrating time in seconds
T is the duration of the event in seconds

So in terms of sound exposure level L_{AE} , and using d = number of flights during the day, and n = number during the night

$$Ldn = 10lg[\{\sum_{i=1}^{i=d} 10^{(LAEi/10)} + \sum_{j=1}^{j=n} 10^{((LAEj+10)/10)}\}/86400] \quad (6)$$

Where L_{AEi} is the sound exposure level of a flight during the day, and L_{AEj} is the sound exposure level of a flight during the night. 86400 is, of course, the number of seconds in 24 hours, since T is in seconds.

Airline A is permitted to make 48% of 64.6 Ldn or an

$$Ldn = 10lg\{0.48*10^{(64.6/10)}\} = 61.4$$

So $61.4 = 10lg[\{d*10^{(100/10)} + n*10^{((100+10)/10)}\}/86400]$

(Since both L_{AEi} and L_{AEj} = 100 dB) thus

$10^{10}d + 10^{11}n = 86400*10^{(61.4/10)} = 1.2*10^{11}$

so d + 10n = 12 giving d=12 for n=0 or d=2 for n=1, no other permutations being possible.

i.e., 12 flights during the day, 0 at night
or 2 flights during the day, 1 at night

Airline B is permitted to make 30% of 64.6 Ldn or an

$$Ldn = 10lg\{0.30*10^{(64.6/10)}\} = 59.4$$

So $59.4 = 10lg[\{d*10^{(91/10)} + n*10^{((91+10)/10)}\}/86400]$

(Since both L_{AEi} and L_{AEj} = 91 dB) thus

$10^{9.1}d + 10^{10.1}n = 86400*10^{(59.4/10)} = 7.5*10^{10}$

so d + 10n = $7.5*10^{10}/10^{9.1}$ = 60

Giving d=60 for n=0, or d=50 for n=1, or d=40 for n=2, or d=30 for n=3, or d=20 for n=4, or d=10 for n=5, or d=0 for n=6.

i.e., 60 flights during the day, 0 at night
or 50 flights during the day, 1 at night
or 40 flights during the day, 2 at night
or 30 flights during the day, 3 at night
or 20 flights during the day, 4 at night
or 10 flights during the day, 5 at night
or no flights during the day, 6 at night

The same example using pasques (Pa^2s):

Suppose an airport has two airlines operating from it, and at the airnoise boundary the sound exposure is not to exceed 100 Pa^2s.

Airline A is allowed to make 48 Pa^2s, Airline B is allowed to make 30 Pa^2s. Each aircraft of Airline A produces a sound exposure at the boundary (E_A) of 4 Pa^2s, and each aircraft of Airline B produces a sound exposure (E_A) of 0.5 Pa^2s. How many flights is each airline permitted?

The day/night sound exposure (Edn) is given by:

$$E_{dn} = E_{day} + 10E_{night} \quad (7)$$

Airline A would be permitted 48/4.0 = 12 = d + 10n

Giving d=12 for n=0, or d=2 for n=1

i.e., 12 flights during the day, 0 at night
or 2 flights during the day, 1 at night

Airline B would be permitted 30/0.5 = 60 = d + 10n

Giving d=60 for n=0, or d=50 for n=1, or d=40 for n=2, or d=30 for n=3, or d=20 for n=4, or d=10 for n=5, or d=0 for n=6.

i.e., 60 flights during the day, 0 at night
or 50 flights during the day, 1 at night
or 40 flights during the day, 2 at night
or 30 flights during the day, 3 at night
or 20 flights during the day, 4 at night
or 10 flights during the day, 5 at night
or no flights during the day, 6 at night

The matter becomes simply that of counting the number of flights – something that everyone can do. This is too simple, of course, for those who believe such civil aviation matters should be given some privacy, and to date in New Zealand at each major airport concerted efforts by the airlines have led to the Courts allowing the use of Ldn instead of pasques while retaining the concept of the airnoise boundary.

6 THE PROGRESS OF AIRPORT NOISE MANAGEMENT AT WELLINGTON

Very early on in Wellington Airport's history, noise from aircraft was of issue. Although super-sonic flight did not eventuate as feared, the rapid increase in aircraft movements of noisy jet aircraft (now known as non-Chapter 3 aircraft) was responsible for much public opposition.

In 1975, the Ministry of Works commissioned a review of studies regarding noise at Wellington, entitled the Wellington Airport Noise Survey. Combining measured noise levels and a survey of local residents, the review concluded there was no silver bullet for the issue. The competing measures of environmental health of residents and the need for safety at the Airport should be accounted for. [10]

Clearly this did little to appease the residents, who were becoming increasingly more organised. Bylaws introduced in the 1980s by the Wellington City Council banning non-Chapter 3 aircraft between 10pm and 7am, with a midnight to 6am curfew for all other aircraft did little to curb the opposition. The Residents' (Airport Noise) Action Group Inc. (RANAG) became a prominent figure, canvassing the community through mail drops, demonstrations and protests trying to promote their cause and raise funds to fight the Airport and the Airlines, and change the noise environment.

Noise peaked in the late 1980s (Figure 10 – yellow line), followed by a decline with the phasing out of non-Chapter 3 aircraft - specifically the replacement of the Ansett New Zealand Boeing 737 100s with the BAe146 Whisper Jets, and then the replacement of the Air New Zealand Hush-kitted Boeing 737s with their current 737-300 fleet in the mid 1990s. RANAG remained an active advocate for the local community against aircraft noise.

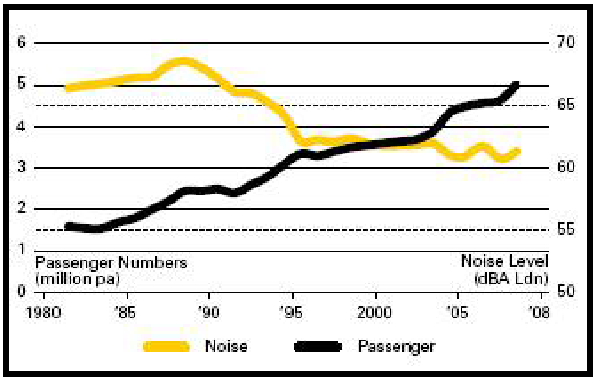

Figure 10 – Noise Levels versus Passenger Numbers [11]

The introduction of NZS 6805:1992 [9] was a key milestone, as now there was an ability to quantify the noise from the airport. The measurement components of the Standard enabled all parties to begin constructive discussions towards a solution.

Wellington International Airport Limited (WIAL), in conjunction with the Wellington City Council installed noise monitors around the airport to measure noise. A representative committee was established incorporating local residents, the Council, the Airport, and representatives from the major Airlines to promote debate on noise. Specifically, this early committee recognised that there would always be conflicting issues which may not be easily reconcilable.

However straight away it became apparent that there would be difficulty implementing the ideal land use controls proposed by NZS 6805:1992. Where the Standard proposed to prohibit noise sensitive activities, there were already at least 700 houses within the 65 Ldn contour, including a school and at the time a child care centre, and some 40 or so within the 75 Ldn contour. Any response at Wellington would therefore have to account for this pre-existing situation.

Under the new effects based legislative planning framework, the Resource Management Act 1991, WIAL introduced in 1994 as a first response a land use designation, primarily to reaffirm the company's rights to operate an airport on the site, but also to establish some essential rules relating to, among other things, the generation and control of noise. A total sound exposure limit was set over a rolling 24 hour 90 day average, a night time curfew was imposed from midnight to 6am for domestic flights and 1am to 6am for internationals, restrictions on engine testing were imposed, and limits on the use of Group Power Units (GPUs) and Auxiliary Power Units (APUs) were imposed.

These rules were brought forward into the second response, being a new Airport Zone within the draft of the District Plan in 1994. RANAG remained active through the consultation process on these District Plan rules, and were a party to Environment Court action that culminated in a decision from the Court in 1997. [12] This decision has quite literally changed the noise environment in Wellington:

(1) It affirmed the curfew and other restrictions imposed by the 1994 designation, albeit with some minor changes.
(2) It directed the Airport and the Wellington City Council to prepare a Noise Management Plan, including objectives and rules for the management and monitoring of noise at Wellington Airport.
(3) It again directed the Airport and the Wellington City Council to set up the Wellington Airnoise Management Committee, a body with the sole purpose to monitor the curfew, total sound exposure, and take action in the event of a breach of either. And finally:
(4) It directed the Wellington Airnoise Management Committee to undertake further investigatory work looking at the effectiveness of land use planning rules within the land surrounding the Airport, and to determine whether the insulation within the existing dwellings was appropriate for the environment. This study, termed LUMINS (Land Use Management and Insulation for airport Noise Study) has recently concluded [13] and is currently being implemented by the Airport and Wellington City Council.

These measures, involving enforcement of rules, community participation and buy-in from the Airlines have lead to a much changed noise environment from the one that existed only 20 years ago. Yes, technology has played its part, but with effective management of noise at Wellington Airport, complaints have dropped from many hundreds per year in the 1980s and 1990s, to only 3 flying related noise complaints in the 12 months to May 2010 [14] in spite of a massive increase in passenger numbers during that time.

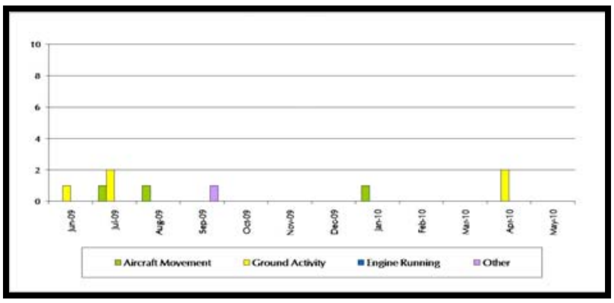

Figure 11 Complaints of noise at Wellington Airport

The end result can only be described as a success.

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