Comments on Bournemouth Airport Draft Noise Action Plan

J Birch, AirportWatch South West, 4/9/2009

Executive Summary

The Draft Noise Action Plan (DNAP) prepared by Bournemouth airport proposes to make no substantial changes to its operations or their impacts upon people living nearby.

It is clear even from the airport's own maps that an area of northern Bournemouth is already within the 57dBA noise contour – the point onset of substantial annoyance. When noise from the road network is taken into account, this area of annoyance grows substantially.

The noise maps are produced from computer models and do not take into account the substantial variation in flight paths seen from the airport, nor the higher levels of disturbance seen on busier days in the summer.

The plans to increase passengers at the airport by a factor of 4 will inevitably lead to a further spreading of the noise contours, meaning that more people will experience substantial annoyance.

The noise guidelines produced by the World Health Organisation imply that much lower noise levels are needed at night in order to avoid disturbed sleep, yet the DNAP does not produce data that would allow for analysis of noise at the relevant threshold.

The night noise quota system currently used has such a high cap that it has no impact upon the airport's operation. The current quota is 3100 but the annual usage is around 900, thus the quota allows for more than a tripling of night flights. The quota is substantially higher than that in place at Bristol airport which has over six times as many passengers.

The noise quota should be reduced to 1000 or less, and absolute flight limits per year and night imposed, along with bans on any flights with QC counts above 1.

Other steps can be taken to reduce ground noise such as reducing the use of APUs and placing noise walls around the airport, but the major benefits would be from improving the departure route and holding planes to that route.

Introduction

The Draft Noise Action Plan (DNAP) is prepared by the airport largely based upon modelling of aircraft movements in 2006. It does not cover movements in 2008, despite a rapid growth in passengers over that period, nor does it show how the impacts will increase in future despite a planned trebling of passengers.

The only real actions to control noise experienced are the existing departure route and the night noise quota count. The departure route does not appear to be optimal to avoid built-up areas or the national park, and compliance with the route appears to be poor and unenforced. The quota count limit is almost four times the current usage levels and thuse provides no limit on the current operations. It is set at a level 43% above that of Bristol International Airport despite Bournemouth Airport only handling a sixth of the passengers of Bristol.

No actions are proposed by the DNAP to enforce noise abatement, to reduce night noise or to even act to discourage and increase in day or night noise. The relevant parts of the section 106 agreement provide no mechanism for external enforcement of noise levels.

No evidence is given of actual noise monitoring in the areas likely to be affected, instead reliance is placed on modelling. A set of permanent monitors should be placed around the northern fringe of Bournemouth in order to validate the modelling and to allow the public to make informed complaints of noise events.

A tight limit should be placed on night flights, violations should be fined and the revenue used to compensate those affected by the noise. The airport should not aim to profit from increasing noise suffered by the public.

Comments on noise maps

The maps in Appendix A of the DNAP have been based on plane movements in 2006/7 using modelling software. They take account of typical departure and arrival paths (as can be seen, the 55dB contour bends northwards slightly at the West end, which reflects the departure paths) but does not correspond to the variety of actual paths flown. As annoyance (particularly at night) is more affected by single events than an average noise value, this can be a significant failing.

In addition, the Lden map gives contours for 55, 60, 65, 70 and 75 dB levels, so the 57 dB contour that corresponds with the "onset of significant annoyance" is missing! It would seem from Map 1 that a corner of Bournemouth would be within the 57dB contour. To avoid this an earlier turn or greater rate of climb might concentrate the noise in the region between Bournemouth and Ferndown, but that would required detailed modelling or measurement to determine. The Lday 57dB contour clips Bournemouth and touches the edge of Ferndown, as does LAeq16.

It can be seen that any increase in flight numbers will increase the size of the noise contours and thus bring more people within annoying levels of noise. Given the comments on noise measures (below) it is likely that the affected area is considerably larger than the 57dB contour would imply.

The Lnight contours imply that no people should be annoyed at night because no built up areas have more than 45dB outside at night, yet this ignores the clear WHO guidelines on single noise events.

It is clear that the quiet and open areas within the Bournemouth agglomeration, are limited towards the northern fringe and in fact the open country to the north would operate as the "quiet area". Unfortunately, this is where the airport is sited and the quietness and amenity of this space will be affected by flights. As housing encroaches on this space, not only will more homes be affected by aircraft noise but also the necessity of preserving and increasing tranquillity in the open areas become more vital. An expanding airport makes this harder to achieve.

As the airport Master Plan expects a doubling of commercial flights between 2008 and 2014, the noise implications are considerable.

The 57dbLAeq contour is estimated to include 450 dwellings and 900 people, but as this is largely on the northern edge of the built up area, a small error in the noise contour would radically increase the number of people affected. Any growth of houses in this area, or change to flight paths, or increase in flights would cause a considerable growth in numbers affected by noise.

The airport of course is not the only source of noise experienced by the areas concerned, hence the overall noise is higher than that shown in maps. Noise from the A348, A341, A347 and the more distant A338 as well as any industrial or commercial sources would add to the overall burden.

Using the data available from the DEFRA noise mapping site[1], where the airport contours were again modelled by the airport (and not independently), we see that in the critical area of the northern fringe of Bournemouth, the only significant other source of noise is the road network. The images below show the Lden and Lnight values for Bournemouth roads and the airport. Lden is derived in a similar way to Leq except evening noise is given a boost of 5dB and night noise is given a boost of 10dB.

Note that all of the maps have been produced from computer models and not from measurements. Also that these are annual average figures, the noise contours for a busty (or even average) summer day would be more widely spread.

As this is a different measure than Leq it is hard to make direct comparisons, except we can see that from the Leq and Lden values that the 60dB contour lies in pretty much the same position in both cases, so we should be able to use the Lden maps to estimate the total noise impact of the roads and airport in that area.

Due to the nature of noise measurements, they add together in a logarithmic fashion which is illustrated by doubling the noise energy only adds 3dB to the total ie doubling the noise energy from 57dB yields 60dB [ie the addition is really 10*log(exp(A/10)+exp(B/10)) where the noise values we are adding are A dB and B dB].

From this we can see that Northbourne area near the A347 already receives 55-75dBA from the road network and 55-60dB from the airport. Even at the lower bound of this the cumulative effect will be to raise the noise to 58dBA Lden (and probably Leq), and the areas with more road noise will also have a much higher total noise burden.

Expansion of the airport to accommodate a factor of 4 increase in passengers could be expected to increase commercial flights by between 2 and 4 times – depending on size of planes and passenger loading. It is not clear how much of the overall noise comes from the commercial flights and how much from other flights, but if we assumed a doubling of noise energy then that would add 3dB to the existing airport noise contours.

1 http://services.defra.gov.uk/wps/portal/noise

Map: Bournemouth Airport

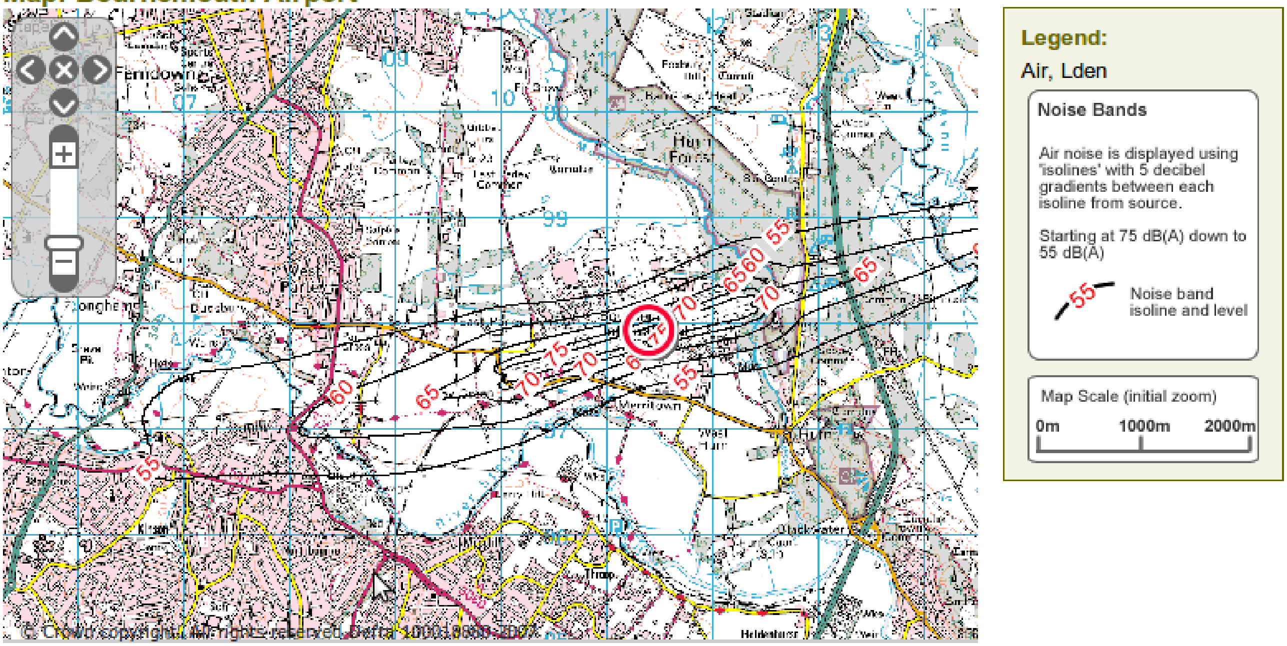


Illustration 1: Lden for Bournemouth airport

Map: BH1, Bournemouth

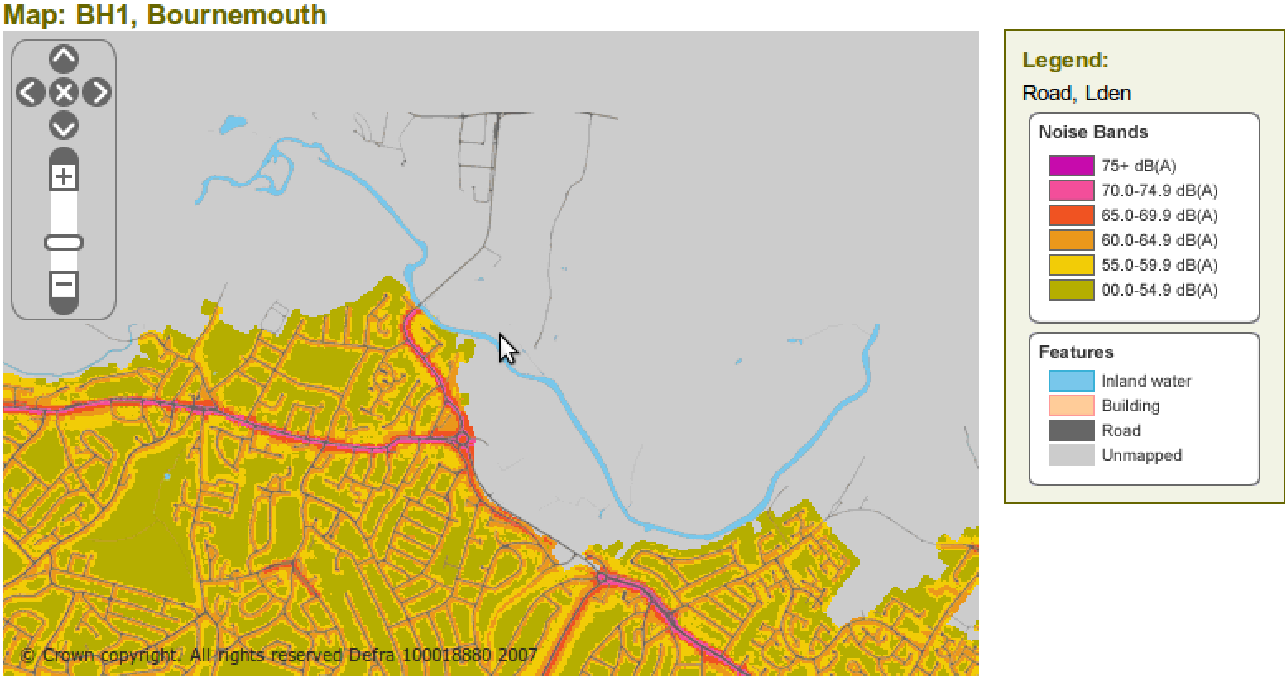


Illustration 2: Lden for Bournemouth roads

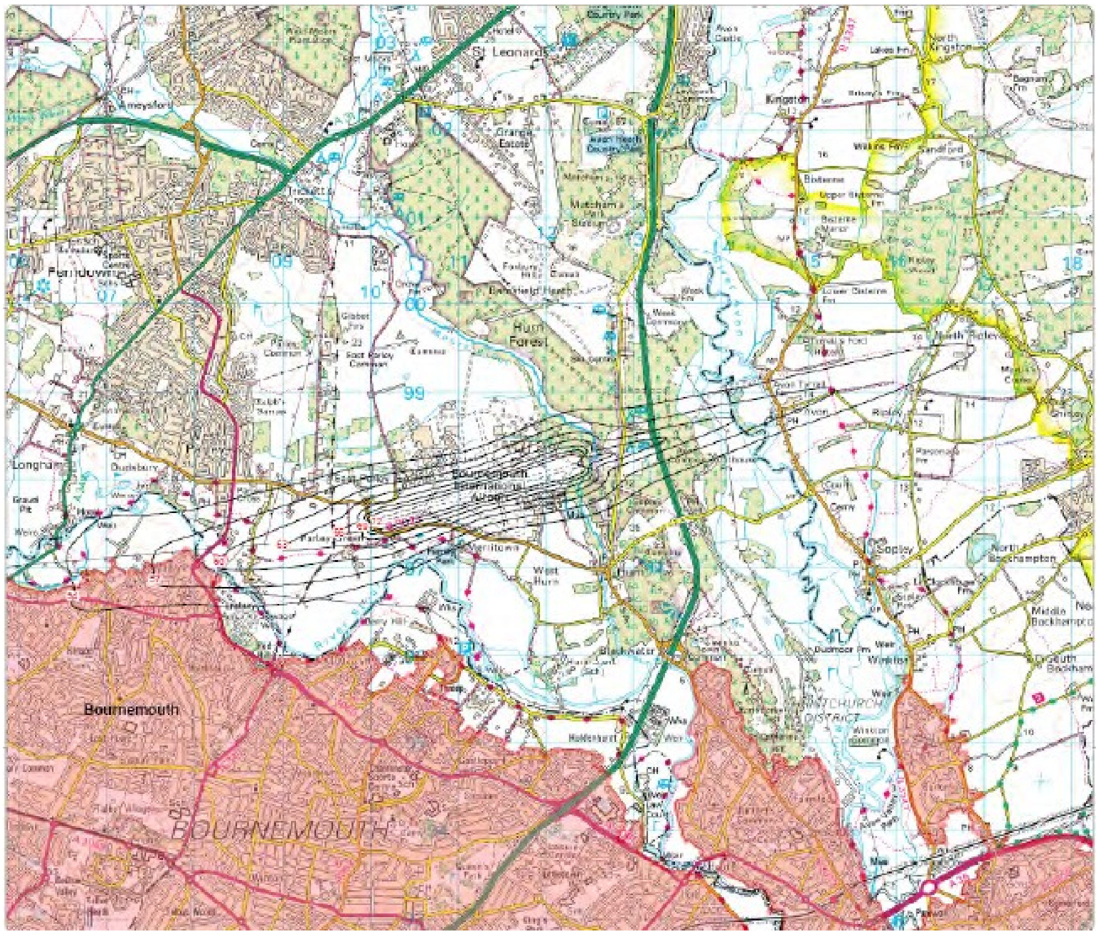


Illustration 3: Leq for Bournemouth airport

For the night measurements, no uplift has been applied (so the 50dB contour relates to the 60dB contour in the Lden map). The uplift in the Lden measure to model greater sensitivity to noise at night.

Following the arguments above on cumulative noise, it is clear that the total impact of the road and airport noise is to make an area of Northbourne well within a 50dB night noise contour.

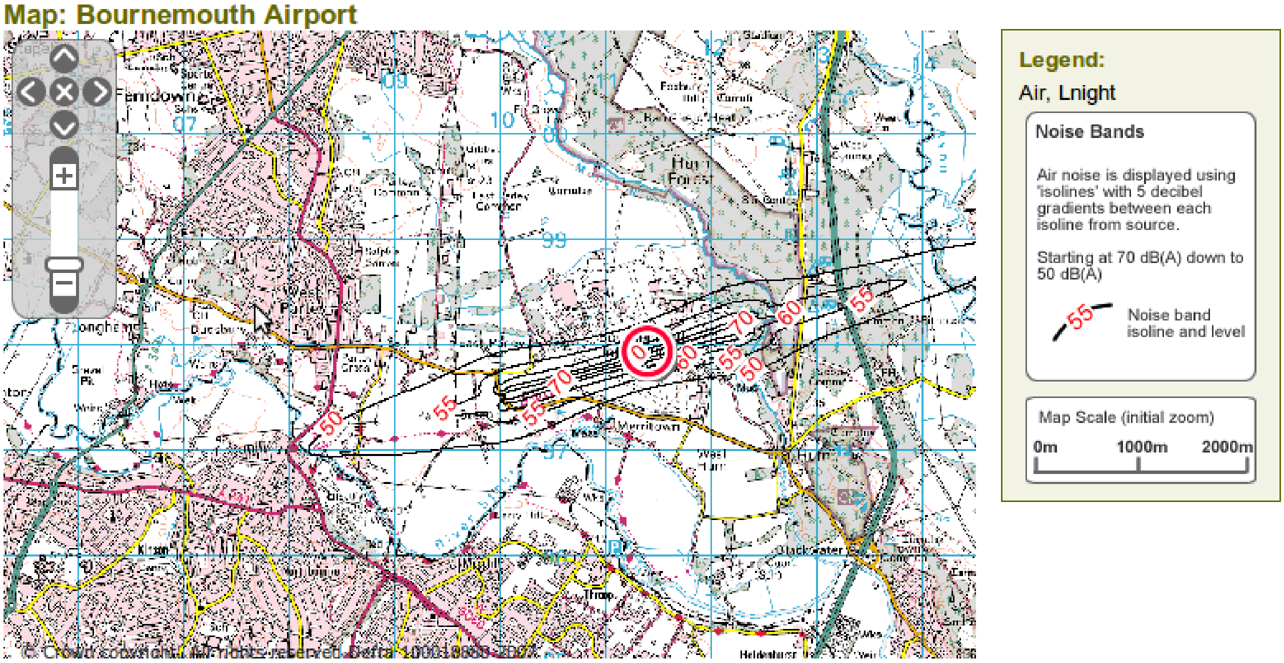


Illustration 4: Lnight for Bournemouth airport

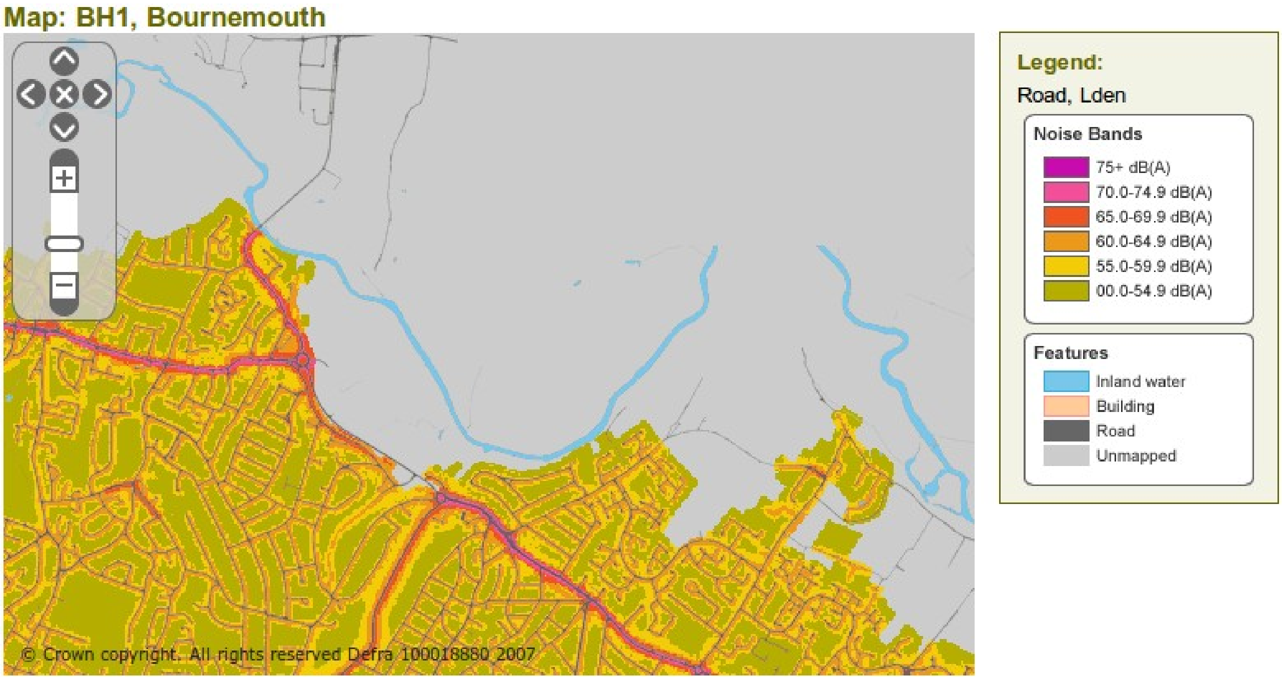


Illustration 5: Lnight for Bournemouth roads

Comments on Section 106 and other controls

The existing section 106 allows for noise in various ways which may be undesirable:

1) circuit flights between 20:00 and 23:30 should not be allowed. No such flights should occur before 07:00 either. In this and other measures it is important to remember that the WHO state that quiet early in the night is more important than later on for achieving restful sleep (ie once you are asleep it is harder to be woken

than it is to fail to get to sleep due to noise). The minimum height for such flights also seems too low. If such flights are for try-out of aircraft after maintenance, it would make sense to do this over the sea during daylight hours. This would require more normal takeoffs before turning at a reasonable height eg 4000 feet.

2) the westerly departure route may need to be adjusted to minimise the number of house overflown, and tighter controls placed on aircraft to abide by these routes until they reach at least 4000 feet. Currently turns can begin at 2000 feet which will create considerable aerodynamic noise.

3) There are no measures stated to fine aircraft operators or the airport if reverse thrust or other noisy practices do occur in contradiction to the agreement.

4) The quota count system is flawed as it does not accurately model the effect of the number of noise events on the public.

5) As aircraft quota counts are now typically 0.5 per flight, it is reasonable to ban all planes with QC above 1 from arriving or departing the airport at night. Any planes that do arrive should be fined and that fine allocated to an independently administered community fund (so that the airport does not profit from this violation)

6) the exceptions to the operation of the QC are too wide. The QC usage should still be counted and the airport should maintain headroom in the QC to allow for this.

7) the quota count is too high – it is 43% higher than in use at Bristol International Airport which carries 6 times as many passengers each year. The quota count should be set at a more reasonable level so that it actually constrains the actions of the airport eg 500 points

8) it is not acceptable that the airport can set its own quota limit. There is no justification for the current QC of 3120 (which would correspond to over 6000 night flights per year for modern jets such as 737-800 and A320). Instead the limit should be set much lower, apply to all movements that occur and have a roadmap for reduction year on year

9) an absolute cap should be in operation on total night flights per year and per night irrespective of the QC

10) no penalty is stated for the airport failing to comply with the section 106 in general, or any specific terms or the QC

11) there is no provision for the airport to publish the quota count usage or the data used to compute it – this is necessary so that the public can understand the operation of the QC and its effectiveness at controlling noise.

12) there is no commitment to actually measure noise, rather than model it. It would aid enforcement and public confidence if noise monitors were placed at least at 3 positions on the anticipated 57dB contour at the western end where the risk of noise impacts is greatest. In addition to the results of this monitoring and the QC count details, a measure of the number of arrivals and departures by direction should be kept.

13) planes that deviate significantly from noise preferential routes, or which are found to have higher noise than is modelled, should be fined

14) use of continuous descent approach (CDA) can reduce noise levels, but it will increase the time that planes are near the ground relative to a more traditional

stepped approach. Planes on approach make noise through use of flaps and undercarriage, and use of reverse thrust on touchdown. The airlines should be fined if pilots do not correctly comply with CDA, approach too rapidly (requiring excess use of reverse thrust and flaps) or lower undercarriage too early.

Comments on noise measures

In section 2.1, the DNAP states “The onset levels for significant disturbance are generally agreed” - yet this is a gross over simplification. The thresholds used by DfT (and the Government as a whole) are based upon old science and do not reflect the specific nature of noise from aviation operations nor its perception by the public.

The noise threshold for the “onset of significant annoyance” is set as 57dBALeq – this means using the “A weighting” to filter the sound beforehand and averaging the noise power out over a long period (typically 16 hours). This has several faults:

1) noise is measured with the “A weighting” system[2]. This models the human perception of loudness using pure tones, for instance we are far more sensitive to 1kHz than we are to 100Hz as a pure tone, so much so that a 50dB sound at 1kHz is perceived the same as a 70dB sound of 100Hz. But human perception is complicated and this means that a noise band around 6kHz is heard as being much louder than the same energy as a tone of 6kHz. This is compensated for in the D weighting system which was specifially designed to measure aircraft noise. In addition, if external noise measurements are being used to indicate annoyance, this will give a misleading result as most hearers will be indoors and lower frequency sounds penetrate buildings more effectively than high frequency ones. The C weighting system may be a more effective way to estimate the indoor noise from outdoor measurements, therefore.

2) the term “onset of significant annoyance” conceals what this actually means. In the DEFRA report “Attitudes to Noise from Aviation Sources in England” (ANASE) report[3] it is made clear that at 57dBLAeq is the level at which 60% of people are at least very annoyed by the noise, with 10% being very annoyed from 43 dBLAeq. The term “onset” would more appropriately be applied to 43dB than 57dB. The use of “significant” implies that only when 50% of people are very annoyed does it matter, which is a very unprogressive measure! General elections are lost on much smaller margins than 50%, battles are counted as disasters with 10% casualties, yet noise only matters if the majority are very annoyed! The report, when commenting changing attitudes to aircraft noise stated:

> “An alternative hypothesis is that LAeq is not the appropriate measure, and that annoyance in both studies would correlate better with another metric. For the ANIS study, there were generally fewer aircraft, but the average sound levels were higher. In the more recent ANASE study, there is a greater number of aircraft, but average sound levels were lower giving rise to the possibility that changes in annoyance levels are due, in part, to differences in noise composition.”

And states that the number of events is considerably more important than the Leq measure would imply (eg 100 events at 80dB is as annoying as 32 events at 90dB, whereas the Leq measure would imply the level would be equivalent to 10 events at 90dB). This also implies that the quota count method is fundamentally flawed.

3) the 57dB threshold is derived for continuous white noise, not discontinuous tonal noise, as found with aircraft movements. It is well known that human perception is able to ignore continuous background noise far better than discrete events. For instance the

2see http://en.wikipedia.org/wiki/A_weighting

3 http://www.dft.gov.uk/pgr/aviation/environmentalissues/Anase/executivesummary2.pdf

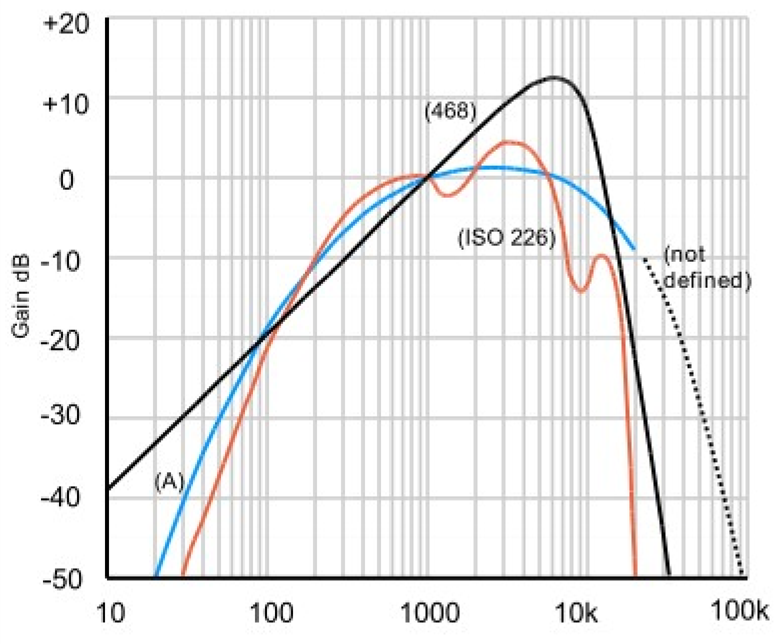
“cocktail party effect” allows people to focus on the speech of an interlocutor against a relatively loud but white noise background, but it is far harder to continue conversation against a background of music or sporadic events of the same average loudness. People generally find it easier to sleep through a continuous background hiss or rumble than through infrequent loud events, even though these may have the same Leq measure. People are far more annoyed by humming noise than hiss due to the tonal element.

4) the Leq system derives an average noise power over a long period, so the same measure could represent the constant rumble of distant traffic or infrequent loud events such as gun-shots or aircraft passing. In the dBLeq system, 3dB represents a halving of noise energy, and this can also be seen as a 50% dilution of the noise. So 60dB noise that is on 50% of the time averages out to a 57dB one, or similarly if aircraft only pass overhead for 5 seconds every 320 seconds then this allows for each event to be 75dB

5) human perception of loudness requires a 10dB drop to give a perceived halving of annoyance, yet the noise quota and modelling systems imply a halving of impact for a 3dB drop. Thus the quota system might allow 2000 0.5 QC planes to fly within a quota that would be limited to 1000 1 QC planes, the noise perceived by the public would actually be higher in the 2000 plane case even though the QC and Leq measures stayed the same.

6) the A weighting system is recognised to only model perception of single tones accurately:

> “In Britain, Europe and many other parts of the world, Broadcasters and Audio Engineers more often use the ITU-R 468 noise weighting, which was developed in the 1960s based on research by the BBC and other organizations. This research showed that our ears respond differently to random noise, and the equal-loudness curves on which the A, B and C weightings were based are really only valid for pure single tones.”



ITU- R 468 (blk), A-weighting (blue), and inverse ISO 226 (2003) (red)

Note that this weighting emphasis both the 6kHz region and also the region below 100Hz, relative to the A weighting.

6) The World Health Organisation in its report on Community Noise[4] states that:

4 http://www.who.int/docstore/peh/noise/guidelines2.html

The effect of a combination of noise events is related to the combined sound energy of those events (the equal energy principle). The sum of the total energy over some time period gives a level equivalent to the average sound energy over that period. Thus, LAeq,T is the energy average equivalent level of the Aweighted sound over a period T. LAeq,T should be used to measure continuing sounds, such as road traffic noise or types of more-or-less continuous industrial noises. However, when there are distinct events to the noise, as with aircraft or railway noise, measures of individual events such as the maximum noise level (LAmax), or the weighted sound exposure level (SEL), should also be obtained in addition to LAeq,T.

When the noise consists of a small number of discrete events, the A-weighted maximum level (LAmax) is a better indicator of the disturbance to sleep and other activities. In most cases, however, the A-weighted sound exposure level (SEL) provides a more consistent measure of single-noise events because it is based on integration over the complete noise event. In combining day and night LAeq,T values, night-time weightings are often added. Night-time weightings are intended t to reflect the expected increased sensitivity to annoyance at night, but they do not protect people from sleep disturbance.

7) The WHO report states that for understanding of complex speech, the background noise level should not exceed 35dBA, and preferably be lower in classrooms. Sleep disturbance begins at 30dBA, and:

> “Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep. Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of the equivalent sound level of the noise, as well as in terms of maximum noise levels and the number of noise events. It should be noted that low-frequency noise, for example, from ventilation systems, can disturb rest and sleep even at low sound pressure levels. … Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep.

It further states that noise in bedrooms should not exceed 30dBALeq and 45dB LAmax for single events and that “To protect the majority of people from beingmoderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq”. This is considerably quieter than the 57dBLAeq level.

Part of the table for limits is:

Specific Environment	**Critical health effects**	**LAeq dBA**	**Time base (hours)**	**LAmax fast dB**
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School classrooms	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
School playground	Annoyance (external source)	55	during play	-

8) The DNAP states:

"With regard to night noise PPG24 accords significance to regular exposure at night to noise events in excess of 82 decibels (Lmax) (which is equivalent to 90 dB(A)SEL). This value is based on the results of field research undertaken for the Government in the 1990's, which found that at noise levels of less than 90 dB(A)SEL there was no discernible effect on levels of sleep disturbance.
These guidance values are well established and well founded and have for many years informed the analysis and interpretation of aircraft noise within the United Kingdom."

Yet it seems that this is in direct conflict with the WHO recommendations, and also contradicted by the ANASE report. The noise to be found outside a bedroom window should not exceed 60dB Lamax according to WHO, yet the DNAP implies that 82dB would be acceptable!

9) It is noted that the DNAP mentions that the ATWP calls 57dBA "the onset of community annoyance" and does not mention "significant". Therefore this usage implies this is the point at which people start to get annoyed, not the point at which the majority of people are very annoyed. This distorts the perception that local decision makers and citizens may have of the noise maps.

Thus it can easily be seen that far from noise being generally agreed, the 57dBALeq measure is contentious and flawed.

Impacts of noise

The WHO report states:

> Noise exposure may also produce after-effects that negatively affect performance. In schools around airports, children chronically exposed to aircraft noise under-perform in proof reading, in persistence on challenging puzzles, in tests of reading acquisition and in motivational capabilities. It is crucial to recognize that some of the adaptation strategies to aircraft noise, and the effort necessary to maintain task performance, come at a price. Children from noisier areas have heightened sympathetic arousal, as indicated by increased stress hormone levels, and elevated resting blood pressure. Noise may also produce impairments and increase in errors at work, and some accidents may be an indicator of performance deficits.
>
> Noise can produce a number of social and behavioural effects as well as annoyance. These effects are often complex, subtle and indirect and many effects are assumed to result from the interaction of a number of non-auditory variables.

The effect of community noise on annoyance can be evaluated by questionnaires or by assessing the disturbance of specific activities. However, it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance. This is because annoyance in populations varies not only with the characteristics of the noise, including the noise source, but also depends to a large degree on many non-acoustical factors of a social, psychological, or economic nature. The correlation between noise exposure and general annoyance is much higher at group level than at individual level. Noise above 80 dB(A) may also reduce helping behaviour and increase aggressive behaviour. There is particular concern that high-level continuous noise exposures may increase the susceptibility of schoolchildren to feelings of helplessness.

Stronger reactions have been observed when noise is accompanied by vibrations and contains low frequency components, or when the noise contains impulses, such as with shooting noise. Temporary, stronger reactions occur when the noise exposure increases over time, compared to a constant noise exposure. In most cases, LAeq,24h and Ldn are acceptable approximations of noise exposure related to annoyance. However, there is growing concern that all the component parameters should be individually assessed in noise exposure investigations, at least in the complex cases. There is no consensus on a model for total annoyance due to a combination of environmental noise sources.

This makes it clear that the noise from airports which contains low frequencies, noise impulses and varies over time (as the schedule varies over the day) will have a higher annoyance than the dbALeq measure would imply.

Quota Count

The quota count used for aircraft is determined from characterised data for the model type, not for the individual aircraft. This means that distortions in the airframe (which would cause considerable noise variations due to altered aerodynamics) are not modelled. There are also likely to be ageing effects to the noise characteristics of the engines. The QC points attributed to a arrivals and departures (see [5]) are determined from measures of the Effective Perceived Noise Levels (EPNL) for lateral, flyover and approach. The method used sets

departure QC db = (lateral EPNdb + flyover EPNdb)/2

arrival QC db = approach EPNdb – 9dB

Thus a particular model of A320 has lateral noise of 93.8dB, flyover noise of 87.2dB and approach of 96dB which give rise to

departure QC db = 90.5 dB

arrival QC db = 87dB

The QC points are awarded from a table:

Qualifying level QC Classification

Greater than 101.9 EPNdB 16
99 - 101.9 EPNdB 8
96 - 98.9 EPNdB 4
93 - 95.9 EPNdB 2

5 http://www.caa.co.uk/docs/33/ercd0204.pdf

90 - 92.9 EPNdB 1
Less than 90 EPNdB 0.5
Less than 87 EPNdB Exempt
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hence the departure QC is 1 and the arrival QC is 0.5.
This system is derived from trying to match characterised plane noise to the footprint of annoyance noise levels, but it means that individuals close to the airport will actuaslly be experiencing single noise events considerably higher than the QC implies. Also, if the airport is at the base of the hill, people living on the facing side of the hill will hear noise closer to the lateral level than the flyover level and hence the QC will not necessarily represent the annoyance they experience.
As all of this is base upon A weighting, the faults in that measure also apply here.

The points where the EPNL measures are taken are:
flyover : on line of runway but 6.5km from “start of roll” so typically 4.5km from takeoff point
lateral : at take off point but 450m to the side
approach : on line of runway but 2km before touch down

so anyone living considerably closer than these distances to the airport will hear higher amounts of noise, eg halving the distance would increase noise levels by 6dB (all other things being equal). This would effectively mean the QC burden would go up by a factor of 4 as well, although this may not reflect the perceived increase in annoyance.

It is interesting that the noise complaints are dominated by night noise and peak in the summer season, yet the night QC usage was highest in May. This can be explained by the greater likelihood of people sleeping with windows open or being active outside at night in the summer. A closed window reduces noise by around 10dB, so the same level of noise may not disturb sleep in the winter but cause restless nights in the summer.

The current QC usage appears to be 884 points from a limit of 3100. For comparison, Bristol airport has a total usage of around 1600 from a limit of 2160 for six times as many passengers. There seems no rational for such a high QC limit or usage. Bournemouth airport should aim to reduce night movements, quota points per movement and the total quota count limit.

Noise near the airport

Most people exposed to airport noise in Bournemouth are affected by planes flying over, but others will be more affected by noise directly from the airport and planes on the ground. Several items can be sources of this noise, including surface access, airport vehicles, auxiliary power units (APUs), reverse thrust breaking, engine testing and take-off power.

Changes to practices can help with this, from improved public transport, supply of power to aircraft stands from the terminal, changed flight procedures to avoid excessive breaking, reduction in engine testing. Little can be done about take-off noise other than phasing out older/noisier aircraft. Some benefit can be seen by near neighbours by placing earth embankments, trees and noise walls around the airport to either absorb noise or to deflect it upwards. No mention is made of increasing such measures in the DNAP.