BEFORE THE HEARINGS PANEL
FOR THE QUEENSTOWN LAKES PROPOSED DISTRICT PLAN

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Rural Hearing Stream 2 (Rural Zone chapter)

STATEMENT OF EVIDENCE OF DR STEPHEN GORDON CHILES ON BEHALF OF QUEENSTOWN LAKES DISTRICT COUNCIL

NOISE – INFORMAL AIRPORTS

6 APRIL 2016

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1. INTRODUCTION

1.1 My name is Dr Stephen Gordon Chiles.

1.2 I am an acoustics engineer and independent commissioner, self-employed by my company Chiles Ltd. I am separately employed half-time by the NZ Transport Agency as a Principal Environmental Specialist, responsible for state highway noise and vibration. I am a visiting academic at the University of Canterbury Acoustics Research Group.

1.3 I have a Doctorate of Philosophy in Acoustics from the University of Bath, and a Bachelor of Engineering in Electroacoustics from the University of Salford, UK. I am a Chartered Professional Engineer, Fellow of the UK Institute of Acoustics and Member of the Resource Management Law Association.

1.4 I have been practicing in acoustics since 1996, as a research officer at the University of Bath and as a consultant for the international firms Arup, WSP, and URS, and for the specialist firms Marshall Day Acoustics and Fleming & Barron. I have previously been responsible for acoustics assessments and design for numerous different activities including infrastructure, industrial, commercial, recreational and residential developments. I routinely work for central and local government, companies and individual residents.

1.5 With respect to aircraft noise issues, I have previously worked for the UK Royal Air Force, where I was involved in a wide range of airport environmental noise assessment and control. I was an independent commissioner, hearing plan changes and notices of requirement relating to aircraft noise at Queenstown and Wanaka Airports. I have also worked for a developer regarding potential noise issues from Omaka Airfield, and for the Queenstown Lakes District Council with respect to numerous helicopter landing areas and the skydiving operation at Jacks Point.

1.6 I am convenor of the New Zealand industry reference group for the international standards committee ISO TC43 (acoustics) and its subcommittees SC1 (noise) and SC2 (building acoustics), which is responsible for approximately 200 published “ISO” standards relating to acoustics. I was Chair of the 2012 Standards New Zealand acoustics standards review group;

Chair for the 2010 wind farm noise standard revision (NZS 6808); and a member for the 2008 general environmental noise standards revision (NZS 6801 and NZS 6802).

1.7 I have been engaged by the Queenstown Lakes District Council (**QLDC**) to provide evidence in relation to informal airports in the Rural Zone of the proposed District Plan (**PDP**), in particular in relation to the Rural Zone chapter 21.

1.8 Although this is a Council hearing, I confirm that I have read the Code of Conduct for Expert Witnesses contained in Environment Court Practice Note 2014 and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise, except where I state that I am relying on the evidence of another person.

1.9 The key documents that I have used, or referred to, in forming my view while preparing this brief of evidence are:

(a) QLDC Operative District Plan (**ODP**);
(b) QLDC Proposed District Plan (**PDP**), in particular Chapters 21 (Rural) and 36 (Noise);
(c) an advice letter from Chiles Limited (that I prepared) to Mr Blair Devlin of QLDC relating to Airport Noise, dated 15 September 2012 (in **Appendix A**) (**Chiles Ltd Letter**);
(d) New Zealand Standard NZS 6805:1992 *Airport noise management and land use planning* (**NZS 6805**); and
(e) New Zealand Standard NZS 6807:1994 *Noise management and land use planning for helicopter landing areas* (**NZS 6807**).

2. EXECUTIVE SUMMARY

2.1 The key findings from my evidence are that:

(a) Informal airports can potentially give rise to daytime annoyance, disturbance and amenity effects;

(b) Aircraft sound levels will generally be acceptable if restricted to within the 55 and 50 dB L_{dn} criteria recommended in NZS 6805 and NZS 6807. However, further account needs to be taken of the sporadic and infrequent nature of aircraft movements at informal airports, which is not well represented by average L_{dn} sound levels;

(c) The standards proposed in the PDP for informal airports, with modifications recommended by Mr Barr in Appendix A of his Officer's report, are generally conservative and should result in acceptable sound levels at neighbouring properties. I consider these rules to be appropriate to control noise effects from informal airports; and

(d) I have detailed three possible scenarios under which higher sound levels may arise under the rules for informal airports. However, the aircraft noise would still be constrained by the proposed general rules 36.5.13 and 36.5.14, which provide that sound from any helicopter landing area or fixed wing aircraft airport must be measured and assessed in accordance with NZS 6807 and NZS 6805 respectively. They also must comply with the limits of acceptability set out in those standards.

3. AIRCRAFT NOISE EFFECTS

3.1 Chapter 2 of the PDP defines 'Informal airports' as the use of land or water for the landing, departure, movement or servicing of aircraft and excludes any designated aerodrome, namely Glenorchy airstrip, Queenstown and Wanaka airports.

3.2 With many sources of environmental noise, a key consideration is potential night-time sleep disturbance effects. I understand informal airports are only used during the day and therefore this health effect would not occur. I note however, aircraft operations are only restricted to hours of daylight (approximately between sunrise and sunset) under Civil Aviation Act controls, rather than being restricted to within the ODP and PDP noise rule definition of daytime, which is 0800h to 2000h. Therefore, under the proposed rules for informal airports some aircraft movements could occur outside the district plan daytime period, such as in the early morning during Summer.

3.3 The main potential noise effect from informal airports is temporary disturbance and annoyance. An aircraft take-off or landing is a short duration event, and for locations close to an informal airport the sound might cause startle, momentary distraction, and interference with activities, such as holding a conversation or reading.

3.4 Aircraft can also generate sound while idling on the ground, and when taxiing. The audibility of aircraft on the ground could affect amenity. However, for most aircraft these activities only last for a few minutes. At a receiver over 500 metres away, while the sound may be audible it should not cause unreasonable disturbance.

3.5 Aircraft in flight can be audible over a wide area and can also affect amenity. I am aware the Resource Management Act 1991 (**RMA**) has limitations on the extent to which the noise effects of aircraft in flight can be addressed. In some situations, consideration has been restricted to the noise effects from aircraft only when they are lower than 500 feet above the ground, but in other situations effects have been considered several kilometres from an airport at which point aircraft are higher than 500 feet. For example, noise contours and associated land use controls in district plans extend a significant distance from major airports including Christchurch, Auckland and Queenstown airports.

3.6 For this evidence I have considered aircraft in flight on approach to a landing, or departing following a take-off, to the extent the aircraft in flight might result in certain sound levels. I will discuss this in the following section of my evidence. I have not considered noise effects from aircraft in flight at more distant receivers.

4. NOISE LIMITS - CRITERIA

4.1 I refer to L_{dn} and L_{AE} sound levels in my evidence. These abbreviations mean:

(a) The L_{dn} is the day/night sound level. It is essentially an average level over 24 hours, with any sound occurring at night penalised by +10 dB before being included in the average. For aircraft, the L_{dn} level is usually further averaged over a number of days or months; and

(b) The L_{AE} is the sound exposure level. It is used to represent single events, such as aircraft movements, by summing all of the sound energy during the single event and representing it over one second.

4.2 NZS 6805 and NZS 6807 recommend airport noise limits of 55 dB L_{dn} and 50 dB L_{dn} for fixed wing aircraft and helicopters respectively. The lower limit for helicopters is due to the greater annoyance caused by their characteristic blade sounds. I consider these noise limits to be generally appropriate to determine the point at which noise effects from an airport are acceptable. However, the L_{dn} is an average sound level over three months (fixed wing aircraft) or seven days (helicopters), which in my opinion does not adequately represent noise effects from sporadic infrequent aircraft movements that are usually associated with informal airports.

4.3 I am not aware of a standardised or recommended approach for assessing sound from infrequently used informal airports. As set out in the **Chiles Ltd Letter** in **Appendix A**, 95 dB L_{AE} is a criterion that has been adopted at several airports in New Zealand for individual aircraft movements with respect to sleep disturbance. This could also be used as a guide to daytime noise effects, although the Chiles Ltd Letter shows the L_{dn} criteria are generally more stringent anyway other than for airports with only one or two flights each day.[1]

4.4 Given the absence of an objective parameter to comprehensively quantify noise effects from infrequently used airports, in my opinion in addition to making reference to the sound level criteria discussed above, a broader consideration of noise effects is required when determining appropriate controls. For example, additional controls on the number of movements each day may be an appropriate regulatory response.

5. INFORMAL AIRPORTS ON PUBLIC CONSERVATION OR CROWN PASTORAL LAND

5.1 Proposed Rule 21.5.25 in the PDP permits informal airports that operate under a recreation permit[2] or concession[3] and are at least 500 metres from the

1 At page 4, paragraph 1.
2 Issued pursuant to Section 66A of the Land Act 1948.
3 Issues pursuant to Section 17 of the Conservation Act 1987.

notional boundary of any residential unit or approved building platform.[4] As set out in the Chiles Ltd Letter,[5] the separation distance of 500 metres should result in compliance with a 50 dB L_{dn} criterion for common helicopter types unless there are more than approximately 10 flights a day. There would also be compliance with a 95 dB L_{AE} criterion for individual helicopter movements.

5.2 There is potentially greater variability in sound levels from fixed wing aircraft than helicopters, and also a greater difference between levels to the side of the airport and in the direction of the runway. This variability is due to the wider variety of fixed wing aircraft sizes and types encountered, compared to helicopters. With respect to the runway orientation, fixed wing aircraft always generate higher sound levels along the fixed flight paths in the direction of the runway, whereas helicopters can have variable flight paths and steeper approach angles causing less sound exposure on the flight paths. Based on a recent assessment submitted to QLDC for a fixed wing aircraft airfield using Cessna 182 aircraft, at 500 metres to the side of the runway there would be compliance with 55 dB L_{dn} and 95 dB L_{AE} criteria for up to 10 flights a day. However, compliance might not be achieved in the direction of the runway until approximately 1 km away from the runway, due to the direction the planes take off and land in.

5.3 In summary, under Rule 21.5.25 in the PDP (as recommended by Mr Barr in his Officer's Report) I consider that there will be acceptable sound levels at neighbouring properties from informal airports. While there are three possible examples where acceptable criteria from NZS 6805 and NZS 6807 could be exceeded under this specific rule, which are listed below, these situations would still be constrained by other rules in the Noise Chapter of the PDP, which I will discuss briefly below. I therefore consider proposed Rule 21.5.25 provides a pragmatic and appropriate control.

5.4 The possible examples where sound levels could exceed the recommended criteria under Rule 21.5.25 are:

(a) Informal airports with more than approximately 10 flights a day;

4 Rule 21.5.25 also provides that informal airports for emergency landings, rescues, fire-fighting and activities ancillary to farming activities are permitted activities.
5 At page 2, paragraph 1.

(b) Informal airports for fixed wing aircraft with the runway orientated towards neighbouring houses; and

(c) Informal airports with aircraft types that are significantly noisier than those in common use.

5.5 While these examples are unlikely, they could result in sound levels above the acceptable criteria based on the controls set out in Rule 21.5.25. However, sound levels above acceptable criteria would still be limited by Rules 36.5.13 and 36.5.14 for helicopters and fixed wing aircraft respectively. These rules in the Noise Chapter of the PDP provide that sounds from any helicopter landing area or fixed wing aircraft airport must be measured and assessed in accordance with NZ 6807 and NZS 6805, and must comply with the limits of acceptability set out in those standards. Non-compliance with these rules is a non-complying activity. I understand that these rules are not within the scope of this hearing and will be considered when the Noise Chapter is heard in the District Wide Matters hearing.

5.6 In the notified version of the PDP the 500 metre separation requirement also applies to roads. In terms of noise effects, road users are generally not considered noise sensitive and I am not aware of other aircraft noise controls in New Zealand applying at roads. I consider it is appropriate to remove the requirement of 500 metres separation from roads as they are not noise sensitive locations.

5.7 The PDP permits aircraft movements associated with emergencies, without controls on locations or number of flights, which is common practice and in my opinion is appropriate. Rules 21.5.25.3 and 21.5.26.3 of the PDP also permit aircraft movements for "activities ancillary to farming activities", without restrictions. I note this provision could potentially give rise to undue adverse noise effects if the permitted use of aircraft extends beyond short-duration seasonal agricultural activities. Mr Barr discusses the practical implementation of these provisions in his report, and based on that, I accept this potential effect can be adequately managed under the proposed rules.

6. INFORMAL AIRPORTS ON OTHER RURAL ZONED LAND

6.1 For informal airports on other rural zoned land, Rule 21.5.26 of the PDP applies and also requires a 500 metre separation from any formed legal road or notional boundary of any residential unit or building platform discussed above. In addition, the rule provides a limitation of three flights a week. In response to submissions Mr Barr has recommended this should be increased to two flights a day.

6.2 With the recommended increase to two flights a day, the control for other rural zoned land is still more stringent than the control for public conservation or crown pastoral land under Rule 21.5.25. Of the possible examples listed in paragraph 5.4 above, which are permitted in Rule 21.5.25 but could result in higher sound levels than acceptable criteria from NZS 6805 and NZS 6807, (a) cannot occur in the other rural zoned land as the number of flights is restricted to two a day.

6.3 I consider proposed Rule 21.5.26 provides a pragmatic and appropriate control for noise effects from informal airports in other rural zoned land.

7. SUBMISSIONS

7.1 I have read Mr Barr's summary of submissions relating to the noise controls for informal airports. He has not raised any technical acoustics issues from the submissions, rather in general some submissions seek more lenient controls and some seek more stringent controls.

7.2 As discussed above, in response to submissions Mr Barr has recommended increasing the number of flights permitted in other rural zoned land from three per week to two per day (equating to a maximum of 14 per week). This increased number of flights remains within the envelope discussed in my report in **Appendix A**, and I consider it still constrains aircraft movements to an extent that will maintain acceptable noise effects.

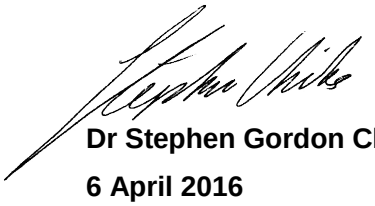
7.3 Mr Barr discusses a submission from the Department of Conservation, requesting that its activities be exempted from Rule 21.5.25. In terms of noise effects, I am not aware of any features that would differentiate these activities from other potential aircraft activities operating under a concession. I therefore

consider that informal airports used by the Department of Conservation should only be permitted on Public Conservation Land by rule 21.5.25 when they are at least 500 metres from the notional boundary of any residential unit or approved building platform not on Public Conservation Land.

7.4 With respect to Mr Barr's other recommendations I note that in my view:

(a) it is appropriate to remove the requirement of 500 metres separation from roads as they are not noise sensitive locations; and

(b) requiring a 500 metre separation from the boundary of other zones is a cautious approach that will further limit potential noise effects.



Dr Stephen Gordon Chiles
6 April 2016

APPENDIX A

CHILES LIMITED LETTER (15 SEPTEMBER 2012)

Chiles Ltd
Private Bag 55037, Christchurch 8154

15 September 2012
Ref: 120502

Queenstown Lakes District Council
Private Bag 50072
Queenstown 9348

Attention: Blair Devlin

Dear Blair

Subject: Airport noise

This letter provides acoustics advice on:

1) A proposed 500 metre buffer/setback distance from helicopter landing areas on Public Conservation or Crown Pastoral Land, and
2) Limitations of the L_{dn} parameter for assessing noise effects of airports with low flight numbers.

500 metre buffer

Southern Planning Group prepared a report on the management of informal airports for the QLDC dated April 2012. Within that report it sets out how informal airports on Public Conservation or Crown Pastoral Land require formal approvals from the Department of Conservation or the Commissioner of Crown Lands respectively. The report suggests that those approvals should be appropriate to manage adverse noise effects on other users within that land. However, those approvals do not consider occupiers of neighbouring land.

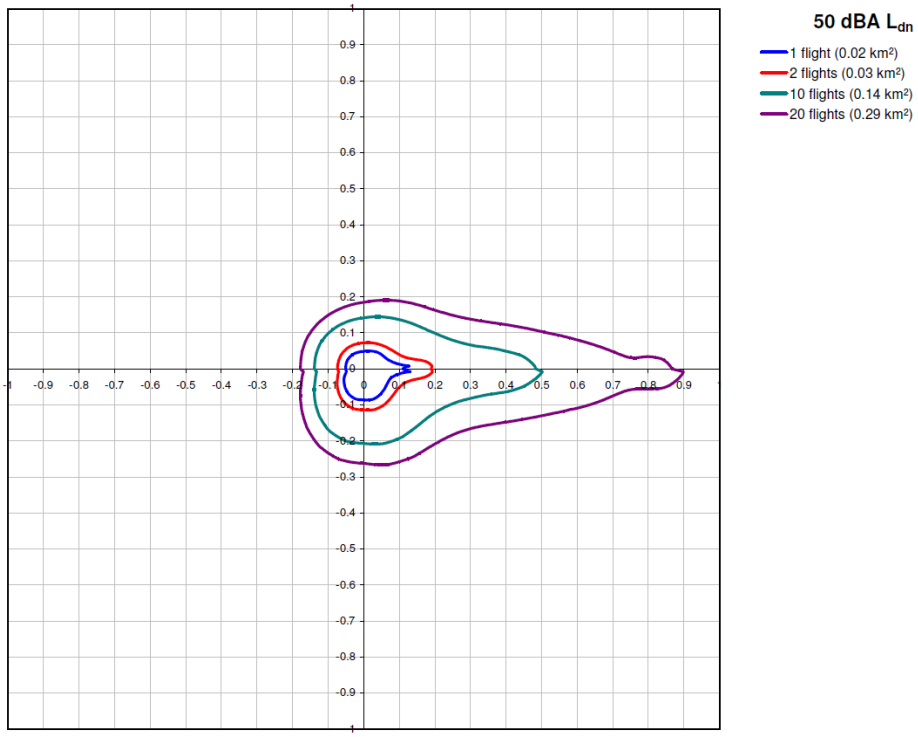
Southern Planning Group suggests that airports on Public Conservation or Crown Pastoral Land could be made permitted activities under the Queenstown Lakes District Plan, but proposes a 500 metre buffer/setback to control any noise effects on neighbouring land. This letter discusses that proposed setback.

Noise effects from helicopters are usually assessed using NZS 6807, which recommends a noise limit of 50 dB L_{dn} at the notional boundary of houses in rural areas (the notional boundary is 20 metres from a house). Experience from existing informal airports in the Queenstown Lakes District is that the 50 dB L_{dn} criterion is usually achieved within a few hundred metres. The actual distance depends on:

- aircraft types,
- aircraft flight paths,
- number and time of movements, and
- terrain.

In previous work for Lakes Environmental Ltd, the author examined a hypothetical airport on flat ground with an AS350 helicopter. The following figure shows the 50 dB L_{dn} contour for different flight numbers, predicted using INM v7.0 software, on a grid extending 1 km in each direction from a

landing site at the centre of the figure. The green contour shows that if there are 10 flights (10 landings and 10 take-offs, being 20 movements) in a day then in the direction of the arrival and departure flight path (to the right of the figure) the 50 dB L_{dn} contour extends to approximately 500 metres. In other directions the contour only extends to approximately 200 metres. If steeper arrival and departure flight paths were used then the extent of the contour could be reduced.



There has previously been debate with respect to resource consent applications in the Queenstown Lakes District as to whether NZS 6807 and the 50 dB L_{dn} criterion are appropriate controls for helicopter noise. In the case of Plan Change 27A, the NZS 6807 criteria were removed from the proposed district plan noise rules during mediation, and as a result there is not a specific helicopter noise limit in the district plan. Our opinion is that, subject to the discussion below on sites with low movement numbers, NZS 6807 and the 50 dB L_{dn} criterion do provide an appropriate control for helicopter noise.

The proposed permitted activity rules for informal airports on Public Conservation or Crown Pastoral Land do not explicitly limit the factors that determine the extent of the sound level contours detailed above. However, from our experience of informal helicopter landing areas in the Queenstown Lakes District it would be unusual to have as many as 10 flights a day. Therefore, the proposed 500 metre setback would generally result in a noise level at neighbouring land within the NZS 6807 criterion of 50 dB L_{dn}, which we consider acceptable.

If greater certainty is desired then the rules could be extended to specify:

- A maximum of 10 flights (20 movements) a day, and
- No flights at night (2200h to 0700h).

The disadvantage of specifying a limit on flights is that airports that are significantly further from neighbouring land would be unnecessarily constrained, or would be unable to take advantage of the permitted activity status.

Low flight numbers

Subjective response to aircraft (fixed wing and helicopter) noise depends on a range of factors. The main factors are the:

- noise level of each aircraft movement,
- number of aircraft movements, and
- time of day of aircraft movements.

The L_{dn} criteria in NZS 6805 (airports) and NZS 6807 (heliports), provide a method to combine these factors in a way that has been shown to correlate to subjective response. The L_{dn} is an average noise level over 24 hours and is sometimes described as a 'noise bucket'. The bucket is filled quicker by noisier aircraft movements and hence the number of flights and their noise levels can be traded-off to some extent. The L_{dn} also includes a penalty for any flights at night, which fill the noise bucket ten times more than the same flights during the day. For informal airports there generally are no night flights.

The L_{dn} provides an effective framework for managing noise effects from airports. However, NZS 6805 is not designed for informal airports and NZS 6807 is only intended to apply to helicopter landing areas with more than ten movements in a month. Regardless of the stated scope of the Standards, it is considered that the L_{dn} criteria do provide a useful reference point for assessment of informal airports. For busier informal airports, such as sky-diving operations for example, it is recommended that the L_{dn} criteria should still be applied, with additional controls if necessary.

An issue with informal airports having low flight numbers is that the L_{dn} criteria could allow excessively noisy individual events. The report by Southern Planning Group suggests that the QLDC could devise specific criteria for informal airports, and indicates that this may be in terms of a sound exposure level (SEL), L_{AE}, which would control individual events.

The L_{AE} is the total sound energy of a single aircraft movement. The L_{dn} 'spreads' sound from all movements over 24 hours, whereas the L_{AE} represents all sound from a single movement effectively in 1 second, hence values of L_{AE} are higher than values of L_{dn}. For example, if a movement has a L_{AE} value of 95 dB, and there are 20 such movements in a day the resulting L_{dn} (59 dB) can be calculated as follows (assuming none of the movements are at night):

L_{dn} =	**L_{AE}**	**+10×log(number of movements)**	**- 10×log(time in seconds)**
L_{dn} =	95 dB L_{AE}	+10×log(20 movements)	- 10×log(24×60×60 seconds)
L_{dn} =	95 dB L_{AE}	+13 dB	- 49 dB
L_{dn} =	59 dB		

In NZS 6805 the primary L_{dn} criterion is 55 dB and in NZS 6807 it is 50 dB (this is more stringent to account for the particular characteristics of helicopter sound). The following table shows the maximum

L_{AE} for a given number of flights (two movements each) that would result in compliance with these L_{dn} criteria.

Number of flights (2 movements)	Maximum L_{AE} to meet 55 dB L_{dn} (NZS 6805)	Maximum L_{AE} to meet 50 dB L_{dn} (NZS 6807)
1	101 dB L_{AE}	96 dB L_{AE}
2	98 dB L_{AE}	93 dB L_{AE}
5	94 dB L_{AE}	89 dB L_{AE}
10	91 dB L_{AE}	86 dB L_{AE}
20	88 dB L_{AE}	83 dB L_{AE}

It can be seen from the table that for low daily flight numbers high values of L_{AE} would be possible for individual flights/movements. The resulting adverse effects might not being well represented by the daily average L_{dn}. This could be avoided by also setting a L_{AE} criterion as suggested by Southern Planning Group.

Within New Zealand we are not aware of a precedent that links subjective responses to a particular L_{AE} criterion. If this issue is pursued, a search could be conducted of international literature to seek further guidance/research. For major airports in New Zealand, 95 dB L_{AE} is often proposed for night-time noise on the basis of sleep disturbance. This established use of a 95 dB L_{AE} criterion for night-time noise might indicate that it would also result in reasonable daytime aircraft noise effects. However, as shown in the table above, this would be achieved in most cases regardless, and potentially a lower L_{AE} criterion could be considered for informal airports.

A 95 dB L_{AE} criterion would have an influence on fixed wing airports with very low flight numbers. For example, if there was a noise limit of 55 dB L_{dn} (NZS 6805), but an airport only had one flight a day, then as shown in the table, the L_{AE} of each movement could be as high as 101 dB L_{AE}. In this instance the imposition of a 95 dB L_{AE} criterion would limit the potential noise effects. This criterion could be achieved with a relatively short setback distance, generally within 100 m if not on the flight path.

An additional issue for informal airports with low flight numbers is that anecdotally the relationship between subjective response to aircraft noise and the L_{dn} appears to be weaker. For low movement numbers subjective responses may be related to the number of movements more so than the noise level (L_{AE}) of each movement. Consequently, in consent RM060820 for example, a maximum number of flights (4/day) was imposed in addition to a L_{dn} limit.

In summary, possible controls for noise from informal airports include:

- L_{dn} criteria,
- L_{AE} criteria,
- Maximum numbers of flights, and
- Setback distances.

For informal airports with low movement numbers we are not aware of robust precedents in New Zealand that could be used to accurately combine these factors to relate to subjective response. For the Rural General Zone, Southern Planning Group proposes permitted activity rules for informal airports as a maximum number of flights (3/day) and a setback (500 m). This is a relatively

conservative approach that has the advantage of being straightforward to monitor and avoids the need for an acoustics specialist.

In other zones a conservative 500 m setback generally cannot be accommodated, and it may be more appropriate to set criteria in terms of L_{dn} and/or L_{AE}. While this adds complexity to the assessment and compliance monitoring, it allows the conservatism to be removed. L_{dn} criteria can be taken from NZS 6805 (55 dB L_{dn}) and NZS 6807 (50 dB L_{dn}), but these should be augmented with a L_{AE} criterion or setback distance, and a limit on the number of flights.

There is not a simple standard currently available for informal airports. A number of potential controls are discussed above, but broader judgement may be required to determine appropriate values for some parameters.

Yours sincerely
Chiles Ltd

Dr Stephen Chiles