

Before an Independent Hearings Panel
appointed by Christchurch City Council

under: the Resource Management Act 1991

in the matter of: the hearing of submissions on Plan Change 14 (Housing
and Business Choice) to the Christchurch District Plan

and: **Christchurch International Airport Limited**
Submitter 852

Summary of Evidence of Christopher Day (Acoustics)

Dated: 23 April 2024

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SUMMARY OF EVIDENCE OF CHRISTOPHER DAY

INTRODUCTION

- 1 My name is Christopher Day. I have worked in the field of acoustics, noise measurement and control for the past 50 years. My firm, Marshall Day Acoustics, is one of the largest acoustic engineering consultancies worldwide and has been engaged by Christchurch International Airport Limited (*CIAL*) since 1992 to advise on various noise related issues.
- 2 I prepared a brief of evidence addressing the relief sought by CIAL on the proposed Plan Change 14 (Housing and Business Choice) to the Christchurch District Plan (*PC14*).¹ I participated in expert conferencing on airport noise matters for PC14 and am a signatory of the joint witness statement (*Airport Noise JWS*).² I also prepared rebuttal evidence that responded to the briefs of evidence of other submitters.³
- 3 My colleague, **Ms Laurel Smith**, also prepared a brief of evidence, is a signatory to the Airport Noise JWS and prepared rebuttal evidence. I refer to the memorandum of counsel filed on behalf of CIAL⁴ that explains that Ms Smith was not available to attend this hearing. I am available to answer questions relating to acoustic matters addressed in Ms Smith's evidence. I understand that **Mr Sebastian Hawken** is available to answer questions arising from Ms Smith's evidence that relate to the noise contour remodelling process.
- 4 I understand that all of the noise evidence, including rebuttal and the JWS for airport noise, has been pre-read by the Panel. This summary statement addresses the key noise issues in dispute, as I understand them, following the exchange of evidence and expert conferencing.
 - Why should 50 dB L_{dn} be retained for land use planning for the purposes of PC14?
 - Does acoustic insulation resolve all the issues with aircraft noise effects?
 - Is the risk of reverse sensitivity real?
 - Was the process used to develop the recently remodelled noise contours appropriate?

¹ Dated 20 September 2023.

² Dated 7 November 2023.

³ Dated 14 November 2023.

⁴ Dated 14 March 2024.

WHY SHOULD 50 dB L_{dn} BE RETAINED FOR LAND USE PLANNING FOR THE PURPOSES OF PC14?

- 5 My evidence explains in detail why the existing approach of using the 50 dB L_{dn} contour for Christchurch International Airport as the point at which land use planning controls commence is the appropriate approach to be used at Christchurch. Key points are summarised below.
- 6 The noise boundary approach for Christchurch Airport has been used for a long period of time and has enabled the authorities to achieve a buffer or 'greenbelt' ensuring that new residential development does not come too close to Christchurch Airport. A Noise Exposure Line and a 50 dB L_{dn} noise contour have been used at Christchurch since 1975. Subsequently many hearings involving a number of noise experts, have debated and reconfirmed 50 dB L_{dn} as the appropriate point to commence land use controls in Christchurch.
- 7 Two significant studies into community annoyance to aircraft noise have been published in the last six years - FAA 2021 and WHO 2018. The clear conclusion from the recent studies (outlined at Figure 2 of my evidence) is that community annoyance from aircraft noise is significantly higher today than the results from 20 to 40 years ago – those previous results were used to develop the recommendations in NZS 6805:1992 and informed the basis for land use planning controls relating to the Christchurch Airport noise contours in previous Christchurch District Plans.
- 8 Four out of the five JWS noise experts agreed (Mr Styles "generally") that the WHO 2018 curve provides a reference for aircraft noise annoyance response (18% to 27%HA at 50 to 55 dB L_{dn}). Prof Clarke considers the Gjestland 2020 curve is a "reasonable compromise" (10% to 17%HA at 50 to 55 dB L_{dn}).
- 9 Either way, all of these studies show a greater level of annoyance than what the research showed when NZS 6805 was developed and when the Christchurch planning regime was first established (Schultz 1992 2% to 4% HA).
- 10 The lower annoyance levels in the 2001 Miedema and Oudshoorn data (6% to 12% HA) was sufficient to convince decision makers at several hearings that I have previously been involved in, that 50 dB L_{dn} should be retained at Christchurch.
- 11 The WHO 2018 "Environmental Noise Guidelines for the European Region" support 50 dB L_{dn} as a conservative guide. The first paragraph under the heading 'Aircraft Noise – Recommendation' states;

"For average noise exposure, the Guideline Development Group (GDG) strongly recommends reducing noise levels produced by aircraft below 45 dB L_{den} ,⁵ as aircraft noise above this level is associated with adverse health effects".

- 12 The second paragraph under the same heading says;

"For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night time below 40 dB L_{night} , as night-time aircraft noise above this level is associated with adverse effects on sleep".

The L_{night} parameter has been developed by the WHO to assess noise induced sleep disturbance. The 40 dB L_{night} contour for Christchurch Airport is roughly the same size and shape as the 50 dB L_{dn} noise contour (see Figure 5 evidence of Ms Smith). This further supports the updated 50 dB L_{dn} location for planning controls.

- 13 Planning controls at other New Zealand airports vary depending on the circumstances – some are less stringent than Christchurch (Wellington has no Outer Control Boundary) and one is more restrictive (at Queenstown Airport new residential development is prohibited inside the 55 dB L_{dn} contour for rural land).

- 14 District Plan noise limits for general (non-transportation) noise sources are set at 50/40 dB L_{Aeq} (approximately 50 dB L_{dn}) for Christchurch (and many other regions). If the Council have thus deemed that it is reasonable to protect people from general industry making more than 50 dB L_{dn} , why would we then deliberately allow people in the same noise sensitive activities establish next to an existing noisy activity at levels higher than 50 dB L_{dn} .

- 15 Ms Aston quotes⁶ noise limits for road noise (57 dB) and rail noise (55 dB) to support using 55 dB for aircraft noise. What Ms Ashton may not be aware of is that the community response to aircraft noise is significantly more adverse than it is for road and rail. This is shown in the work by Miedema and Ourdshoorn 2001 and also later in the 2010 European Environment Agency document, *"Good practice guide on noise exposure and potential health effects"*. On page 24 it provides the following table of annoyance for different noise sources.⁷ This table shows that for aircraft noise 18% of the

⁵ L_{den} is effectively the same as L_{dn} .

⁶ Statement of evidence of Ms Fiona Aston dated 20 September 2023 at paragraph 45.

⁷ Page 24 of the European Environment Agency Technical report No 11/2010 *Good practice guide on noise exposure and potential health effects*.

population is highly annoyed whereas for road and rail it is 4% and 2% respectively.

Table 6.1 Comparison of L_{den} values for different sources with respect to annoyance

Percentages of highly annoyed					
L_{den}	Road	Rail	Aircraft (revised estimate)	Industry	Windturbine
55 dB	6 %	4 %	27 %	5 %	26 %
50 dB	4 %	2 %	18 %	3 %	13 %
45 dB	1 %	0 %	12 %	1 %	6 %

- 16 All this data supports my view that the existing planning framework at Christchurch should not be relaxed through PC14.

DOES ACOUSTIC INSULATION RESOLVE ALL THE ISSUES WITH AIRCRAFT NOISE EFFECTS?

- 17 The main area of disagreement between the noise experts appears to be that Prof Clarke and Mr Styles consider that density controls are not necessary to reduce the effects of aircraft noise because ‘acoustic insulation and ventilation will solve the noise issues’. This is a matter that has been raised many times previously and I disagree with this opinion for a number of reasons.
- 18 Firstly, acoustic insulation does not reduce the noise effects in the outdoors. I refer to Mr Darryl Millar’s rebuttal evidence which explains that the planning framework anticipates that outdoor living spaces form an integral part of the residential environment,⁸ and Mr David Compton-Moen’s rebuttal evidence which explains that “*the provision of high quality private outdoor living spaces generally becomes more significant as densities increase*”.⁹
- 19 Secondly, acoustic insulation is negated when people open their windows. My experience is that people like to open their windows rather than rely totally on air-conditioning. It is interesting to note that all experts agreed (in the JWS) that “a disadvantage of insulation options is that windows must be kept shut”.
- 20 Thirdly, Professor Clarke and Mr Styles are of the opinion that part of the annoyance reported in the community response studies is caused by ‘non acoustical factors’. However, their solution to the annoyance problem is to provide acoustic insulation. Clearly, acoustic insulation will have no effect on alleviating annoyance due to ‘non acoustical factors’. On the other hand, avoiding

⁸ Rebuttal evidence of Mr Darryl Millar dated 14 November 2023 at paragraph 24.

⁹ Rebuttal evidence of Mr David Compton-Moen dated 14 November 2023 at paragraph 9.

intensification around Christchurch Airport will prevent additional people being exposed to 'non acoustical factors'.

- 21 Finally, it is interesting to note that the Operative District Plan internal noise requirement of 40 dB L_{dn} , can be met with standard house construction materials and with the windows open – no noise mitigation will be required for new dwellings within the 50 to 55 dB L_{dn} band (agreed by all in the JWS).
- 22 It is also noteworthy that the respondents to the community noise surveys (summarised above) in the 50 to 55 dB L_{dn} band will be living in houses that achieve this same indoor sound level (40 dB L_{dn} or less) but they report significant levels of annoyance (10% to 27% HA).
- 23 All experts agree that Land Use Planning (including density controls) is one of the four internationally sanctioned tools¹⁰ to manage the adverse effects of noise on people (JWS item 1). The other experts have offered acoustic mitigation as an alternative tool however, as discussed above, it doesn't resolve all the issues with aircraft noise effects. On the other hand, I haven't seen a compelling acoustic reason offered for why density controls shouldn't be used.

IS THE RISK OF REVERSE SENSITIVITY REAL?

- 24 Some of the experts don't appear to accept that reverse sensitivity is a real issue. In my opinion, reverse sensitivity is a very real effect for airports worldwide. Costly operational constraints have been implemented at many.
- 25 Schiphol Airport in the Netherlands is incurring significant costs and constraints on operational efficiency to reduce the number of people inside their noise contours by way of noise abatement measures (cutting flights and curfews) as explained in my primary evidence. This real world example begs the question in my mind, why would you willingly increase the number of people inside the noise contours through intensification in this case (the applicable contour for Christchurch being the 50dB L_{dn} contour, as explained above)?
- 26 Curfews at airports such as Wellington are a direct operational constraint caused by the adverse effects of aircraft noise on people – reverse sensitivity in action.
- 27 I can understand that a regulatory authority may ultimately decide that land that is compromised by aircraft noise has to be used for residential purposes because there are extreme shortages of

¹⁰ I refer to Mr Sebastian Hawken's evidence at paragraph 53 which outlines the International Civil Aviation Organisation *Balanced Approach to Aircraft Noise Management*.

residential land elsewhere. However, I can't understand why a noise consultant would support increasing the number of people exposed to noise levels where 10% to 27% of the population will be highly annoyed – either from a reverse sensitivity point of view or for the adverse effects on residents' health.

- 28 In the Airport Noise JWS, Mr Styles and Mr Chiles (for NZTA) recommend that "airport management policies and practices should have regard to existing effects on communities". CIAL have several management policies and practices in place to reduce noise effects – they have annual noise compliance monitoring and sound insulation programmes. Requests to increase noise management practices such as modifying flight tracks is a practical example of reverse sensitivity at work. In any case, CIAL do not determine how and where aircraft fly.

WAS THE PROCESS USED TO DEVELOP THE REMODELLED NOISE CONTOURS APPROPRIATE?

- 29 Some of the technical remodelling assumptions have been criticised and I understand that the question of whether the outer envelope or annual average remodelling approach should be preferred has also been raised. I address these issues below.

Noise contour remodelling assumptions

- 30 Professor Clarke has criticised some of the noise modelling assumptions. In the Airport Noise JWS he stated the 'remodelling should have included quiet aircraft assumptions as well as improved flight tracking accuracy'.
- 31 'Improved flight track accuracy' generally means concentrated flight tracks due to improved navigational systems. Concentrated tracks can have a benefit to some people, but can also make it worse for people directly under the flight paths.
- 32 Noise reductions due to aircraft technology appear to have plateaued in my opinion - only minor gains appear likely in the medium to near future (see my evidence Figures 4 & 5). Certainly nothing significantly quieter will be flying into Christchurch within the next ten years due to the length of time it takes to get new designs into operation for safety reasons.
- 33 Electric aircraft will only operate on regional routes – a small contributor to the noise contours. Jet aircraft may end up burning hydrogen instead of aviation fuel in their turbine engines, but no significant noise reduction is anticipated.
- 34 Professor Clarke states in paragraph 19 of his evidence that "*It does not make sense to assume that aircraft noise will not decline over the next 60 years.*" Marshall Day Acoustics is involved with noise

monitoring at all the major airports in New Zealand. Leaving aside the COVID years, all of these airports have shown an increase in airport noise over the years of monitoring. This is because the growth in air traffic outstrips the small reductions in aircraft noise.

- 35 In the unlikely event that a reduction in airport noise does eventuate in the long term, this will inform the next review of the noise contours for Christchurch Airport in what I understand will be 10 years time.
- 36 My colleague, Ms Smith, has explained the detailed remodelling process and the year long peer review process in her evidence. Mr Hawken can also speak to this. ECan's peer review panel was a highly qualified collection of experts who recommended amendments to some of the assumptions in the original remodelling – it was a highly robust process. None of these experts recommended making assumptions about hypothetical future quiet aircraft technology and an appropriate level of flight track accuracy was agreed in the process to achieve the final contours.
- 37 In my opinion the remodelled contours represent the best estimate available of the future level of aircraft noise at Christchurch International Airport. They have undergone significant peer review by ECan's expert panel.

Outer Envelope versus Annual Average

- 38 These two concepts are explained in the evidence of Ms Smith. In short, the OE uses the worst case (highest) use of each runway over a three month period and the Annual Average is just that, a measurement of the average noise exposure over a one-year period.
- 39 From a technical acoustics perspective, either approach is valid. Overall, in this context, the OE is preferred because;
- The OE approach has been used for the north-west runway in the two previous iterations of the Christchurch Airport Noise Contours;
 - 3 month averaging is recommended in NZS 6805; and
 - The OE provides a more accurate representation of the aircraft noise effects, particularly for the people under the north west approach path over Christchurch City, during the seasonal bias due to north west winds. I note that seasonal bias is during Spring, at a time when people like to be outdoors and/or have their windows and doors open.

CONCLUSION

- 40 There is no doubt there are adverse effects from aircraft noise at 50 dB L_{dn} as shown by the various research studies (**Figure 2**).
- 41 From a noise perspective, it is my opinion that 50 dB L_{dn} should be retained as the commencement of land use planning restrictions around Christchurch Airport and intensification should be avoided.

Dated: 23 April 2024

Christopher Day