MARSHALL DAY Acoustics

CHRISTCHURCH AIRPORT NOISE MONITORING 2022 NOISE MONITORING REPORT

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Project: **CHRISTCHURCH AIRPORT NOISE MONITORING**

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DEFINITIONS AND ACRONYMS

Definitions

Aircraft Operations	Also referred to as 'Operational Noise' (refer Section 6.1) a) the landing and take-off of aircraft; and b) aircraft flying along any flight path associated with a landing or take-off. For the purposes of Rule 6.1.6 Activity specific noise rules, it excludes: a) aircraft operating in an emergency for medical or national/civil defence reasons; b) air shows; c) military operations; d) Antarctic operations; e) helicopter operations; f) aircraft using the airport as an alternative to a scheduled airport elsewhere; g) aircraft taxiing; and h) aircraft engine testing.
Air Noise Compliance Contour	The 65 dB L_{dn} noise contour included in the Christchurch District Plan that cannot be exceeded. The determination of compliance or otherwise with this control is demonstrated by the preparation of the AANC for the preceding year's aircraft operations and reported annually.
Air Noise Boundary (ANB)	A composite line formed by the outer extremity of the 65 dB L_{dn} noise contour and the 95 dB L_{AE} noise contour. The Air Noise Boundary defines an area in which the future daily aircraft noise exposure from aircraft operations is sufficiently high as to require land use planning controls
Decibel (dB)	The unit of sound level. Expressed as a logarithmic ratio of sound pressure relative to a reference pressure
L_{AE}	The Sound Exposure Level. The sound level of one second duration which has the same amount of energy as the actual noise event measured. Usually used to measure the sound energy of a particular event, such as an aircraft flyover
L_{Aeq}	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.
L_{dn}	The day night noise level which is calculated from the 24-hour L_{Aeq} with a 10dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
Noise Calculations	Noise levels calculated using computer modelling software, typically to predict current and future noise levels. Noise measurements are used to verify accuracy of calculated noise levels.
Noise Measurements	In-situ noise measurements of actual noise levels using either semi-permanent noise monitoring terminals or hand-held equipment (sound level meters).
Noise Monitoring	Monitoring of noise levels (generally with respect to assessing compliance with the District Plan), using both noise measurements and calculated noise levels.
On-Aircraft Engine Testing	The testing of engines on aircraft.

Acronyms

AANC	Annual Aircraft Noise Contour
ANB	Air Noise Boundary
ANLC	Airport Noise Liaison Committee

CIAL	Christchurch International Airport Limited
ETMS	Engine Testing Management Software
INMP	Integrated Noise Modelling Program
NMP	Noise Management Plan
NMR	Annual Noise Monitoring Report
NZS 6805	New Zealand Standard NZS 6805:1992 “Airport Noise Management and Land Use Planning”
USAP	United States Antarctic Programme

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1.0 INTRODUCTION

Christchurch International Airport Limited (CIAL) is required to prepare an Annual Noise Monitoring Report each year in accordance with the provisions of Chapter 6 of the Christchurch District Plan (CDP).

This report has been prepared by Marshall Day Acoustics (MDA) on behalf of CIAL and provides an overview of the noise monitoring programme for 2022 including:

- Calculation of noise contours known as the Annual Aircraft Noise Contours (AANC) to determine compliance;
- Analysis of measured aircraft operations noise levels, to verify the calculated AANC;
- Analysis of calculated engine testing noise levels from the Engine Testing Management Software (ETMS) to determine compliance;
- Update of the Acoustic Treatment Programme (ATP) schedule of eligible dwellings;
- Summary of noise complaints.

Measurement of engine testing noise levels to verify the ETMS calculations occurred in 2021, therefore is not required for the 2022 noise monitoring programme.

2.0 STATUTORY REQUIREMENTS

The full list of rules relating to airport noise compliance at Christchurch is given in Appendix A.

Rule 6.1.6.2.5 iv of the Christchurch District Plan requires CIAL to prepare and submit annually an aircraft operations noise monitoring report, including the following information:

- the calculated AANC;
- the results of the verification measurements (if conducted);
- analysis of compliance with reference to Rule 6.1.6.2.5 a.i. and ii. (including the number of exceedances and the reasons for them); and
- a summary of complaints received over the previous year in relation to noise from aircraft operations, and any actions taken in response.

Rule 6.1.6.2.6 vi of the Christchurch District Plan requires CIAL to prepare and submit annually an on-aircraft engine testing noise monitoring report, including the following information:

- the results of verification measurements in accordance with activity standard v.B.; and
- analysis of compliance with reference to Rule 6.1.6.2.6 a.i.; and
- a summary of complaints received over the previous year in relation to noise from on-wing aircraft engine testing, and any actions taken in response.

Rule 6.1.6.2.7.2 of the Christchurch District Plan sets out the requirements for CIAL to implement an Acoustic Treatment Programme (ATP) and identify annually if additional dwellings become eligible for treatment within the AANC 65 dB L_{dn} contour.

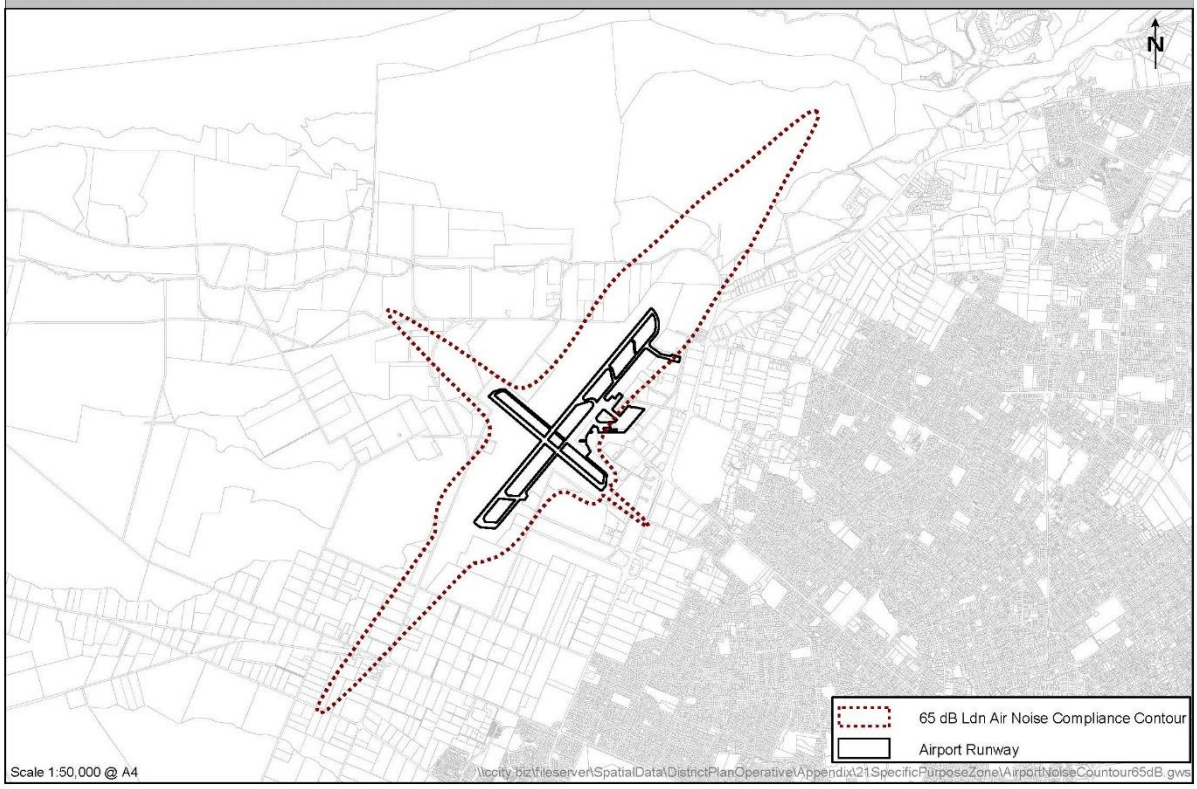
The following noise monitoring report details information required under both 6.1.6.2.5 (iv) (aircraft operations) and 6.1.6.2.6 (vi) (on aircraft engine testing) and provides an updated schedule of eligible dwellings for the ATP. The purpose of this report is to assess compliance of aircraft operations with rule 6.1.6.2.5 (a) and on-aircraft engine testing with rule 6.1.6.2.6 (a)(i) and (v) for the period of 1 January 2022 to 31 December 2022.

2.1 Noise Limits - Aircraft Operations

Aircraft operational noise limits are set in rule 6.1.6.2.5 (a) (i):

"Noise from aircraft operations shall not exceed 65 dB Ldn outside the 65 dB Ldn Air Noise Compliance Contour shown in Figure 1, other than as provided for in Rule 6.1.6.2.5 (a) (ii)."

Figure 1: Map of 65 dB Ldn Air Noise Compliance Contour



insert from rule 6.1.6.2.5 (a) (i) in the Christchurch District Plan.

Rule 6.1.6.2.5 (a) (iii) of the District Plan describes the noise monitoring required to determine compliance with rule 6.1.6.2.5 (a) (i).

2.2 Noise Limits - On Aircraft Engine Testing

Table 5 in rule 6.1.6.2.6 (a) of the District Plan sets out noise limits for on-aircraft engine testing. These are reproduced in Table 1 below.

Table 1: On-aircraft engine testing noise limits

Noise Limit	Engine testing compliance monitoring positions (ETCMP) – refer Figure 2
65 dB Ldn, 7 day	8 points
55 dB Ldn, 7 day	8 points
75 dB L_{Amax} 22:00 to 07:00 only	Edge of residential zone – 3 points

Rule 6.1.6.2.6 (a) (v) of the District Plan describes the monitoring required to determine compliance with rule 6.1.6.2.6 (a).

3.0 OPERATIONAL NOISE

As defined in the Christchurch District Plan, aircraft operational noise includes:

The landing and take-off of aircraft and aircraft flying along any flight path associated with a landing or take-off. Operational noise excludes aircraft operating in an emergency for medical or national/civil defence reasons, air shows, military operations, Antarctic operations, helicopter operations, aircraft using the airport as an alternative to a scheduled airport elsewhere, aircraft taxiing and aircraft engine testing.

3.1 Summary of Operational Aircraft Movements

Prior to COVID-19, Christchurch Airport had approximately 80,000 - 110,000 aircraft movements per year, of which around 75,000 to 80,000 were scheduled commercial movements.

The pandemic caused a sudden decrease in operations in 2020 and aircraft movements have been gradually increasing since then but have not yet reached pre-pandemic levels. Aircraft movement data from Airways Corporation NZ for the year 2022 shows there were:

- 62,143 scheduled commercial aircraft movements, and
- 84,330 total aircraft movements.

Scheduled commercial movements over the last 8 years are as shown in Table 2 below.

Table 2: Scheduled Commercial Aircraft Movements

Aircraft Movements	2022	2021	2020	2019	2018	2017	2016	2015
Scheduled Commercial Movements	62,143	56,813	49,084	75,663	75,738	76,585	74,130	74,144

The busiest three months for scheduled aircraft movements in 2022 were October, November and December. A summary of the aircraft movement data from this period used to calculate the 2022 Annual Aircraft Noise Contours (AANC) is provided in section 3.2 of this report.

3.2 Modelling Methodology

The 2022 AANC has been calculated using the latest version of the Aviation Environmental Design Tool (AEDT3e) developed by the US Federal Aviation Authority. Previous AANC were calculated using the Integrated Noise Model (INM) software to be consistent with the software used to produce the Christchurch District Plan contours. The INM has been replaced by the AEDT and is no longer supported or updated with data for new aircraft types. In New Zealand there is no national statutory requirements for noise modelling software and the Christchurch District Plan does not define the software to be used.

The AEDT has been used for the 2022 AANC for the following reasons:

- AEDT contains noise data for newer aircraft types that are now prevalent in New Zealand whereas the INM does not;
- Recent flight path analysis for Christchurch Airport has been modelled in AEDT rather than INM meaning the AEDT model contains more accurate flight paths for current operations.

A review of the AEDT shows that predicted noise levels are very similar to the INM for the same operational scenarios therefore is reasonably consistent with the software used to produce the Christchurch District Plan contours.

The 2022 AANC is based on aircraft movements provided by Airways Corporation NZ. The definition of aircraft operations in the Christchurch District Plan (given in Appendix A) excludes military, Antarctic and helicopter movements therefore these are not included in the AANC calculation. The busiest three months were determined by the scheduled commercial movements.

The busiest consecutive three months for scheduled commercial movements in 2022 was October, November and December in accordance with rule 6.1.6.2.5 (iii) (b).

A diagram of the Christchurch Airport runway system is included in Appendix B for reference.

The 65 dB L_{dn} Air Noise Compliance Contour in the Christchurch District Plan was developed without inclusion of GA operations. Therefore, the AANC are also prepared without inclusion of GA movements.

Based on the nature and frequency of GA flights at the time of preparing the 65 dB L_{dn} Air Noise Compliance Contour, it was considered that GA aircraft noise would not significantly affect the extent of the noise contours. It was also noted that GA aircraft are generally light aircraft.

The 2009 CIAL Noise Monitoring Report confirmed that noise from light aircraft does not contribute significantly to overall noise levels within the 65 dB L_{dn} contour, this conclusion was confirmed in all subsequent noise monitoring reports to date. A review of the annual number of GA movements between 2008 and 2022 shows that GA activity is still at a lower relative level (compared with scheduled commercial operations) than 2009 so this conclusion remains valid, even taking into account the drop off of international movements relative to domestic flights. MDA has previously calculated the effect of GA operations on the AANC and conclude that GA operations typically contribute less than 0.1 dB to the noise contours which is a negligible difference.

The movements for the modelled scenario are shown in Table 3 as well as a breakdown of the day and night-time movements. Night-time movements are those that occur between 10pm and 7am. The number of night-time movements is relevant as night-time activity receives a +10 decibel weighting when calculating L_{dn}.

Table 3: Summary of modelled aircraft movements

	Busiest 3 Months (Oct, Nov, Dec 2022)
Total Movements	17,228
Day Time Movements	15,297
Night-time Movements	1,931

A summary of the total aircraft movements by month is shown in Table 4 and a breakdown of the average daily aircraft movements by aircraft type and runway is included in Table D1, Appendix D.

Table 4: Summary of 2022 scheduled aircraft movements

Month (2022)	Monthly total	Consecutive 3 months total
Jan	5,343	
Feb	4,084	
Mar	4,247	13,674
Apr	4,679	13,010
May	5,115	14,041
Jun	4,994	14,788
Jul	5,548	15,657
Aug	5,446	15,988
Sep	5,457	16,451
Oct	5,605	16,508
Nov	5,696	16,758
Dec	5,927	17,228

Data provided by Airways includes actual runway usage data which has been used in the preparation of the 2022 AANC. For the busy three months the main runway was used 98% of the time and the crosswind runway used 2% of the time. The 12-month runway usage for 2022 was the same as the busy three months.

3.3 Flight Tracks

The flight tracks used in the model are based on recent analysis of actual flown flight tracks at Christchurch Airport using radar data[1]. In the noise model, aircraft have been allocated to flight tracks based on aircraft type and destination/origin which was determined from the radar data analysis.

A representative of Airways NZ, CIAL and MDA discussed the proposed approach to use the results of the radar data analysis. Airways NZ advised there were no planned changes to flight paths for the coming year and supported the proposed approach. Airways NZ concluded the flight tracks in the 2022 noise model are a reasonable approximation of long-term average flight tracks flown.

3.4 Verification Noise Measurements

Rule 6.1.6.2.5a iii d of the Christchurch District Plan sets out that the calculated AANC shall be verified by noise measurements carried out in accordance with the Airport Noise Management Plan (NMP). Section 6.1.2 of the NMP states that verification measurements are to be carried out no less than every three years and location of the monitors is to be decided in consultation with the ANLC.

Noise loggers were installed between 14 October and 6 December 2022 at two monitoring sites close to the 65 dB L_{dn} Air Noise Compliance Contour. Consultation and confirmation of the logger locations

[1] Departure tracks are based on radar data from June 2022 and arrival flight tracks are based on radar data from representative days in 2019 and 2021.

took place during the ANLC meeting on the 1 September 2022. The locations are summarised in Table 5 and shown on a map in Appendix B.

The noise monitors record one second noise levels continuously. When the noise rises above a defined threshold for a defined number of seconds, this is identified as a *triggered noise event*. The thresholds are set to capture aircraft events however other noise sources such as high winds and local traffic can also register as triggered events. The measured aircraft L_{dn} is calculated using measured noise from all triggered events, therefore some extraneous noise is likely to be included. Daily weather records have been obtained and the measurement results refined by excluding days affected by high winds. A further check is carried out to compare the number of triggered noise events with the number of aircraft operations per day. In all cases the number of triggered noise events was greater than the number of possible flyovers meaning that all aircraft noise was most likely recorded.

Table 5 summarises the average measured L_{dn} from triggered noise events excluding days affected by high winds. Graphs showing the daily L_{dn} for each site and further statistics are provided in Appendix B.

Table 5: Noise monitoring summary

	Location	Measurement Dates	Average Daily L_{dn} for Triggered Events
Logger 1	Shipleys Road	14/10/22 – 6/12/22	63.1
Logger 2	653 Pound Road	14/10/22 – 6/12/22	62.4

The noise loggers were installed close to the 65 dB L_{dn} Air Noise Compliance Contour at each end of the main runway. Both loggers were also placed under the recently introduced DMAPS (15/15) departure flight paths. The intent was to measure compliance with the 65 dB L_{dn} limit under the new flight paths. The measured L_{dn} noise levels attributed to aircraft at the two monitors shows that compliance was achieved at both locations.

The measurement data is also used to verify the 2022 AANC calculated in AEDT. The monitoring period coincided with the busy three month period used to model the 2022 AANC. The calculated noise level at the two monitoring locations compared with the measured level is summarised in Table 6.

Table 6: Comparison of measured and modelled aircraft operations noise 2022

	Location	Modelled L_{dn} (dB)	Measured L_{dn} (dB)	Difference (dB)
Logger 1	Shipleys Road	61.1	63.1	2.0
Logger 2	653 Pound Road	61.7	62.4	0.7

It is expected that the measured noise levels may be higher than modelled levels as the measurements include some extraneous noise. The correlation between measured and modelled noise levels at Logger 2 is very good. At Logger 1, the measured noise level was 2 dB higher than the modelled level. Logger 1 recorded significantly more extraneous noise events than Logger 2 which explains the larger discrepancy between modelled and measured noise at Logger 2.

Given the close correlation at Logger 2, and a clear reason for the disparity at Logger 1, it is considered that the monitoring results provide sufficient verification of the noise modelling. In summary, it is considered that the modelled 2022 ANNC is an accurate representation of noise levels received around the airport.

3.5 2022 Annual Aircraft Noise Contour

The calculated 2022 AANC is shown below in Figure 1. The 2022 AANC demonstrates that aircraft operations comply with the 65 dB L_{dn} Air Noise Compliance Contour.

Towards the north-east of RW02/20, the 2022 AANC is 6 decibels less than the CDP Air Noise Compliance Contour.

Towards the south-west of RW02/20 the 2022 AANC is 4 decibels less than the CDP Air Noise Compliance Contour.

On the RW11/29 on centreline the 2022 AANC is 5 or more decibels less than the CDP Air Noise Compliance Contour.

When compared to the 2021 AANC, the 2022 AANC is similar in extent.

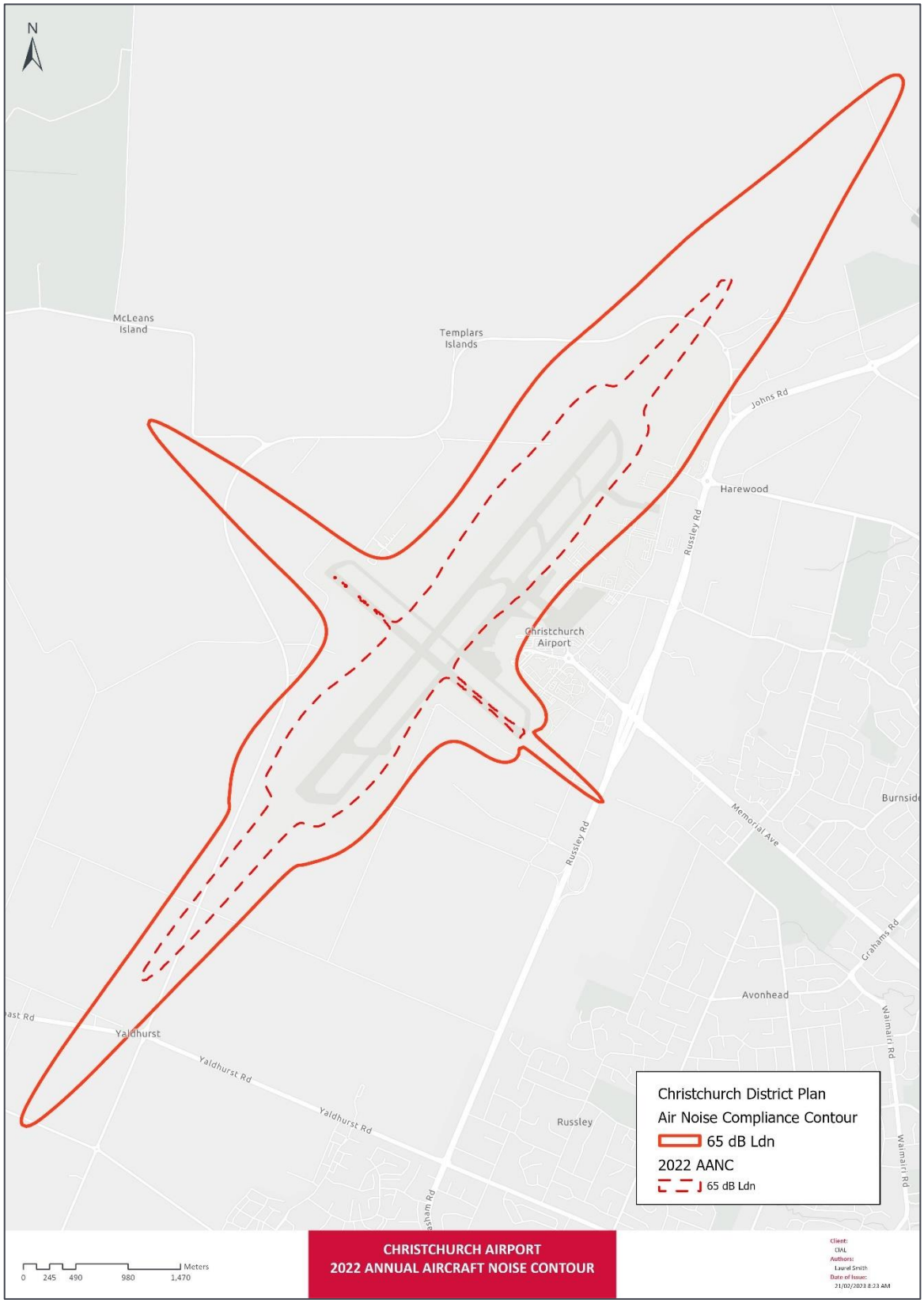
CIAL's Noise Management Plan (Rev D, dated May 2019) states in section 6.1.1: "*Where the AANC are calculated to be within 2 decibels of the District Plan compliance contour, Christchurch Airport will conduct an initial summary review as to the extent and cause of this margin. The Compliance and Development Manager and Acoustic Engineer will be responsible for making the decision to conduct the initial summary review and any further analysis that may be required.*"

For 2022, there is no requirement to conduct such a summary review.

Overall, the 2022 AANC is considered an accurate representation of aircraft noise exposure around the airport for the busiest three months in 2022 and has been calculated in accordance with the relevant requirements of the CDP, CIAL's NMP and New Zealand Standard NZS 6805:1992 *Airport Noise Management and Land Use Planning*.

In accordance with the rule contained in Appendix 6.11.4 (a)(ii).C of the CDP, the 2022 AANC showing 1 dB increments from 55 dB to 70 dB L_{dn} is shown in Appendix E.

Figure 1: 2022 AANC



The noise modelling, aircraft movement analysis and AANC calculation was conducted by a person suitably qualified and experienced in airport noise modelling and acoustics assessments, in accordance with rule 6.1.6.2.5 (iii) (c). The person who undertook the airport noise modelling,

acoustical assessment and preparation of the technical content of this 2022 NMR is the author of this report, Laurel Smith of Marshall Day Acoustics.

4.0 ON-AIRCRAFT ENGINE TESTING

As defined in the Christchurch District Plan on-aircraft engine testing includes the testing of engines on an aircraft.

4.1 Summary of On-Aircraft Engine Testing

Based on information obtained from the ETMS, for the year 2022 there were:

- 623 total on-wing engine tests
- 353 ATR tests
- 139 A320 tests
- 131 other tests

The total number of recorded engine testing events over the last 8 years is as follows.

Table 7: Engine testing events by year

Engine Testing Events	2022	2021	2020	2019	2018	2017	2016	2015
Total number of events	623	843	1045	1114	1369	1384	1023	805

4.2 Verification Noise Measurements

Rule 6.1.6.2.6 (v) (B), in the CDP states that the engine testing calculations "*shall be verified by measurements undertaken with reference to at least four ETCMPs for a sample of at least two different on-aircraft engine test configurations".*

As has been agreed between CIAL and CCC, the definition of the engine test configuration simply means consideration of two different engine test events with at least one of the following being different between the tests; aircraft type, location of test, orientation or power setting.

The rule requires that this be undertaken "*at least once every two years*". The last engine testing measurements were conducted in 2021, so there was no requirement to repeat the measurements in 2022.

4.3 Engine Testing Management Software

The Engine Testing Management Software (ETMS) is used to calculate noise levels emitted from on-aircraft engine testing including the 7-day rolling average noise level. CIAL has used the ETMS since 2010 and in July 2017 the software was updated to meet new provisions in the District Plan including:

- The requirement to calculate the 7-day rolling average;
- Development of the ETMS on a web-based platform and;
- Initial 6-month period of verification of the ETMS calculated noise levels at the Engine Testing Compliance Monitoring Positions (ETCMP) locations, using in-situ noise measurements and thereafter biannual verification measurement.

4.3.1 Calculated Engine Testing Noise Levels

Calculated noise levels for 2022 generated from the ETMS at the ETCMPs are detailed in Table 8 (65 dB L_{dn} limit) and

Table 9 (55 dB L_{dn} limit) below. The location of the ETCMPs is shown in Figure 2 below.

Figure 2: Insert from Christchurch District Plan On-Aircraft Engine Testing Compliance Monitoring

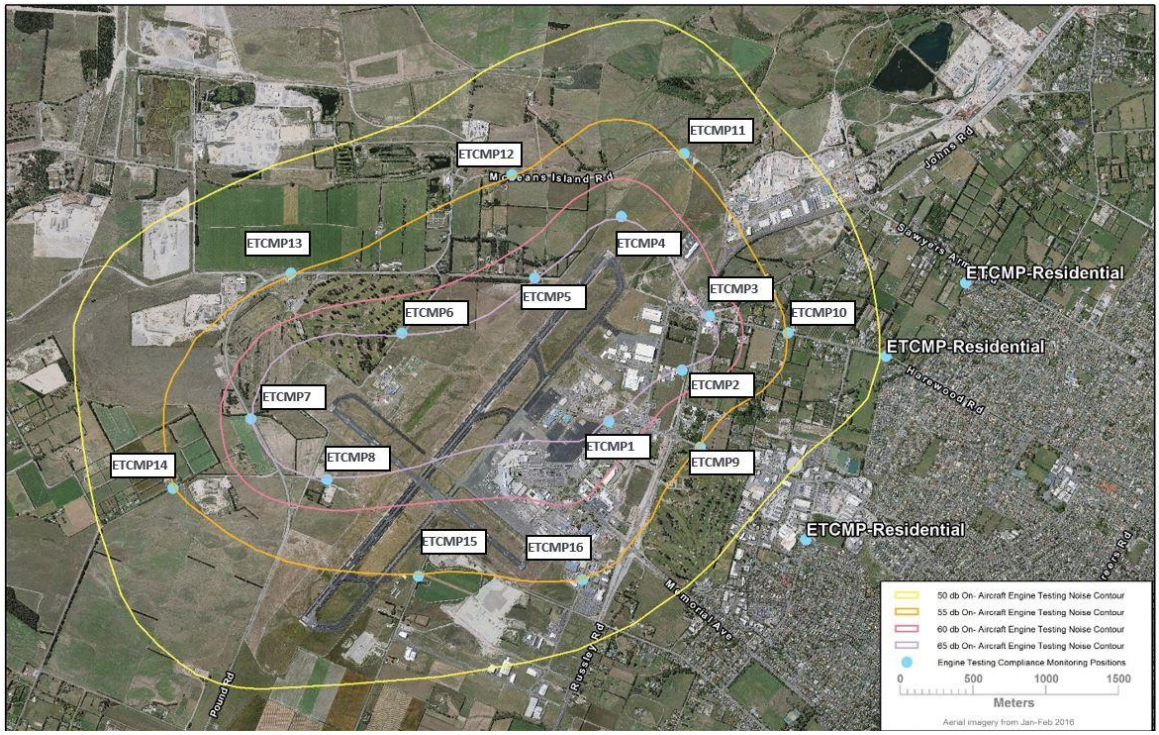


Table 8 and Table 9 below show calculated noise levels generated using the ETMS are compliant with noise limits detailed in rule 6.1.6.2.5 (a) (i).

Table 8: ETMS Prediction Results - 65 dB L_{dn} limit – Highest 7 Day L_{dn} Rolling Average

ETCMP Location	Min	Max	Median	Average
1	38	58	52	51
2	34	52	45	45
3	37	57	50	49
4	36	60	50	50
5	38	58	51	51
6	29	48	41	41
7	19	40	33	33
8	22	43	36	35

Table 9: ETMS Prediction Results - 55 dB L_{dn} limit –Highest 7 Day Rolling Average

ETCMP Location	Min	Max	Median	Average
9	31	52	46	45
10	31	49	43	42
11	30	50	42	42
12	30	50	41	42
13	21	41	34	34
14	16	36	29	28
15	22	43	35	35
16	28	48	41	41

Maximum noise levels at ETCMP 17, ETCMP 18 and ETCMP 19 were all below the noise limit of 75 dB L_{AFmax} contained in rule 6.1.6.2.5 (a) (i). The maximum noise level for each of these was 62, 63, 59 dB L_{AFmax} respectively.

Figure 3 and Figure 4 below display the 7-day rolling average calculated noise levels at each of the ETCMPs for 2022. As shown in the two graphs, compliance was predicted to be achieved at all ETCMPs during the engine testing events in that period.

Figure 3: ETMS predicted noise levels for ETCMP 1 to 8 located on the 65 dB L_{dn} engine testing contour

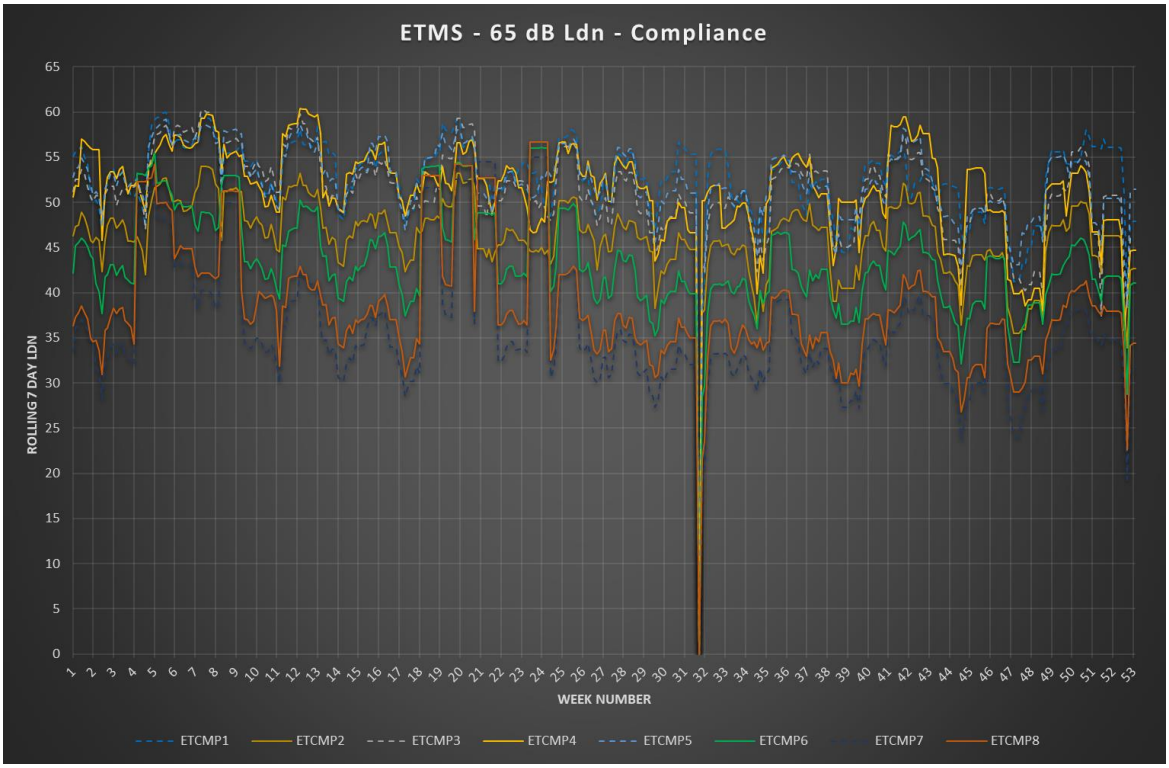
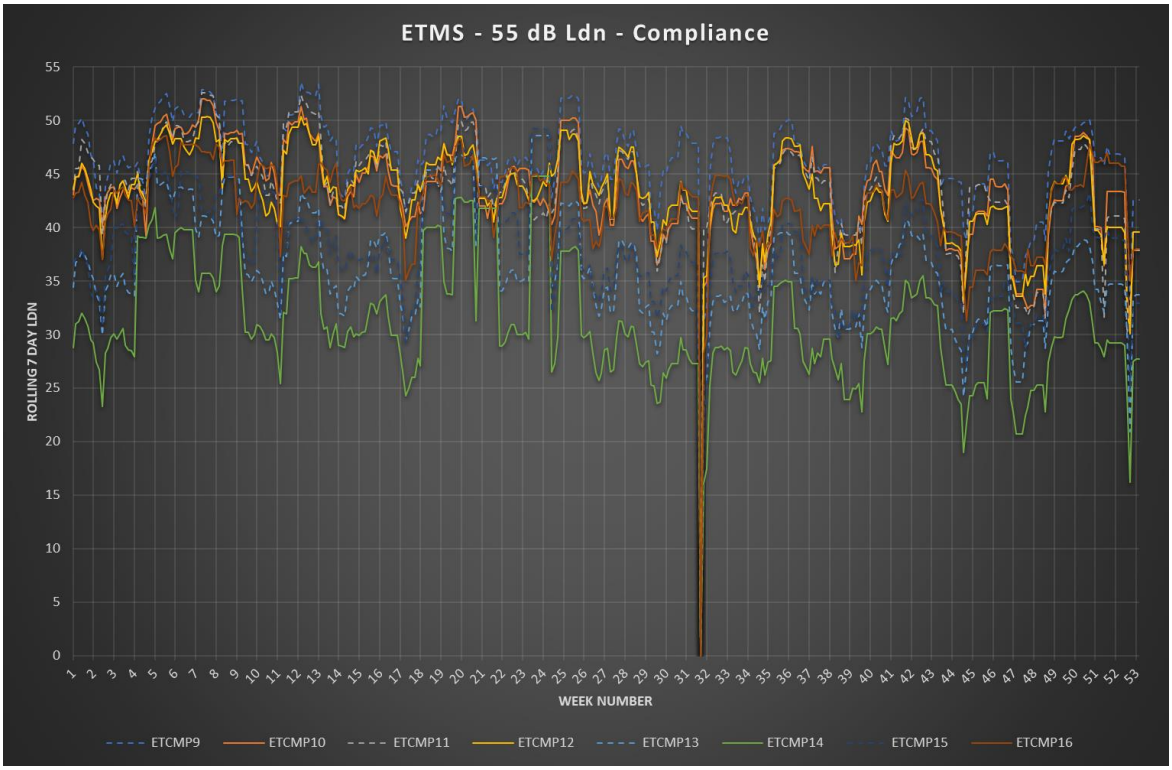


Figure 4: ETMS predicted noise levels for ETCMP 9 to 16 located on the 55 dB L_{dn} engine testing contour



The figures identify a variation in calculated noise levels across the ETCMPs with some distinct peaks. These peaks are a result of noise emissions from a given test; notably, high power runs near the ETCMP.

5.0 COMPLAINTS

5.1 Complaints Summary

In accordance with Rule 6.1.6.2.5 a.iv.D and Rule 6.1.6.2.6 a.vii.C of the CDP, the noise complaints summary below details:

- Complaints received over the previous year in respect to aircraft operations and on-aircraft engine testing, and
- Any actions taken in response to these complaints.

All names and addresses have been omitted for privacy purposes.

Complaints have been grouped by the type of operation and aircraft; the actions taken for each complaint are included in the table. In summary, 31 complaints were received from 13 individuals during the period 1 January to 31 December 2022.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
Low Flying Aircraft	Jet	2	Two separate residents from suburbs to the north of Christchurch complained about a low flying freighter aircraft in the early hours of the morning. CIAL confirmed to the first complainant that the noise was from freight aircraft, CIAL described freighter movements, flight times and why sometimes overfly this area. CIAL outlined that all aircraft are controlled by CAA rules and follow the operational charts for the airspace. Complainant understood the need for freighters to fly over Kaiapoi, however they would prefer they flew at a higher altitude. The second resident experienced an unusual event where the freight aircraft transited over their suburb both on arrival and departure. This was operationally required to manage traffic in the airspace on that day. CIAL responded to the resident with this information along with additional details that dictate aircraft movements.
		1	A complaint was made regarding a low flying Jet aircraft over a property in Fendalton. The long-time Fendalton resident did not think they were under the flight path. CIAL confirmed the cross-wind runway was being used that evening, and that this runway is only used 4-5% of the time. The resident thought aircraft used to turn much earlier to come into land on the cross-wind runway. Airways via CIAL explained the reason for this, and CIAL provided information on cross runway arrival movements. An offer to meet with Airways was given as well as all the RWY 29 arrival paths in November 2022. CIAL's noise compliance requirements and reporting with the CDP to the CCC was explained and links to the reports provided. The complainant thanked CIAL for the explanation but declined the offer to meet with Airways. They believe that the airport corridor is too narrow and should be widened to reduce noise over their property. There has been no further correspondence.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
Low Flying Aircraft	Jet	1	The complainant was concerned about a loud noise from a low flying aircraft that went on for a long time. This aircraft was the USAP C17. FlightRadar24 showed that the aircraft was unusually low over Rolleston. Airways could not access their software at the time of the complaint, and CIAL are still awaiting their response. Complainant was informed of this and there has been no further communication.
	Single Propeller	1	A resident in West Melton complained about a very loud noise that appeared to be coming from a very low flying aircraft. CIAL spoke to the complainant who thought the aircraft could have been a warbird. There was a Mustang flying around the area around that time, but it was outside of the Controlled Airspace. The complainant was given details of the CAA if they wanted to make further enquiries.
	All Aircraft	1	A complaint was made about a low flying aircraft over Kaiapoi. CIAL responded that they would investigate and provide an informed response. The complainant replied to withdraw the complaint and apologised for making it.
		1	A resident complained about constant aircraft noise affecting his health. They felt that aircraft are always flying over where he is living and when he is out walking. CIAL responded to explain the many factors that determine where aircraft fly. There has been no further response.
	Helicopter	2	Two complaints from the same household regarding a helicopter completing loops over their house. This was related to a helicopter pilot completing night flying training. The complainant told CIAL that they are very bothered by the helicopter noise over their property in the past 6-8 months and they had been keeping records. CIAL has been in communication with the residents as well as Garden City Helicopters and Christchurch Helicopters regarding the issue. This complaint is on-going.
		2	Two complaints from separate residents in Wigram Skies subdivision about low flying helicopters prior to Christmas. Neither complainant provided contact details nor wished to be contacted by CIAL to discuss further.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
Low Flying Aircraft	Helicopter	2	A Lincoln resident complained about two low flying helicopters passing over his property in the early morning on the same day. Both movements were related to a rescue helicopter flying between Christchurch and Dunedin Hospital. Earlier in the year, the resident expressed his concerns about increased air traffic over Lincoln. Refer to the entry denoted with an * under Flight Path Change below.
	GA Aircraft	1	Complainant reported on-going noise over a three-night period. This noise was related to the Canterbury Aero Club (CAC) conducting night flights. CIAL called the complainant on two occasions and left a message. There has been no further response. Complainant contacts CIAL every 1-2 years to query either GA movements or engine testing.
Flight Path Change	All Aircraft	16	Sixteen complaints were made from a resident living south of the main runway in 2022 regarding the noise generated from aircraft departing the southern runway. The complainant questions whether the airport is complying with the noise contours. Airways have implemented new flight paths known as 15/15/ DMAPS which mean aircraft are no longer flying directly south but turning 15 degrees shortly after departure. In summary, 20 separate complaints have been made since March 2021. A considerable amount of time has been spent by CIAL and consultants to communicate the changes to the resident (by way of emails, reports, OIA responses and meetings), and to show that CIAL are compliant with the legislation set out in the CDP. As a result of this complaint, a review of CIAL NMP was undertaken, so that complex technical data can be better communicated to the public. This complaint is on-going.
Flight Path Change & Low Flying Aircraft	All Aircraft*	1	This complainant initially made contact about a low flying helicopter, but then expressed concern about the increase in aircraft noise over Lincoln and requests a flight path change. Airways via CIAL provided them some background detail to explain aircraft movements over Lincoln. The cause of the traffic over Lincoln is that many aircraft are still using ILS (instrument landing system) which requires them to more frequently turn over Lincoln when coming into land on RWY 02. When more aircraft are flying with RNP (Required Navigation Procedures) they will turn earlier minimising noise over Lincoln.

			CIAL and Airways provided the complainant with maps, diagrams and written explanation on the flight paths owing to the ILS approach, afterwards both parties met with the complainant virtually to explain further. The complainant was not satisfied post this meeting, and contacted their local MP, who in turn contacted CIAL on his behalf. CIAL responded with details of the change from ILS to RNP and the timeframe that this will occur in is dependent on the airlines and Airways. There was no further correspondence.

6.0 SCHEDULE OF ACOUSTIC TREATMENT

In accordance with Rule 6.1.6.2.7.2 of the Christchurch District Plan, CIAL has developed an Acoustic Treatment Programme (ATP) whereby dwellings existing as of 6 March 2017 within Rural Urban Fringe and Rural Waimakariri Zones become eligible for acoustic treatment.

There are three circumstances when owners are to be offered the opportunity for acoustic treatment,

- Dwellings located within the 65 dB L_{dn} Annual Aircraft Noise Contour;
- Dwellings located within the 65 dB L_{dn} Engine Testing Contour; and
- Dwellings located within the 60 to 65 dB L_{dn} Engine Testing Contour (mechanical ventilation only).

Unlike the Annual Aircraft Noise Contour, the Engine Testing Contour has been fixed by the District Plan. Therefore, there is no change to the number of eligible dwellings inside these noise contours. For engine testing there are ten dwellings eligible for the installation of mechanical ventilation.

For operational noise, a schedule of eligible dwellings is maintained and updated annually when the AANC is prepared. The schedule contains a complete list of 'Existing Dwellings' located within the Future Aircraft Operations Contour (65 dB L_{dn}) and each year the AANC is mapped to identify which of these Existing Dwellings fall within the 65 dB L_{dn} AANC and hence become eligible for treatment.

The 2022 AANC incorporates no additional dwellings compared with the 2020 and 2021 AANC. This is because both the 2022 and 2021 AANC are smaller than the 2020 AANC. Therefore, no additional mitigation offers are required this year.

7.0 CONCLUSION

Marshall Day Acoustics has prepared a compliance report with regards to aircraft operations and on-aircraft engine testing at the Christchurch International Airport. The report has been prepared in accordance to Rules 6.1.2.1.5 and 6.1.2.1.6. The main conclusions are:

- The 2022 AANC demonstrates compliance with the 65 dB L_{dn} Air Noise Compliance Contour contained in the CDP and is similar in extent to the 2021 AANC.
- The 2022 AANC is generally 4 or more decibels below the 65 dB L_{dn} limit.
- Verification measurements of noise from aircraft operations confirmed compliance with the 65 dB L_{dn} Air Noise Compliance Contour and verified the calculated 2022 AANC is representative of the actual noise levels.
- Predictions of engine testing noise levels using the ETMS software shows compliance with noise limits detailed in the CDP.
- Verification measurements of engine testing noise occurred in 2021 so were not required in 2022.
- The 2022 AANC is similar to the 2021 AANC and both are smaller than the 2020 AANC. Therefore, no additional dwellings are eligible for acoustic treatment.

APPENDIX A REGULATORY REQUIREMENTS

6.1.2.1.5 Policy – Airport Noise

a. Require the management of aircraft operations and engine testing at Christchurch International Airport, so that:

i. noise generated is limited to levels that minimise sleep disturbance and adverse effects on the amenity values of residential and other sensitive environments so far as is practicable;

ii. where practicable, adverse noise effects are reduced over time.

b. Mitigate adverse noise effects from the operations of the Christchurch International Airport on sensitive activities, by:

i. prohibiting new sensitive activities within the Air Noise Boundary and within the 65 dB Ldn engine testing contour; and

ii. requiring noise mitigation for new sensitive activities within the 55 dB Ldn air noise contour and within the 55 dB Ldn engine testing contour; and

iii. requiring Christchurch International Airport Limited (CIAL) to offer appropriate acoustic treatment in respect of residential units existing as at 6 March 2017 within the 65 dB Ldn Annual Airport Noise Contour, and within the 60 dB Ldn engine testing contour.

Note: Policy 17.2.2.10 also mitigates noise effects from the operations of Christchurch International Airport on rural land.

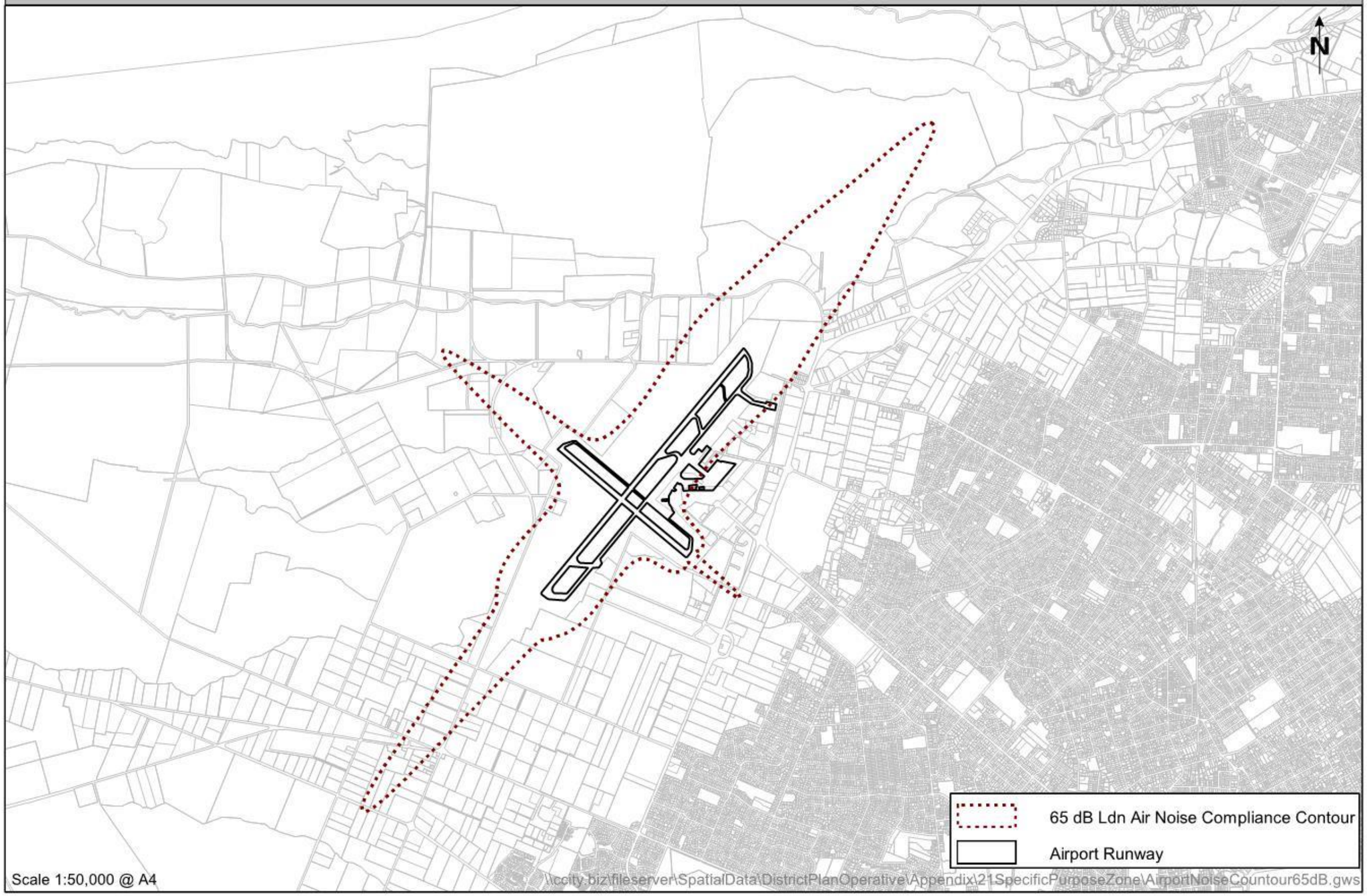
The relevant rules relating to aircraft operation and engine testing noise are given in 6.1.6.2.5 – 6.1.6.2.7.1 and Appendix 6.11.14. They state:

6.1.6.2.5 Aircraft operations at Christchurch International Airport

a. Aircraft operations at Christchurch International Airport shall meet the following activity standards:

i. Noise from aircraft operations shall not exceed 65 dB Ldn outside the 65 dB Ldn Air Noise Compliance Contour shown in Figure 1, other than as provided for in Rule 6.1.6.2.5 a.ii.

Figure 1: Map of 65 dB Ldn Air Noise Compliance Contour



ii. *Noise from aircraft operations may exceed the aircraft noise limit in Rule 6.1.6.2.5 a.i by not more than 2 dB, provided that such exceedance is due to atypical weather, national flight disruption, natural disaster or other unplanned circumstances.*

iii. *Monitoring and determining compliance with activity standards i. and ii. above shall be as follows:*

A. *Noise monitoring of aircraft operation shall be based on calculations from an operational aircraft noise model, and records of actual aircraft operations at Christchurch International Airport over the previous year's aircraft operations.*

B. *Noise from aircraft operations shall be calculated as the Annual Aircraft Noise Contour (AANC), over the busiest three month period of the previous year.*

C. *The calculations shall be performed by a person with appropriate qualifications and experience in airport noise modelling and acoustics assessments.*

D. *The calculated results shall be verified by noise measurements carried out in accordance with the Airport Noise Management Plan required under Rule 6.1.6.2.7.1.*

E. *The measurement of aircraft sound exposure levels and the derivation of the 65 dB Ldn contour shall be in accordance with NZS 6805:1992.*

iv. *An Aircraft Operations Noise Monitoring Report shall be provided annually by the airport operator to the Council, with the first required by the 6 March 2018. The report shall include:*

A. *the calculated AANC;*

B. *the results of the verification measurements;*

C. *analysis of compliance with reference to Rule 6.1.6.2.5 a.i. and ii. (including the number of exceedances and the reasons for them); and*

D. *a summary of complaints received over the previous year in relation to noise from aircraft operations, and any actions taken in response.*

v. *The additional activity standards in Rule 6.1.6.2.7 for aircraft operations at Christchurch International Airport shall be met.*

Definition: Aircraft operations

means:

a. *the landing and take-off of aircraft; and*

b. *aircraft flying along any flight path associated with a landing or take-off.*

For the purposes of Rule 6.1.6 Activity specific noise rules, it excludes:

c. *aircraft operating in an emergency for medical or national/civil defence reasons;*

d. *air shows;*

e. *military operations;*

f. *Antarctic operations;*

g. *helicopter operations;*

h. *aircraft using the airport as an alternative to a scheduled airport elsewhere;*

i. *aircraft taxiing; and*

j. *aircraft engine testing.*

6.1.6.2.6 On-aircraft engine testing at Christchurch International Airport

a. The testing of engines on aircraft at Christchurch International Airport shall meet the following activity standards:

i. Noise from testing of engines on aircraft shall not exceed the noise limits shown in Table 5 below at the engine testing compliance monitoring positions (ETCMPs) shown in Figure 2.

Table 5: On-aircraft engine testing noise limits

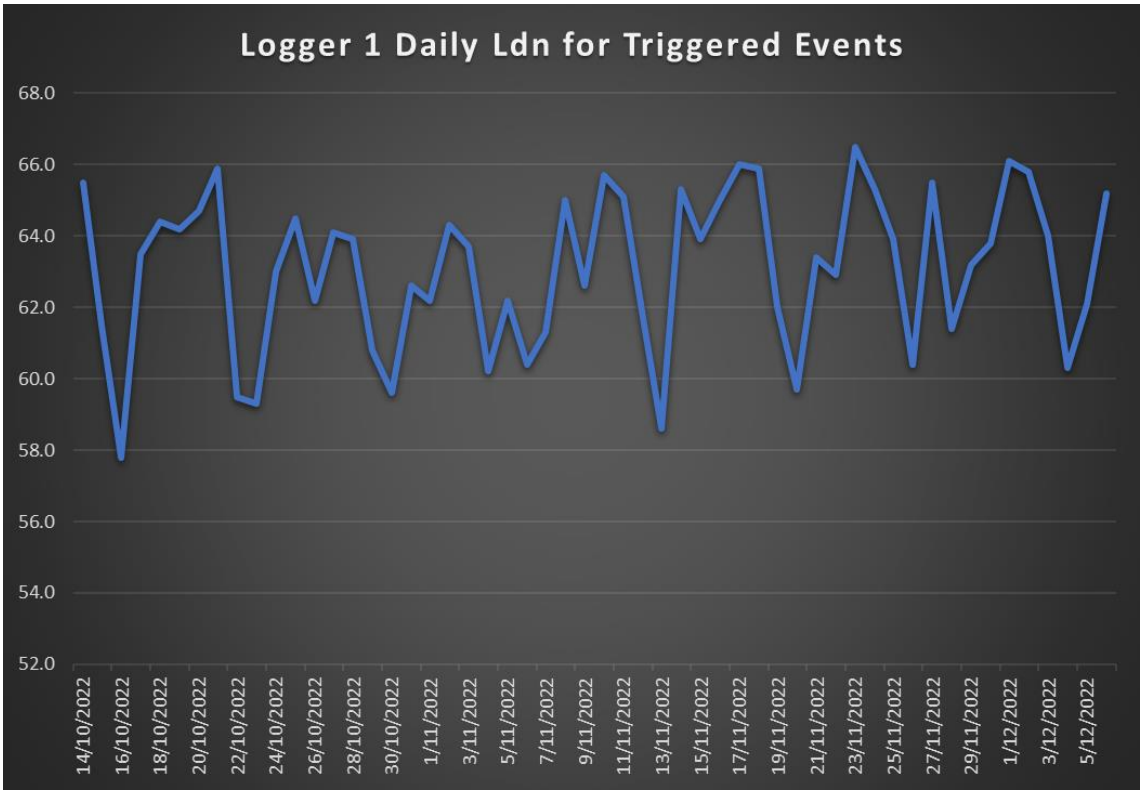
Noise Limit	***Engine testing compliance monitoring positions (ETCMP) – refer Figure 2***
65 dB Ldn, 7 day	*8 points*
55 dB Ldn, 7 day	*8 points*
75 dB L_{Amax} 22:00 to 07:00 only	*Edge of residential zone – 3 points*

APPENDIX B DETAILED MEASUREMENT RESULTS

2022 Aircraft Operations Noise Monitoring Locations

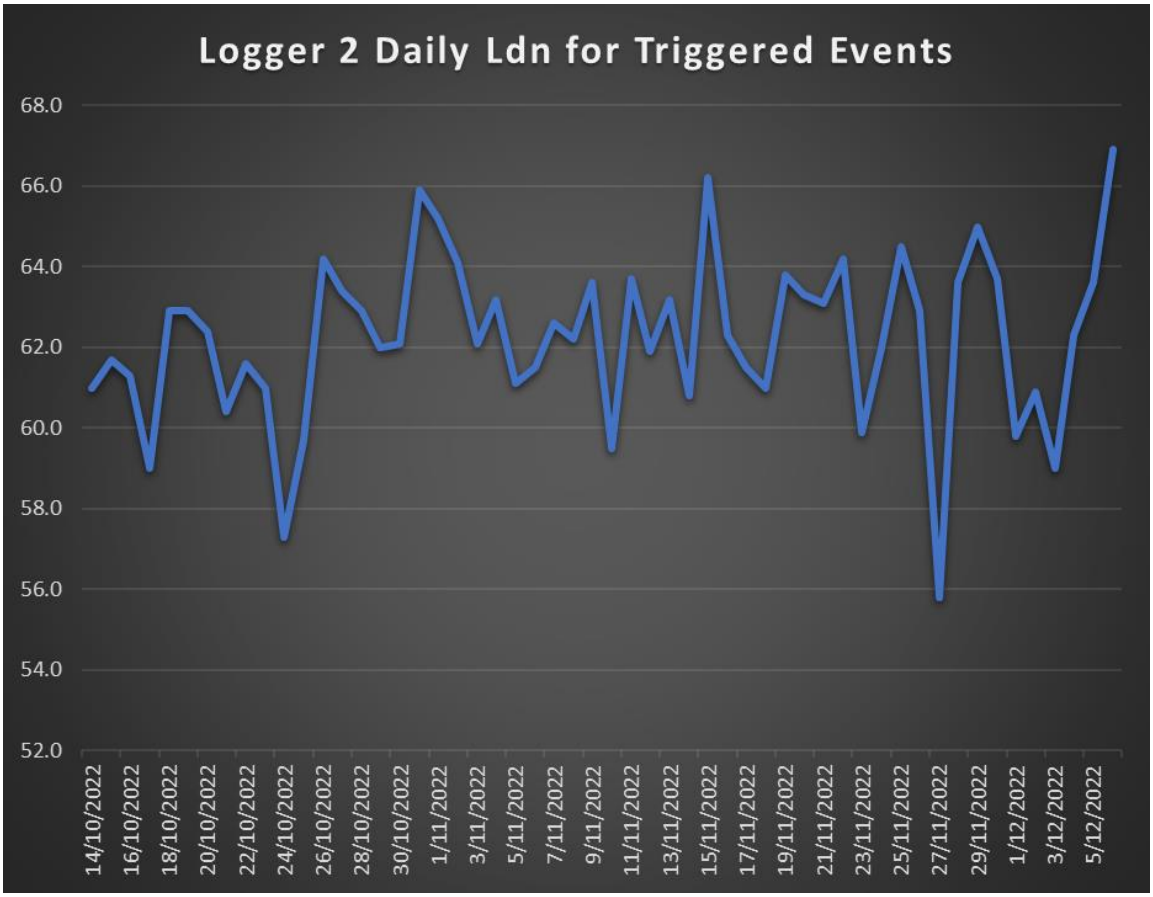
B1 Noise measurement results for Logger 1 (North)

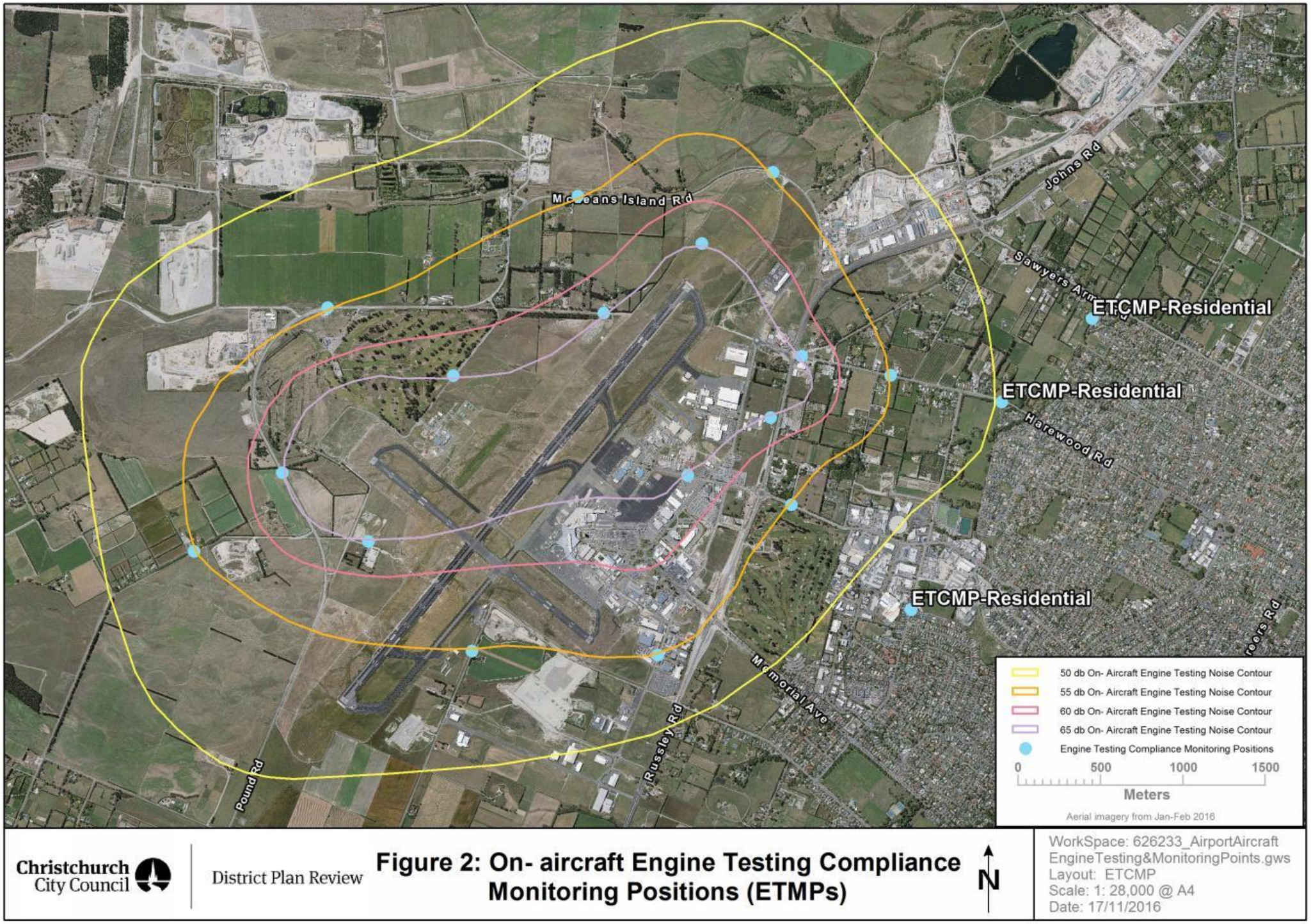
	Daily L_{dn} (dB) for Triggered Noise Events	
	Wind Affected Days Excluded	All Days
Minimum	57.8	57.8
Maximum	66.0	66.5
Average	63.1	63.6
Number of Days	32	53



B2 Noise measurement results for Logger 2 (South)

	Daily L_{dn} (dB) for Triggered Noise Events	
	Wind Affected Days Excluded	All Days
Minimum	59.0	55.8
Maximum	65.2	66.9
Average	62.4	62.6
Number of Days	31	53





ii. *All high power testing of jet engines on an aircraft shall occur between the hours of 07:00h and 22:00h, except that a maximum of 5 unplanned engine testing events within any three month period, up to a maximum of 12 unplanned engine testing events per annum, may occur between the hours of 22:00h and 07:00h.*

iii. *Testing of turbo prop engines on an aircraft between the hours of 22:00h and 07:00h, when the total duration of testing at high power is five minutes or more per aircraft, shall be conducted in the vicinity of the threshold of Runway 11 (i.e. the north-western end of the cross-runway).*

iv. *The following exclusions apply:*

   A. *The testing of engines on an aircraft used for Antarctic operations, is excluded from activity standards i.-iii..*

   B. *The testing of engines on any aircraft is excluded from activity standards i.-iii., where such work is necessary to satisfy an airworthiness direction or other like safety requirement issued by the Minister of Transport, the Director of Civil Aviation or the Civil Aviation Authority, as is any other unplanned engine testing arising from an aircraft operator's identification of a safety issue relating to an aircraft fleet, or required as a result of a natural disaster including volcanic eruption.*

   C. *The testing of turbo prop engines on an aircraft is exempted from activity standard iii. When Runway 11/29 is in use.*

v. *Monitoring and determining compliance with activity standard a.i. above shall be as follows:*

   A. *Compliance or otherwise with activity standard a.i. shall be demonstrated by calculations of on-aircraft engine testing noise emissions based on the actual on-aircraft engine testing events and calculations of noise emissions for the engine testing events and configurations in question. The noise level (Ldn, 7 days) shall be calculated as a 7 day rolling average.*

   B. *The calculations in activity standard a.v.A. shall be verified by measurements undertaken with reference to at least four ETCMPs for a sample of at least two different on-aircraft engine test configurations. Verification measurements shall be carried out for an initial period of 6 months from 6 March 2017 and subsequently be undertaken at least once every two years.*

vi. *An On-aircraft Engine Testing Report shall be provided quarterly by the airport operator to the Council, with the first covering the period ending the 30 June 2017 and provided to the Council by the 15 July 2017. The report shall include:*

   A. *a summary of all on-aircraft engine testing activities undertaken in the quarter; and*

   B. *identification of all tests undertaken both in accordance with activity standard a.i. and those excluded by activity standard a.iv., including reasons for the tests excluded an any measures taken to manage noise effects during those excluded tests.*

vii. *An On-aircraft Engine Testing Noise Monitoring Report shall be provided annually by the airport operator to the Council by 6 March 2018, and annually thereafter. The report shall include:*

   A. *the results of verification measurements in accordance with activity standard v.B.; and*

   B. *analysis of compliance with reference to Rule 6.1.6.2.6 a.i.; and*

   C. *a summary of complaints received over the previous year in relation to noise from on-aircraft engine testing, an any actions taken in response.*

viii. *The additional activity standards in Rule 6.1.6.2.7 for on-aircraft engine testing at Christchurch International Airport shall be met.*

6.1.6.2.7 Additional activity standards for aircraft operations and on-aircraft engine testing at Christchurch International Airport

a. The following additional activity standards apply to aircraft operations and to the testing of engines on aircraft at Christchurch International Airport.

6.1.6.2.7.1 Airport Noise Management Plan

a. Within 12 months of 6 March 2017, noise from aircraft operations and on-aircraft engine testing at Christchurch International Airport shall be managed in accordance with an Airport Noise Management Plan prepared by a suitably qualified and experienced person on behalf of the airport operator and in consultation with the Airport Noise Liaison Committee, in accordance with the requirements set out in Appendix 6.11.14. The Airport Noise Management Plan shall be reviewed, and updated if required, at least once every two years.

b. The Airport Noise Management Plan shall:

i. demonstrate how compliance with the following noise limits will be achieved:

A. for aircraft operations – Rule 6.1.6.2.5; and

B. for on-aircraft engine testing – Rule 6.1.6.2.6.

ii. provide the details of the noise monitoring programme;

iii. incorporate a procedure for transparently and expediently responding to any compliance received in relation to noise from aircraft operations and on-aircraft engine testing; and

iv. incorporate a procedure for transparently and expediently presenting, in a publicly accessible forum, the following:

A. the Aircraft Operations Noise Monitoring Report, On-aircraft Engine Testing Report, and On-aircraft Engine Testing Noise Monitoring Report required by Rules 6.1.6.2.5 and 6.1.6.2.6;

B. a 7-day rolling report of noise from on-aircraft engine testing against the requirements of Rule 6.1.6.2.6 a.; and

C. a daily LAmax report of noise from on-aircraft engine testing against the requirements of Rule 6.1.6.2.6 a. at the edge of the residential zone.

Appendix 6.11.14 Airport Noise Management Plan

a. The Airport Noise Management Plan required by Rule 6.1.6.2.7.1 shall:

i. document noise management actions including ongoing investigations, methods, processes and resources to provide for:

A. the management of aircraft operations and on-aircraft engine testing to ensure comp liance with Rules 6.1.6.2.5 a.i. and ii. and 6.1.6.2.6 a.i.-iv.; and

B. consideration of alternative methods of noise management and mitigation to achieve the reduction of noise effects from all aspects of aircraft operations including on-aircraft engine testing; and

C. engine maintenance ground run procedures to be implemented in conjunctionwith all aircraft operators or their agents, including:

i. compliance with Rule 6.1.6.2.6 a.i.-iv., including documentation required by Rule 6.1.6.2.6 a.v.-vii.; and

ii. procedures which will encourage Antarctic and NZDF engine testing on the win g to occur between the hours of 07:00 to 19:00.

ii. provide the details of a noise monitoring programme to maintain compliance with Rules 6.1.6.2. 5 a.iii.-iv. and 6.1.6.2.6 a.v.-vii. and, in particular, the following:

A. the monitoring, recording, verification and calculation of aircraft operation and On-aircraft Engine Testing noise levels;

B. the preparation of the annual Aircraft Operations and On-aircraft Engine Testing Nois e Monitoring Reports and quarterly On-aircraft Engine Testing Report;

C. the preparation of the AANC maps, showing actual noise contours in 1 dB increments from 55 dB to 70 dB Ldn; and

D. the review of the software used for predicting aircraft operation noise and the software used for predicting engine testing noise, at least once every five years to determine whether the models and/or software require updating.

iii. establish dispute resolution procedures.

iv. establish a procedure for transparently and expediently responding to any complaints received in relation to noise from aircraft operations and on-aircraft engine testing.

v. require the maintenance of a website that provides for the transparent and accessible display of

A. the current version of the Airport Noise Management Plan as required by Rule 6.1.6.2. 7.1;

B. the Aircraft Operations Noise Monitoring Report, On-Aircraft Engine Testing Report, a nd On--Aircraft Engine Testing Noise Monitoring Report for the previous year, required by Rules 6.1.6.2.5 and 6.1.6.2.6, including a summary of noise monitoring conducted, and the AANC;

C. A 7-d-ay rolling report of noise from On-Aircraft aircraft engine testing over the previous seven days updated daily and identifying all tests undertaken both within the Ldn limits and those exempted, including reasons for the tests exempted;

D. a summary of complaints received annually and a description of actions taken to addr ess complaints.

vi. document schedules of:

A. acoustic treatment implemented over the past calendar year as required by Rule 6.1.6.2.7.2; and

B. *acoustic treatment offered, where the conditions of the offer required by section b. of Appendix 6.11.15 have not yet been met.* ETCMPs positions

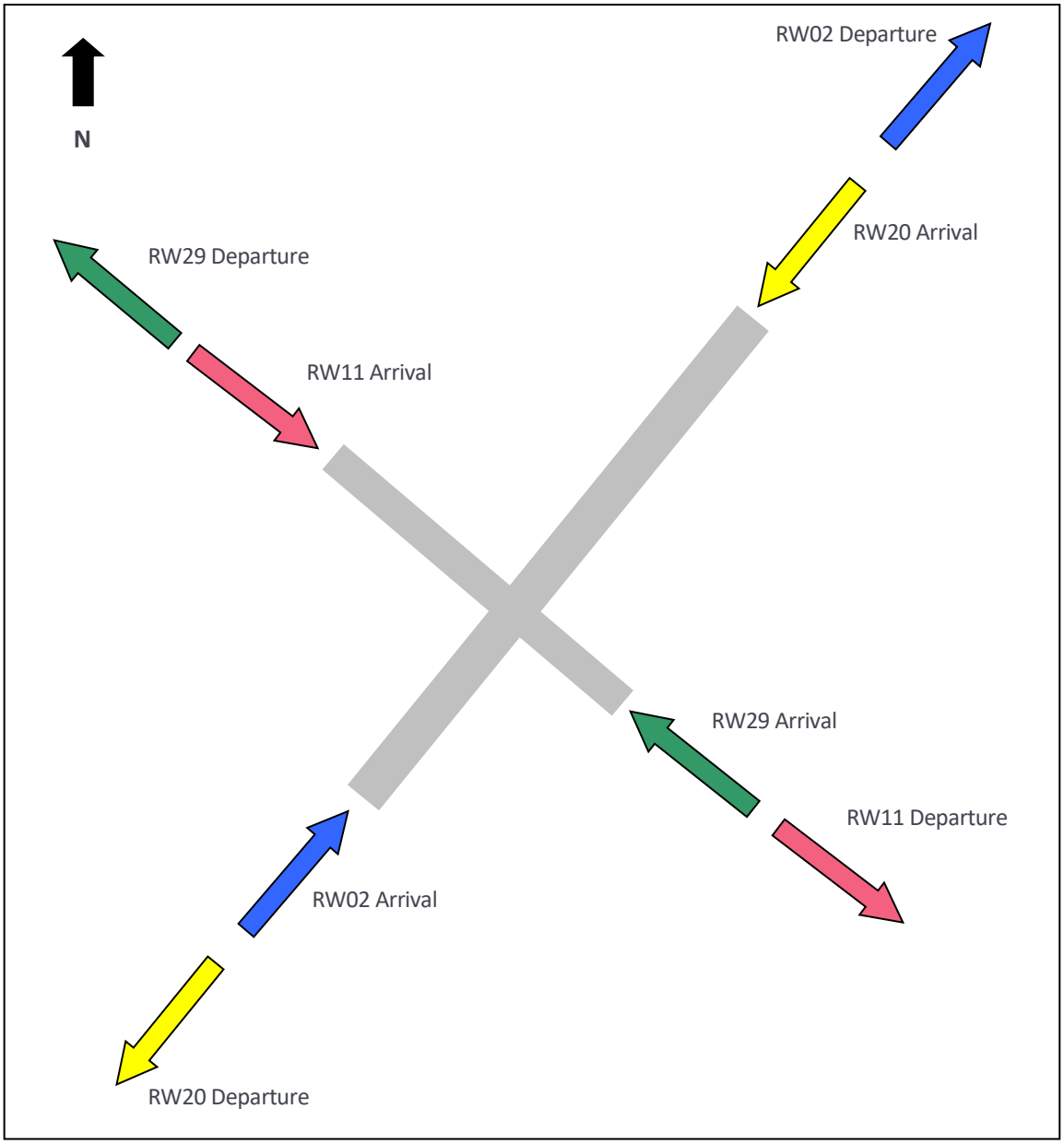
APPENDIX C CHRISTCHURCH AIRPORT RUNWAY VECTORS

Runway 02 refers to operations using the main runway with a heading of 20 degrees from true north i.e. arrivals from the south west landing in a north easterly direction and departures towards the north east.

Runway 20 refers to operations using the main runway with a heading of 200 degrees from true north i.e. arrivals from the north-east landing in a south westerly direction and departures towards the south west.

Runway 11 refers to operations using the crosswind runway with a heading of 110 degrees from true north i.e. arrivals from the north-west landing in a south easterly direction and departures towards the south east.

Runway 29 refers to operations using the crosswind runway with a heading of 290 degrees from true north i.e. arrivals from the south-east landing in a north westerly direction and departures towards the north west.



APPENDIX D MODELLED AIRCRAFT MOVEMENTS

Table D1: 2022 AANC Modelled Aircraft Movements by Runway

Aircraft type	Aircraft	RW02		RW11	RW20		RW29	
		Day	Night	Day	Day	Night	Day	Night
Scheduled jet	A20N	2.53	3.11	0.00	1.12	1.59	0.05	0.00
	A21N	0.79	0.02	0.01	0.30	0.01	0.03	0.00
	A320	31.86	2.45	0.09	13.60	1.36	0.88	0.00
	A332	0.10	0.14	0.00	0.04	0.17	0.00	0.00
	A333	0.04	0.17	0.00	0.01	0.03	0.00	0.00
	A359	1.38	0.00	0.00	0.61	0.00	0.01	0.00
	B734	3.28	3.26	0.00	1.32	1.82	0.02	0.01
	B738	2.63	2.29	0.00	0.82	1.15	0.08	0.00
	B763	0.21	0.22	0.00	0.12	0.20	0.00	0.00
	B77W	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	B789	0.26	0.28	0.00	0.05	0.03	0.00	0.00
Scheduled turboprop	AT75	2.02	0.04	0.00	0.87	0.03	0.12	0.00
	AT76	47.68	1.27	0.11	20.40	0.91	1.62	0.01
	DH8C	13.41	0.27	0.03	6.05	0.12	0.46	0.00
	PC12	6.73	0.00	0.01	3.22	0.00	0.27	0.00
	SW4	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Non-Scheduled jet	A20N	0.03	0.00	0.00	0.00	0.00	0.00	0.00
	B789	0.00	0.25	0.00	0.00	0.06	0.00	0.00
	BE40	0.00	0.06	0.00	0.06	0.00	0.00	0.00
	C510	0.28	0.00	0.00	0.00	0.00	0.03	0.00
	C680	0.16	0.00	0.00	0.09	0.00	0.00	0.00
	GLF6	0.00	0.00	0.00	0.03	0.00	0.00	0.00
	CL60	2.19	0.22	0.00	0.72	0.00	0.06	0.00
	B734	0.00	0.00	0.00	0.00	0.00	0.06	0.00
	B737	0.03	0.00	0.00	0.03	0.00	0.00	0.00
	A319	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Non-Scheduled piston	BE58	0.03	0.00	0.00	0.00	0.00	0.00	0.00
	P28A	0.06	0.00	0.00	0.00	0.00	0.00	0.00
	PA31	0.06	0.00	0.00	0.00	0.00	0.00	0.00
	PA46	0.09	0.00	0.00	0.03	0.00	0.00	0.00
	PA34	0.06	0.00	0.00	0.00	0.16	0.00	0.00
Non-Scheduled turboprop	AT75	0.69	0.00	0.00	0.16	0.00	0.00	0.00
	BE20	4.75	0.41	0.00	2.03	0.16	0.44	0.00
	BE30	0.63	0.13	0.00	0.13	0.06	0.06	0.00
	BE9L	0.03	0.00	0.00	0.03	0.00	0.00	0.00
	C441	0.13	0.00	0.00	0.19	0.00	0.00	0.00
	PC12	0.00	0.00	0.00	0.03	0.00	0.00	0.00
	JS32	0.38	0.19	0.00	0.22	0.09	0.00	0.00
	SF34	0.13	0.00	0.00	0.09	0.00	0.00	0.00
	SW4	0.13	0.00	0.00	0.03	0.00	0.03	0.00
	SW4B	0.09	0.00	0.00	0.06	0.00	0.00	0.00
	B350	0.69	0.03	0.03	0.38	0.16	0.03	0.00

APPENDIX E: 2022 AANC (55 – 70 DB L_{DN} IN ONE DECIBEL INCREMENTS)