MARSHALL DAY Acoustics

CHRISTCHURCH AIRPORT NOISE MONITORING 2017 NOISE MONITORING REPORT

Rp 001 20180006 | June 2018

84 Symonds Street
PO Box 5811 Wellesley Street
Auckland 1141 New Zealand
T: +64 9 379 7822 F: +64 9 309 3540
www.marshallday.com

Project: **CHRISTCHURCH AIRPORT NOISE MONITORING**

Prepared for: **Christchurch International Airport Limited**
PO Box 14001
Christchurch 8455

Attention: **Rhys Boswell**

Report No.: **Rp 001 R02 20180006**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
	-	Client Draft	31 May 2018	Steve Peakall	
	R01	CIAL Review	20 June 2018	Steve Peakall	Felicity Blackmore
	R02	CCC comments	19 September	Steve Peakall	Felicity Blackmore

TABLE OF CONTENTS

1.0 INTRODUCTION

Christchurch International Airport Limited (CIAL) are 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 program for 2017 including:

- Calculation of noise contours known as the Annual Aircraft Noise Contours (AANC) to determine compliance
- Calculation of engine testing noise level emissions at the Engine Testing Compliance Monitoring Positions (ETCMPs) to determine compliance
- Analysis of measured noise levels, if undertaken, to verify the compliance calculations

This Noise Monitoring Report has been prepared by Marshall Day Acoustics on behalf of Christchurch International Airport Limited.

A list of definitions and acronyms is provided in Appendix A.

2.0 STATUTORY REQUIREMENTS

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

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;
- 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 vii 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-aircraft engine testing, and any actions taken in response.

The following noise monitoring report details information required under both 6.1.6.2.5 (iv) (aircraft operations) and 6.1.6.2.6 (vii) (on aircraft engine testing). 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 2017 to 31 December 2017.

Full copies of rules 6.1.1.2.5 and 6.1.6.2.6 are included in appendix A.

Rule 6.1.2.6vi of the Christchurch District Plan also requires CIAL to prepare and submit quarterly on-aircraft engine testing reports. These reports re submitted to CCC quarterly and contain the following information:

- a summary of all on-aircraft engine testing activities undertaken in the quarter and
- identification of all testing undertaken in accordance with 6.1.2.6 (a) i and excluded from 6.1.2.6 (a).iv.

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

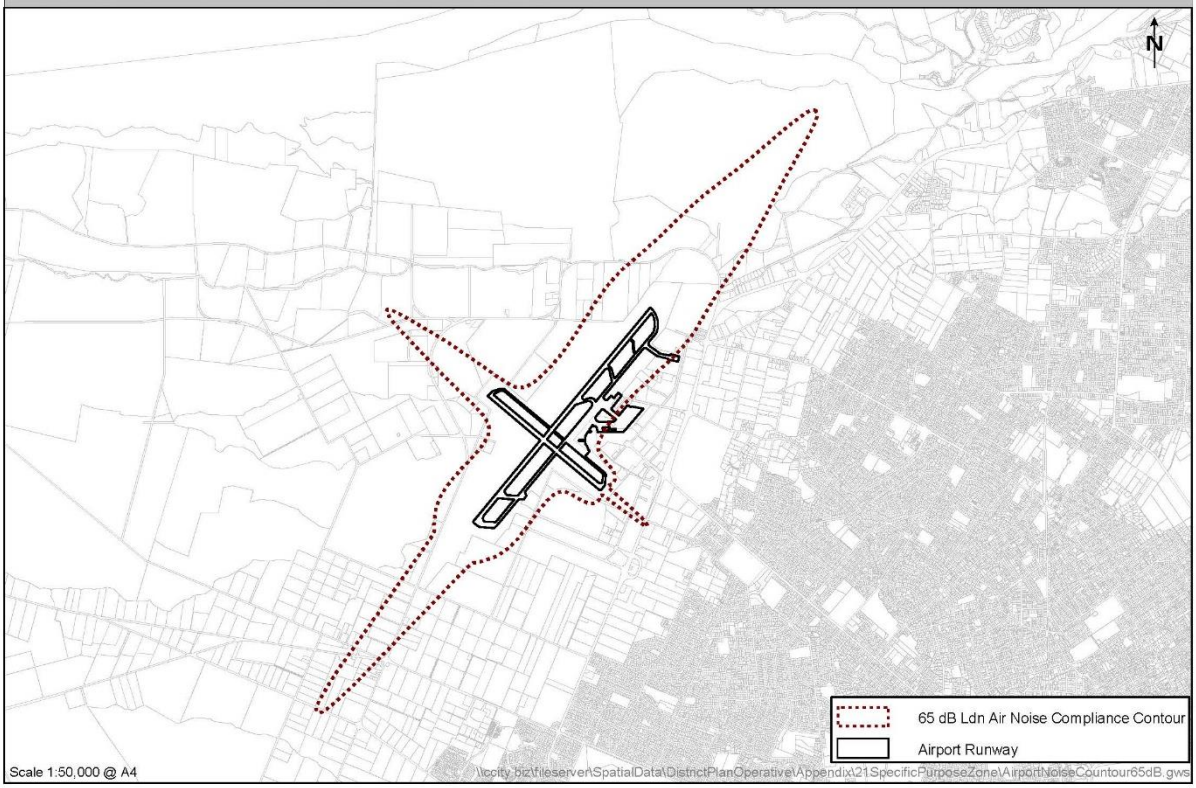


Figure 1: insert from rule 6.1.6.2.5 (a) (i) in the Christchurch District Plan.

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

2.2 Noise Limits - On Aircraft Engine Testing

Table 5 (refer to table 1 below) in rule 6.1.6.2.6 (a) of the District Plan outlines noise limits for on aircraft engine testing.

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 or 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

Christchurch International Airport (CIAL) is the main gateway to the South Island with current *total* aircraft movements of 95,000 to 105,000 per annum over the last 5 years.

Based on information provided by Airways Corporation NZ, for the year 2017 there were;

- 76,585 scheduled commercial aircraft movements, and
- 99,203 total aircraft movements.

Scheduled commercial movements over the last 5 years are as shown in Table 1 below

Table 2: Scheduled Commercial Aircraft Movements

Aircraft Movements	2017	2016	2015	2014	2013	2012	2011
Scheduled Commercial Movements	76,585	74,130	74,144	75,072	71,715	73,184	75,529

The busiest three months for aircraft movements in 2017 were October, November and December. With a total of 20034 scheduled commercial movements.

A summary of the movement data input into the Integrated Noise Model (INM) used to produce the 2017 Aircraft Noise Contours is provided in section 3.2 of this report.

3.2 Modelling Methodology

To ensure consistency with the 65 dB $_{Ldn}$ Air Noise Compliance Contour in the Christchurch District Plan, the 2017 AANC has been calculated using version 7 of the Integrated Noise Model (INM) developed by the US Federal Aviation Authority.

The INM software (like most software), has been upgraded regularly over the last 10 years. Each update to the INM program has resulted in slightly different calculation results. As the District Plan contour and AANC are both used for noise control purposes, and as the District Plan contours are used as the basis of determining appropriate land use planning controls and the selection of mitigation treatment, it is therefore considered that the same software version should be used to prepare the AANC.

The 2017 AANC is based on aircraft movements provided by Airways Corporation NZ for the months October, November and December, in accordance with rule 6.1.6.2.5 (iii) (b). As well as being the busiest three months of movements for the year, these months included aircraft movements that were part of the Performance Based Navigation (PBN) trial that commenced in November 2017 (refer Section 6.0).

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

Aircraft movement data is input into the INM in the form of daily movements by aircraft type, operation, runway and time of day. Data includes all movements of aircraft that are fitted with a

transponder. As some general aviation (GA) aircrafts do not have transponders, not all GA movements are accounted for.

The 65 dB $_{Ldn}$ Air Noise Compliance Contour in the Christchurch District Plan was developed without inclusion of GA operations. Based on the nature and frequency of GA flights at the time of preparing the 65 dB $_{Ldn}$ 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 2008 CIAL noise monitoring report confirmed that noise from light aircraft do 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 2017 shows GA movements have been steadily decreasing since 2010, GA movements in 2017 were 25,000 (rounded to the closest 1000) which is considerably less than in previous years. MDA has calculated the effect of GA operations on the AANC in 2008 and again in 2017 and conclude that GA operations typically contribute less than 0.1 dB to the noise contours. Further summary discussion is included in Appendix H, consistent with previous Annual Noise Monitoring Reports.

However, because the impact of GA on the noise contours has consistently been shown to be negligible, it is not intended in future Noise Monitoring Reports to provide this level of detail. Overall, GA flights do not affect the overall noise levels and therefore would not influence the location of the AANC significantly. Therefore, it is recommended noise resulting from GA operations continue to be excluded from the AANC.

The total movements for the modelled scenario is 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 has an associated +10 decibel adjustment. A summary of the total aircraft movements by month is shown in Table D1, Appendix D, and a breakdown of the average daily aircraft movements by aircraft type and runway is included in Table D2, Appendix D.

Table 3 Summary of Modelled Aircraft Movements

	Busiest 3 Months (Oct-Nov-Dec 2017)
Total Movements	20848
Day Time Movements	18395
Night Time Movements	2453

Data provided by Airways includes actual runway usage data, this data has been used in the preparation of the 2017 AANC. The main runway is used 96% pf the time compared with the crosswind runway.

The aircraft movements are distributed across the same flight tracks as were used during the development of the 65 dB L_{dn} Air Noise Compliance Contour. These flight tracks have been reviewed by Airways in 2014 and 2017 Airways fights tracked used to compile the 2017 AANC remain a reasonable approximation of long term average flight tracks flown. In addition, because the AANC for 2017 includes flight movements during the PBN trial, the AANC calculations include the use of the appropriate PBN tracks for these aircraft.

The 2017 Annual Aircraft Noise Contour (AANC) demonstrates 2017 Aircraft Operations comply with the 65 dB L_{dn} Air Noise Compliance contour (Figure 2 and Appendix E).

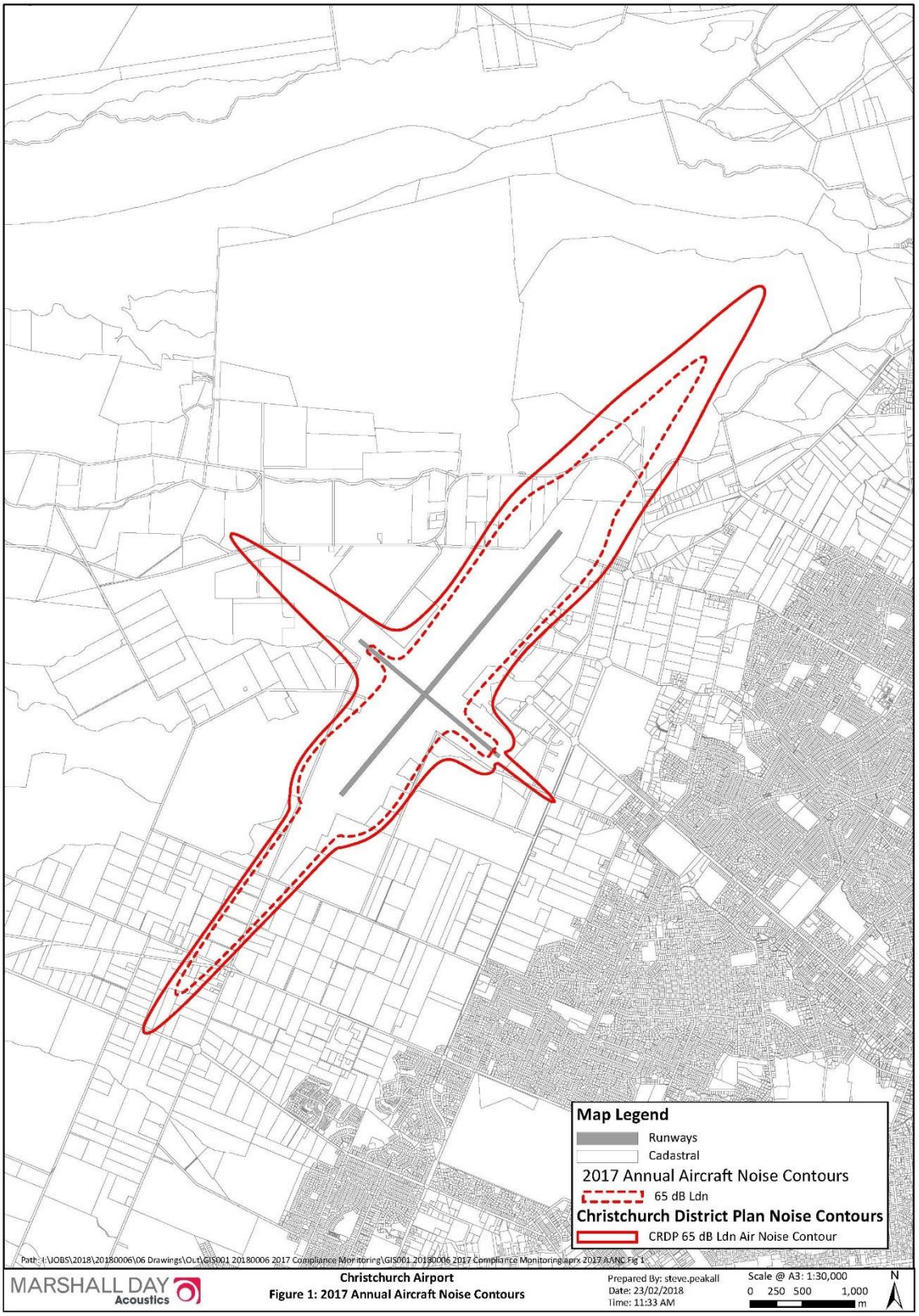


Figure 2: 2017 AANC and 65 dB L_{dn} Air Noise Compliance contours

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 2017 NMR is the author of this report, Steve Peakall acoustic engineer at Marshall Day Acoustics.

3.3 Verification Noise Measurements

Noise measurements were carried out in 2017 for the PBN trial that commenced in November 2017. The measurement programme included noise measurements undertaken prior to the trial commencing and these can be used for the purposes of verifying the AANC.

Noise measurements were undertaken at 6 locations between 16th March 2017 and 2nd August 2017.

Noise Monitoring Terminals (NMTs) comprising automatic noise and weather data logging were deployed to measure overall aircraft noise exposure as well as individual aircraft noise events. The locations are summarised in Table 4 below. A figure showing the overall airport environs, the measurement locations is included as Appendix F.

Table 4: Noise measurement locations

Measurement Date	Figure 1 ID	Address/Location
16/03/17 – 03/05/17	MP1	Salmond St, Halswell
16/03/17 – 03/05/17	MP2	Chateau on the Park
04/05/17 – 13/06/17	MP3	Edwin Lane, Kaiapoi
04/05/17 – 13/06/17	MP4	Elders Rd, Clarkville
14/06/17 – 02/08/17	MP5	Maddisons Rd
14/06/17 – 20/07/17	MP6	Main South Rd

Details of the measurement results for all six sites are shown in Appendix G. Graphs showing the daily L_{dn} for each site are also shown. NMT positions were decided in relation to measuring changes in noise levels resulting from the PBN trial, as such they are not located in close proximity to the 65 dB L_{dn} Air Noise Compliance Contour. It is considered appropriate to use data from the six NMT to verify calculated noise levels generated under the 2017 AANC.

Predicted noise levels derived from the 2017 AANC model scenario in the INM at the 6 NMT correlate well with the measured noise levels. Predicted noise levels at all six NMT were within 2dB of the measured noise levels showing there is good agreement between the measurements and predictions. It is therefore considered noise levels calculated using the IMN v7 for the 2017 AANC should be considered accurate.

In addition, the overall measured L_{dn} noise levels from aircraft at the 6 NMT shows that compliance was achieved at all locations. This is as expected as they are all at considerable distance from the compliance contour.

Overall it is considered that predictions are an accurate representation of noise levels received around the airport.

4.0 ON AIRCRAFT ENGINE TESTING

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

4.1 Summary of On-Aircraft Engine Testing

Based on information obtained from the ETMS, for the year 2017 there were;

- 1384 total on-wing engine tests
- 932 ATR tests
- 362 A320 tests
- 90 other tests

The total number of recorded engine testing events over the last 5 years is as follows.

Table 5: Engine Testing Events by year

Engine Testing Events	2017	2016	2015	2014	2013
Total number of events	1384	1023	805	663	751

It is noted that the CDP rules requiring the control of engine testing noise became operative on 6 March 2017. The above summary includes all records collected for 2017.

4.2 Engine Testing Management Software

The Engine Testing Management Software (ETMS) is used to calculate noise levels emitted from on aircraft engine testing and calculate the 7-day rolling average. CIAL have used the ETMS since 2010, in July 2017 this 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;
- Verification of the ETMS calculated noise levels at the Engine Testing Compliance Monitoring Positions (ETCMP) locations, which had only been confirmed in the District Plan on 6 March 2017.

Improvements to the ETMS software went live on 21 July 2017, and from that point onwards compliance could be readily assessed at the ETCMPs. For the period 6 March 2017 to 21 July 2017, compliance is assessed using the original version of the ETMS. This is discussed in section 4.2.1 below. Compliance assessment using the updated version of the ETMS is discussed in section 4.2.2

4.2.1 Compliance of Calculated Noise Levels (6 March - 21 July)

Records of engine testing activity up until 21 July 2017 were manually entered into the ETMS, based on records kept by ground run engineers that were passed to MDA. The ETMS was then used to calculate noise levels at 16 receivers located around the airport. These receivers were chosen in the early stages of the ETMS development in 2010 to be representative of all locations potentially affected by engine testing noise. However, in most cases they are not located directly on the engine testing noise contours now contained in the CDP.

MDA has calculated the highest rolling L_{dn} 7 day noise level at each receiver for the period 6 March 2017 to 21 July 2017. These noise levels have then, by interpolation, been compared to the noise levels permitted at these receivers by the CDP engine testing noise contours.

The results are presented in Table 5 below:

Table 6: ETMS Prediction Results – 6 March 2017 – 21 July 2017 – Highest 7 Day L_{dn} Rolling Average

ETMS Receiver ID	Location	ETMS Calculated Noise Level	CDP permitted Noise Level (interpolated)	difference
1	7 Whitchurch Place	58	64	-6
2	50 Savills Road	49	58	-9
3	70 Grays Road	43	54	-11
4	75 Stanleys Road	50	55	-5
5	87 Jessons Road	61	65	-4
6	117 Savills Road	55	63	-8
7	148 Grays Road	49	55	-6
8	559 Memorial Avenue	53	60	-7
9	560 Russley Road (N)	53	62	-9
10	560 Russley Road (S)	57	63	-6
11	565 Avonhead Road	46	53	-7
12	609 Avonhead Road	47	54	-7
13	655 Russley Road	65	69	-4
14	733 Harewood Road	57	64	-7
15	750A Wairakei Road	54	58	-4
16	Harewood Golf Club	50	58	-8

It is shown that at all locations for the period 6 March – 21 July 2017, noise levels calculated by the ETMS were 4- 11 decibels below the CDP permitted noise level,

4.2.2 Compliance of Calculated Noise Levels (21 July onwards)

Calculated noise levels generated from the ETMS at the ETCMPs are detailed in table 6 (65 dB L_{dn} limit) and table 7 (55 dB L_{dn} limit) below. The date range for the calculated data is between 21 July 2017 and 31 December 2017. The location of the ETCMPs is shown on Figure 3, below.

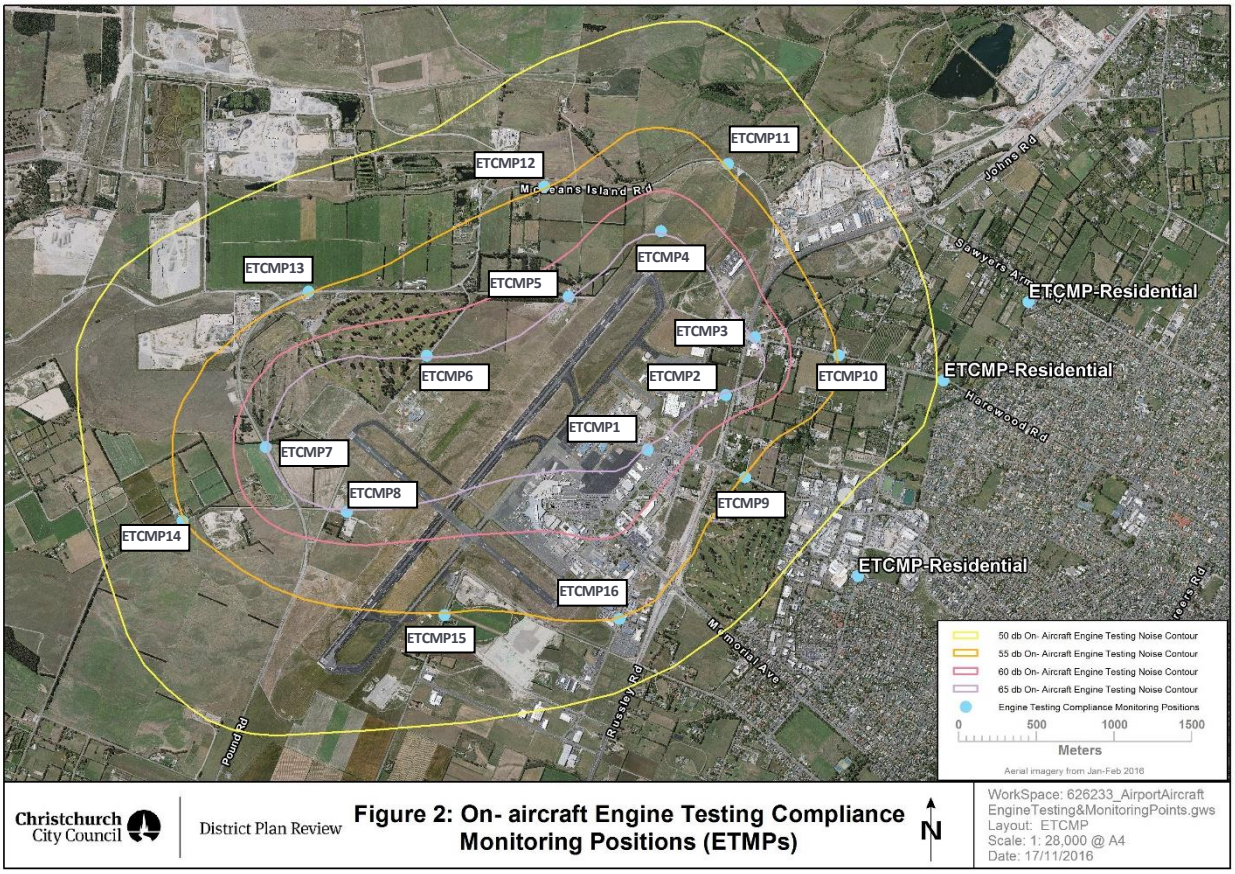


Figure 3: Insert from CDP On-Aircraft Engine Testing Compliance Monitoring.

Table 6 and 7 identify calculated noise levels generated using the ETMS are compliant with noise limits detailed in rule 6.1.6.2.5 (a) (i). Analysis of records contained in the earlier version of the ETMS are consistent with calculated noise levels detailed in tables 6 and 7.

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 54, 56, 50 dB L_{AFmax} respectively.

Table 6: ETMS Prediction Results - 65 dB L_{dn} limit – 7 Day L_{dn} Rolling Average

ETCMP Location	Min	Max	Median	Average
1	50	62	55	55
2	43	52	49	49
3	48	55	52	52
4	46	60	55	55
5	49	57	55	54
6	40	58	53	53
7	32	59	54	53
8	36	60	56	55

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

ETCMP Location	Min	Max	Median	Average
9	45	52	48	48
10	41	49	45	45
11	38	50	46	46
12	40	49	46	46
13	32	52	47	47
14	28	48	43	43
15	37	51	48	47
16	43	51	46	46

Graphs 5.1 and 5.2 below display the 7-day rolling average calculated noise levels at each of the ETCMPs for the period 21 July 2017 to 31 December 2017. As shown in the two graphs, compliance was predicted to be achieved at all Engine Testing Compliance Monitoring Positions (ETCMPs) during the engine testing events in that period.

For the first 7 days of the calculations shown in figures 4 and 5 below, noise levels are lower because of the use of the $L_{dn\ 7day}$ metric. This is because the noise energy from the first day of testing is effectively averaged over that day and the 6 preceding days of testing. Because the software went live on 21 July, the ETMS does not contain testing events for the days prior to the 21 July. Therefore, the $L_{dn\ 7day}$ value is reported as artificially lower for week 29 as it is averaged over days with no engine testing data in the software. This effect terminates once there are 7 consecutive days of data.

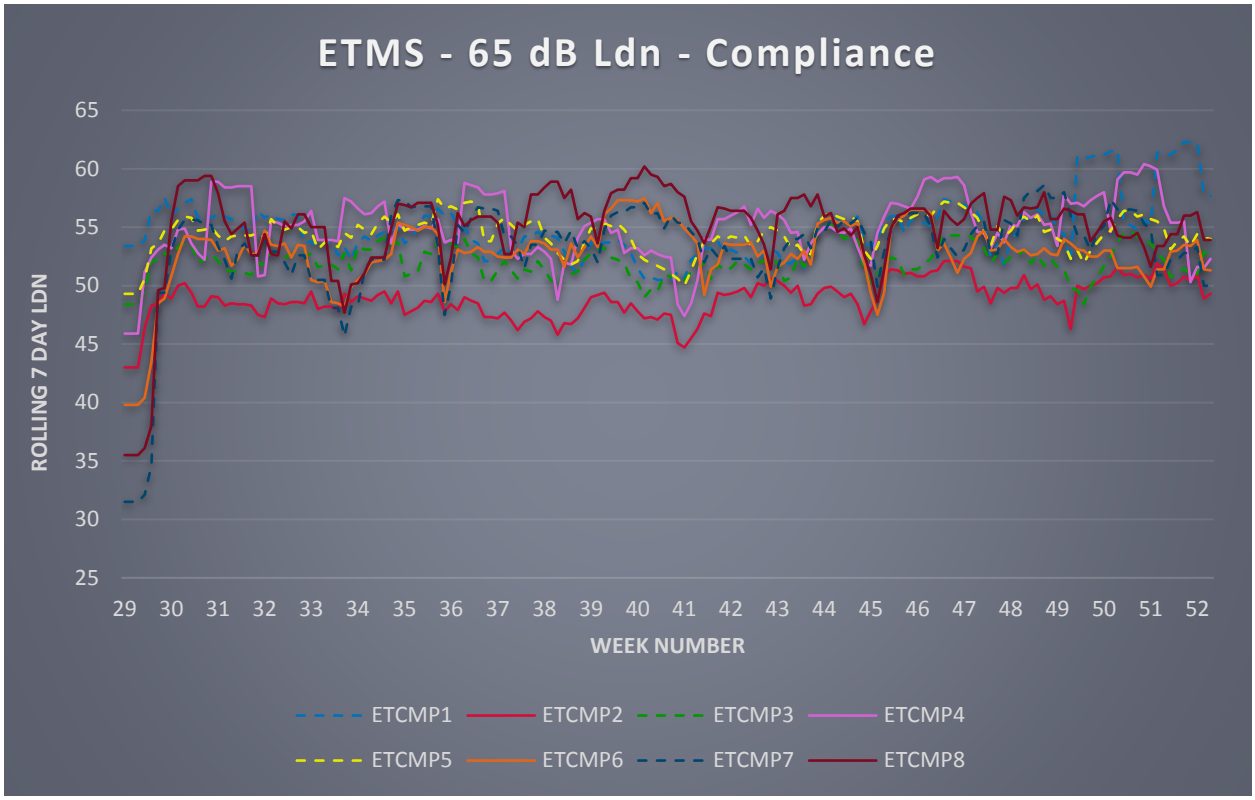


Figure 4: ETMS predicted noise levels for ETCMP 1 to ETCMP 8, located on the 65 dB L_{dn} engine testing contour from week 29 to week 52 in 2017

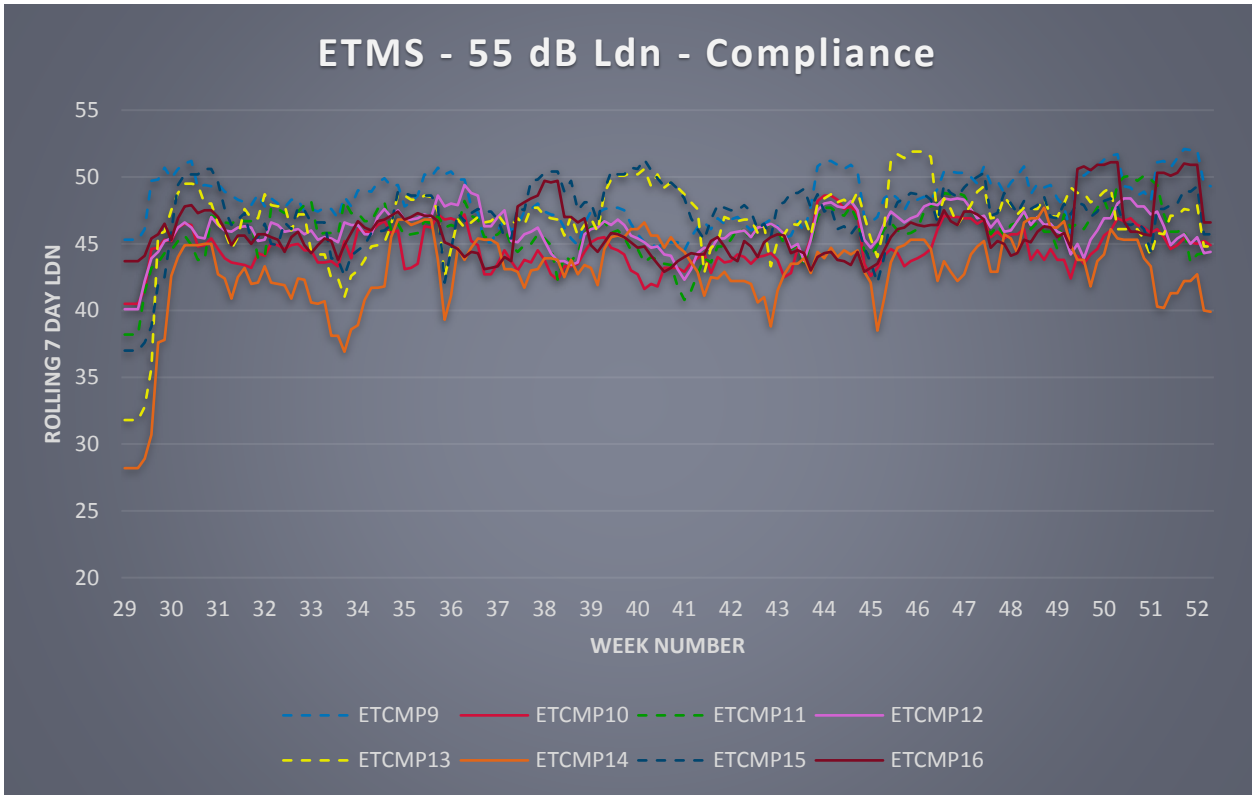


Figure 5: ETMS predicted noise levels for ETCMP 9 to ETCMP 16, located on the 55 dB L_{dn} engine testing contour from week 29 to week 52 in 2017.

Figures 4 and 5 identify a variation in calculated noise levels with some distinct peaks for some of the ETCMPs. These peaks are a result of noise emissions from a given test; notably, high power runs in close proximity to the ETCMP.

4.3 Verification Noise Measurements

In accordance with rule 6.1.6.2.6 a (V) (B) in the CDP, noise verification measurements referenced to four ETCMP for at least two on-aircraft engine test configurations were undertaken. Analysis of noise measurement data regarding verification of the calculated noise levels produced from the ETMS is detailed in section 4.3.2 below.

Two Noise Monitoring Terminals (NMTs) were deployed at four different ETCMPs over two measurement periods, 23 February to 3 July 2017 and 14 July to 13 October 2017. The deployment schedule is shown in Table 8. Each NMT consisted of a Norsonic Nor140 noise logging monitor with a meteorological station capable of logging wind speed, wind direction, temperature, and rainfall. Data was recorded in 1 second intervals.

Table 8: NMT deployment table

ETCMP	Mobilise date	Demobilise date
ETCMP2	23/2/17	3/7/17
ETCMP10[1]	23/2/17	3/7/17
ETCMP5	14/7/17	13/10/17
ETCMP8	3/7/17	31/12/17

[1] For logistical reasons the NMT was placed 100m to the south of ETCMP10 and 40m inside the 55 dB L_{dn} contour

4.3.1 Measurement Analysis

NMTs measure individual engine testing noise events at the site and daily noise levels for the duration of the survey, enabling an assessment of overall engine testing noise exposure. NMTs measure noise levels continuously at the site and therefore also measure extraneous noise.

Methods are applied to the data to exclude extraneous noise from the results as far as possible. These methods include event recognition software which, based on measured noise level and time thresholds, identify discrete high noise energy events that last for a given duration and collate these into a series of measurement events. The software can also use frequency based recognition that include or exclude noise events with a given frequency of sound. In addition, manual review of measured noise levels and associated audio files can be used to further exclude extraneous noise events. However, in some instances it may not be possible to remove *all* extraneous noise because of the noise level, duration and nature of noise under consideration.

The event recognition software is able to satisfactorily capture most discrete engine testing noise events. The measured noise events are then correlated with records of aircraft engine testing events provided in the ETMS by the ground run engineers. Correlation of the two data sets ensures that the measured noise levels represent noise from aircraft engine testing events as far as is practical. For some locations, particularly closer to busy roads, and further from the airport, measured noise levels can still be impacted by extraneous noise.

For each day that the NMT is deployed, the daily L_{dn} noise level is calculated, using noise emissions associated with engine testing for that day. The daily L_{dn} noise levels are then averaged over a rolling 7-day period to give the measured $L_{dn\ 7day}$ noise level at the site. This is the same process applied to

generate the calculated noise levels in the ETMS. Therefore, the measurement results are directly comparable with the calculated noise levels.

The daily reported measured L_{dn} noise level at ETCMP2 includes extraneous noise. At this location it was not possible to remove all extraneous noise from the measurement results. This is discussed further in section 4.3.2.

4.3.2 ETMS Verification Results

Data from each NMT has been analysed to verify noise levels generated from the ETMS. Rule 6.1.6.2.6 (v) (B), in the CDP states:

"*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"* For the purposes of verification of the ETMS a representative 7-day period of multiple different test configurations has been used.

MDA interprets the dentition of "engine testing configuration" to mean a representative 7-day period of multiple different test configurations, rather than referring to a single aircraft test configuration (which is dependent on that aircraft's type, power setting, location and orientation).

Further, because the ETMS calculates noise over a 7-day rolling average period, two representative weeks' worth of engine testing activity have been analysed at each ETCMP, as detailed below:

ETCMP 2

Table 9: Comparison of measured and calculated noise levels at ETCMP2

Representative Engine Testing Configuration	Measured Noise Level ($L_{dn\ 7day}$ (dB))	Calculated Noise Level ($L_{dn\ 7day}$ (dB))
25-31 May 2017 Includes primarily ATRs at the run up pad with high power runs, plus some A320s at the gate and run up pad	63	48
17-23 June 2017 Includes ATRs on high power and A320s on idle power at the run up pad plus testing on the gates and at the Number 3 Hangar and A2 Apron test locations for ATRs	63	49

Measured noise levels at ETCMP2 do not correlate to an acceptable level with noise levels calculated by the ETMS. Further analysis of noise measurements at ETCMP 2 indicates noise measurements were contaminated by extraneous noise from traffic using the adjacent Russely Rd section of State Highway 1 (SH1). As detailed in table 9 measured noise levels are higher than the calculated ETMS noise levels. In this instance methods used to remove extraneous traffic noise from the engine testing noise measurements have not been effective, as explained below.

Idle ground run up events typically occur over a 5-10-minute period, at relatively low and continuous noise levels during the event in question. Traffic using the adjacent SH1 is at a much higher noise level relative to the idle engine testing noise levels and individual vehicle movements occur continuously throughout the measurements. Every time traffic passes the NMT, the measured noise level goes up and the microphone is measuring traffic noise, not engine testing noise. Measured noise levels of the engine testing event include traffic noise which cannot be distinguished from individual testing events therefore measurement noise levels are contaminated by traffic noise.

It is concluded that because the overall reported L_{dn} noise levels above are contaminated with traffic noise they are not sufficient to verify calculated noise levels generated from the ETMS.

ETCMP 5

Table 10: Comparison of measured and calculated noise levels at ETCMP5

Representative Engine Testing Configuration	Measured Noise Level ($L_{dn\ 7day}$ (dB))	Calculated Noise Level ($L_{dn\ 7day}$ (dB))
7-13 October 2017 Includes ATRs at run up pad, the Number 3 Hangar and at the threshold of Runway 11, with high power runs, plus an A320 high power run at the run up pad during the day.	51	49
7-13 August 2017 Includes high power runs of ATRs and idle power runs of A320s at run up pad, the Number 3 Hangar and occasional ATRs at the threshold of Runway 11. Also includes several idle power B738 runs at the Apron area	54	53

Measured noise levels at ETCMP5 correlated reasonably well with noise levels calculated by the ETMS. For most individual test events, there was good agreement between measured and calculated noise levels.

For idle power run-up engine testing events at the threshold of runway 11 there was some variation in measured noise level. For these events measured noise levels are typically 2-3 dB higher than calculated. It is observed that measured noise levels often fluctuate by 2 or 3 decibels over the testing duration, despite engine power settings remaining generally constant. This is likely to be due to meteorological variation (wind and other effects).

Noise levels from engine tests at idle power during the day do not significantly contribute to the measured $L_{dn\ 7\ day}$ noise level. Engine tests carried out at idle power emit relatively low noise levels and engine tests carried out during the day are not subject to the 10-decibel night time noise penalty. Low level noise measurements at ETCMP5 are also impacted by aircraft operations due to proximity to the airfield. As such at ETCMP5 measured noise levels for engine testing events at idle power during the day have been excluded from the verification measurements.

Measured noise levels for three high power ATR events at the threshold of runway 11 were 3 decibels lower than calculated noise levels from the ETMS. Differences in measured and calculated noise is likely due to slight discrepancies in the aircraft orientation in practice compared with that assumed in the calculations

Overall, measured noise levels from individual events were slightly higher than calculated, but remain within acceptable limits of accuracy and tolerance. It is concluded therefore that measured noise levels are sufficient to verify calculated noise levels generated from the ETMS.

ETCMP 8

Table 11: Comparison of measured and calculated noise levels at ETCMP8

Representative Engine Testing Configuration	Measured Noise Level ($L_{dn\ 7day}$ (dB))	Calculated Noise Level ($L_{dn\ 7day}$ (dB))
7-13 October 2017 Includes high power AT run ups at run up pad, Number 3 Hangar and at the threshold of Runway 11, plus A320 idle power run ups at the run up pad and two A320 high power run at the run up pad during the day.	60	57
17-23 November 2017 Includes high power AT run ups at run up pad, the Number 3 Hangar and at the threshold of Runway 11, plus A320 idle power run ups at the run up pad and two A320 high power run at the run up pad during the day.	57	55

Measured noise levels at ETCMP8 correlated reasonably well with noise levels calculated by the ETMS. For most individual test events, there was good agreement between measured and calculated noise levels.

As detailed under the analysis for ETCMP5, measured noise levels at ETCMP8 for idle run up events are also typically 2-3 dB higher than calculated. Again, it is observed that the measured noise levels often fluctuate by 2 or 3 decibels over the testing duration, despite engine power settings remaining generally constant.

Overall, measured noise levels were similar to calculated noise levels, with some events 2-3 decibels higher than calculated and some marginally lower. The measured and calculated noise levels remain within acceptable limits of accuracy and tolerance. It is concluded therefore that measured noise levels are sufficient to verify calculated noise levels generated from the ETMS

ETCMP 10

Table 12: Comparison of measured and calculated noise levels at ETCMP10

Representative Engine Testing Configuration	Measured Noise Level ($L_{dn\ 7day}$ (dB))	Calculated Noise Level ($L_{dn\ 7day}$ (dB))
25-31 May 2017 Includes primarily ATRs at the run up pad with high power runs, plus some A320s at the gate and run up pad	52	54
17-23 June 2017 Includes ATRs on high power and A320s on idle power at the run up pad plus testing on the gates and at Number 3 Hangar and A2 Apron test locations for ATRs	53	52

Measured noise levels at ETCMP10 correlated reasonably well with noise levels calculated by the ETMS. For most individual test events, there was good agreement between measured and calculated noise levels.

Analysis of measured noise levels at ETCMP10 highlighted variation between measured noise levels and calculated noise levels for some ATR high power engine tests located at the run-up pad. Of the 90 ATR high power engine tests at the run up pad, 71 tests were within 1-3 decibels of calculated noise levels. However, for 19 events, there is a larger variation between measured and calculated noise levels.

Possible reasons for the variation include meteorological effects, differences in the procedures used by the engineers for high power runs, differences in locations for the testing resulting in different noise propagation paths, or variation in aircraft hardware.

Overall, reasons for the variation in measured noise levels for the ATR engine testing events is not clear and further investigation is required to understand what the cause may be. CIAL and MDA will continue investigations into the engine testing events to assess if an update to the ETMS is required at this location.

4.3.3 Discussion

A noise monitoring programme, comprising of two NMTs deployed at four ETCMPs between 23 February and 13 October 2017 was conducted for the purposes of verifying the ETMS calculations. Measured noise levels at the ETCMPs correlated well with noise levels calculated by the ETMS. For most individual test events, there was good agreement between measured and calculated noise levels.

It is concluded that that measured noise levels are sufficient to verify calculated noise levels generated from the ETMS. The only exception to this is at ETCMP2, where measured noise levels from engine testing are considered contaminated by extraneous noise to an extent that for this particular ETCMP, calculated noise levels are not considered to be satisfactorily verified.

For ETCMP10 further analysis to quantify the reasons for some small variations for ATR high power engine tests located at the run-up pad is required. Once these discrepancies are understood an assessment will be undertaken as to whether an update to the ETMS is required.

Nevertheless, because of the overall verification accuracy at the other ETCMPs, it is concluded that the ETMS software calculations have been verified by the noise measurements, in accordance with rule 6.1.6.2.6 a (V) (B).

5.0 COMPLAINTS

5.1 Complaints Summary

In accordance with 6.1.6.2.5 a.iv.D & 6.1.6.2.6 a.vii.C the noise complaints summary below details:

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

The noise complaint summary also includes noise complaints received in relation to the performance based navigation trial (refer to section 5.1.2).

All names and addresses have been omitted for privacy purposes.

5.1.1 Aircraft Operations and On-Aircraft Engine Testing

Complaints have been grouped by the type of operation and description of noise; actions taken as a result of the of the complaints are also listed. In summary, 47 complaints were received from 19 individuals from the period 1 January to 31 December 2017, excluding complaints relating to the PBN Trial.

Type of Operation	Description of Noise	Number of Complaints	Actions Taken
Aircraft Operations	Helicopters	3	• A new Helicopter instructor had chosen a slightly different flight path which cause disruption to residents. The instructor was advised and agreed to avoid flying this path • Explained that Helicopters are governed by CAC regulations, identified the height restrictions and explained that it is enforced in real time by Air Traffic Control. • Complainant agreed to meet with Garden City Helicopters to discuss concerns. GCH modified their procedures to mitigate noise in the area.
	High Traffic	29	• 28 Complaints came for 1 complainant. This person was given the opportunity to meet with the Airport Noise Liaison Committee (ANLC) to discuss concerns but declined the offer. The ANLC met of the 16 October 2017 and addressed concerns raised by the complainant in two separate emails. All concerns were discussed in detail by the ANLC and a written response was sent to the complainant. Feedback was accepted. No further action is necessary unless the complainant contacts the airport or a member of the ANLC again. • The other complainant did not wish to be contacted
	Flight Paths	2	• Change in wind direction and peak travel periods led to an increase in noticeable aircraft traffic in the complainant's area for a short period of time. • The other complainant did not wish to be contacted
Low flying aircraft	At Night	3	• Two complaints related to Canterbury Aero Club (CAC) night training. As a result, CAC was contacted to assist in responding. The complainant was happy not to progress further on both occasions. • Complainant was provided with an aerial image to show the track of one aircraft flying at the time in question.
	High traffic	4	• Increase in traffic was associated with efforts to control the Port Hills fire • Noise was caused by training pilots completing circuit training. Complainant explained that it is only an issue on occasion and is not persistent. • CIAL offered to meet with a repeat complainant (multiple complaints in 2016) to address concerns but this offer has been declined. To date, all issues have been resolved but it is likely that this complainant will contact CIAL again. • Complaint related to the A380 and this was passed on to Air Traffic Control and Emirates for consideration. Complainant was concerned that their complaint wasn't taken seriously. CIAL responded that we do our best to resolve issues when possible but complaints must be balanced against the operational safety of people & aircraft.
Engine Testing	During the Day	1	• CIAL explained that on this occasion unusual westerly winds and the type of engine test was rare but compliant with the District Plan and Engine Testing Procedures document. The complainant was happy not to progress further.
	At Night	5	• All tests enquired about were complaint with the District Plan rules and the Engine Testing Procedures document, after responding with detail of each test and the reasons why testing needs to occur at night, no further action was required.

5.1.2 Performance Based Navigation Trial

18 complaints relating to the PBN Trial were received from 14 individuals from the period 9 November to 31 December 2017. All complaints related to low flying aircraft and an increase in aircraft traffic in their area. All complaints and feedback received will be reviewed during the 6-month mid-trial report and following the completion of the 12-month trial.

Type of Operation	Description of Noise	Runway Approaches	Number of Complaints	Nature of the feedback
Aircraft Operations PBN Trial	Flight Path	02	8	Concerns about proximity to residence
	Increased Traffic, Increased Noise & Low flying aircraft	02	8	Concerns that the number of aircraft has increased, aircraft are flying lower and aircraft are noisier than pre-trial due to flying altitudes
	Flight Paths	29	1	Concerns about proximity to residence
	Increased Noise	29	1	Concerned aircraft are noisier than pre-trial due to flying altitudes

6.0 PERFORMANCE BASED NAVIGATION TRIAL

On 9 November 2017, Airways New Zealand, Christchurch Airport and the Board of Airline Representatives New Zealand (BARNZ) commenced a trial of Performance Based Navigation (PBN) flightpaths in Christchurch. PBN is a global air navigation standard, being introduced in accordance with international guidance and New Zealand government policy. The 12-month flight paths trial is for arrivals to Christchurch only and is part of New Southern Sky (NSS), a 10-year programme led by New Zealand Civil Aviation Authority, which is introducing major changes to New Zealand's aviation system to make air travel smarter, quicker, safer and more sustainable.

The Christchurch Flight Paths Trial website was launched providing information to the public and giving residents the opportunity to lodge feedback or complaints specifically related to the trial.

MDA has investigated whether noise from aircraft using the PBN tracks could cause a localised exceedance of the noise boundaries. Investigations include:

- **Pre- trial calculated noise contours:**

  Pre- trial calculated noise contours showed that although there may be a slight change in the shape of the annual compliance contours, exceedance of the noise boundaries was unlikely.

- **Noise measurements:**

  Noise measurements were conducted allowing for a comparative assessment of noise levels before and during the trial. The results will be presented as part of the Trial review process and the conclusions are likely to be summarised in the 2018 Noise Monitoring Report

- **Mid trial calculated noise contours:**

  Mid-trial calculated noise contours were well within the 50,55 and 65 dB Ldn Air Noise Compliance Contours.

7.0 CONCLUSION

Marshall Day Acoustics have prepared a report of compliance 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 AANC demonstrates compliance with the 65dB L_{dn} Air Noise Compliance Contour contained in the CDP
- The AANC calculations have been verified as accurate using noise measurements undertaken at Christchurch Airport in 2017.
- Predictions using the ETMS software shows compliance with noise limits detailed in the CDP
- On-aircraft engine testing verification measurements were carried out for multiple on-aircraft engine test configurations and the results generally verify the ETMS calculations. There is one exception to this at ETCMP10. The cause of this is unknown and further investigatory work is to be completed.

APPENDIX A 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.
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

APPENDIX B 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.

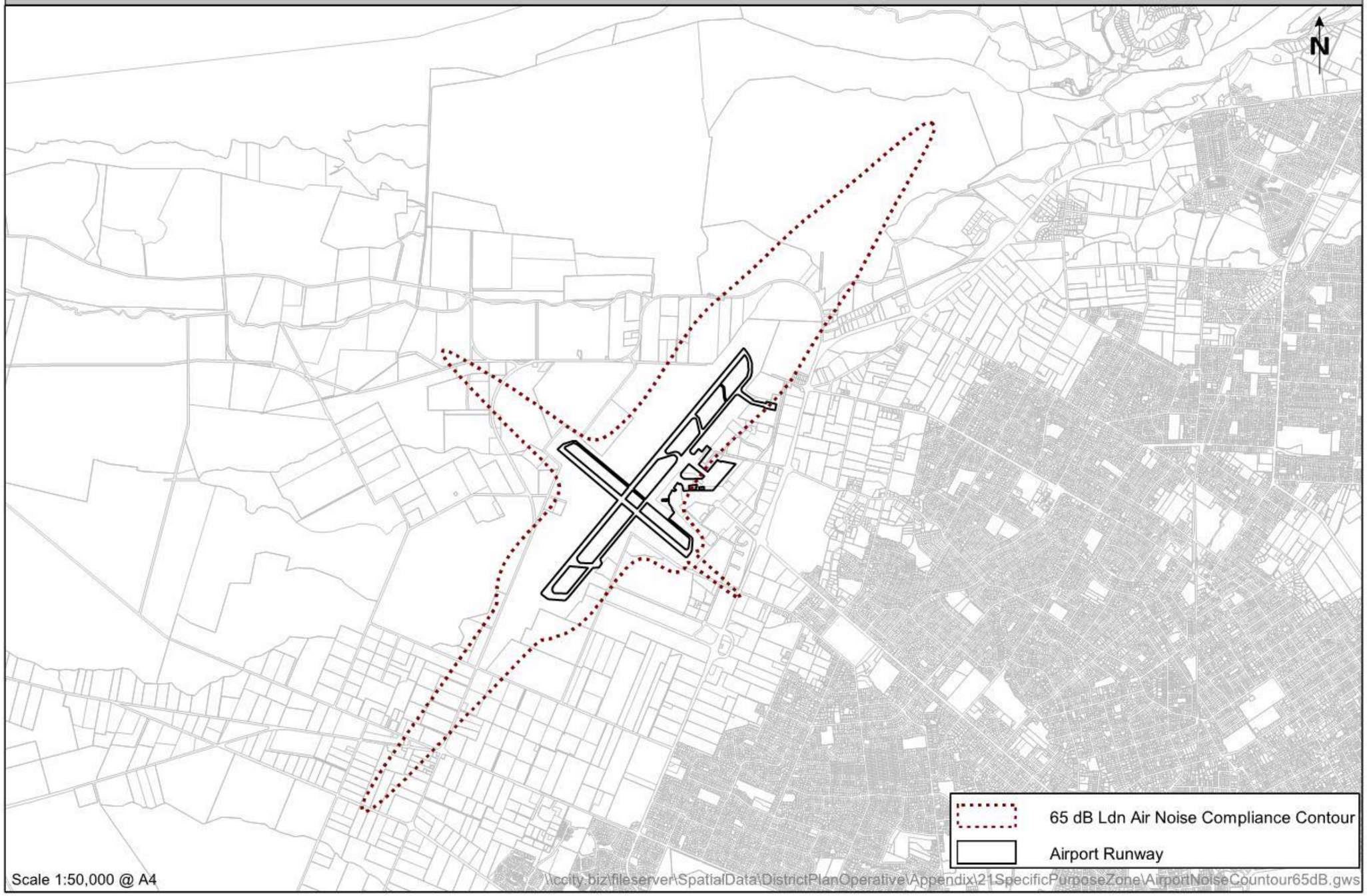
The relevant rules relating to aircraft operation and engine testing noise are given in 6.1.6.2.5 – 6.1.6.2.7.1 and Appendix 6.11.14. They state:

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.*

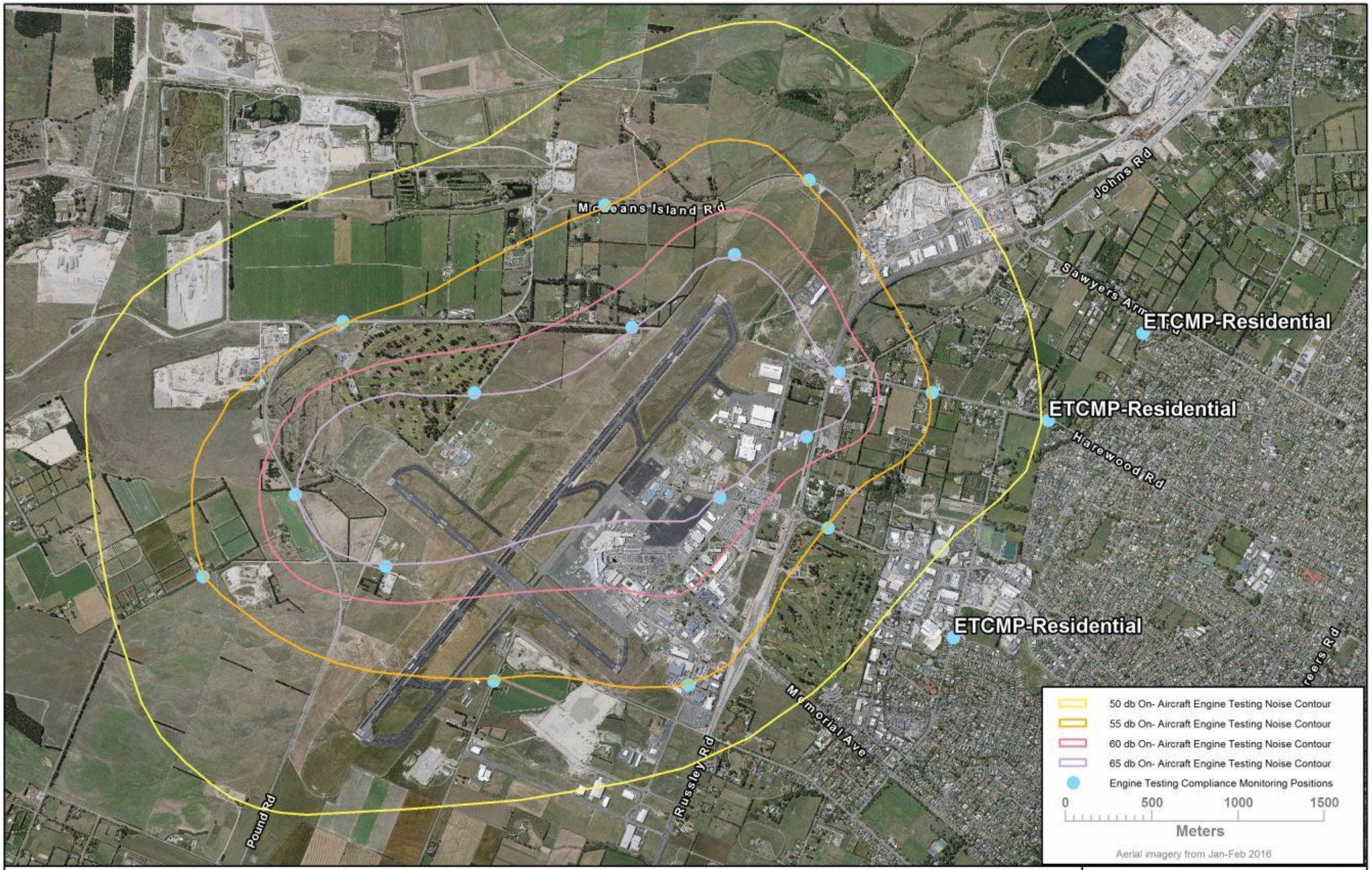
6.1.6.2.6 On-aircraft engine testing at Christchurch International Airport

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*



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-air craft 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-day rolling report of noise from on-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 last 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

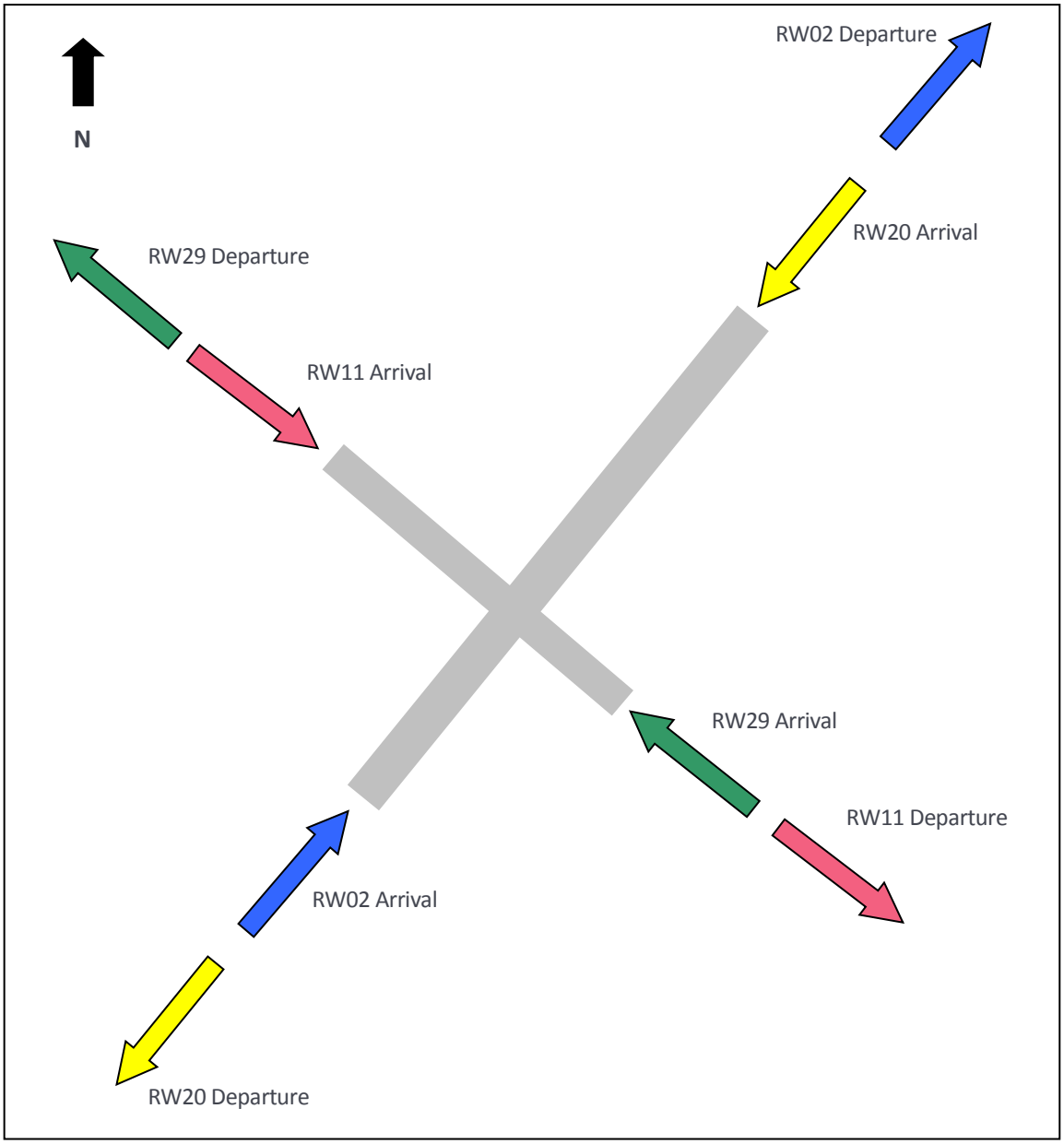
APPENDIX C CHRISTCHURCH AIRPORT RUNWAY VECTORS

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: Summary of 2017 aircraft movements (excl GA)

Month (2017)	Monthly total	Consecutive 3 months total
Jan	6490	
Feb	6304	
Mar	6953	19747
Apr	6401	19658
May	6310	19664
Jun	6209	18920
Jul	6592	19111
Aug	6636	19437
Sep	6404	19632
Oct	6954	19994
Nov	6868	20226
Dec	7026	20848

Table D2: Modelled Aircraft Movements by Runway

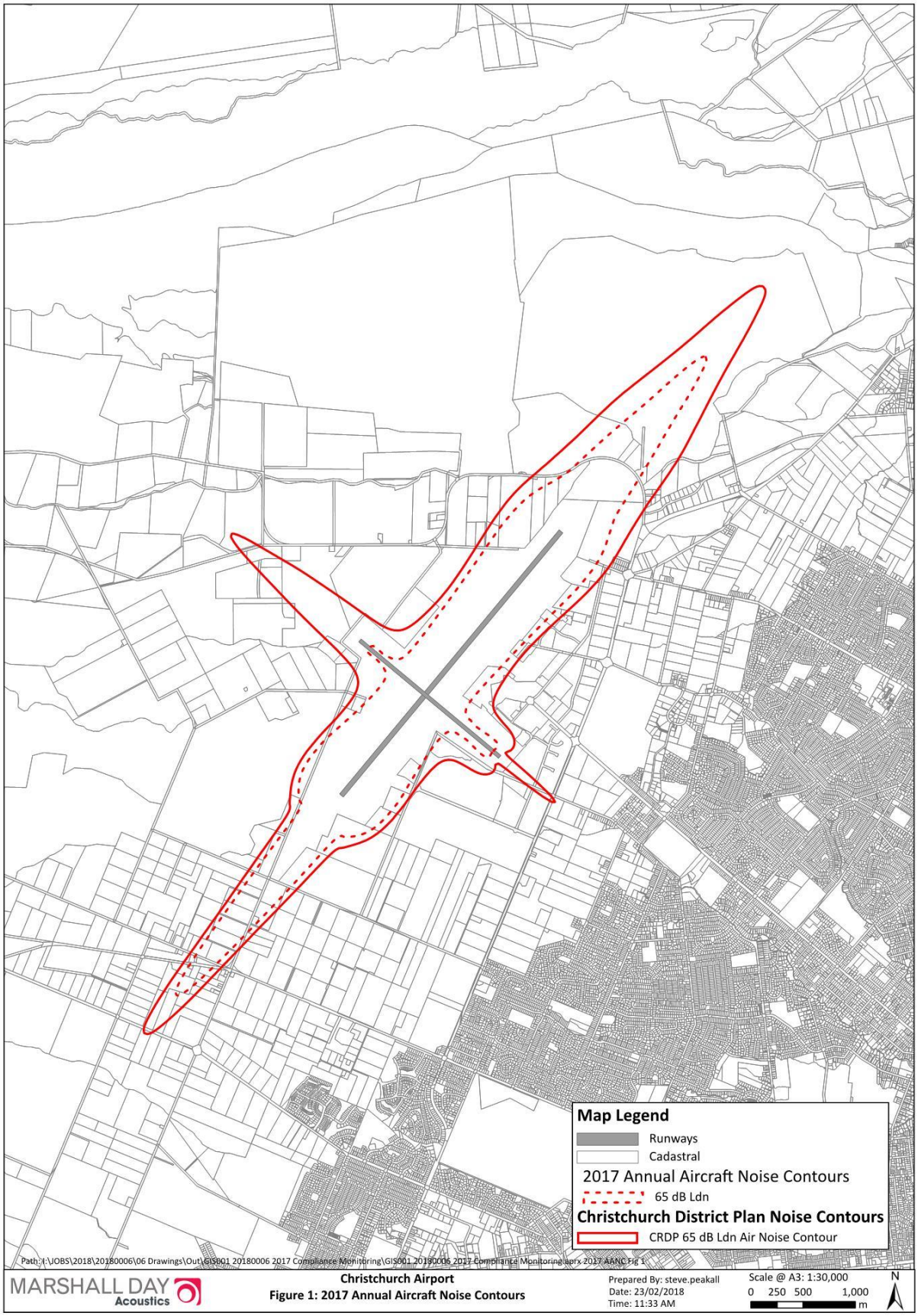
Total per day (90 days)

		Runway 02		Runway 11		Runway 20		Runway 29	
Aircraft Type	**Aircraft**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
Scheduled Jets	A320	43.80	5.43	0.00	0.00	17.94	2.72	2.75	0.07
	A332	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
	A333	0.41	0.00	0.00	0.00	0.09	0.00	0.00	0.00
	A359	0.17	0.01	0.00	0.00	0.09	0.01	0.00	0.00
	A388	1.42	0.00	0.00	0.00	0.57	0.00	0.01	0.00
	B733	0.00	0.22	0.00	0.00	0.01	0.05	0.00	0.01
	B734	1.35	3.31	0.01	0.00	0.40	1.60	0.01	0.02
	B737	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	B738	3.80	4.21	0.00	0.00	1.35	2.47	0.14	0.05
	B752	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	B763	0.18	0.60	0.00	0.00	0.10	0.39	0.00	0.01
	B772	1.55	0.00	0.00	0.00	0.70	0.00	0.01	0.00
	B788	0.60	0.55	0.00	0.00	0.20	0.24	0.00	0.00
	B789	0.07	0.02	0.00	0.00	0.04	0.00	0.00	0.00

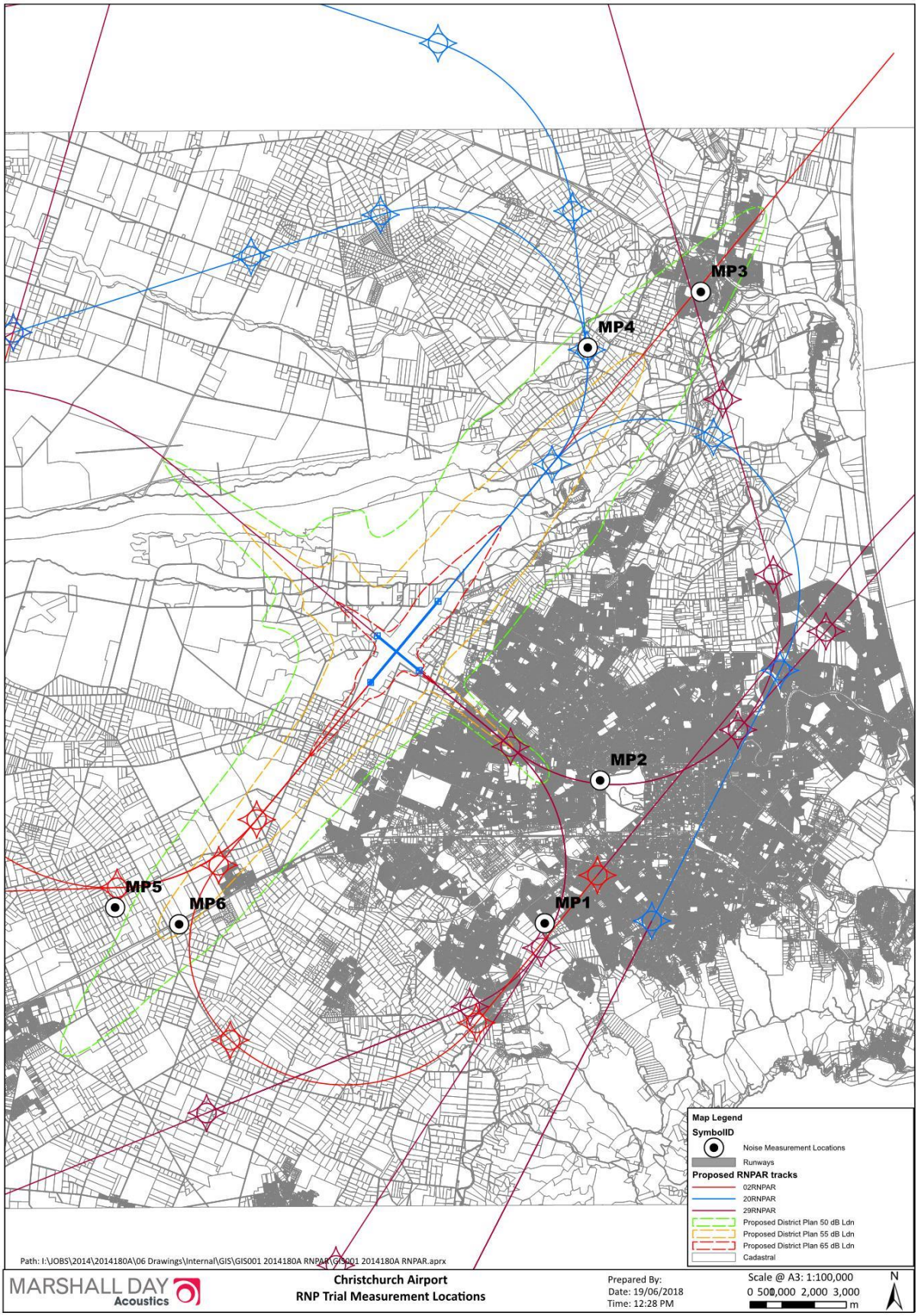
Scheduled Turbo-Props	AT75	6.05	0.39	0.11	0.00	2.39	0.26	0.44	0.00
	AT76	52.21	1.35	0.28	0.00	21.59	1.04	3.40	0.00
	C208	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CVLT	0.17	0.00	0.00	0.00	0.08	0.00	0.01	0.00
	DH8C	14.67	0.14	0.50	0.00	6.35	0.09	1.10	0.00
	JS3A	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	PA31	0.17	0.00	0.01	0.00	0.02	0.01	0.04	0.00
	PC12	3.36	0.00	0.00	0.00	1.41	0.00	0.18	0.00
Non-Scheduled	A320	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.00
	AT75	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AT76	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B734	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B738	0.05	0.18	0.00	0.00	0.00	0.01	0.00	0.00
	B752	0.04	0.01	0.00	0.00	0.01	0.00	0.00	0.00
	B763	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	B772	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BE20	0.65	0.03	0.00	0.00	0.24	0.04	0.05	0.00
	BE30	0.13	0.03	0.00	0.00	0.05	0.01	0.03	0.00
	BE40	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	BE9L	0.28	0.00	0.01	0.00	0.09	0.00	0.00	0.00
	C130	0.09	0.16	0.00	0.00	0.05	0.02	0.00	0.00
	C208	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C421	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	C441	0.38	0.04	0.00	0.00	0.21	0.01	0.01	0.00
	C510	0.05	0.00	0.00	0.00	0.00	0.00	0.03	0.00
	CVLT	0.02	0.28	0.00	0.00	0.03	0.18	0.00	0.00
	DA42	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JS32	0.16	0.01	0.00	0.00	0.00	0.00	0.02	0.00
	JS3A	0.05	0.00	0.00	0.00	0.01	0.00	0.02	0.00
	P68	0.01	0.00	0.00	0.00	0.04	0.00	0.00	0.00
	PA34	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	PAY4	0.02	0.12	0.00	0.00	0.00	0.00	0.00	0.00
	PC12	0.10	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	SW4B	0.11	0.04	0.00	0.00	0.00	0.00	0.00	0.00
	CL60	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	DC87	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	PAY4	0.26	0.00	0.00	0.00	0.14	0.00	0.01	0.00
Military	B350	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	B737	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B752	0.25	0.00	0.00	0.00	0.15	0.01	0.00	0.00
	BE20	0.32	0.00	0.00	0.00	0.23	0.00	0.03	0.00
	C130	0.93	0.05	0.00	0.00	0.36	0.00	0.05	0.00
	C17	0.35	0.03	0.00	0.00	0.16	0.00	0.03	0.00
	C27J	0.04	0.00	0.00	0.00	0.05	0.00	0.01	0.00
	C30J	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	CN35	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00

GLF5	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KC2	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T6	0.03	0.00	0.00	0.00	0.02	0.00	0.00	0.00
T6C	0.27	0.00	0.00	0.00	0.12	0.00	0.01	0.00

APPENDIX E NOISE COMPLIANCE CONTOURS



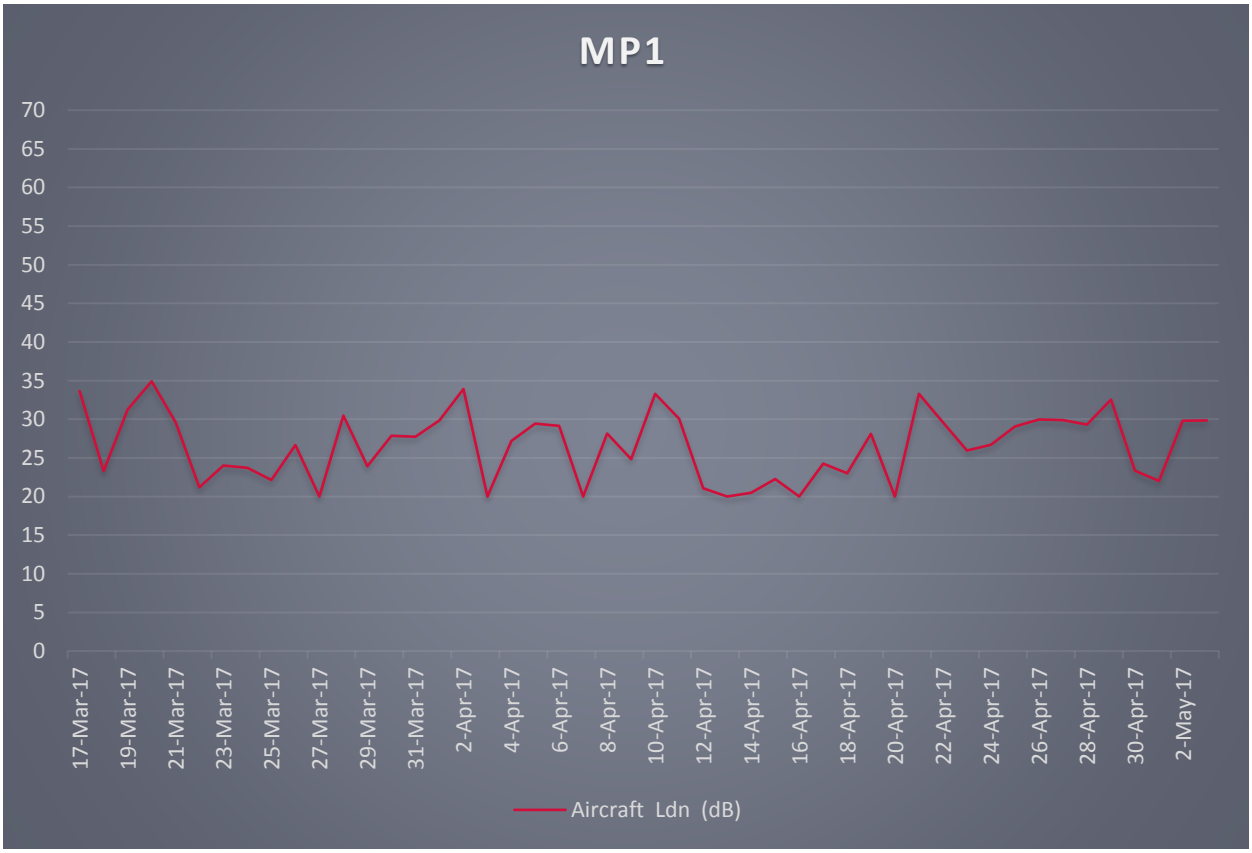
APPENDIX F Noise measurement positions for verification of the AANC



APPENDIX G DETAILED MEASUREMENT RESULTS

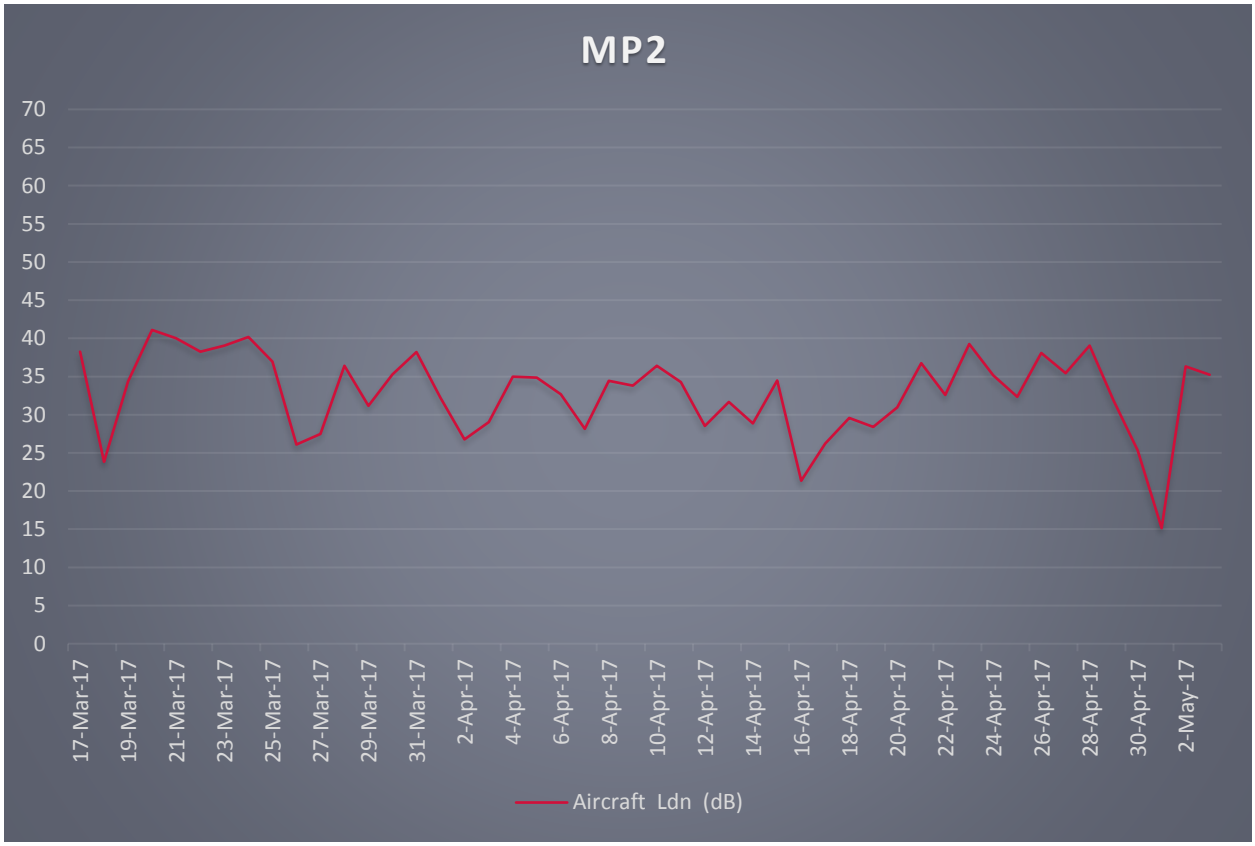
G1 Noise Measurements Results: MP1 – Salmond St, Halswell

	Aircraft L_{dn} (dB)
Minimum	<20
Maximum	35
Average	29



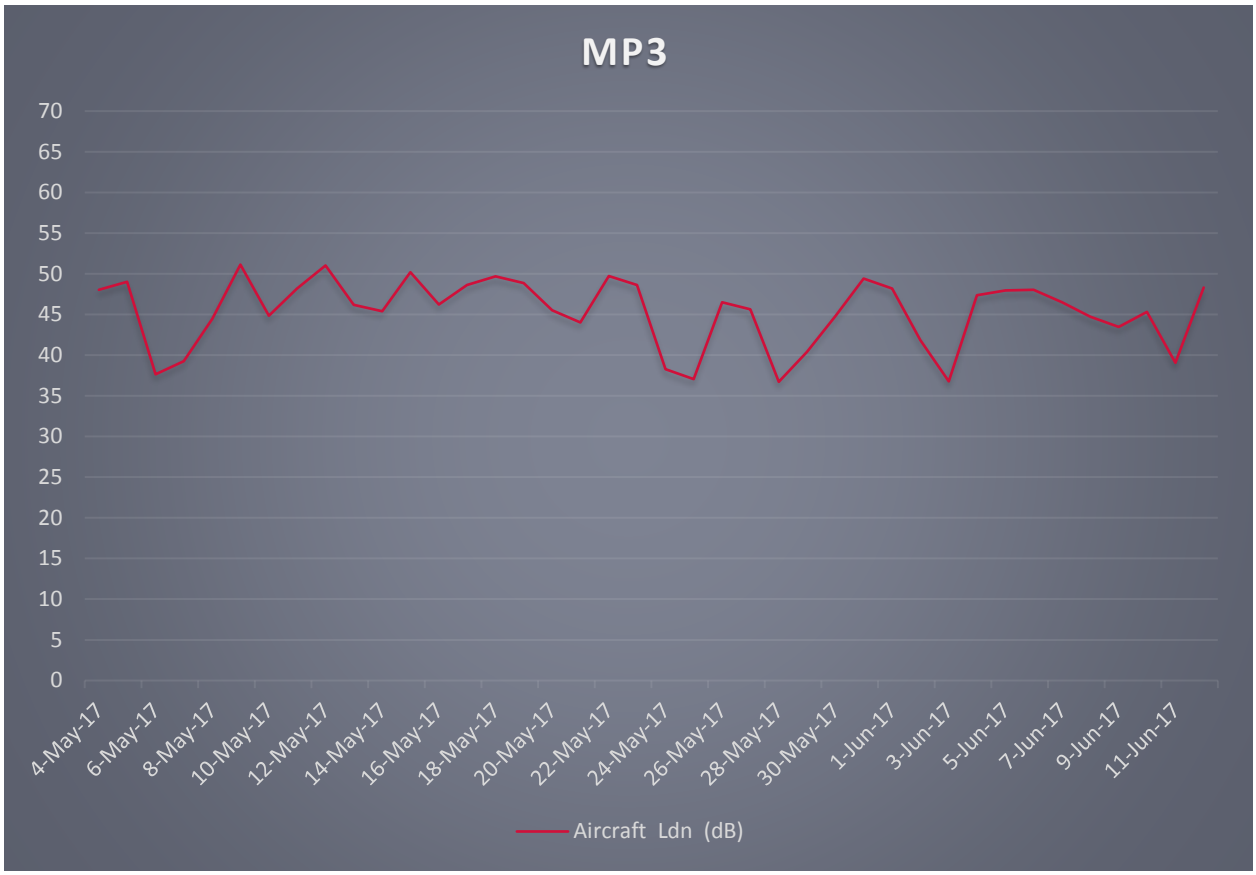
G2 Noise Measurements Results: MP2 - Chateau on the Park

	Aircraft L_{dn} (dB)
Minimum	<20
Maximum	41
Average	35



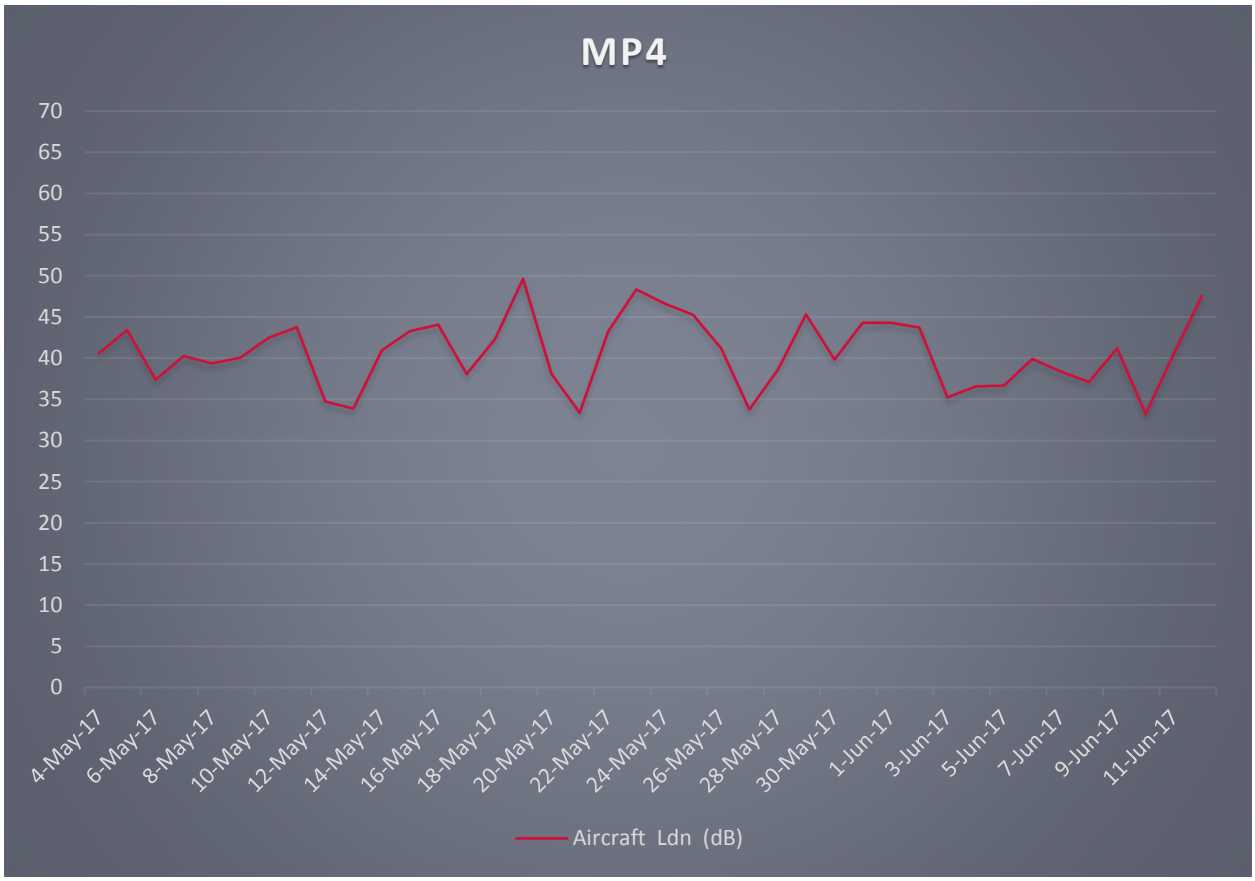
G3 Noise Measurements Results: MP3 - Edwin Lane, Kaiapoi

	Aircraft L_{dn} (dB)
Minimum	37
Maximum	51
Average	47



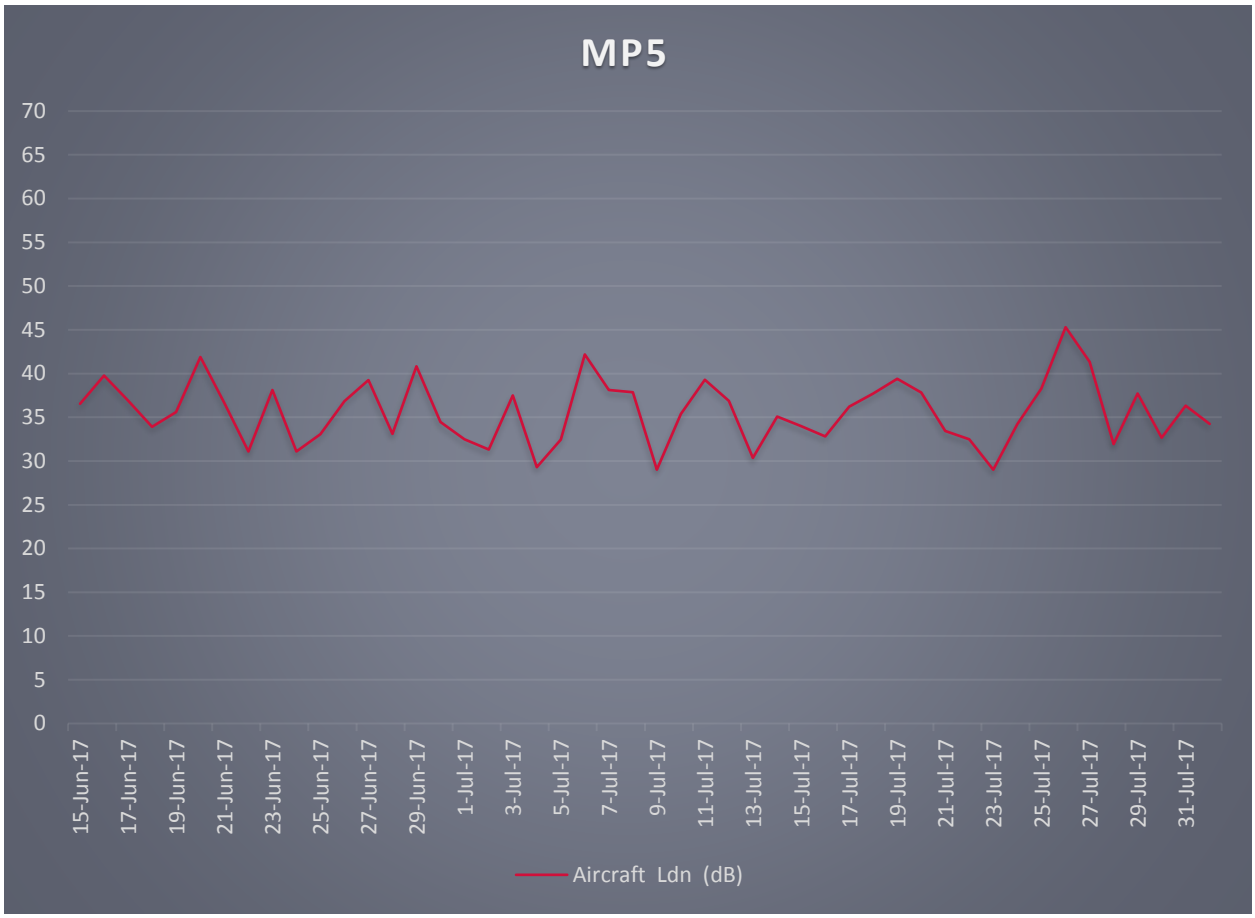
G4 Noise Measurements Results: MP4 -Elders Rd, Clarkville

	Aircraft L_{dn} (dB)
Minimum	33
Maximum	50
Average	43



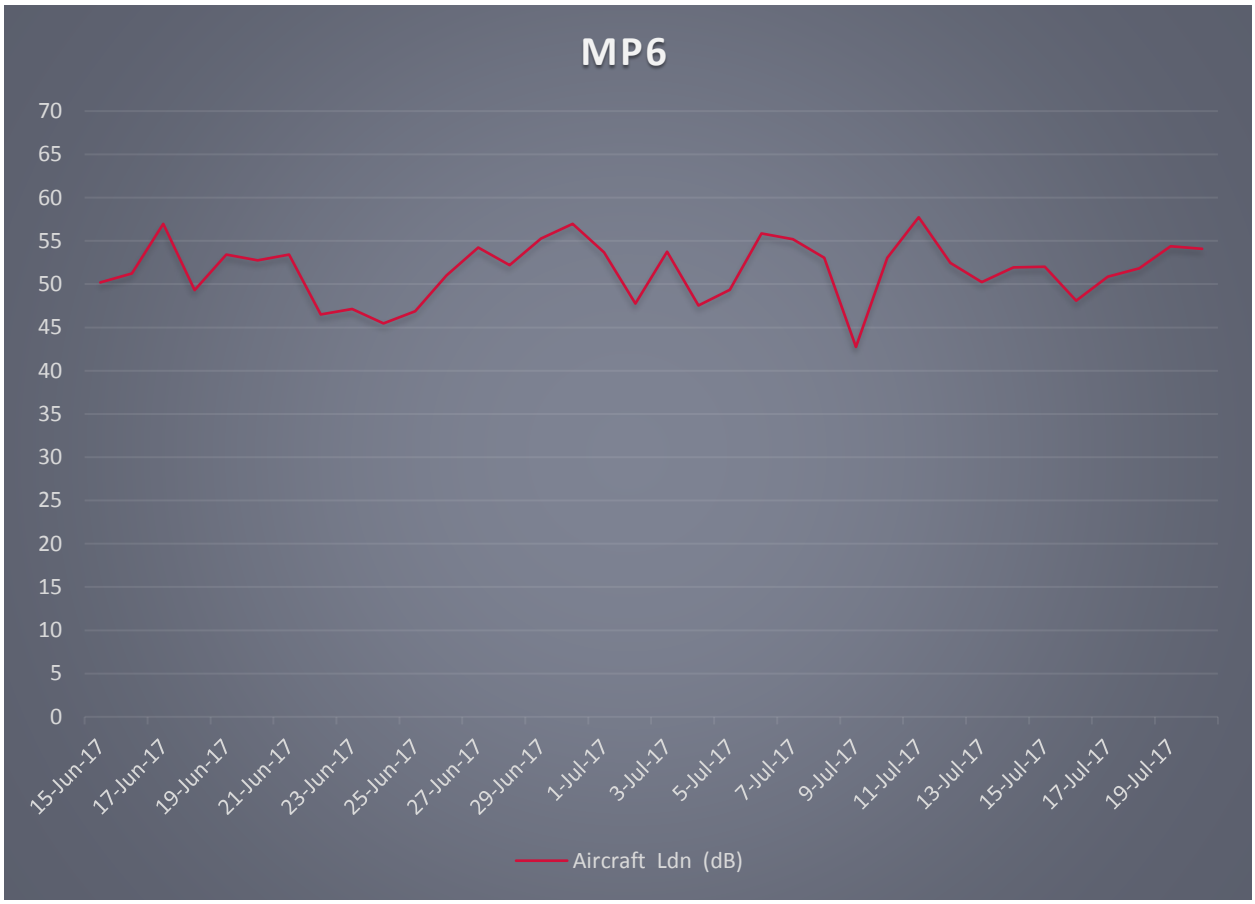
G5 Noise Measurements Results: MP5 - Maddisons Rd

	Aircraft L_{dn} (dB)
Minimum	29
Maximum	45
Average	37



G6 Noise Measurements Results: MP6 - Main South Rd

	Aircraft L_{dn} (dB)
Minimum	43
Maximum	58
Average	53



APPENDIX H THE EFFECT OF GA ACTIVITY ON THE NOISE CONTOURS

General Aviation (GA) aircraft are light piston powered propeller driven aircraft typically operated by small businesses, private operators and aero club members. There are a considerable number of GA aircraft operating from Christchurch Airport, but the noise emission of a GA aircraft is significantly lower than a commercial jet. The 'Expert Panel' noise boundaries that form the basis of the Christchurch District 65 dB $_{Ldn}$ Air Noise Compliance Contour exclude GA activity in the modelling. The Expert Panel agreed that the contribution of GA aircraft to the Airport's noise contours was insignificant and therefore it was not necessary to include this activity in the modelling.

To validate this assertion, the noise contours for the busiest three months in 2008 and 2017 were calculated both with and without GA activity. The inclusion of GA in the model resulted in an increase of approximately 0.1 dB in L_{dn} which is considered to be a negligible change. Due to the small contribution to overall noise from the GA aircraft, it is considered reasonable to exclude this activity from the INM calculations.

The effect that GA activity has on the noise contours in the future will depend on the ratio of GA movements to large commercial aircraft movements. To monitor any significant change in this ratio, the table below lists the annualised busiest three months of airport operations by aircraft category.

It is not intended to update this table each year as historical records consistently highlight the negligible impact that changes in GA activity ratios have on the noise contours.

Annualised Busiest Three Months of Aircraft Movements by Aircraft Category

	Jet	Turbo-Prop	General Aviation
2008	47,000	40,000	30,000
2009	39,000	40,000	54,000
2010	37,000	40,000	47,000
2011	39,000	35,000	44,000
2012	42,000	44,000	42,000
2013	36,000	51,000	37,000
2014	34,000	41,000	36,000
2015	36,000	47,000	25,000
2016	35,000	42,000	30,000
2017	37,000	46,000	25,000

Note: Figures are rounded to the nearest 1000 movements and are not exact