CHRISTCHURCH INTERNATIONAL AIRPORT

2015 AIRCRAFT OPERATIONS NOISE MONITORING REPORT

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1.0 INTRODUCTION

1.1 General

This Noise Monitoring Report is required to be prepared annually by Rule 1.2.4.2 in Part 11 of the Christchurch City Plan. The purpose of the report is to present the annual calculated noise contours and any associated monitoring results which have been prepared to assess compliance with the City Plan noise standard for aircraft operations at the Airport. This report for the 2015 calendar year includes the calculated noise contours, noise measurement results and information on engine testing activity.

Christchurch International Airport is the main gateway to the South Island with current total aircraft movements of 95,000 to 105,000 per annum.

Based on information provided by Airways Corporation NZ, the total number of scheduled commercial aircraft movements for the 2015 calendar year was 74,144, as shown below. A summary of the movement data input to the INM computer model for producing the 2015 Aircraft Noise Contours is provided in section 2.1 of this report.

Table 1: Total Aircraft Movements

Total Aircraft Movements	2015	2014	2013	2012	2011
Scheduled Commercial Movements	74144	75072	71715	73184	75529

1.2 Noise Performance Standards – Aircraft Operations

The Christchurch City Plan refers to airport noise in a number of locations. Rule 11-1.3.6 refers to the Airport's requirement to not exceed 65 dB L_{dn} outside the airport noise contour shown in the City Plan (Volume 3, Part 2, Appendix 3 – 65 dB L_{dn} Airport Noise Monitoring contour - CIAL). The rule states:

> *"1.3.6 Aircraft Noise*
>
> *Critical Standard*
>
> *CIAL shall manage the Christchurch International Airport so that the noise from aircraft operations does not exceed L_{dn} 65 dBA outside the L_{dn} 65 dBA airport noise contour shown in Appendix 3 to Part II.*
>
> *Noise from aircraft operations shall be based on noise data from the Integrated Noise Model (INM) and records of actual aircraft operations at CIA. The noise level shall be calculated over the busiest three month period of the year.*
>
> *Aircraft operations means:*
>
> - *the landing and take off of aircraft at CIA*

- *aircraft flying along any flight path associated with a landing or take off at CIA*

The following activities are excluded from the definition of Aircraft Operations:

- *aircraft operating in an emergency for medical or national/civil defence reasons*
- *air shows*
- *military operations not associated with the Antarctic programme*
- *aircraft using the airport as an alternative to a scheduled airport elsewhere*
- *aircraft taxiing*
- *aircraft engine testing.*

Exceedance by up to 1 dBA of the noise limit is permitted provided CIAL demonstrates at the request of, and to the satisfaction of, the Council that any such exceedance is due to atypical weather patterns."

The Christchurch Airport 65 dB L_{dn} District Plan noise contour is contained entirely in the Christchurch City District. In 2007 a new set of District Plan noise contours were formulated (commonly referred to as the "Expert Panel Contours"), including the 50 dB L_{dn} and 55 dB L_{dn} contours used for land use planning purposes. These new contours have been implemented, and are operative in the Selwyn and Waimakariri District Plans.

For Christchurch City, the Land Use Recovery Plan has adopted the new contours for land use planning purposes but the rule relating to airport noise control (rule 1.2.4.2) currently refers to the old District Plan noise contours.

The Christchurch Replacement District Plan Hearings are currently underway. It is expected that during the course of the Hearings on the chapters relevant to aircraft noise, that the 2007 contours will be formally adopted. However, there is no guarantee this will be accepted, and until that time the existing District Plan rules still apply.

In view of this, the 2015 Annual Aircraft Noise Contours (AANC) are assessed against the old District Plan noise contours in the Christchurch City District Plan.

It is anticipated that once new contours are adopted formally as part of the Christchurch City Plan Review, compliance in the future will be assessed using the new contours. This is expected to occur for 2016 compliance onwards.

Under the Operative District Plan, Rule 11 – 1.2.4.2 sets out the airport's obligation to provide annual calculations of the aircraft noise levels and the results of noise measurements where necessary.

"1.2.4.2 Aircraft noise monitoring

CIAL shall annually provide to the Council's Environmental Services Manager the result of calculations based upon monitored aircraft movements for the preceding year and the known noise characteristics of those aircraft. These calculations will be performed by a person with appropriate qualifications and experience in airport noise modelling and acoustic assessments. The provided result shall be verified by noise measurements and shall be in the form of a 65 dBA L_{dn} contour representing *the noise created by aircraft operations over that year (other than movements of a kind excluded in the Aircraft Noise Rule 1.3.5) superimposed upon a copy of the plan forming Appendix 3 to Part II of this Plan. The measurement of aircraft sound exposure and the resultant derivation of a 65 dBA L_{dn} shall be in accordance with NZS 6805:1992."*

2.0 ANNUAL AIRCRAFT NOISE CONTOURS

To ensure compliance is fully assessed, 2015 Annual Aircraft Noise Contours have been calculated based on the average daily movements over the busiest three months. Overall, to ensure the worst case scenario is calculated, the busiest 3 months of operations on Runway 02-20 is adopted. In previous years another contour has been calculated which represents the busiest three months on Runway 11-29.

The purpose of calculating noise contours for the busiest three months on Runway 11-29 is to assess compliance for the period of time when the north-west winds are prevalent and aircraft utilise Runway 11-29 more than usual.

Although this is not expressly required by the District Plan, we believe that it is necessary as it provides a worst case scenario when confirming noise levels over the City within the 65 dB L_{dn} contours as identified in the city Plan (Volume 3, Part 2, Appendix 3 - 65 dB L_{dn} Airport Noise Monitoring Contour - CIAL).

A further reason to prepare this contour for 2015 is because during the year runway maintenance works were undertaken on the main runway, causing a requirement to shift operations to the crosswind runway for long periods of time. This could be especially significant because the works occurred at night. It is noted that such maintenance works are unusual, and do not occur often.

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

2.1 INM Inputs

Both sets of the 2015 annual contours discussed in section 2.0 above have been calculated using the INM version 6.0c which is the same version used to prepare the existing Christchurch City District Plan noise contours.

A record of the aircraft activity for 2015 has been provided by CIAL for input in to the INM in the form of monthly movements by aircraft type, operation, runway and time of day. This data is recorded by Airways Corporation and includes all movements of aircraft that are fitted with a transponder. As some general aviation (GA) aircraft do not have transponders, not all GA movements are accounted for.

Noise from these light aircraft does not contribute significantly in terms of noise levels within the 65 dB L_{dn} contour. For that reason, the nature and frequency of GA flights on the overall noise exposure would not affect the location of the 65 dB L_{dn} noise contour significantly. The effect of general aviation aircraft on the overall noise exposure and compliance with the District Plan noise contours is identified in Appendix E.

MDA has analysed the movement data and determined that the busiest three consecutive months for Runway 02-20 were July, August, September. The busiest three months for Runway 11-29 were October, November, December.

The annualised total movements for both modelled scenarios are shown in Table 1 as well as a breakdown of the annualised day and night time movements. The number of night time movements is relevant as night time activity has an associated + ten decibel adjustment. A breakdown of the average daily aircraft movements by aircraft type and runway for each of the modelled scenarios is included as Appendix B.

Table 2: Summary of Modelled Aircraft Movements

	Busiest 3 Months RW 02-20	Busiest 3 Months RW 11-29
Annualised Total Movements	105472	106360
Annualised Day Time Movements	93664	95364
Annualised Night Time Movements	11808	10996

The aircraft movement data is defined as using either the main runway (02/20) or the crosswind runway (11/29). During the generation of the District Plan contours, historical records of aircraft movements at the airport have been analysed to determine the predominant runway usage at the airport. This predominant usage has historically been used to generate the compliance contours. Data provided by Airways now includes actual runway usage data and this has been used in the preparation of the 2015 compliance contours. Based on the Airways records the runway usage is as follows:

Main Runway: RW 02 = 60 %
RW 20 = 40%

Crosswind Runway: RW11 = 15%
RW 29 = 85%

In the model, aircraft movements have been distributed across flight tracks which were developed in 2007 during the review of the airport noise boundaries. The contour outcomes of the 2007 review are implemented in Change 1 to the Regional Policy Statement.

It is noted that for the purpose of modelling the location of the 65 dB L_{dn} contour, the flight track details beyond 4 km from the runway are irrelevant as the contour does not extend further than this. Therefore the approach taken is considered to be robust, valid and appropriate.

2.2 Calculated Contours

The calculated 65 dB L_{dn} contour for 2015 activity, as described above, is shown in Figure 1, Appendix C for the busiest 3 months on Runway 02-20 and Figure 2, Appendix C for the busiest 3 months on Runway 11-29, both compared with the Christchurch City District Plan 65 dB L_{dn} noise contour.

The Christchurch City District Plan 65 dB L_{dn} noise contour is not exceeded. It is noted that Figure 2 shows compliance is only just achieved. This is mainly because of the unusually large number of Runway 11-29 movements occurring at night during the year as a result of the main runway maintenance works. Accordingly, this report confirms compliance with the requirements of Rule 11-1.3.6 'Aircraft Noise'.

3.0 MEASURED NOISE LEVELS

3.1 Site Location

Marshall Day Acoustics airport noise monitor was located at 99 Stanleys Road, Christchurch from 6 July 2015 to 13 August 2015 for the main purpose of measuring L_{dn} noise levels from engine testing operations (refer section 4). However noise levels from general aircraft operations are also able to be determined. The site is approximately 1250 metres from the threshold of runway 20 and approximately 1000m from the Engine Testing run up pad. The site location relative to the Christchurch City District Plan 65 dB L_{dn} noise contour is shown in Figure 1 and Figure 2, Appendix C.

3.2 Airport Noise Monitoring Equipment

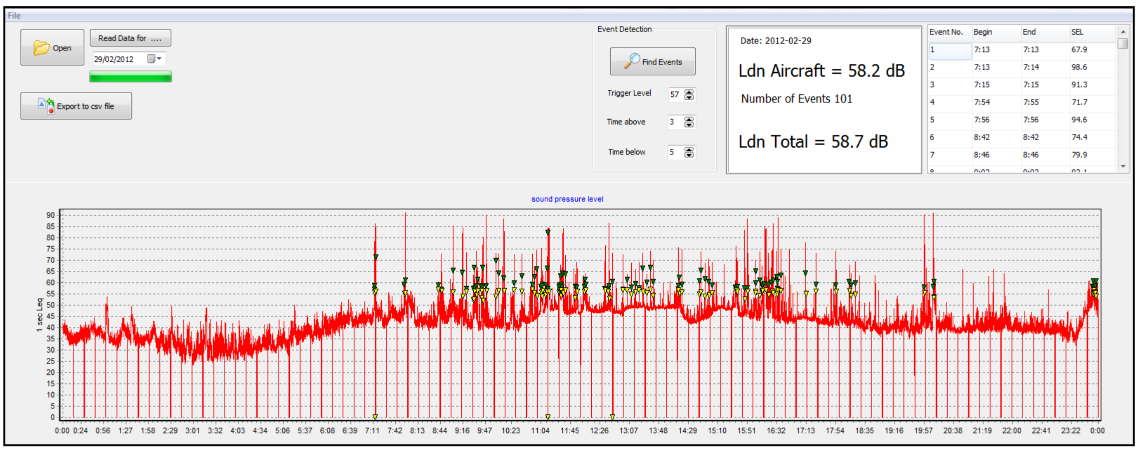
Noise monitoring was carried out in general accordance with New Zealand Standard NZS 6802:2008 "*Acoustics - Environmental Noise*" and New Zealand Standard NZS 6805:1992 "*Airport Noise Management and Land Use Planning*". The Marshall Day Acoustics airport noise monitor consists of a Norsonic 1225 sound level meter with an outdoor microphone kit. Data is stored on a memory card and downloaded through the Noise and Weather website. The noise monitoring equipment and set-up is shown below.

Figure 3: Typical Noise Monitor Set-up

The system uses the aircraft identification software in post processing to isolate any events with aircraft characteristics, and therefore it is capable of discriminating between engine testing events, operational aircraft events and extraneous environmental noise (such as from nearby roads, rubbish truck etc).

The analysis software allows calculations to be undertaken over a wide range of parameters, and provides graphical noise level traces that can be used in the analysis process. Figure 5 shows a typical screenshot of the software analysis module.

Figure 5: Analysis Software Screenshot



For operational noise, the measurement results presented in this report have been generated using the above software.

Measured engine testing noise levels are discussed further in section 4.1.

3.3 Noise Measurement Results

A total of 35 full days of data were recorded. We consider that the data is sufficient to provide a robust and reliable assessment of the Airport's operating noise level.

The average, maximum and minimum noise level and the daily number of noise events is shown in Table 3.

Table 3: Summary of Noise Measurement Results

	Measured Aircraft Noise Level (dB L_{dn})	Number of Events
Minimum	48	38
Maximum	62	116
Average	**56**	71

The overall measured aircraft noise levels are also shown graphically in Appendix D.

We consider that this data is sufficient to provide a reliable assessment of the Airport's operating noise level. This is because the measured noise level is generally consistent over the monitoring period, suggesting that the monitoring is accurate.

Based on the Christchurch City District Plan 65 dB L_{dn} noise contour as shown on Figure 1 and 2, the noise level at the monitoring site is approximately 9 decibels below the level at the Christchurch City District Plan 65 dB Ldn noise contour.

Overall, the measured noise levels are consistent with the predicted noise levels of Figure 1, verifying that the predictions are an accurate representation of noise levels received in the community.

Based on the above, the monitoring results demonstrate that noise from aircraft operations during the monitoring period comfortably complied with the relevant noise limit.

4.0 ENGINE TESTING

The Noise Management Plan discusses the methods used to manage noise from engine testing at Christchurch Airport. The Noise Management Plan States:

> *"3.0 Engine Testing*
>
> *Under the by laws and the Airside operations Agreement details of each night-time engine testing event are recorded by the aircraft operator and forwarded to CIAL. CIAL will record the details of each event in a purpose made engine testing noise monitoring application. This software will be used to calculate noise levels in the wider community resulting from night time 'on wing' engine testing. The noise levels received at the most affected dwellings shall be calculated and monitored over a period of not less than 3 months for the purpose of carrying out an assessment of engine testing noise effects.*

Following the assessment of noise effects, consideration will be given to developing additional or alternative controls on engine testing and land use management should the outcome of the assessment signal that this is appropriate. The target completion date of the assessment of engine testing noise effects is March 2014."

The software referred to in the NMP has been developed by MDA over the last 5 years and is now being used to collect and analyse engine testing data. The MDA software (Engine Testing Monitoring Software - ETMS) is being used to calculate and assess the noise levels emitted over the period November 2010 to the present time (where Air New Zealand (ANZ) records are available).

These historical noise emissions have be compared with appropriate engine testing noise limits. At present there is no actual requirement in the Christchurch International Airport By-Laws Approval Order 1989 regarding engine testing noise levels. This is the reason that the software is being used in reviewing the calculated noise levels in relation to controls used elsewhere in NZ.

A report has been prepared on the results (Marshall Day Acoustics Report (Rp 001 R042012503A, dated 20 October 2015), including an opinion on the magnitude of the noise exposure. The report includes a comparison of the historical noise emissions with various noise controls with respect to ground running of aircraft engines in the Russley area and an opinion on the noise exposure for residents surrounding the airport.

Since this time engine testing noise control continues to be thoroughly examined through the Christchurch Replacement District Plan hearings process. At this stage final engine testing noise controls have not been fully determined, although it is known that a new engine testing noise limit is likely to be implemented.

Therefore engine testing noise control mechanisms and actual calculated noise levels are anticipated to be presented in this Noise Monitoring Report from 2016 onwards. It is likely that by this time the Christchurch City Plan Review will be advanced and engine testing noise controls will be in place.

4.1 Measured Engine Testing Noise Levels

As part of the preparation for the District Plan Review process, engine testing noise levels were measured at a representative site in the community near the run up pad. The site, at 99 Stanleys Road was chosen because it is located in an area less affected by extraneous noise, yet is still close to the run up pad where the majority of engine testing occurs. Further details as to the set up of the system are given in section 3.

Measured engine testing noise levels are shown in Appendix D. Full details of the noise measurement survey, including the methodology used and comparisons with ambient noise levels are given in Appendix F.

In summary the results show that engine testing noise levels would be audible at the house (based on the actual measured noise level and the characteristics of the noise).

However, we note that engine testing noise levels ($L_{dn\ 7\ day}$) are below the notified engine testing noise contours, and lower than that allowed for under the Constrained engine testing noise contours presented at the hearing and therefore engine testing noise is considered acceptable in the context of the existing environment and the overall noise level at this location.

5.0 COMPLAINTS

Noise Complaints are occasionally received as a result of both general airport operations and specifically related to engine testing. CIAL currently investigate complaints in the following manner:

The CIA Noise Complaints Procedure provides individuals with the ability to express, and have recorded, their concerns about aviation noise (activities) or to ask questions regarding noise at CIA.

Noise complaints may be made by calling the CIAL Integrated Operation Centre (IOC) office which is manned 24 hours a day (on phone 353 7777). IOC staff document noise complaints by obtaining information from the caller about the nature of the complaint, time of the occurrence, location of callers residence and the activity that caused disturbance. This information is used to determine the probable activity that was responsible for the complaint.

CIAL firstly screens complaints to determine if the complaint can be dealt with in-house or if further investigation or analysis of data by Marshall Day Acoustics needs to be undertaken in order to provide a satisfactory outcome.

A follow up phone call will be made followed by a written response / e-mail if requested by the caller detailing the complaint and details of the activity responsible, the meteorological conditions and the runway in use at the time of the disturbance. A notice of action taken by CIAL in respect of the complaint will be included. Typically it will take CIAL staff up to 2 days to make a follow up phone call and up to 7 days to respond in writing if where required

The following is a summary of noise complaints received in 2015:

Complaints Type	Number
General Aviation (GA)	6
Low flying aircraft	26
Engine testing	6

5.1 Specific Complaint investigation

No Specific noise complaint investigations were carried out in 2015 by Marshall Day Acoustics, as no specific complaint response investigation was deemed necessary. Where required, desktop complaint responses were provided by CIAL in accordance with the provisions of section 5, above.

6.0 CONCLUSION

Noise contours have been calculated and in-field monitoring carried out to establish whether noise from aircraft operations at Christchurch International Airport during 2015 complied with the Christchurch City District Plan 65 dB L_{dn}

noise contour limit. Both the contouring exercise and the noise monitoring results confirm that noise from aircraft operations in 2015 comfortably complied with the 65 dB L_{dn} limit.

Engine testing noise levels are currently being assessed and will be reported on as part of the City Plan Review process. It is expected the engine testing noise assessment in the 2016 Noise Monitoring Report will be expanded and take account of the new District Plan Requirements.

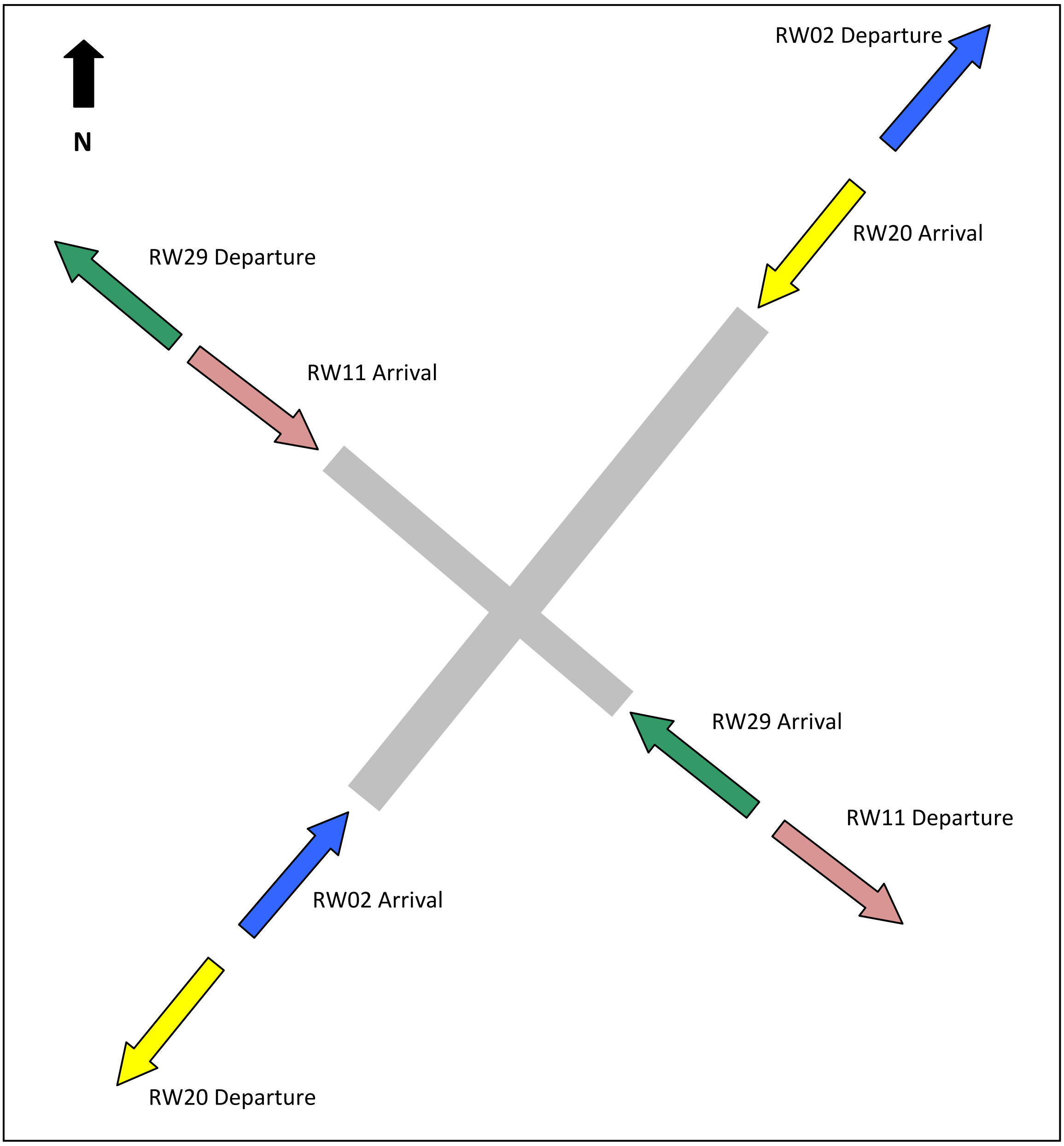
APPENDIX A: CHRISTCHURCH AIRPORT RUNWAY VECTORS

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 B: MODELLED AIRCRAFT MOVEMENTS

Aircraft movements for busiest three month contour (Figure 1)

		Runway 02		Runway 20		Runway 29	
Aircraft Type	**Aircraft**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
Scheduled Jets	A320	31.66	5.80	27.53	4.94	0.43	0.04
	B733	1.78	1.48	1.36	1.25	0.03	0.02
	B738	1.27	2.33	1.14	1.78	0.01	0.02
	B763	0.05	0.55	0.04	0.85	0.00	0.00
	B772	1.07	0.00	0.97	0.00	0.00	0.00
	B77L	0.00	0.02	0.00	0.00	0.00	0.00
	B77W	1.07	0.00	0.95	0.00	0.00	0.00
	GLF4	0.02	0.00	0.00	0.00	0.00	0.00
Scheduled Turbo-Props	AT75	13.66	0.20	12.67	0.47	0.40	0.02
	AT76	14.40	0.13	12.74	0.37	0.35	0.01
	B190	5.37	0.00	4.88	0.00	0.82	0.01
	BE20	0.07	0.00	0.04	0.00	0.00	0.00
	C208	0.07	0.00	0.02	0.00	0.00	0.00
	CVLT	1.08	3.90	0.66	2.82	0.02	0.11
	DH8C	17.66	0.00	15.96	0.02	0.87	0.00
	PA31	0.00	0.00	0.03	0.00	0.00	0.00
	SW4B	0.52	0.74	0.27	1.16	0.04	0.01
General Aviation	AS50	0.00	0.00	0.00	0.00	0.00	0.00
	AS55	0.00	0.00	0.00	0.00	0.00	0.00
	B06	0.00	0.00	0.00	0.00	0.00	0.00
	B190	0.01	0.00	0.01	0.00	0.00	0.00
	BE20	0.23	0.03	0.24	0.01	0.00	0.00
	BE30	0.02	0.00	0.01	0.00	0.00	0.00
	BE36	0.07	0.00	0.03	0.00	0.01	0.00
	BE40	0.02	0.00	0.02	0.00	0.00	0.00
	BE9L	0.42	0.00	0.20	0.00	0.02	0.00
	BK17	0.01	0.00	0.01	0.00	0.00	0.00
	C130	0.03	0.00	0.01	0.00	0.00	0.00
	C172	1.68	0.00	1.24	0.00	0.21	0.00
	C180	0.29	0.00	0.21	0.00	0.04	0.00
	C182	0.21	0.00	0.15	0.00	0.03	0.00
	C185	0.16	0.00	0.12	0.00	0.02	0.00
	C206	0.11	0.00	0.08	0.00	0.01	0.00
	C210	0.01	0.00	0.01	0.00	0.00	0.00
	C402	0.02	0.00	0.02	0.00	0.00	0.00
	C441	0.34	0.06	0.32	0.07	0.01	0.00
	C510	0.01	0.00	0.08	0.00	0.00	0.00
	C650	0.00	0.00	0.02	0.00	0.00	0.00
	C77R	0.01	0.00	0.01	0.00	0.00	0.00
	C82R	0.01	0.00	0.00	0.00	0.00	0.00
	CL60	0.02	0.00	0.00	0.00	0.00	0.00
	DA42	0.00	0.00	0.00	0.01	0.01	0.00
	EC20	0.00	0.00	0.00	0.00	0.00	0.00
	EC45	0.00	0.00	0.00	0.00	0.00	0.00
	ECHO	0.01	0.00	0.01	0.00	0.00	0.00
	G2CA	0.00	0.00	0.00	0.00	0.00	0.00
	GA8	0.04	0.00	0.03	0.00	0.00	0.00
	GLF4	0.00	0.00	0.02	0.00	0.00	0.00
	GLF6	0.03	0.00	0.00	0.00	0.00	0.00
	H269	0.00	0.00	0.00	0.00	0.00	0.00
	JPRO	0.00	0.00	0.00	0.00	0.00	0.00
	JS32	0.01	0.00	0.00	0.01	0.00	0.00

	L29	0.00	0.00	0.00	0.00	0.00	0.00
	LJ45	0.00	0.01	0.01	0.00	0.00	0.00
	M9	0.01	0.00	0.01	0.00	0.00	0.00
	NH90	0.00	0.00	0.00	0.00	0.00	0.00
	P210	0.04	0.00	0.03	0.00	0.00	0.00
	P28A	15.02	1.13	11.26	0.82	1.84	0.14
	P28B	0.12	0.00	0.09	0.00	0.02	0.00
	P28R	0.47	0.00	0.34	0.00	0.06	0.00
	P28T	0.02	0.00	0.02	0.00	0.00	0.00
	P68	2.52	0.00	1.74	0.00	0.18	0.02
	PA18	0.41	0.00	0.30	0.00	0.05	0.00
	PA22	0.01	0.00	0.01	0.00	0.00	0.00
	PA24	0.01	0.00	0.00	0.00	0.00	0.00
	PA31	0.01	0.00	0.03	0.00	0.00	0.00
	PA34	2.30	0.19	2.26	0.14	0.17	0.02
	PA38	6.02	0.00	4.37	0.00	0.77	0.00
	PAY4	0.01	0.00	0.02	0.00	0.01	0.00
	PNR2	0.01	0.00	0.00	0.00	0.00	0.00
	PNR3	0.01	0.00	0.01	0.00	0.00	0.00
	R200	10.87	0.00	7.91	0.00	1.39	0.00
	R22	0.00	0.00	0.00	0.00	0.00	0.00
	R44	0.00	0.00	0.00	0.00	0.00	0.00
	RV12	0.01	0.00	0.00	0.00	0.00	0.00
	RV7	0.06	0.00	0.04	0.00	0.01	0.00
	SR22	0.09	0.00	0.08	0.00	0.02	0.00
	T18	0.02	0.00	0.02	0.00	0.00	0.00
	T6	0.01	0.00	0.01	0.00	0.00	0.00
Non-Scheduled	A319	0.03	0.01	0.04	0.00	0.00	0.00
	A320	0.07	0.00	0.02	0.00	0.00	0.00
	B74S	0.05	0.00	0.16	0.00	0.00	0.00
	AT76	0.01	0.00	0.01	0.00	0.00	0.00
	B190	0.01	0.00	0.00	0.00	0.00	0.00
	B733	0.09	0.00	0.16	0.00	0.00	0.00
	B737	0.10	0.00	0.04	0.01	0.00	0.00
	B738	0.05	0.05	0.06	0.04	0.00	0.00
	B74S	0.07	0.03	0.04	0.01	0.00	0.00
	BE20	0.25	0.03	0.17	0.00	0.01	0.00
	BE30	0.09	0.00	0.11	0.01	0.00	0.00
	BE40	0.00	0.00	0.02	0.00	0.00	0.00
	BE9L	0.05	0.00	0.10	0.00	0.00	0.00
	C441	0.51	0.05	0.42	0.01	0.00	0.01
	C680	0.01	0.01	0.00	0.00	0.00	0.00
	DH8C	0.01	0.00	0.00	0.00	0.00	0.00
	F27	0.01	0.00	0.04	0.01	0.02	0.03
	F2TH	0.01	0.00	0.01	0.00	0.00	0.00
	JS32	0.02	0.00	0.11	0.00	0.00	0.00
	PA31	0.05	0.01	0.00	0.00	0.00	0.00
	PA34	0.03	0.00	0.00	0.00	0.01	0.00
	PAY4	0.02	0.00	0.02	0.00	0.00	0.00
	PAY4	0.27	0.00	0.20	0.00	0.03	0.00
	SW4B	0.15	0.00	0.08	0.01	0.00	0.00
Military	A109	0.00	0.00	0.00	0.00	0.00	0.00
	B752	0.09	0.00	0.09	0.00	0.00	0.00
	BE20	0.12	0.00	0.15	0.00	0.00	0.00
	C130	0.08	0.00	0.11	0.00	0.00	0.00
	C17	0.13	0.01	0.04	0.03	0.00	0.01
	D328	0.04	0.00	0.00	0.00	0.00	0.00
	NH90	0.12	0.00	0.02	0.00	0.00	0.00

T6

Aircraft movements for busiest three month-Runway 29 contour (Figure 2)

		Runway 02		Runway 20		Runway 11		Runway 29	
Aircraft Type	**Aircraft**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
Scheduled Jets	A320	39.30	5.98	19.64	2.22	0.41	0.40	6.79	1.58
	A333	0.80	0.00	0.43	0.00	0.00	0.00	0.01	0.00
	B733	0.11	0.88	0.02	0.70	0.00	0.16	0.02	0.74
	B734	0.03	0.05	0.00	0.09	0.01	0.00	0.03	0.01
	B738	2.89	2.68	1.32	1.05	0.01	0.29	0.18	0.83
	B744	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00
	B763	0.27	0.54	0.13	0.51	0.00	0.01	0.00	0.03
	B772	1.45	0.00	0.83	0.00	0.00	0.00	0.00	0.00
	B77W	1.39	0.00	0.63	0.00	0.00	0.00	0.00	0.00
	B788	0.05	0.05	0.02	0.02	0.00	0.00	0.00	0.00
Scheduled Turbo-Props	AT75	19.77	0.28	10.40	0.30	0.26	0.01	3.63	0.10
	AT76	15.89	0.40	7.61	0.22	0.09	0.01	2.88	0.02
	B190	6.01	0.02	3.12	0.01	0.60	0.00	1.65	0.00
	BE20	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C208	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CVLT	0.70	2.63	0.54	2.01	0.10	0.59	0.29	2.19
	DH8C	21.75	0.21	11.53	0.01	0.83	0.00	4.71	0.01
	PA31	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00
	PC12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SW4B	0.04	0.05	0.01	0.03	0.00	0.00	0.00	0.00
General Aviation	AS50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B190	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BE20	0.30	0.04	0.20	0.02	0.02	0.00	0.05	0.00
	BE36	0.10	0.00	0.08	0.00	0.00	0.00	0.00	0.00
	BE40	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	BE9L	0.33	0.02	0.18	0.00	0.00	0.00	0.07	0.01
	BK17	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	C130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C172	2.00	0.00	1.45	0.00	0.05	0.00	0.25	0.00
	C180	0.36	0.01	0.26	0.01	0.01	0.00	0.05	0.00
	C182	0.11	0.00	0.08	0.00	0.00	0.00	0.01	0.00
	C185	0.22	0.00	0.16	0.00	0.01	0.00	0.03	0.00
	C206	0.12	0.00	0.09	0.00	0.00	0.00	0.02	0.00
	C208	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	C210	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	C310	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	C402	0.19	0.00	0.14	0.00	0.01	0.00	0.02	0.00
	C421	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	C441	0.27	0.02	0.16	0.01	0.02	0.01	0.09	0.02
	C510	0.10	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	C650	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C82R	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	CL60	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	COUR	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	DA40	0.12	0.00	0.06	0.00	0.00	0.00	0.03	0.00
	DA42	0.03	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	E190	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	EC20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F406	0.08	0.00	0.05	0.00	0.00	0.00	0.01	0.00

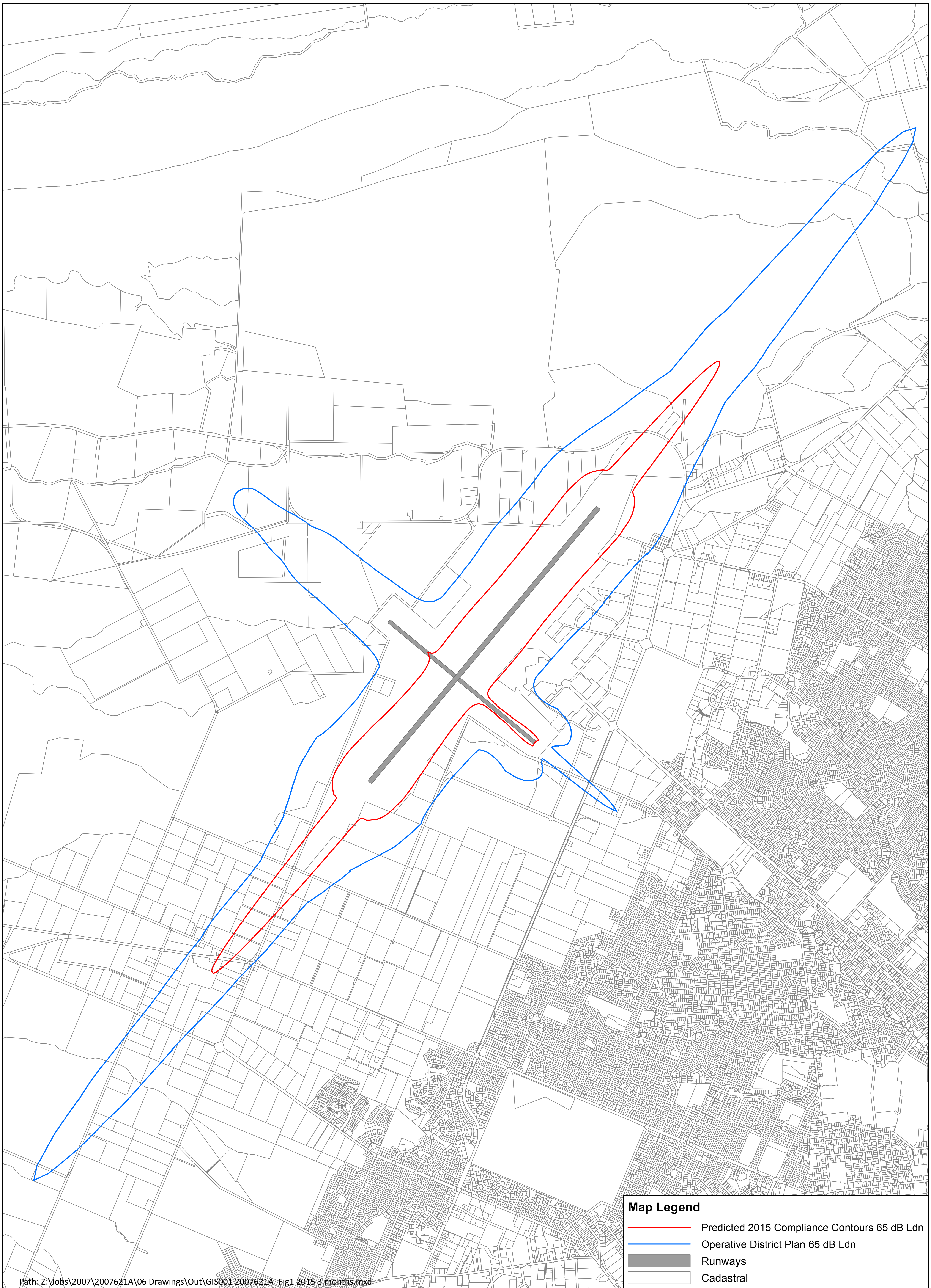
	G2CA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLEX	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLF5	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLF6	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	H500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JPRO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JS32	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
	L29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	M5	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	MU2	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NH90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	P210	0.05	0.00	0.04	0.00	0.00	0.00	0.01	0.00
	P28A	7.57	0.46	5.19	0.34	0.18	0.01	0.95	0.06
	P28B	0.09	0.00	0.06	0.00	0.00	0.00	0.01	0.00
	P28R	0.80	0.00	0.58	0.00	0.02	0.00	0.10	0.00
	P28T	0.06	0.00	0.04	0.00	0.00	0.00	0.01	0.00
	P68	3.20	0.47	2.15	0.31	0.04	0.01	0.53	0.05
	PA18	0.28	0.00	0.20	0.00	0.01	0.00	0.04	0.00
	PA30	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	PA31	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	PA32	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	PA34	2.33	0.13	1.59	0.09	0.04	0.00	0.40	0.02
	PA38	6.13	0.00	4.46	0.00	0.17	0.00	0.79	0.00
	PC12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PNR2	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	R200	11.37	0.02	8.27	0.01	0.32	0.00	1.46	0.00
	R22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	R44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RALL	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	RV4	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	RV7	0.11	0.00	0.08	0.00	0.00	0.00	0.01	0.00
	SF34	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	SPIT	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	SR22	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	T18	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	T6	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	TL20	0.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Non-Scheduled	A320	0.05	0.02	0.03	0.00	0.00	0.00	0.04	0.00
	A333	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AT75	0.10	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	AT76	0.05	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	B733	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.01
	B734	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.02
	B737	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00
	B738	0.03	0.05	0.06	0.04	0.00	0.00	0.02	0.01
	B763	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00
	B772	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.00
	BE20	0.48	0.09	0.22	0.02	0.00	0.00	0.02	0.00
	BE30	0.10	0.02	0.03	0.00	0.00	0.00	0.00	0.00
	BE9L	0.10	0.00	0.03	0.00	0.03	0.00	0.05	0.00
	C130	0.04	0.08	0.01	0.04	0.01	0.00	0.02	0.02
	C208	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
	C25C	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00
	C402	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	C421	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C441	0.41	0.02	0.27	0.04	0.01	0.00	0.05	0.03
	C510	0.03	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	C650	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00

	CL60	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	CVLT	0.00	0.14	0.02	0.08	0.00	0.03	0.00	0.13
	DH8C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	F27	0.09	0.02	0.07	0.03	0.00	0.02	0.00	0.08
	F406	0.05	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	F50	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00
	FA20	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLF4	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
	H25B	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	JS32	0.08	0.02	0.04	0.00	0.00	0.00	0.03	0.00
	JS3A	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PA31	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00
	PA34	0.01	0.01	0.01	0.02	0.00	0.00	0.02	0.00
	PAY4	0.20	0.01	0.14	0.00	0.01	0.00	0.02	0.00
	SW4B	0.08	0.04	0.03	0.05	0.00	0.00	0.01	0.03
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	0.07	0.00	0.03	0.00	0.00	0.00	0.03	0.00
	BE20	0.04	0.00	0.07	0.00	0.00	0.00	0.04	0.00
	C130	0.62	0.03	0.34	0.02	0.00	0.01	0.10	0.02
	C17	0.37	0.04	0.20	0.02	0.00	0.02	0.03	0.03
	C30J	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NH90	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	P3	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	T6	0.06	0.00	0.04	0.00	0.00	0.00	0.01	0.00

APPENDIX C: NOISE COMPLIANCE CONTOURS

Figure 1: Noise from Aircraft Operations – 2015 AANC

Figure 2: Noise from Aircraft Operations 2015 (busiest 3 months of Runway 11-29 use)



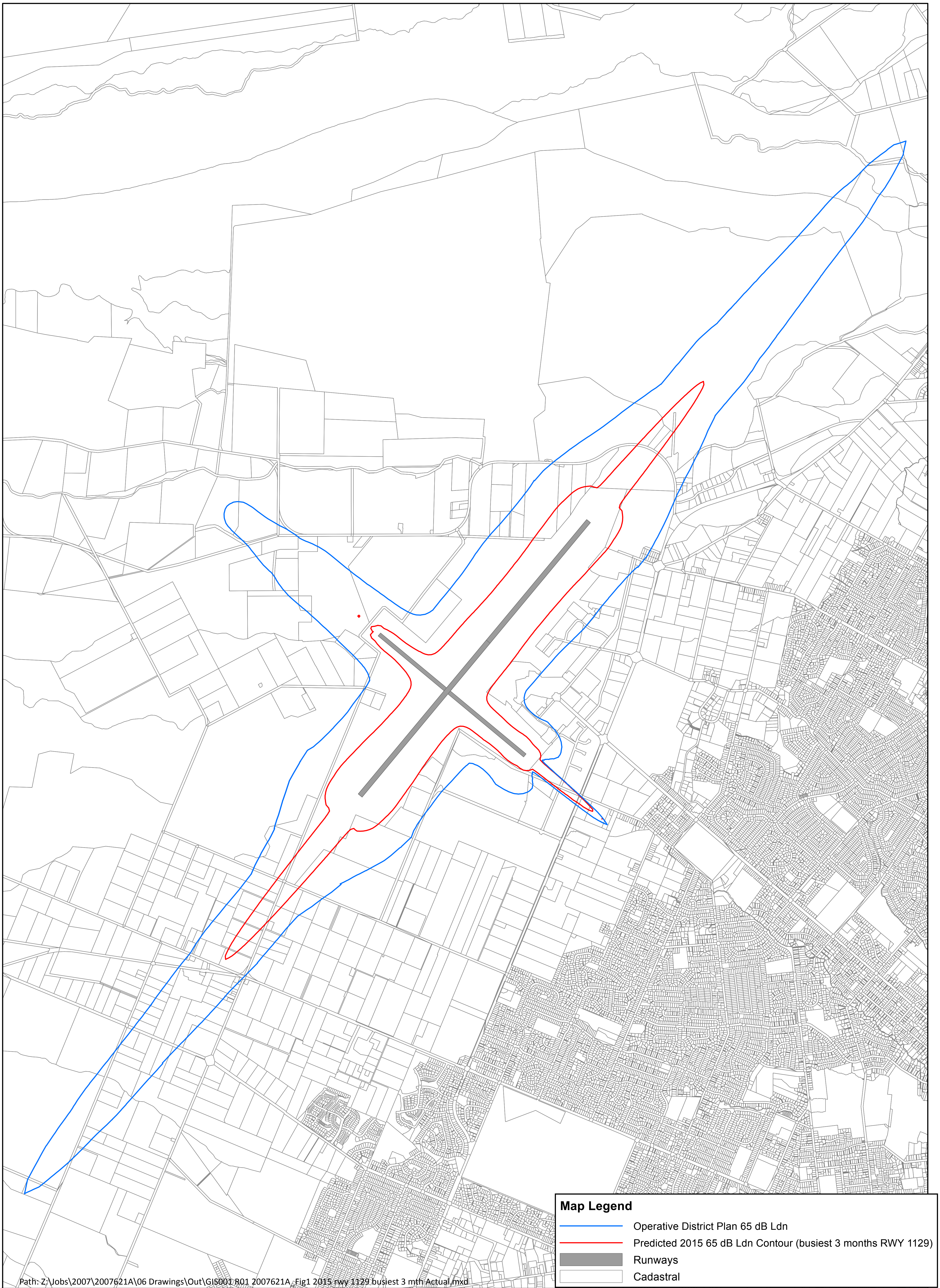
MARSHALL DAY Acoustics

Christchurch Airport
2015 Annual Aircraft Noise Contours

Prepared By: SJP
Date: 10/02/2016
Time: 12:19:30 p.m.

Scale @ A3: 1:30,000
0 250 500 1,000 m

N



MARSHALL DAY Acoustics

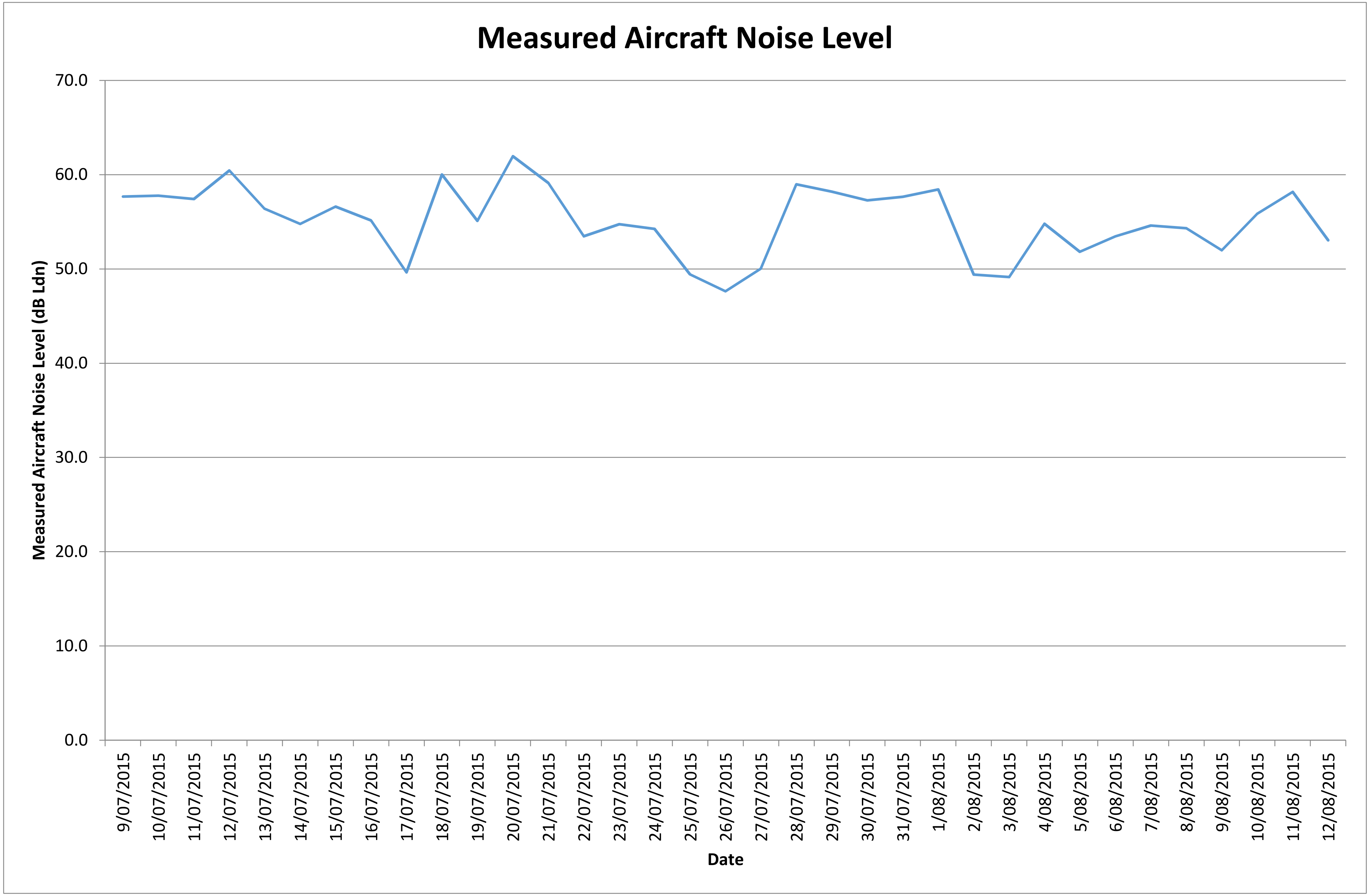
Christchurch Airport
2015 Annual Aircraft Noise Contours - Busiest 3 Months RWY 29

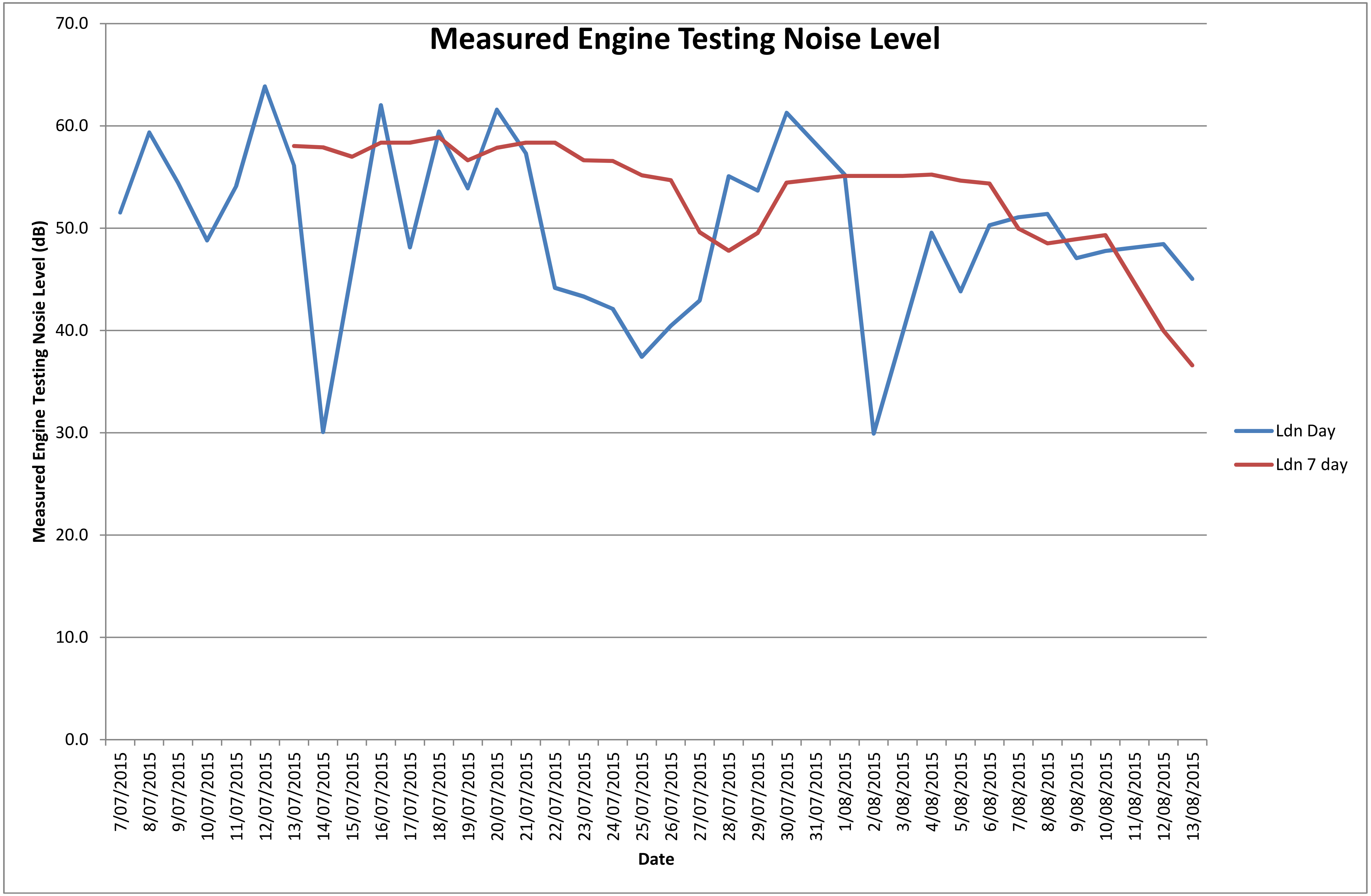
Prepared By: SJP
Date: 2/05/2016
Time: 8:48:07 a.m.

APPENDIX D: MEASURED NOISE LEVELS – 99 STANLEYS ROAD

Measured Aircraft Noise Level (dB L_{dn})

Measured Engine Testing Noise Level (dB L_{dn} and dB $L_{dn\ 7day}$)


Measured Aircraft Noise Level
Measured Aircraft Noise Level (dB Ldn)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
9/07/2015
10/07/2015
11/07/2015
12/07/2015
13/07/2015
14/07/2015
15/07/2015
16/07/2015
17/07/2015
18/07/2015
19/07/2015
20/07/2015
21/07/2015
22/07/2015
23/07/2015
24/07/2015
25/07/2015
26/07/2015
27/07/2015
28/07/2015
29/07/2015
30/07/2015
31/07/2015
1/08/2015
2/08/2015
3/08/2015
4/08/2015
5/08/2015
6/08/2015
7/08/2015
8/08/2015
9/08/2015
10/08/2015
11/08/2015
12/08/2015
Date


Measured Engine Testing Noise Level
Measured Engine Testing Nosie Level (dB)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
7/07/2015
8/07/2015
9/07/2015
10/07/2015
11/07/2015
12/07/2015
13/07/2015
14/07/2015
15/07/2015
16/07/2015
17/07/2015
18/07/2015
19/07/2015
20/07/2015
21/07/2015
22/07/2015
23/07/2015
24/07/2015
25/07/2015
26/07/2015
27/07/2015
28/07/2015
29/07/2015
30/07/2015
31/07/2015
1/08/2015
2/08/2015
3/08/2015
4/08/2015
5/08/2015
6/08/2015
7/08/2015
8/08/2015
9/08/2015
10/08/2015
11/08/2015
12/08/2015
13/08/2015
Date
Ldn Day
Ldn 7 day

APPENDIX E: 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. Neither the existing City Plan noise boundaries nor the recently developed 'Expert Panel' noise boundaries include 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 were calculated both with and without GA activity. The actual aircraft type for each GA movement was not identified in the available records therefore the calculations were based on the noisier GA aircraft types operating at the airport. The inclusion of GA in the model resulted in an increase of approximately 0.1 dB in Ldn 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. Each year the table will be updated in order to develop a historical record and highlight any significant changes in GA activity ratios.

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

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

APPENDIX F: ENGINE TESTING NOISE MEASUREMENTS

Engine testing noise levels were measured during 2015 to gather community engine testing noise data to support the Christchurch Replacement District Plan engine testing noise assessment work. Noise levels were measured at 99 Stanleys Road. The site was chosen because it is located in an area less affected by extraneous noise, yet is still close to the run up pad where the majority of engine testing occurs. Further details as to the set up of the system are given in section 3.

Noise measurements were undertaken on-site between 6 July 2015 and 13 August 2015.

A comparison was made between records of engine testing activity (prepared by the engine testing ground run engineers and compiled by CIAL) and measured noise levels at the site.

This has been undertaken using the CIAL Engine Testing Monitoring Software (ETMS). MDA has previously developed the ETMS that will be used to undertake engine testing noise assessment in accordance with the noise rules and requirements being finalised for the Christchurch Replacement District Plan.

The software comprises two aspects;

- ETMS Inputs –Aircraft engineers performing engine tests input details of the type of test, engine power settings, duration, aircraft location and orientation into the software database.
- ETMS Outputs – Noise levels are calculated for 16 key receiver locations based on the use of the input data (above). These receivers have been chosen as the reasonable worst case locations relative to engine testing noise levels.

For this investigation, the input data has been extracted to examine correlation between actual engine test events and noise levels as measured at 99 Stanelys Road.

Measured engine testing noise levels for all identified events ranged between 39 – 70 dB L_{Aeq} for the duration of the event. When compared with the typical measured background noise level at the residence, it is noted that these engine testing noise levels would be noticeable and that many events at the higher noise levels would also be clearly audible at night.

The testing of aircraft engines is an activity which is vital to the operational viability of a commercial airport, and like aircraft movements, it cannot normally be accommodated within standard District Plan noise rules. As such engine testing often requires a specific noise assessment. The approach adopted here is generally in line with that used at other New Zealand airports for engine testing. The assessment uses the L_{dn} metric measured over the daytime and night-time periods.

The measured noise level from each correlated engine test event has been used to calculate the daily noise exposure from engine testing noise at the site. The data recorded at the noise monitor has also been analysed more simply to compare the overall noise exposure at the residence (ambient L_{dn}; including road traffic noise, residential activity etc) with engine testing noise alone.

Calculated noise exposure levels are shown in Table 4 below:

Table 4: Calculated noise exposure levels

Day	Engine testing noise level (dB L_{dn})	Community noise level (dB L_{dn})
9/07/2015	54	57[1]
10/07/2015	49	57
11/07/2015	54	56
12/07/2015	64	55
13/07/2015	56	54
14/07/2015	30	56
15/07/2015	46	55
16/07/2015	62	55
17/07/2015	48	51
18/07/2015	59	53
19/07/2015	54	55
20/07/2015	62	56
21/07/2015	57	57
22/07/2015	44	56
23/07/2015	43	54
24/07/2015	42	57
25/07/2015	37	53
26/07/2015	40	52
27/07/2015	43	54
28/07/2015	55	55
29/07/2015	54	60[2]
30/07/2015	61	56
31/07/2015	No engine tests occurred	56
1/08/2015	55	53
2/08/2015	30	51
3/08/2015	40	53
4/08/2015	50	56
5/08/2015	44	57
6/08/2015	50	55
7/08/2015	51	55
8/08/2015	51	55
9/08/2015	47	55
10/08/2015	48	55
11/08/2015	No engine tests occurred	57
12/08/2015	48	53[1]

[1]Community noise levels calculated for these days on the basis of an estimate of night-time contribution. Noise levels were not measured during the night on these days because of equipment issues or logger deployment or retrieval. Noise levels were estimated based on night-time noise levels occurring on other days in the monitoring period

[2]Measured community noise levels on this day was adversely affected by high winds and rain, and is therefore not considered representative of the typical noise environment at this dwelling.

Overall, the measured community noise levels are in the normal range expected for a residential noise environment. It is also observed that engine testing noise exposure can be similar to the community ambient noise at this location, with some seven days where engine testing noise levels were higher.

The results show that although engine testing noise levels would be audible at the house for short durations (based on the actual measured noise level and the characteristics of the noise), the engine testing noise is regarded as acceptable in the context of the overall ambient noise level.