MARSHALL DAY Acoustics

QUEENSTOWN AIRPORT
2022 NOISE COMPLIANCE REPORT

Rp 001 20221139 | 19 June 2023

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Project: **Queenstown Airport 2022 Noise Compliance Report**

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by Queenstown Airport Corporation (QAC) to undertake noise compliance assessment for 2022 with respect to the relevant Queenstown Lakes District Council District Plan (QLDP) obligations.

This report has been prepared by MDA on behalf of QAC and provides an overview of the noise compliance program for 2022 including calculation of noise contours known as the Compliance Annual Aircraft Noise Contours (CAANC) to determine compliance or otherwise with the Airnoise Boundary and Outer Control Boundary and the aircraft noise monitoring related designation conditions applicable to the airport.

A glossary of terms is provided in Appendix A.

2.0 STATUTORY REQUIREMENTS

The relevant Designation conditions relating to airport noise compliance at Queenstown is given below:

Designation D1

7. *The Airport shall be managed so that the noise from aircraft operations does not exceed 65 dB L_{dn} outside the Air Noise Boundary (ANB) or 55 dB L_{dn} outside the Outer Control Boundary (OCB). The ANB and OCB are as shown on the District Plan Maps. Compliance with the ANB and OCB shall be determined on the basis of the Compliance AANC required to be prepared by Condition 8 and 9.*

8. *Each year, QAC, shall produce 55 dB, 60 dB and 65 dB AANC, using airport noise prediction software to be determined by the QALC [Queenstown Airport Liaison Committee] in accordance with the NMP and records of actual aircraft movements for the busiest three consecutive months of the preceding year.*

9. *At least every three years, QAC shall undertake a monitoring programme to compare the measured aircraft noise levels with the AANC. The AANC shall be corrected for any differences arising from the measured levels to produce the Compliance AANC. The monitoring programme shall include the following measurements within a three year period: a minimum of one month summer and one month winter undertaken at a minimum of three points located west, north-east and south of the airport with the exact positions to be determined by the QALC under the NMP.*

10. *Each year the Compliance and Projected AANC (required under conditions 9 and 14 respectively) shall be reported to the QALC. Compliance AANC produced for years when noise measurements have not been undertaken shall be prepared using the same corrections determined from the most recently measured aircraft noise levels undertaken for Condition 9.*

Other Noise

11. *Sound from activities which are outside the scope of NZS 6805:1992, shall comply with the District Plan noise limits set in the zone standards for each zone in which the sound is received. This requirement includes engine testing other than for essential unplanned engine testing of aircraft for scheduled passenger services.*

12. *No noise limits shall apply to essential unplanned engine testing of aircraft for scheduled passenger services. The NMP shall detail noise management practices for unplanned engine testing including preferred locations and times. Following each unplanned engine test the QAC shall report to the next meeting of the QALC why the testing was required and what noise management practices were followed.*

14 *Each year QAC shall produce 55 dB, 60 dB and 65 dB Projected AANC for the purpose of determining when mitigation shall be offered under Conditions 15 and 16 using the same aircraft noise prediction software as used for the Compliance AANC required under Condition 8, adjusted for annual growth estimated for the following year based on trends derived from historical aircraft movement data.*

This noise monitoring report details information required under Designation condition D1.7 of the QLDP. The purpose of this report is to assess compliance of aircraft operations with conditions D1.8 and D1.9 for the period of 1 January 2022 to 31 December 2022.

2.1 Noise Limits - Aircraft Operations

Rule D1.7 states that "*The Airport shall be managed so that the noise from aircraft operations does not exceed 65 dB L_{dn} outside the Air Noise Boundary (ANB) or 55 dB L_{dn} outside the Outer Control Boundary (OCB). The ANB and OCB are as shown on the District Plan Maps.*"

The noise boundaries are shown on the QLDP planning map in Figure 1 and overlaid on aerial photography in Figure 2.

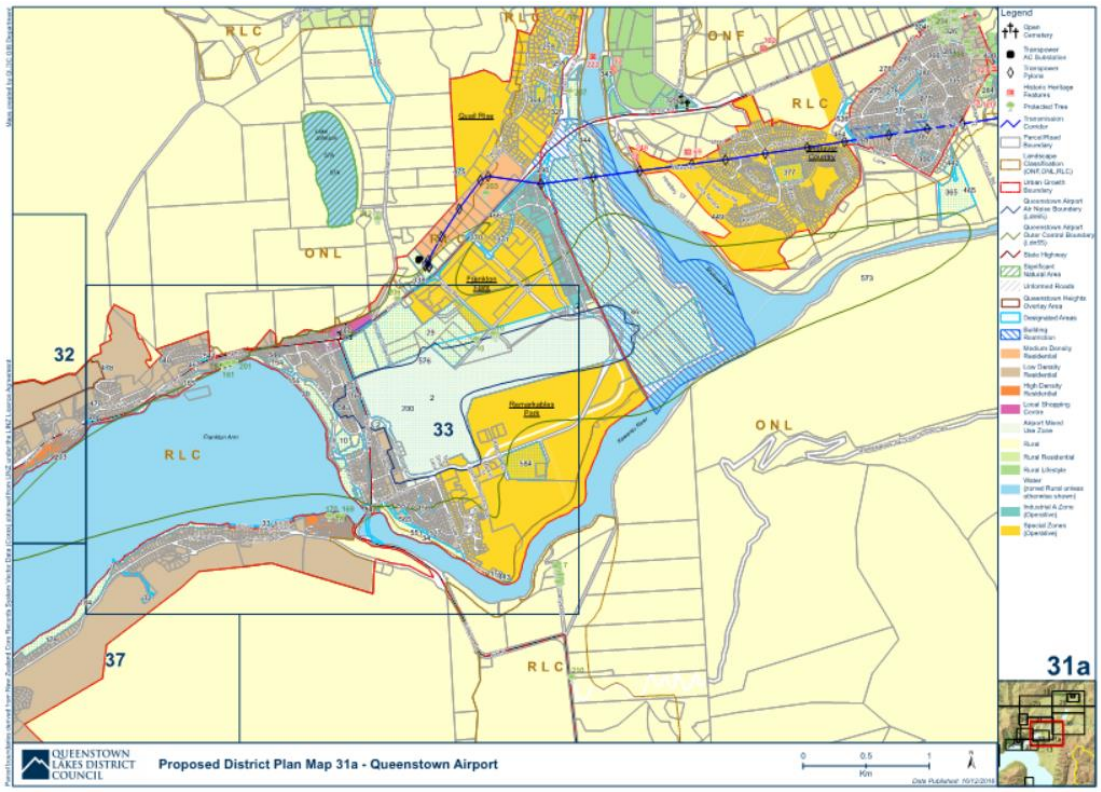

Figure 1: QLDP noise boundaries

Figure 2: Queenstown Airport noise boundaries

3.0 OPERATIONAL NOISE MODELLING

3.1 Summary of Operational Aircraft Movements

Based on the information provided by QAC and derived from Airways data, for the year 2022 there were 23,123 fixed-wing movements and 26,431 helicopter movements at Queenstown, with a total number of 49,544. This was 14,345 more than for 2021.

The increased number of aircraft movements in 2022 compared with 2021 is likely because of the resurgence of air travel following the global Covid-19 pandemic and its impacts on travel (and therefore on the aviation industry) in 2020 and 2021. Total aircraft movements in 2022 started steadily increasing as domestic and international travel increased because further Covid-19 lockdowns did not occur.

The busiest three months for aircraft movements in 2022 were October, November and December. This represents a return to the typically busy summer periods of operations at the airport, with significant increases in General Aviation activity. A summary of the movement data input into the Integrated Noise Model (INM) used to produce the 2022 Annual Aircraft Noise Contours (AANC) is provided in section 3.2 of this report.

3.2 Modelling Methodology

To ensure consistency with the noise boundaries in the QLDP and in accordance with the Noise Management Plan, noise compliance contouring has previously been confirmed by the QALC (in 2015) to be calculated using version 7a of the Integrated Noise Model (INM) developed by the US Federal Aviation Authority.

The INM software (like most software), has been upgraded regularly over time. Each update to the INM program has resulted in slightly different calculation results. However, the INM is now no longer supported, and is out of date. Notwithstanding this, 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 at this stage.

However, Because the INM does not contain the latest noise data for more modern aircraft, and its replacement software (AEDT) does, it is considered prudent to consider its use in future compliance assessments. It has not been used this time because the measurement programme (section 5) accounts for the most significant new aircraft (A320 NEOs) in the verification process, and ratification via the QALC is also required before using different compliance software. We recommend that AEDT be used in future compliance assessments, following assessment of it's suitability for use at Queenstown.

The total movements for the modelled scenario are shown in Table 1 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.

Table 1 Summary of Modelled Aircraft Movements

	Busiest 3 Months (October, November, December 2022)
Total Movements	15,994
Day Time Movements	15,994
Night Time Movements	0

For runway usage splits, data provided by Airways now includes actual runway usage data for the main runway which has been used in the preparation of the 2022 AANC. We have also held discussion with Airways regarding the crosswind runway usage splits that occurs in practice, to ensure a more accurate representation of crosswind operations.

The flight tracks used in the model are the same regular flight tracks that were used for the development of the noise control boundaries. Minor updates have been made over time to the tracks based on discussions with Airways regarding the RNP tracks percentages flown. It is considered that the tracks used in the noise modelling remain the best approximation of long-term average flight tracks flown.

3.3 2022 Annual Aircraft Noise Contour

The 2022 AANC, prepared using the methodology described above, is shown in Figure 1 Appendix B.

It can be seen that the predicted 65 dB L_{dn} contour remains inside the ODP ANB.

In addition, there is a requirement in Rule D1.9 that "*The AANC shall be corrected for any differences arising from the measured levels to produce the Compliance AANC.*"

The following sections detail the noise measurement programme and the derived adjustments. Section 6 reports the 2022 Compliance AANC.

4.0 NOISE MEASUREMENT PROGRAMME

Noise measurements are required so that QAC can monitor noise from aircraft operations at the Airport in accordance with the rules set out in Rule D1.11 of the QLDP. The purpose of the noise measurements is to verify the noise contouring calculations as well as to confirm compliance or otherwise with Rule D1.9.

Noise measurements are required every 3 years in accordance with rule D1.9, so the most recent specific compliance noise measurements in 2019 could not be used again to calibrate the noise model.

However, noise monitoring was carried out between 13 November 2021 and 11 May 2022 for the purpose of measuring the noise emissions of the Airbus NEO fleet that were using the airport at the time. A benefit of this measurement programme is that it can also be used in lieu of the standard compliance measurement programme to ascertain the average day-night level (L_{dn}) noise level from aircraft activity at the Airport. The measurements were used for this purpose in the 2021 NMR as well.

The following sections of the report detail the monitoring setup, monitoring results and assesses compliance with the relevant noise rules.

Two automatic Noise Monitoring Terminals (NMT) were deployed on 13 November 2021 until 6 May 2022. A total of 179 whole days of data were subsequently recorded. However, for the purposes of this compliance assessment we have only analysed January-March 2022 data, being typically the busiest three months at the airport.

The NMT locations are shown in Figure 3 Appendix B. NMT1 was deployed at 82 McBride Street and NMT2 was deployed at the tennis courts to the north adjacent to the Queenstown Events Centre.

These locations for noise monitoring have been used consistently over the past few years and remain the preferred monitoring locations because of their ongoing suitability. For background, all NMT locations were previously selected by MDA (and ratified by the QALC) using the following criteria:

- The noise environment must generally not be significantly affected by sources other than aircraft (i.e. not next to a busy road)
- Aircraft noise to be high relative to other ambient noise sources
- Safety for airborne aircraft (as advised by QAC).

All sites were suitable for logistical purposes, such as access, security and general proximity to airport operations.

The NMTs consisted of 01dB 'Cube' noise data logging instrumentation with an outdoor microphone kit. The microphone was installed at generally 4 - 6 metres in the air via a metal mast in general accordance with the measurement requirements of New Zealand Standard NZS 6805:1992 *"Airport Noise Management and Land Use Planning".*

The NMT stored the noise level (L_{Aeq}) every second during the monitoring period. Noise events meeting certain noise level and duration criteria that are typical of aircraft events were identified using event recognition software in the system and the L_{dn} noise level calculated from these aircraft events.

The day-night noise level (L_{dn}) is expressed in decibels and represents the 24 hour average noise level that includes a +10 dB weighting for noise at night-time (between 10pm and 7am) to account for increased annoyance due to noise during the night hours. This is the metric used in airport noise assessment according to NZS 6805.

L_{dn} is calculated by identifying aircraft noise events and calculating an overall cumulative L_{Aeq} value for these events. A 10 decibel adjustment is then added to each hour between 10pm and 7am and the average level calculated over the whole day (24 hours) is the L_{dn}. Appendix C shows a diagram demonstrating this.

5.0 NOISE MEASUREMENT RESULTS

The daily noise exposure reported below is for all the aircraft events where the event recognition software was triggered in the data logging instrumentation. In other words, where noise exceeded a

given noise level, (calibrated to be as close as possible to an aircraft noise event) the data logging instrumentation would mark this as a discrete noise event. All other noise, not above the threshold, is disregarded. Thus, only noise from the discrete noise events are included in the overall daily noise exposure.

Several representative days of measurements, including the loudest day were analysed discretely with direct correlation to Airways records at each NMT to verify the accuracy of the event recognition methodology. In all cases the measured noise level varied by less than half a decibel when additional extraneous events that triggered the NMT were removed from the data.

We consider this provides acceptable levels of accuracy and that the methodology employed to collect the results of the noise measurement programme reported in this document can be considered accurate.

5.1 General Compliance Measurements

5.1.1 NMT1 – 82 McBride Street

The average daily measured noise level was 60 dB L_{dn}. The maximum daily noise level was 63 dB L_{dn} recorded on the 23 January 2022. The minimum daily noise level was 55 dB L_{dn} recorded on 22 March 2022

Table 2: Measured L_{dn} Noise Levels

	Daily measured noise level (dB L_{dn})
Average	60
Maximum	63
Minimum	55

We note that according to Rule D1.11 the noise levels must be measured over a minimum one-month period. However, in accordance with Rule D1.10 the noise contours shall be based on '*aircraft movements for the busiest three consecutive months*'. In this measurement period, our results are collated over a three-month period.

Therefore, for compliance assessment the above noise measurement results can be used without further adjustment. The measured noise level of 60 dB is well below the relevant District Plan noise limit for this location.

For verification of the 2022 AANC, the measured noise level can be further used by considering the number of aircraft movements in the 3 month measurement period, relative to the number of movements used in the calculation of the 2022 AANC. Because the number of movements in the measurement period (January to March) was approximately half that which occurred in the October to December period, this results in a ratio adjustment to the measured noise level of 3 dB giving a theoretical '2022 measured' noise level of 62.8 dB

This is almost 2 dB lower than the predicted noise levels shown in the 2022 AANC for McBride Street where the predicted noise exposure is 64.6 dB. As has occurred in previous years compliance monitoring, an adjustment to the 2022 AANC in this location is therefore warranted. This is discussed in section 5.2.

5.1.2 NMT4 – Tennis Court location

The average daily noise level was 60 dB L_{dn}. The maximum daily noise level was 63 dB L_{dn} recorded on the 6 January 2022. The minimum daily noise level was 57 dB L_{dn} recorded on a number of occasions.

Table 4: Measured L_{dn} Noise Levels

	Daily measured noise level (dB L_{dn})
Average	60
Maximum	63
Minimum	57

For compliance assessment the above noise measurement results can be used without further adjustment. The measured noise level of 60 dB is well below the relevant District Plan noise limit for this location.

For verification of the 2022 AANC, the measured noise level can be further used by considering the number of aircraft movements in the 3 month measurement period, relative to the number of movements used in the calculation of the 2022 AANC. Because the number of movements in the measurement period (January to March) was approximately half that which occurred in the October to December period, this results in a ratio adjustment to the measured noise level of 3 dB giving a theoretical '2022 measured' noise level of 62.6 dB.

This is approximately 1 dB lower than the predicted noise levels shown in the 2022 AANC for the tennis court location where the predicted noise exposure is 63.7 dB. As has occurred in previous years compliance monitoring, an adjustment to the 2022 AANC in this location is therefore warranted. This is discussed in section 5.2.

5.2 Adjustments to 2022 AANC

Even taking into account the calibrated noise emissions for the NEO model variants used for the calculations, the difference of -1 dB and -2 dB at the two measurement locations in the 2022 AANC shows that the actual measured values are generally 1 -2 dB less than the calculated values (in this case this was the 2022 AANC contours). This remains consistent with the last few years results.

However, this is still regarded as showing very good correlation between the measured and modelled noise levels. Nevertheless, an overall -1 dB adjustment is again recommended to the AANC to form the 'Compliance AANC'. This is slightly conservative, based on the measurement results discussed in Section 5.1.1

6.0 2022 COMPLIANCE ANNUAL AIRCRAFT NOISE CONTOUR (CAANC)

The Compliance AANC (CAANC) are obtained after the adjustments derived in the previous section are applied to the 2022 AANC.

The 2022 CAANC, prepared using the methodology described above, is shown in Figure 2 Appendix B. The 2022 CAANC demonstrates 2022 aircraft operations comply with the 65 dB L_{dn} Airnoise Boundary and 55 dB L_{dn} Outer Control Boundary.

We conclude that the QAC is compliant with its District Plan aircraft noise emission compliance obligations.

7.0 2022 PROJECTED ANNUAL AIRCRAFT NOISE CONTOUR (PAANC)

Once the CAANC are produced, then in accordance with Rule D1.14 the Projected AANC (PAANC) can be prepared. This requires QAC to provide future year growth estimates so that these can be applied to the CAANC to produce the PAANC.

For this 2022 NMR, the 2022 CAANC provides the baseline for the 2022 (2023) PAANC. This shows the projected contours for 2023, based on the 2022 CAANC but with some future 'growth' applied.

Figure 3 Appendix B shows the 2022 (2023) PAANC.

As can be seen, the 2022 (2023) PAANC are larger in extent than the 2022 CAANC. This is due to the recovery following the global Covid-19 pandemic, and the resultant return to the number of aircraft operations seen in the years prior to the pandemic.

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L_{dn}	The day night noise level which is calculated from the 24 hour L_{Aeq} with a 10 dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}.
SEL or L_{AE}	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 a train pass-by or an aircraft flyover
NZS 6805:1992	New Zealand Standard NZS 6805:1992 *"Airport Noise Management and Land Use Planning"*

APPENDIX B FIGURES

The noise contours in this Figure were obtained by computer interpolation between calculated grid points. There is an interpolation accuracy of approximately ± 1.5 dB. For precise noise levels at specific locations, refer to point receiver calculations.

Map Legend

- Cadastral
- Runways
- Outer Control Boundary (OCB)
- 60 dB Ldn Boundary
- Airnoise Boundary (ANB)

2022 Annual Aircraft Noise Contours

- 55 dB Ldn
- 60 dB Ldn
- 65 dB Ldn

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Figure 1 - 2022 Annual Aircraft Noise Contours

Client: Queenstown Airport Corporation Ltd
Path: I:\JOBS\2020\20221139\09 Drawings\Out\
Filename: 2022 AANC Figure 1 R03.SGS
Prepared by: SJP Date: 14/06/2023 INM case: 2022 AANC Oct Dec R03

Scale 1:20000

0 100 200 400 600 800 m

N

The noise contours in this Figure were obtained by computer interpolation between calculated grid points. There is an interpolation accuracy of approximately ± 1.5 dB. For precise noise levels at specific locations, refer to point receiver calculations.

Map Legend

- Cadastral
- Runways
- Outer Control Boundary (OCB)
- 60 dB Ldn Boundary
- Airnoise Boundary (ANB)

2022 Compliance Annual Aircraft Noise Contours

- 55 dB Ldn
- 60 dB Ldn
- 65 dB Ldn

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Figure 2 - 2022 Compliance Annual Aircraft Noise Contours

Client: Queenstown Airport Corporation Ltd
Path: I:\JOBS\2020\20221139\09 Drawings\Out\
Filename: 2022 CAANC Figure 2 R03.SGS
Prepared by: SJP Date: 14/06/2023 INM case: 2022 AANC Oct Dec R03

Scale 1:20000

0 100 200 400 600 800 m

N

Map Legend

Cadastral

Runways

Outer Control Boundary (OCB)

60 dB Ldn Boundary

Airnoise Boundary (ANB)

2022 (2023) Projected Annual Aircraft Noise Contour

55 dB Ldn

60 dB Ldn

65 dB Ldn

The noise contours in this Figure were obtained by computer interpolation between calculated grid points. There is an interpolation accuracy of approximately ± 1.5 dB. For precise noise levels at specific locations, refer to point receiver calculations.

MARSHALL DAY Acoustics

Figure 3 - 2022 (2023) Projected Annual Aircraft Noise Contours

Client: Queenstown Airport Corporation Ltd
Path: I:\JOBS\2020\20221139\09 Drawings\Out\
Filename: 2022 (2023) PAANC Figure 3 R03.SGS
Prepared by: SJP Date: 14/06/2023 INM case: 2022 (2023) PAANC R03

Scale 1:20000

0 100 200 400 600 800 m

N

APPENDIX C CALCULATION OF L_{DN}

The graphs below show how L_{dn} is calculated. The average hourly aircraft noise level (L_{Aeq}) is determined and a 10 decibel penalty applied to night time aircraft events (10pm-7am). The average of the hourly L_{Aeq} values is determined over a 24 hour period which then gives the L_{dn}.

The first graph shows an hour's worth of L_{Aeq} data. From this, the data which corresponds to aircraft noise is identified and the 1 hour L_{Aeq} noise level from aircraft noise is calculated. This 1 hour aircraft L_{Aeq} represents one of the bars on the second graph. After applying the 10 dB Penalty to night-time hours, all of the bars on the second graph are then averaged to calculate the overall daily L_{dn} value. For Queenstown Airport the noise limits are based on the busiest consecutive 3 months of aircraft movements and hence the L_{dn} is also based on a value averaged over this busiest 3 months.