



MARSHALL DAY
Acoustics 

QUEENSTOWN AIRPORT
2023 NOISE COMPLIANCE REPORT

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Project: Queenstown Airport 2023 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 2023 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 2023 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 2023 to 31 December 2023.

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

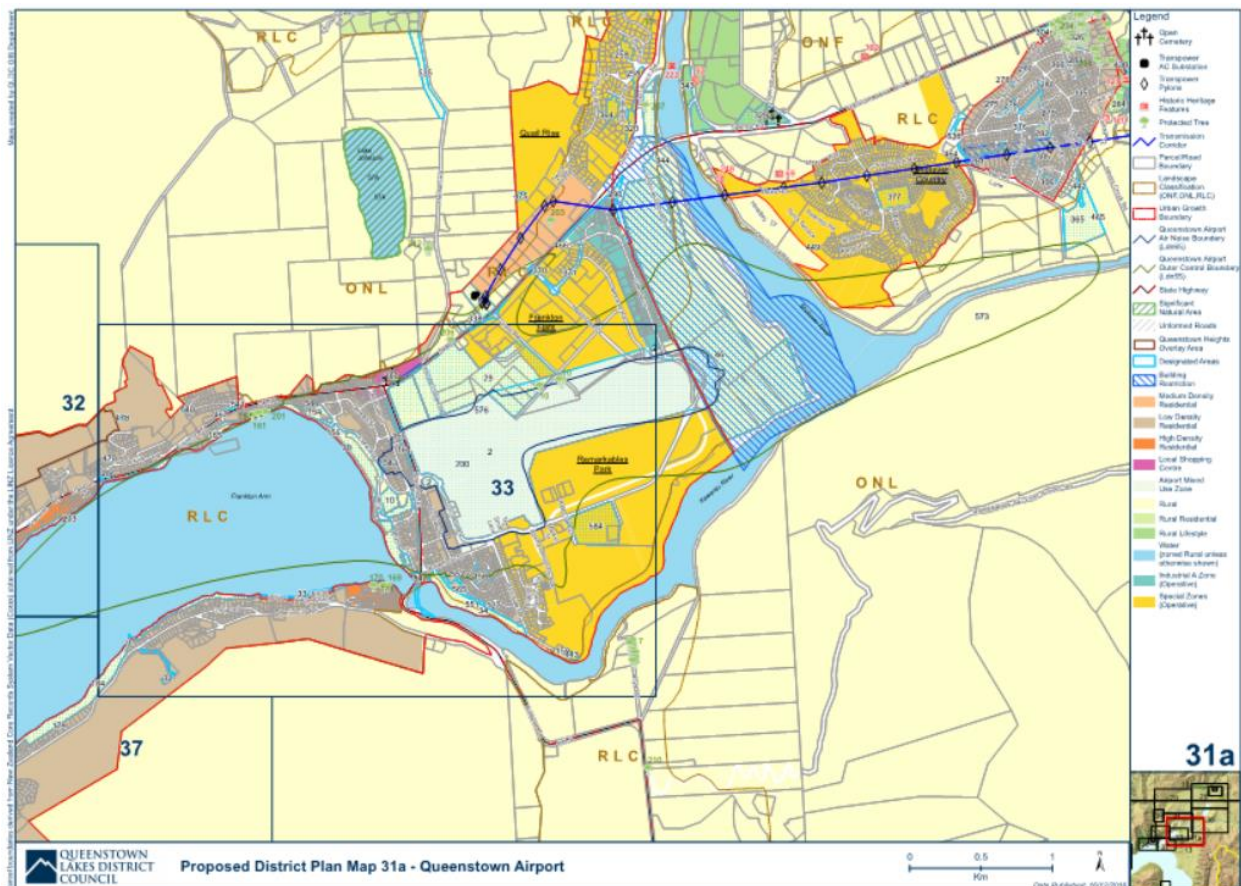


Figure 2: Queenstown Airport noise boundaries



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 2023 there were 31,614 fixed-wing movements and 29,214 helicopter movements at Queenstown, with a total number of 60,828. This was 11,284 more than for 2022.

The increased number of aircraft movements in 2023 compared with 2022 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 number of aircraft movements in 2023 started high, slowed down during the winter months, and increased again towards the end of the year. This represents a return to normal activity for Queenstown Airport with the busiest months being the summer months.

The busiest three months for aircraft movements in 2023 were January, February and March. 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 Aviation Environmental Design Tool (AEDT) used to produce the 2023 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. The Aviation Environmental Design Tool (AEDT) developed by the US Federal Aviation Authority has now replaced INM and is under continued development by the agency. The Aviation Environment Design (AEDT) tool is currently on version 3e and is a more accurate tool. The noise calculation algorithms within AEDT are based on the same aircraft noise calculation standards as INM. However, AEDT currently has a much larger database of aircraft including newer aircraft such as the Airbus Neo variants.

In 2023 Marshall Day Acoustics conducted a comparison study of the two software's for Queenstown airport. This study included developing a new model of Queenstown airport in the AEDT 3e and rerunning the 2022 compliance model inputs, used in the INM the previous year. Both the INM and the AEDT model outputs were then compared to evaluate the differences between the two software's and the accuracy of the AEDT over the INM.

Marshall Day Acoustics review of the AEDT 3e software showed that predicted noise levels are almost identical to the INM v7a result for the same 2022 compliance scenario and we are therefore satisfied that AEDT represents an equivalent method of calculating compliance contours.

In New Zealand there are no national statutory requirements for airport noise modelling, and for the Queenstown, neither the District Plan nor the Queenstown Airport Designation explicitly defines the software to be used. However, the Queenstown Lakes Operative District Plan (ODP Designation for Queenstown Airport States at D1 Condition 8 that:

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.*

The Queenstown Airport Liaison Committee subsequently approved the AEDT software to be used in all future compliance contour modelling, beginning with the 2023 AANC.

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 (January, February, March 2023)	Busiest 3 Months (October, November, December 2022)
Total Movements	17,661	15,994
Day Time Movements	17,654	15,994
Night-Time Movements	7	0

The total movements for the modelled scenario broken down into categories for both 2022 and 2023 are shown below in Table 2.

Table 2: Summary of Modelled Aircraft Movements by Category

	2023 AANC (busiest 3 months Jan, Feb, Mar)	2022 AANC (busiest 3 months Oct, Nov, Dec)
Scheduled	4,890	4,562
Other Fixed Wing	4,641	3,246
Helicopter	8,130	8,186

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 2023 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. Runway splits broken down into categories are shown in Tables 3 and 4.

Table 3: Fixed Wing Aircraft Runway Splits

	RW05		RW23		RW14		RW32	
Operation	A	D	A	D	A	D	A	D
Scheduled/Corp Jet	23%	16.5%	77%	83.5%				
Other Fixed Wing	20%	15%	68%	73%	8%	8%	4%	4%

Table 4: Helicopter Pad Splits

	General Aviation Precinct environs		Northern Helicopter Hangars	
Operation	A	D	A	D
Helicopter	78%	76%	22%	24%

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 percentage those tracks are used, based on discussions with Airways. It is considered that the tracks used in the noise modelling remain the best approximation of long-term average flight tracks flown.

3.3 2023 Annual Aircraft Noise Contour

The 2023 AANC, prepared using the methodology described above, is shown in Figure B1 in 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 5 reports the 2023 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, the most recent specific compliance noise measurements were in 2019. 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 also used for this purpose in the 2022 NMR.

The monitoring results were previously used to calibrate the INM model since INM has an outdated fleet database that does not include newer aircraft such as the Airbus NEO variants. The AEDT model has a more up to date fleet database that includes newer aircraft. We therefore expect the AEDT fleet database to reflect actual aircraft movement more accurately.

A winter compliance noise measurement program has been scheduled for this winter (2024). With operations likely returning to normal levels after the Covid-19 pandemic, the compliance measurements program will return to the normal schedule in accordance with rule D1.9. These compliance measurements can be used to retrospectively to validate the accuracy of the AEDT model for compliance purposes.

4.1 Adjustments to 2023 AANC

As stated in Section 4.0 the AEDT 3e program contains an up-to-date fleet database including the latest aircraft currently flying at Queenstown airport. The accuracy of this database along with the modelling methodology set out in Section 3.2 improves the accuracy of the model without the current need for further adjustment to the AANC.

The AEDT has been compared to the INM v7a for the 2022 AANC and has shown to be accurate in its extent and shape, with no unusual artefacts to cause any question about its accuracy. Therefore, we consider the 2023 AANC to be generally accurate and the -1dB adjustment applied to previous contours is not necessary at this stage. This is considered conservative at this stage.

Should the winter measurements show any appreciable measured differences (+ or -), these will be adopted in the 2024 NMR.

5.0 2023 COMPLIANCE ANNUAL AIRCRAFT NOISE CONTOUR (CAANC)

The Compliance AANC (CAANC) are obtained after the adjustments derived in the previous section are applied to the AANC. As explained above, no adjustments have been made to the 2023 AANC. *We are therefore recommending the 2023 AANC be used as the basis of the 2023 CAANC.*

The 2023 CAANC, prepared using the methodology described in Section 4.1 above, is shown in Figure B2 in Appendix B. The 2023 CAANC demonstrates 2023 aircraft operations comply with the 65 dB L_{dn} Airnoise Boundary and 55 dB L_{dn} Outer Control Boundary. Towards the South-western end of the 55 dB L_{dn} CAANC the contour is within 1 decibel of the 55 dB L_{dn} Outer Control Boundary, albeit at some distance from the airport.

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

6.0 2023 (2024) 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 2023 NMR, the 2023 CAANC provides the baseline for the 2023 (2024) PAANC. This shows the projected contours for 2024, based on the 2023 CAANC but with some future 'growth' applied.

Figure B3 in Appendix B shows the 2023 (2024) PAANC.

As can be seen, the 2023 (2024) PAANC are larger in extent than the 2023 CAANC. This is due to the continued 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.
dB(A)	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}	<u>Sound Exposure Level</u> 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 <i>“Airport Noise Management and Land Use Planning”</i>

APPENDIX B FIGURES



**QUEENSTOWN AIRPORT FIGURE B1
2023 ANNUAL AIRCRAFT NOISE CONTOURS**

Calculations carried out using the FAA's Aviation Environmental Design Tool (AEDT) 3e. Note the ODP noise boundaries were prepared using the FAA's Integrated Noise Model (INM) V7a in 2010, and are based on input assumptions and activity data provided by QAC.

- Airnoise Boundary (ANB)
 - 60 dB Ldn Boundary
 - Outer Control Boundary (OCB)
- 2023 AANC**
- - - 55 dB Ldn
 - - - 60 dB Ldn
 - - - 65 dB Ldn



Client:
QAC
Authors:
stephanie.king
Date of Issue:
24/06/2024 5:22 pm

Drawing Details:
Scale: 1:24,000
Projection: NZGD 2000 New Zealand Transverse Mercator
Map Rotation: 0°
Noise Model details:
AEDT 3e - QAC_2023_AANC

Map Note / Comments:
This map is for general purposes only. While every effort has been made to ensure that the data are accurate and reliable, Marshall Day Acoustics cannot assume liability for errors or omissions in the data graphically represented.
The noise contours were obtained by interpolations of calculated grid points (spacing typically 5-25m), with varying interpolation accuracy. Precise noise levels at specific locations, can be made available at request if not included in the projects point receiver calculations.





QUEENSTOWN AIRPORT FIGURE B2
2023 COMPLIANCE ANNUAL AIRCRAFT NOISE CONTOURS

Calculations carried out using the FAA's Aviation Environmental Design Tool (AEDT) 3e. Note the ODP noise boundaries were prepared using the FAA's Integrated Noise Model (INM) V7a in 2010, and are based on input assumptions and activity data provided by QAC.

- Airnoise Boundary (ANB)
 - 60 dB Ldn Boundary
 - Outer Control Boundary (OCB)
- 2023 CAANC**
- - - 55 dB Ldn
 - - - 60 dB Ldn
 - - - 65 dB Ldn



Client:
QAC

Authors:
stephanie.king

Date of Issue:
24/06/2024 5:22 pm

Drawing Details:
Scale: 1:24,000
Projection: NZGD 2000 New Zealand Transverse Mercator
Map Rotation: 0°

Noise Model details:
AEDT 3e - QAC_2023_AANC

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QUEENSTOWN AIRPORT FIGURE B3
2023 (2024) PROJECTED ANNUAL AIRCRAFT NOISE CONTOURS



Calculations carried out using the FAA's Aviation Environmental Design Tool (AEDT) 3e. Note the ODP noise boundaries were prepared using the FAA's Integrated Noise Model (INM) V7a in 2010, and are based on input assumptions and activity data provided by QAC.

- Airnoise Boundary (ANB)
 - 60 dB Ldn Boundary
 - Outer Control Boundary (OCB)
- 2023 PAANC**
- - - 55 dB Ldn
 - - - 60 dB Ldn
 - - - 65 dB Ldn

Client: QAC
Authors: stephanie.king
Date of Issue: 24/06/2024 5:22 pm

Drawing Details:
 Scale: 1:24,000
 Projection: NZGD 2000 New Zealand Transverse Mercator
 Map Rotation: 0°

Noise Model details:
 AEDT 3e - QAC_2023_AANC

Map Note / Comments:
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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.

