BRISBANE AIRPORT

CEDAR CREEK SHORT-TERM NOISE MONITORING

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PREPARED FOR

BRISBANE AIRPORT CORPORATION PTY LTD
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TABLE OF CONTENTS

GLOSSARY OF TERMS

L_{Amax}	The maximum noise level over a sample period is the maximum level measured during the sample period. For aircraft noise, the maximum noise level is measured using slow response.
N-above	'Number-above', or 'N-above', describe the number of aircraft noise events that exceed a particular noise threshold. The most common 'N-above' are N70 and N60, describing the number of events above 70 dB(A) and 60 dB(A) respectively.
RNP-AR	Required Navigation Performance Authorisation Required (RNP-AR) is a precision arrival or departure procedure which uses satellite navigation. RNP-AR is typically developed to provide a shortened arrival procedure (as is the case at Brisbane Airport).
ILS	Instrument Landing System is a radio navigation system. ILS is typically available in most weather conditions, including poor conditions that may prohibit some other navigation methods. ILS require a long, straight arrival path.
CNE	Correlated Noise Events (CNE) are events recorded in the noise monitoring data that are correlated with a simultaneous aircraft operation nearby, for which valid air traffic surveillance data has also been collected.
AHD	The Australian Height Datum (AHD) is the official national vertical datum for Australia.

AIRCRAFT TYPES AND ABBREVIATIONS

717-200	Boeing 712-200 (narrow body jet)
737-700	Boeing 737-700 (narrow body jet)
737-800	Boeing 737–800 (narrow body jet)
777-300ER	Boeing 777-300ER (wide body jet)
A320-200	Airbus A320-200 (narrow body jet)
A350-900	Airbus A350-900 (wide body jet)
A380-800	Airbus A380-800 (wide body jet)
F100	Focker 100 (narrow body jet)
F70	Focker 70 (narrow body jet)
DH8D	DeHavilland Dash 8 (turbo propeller)
SF34	Saab 340 (turbo propeller)
AW139	AgustaWestland AW139 (helicopter)

1 INTRODUCTION

Brisbane Airport operates a north-south oriented parallel runway system. The system comprises the legacy runway, Runways 01R/19L, and the new runway, Runways 01L/19R.

Brisbane Airport Corporation (BAC) engaged Envirosuite to undertake short-term noise monitoring in Cedar Creek in response to community enquiries regarding aircraft noise. SoundIN Pty Ltd (SoundIN) has been engaged by BAC to review and analyse the results of that noise monitoring. This report details the results of that analysis.

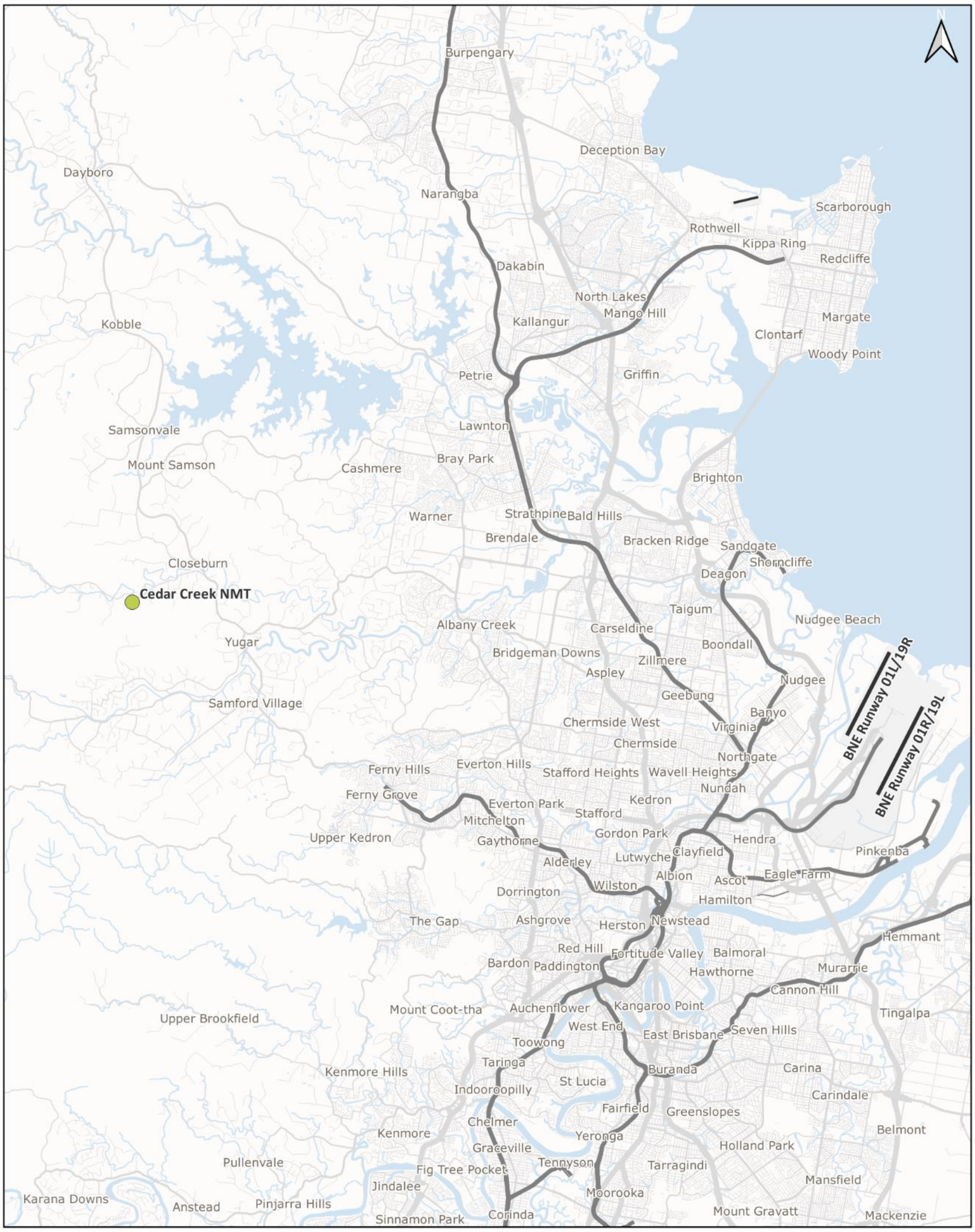
Short-term noise monitoring is periodically undertaken by BAC at locations surrounding the airport based on community feedback. This short-term noise monitoring augments the permanent Noise and Flight Path Monitoring System (NFPMS) operated by Airservices Australia (Airservices).

The short-term monitoring detailed in this report was undertaken for the purposes of:

- Recording the aircraft noise levels at the Cedar Creek site from aircraft arriving and departing from Brisbane Airport; and
- Recording the relative altitude of aircraft overflying the Cedar Creek area; and
- Facilitating an investigation into noise and flight path data affecting the Cedar Creek area.

Brisbane Airport and the Cedar Creek noise monitoring site are indicated in **Figure 1-1**.

Figure 1-1 Site Locality



CEDAR CREEK SHORT-TERM NOISE MONITORING

SITE LOCALITY

LEGEND

Noise Monitoring Site

0 2 4 6 8 km

Note: Locations of features are indicative only and are shown solely to demonstrate features pertinent to the noise assessment.

2 NOISE MONITORING DESCRIPTION

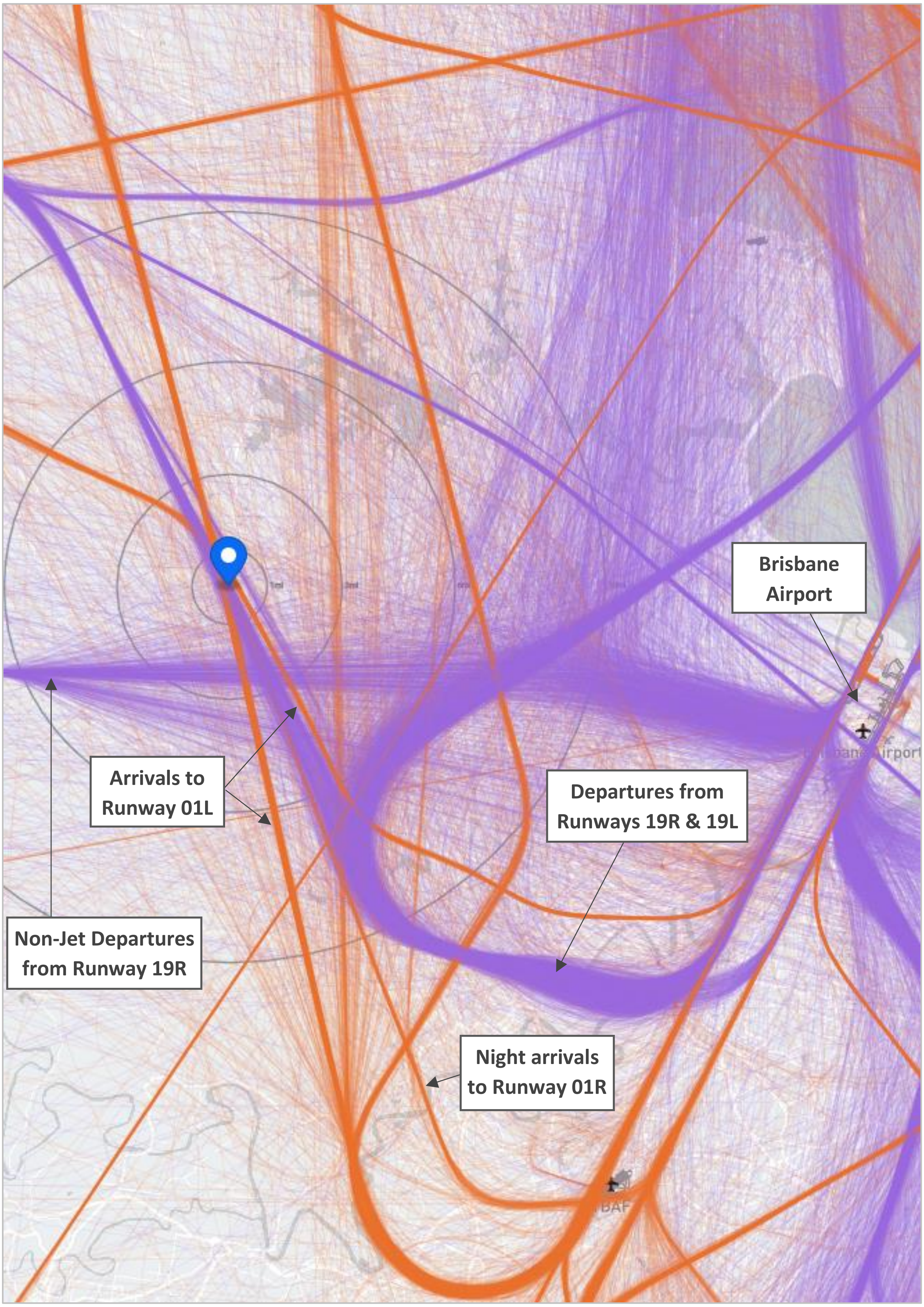
2.1 Details of the Short-Term Noise Monitor Deployment

The following details of the noise monitor deployment are pertinent.

- Monitoring was undertaken at the Cedar Creek site from 7 February 2022 to 11 April 2022. The duration of this monitoring (9 weeks) is considered sufficient to collect a representative sample of operations from Brisbane Airport, including variations in operating modes, aircraft flown, and weather conditions.
- The Cedar Creek noise monitor was installed at an elevation of approximately 131 m AHD.
- The monitor captured both arrival and departure operations.
- Operations in the area include arrivals and departures to and from the new runway during the day and evening (arrivals onto Runway 01L and departures from Runway 19R).
- At night, similar flight paths are available to and from the legacy runway (arrivals onto Runway 01R and departures from Runway 19L). The use of night flight paths in the area is limited to periods when "Simultaneous Opposite Direction Parallel Runway Operations" (SODPROPS), which utilise departures and arrivals over the bay, are unavailable.
- Non-jet departures off Runway 19R pass south of the monitoring site (typically between 1 km and 4 km). Some of these non-jet departures were captured by the noise monitoring; however, others remained outside the capture zone (see section 2.2) and thus were not captured.
- The short-term noise monitoring consisted of noise monitor terminal equipped with AU-2000 Outdoor Smart Microphone. The microphone was verified in conformance with IEC 61672-1 before the deployment.
- Self-calibration checks on the noise monitor terminal occurred daily on time, and the monitor had maintained within the calibration range throughout the entire deployment period.

Figure 2-1 demonstrates the location of the noise monitoring site with respect to the various flight paths.

Figure 2-1 Noise Monitoring Site



2.2 Aircraft Noise Event Detection

Noise events exceeding a defined threshold were automatically identified by the noise monitoring terminal and noise level data saved. Events which were correlated with a simultaneous aircraft operation nearby were automatically identified as aircraft noise events. These events are described as correlated noise events (CNE). The noise level data and aircraft operation data for these events were subsequently associated and saved for post-processing and analysis.

To permit the correlation of aircraft events with measured noise events, a three-dimensional cylinder-like capture zone at Cedar Creek deployment site established in the processing software. The capture zone was defined by a circular radius 2,000 m, projected 4,550 m (15,000 ft) up from the monitor site.

The capture zone includes the various flight paths described in section 2.1 – i.e. day and evening arrivals to Runway 01L; night arrivals to Runway 01R; day and evening departures from Runway 19R; night departures from Runway 19L; and some non-jet departures from Runway 19R.

The automated noise monitoring system requires several criteria to be met in order to classify an aircraft noise event. These criteria relate to the validity of recorded noise level and air traffic control (ATC) surveillance data, the proximity of aircraft (i.e. within the relevant capture zone) and that the noise level, duration and rise and fall accords with that of an aircraft noise event.

In this way, the system is able to automatically eliminate most extraneous noise events. However, it is possible that some aircraft noise events are not recorded. Most often these are due to the absence of valid ATC surveillance data, or due to the aircraft noise levels being insufficient to satisfy the defined thresholds for noise level and duration.

The noise detection thresholds applied for the monitoring described in this report were:

- 00:00 to 05:00 45 dB(A)
- 05:00 to 21:00 50 dB(A)
- 21:00 to 00:00 45 dB(A)

3 NOISE MONITORING RESULTS

3.1 Correlated Aircraft Departure Operations

Table 3-1 presents a summary of the correlated aircraft departure noise events at the Cedar Creek site.

Table 3-1 Summary of Correlated Aircraft Departure Noise Events at Cedar Creek

Aircraft [1]	Number of CNE	Average L_{Amax} - dB(A)	90th Percentile L_{Amax} [2] - dB(A)	Standard Deviation of L_{Amax}	Average Slant Distance [3] - feet	10th Percentile Slant Distance [3,4] - feet
737-800	112	56.8	60.1	2.5	11594	10939
A350-900	54	55.3	60.3	3.8	10752	10103
F100	26	56.7	60.3	4.1	11037	10174
F70	25	55.4	59.5	2.6	10722	9622
777-300ER	21	59.6	62.0	2.7	10711	10000
SF34	18	57.6	61.3	3.6	7231	6017
A320-200	14	54.0	56.8	3.9	11016	10256
DH8D	11	57.2	61.1	2.8	9803	8209
A380-800	11	62.5	63.8	1.5	9646	8445
AW139	10	56.2	59.2	3.0	7118	6142
All Jet	290	56.6	61.3	3.5	11160	10060
All Turboprop	40	57.0	61.3	3.6	8314	6714

Note:
1. Presentation of individual aircraft types in **Table 3-1** is limited to the ten aircraft types with the most correlated departure events.
2. The 90th percentile L_{Amax} presents the loudest 10% of events.
3. Slant distance is the nearest three-dimensional distance from the aircraft to the noise monitoring terminal.
4. The 10th percentile slant distance presents the nearest 10% of events.

The following can be observed from the noise monitoring results.

- The most numerous aircraft demonstrate similar average noise levels around 55-57 dB(A).
- Narrow body jets are most prevalent (737-800, F100, F70, A320-200 and others not shown), representing 56% of the total correlated aircraft departures for fixed-wing aircraft.

- Wide body jets are also prevalent (A350-900, 777-300ER, A380-800 and others not shown), represent 30% of the total correlated departures for fixed-wing aircraft.
- Turboprop aircraft (SF34, DH8D and others not shown), represent 12% of the total correlated aircraft arrivals for fixed-wing aircraft.
- All aircraft exhibit some variation in L_{Amax}; demonstrated by the standard deviation of L_{Amax} and the difference between the 90th percentile and average. For most aircraft, the 90th percentile L_{Amax} is approximately 3-4 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The average slant distance for most jets is approximately 11,000 ft.
- The 10th percentile slant distance (i.e. lowest 10%) ranges between 600 ft and 1,600 ft lower than the mean across the presented aircraft.
- The A380-800 is the lowest (by average and 10th percentile) and loudest (by average and 90th percentile) jet aircraft.
- Turboprop aircraft (SF34 and DH8D) are notably lower than most jet aircraft. Measured L_{Amax} noise levels from turboprops are similar to jet aircraft.

3.2 Correlated Aircraft Arrival Operations

Table 3-2 presents a summary of the correlated aircraft arrival noise events at the Cedar Creek site.

The following can be observed from the noise monitoring results.

- The most numerous aircraft demonstrate similar average noise levels around 55-57 dB(A).
- Narrow body jets are most prevalent (737-800, F70, A320-200, F100, 737-700, 717-200 and others not shown), representing 79% of the total correlated aircraft arrivals for fixed-wing aircraft.
- Turboprop aircraft are also prevalent (SF34, DH8D and others nor shown), representing 12% of the total correlated aircraft arrivals for fixed-wing aircraft.
- Wide body jets (A350-900, 777-300ER and others not shown) represent 9% of the total correlated arrivals.
- All aircraft exhibit some variation in L_{Amax}; demonstrated by the standard deviation of L_{Amax} and the difference between the 90th percentile and average. For most aircraft, the 90th percentile L_{Amax} is approximately 3-5 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The average slant distance for most jets is approximately 6,500 ft.

- The 10th percentile slant distance (i.e. lowest 10%) ranges between 500 ft and 1,200 ft lower than the mean across the presented aircraft.
- Turboprop aircraft are notably higher than most aircraft. Despite this, turboprops exhibited similar L_{Amax} noise levels to jets.

Table 3-2 Summary of Correlated Aircraft Arrival Noise Events at Cedar Creek

Aircraft [1]	Number of CNE	Average L_{Amax} - dB(A)	90th Percentile L_{Amax} [2] - dB(A)	Standard Deviation of L_{Amax}	Average Slant Distance [3] - feet	10th Percentile Slant Distance [3,4] - feet
737-800	485	56.7	60.1	2.7	6433	5298
F70	86	55.0	58.8	2.6	6493	5967
A320-200	81	56.8	62.6	3.5	5721	4721
SF34	75	56.6	59.8	2.4	7283	6363
F100	69	54.8	58.1	2.2	6529	6064
737-700	63	56.6	58.7	2	6231	5285
A350-900	37	56.6	58.7	1.6	6523	5917
717-200	28	54.3	58.8	2.8	6454	5919
DH8D	23	57.0	61	3.3	7715	7038
777-300ER	21	56.7	60.8	2.5	6119	4885
All Jet	963	56.3	60	2.8	6360	5295
All Turboprop	131	56.6	60.2	3.1	7270	6066

Note: 1. Presentation of individual aircraft types in **Table 3-2** is limited to the ten aircraft types with the most correlated arrival events.
5. The 90th percentile L_{Amax} presents the loudest 10% of events.
6. Slant distance is the nearest three-dimensional distance from the aircraft to the noise monitoring terminal.
7. The 10th percentile slant distance presents the nearest 10% of events.

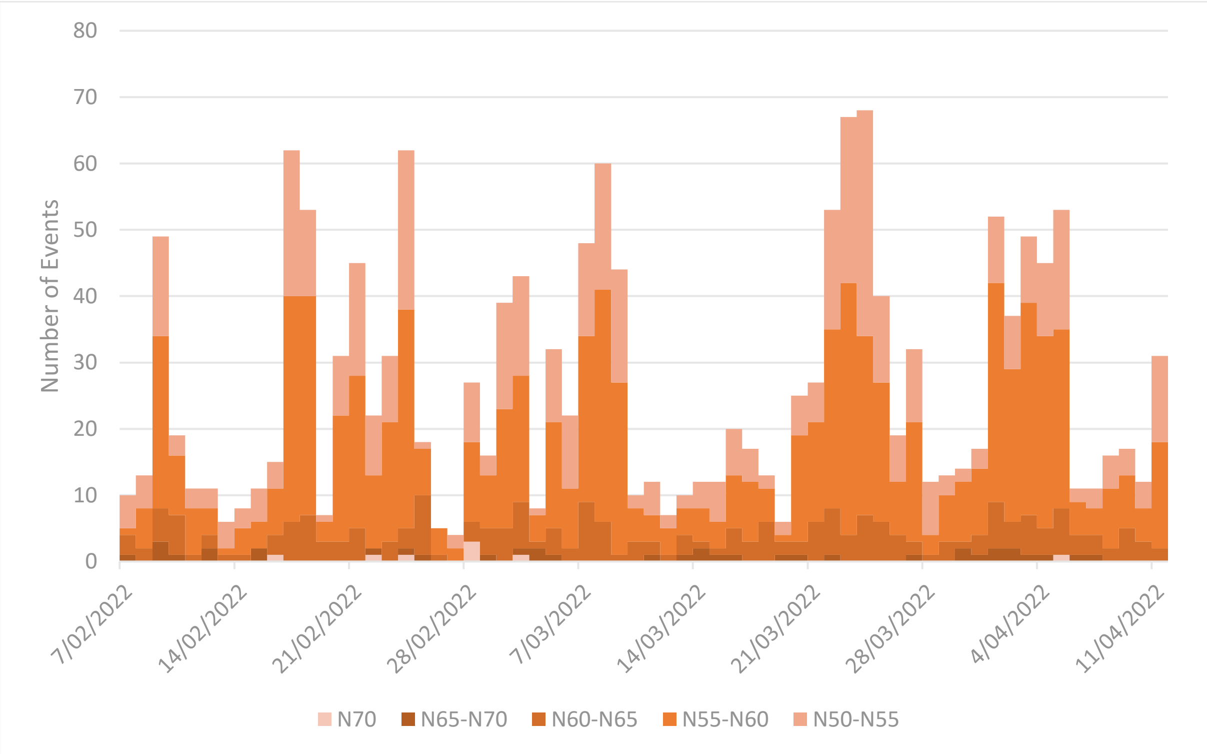
3.3 Daily Distribution of Correlated Noise Events

Figure 3-1 presents the number of events within various noise thresholds for each day of the monitoring. The number of events above a noise level threshold is denoted 'number-above' or 'N-above' and is typically expressed in the form N70 (i.e. number of events above 70 dB(A)).

The following is noted from **Figure 3-1** and statistical analysis of the daily N-above values.

- The number of correlated noise events can be seen to vary significantly from day to day. This is likely largely due to different wind conditions requiring Brisbane Airport to utilise different operating modes (i.e. runway directions). Varying traffic numbers and schedules from day to day are also a likely contributing factor.
- The maximum N60 measured was 10 and the average was 4.2. Aircraft noise events above 70 dBA were infrequently observed; the maximum N70 was three and the average was 0.1.
- On most days, the largest proportion of measured aircraft noise events were in the range 55-60 dBA. This accords with the data presented in the previous sections.

Figure 3-1 N-above Distribution During the Monitoring



4 CONCLUSION

SoundIN has undertaken an analysis of short-term aircraft noise monitoring at Cedar Creek.

The following observations have been made in our analysis.

Departure Aircraft Events at the Cedar Creek Site

- Average noise levels for departures were similar amongst the most prolific aircraft – approximately 55-57 dB(A).
- All aircraft exhibited some variation in L_{Amax}; meaning that even for like operations, the noise level on the ground can be expected to vary from flight to flight. For most aircraft, the 90th percentile L_{Amax} (i.e. the 10th loudest out of every 100 events) is approximately 3-4 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The most prolific aircraft had an average slant distance of approximately 11,000 ft.

Arrival Aircraft Events at the Cedar Creek Site

- Arrival noise events were three times more prevalent than departures.
- Average noise levels for arrivals were similar amongst the most prolific aircraft – approximately 55-57 dB(A).
- All aircraft exhibited some variation in L_{Amax}; meaning that even for like operations, the noise level on the ground can be expected to vary from flight to flight. For most aircraft, the 90th percentile L_{Amax} is approximately 3-4 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The most prolific aircraft had an average slant distance of approximately 6,500 ft.

Daily Distribution of Correlated Noise Events

- The number of correlated noise events varies significantly from day to day.
- The majority of aircraft noise events produced a maximum noise level in the range 55-60 dB(A).
- Aircraft noise events above 60 dB(A) are infrequent, with an average of 4.2 per day.
- Very few aircraft noise events above 70 dB(A) were measured, with a maximum of three events on any day and an average of 0.1 per day.