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DOWNWIND LEG NOISE MONITORING SUMMARY REPORT

Introduction

This report presents a summary of the results obtained from the deployment of five portable noise monitor stations that measured noise data for the Calgary Airport Authority's Downwind Leg Study.

A "downwind leg" is a flight path parallel to the landing runway in the direction opposite to landing. Downwind legs are designed to be 5 to 6 miles from the runway centerline, which allows aircraft to smoothly transition to the final approach for landing (see Figure 1). The purpose of the study was to measure noise levels in areas near the downwind legs not typically monitored. The noise monitors recorded noise from all sources in the vicinity of the monitor, including in addition to aircraft on the downwind leg, community noises and helicopter overflights. This information supplements measurements collected by the airport's network of permanent noise monitoring terminals.

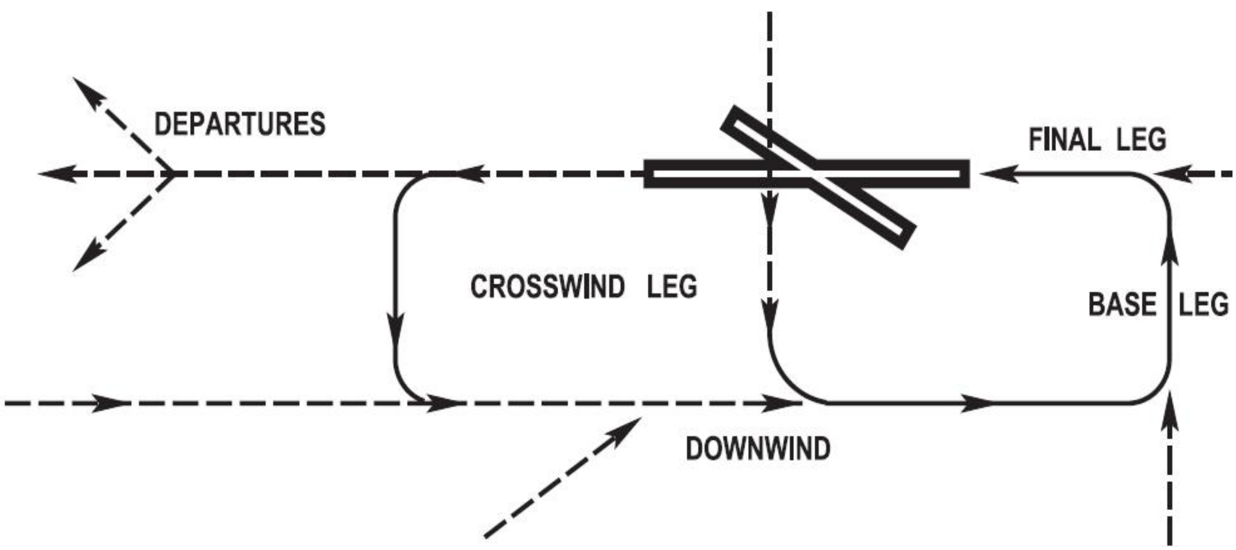

Figure 1: "Downwind Leg" Flight Path Basic Concept

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Monitoring Location & Equipment

Five monitoring locations were selected by representatives of the Calgary Airport Authority and RWDI in consultation with Community Associations and Airport Community Consultative Committee members. Table 1 lists the addresses at which the monitors were installed, and the survey dates for each location. Figure 2 illustrates the monitor locations in relation to the downwind flight paths.

The surveys were conducted with Brüel and Kjær Model 2250 Type 1 Precision Integrating Sound Level Meters, which meet the ANSI S1.43-1997 standard for noise monitoring. Type 1 sound level meters are the most accurate instruments practical for environmental noise measurements.

The microphone of each sound level meter was mounted on a 1.5 m tripod and protected with a wind screen. The sound level meters were supplied with AC power, and installed with a battery backup; except for the meter at Shore Drive which was supplied with power from batteries and solar panels set up by RWDI. An email alert system was employed to notify RWDI staff of equipment problems; however, due to a malfunction during download, the July 30th to August 13th data from the Chestermere location and August 19th data from the Shore Drive location were lost. Otherwise, the data are complete, and provide continuous one second A-weighted sound levels (one second L_{eq} dBA) for the periods shown in Table 1.

Table 1: Monitor Location Summary

Monitor Location Name	Equip. ID	Monitoring Period	Location
Chestermere	PM42	July 8 - July 29, August 14 – September 20	Chestermere Rec Centre 201 W Chestermere Drive
Shore Drive	PM43	July 8 – September 19 (except August 19)	Personal Touch Car Care 400 Shore Drive
Montgomery	PM44	July 11 – September 20	Maranatha Christian Reformed Church 2111 52 Street NW
Hawkwood	PM45	July 8 – September 20	St. Thomas United Church 100 Hawkwood Blvd NW
Glenbrook	PM46	July 19 – September 20	Abundant Life Church 3325 49 Street SW

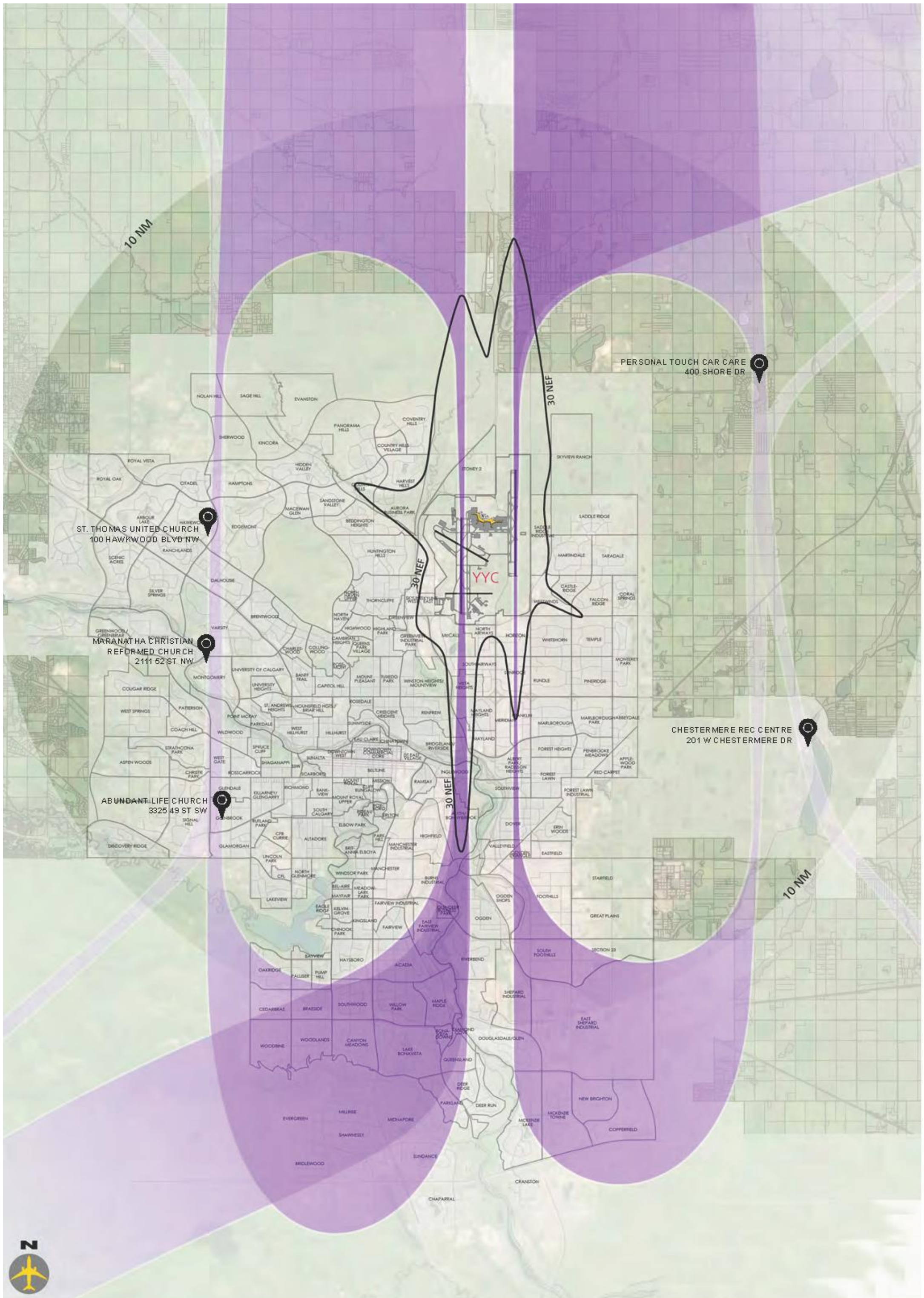


Figure 2: Downwind Leg Portable Noise Monitor Locations

Monitoring Results

A noise event has been defined to occur when the sound level and duration exceed a predefined threshold. For the Downwind Leg Study, the event threshold was set to 60 dBA and the event time duration was set at 5 seconds.

Noise events can be either aircraft or non-aircraft related. Recorded noise events have been correlated with flight operations by HARRIS Inc., using radar data supplied by NAV CANADA. Noise events that occurred while an aircraft was within a reasonable proximity of the monitoring location have been attributed to aircraft movement. This allows the contribution of aircraft noise to be determined in relation to other community noise sources.

The numbers of noise events recorded over the noise monitoring period are summarized in Tables 2 & 3.

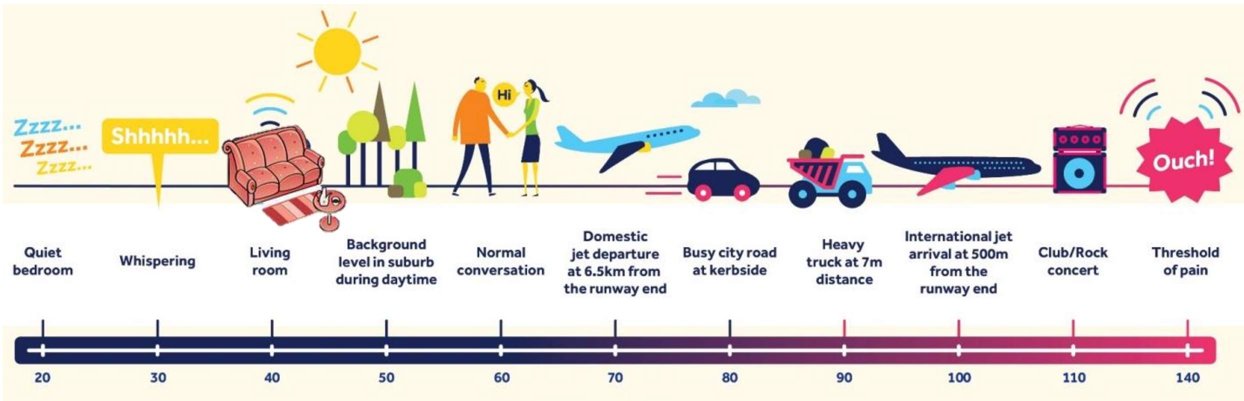
Table 2: Noise Events Recorded over Monitoring Period

Events by Type	Chestermere (60 days)	Shore Drive (73 days)	Montgomery (72 days)	Hawkwood (75 days)	Glenbrook (64 days)
Community	12203	1487	4612	4983	2712
Fixed Wing Aircraft	254	94	149	98	258
Helicopters	7	4	30	6	20
Total	12464	1585	4791	5087	2990

Table 3: Aircraft Noise Events by Operations

Aircraft Events by Type	Chestermere (60 days)	Shore Drive (73 days)	Montgomery (72 days)	Hawkwood (75 days)	Glenbrook (64 days)
Arrival	238	91	126	90	250
Departure	1	0	11	4	4
Helicopters	7	4	30	6	20
Overflights	15	3	12	4	4
Total	261	98	179	104	278

Figures 4 through 8 categorize the noise events at each location according to the maximum sound level (L_{max}) during the noise event. Figure 3 provides examples of typical indoor and outdoor sound levels for context.



Source: Based on Melbourne Airport, http://melbourneairport.com.au/about-melbourne-airport/planning/aircraft-noise/how-is-noise-generated.html

Figure 3: Typical Indoor and Outdoor Sound Levels

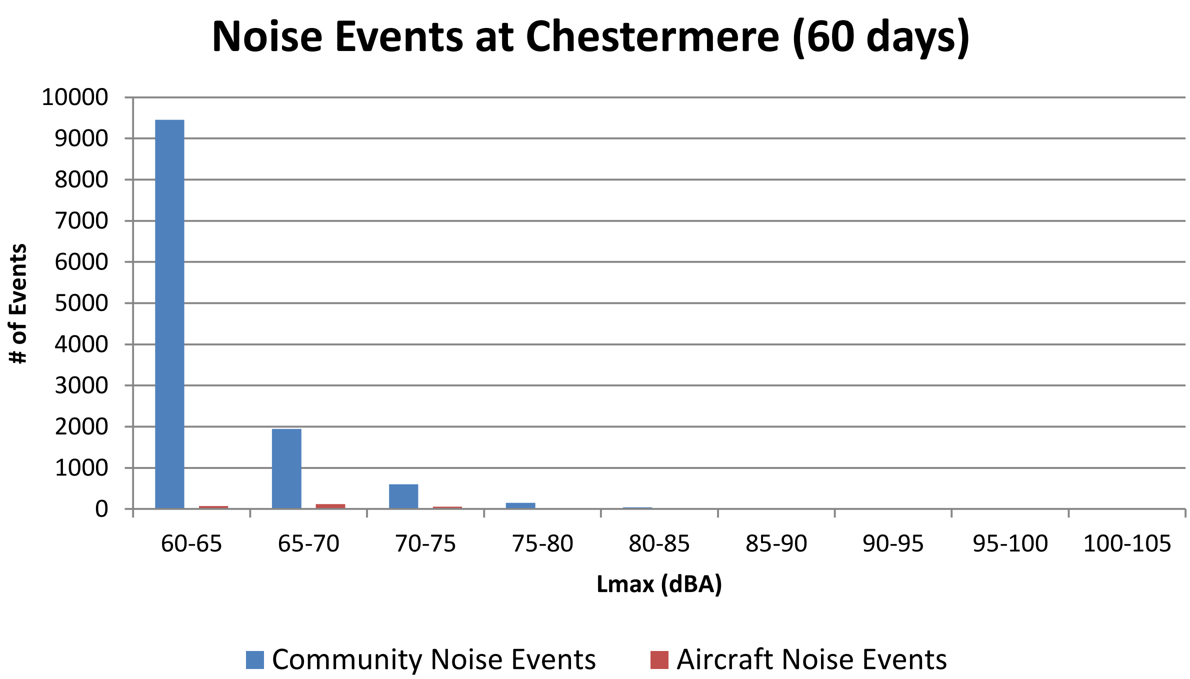


Figure 4: Comparison of Aircraft and Community Noise Events at Chestermere

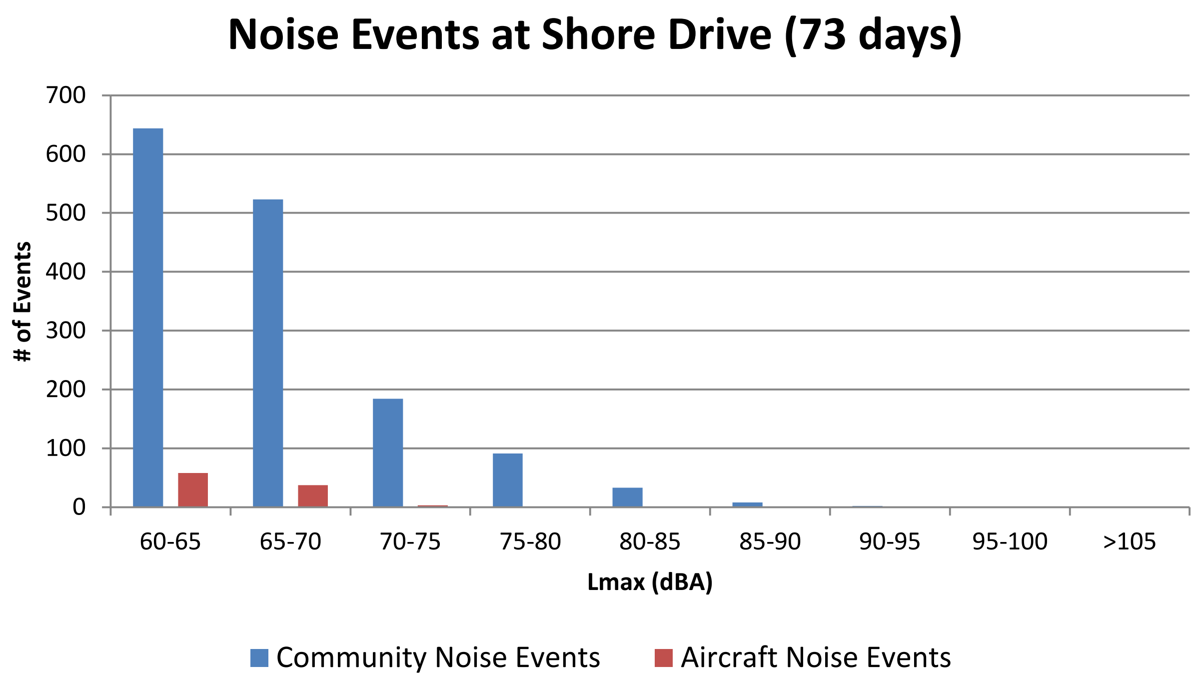


Figure 5: Comparison of Aircraft and Community Noise Events at Shore Drive

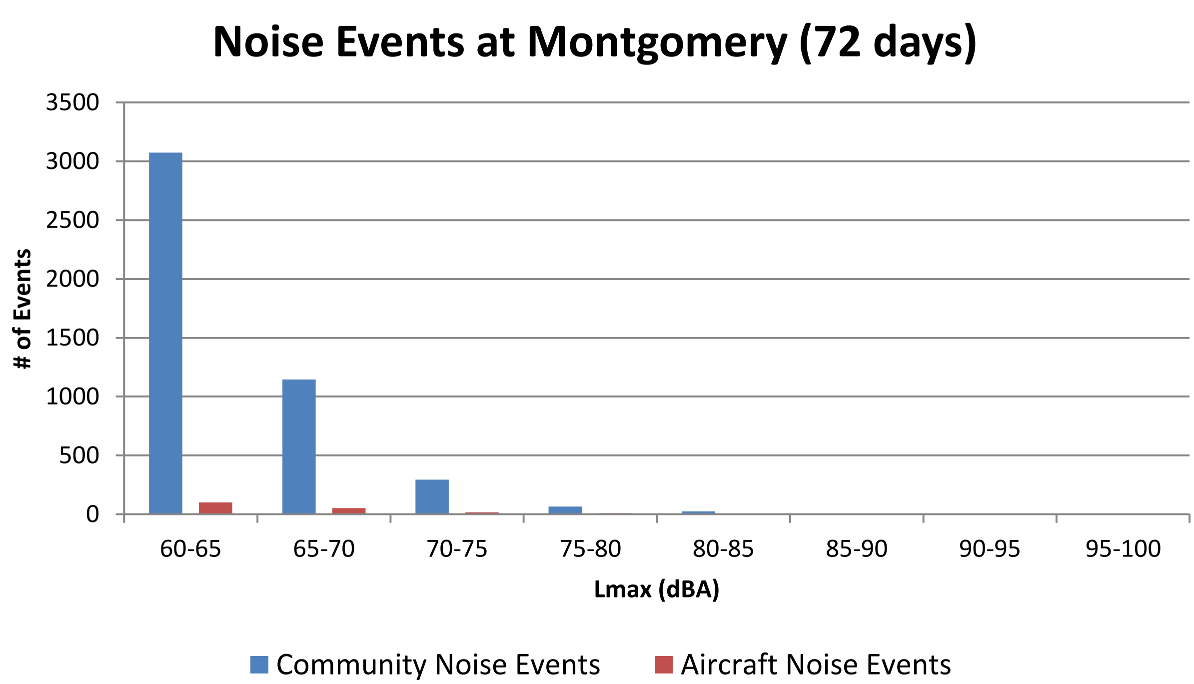


Figure 6: Comparison of Aircraft and Community Noise Events at Montgomery

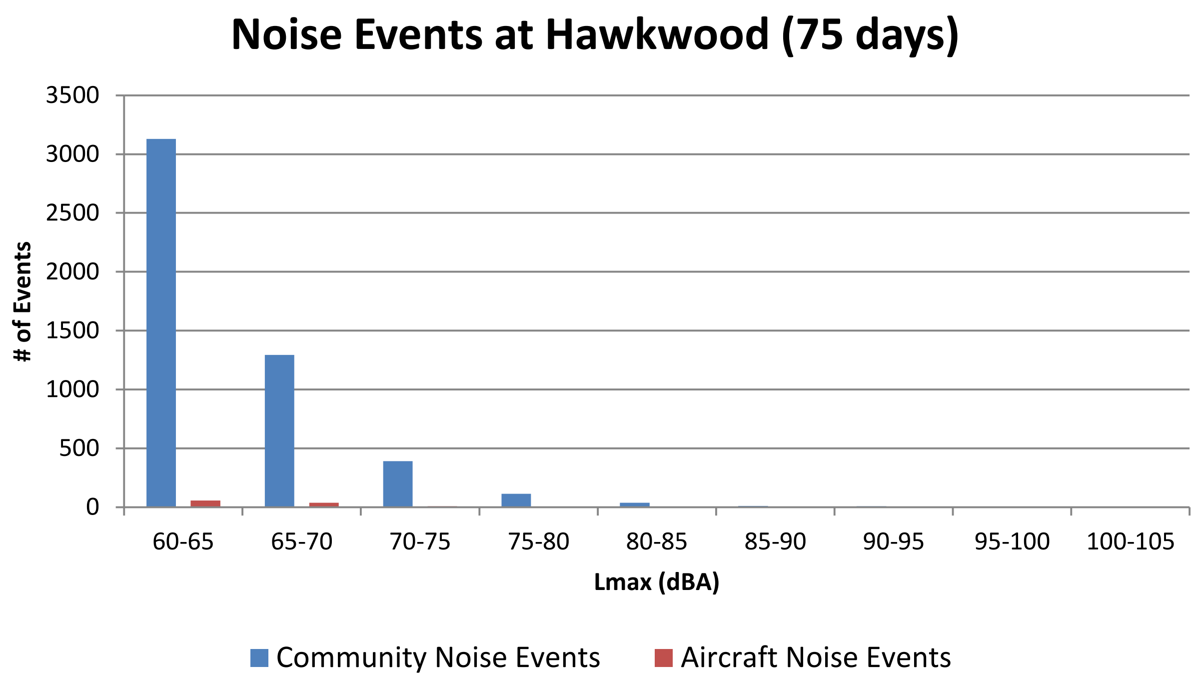


Figure 7: Comparison of Aircraft and Community Noise Events at Hawkwood

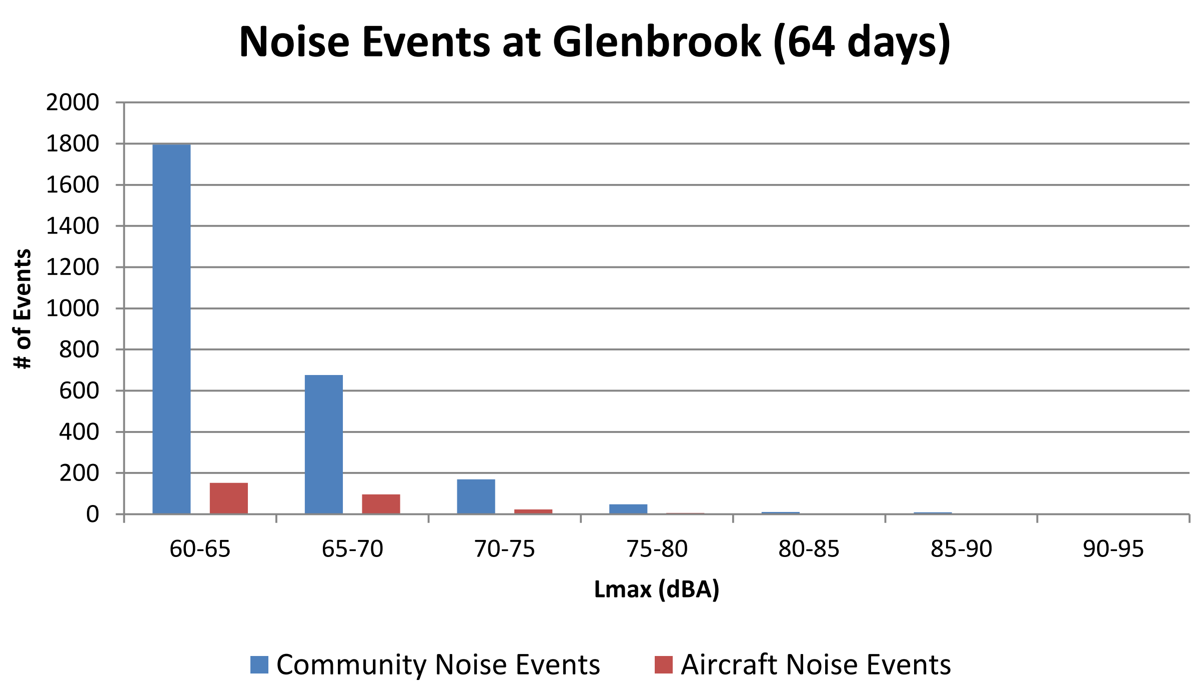


Figure 8: Comparison of Aircraft and Community Noise Events at Glenbrook

Average Sound Level (L_{eq}) and Average Day-Night Sound Level (DNL)

As environmental noise varies over time, a single number descriptor known as the L_{eq} is commonly used to quantify noise. The L_{eq} (expressed in dBA) is defined as the steady continuous sound level that has the same energy as the actual varying sound levels occurring over a chosen time frame. For reference, in most environments a 3 dB change in sound level is the threshold of perceptible change. A 10 dB increase is perceived as a being twice as loud, and a 10 dB reduction is perceived as being half as loud.

The average sound levels over the monitoring period are summarized in Table 4.

Table 4: Average Sound Levels (L_{eq}) over Monitoring Period

Monitoring Period L_{eq}	Chestermere	Shore Drive	Montgomery	Hawkwood	Glenbrook
From Community Noise Events	56	54	58	53	52
From Aircraft Noise Events (including helicopters)	38	25	33	31	34

The Day-Night Average Sound Level (DNL) is a 24-hour average noise metric in which events occurring at night (between 10 PM and 7AM) are penalized by 10 dBA. This night-time weighting treats one nighttime noise event as equivalent to 10 day-time noise events of the same magnitude and is intended to account for greater community annoyance with night-time noise.

The average DNLs over the monitoring period are summarized in Table 5.

Table 5: Average Day-Night Sound Level (DNL) over Monitoring Period

Monitoring Period DNL	Chestermere	Shore Drive	Montgomery	Hawkwood	Glenbrook
From Community Noise Events	60	55	66	57	57
From Aircraft Noise Events (including helicopters)	45	29	35	33	36

Conclusion

Noise monitoring was carried out from July to September 2016 at 5 locations near the Calgary International Airport downwind leg flight paths. Over the monitoring period, the majority of aircraft noise events recorded were from fixed-wing aircraft arrivals. The maximum sound levels recorded during aircraft noise events were within the range of community noise event maximum sound levels. The daily average sound levels (both Leq and DNL) from aircraft noise events were found to be well below the daily average community noise level.

Definitions

Maximum Sound Level (Lmax)

The Lmax is the loudest (1 second) sound level recorded during a noise event.

Equivalent Continuous Sound Pressure Level (Leq)

The L_{eq} value, expressed in dBA, is the energy-averaged A-weighted sound level for a specified time period. It is defined as the steady continuous sound level that has the same acoustic energy as the actual varying sound levels occurring over the same time period. The L_{eq} values are reported as A-weighted decibels to account for the frequency response of the human ear, which is most sensitive to mid-frequency sounds.

Day-Night Average Sound Level (DNL)

The DNL is a 24-hour average noise metric in which noise occurring at night (between 10 PM and 7AM) is penalized by 10 dBA to account for the increased likelihood of community annoyance at night-time.