AIRCRAFT NOISE OMBUDSMAN

Full length departures – Potential noise benefits (Perth)

October 2012

1 Purpose

1.1 This report provides details of an analysis of data by the Aircraft Noise Ombudsman's office comparing full length runway departures and departures from an intersection. It incorporates information from various sources and draws a conclusion on the merits, or otherwise, of further research to determine whether there are significant noise benefits in full length departures as opposed to intersection departures.

2 Overview

2.1 In May 2012, the Aircraft Noise Ombudsman (ANO) received a letter from Mr Steve Irons MP about the potential for improving the noise exposure in Perth by increasing the number of 'full power' and/or 'full length' runway takeoffs.

2.2 Full power takeoffs were previously considered by the Perth Airport Noise Management Consultative Committee (ANMCC). At the December 2010 meeting Qantas stated that "full thrust takeoffs would be inconsistent with manufacturer's recommendations and would not be mandated for Qantas aircraft". Full power takeoffs are not considered in this report.

2.3 In August 2011, the ANMCC was provided with further information from Qantas on a trial of full length departures compared to those that departed from an intersection point along the runway. An intersection departure means the aircraft does not start the takeoff from the end of the runway, but some point along the runway (where a taxiway intersects with the runway). The ANMCC minutes state "the noise data did not indicate any difference in noise impact on the ground between full length and Taxiway Lima intersection departures". Surprisingly, the findings were that the full length departures actually recorded a higher noise impact than the intersection departure with "no relationship to influencing factors such as takeoff weight or altitude". The meeting also agreed that the issue had been considered over many years and that "the matter be closed".[1]

2.4 In September 2012, Airservices provided the ANO with technical modelling which showed that in theory, with all other factors being equal, a "full length" departure may result in a 3.75 decibel reduction in noise at a point 1 kilometre from the end of the runway[2] (which is close to being on the airport boundary). The theoretical benefits reduce with distance, so at a point 7 kilometres from the end of the runway, the difference would be 2.1 decibels. It is often cited that a three decibel difference in sound is the minimum that can be discernible by people, although this could be debated due to the technical nature of sound, the subjective nature of hearing and propagation properties.

2.5 The theoretical benefits indicated above are based on points directly in line with the runway centreline. In Perth, the nearest residents aligned with the north-south runway are approximately 4.5 kilometres to the south of the airport (Queens Park) and 2 kilometres to the north of the airport (south Guildford). There are residents that do live closer to the airport, for example Cloverdale residents who live as close as 600 metres from the runway, however their homes are off to the side of the runway centreline. The theoretical benefit for this location has not been determined, however it is likely to be less that 3.75 decibels and perhaps not discernible.

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[1] Minutes of the ANMCC are published at http://www.perthairport.com.au/AboutUs/NoiseManagement.aspx
[2] Based on a Boeing 737-800 series using a 1km distance between full length and intersection.

3 Analysis and Findings

3.1 The ANO analysis was based on data from 23 and 30 July. These dates were chosen as the runway in use was different for each of those days. The aircraft selected for analysis were the 737 (most common medium size jet), A332 (most common wide-bodied jet) and the E190 (similar in sound to the F100).

3.2 Analysis by the ANO office (see Section 2) compared full length departures with intersection departures. Key findings were:

- Just over half of the jet departures assessed were already from the full length of the runway
- Boeing 737 aircraft were nearly always higher when departing from the full length of the runway compared to the average from the intersection
- Boeing 737 aircraft were, on average, 1 decibel quieter from the full length (unlikely to be discernible on the ground) at a point 3 kilometres from the end of the runway.
- E190 aircraft were nearly always lower when departing from the full length of the runway compared to the average from the intersection. No reason was evident, however it could have been due to wind, aircraft loadings, power settings or other factors.
- E190 aircraft were, on average, the same in sound levels for full length and intersection departures
- There did not seem to be any clear correlation between altitude and noise (for example, a Boeing 737 at 1,946 feet and another at 3,087 feet both produced 75 decibel sound levels). The variation could have been caused by wind, power settings or the actual distance from the noise monitor.

3.3 The analysis undertaken by the ANO office was based on a very small sample, and no firm conclusions can be drawn from the data. It can, however be said that the review showed no clear correlation between full length departures and discernibly lower sound levels. This is consistent with the results of the previous analysis by the Perth ANMCC and also with Airservices theoretical modelling.

4 Variability of the data

4.1 The noise levels from an aircraft measured by ground based monitors will be affected by many factors. These include wind direction and speed, air temperature and humidity, cloud cover, surrounding vegetation or buildings and the distance from the monitor at the aircraft's closest point. Additionally, the level of noise is dependent on the height of the aircraft which is affected by many of the factors already mentioned, together with type and age of aircraft, variability in pilot actions and the amount of fuel, passengers and freight that is carried.

4.2 Given the many factors involved, there will be significant variability in the data. Since the sample of aircraft noise levels analysed is so small it must be accepted that the data collected will have a significant potential for statistical error. Nevertheless, the data does provide a basis for some general conclusions, particularly when considered alongside the ANMCC minutes and the Airservices modelling.

5 Runway 21 investigation

5.1 The data for 23 July revealed a total of 218[3] aircraft departures from Runway 21. Details (excluding the 62 non-jet flights) are included in table 1 below.

Table 1 – Perth jet departures - 23 July 2012

Aircraft type	Full length departures	Intersection departures	Total
Small jets			
• F100	7	14	**21**
• BAe146	0	3	**3**
• Other	1	8	**9**
Medium jets			
• E190	1	6	**7**
• B712	5	10	**15**
• A320	6	13	**19**
• B737	11	34	**45**
Wide bodied jets			
• A330 series	11	11	**22**
• B747	0	1	**1**
• B767	1	9	**10**
• B777	4	0	**4**
Total	**47**	**109**	**156**

5.2 Overall, 70% of jet departures were from an intersection, with 21 (57%) of the wide-bodied jets taking off from an intersection point.

5.3 Average sound readings recorded at Queens Park (4.5 km from end of runway) and Cannington (5.5 km from end of runway) for E190 aircraft are presented in Table 2 below.

Table 2 – Average sound levels Queens Park/Cannington

Aircraft type	Full length (decibels)	Intersection (decibels)	Full length - intersection
E190	77/73.5	76.8/73.6	**+ 0.2 / - 0.1**

[3] The average number of departures per day in July 2012 was approximately 210

6 Runway 03 investigation

6.1 The data for 30 July revealed a total of 220[4] aircraft departures from Runway 03. Details (excluding the 74 non-jet flights) are included in table 3 below.

Table 3 – Perth jet departures - 30 July 2012

Aircraft type	Full length departures	Intersection departures	Total
Small jets			
• F100	0	4	**4**
• BAe146	2	2	**4**
• Other	3	2	**5**
Medium jets			
• E190	3	6	**9**
• B712	13	3	**16**
• A320	17	5	**22**
• B737	40	8	**48**
Wide bodied jets			
• A330 series	22	3	**25**
• B747	2	0	**2**
• B767	9	0	**9**
• B777	2	0	**2**
Total	**113**	**33**	**146**

6.2 Overall, 23% of jet departures were from an intersection, however only three (6%) of the wide-bodied jets took off from an intersection point.

6.3 Average sound readings as recorded by the Guildford (3 km from end of runway) for A332 and B737 aircraft are presented in Table 4 below.

Table 4 – Average sound levels at Guildford

Aircraft type	Full length (decibels)	Intersection (decibels)	Full length - intersection
A332	78	76.7	**+ 1.3**
B737	75.4	76.4	**- 1.0**

[4] The average number of departures per day in July 2012 was approximately 210

7 Aircraft departure geometry

7.1 It is difficult to determine the extra height that can be obtained by an aircraft departing from the full length of the runway compared to an intersection departure. This is due to the variation in aircraft weight, performance, takeoff thrust and weather conditions. In other words, it is not possible to make a 'like for like' analysis using real data.

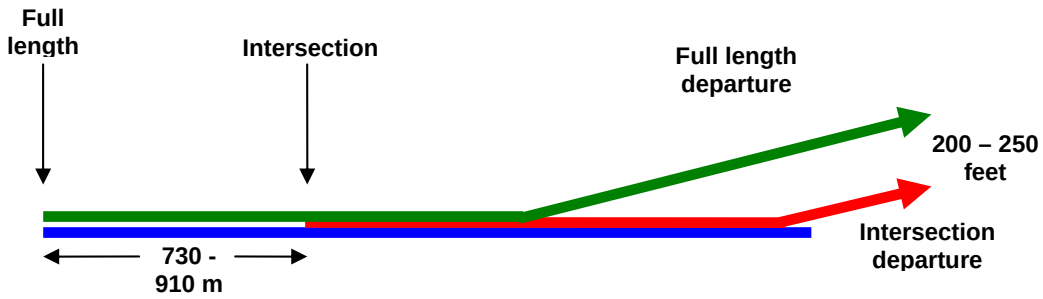
7.2 In a theoretical sense, it is also difficult to determine the height advantage due to many of the potential variables listed above, however an indicative assessment can be calculated.

7.3 If we assume the initial climb rate of an aircraft is 2,500 feet per minute[5], or approximately 500 feet[6] per nautical mile[7], then the following height improvements would be obtained, given all other factors being equal:

Table 5 – Theoretical height advantage from full length

Runway	Extra distance from full length to relevant intersection	Increase in height
Runway 03	Lima - approximately 910 metres	250 feet (approx 75 metres)
Runway 21	Delta - approximately 730 metres	200 feet (approx 60 metres)

7.4 The data included in table 5 above can be presented graphically as follows:



[5] Climb rates vary significantly between aircraft, however 2,500 feet/minute seems an appropriate figure based on web research by the ANO.
[6] In aviation, height and longer distances are measured in feet and nautical miles.
[7] One nautical mile equals 1,852 metres

8 Conclusion

8.1 Using full length departures for all jet aircraft would have the following detrimental effects:

- Reduction in airport capacity due to lack of aircraft being ready for departure from the intersection points (that is, less flexibility in choosing the next departure aircraft). It is however noted that this review has not considered any modelling to quantify the capacity change, as it would not have had an affect on the conclusion.
- Additional fuel and CO_2 emissions due to additional taxiing distance and potential delays due lack of capacity mentioned above. Again, no modelling has been undertaken to quantify the cost.
- Potential safety implications due to additional runway crossings on Runway 03. This is because the taxiway from the international terminal does not go all the way to the runway threshold, and aircraft would have to cross the runway at taxiway Lima and proceed to the full length from the other side of the runway.

8.2 While there are minor differences in the findings between the three sources (this report, Airservices modelling and the ANMCC findings), the measured increases or decreases are well within the levels of statistical variation that can be expected from the small sample size. In effect, the results from our analysis match the theoretical modelling. All three sources show no significant or discernible difference in noise for Perth residents when full length departures are used for jet aircraft.

8.3 The sampling size for this report is too small to draw any firm conclusions, however it can be said that there does not appear to be any evidence of discernible improvements in noise outcomes to contradict the theoretical modelling. Therefore there is no justification for additional investigation at this time.

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