Assessment of Suitability for Conversion to a Permanent EMU Installation

Keilor, VIC

connecting australian aviation

Version Control

Version 1: 10 August 2016	
Section	**Summary**

Glossary of Terms

A	Arrivals
Background noise level (L90)	The sound level in dB(A) that is exceeded 90% of the time
Capture Zone	The capture zone is the region that an aircraft can be within, to the noise monitor and be able to be correlated to a noise event.
Correlated Noise Event (CNE)	A noise event matched to an aircraft operation that flew through the capture zone
D	Departures
Day	6:00am to 11:00pm
EMU	Environmental Monitoring Unit
General Aviation	Operations other than scheduled commercial airline operations. This includes private, sports, charter and training operations.
H	Helicopters
LAmax	Maximum sound level in dB(A)
Local	Operation that departs and arrives at the same airport, including circuits and training flights.
Movement	An aircraft operation, such as a arrival or departure
Night	11:00 pm to 6:00 am
NFPMS	Noise and Flight Path Monitoring System
Noise Event	A noise that exceeds the threshold sound level for longer than the threshold time that is set
O	Overflight i.e. an aircraft movement that flew over the area but did not arrive or depart from the airport of concern
Overall Correlation Ratio	Percentage of captured aircraft operations correlated with noise events recorded by the noise monitor
T	Local operation including Circuits (Departure and Arrival at the same airport)
Threshold	Determined level on noise monitor that triggers a noise event when exceeded

For further information on the metrics used in this report refer to Australian Standard 1055.1–1997 “Acoustics – Description and measurement of environmental noise”.

Airservices Noise Monitoring Program

Information about Airservices noise monitoring program is available on the Airservices website, including reports of the noise and operational data collected by the Noise and Flight Path Monitoring System, as well as fact sheets about topics related to aircraft noise. The website is available at: www.airservicesaustralia.com/aircraftnoise/

Contact Us

To lodge a complaint or make an enquiry about aircraft operations,
you can go to WebTrak (www.airservicesaustralia.com/aircraftnoise/webtrak/)
use our online form (www.airservicesaustralia.com/aircraftnoise/about-making-a-complaint/)
telephone 1800 802 584 (freecall) or 1300 302 240 (local call –Sydney)
fax (02) 9556 6641 or write to, Noise Complaints and Information Service, PO Box 211, Mascot ACT 1460.

Deployment Purpose

The purpose of this deployment was to identify a location that captures Melbourne Airport Runway 34 Arrivals and Runway 16 Departures. Short term noise monitoring commenced on 28 April 2016, at Keilor East (Location 1) and Horseshoe Bend Road Keilor (Location 2), in order to evaluate the comparative suitability of both sites and regions for installation of a permanent Environmental Monitoring Unit (EMU).

The two locations were proposed in consultation with the Melbourne CACG and the final outcome is to determine the final potential permanent location. The Melbourne CACG had identified Horseshoe Bend Farm, Keilor for Location 2 however agreement with the owner was not possible. The installation of Location 2 was as close as practical to the preferred location.

An explanation of terms used within this report can be found in the Glossary on page 2 of the report.

Deployment Monitoring Period

28/04/16 12:00 am – 28/07/16 12:00 am

Environmental Monitoring Unit (EMU) Details

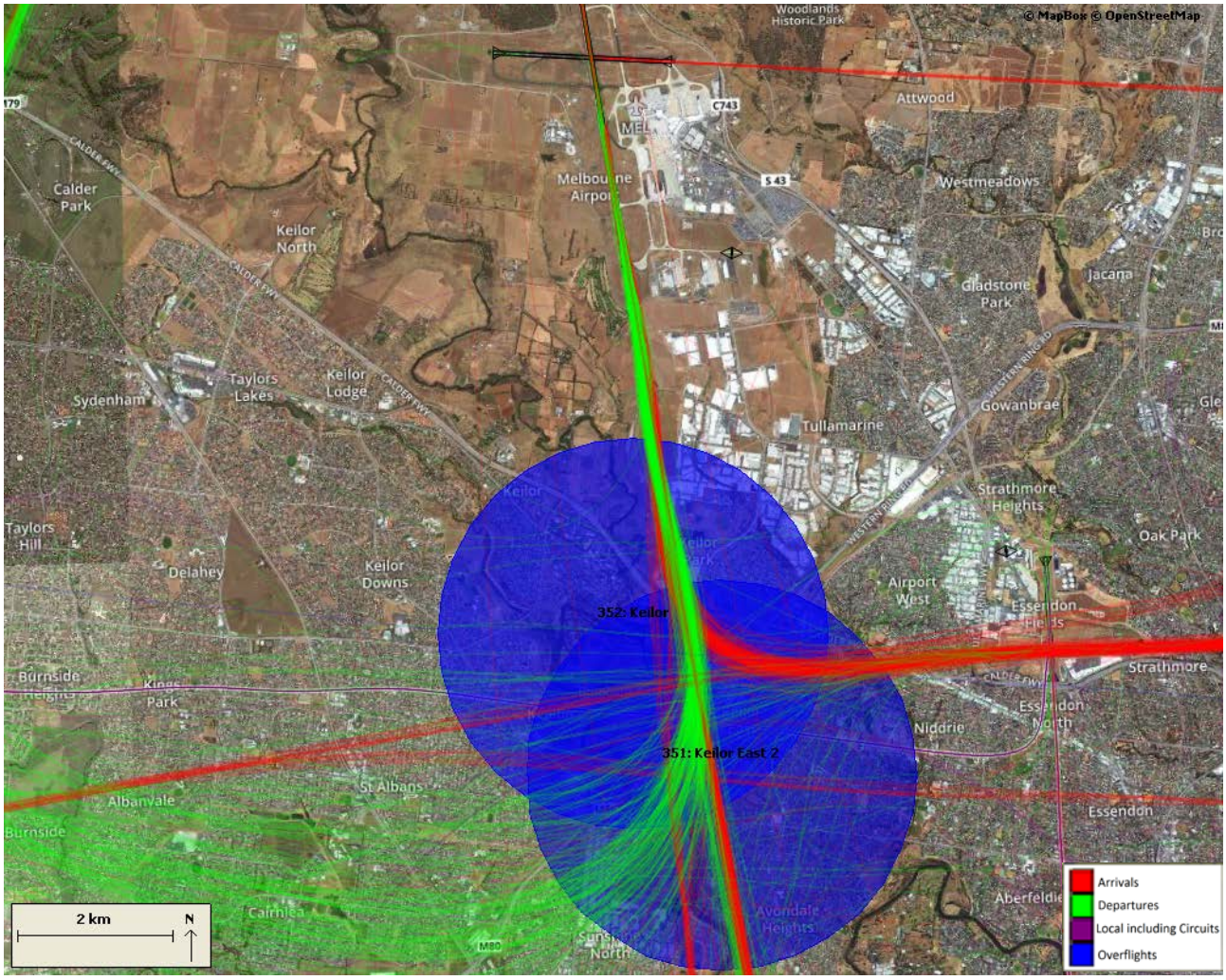

FIGURE 1: LOCATION OF EMU 351(LOCATION 1) AND EMU 352 (LOCATION 2), INCLUDING 2.5KM CAPTURE ZONE (BLUE CIRCLE) AND MELBOURNE BASIN OPERATIONS FOR 13-19 JUNE 2016

TABLE 1: DETAILS FOR LENVIRONMENTAL NOISE MONITORS (EMUS) AT LOCATION 1 AND 2

	Location 1	Location 2
Location	Norwood Drive, Keilor East, VIC	Horseshoe Bend Road, Keilor VIC
Latitude	37° 44' 40.86" S	37° 43' 41.35" S
Longitude	144° 51' 10.65" E	144° 50' 26.22" E
NMT Altitude	226 ft. above mean sea level	118 ft. above mean sea level
Capture Zone	2.5 km radius with 8,000 ft. (above ground level) height for noise data capture	2.5 km radius with 8,000 ft. (above ground level) height for noise data capture
Threshold Settings	55.0 dB(A) to 61.0 dB(A) depending on time of day	53.0 dB(A) to 62.0 dB(A) depending on time of day
Position to Melbourne Airport	6.6km	4.7km south of Runway 16/34
Sideline distance to median tracks	0.125km east of arrival path 0.475km east of departure path	0.690km west of arrival path 0.720km west of departure path

The Noise and Flight Path Monitoring System Improvement Program (NFPMS)

Airservices monitors aircraft noise meet its legislative (and regulatory) obligations and its business needs. In accordance with Ministerial Direction (M37/99) made under the Air Services Act Airservices is required to:

- Provide a Noise and Flight Path Monitoring System (NFPMS) at major airports
- Provide quality information to government and community stakeholders derived from the NFPMS data.

The NFPMS operates at Adelaide, Brisbane, Cairns, Canberra, Essendon, Gold Coast, Melbourne, Perth and Sydney airports. The system collects, stores and analyses weather, noise and operational data at these airports.

Determination

Based on the below considerations, for both Location 1(EMU 351) and Location 2(EMU 352), the location of EMU 351 (Location 1) is most suited for the installation of a permanent noise monitor.

Location 2(EMU 352) was confirmed as a suitable location for short-term monitoring but not suited for installation of a permanent EMU. One of the critical factors in this conclusion is that over 81% of arrival operations at EMU 352 do not meet the minimum requirement of an angle as per ISO 20906. A total of 70% of correlated noise events at EMU 352 are not compliant against this criteria, compared to 20% at EMU 351.

It was noted for EMU 351 that 36% of noise event were flagged due to the duration of the noise event. This can indicate community noise contributing to a captured noise event. This is addressed in more detail on page 13 and indicates that modification of the noise monitor settings is required.

It is recommended that EMU 351 or a site close to the current location, within 250m to the east of EMU 351's current location, be sourced for installation of a permanent noise monitor and the contract negotiations progress, at the earliest opportunity, in order that a suitable location for a permanent installation can be finalised. As per Airservices installation requirements, the installation location will be required to be a public or commercial facility. Airservices experiences are that residential sites are not suitable for permanent noise monitoring.

Constraints and criteria relevant to the evaluation and comparison of the Keilor locations

Depending on the location and purpose of a deployment, different objectives may intend to be achieved. These objectives are outlined below as well as the constraints applicable to all noise monitoring.

Suitable locations for remote (unattended) noise monitoring need to meet the acoustic standard ISO 20906: which specify that aircraft need to a minimum of 30 degrees from the ground, aircraft noise levels should be at least 15dB(A) above the non-aircraft background level, and the event should not affected by reflective surfaces.

> ***NB:*** *The difference between the LAmax and threshold being greater than 5dB(A) (assuming that the average background level (L90) and threshold setting are 10dB apart) would normally be assessed however to enable a comparison of both locations, a shared threshold setting of 62dB(A) was implemented for the purpose of this report. This setting was not assessed as a result but would be verified at the time of installation of a permanent installation.*

All noise events captured can be considered to have a level of uncertainty as a result of the position of the aircraft, relative to the microphone. When an aircraft is outside of the ideal requirements set out, at the time of the noise event, the level of measurement uncertainty is increased due to the contribution of the orientation of the measurement equipment and the influences of ground effects on the measurement.

There are three zones as shown in Figure 2 below which are used to describe the uncertainty level:

- The red zone are aircraft between 0°-30° to the microphone – a **high degree of uncertainty** due to the ground effects, are applicable. This is the region identified within ISO 20906
- The orange zone are aircraft between 30°- 60° to the microphone –**moderate uncertainty** due to the microphone and ground effects would apply.
- The green zone in Figure 2 is the **ideal capture region**, where aircraft are greater than 60° to the microphone there is almost no uncertainty associated with these noise events.

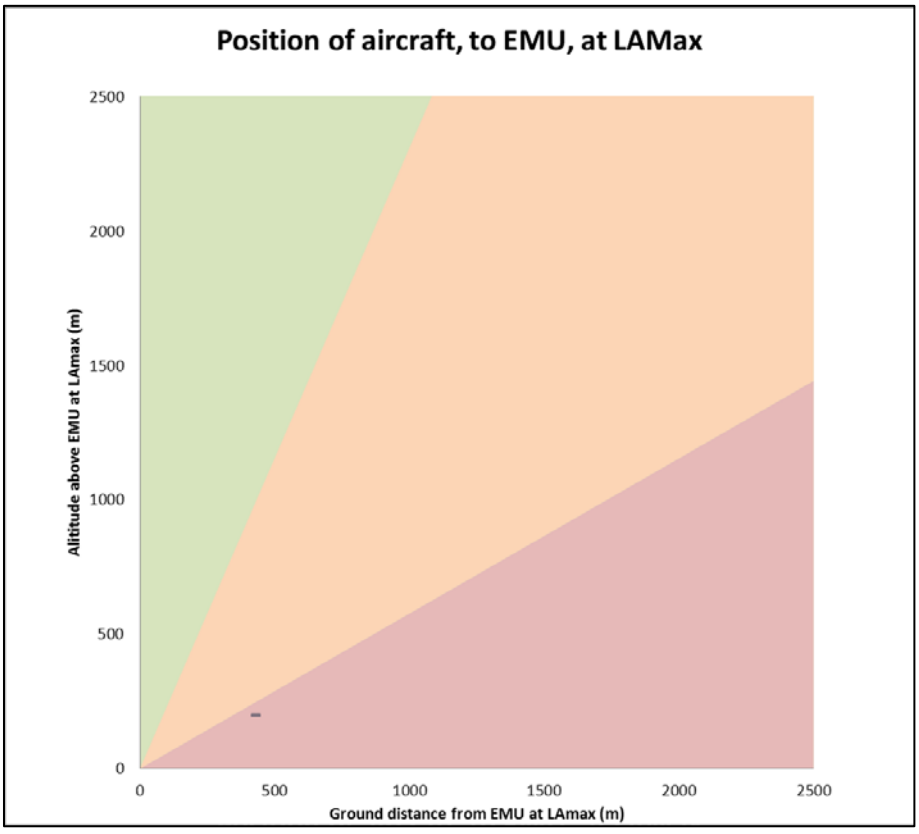

FIGURE 2: SAMPLE GRAPH SHOWING AIRCRAFT LOCATION RELATIVE TO THE MICROPHONE AT TIME OF LAMAX AND DEGREE OF UNCERTAINTY.

In addition to this Standard Airservices requires the non-aircraft background should be representative of overall community noise that the local area experience.

Monitoring locations also need to meet certain physical requirements: including being secure from malicious damage, have good mobile data coverage, access to power, protected from wild life and have good radar coverage (down to the level of the runways).

Because the cost of installing a permanent noise monitor is significant (approximately $70 in 2016) a long term lease (10 years or more) needs to be established. This is best achieved using public land (schools, council depots, childcare centres etc). Commercial sites are the next best option. However private residence are not suitable as a long term lease is at risk due to the high probability of a change in ownership within the 10 year period.

The monitoring location should also provide clear and unambiguous noise information that the local area is exposed to. It needs to be in a position:

- To capture all of the major aircraft types that operate at the airport
- Where the information collected represents the extremes of aircraft noise for the local region

For this reason the monitor should be positioned so that it measures, as much as possible, the highest aircraft noise levels that the local community is exposed to.

Another consideration is the effected population within the local community, identified as those within a 1km radius of the noise monitor.

To assist those who use the noise data collected by the NFPMS, Airservices deploys permanent noise monitors to the local community and analyses this noise data to:

- Identify how loud aircraft types operating at an airport are
- Determine the distribution of aircraft overflights over the local community, quantifying the noise impact of variations in lateral position and height
- Quantify how flight paths and noise levels change over time

Summary for Location 1 and Location 2

This section provides a comparison of the results for both locations. The location of each noise monitor relative to Runway 16/34 and the median jet arrival and departure paths, are shown in Figure 1 and 2.

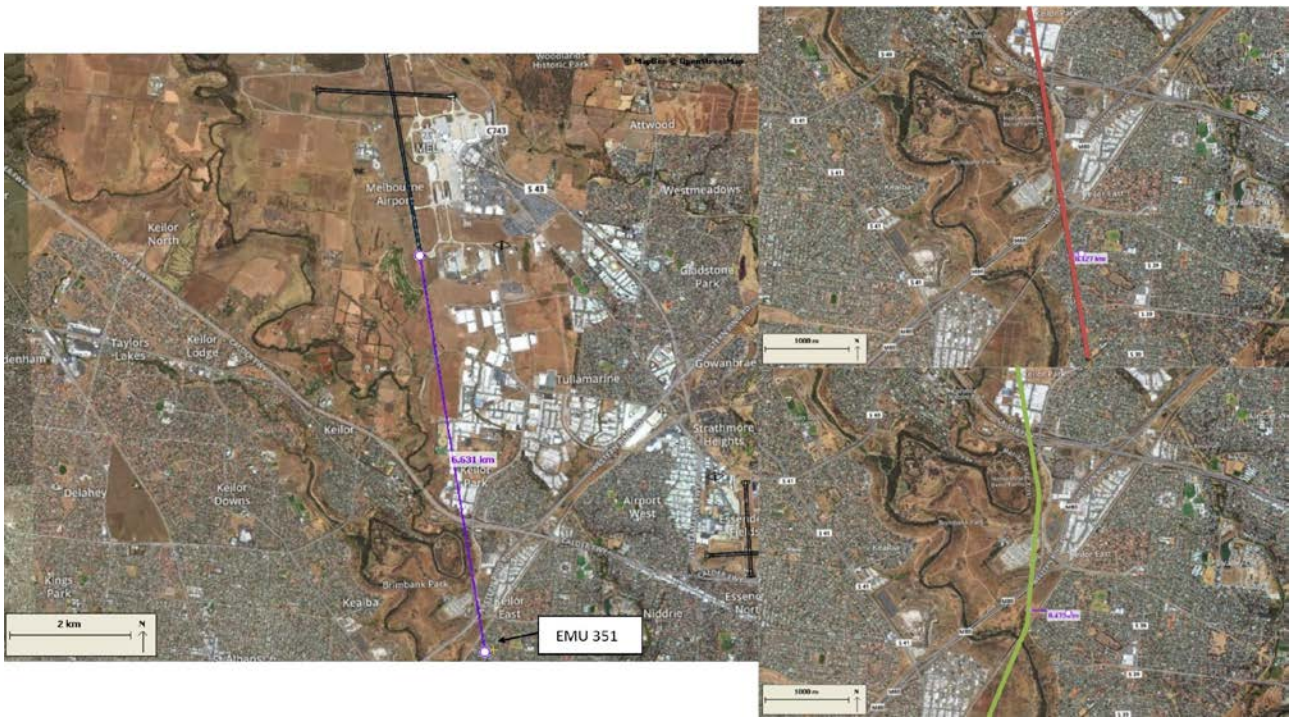

FIGURE 3: LOCATION 1 (EMU 351) RELATIVE TO MELBOURNE AIRPORT (LEFT), DISTANCE FROM LOCATION 1 (EMU 351) TO THE MEDIAN JET ARRIVAL PATH (TOP RIGHT) AND MEDIAN JET DEPARTURE PATH (BOTTOM RIGHT)

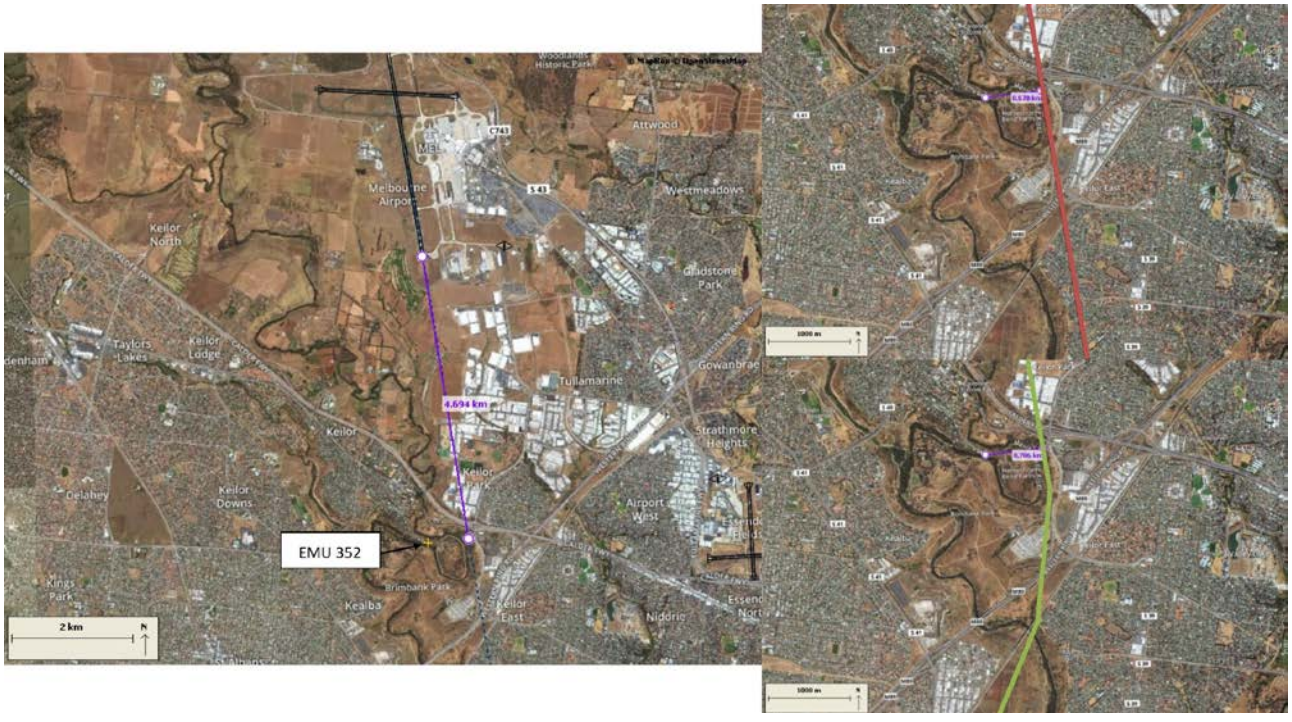

FIGURE 4: LOCATION 2 (EMU 352) RELATIVE TO MELBOURNE AIRPORT, DISTANCE FROM LOCATION 2 (EMU 352) TO THE MEDIAN JET ARRIVAL PATH (TOP RIGHT) AND MEDIAN JET DEPARTURE PATH (BOTTOM RIGHT)

Due to the position of Location 1 and 2, different settings were appropriate for the noise monitors. Of particular note is difference in threshold settings. Due to these differences, only noise events at or above 62dB(A) have been included within the following analysis for both sites. The threshold setting, comparison level and all correlated noise events for each monitor are shown in Figure 4 below.

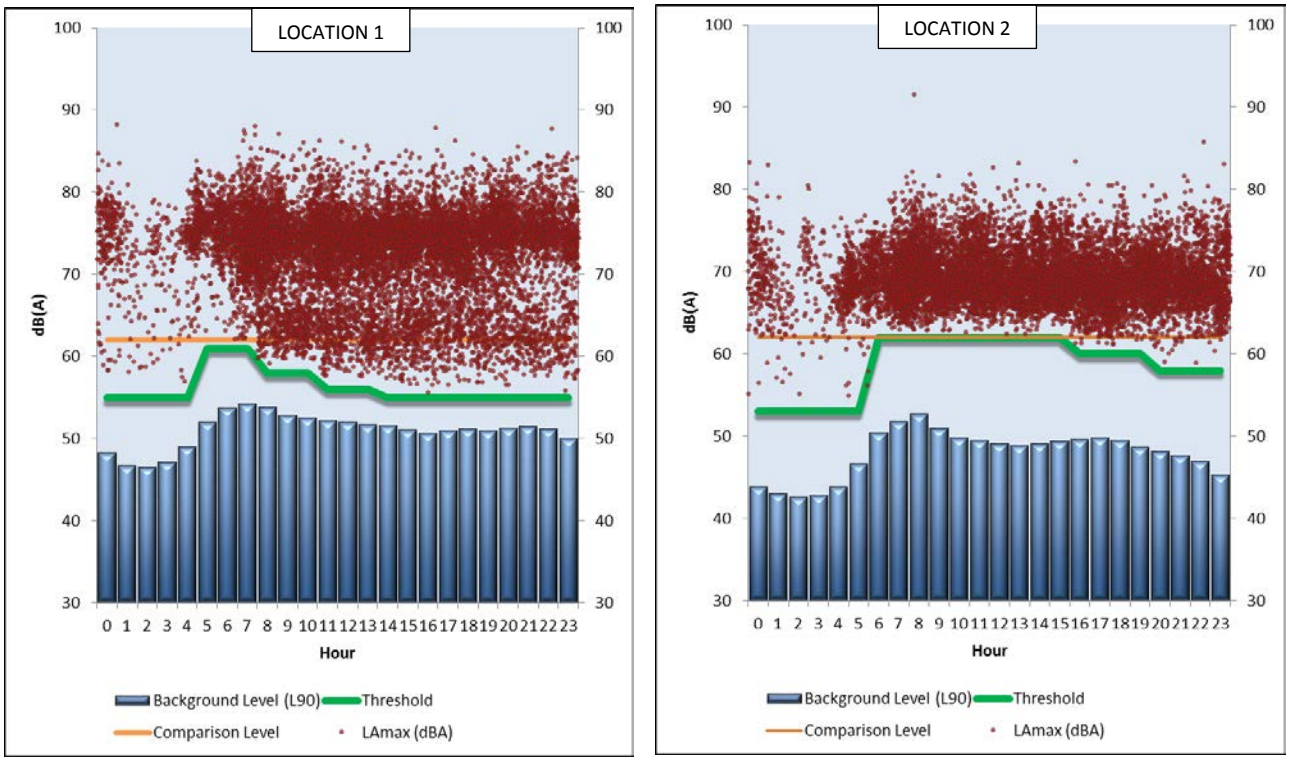

FIGURE 5: LOCATION 1 – EMU 351 NOISE SUMMARY AND SETTINGS (LEFT) AND LOCATION 2 – EMU 352 NOISE SUMMARY AND SETTINGS FOR 28/04/2016 12:00AM – 28/07/2016 12:00AM

Figure 6 below highlights the 2011 Census Population Grids which are within or overlap the 1km radius, shown in purple, for each EMU. The total population identified for each location is provided within Table 2.

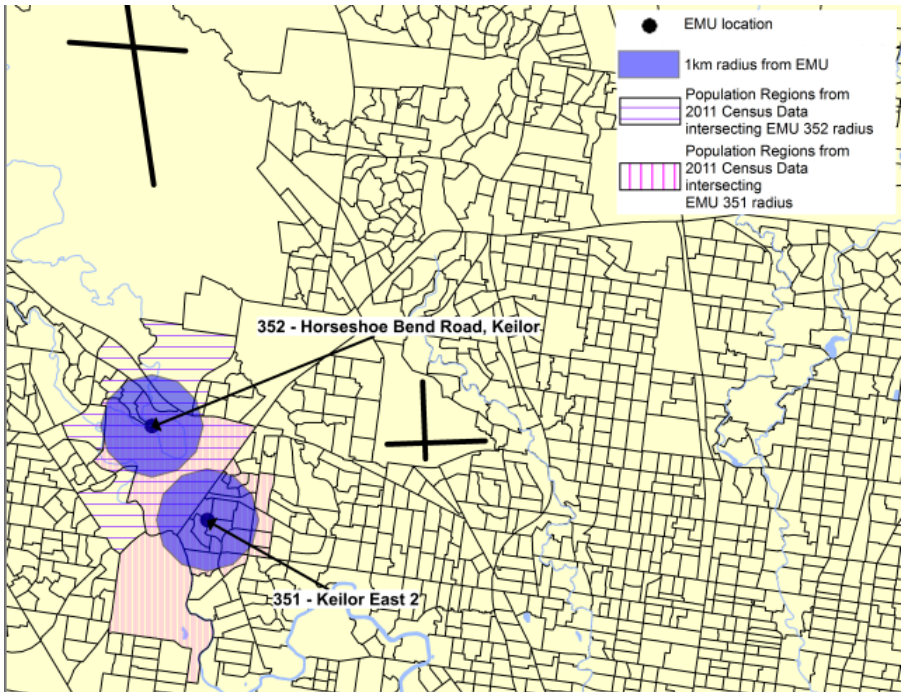

FIGURE 6: MAP SHOWING LOCATION OF EMU 351 AND EMU 352, WITH A 1KM ZONE FOR POPULATION IDENTIFICATION AND IDENTIFICATION OF 2011 CENSUS GRIDS INDENTIFIED FOR EACH EMU.

Key criteria which contributed to the final determination on the final potential permanent location is summarised below. Data which made either location particularly appropriate (shaded green) or inappropriate (shaded orange) in comparison to the other, is identified by a coloured cells.

TABLE 2: SUMMARY OF CRITERIA USED TO COMPARE LOCATION 1 AND 2

Specific criteria	Location 1: Keilor East	Location 2: Horseshoe Bend Road, Keilor
Operations are greater than 30^{o} at the point of LAmax	17% of all CNEs have a high degree of uncertainty due to the ground effects and are not compliant with ISO 20906.	81% of all CNEs associated with arrivals and 70% of all CNEs have a high degree of uncertainty due to the ground effects and are not compliant with ISO 20906.
Correlated Noise Events (CNEs)are an appropriate length (9-90secs)	36% of all CNEs were flagged due to a length less than 9 sec or greater than 90 sec. This is due to noise monitor settings which can be adjusted. Further details are provided within *Location 1: Keilor East Findings against Suitability Criteria.*	4% of CNEs on EMU 351 were flagged due to a length less than 9 sec or greater than 90 sec.
Secure from Vandalism and Wildlife	No issues to date	No issues to date
Reliable Mobile Data Coverage	No issues to date	No issues to date
Power Access	Yes	Yes
Reliable Radar Coverage to Runway	Yes – major airport	Yes – major airport
Aircraft noise representative of local experience and represents the extreme of noise levels experienced within the local area	As shown in Figure 2, EMU 351 is approximately 0.125km from the median arrival path and 0.475km from the median departure path. For the most common aircraft operating the B738, this sideline distance would result in a modelled decrease of 1dB for arrivals and no decrease for departures to the levels experienced by those directly underneath the path (based on AS 2021) – comparisons for the other most common aircraft type is shown in Table 3.	As shown in Figure 3, EMU 352 is approximately 0.678km from the median arrival path and 0.706km from the median departure path. For the most common aircraft operating the B738, this sideline distance would result in a modelled 12dB decrease for arrivals and 10dB decrease for departures to the levels experienced by those directly underneath the path (based on AS 2021) – comparisons for the other most common aircraft type is shown in Table 9.
Placement within a local community – determined by population within 1KM of EMU	As shown in Figure 4, populations within 1km of EMU 351 are identified based on 2011 census data. The entire population of a region has been counted where any segment of that region overlaps the 1KM zone. For Keilor East – a population of 7,817 were identified intersecting or within a 1km radius of the noise monitor.	As shown in Figure 4, populations within 1km of EMU 352 are identified based on 2011 census data. The entire population of a region has been counted where any segment of that region overlaps the 1KM zone. For Horseshoe Bend Road, Keilor – a population of 2,289 were identified intersecting or within a 1km radius of the noise monitor.
Capture all Major Aircraft Types operating	As shown in Table 5, 6 of the top 10 aircraft type operating have a high correlation rate.	As shown in Table 11, 7 of the top 10 aircraft type operating have a high correlation rate.

Further findings, including detail on the criteria summarised in Table 2, is outlined in the following sections for each location.

Location 1: Keilor East Findings against Suitability Criteria

Based on AS 2021:2015, for operations 6.5KM from the runway end the predicted reduction in noise level, compared to the highest aircraft noise levels that the local community is exposed to directly under an operation, due to the noise monitors location 125-475m from the median flightpath is considered below.

TABLE 3: REDUCTION IN NOISE LEVELS AS PREDICTED BY AS 2021: 2015, DUE TO SIDELINE LOCATION OF EMU 351

Aircraft Type	Reduction in noise level –125m sideline from median arrival path	Reduction in noise level – 475m sideline from median departure path
A320	0	4
B738	1	3

- 15,235 movements flew through the capture zone during the reporting period. 14,129 of these were Melbourne Airport operations.
- 80% of total operations that flew through the capture zone (as shown in Figure 1) were Runway 34 Arrival operations.
- A summary of the total number of Correlated Noise Events (CNE) by time of day, and the minimum to maximum number of CNE in a day, are summarised within Table 4.

TABLE 4: SUMMARY OF CORRELATED NOISE EVENTS BY TIME OF DAY AND MINIMUM TO MAXIMUM RANGE OF OCCURRENCES, FOR LOCATION 1

Correlated Noise Events (CNE) over the Reporting Period:	Day *(6:00am to 11:00pm)*	Night *(11:00 pm to 6:00 am)*	Number of Correlated Noise Events per day *(min to max)*
above 65 dB(A) *(N65)*	11,106	1,253	29 to 336
above 70 dB(A) *(N70)*	9,707	1,148	26 to 318
above 75 dB(A) *(N75)*	4,699	654	14 to 235

- The correlation summary for all movements, with a LAmax of 62dB(A) or greater, was 84.0%. This is the level expected considering the proximity of the noise monitor to Melbourne Airport.

TABLE 5: TOP 10 MOST CORRELATED AIRCRAFT OPERATIONS (SHADED GREEN) AND TOP 10 UNCORRELATED AIRCRAFT OPERATIONS (SHADED RED)

Aircraft Type	Airport	Operation Type	RWY	No. Correlated Noise Events	LAmax dB(A) Average	LAmax dB(A) Maximum	No. Uncorrelated Operations
Boeing 737-800 (J)	Melbourne	A	34	3699	73.1	85.5	728
Airbus A320 (J)	Melbourne	A	34	1771	72. 6	86.3	435
Airbus A330-200 (J)	Melbourne	A	34	1078	74.9	88.0	34
Airbus A330-300 (J)	Melbourne	A	34	861	75.9	85.4	9
Saab SF340 (T)	Melbourne	A	34	498	70.6	81.8	136
Boeing 737-800 (J)	Melbourne	D	16	478	72.1	77.6	9
Boeing 777-300ER(J)	Melbourne	A	34	470	78.0	83.5	2
Airbus A380-800 (J)	Melbourne	A	34	431	77.1	84.9	2
Airbus A321 (J)	Melbourne	A	34	407	73.3	83.1	84
Boeing 787-800 (J)	Melbourne	A	34	347	73.9	80.7	8
DHC Dash 8D (T)	Melbourne	A	34	320	70.6	78.6	135
Embraer ERJ-190/195 (J)	Melbourne	A	34	265	70.9	79.2	74
Beech 200&1300S (T)	Essendon	D	26	133	68.7	80.4	41
Boeing 717-200 (J)	Melbourne	A	34	123	70.3	87.8	82
Airbus A330-200 (J)	Melbourne	A	27	29	65.3	69.9	44
General Aviation	Essendon	D	26	21	66.0	73.0	37

Aircraft Category: Jet (J), Turboprop (T), Propeller (P), Helicopter (H), General Aviation (GA)
Operation Type: Arrival (A), Departure (D), Local Operation (T), Overflight (O)

A process of ranking noise events has been developed to assess against the two main criteria identified in ISO 20906:

- angle greater than 30^{o} to the aircraft, while this is specified as from the ground, calculations are based on angle from the EMU microphone.
- length of the noise event should be between 9 and 90 seconds. Events outside this time generally indicate community noise contributing to the event or that a review of the noise monitors settings may be required.

Each noise event was allocated a ranking from 0 to 2, where 0 meant that the noise event failed against both criteria and 2 meant that a noise event passed both criteria.

TABLE 6: RANKING PROCESS SCORES FOR CORRELATED NOISE EVENTS

Ranking	Total Operations	%
0	956	7%
1	5,176	38%
2	7,365	55%
Grand Total	**13,497**	

55% of all captured noise events are compliant against both criteria assessed, angle and event duration, as shown in Table 6.

TABLE 7: RANKING PROCESS SCORES FOR CORRELATED NOISE EVENTS

Effects upon Noise Events	Number of affected Events	% of affected Noise Events
Angle	1,287	10%
Angle and Duration	956	7%
Duration	3,889	29%
No Effects	7,365	55%
Grand Total	**13,497**	

As identified in Table 7 above, 36% of EMU 351 CNEs had a duration less than 9 seconds or greater than 90 seconds. This is due to a lower than average background level, at the time when the short-term noise monitor settings were set. Adjustment of the settings, based on a longer timeframe, will address this issue.

TABLE 8: ANGLE RELATIVE TO EMU351 AT POINT OF LAMAX – 30^{O} AND ABOVE (MINIMUM ANGLE FOR ISO 20906 COMPLIANCE)

Operation Type	Aircraft angle less than 30°		Aircraft angle 30° or greater	
Arrival	1,968	18%	9,155	82%
Departure	233	10%	2,031	90%
Overflight	7	47%	8	53%
Local Operation	35	37%	60	63%
All operation types	*2,243*	*17%*	*11,254*	*83%*

Location 2: Horseshoe Bend Road Findings against Suitability Criteria

Based on AS 2021:2015, for operations 4.75KM from the runway end the predicted reduction in noise level, compared to the highest aircraft noise levels that the local community is exposed to directly under an operation, due to the noise monitors location 690-720m from the median flightpath is considered below.

TABLE 9: REDUCTION IN NOISE LEVELS AS PREDICTED BY AS 2021: 2015, DUE TO SIDELINE LOCATION OF EMU 352

Aircraft Type	Reduction in noise level –690m sideline from median arrival path	Reduction in noise level –720m sideline from median departure path
A320	12	8
B738	12	10

- 14,883 movements flew through the capture zone during the reporting period. 14,121 of these were Melbourne Airport operations.
- 82% of total operations that flew through the capture zone (as shown in Figure 1) were Runway 34 Arrival operations.
- A summary of the total number of Correlated Noise Events (CNE) by time of day, and the minimum to maximum number of CNE in a day, are summarised within Table 8.

TABLE 10: SUMMARY OF CORRELATED NOISE EVENTS BY TIME OF DAY AND MINIMUM TO MAXIMUM RANGE OF OCCURRENCES, FOR LOCATION 2

Correlated Noise Events (CNE) over the Reporting Period:	Day *(6:00am to 11:00pm)*	Night *(11:00 pm to 6:00 am)*	Number of Correlated Noise Events per day *(min to max)*
above 65 dB(A) *(N65)*	10,679	1,181	18 to 315
above 70 dB(A) *(N70)*	4,166	499	9 to 223
above 75 dB(A) *(N75)*	640	93	0 to 50

- The correlation summary for all movements was 83.8%. This is the level expected considering the proximity of the noise monitor to Melbourne Airport.

TABLE 11: TOP 10 MOST CORRELATED AIRCRAFT OPERATIONS (SHADED GREEN) AND TOP 10 UNCORRELATED AIRCRAFT OPERATIONS (SHADED RED)

Aircraft Type	Airport	Operation Type	RWY	No. Correlated Noise Events	LAmax dB(A) Average	LAmax dB(A) Maximum	Uncorrelated Operations
Boeing 737-800 (J)	Melbourne	A	34	4176	68.6	82.2	62
Airbus A320 (J)	Melbourne	A	34	1686	67.0	78.5	436
Airbus A330-200 (J)	Melbourne	A	34	1025	71.0	81.8	8
Airbus A330-300 (J)	Melbourne	A	34	827	70.7	91.5	0
Boeing 737-800 (J)	Melbourne	D	16	485	73.0	78.8	1
Boeing 777-300ER(J)	Melbourne	A	34	460	71.2	80.4	0
Airbus A380-800 (J)	Melbourne	A	34	414	70.1	77.6	1
Airbus A321 (J)	Melbourne	A	34	409	67.9	78.3	59
Boeing 787-800 (J)	Melbourne	A	34	336	67.1	76.6	6
Embraer ERJ-190/195 (J)	Melbourne	A	34	317	68.6	75.6	23
Saab SF340 (T)	Melbourne	A	34	272	66.0	76.8	351
DHC Dash 8D (T)	Melbourne	A	34	95	65.5	73.5	355
Boeing 717-200 (J)	Melbourne	A	34	55	66.1	78.7	146
Beech 200&1300S (T)	Essendon	D	26	31	66.0	74.8	99
Saab SF340 (T)	Melbourne	D	16	11	64.8	66.7	72
Fairchild MerlinIV/C Metro23 (T)	Essendon	D	26	9	67.3	79.4	41
Airbus A330-200 (J)	Melbourne	A	27	0	-	-	71

Aircraft Category: Jet (J), Turboprop (T), Propeller (P), Helicopter (H), General Aviation (GA)
Operation Type: Arrival (A), Departure (D), Local Operation (T), Overflight (O)

A process of ranking noise events has been developed to assess against the two main criteria identified in ISO 20906:

- angle greater than 30^{o} to the aircraft, while this is specified as from the ground, calculations are based on angle from the EMU microphone.
- length of the noise event should be between 9 and 90 seconds. Events outside this time generally indicate community noise contributing to the event or that a review of the noise monitors settings may be required.

Each noise event was allocated a ranking from 0 to 2, where 0 meant that the noise event failed against both criteria and 2 meant that a noise event passed both criteria.

TABLE 12: RANKING PROCESS SCORES FOR CORRELATED NOISE EVENTS

Ranking	Total Operations	%
0	337	3%
1	8,570	68%
2	3,697	29%
Grand Total	**12,604**	

29% of all captured noise events are compliant against both criteria assessed – angle and event duration, as shown in Table 12.

TABLE 13: RANKING PROCESS SCORES FOR CORRELATED NOISE EVENTS

Effects upon Noise Events	Number of affected Events	% of affected Noise Events
Angle	8,437	67%
Angle and Duration	337	3%
Duration	133	1%
No Effects	3,697	29%
Grand Total	**12,604**	

As shown in Table 14 below, 81% of arrival operations at Location 2 (EMU 352) were at an angle less than 30^{o} to the EMU microphone at the point of LAmax. This means that for arrival operations, there is a high degree of uncertainty in the levels measured. The angle of an aircraft relative to the EMU indicates that the installation location is too sideline to the majority of aircraft operations within the local area.

TABLE 14: ANGLE RELATIVE TO EMU352 AT POINT OF LAMAX – 30^{O} AND ABOVE (MINIMUM ANGLE FOR ISO 20906 COMPLIANCE)

Operation Type	Aircraft angle less than 30 ^{o}		Aircraft angle 30 ^{o} or greater	
Arrival	8,705	81%	2,097	19%
Departure	58	3%	1,710	97%
Overflight	2	20%	8	80%
Local Operation	9	38%	15	63%
All operation types	*8,774*	*70%*	*3,830*	*30%*