Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 174

Program: n/a
Division/Agency: Airservices Australia
Topic: Flights over Blue Mountains
Proof Hansard Page: 7-8 (8 February 2016)

Senator Cameron, Doug asked:

Senator CAMERON: Could you also clarify or take on notice whether there has been an increase in flights over the Blue Mountains recently? Anecdotal evidence has come to me that flights have increased over the Blue Mountains. Could you give me, over the last two years, the number of flights going over the Blue Mountains and at what heights those flights are going over at?
Mr Mrdak: Certainly.
Senator CAMERON: I do not want every flight. I want some broad based parameters.
Mr Mrdak: Certainly. As you are aware, particularly on approaches from the south to Sydney, the Blue Mountains is overflown.
Senator CAMERON: And take off?
Mr Mrdak: Less so on take-off. There is some, but less so. There is an established arrival path over certain sections of the Blue Mountains. I will ascertain to give you the latest traffic figures as best we can.

Answer:

The Airservices Noise and Flight Path Monitoring System (NFPMS) monitors noise data for the Sydney region and also displays near real time information flight information through WebTrak to a range of approximately 50km from the airport.

The Blue Mountains are outside the NFPMS coverage area, however flights within the coverage area (in areas west of Penrith) which would be expected to overfly the Blue Mountains have been analysed. Two separate months during 2013, 2014 and 2015 have been used to take into consideration seasonal variations.

The number of flights captured in this data is shown in the table below.

Month	Flights
April 2013	2921
October 2013	3039
April 2014	2731
October 2014	3116
April 2015	2611
October 2015	3171

Aircraft over the Blue Mountains area are generally at altitudes between 12 000ft and 22 000ft above sea level.

Question no.: 175

Program: n/a
Division/Agency: Airservices Australia
Topic: WebTrak release date
Proof Hansard Page: 132 (8 February 2016)

Senator Sterle, Glenn asked:

Senator STERLE: As I said, good luck. Now I want to go to Airservices Australia, if I can, and I want to talk about WebTrak. Can you tell us, Mr Harfield, why WebTrak was introduced.
Mr Harfield: WebTrak was introduced as a way of allowing the community to monitor air traffic to see where there were potential noise from flight paths impacts around the community and at various airports.
Senator STERLE: When was that?
Mr Harfield: Off the top of my head, I think it was around the 2011 mark. We can confirm the exact date.
Senator STERLE: I remember doing an inquiry and it was way before 2011.
Mr Harfield: There was the noise inquiry. It was around that time, whenever that was. I am just trying to remember.
Senator STERLE: Sure. Take it on notice. I think you will probably find that it was earlier. Anyway, you can tell us.
Mr Harfield: It might have been 2010, but we will get the exact date.

Answer:

WebTrak was introduced by Airservices in December 2008. It is a web-based interactive service which allows the public to observe aircraft movements and noise information in near-real time at Australia's busiest airports. WebTrak operates to a range of approximately 50 kilometres from an airport.

Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 176

Program: n/a
Division/Agency: Airservices Australia
Topic: WebTrak identification of flights
Proof Hansard Page: 132 (8 February 2016)

Senator Sterle, Glenn asked:

Senator STERLE: Are aircraft turning their ID off—or have they done—such that they are not able to be identified by WebTrak?
Mr Harfield: I will have to take that on notice. Not to my knowledge.
Senator STERLE: Is there any other reason aircraft movements around the relevant airports would not be fully captured by WebTrak?
Mr Harfield: No. All of the air traffic that we monitor—to my understanding—should be fed into WebTrak. I will take it on notice to confirm it, but some police operations may be suppressed from WebTrak for security reasons.

Answer:

Please refer to 183 for information on WebTrak.

Question no.: 177

Program: n/a
Division/Agency: Airservices Australia
Topic: WebTrak monitor Kingsford Smith to Blue Mountains
Proof Hansard Page: 132 (8 February 2016)

Senator Cameron, Doug asked:

Senator CAMERON: Does that system monitor existing noise from Kingsford Smith over the Blue Mountains?
Mr Harfield: There would be a range of monitors that would be around or in close proximity to Kingsford Smith that would be monitored. I am unaware—we can take it on notice—whether there are any up in the Blue Mountains.

Answer:

Due to the distance from Sydney Airport, the Blue Mountains are outside the coverage area of the Noise and Flight Path Monitoring System and there are no noise monitors in place.

Noise monitors for Sydney Airport are located at: Runway 34L at Sydney Airport, Penshurst, Bexley, East Lakes, Coogee, Sydenham, Kurnell, Annandale, St Peters, Croydon, Hunters Hill and Leichhardt.

Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 178

Program: n/a
Division/Agency: Airservices Australia
Topic: Loss of Separation
Proof Hansard Page: 137 (8 February 2016)

Senator Xenophon, Nick asked:

Senator XENOPHON: Because of time constraints—I have got a very patient chair—could you explain, not now but on notice, why that is the case. You are aware that, under the Transport Safety Investigation Act, it is compulsory reporting—the loss of separation must be reported.
Mr Harfield: That is correct—and breakdowns of coordination are also compulsorily reported.
CHAIR: Senator Xenophon, can we go to putting some on notice?
Senator XENOPHON: I am doing my best. That is what I am doing.

Answer:

The incident on 12 November 2013 related to a Breakdown of Coordination where a documented procedure was not correctly followed. A review of the incident determined that there was no Loss of Separation between any aircraft during the event. Full details are described in Question on Notice 156 from Additional Estimates in February 2015.

The event on 26 January 2016 also involved a Breakdown of Coordination, however a review of the incident determined that there was a Loss of Separation because a prescribed standard was not met between a helicopter operating at Essendon and departures from Melbourne.

Both incidents were reported and reviewed in accordance with Airservices normal safety management processes which also include routine notification to both the Australian Transport Safety Bureau and the Civil Aviation Safety Authority.

The *Transport Safety Investigations Act* 2003 Regulations classifies both “Loss of Separation” and “Breakdown of Coordination” events as reportable matters.

Question no.: 179

Program: n/a
Division/Agency: Airservices Australia
Topic: Request for metadata
Proof Hansard Page: 137 (8 February 2016)

Senator Xenophon, Nick asked:

Senator XENOPHON: This is just a broad question—it is not a fishing question—but I want to ask: has Airservices made any requests for the metadata of air traffic controllers to be obtained?
Mr Harfield: Not to my knowledge. I will confirm that, but, to my knowledge, no.

Answer:

No.

Question no.: 180

Program: n/a
Division/Agency: Airservices Australia
Topic: Incident 14 December 2013
Proof Hansard Page: 138 (8 February 2016)

Senator Xenophon, Nick asked:

Senator XENOPHON: Can you provide me more information about the afternoon 14 December 2013 on a Qantas aircraft where a passenger said the pilot went on air on the PA afterwards and said: we needed to take that action so that we could avoid collecting—or language to that effect—a Virgin aircraft on the tarmac.
Mr Harfield: I will look into it.

Answer:

Airservices has reviewed occurrences for the month of December 2013 and did not identify an event relating to a 'go-around' on 14 December 2013 involving a Qantas aircraft.

Question no.: 181

Program: n/a
Division/Agency: Airservices Australia
Topic: Melbourne incident
Proof Hansard Page: 138 (8 February 2016)

Senator Xenophon, Nick asked:

Senator XENOPHON: Another go-around occurred on Jetstar flight JQ 710 on 22 December 2015. If you could let us know what occurred there. Can you provide us with any documents between CASA and Air Services and any other relevant documents because those operations have been suspended.
Mr Harfield: We will do that but there is also another document we will have to table.

Answer:

a. The crew of JQ710 initiated a 'go-around' from their approach to Runway 16 at Melbourne on 22 December 2015. An aircraft was departing on the crossing runway (Runway 27) and JST710 had been advised to expect a late landing clearance due to the crossing traffic.

b. All documentation related to Land and Hold Short (LAHSO) night operations suspension between Airservices and CASA is summarised below and is attached. Information has been redacted from Attachments 1-22 to remove personal information or information not relevant to the issue.

	Date	Topic
1	10 July 2015	Email to CASA outlining immediate actions taken after the July double go-around.
2	22 July 2015	Quarterly meeting between CASA and Airservices. Discussion on the immediate actions after the July 2015 double go-around and other ongoing actions (as part of the quarterly meeting with CASA Part 172 auditors and Manager CNS/ATM).
3	28 July 2015	Email to CASA providing evidence of suspending ADC training while LAHSO is in progress.
4	28 July 2015	CASA letter to Airservices regarding LAHSO related concerns, and requesting an action plan to address the concerns.
5	7 Aug 2015	Airservices provided an action plan (from Targeted Melbourne LAHSO Safety Assurance Review and short-term actions after the July 2015 double go-around).
6	18 Aug 2015	Provision to CASA of risk modelling report.
7	18 Aug 2015	Provision of options paper to CASA which addresses implementation of a stagger, as well as other opportunities to further mitigate LAHSO safety risks.
8	19 Sept 2015	Minutes of the August 2015 LAHSO Steering Committee Meeting provided to CASA.
9	8 Oct 2015	Bi-monthly update to CASA on improvement LAHSO actions underway (commitment as per letter 7/8/2016).
10	13 Oct 2015	FAA LAHSO reference material provided to CASA.
11	13 Oct 2015	Letter to CASA outlining status of actions taken in the last 12 months. Addendum to 2012 Safety Assessment Report (SAR).
12	16 Oct 2015	Email to CASA advising Aeronautical Information Publication (AIP) update re LAHSO.
13	2 Nov 2015	Letter advising CASA's intention to issue a Direction to suspend LAHSO at night at Melbourne until certain conditions met.
14	6 Nov 2015	Letter from Executive General Manager Air Traffic Control to CASA confirming that Airservices will suspend LAHSO at night at Melbourne and Adelaide. Airservices also advised CASA of additional safety actions being undertaken and that bi-monthly updates would be provided to CASA.

	Date	Topic
15	9 Nov 2015	CASA letter to Airservices requesting clarification on the timeframe to suspend LAHSO at night.
16	9 Nov2015	Airservices provided CASA a copy of the local instruction issued to Air Traffic Control implementing the suspension effective 10 November 2015.
17	9 Nov 2015	Airservices wrote to CASA with formal confirmation of the suspension of LAHSO at night.
18	10 Nov 2015	CASA wrote to Airservices advising of a determination not to issue Airservices with proposed Direction.
19	9 Dec 2015	Bi-monthly update on improvement actions provided to CASA.
20	5 Feb 2016	Bi-monthly update on improvement actions provided to CASA.
21	12 Feb 2016	Update provided to CASA on the development and delivery of night time compromised separation training for Melbourne Tower.
22	12 Feb 2016	CASA provided with presentation summary of Manual of Air Traffic Standards (MATS) and AIP changes relevant to LAHSO.

Attachment 1

10 July 2015	Email to CASA outlining immediate actions taken after the July double go-around

From: [redacted]
Sent: Friday, 10 July 2015 10:06 AM
To: [redacted]
Cc: 'atcsurveillance@casa.gov.au' <atcsurveillance@casa.gov.au>; [redacted]>; CASA Compliance <CASACompliance@AirservicesAustralia.com>
Subject: Update for CASA - LAHSO double go around occurrence [SEC=UNCLASSIFIED]

Morning [redacted]

As we keep playing telephone tag I thought I'd drop you an email and we can follow up with a discussion.

In relation to the double go around during LAHSO on Sunday, Airservices continues to apply its SMS in its review of the occurrence and determination of appropriate actions.

We have taken the following immediate actions in relation to the occurrence while additional risk work is underway:

- Suspend ADC training during LAHSO (the controller during the occurrence was in training)
- Only aircraft operationally requiring runway 34 will be permitted to use it
- Tighter tactical management of departures from runway 34 during LAHSO
- SE&A has commenced a full investigation into the occurrence

In addition, risk modelling commenced in May as part of the actions from the LAHSO review indicates that the operational risk associated with departures on runway 34 during LAHSO requires further mitigation. Over the next few weeks we intend to:

- Introduce procedures to give greater risk mitigation when using runway 34 for departures
- Complete the updated SAR, including associated risk modelling and analysis (an action from the LAHSO review) and
- Determine what, if any, additional risk mitigators should be introduced to ensure the risk is ALARP

I received your message to expect a data request for a replay of the occurrence – no problem.

Let me know if you'd like further information at this stage. We can organise a more detailed briefing from ATC as required.

[redacted]

Attachment 2

22 July 2015	Quarterly meeting between CASA and Airservices. Discussion on the immediate actions after the July 2015 double go-around and other ongoing actions (as part of the quarterly meeting with CASA Part 172 auditors and Manager CNS/ATM)

airservices

Quarterly CASA / Airservices Working Level Meeting – Air Traffic Services			
Airservices Projects and Initiatives Update			
Date: **Time:**	22 July 2015 1000am to 12.00pm	**Location:**	Airservices Alan Woods Building Canberra • Conf Video CB (AWB) Lt Col Horace Brinsmead Small • Conf Video ML (Bldg 212) Small • BN (CTC) Torres Small
Participants:	[redacted]		

Summary of Meeting Discussions

[redacted]

*. Redactions on the basis the information is not LAHSO related and therefore not pertinent to the question.

~~LAHSO~~

Airservices briefed CASA on the recent work undertaken to manage the risk associated with a double go-around event. In summary:

- ADC training remains suspended until assurance available that there were no contributory factors, or if so, they are addressed.
- Runway 34 departures are only available if required and 09/34 LAHSO has been suspended.
- Airservices main focus is on:
    - Reducing missed approach rates in general
    - Reducing the likelihood aircraft coming into unsafe proximity should they both go around
- ~~Ongoing actions:~~
    - An options paper on managing both those areas is being finalised.
    - Work is underway to improve go around rates.
- A risk workshop was held on 15 July 15 with approximately 20 participants (including active controllers).

CASA advised that they were yet to determine a formal response to the issue and were appreciative of Airservices updates to-date. In addition, CASA were very positive about Airservices handling of the CIRRIS occurrence report (including re-submissions and updates) including engagement with CASA and ATSB.

CASA advised that they were in favour of a stagger/dependency solution and were seeking information to gain assurance and to assist with their formal response.

Action 4: *Provide CASA with any briefings/emails to controllers regarding procedure changes associated with LAHSO as described above (not TLIs).*

Action 5: *Airservices to provide CASA with the 'SAR addendum' to acquit the commitment to the annual review of CROPS/DROPS. In addition, a technical brief on the LAHSO modelling results will be provided.*

Action 6: *Airservices to provide CASA with the options paper on dependent operations/stagger.*

[redacted]

[redacted]

[redacted]

[redacted]

Attachment 3

28 July 2015	Email to CASA providing evidence of suspending ADC training while LAHSO is in progress

From: [redacted]
Sent: Tuesday, 28 July 2015 4:13 PM
To: [redacted]
Cc: CASA Compliance <CASACompliance@AirservicesAustralia.com>
Subject: Data request - LAHSO briefings [SEC=UNCLASSIFIED]

Hi [redacted]

As promised at the recent quarterly meeting re any non-TLI 'briefings' to controllers on changes to LAHSO procedures:

- Please see attached email suspending ADC training which covers the gap through to the 14 Jul when the TLI was issued.

- Please see attached a copy of the 'sight and sign' folder. There are some instructions (blue highlight) provided to controllers regarding training and limiting off mode departures prior to the TLI being released on the 14 Jul.

Please let me know if you have any questions.

Kind regards

[redacted]

[redacted]
Safety and Regulatory Compliance Advisor
Operational Assurance and Regulatory Services

-----Original Message-----
From: [redacted]
Sent: Thursday, 9 July 2015 2:51 PM
To: [redacted]
Cc: [redacted]
Subject: Suspension of OJT during LAHSO

[redacted],

As we just discussed. Whilst Safety work is underway to assess the LAHSO incident of last week, please suspend all ADC training whist LAHSO is in progress. This is only a short-term measure until we complete the safety work associated with any changes to LAHSO operations.

The situation will be reviewed and you will be updated on 13th July 2015.

Regards

[redacted]
A/Manager ECSS

ML IWR Handover sheet 8/07/2015 3:23:05

Attachment 3:
Provided by email on 28.7.15
re: Instructions to controllers [redacted]

Effective Date	
[redacted]	
	General
Current	Report all cases of RXA aircraft going missing from screen on Echo west of 16/34. NO ADC TRAINING, DURING LAHSO AFTER DARK.

[redacted]

ML TWR Handover sheet 9/07/2015 3:09:03

Effective Date	
[redacted]	
Current	No ADC training during LAHSO operations ~~after last light or prior to first light~~ UFN.
[redacted]	

ML TWR Handover sheet 10/07/2015 3:03:00

Effective Date	
[redacted]	
Current	No ADC training during LAHSO operations UFN. (will be reviewed on 13th July)
Current	Limit off mode runway 34 departures during 27/34 LAHSO to operational requirements only.

[redacted]

Effective Date	
[redacted]	
Current	No ADC training during LAHSO operations UFN. (will be reviewed on 13th July)
Current	Limit off mode runway 34 departures during 27/34 LAHSO to operational requirements only.

[redacted]

Attachment 4

28 July 2015	CASA letter to Airservices regarding LAHSO related concerns, and requesting an action plan to address the concerns

Australian Government

Civil Aviation Safety Authority

AIRSPACE AND AERODROME REGULATION
CASA file: F11/10239

28 July 2015

Dr Rob Weaver
Executive General Manager
Safety, Environment & Assurance
Airservices Australia
GPO Box 367
Canberra ACT 2601Address

Dear Dr ~~Weaver~~, Rob

Land and Hold Short Operations (LAHSO) at Melbourne airport

In light of the current and forecast traffic levels at Melbourne airport, CASA is concerned about the ability of Airservices to consistently provide a safe and effective Air Traffic Service (ATS) in relation to LAHSO operations.

In addition to the most recent LAHSO incident (5 Jul 2015 – Cirris Occurrence Report ATS-0137977 – double go-around after dark), of concern to CASA is the number of LAHSO related safety reports submitted by ATC at Melbourne, including:

- 16 Jan 2015 – Cirris Occurrence Reports ATS-0134445 and ATS-0134447;
- 29 Jun 2014 - Cirris Occurrence Report ATS-0130118 (recorded as non-LAHSO);
- 11 Mar 2014 - Cirris Occurrence Report ATS-0127744;
- 15 Jan 2014 - Cirris Occurrence Report ATS-0126521 (recorded as non-LAHSO);
- 7 Dec 2013 - Cirris Occurrence Report ATS-0125662;
- 27 Oct 2011 – ESIR 4269 ECS South 2011.

Following the LAHSO occurrence on 28 October 2011, CASA wrote to Airservices (File: EF11/12039) requesting an explanation of the mitigations in place to ensure the safety of aircraft participating in LAHSO at night and asking why this procedure should not be suspended at night (attachment 1).

CASA again wrote to Airservices on 4 Nov 2011 (File: EF11/12039) stating that Airservices needed to consider the design of an appropriate ATM system that provides systemic safety for aircraft operations with intersecting runways. We provided you with guidance information about current practices in North America (attachment 2).

In 2013, CASA provided Airservices with a LAHSO discussion paper (File: EF11/12039) that contained, amongst other items, an independent quantitative analysis using fast time modelling (TAAM). This safety analysis indicated that LAHSO at Melbourne was near the upper level of the ALARP band. CASA recommended that Airservices develop an action plan to implement the capability to provide a stagger through the runway intersection or flight paths during LAHSO operations (attachment 3).

The Airservices Executive General Manager Safety & Assurance wrote to CASA on 1 March 2013, stating that "Airservices supports the concept of a stagger and will explore options to implement a stagger within our current tools and systems" (attachment 4).

The safety incidents at Melbourne airport on 16th January 2015 and 5th July 2015 involving double go-arounds (missed approaches) have reinforced CASA's concerns. These events highlight that despite CASA communicating concerns about Melbourne LAHSO operations to Airservices since 2011, by mid-2015 Airservices had not introduced any LAHSO stagger methodology for Melbourne airport nor communicated to CASA any related action plan intended to review the safety of LAHSO operations at Melbourne airport.

CASA therefore requires Airservices to provide, as a matter of urgency, an action plan with near term deliverables that address the concerns raised.

Yours sincerely,

Peter Cromarty
Executive Manager

Enclosed: Attachments 1, 2, 3 & 4

7 August 2015	Airservices provided an action plan (from Targeted Melbourne LAHSO Safety Assurance Review and short-term actions after the July 2015 double go-around)

airservices

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GPO Box 367, Canberra, ACT 2601

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ABN 59 698 720 886

Mr Peter Cromarty
Executive Manager
Airspace and Aerodrome Regulation
Civil Aviation Safety Authority
GPO Box 2005
Canberra ACT 2601

Dear Peter

RE: Land and Hold Short Operations (LAHSO) at Melbourne Airport

I refer to your letter dated 28 July 2015 regarding CASA's concerns in relation to the safety of LAHSO at Melbourne.

Airservices has maintained a strong safety focus on LAHSO over the last 12 months and has a number of actions underway to strengthen existing safety risk controls and provide assurance that the risk of ongoing LAHSO operations is tolerable and being managed to ALARP.

In March 2015 Airservices completed a review of Melbourne LAHSO safety assurance, which examined the application of our Safety Management System (SMS) to assure the ongoing safety of LAHSO. The review resulted in a number of improvement actions including a review of rule sets to ensure consistent application of LAHSO, additional safety risk modelling and an update to the 2012 Safety Assessment Report. All actions from the review have been substantially progressed.

Airservices continues to explore options to ensure air traffic segregation during high-capacity crossing runway operations in Australia, including dependent operations, taking into consideration the lessons learned from the implementation of Dependent Runway Operations (DROPS) in Brisbane in 2014. An options paper is well advanced and we will organise to brief CASA on this paper in the near future.

Airservices has also recently advised CASA of a number of short term safety actions taken after a double go-around occurrence during LAHSO on 5 July 2015, including suspension of aerodrome controller training during LAHSO and tightening the tactical management of the use of Runway 34. These temporary risk mitigators were introduced while longer term safety improvements are considered in accordance with our SMS. Airservices is investigating this occurrence to identify potential system improvements and the ATSB has also advised that it will undertake an investigation.

An action plan including the status of all actions underway is at Attachment 1. Airservices will provide CASA with a bi-monthly progress report, together with more detailed briefing on any proposed changes as appropriate.

I would like to assure you that Airservices continues to closely monitor the ongoing safety of LAHSO and will maintain this oversight via its established monitoring and review processes, including the annual safety review of LAHSO.

If you would like additional detail on any of the actions underway or would like to further discuss your concerns please let me know.

Yours sincerely

Rob Weaver
Executive General Manager
Safety, Environment and Assurance

7 August 2015

Attachment 1 – Summary of actions

Action	Deliverable	Current Status	CIRRIS	Planned Completion
Conduct a review of the definitions and terminology contained in national standards, rule set and procedures to ensure consistency and application intent.	Implemented changes to rule sets / procedures	The review is substantially complete and a number of amendments to MATS have already been implemented.	ACT-0006907	31/08/15
Conduct a review of LAHSO procedures and practices at Melbourne and Adelaide to ensure the application is consistent with the intent of the CASA Manual of Standards (MOS) Part 172, the Aeronautical Information Package (AIP) and the Manual of Air Traffic Services (MATS).	Implemented changes to rule sets / procedures.	The outcome from the double go-around occurrence on 5 July 2015 is currently being reviewed by ATS Integrity to ensure all relevant rule-set items have been addressed.	ACT-0006909	31/08/15
Reassessment of the data modelling completed for the 2013 Melbourne Go-Around Study. Incorporate data modelling as an addendum to 2012 LAHSO Safety Assessment Report (SAR)	Risk modelling report	The report is complete and the modelling will be incorporated into the SAR addendum.	ACT-0006925	Complete
Risk assessment of all LAHSO procedures and practices at Melbourne using additional top-down and bottom up techniques as described in AA-GUIDE-SAF-0105C to ensure the identification and assessment of all potential failure modes associated with all operational airspace and runway mode configurations. Incorporate assessment as an addendum to 2012 LAHSO SAR and update ORAs as appropriate	Addendum to the 2012 CROPS/LAHSO SAR report. Updated Melbourne Tower and TCU ORA	The risk assessment of LAHSO procedures (including supporting evidence) has been completed and is currently under review/consultation. The action is on track for completion within the specified timeframe.	ACT-0006924	31/08/15
Conduct a review of the training and support for personnel with National Request for Change (NRFC) safety management roles and responsibilities to ensure safety change is managed in accordance with Safety Change Management Requirements.	NRFC Safety Management Roles Training and Support Review (Version 4)	Complete. The following further actions address the findings: – Development of the safety competency framework to include competency requirements for safety specialists and managers approving	ACT-0006910	Complete

Action	Deliverable	Current Status	CIRRIS	Planned Completion
		operational change. (ACT-0007754). – Procedure changes to clarify the relationship between the role of the 'Safety Coordinator' and 'Lead Safety Specialist' (ACT-0007773 and ACT-0007774).		
Implement a scheduled programme of operational surveillance activities of sufficient scope and periodicity to provide assurance that the application of procedures and practices remain consistent with national standards and the rule set.	Program of operational surveillance activities.	CATC is developing the approach to operational surveillance activities through the implementation of an assurance model and a decision/categorisation matrix to ensure that compliance monitoring activities used for LAHSO are scalable and applied to all operations. The action is on track for completion within the specified time frame.	ACT-0006911	03/09/15
Conduct a study to determine whether alternative means of air traffic segregation (such as dependent runway operations) could be safely applied in Melbourne without material reductions to capacity.	Options study paper.	Draft options paper is well-advanced and is expected to be complete before the due date.	ACT-0006912	30/09/15
Suspension of aerodrome controller training during LAHSO	Local instructions*	Implemented		Complete
Only aircraft operationally requiring the use of runway 34 for departures are permitted to use it during LAHSO. Ad hoc requests will not be accommodated.	Local instructions*	Implemented		Complete
09/34 LAHSO mode has been suspended (because all departures in this mode are from runway 34)	Local instructions*	Implemented		Complete
Airservices safety investigation into 5 July 2015 double go around	Investigation report	Findings have been agreed, and actions to address the findings are under development.	ATS-0137977	31/08/15
Undertake an annual safety review of LAHSO	Annual review report	Next review due November 2015 (ACT-0006630)	ACT-0006466	Ongoing annual action

* Short term mitigators while longer safety actions are considered

Attachment 6

18 August 2015	Provision of risk modelling report to CASA

Likelihood of Melbourne LAHSO go-arounds

airservices

Operational Analysis
Safety, Environment and Assurance
Airservices

Version 3.5

Effective 2015-08-04

Major Change summary

Version	Date	Change Description
0.1	2015-06-01	Initial document written [redacted]
1.0	2015-06-04	Additional analysis and review [redacted]
2.0	2015-06-15	Additional comments in response to ATC [redacted] feedback and reviews by [redacted]
3.0	2015-07-03	Further editing after Feedback from subject matter experts and management.
3.2	2015-07-16	Additional analysis by [redacted] of correlated go-around likelihood included which increases likelihood; Additional [redacted] series of go-around rate showing increase. Additional results based on a 60s definition of DGA.
3.5	2015-08-03	Edits by [redacted] to include SME and management feedback

	Staff	Hours	Signature
Requested by	ATC group	-	
Prepared by	[redacted] Operational Analysis,	51 hours	
Analysis	[redacted] Operational Analysis, SE & A	240 hours	[redacted]
Analysis	[redacted], Operational Analysis, S & A	42 hours	[redacted]
Authorised v3.5	[redacted], Operational Analysis, S & A	5 hours	[redacted]
Authorised v3.5	[redacted] Operational Analysis, S & A	5 hours	[redacted]
Authorised v3.5	[redacted] Operational Analysis, S & A	2 hours	[redacted]
Authorised v3.5	[redacted] Operational Analysis, S & A	2 hours	[redacted]

Contents

1 Executive Summary

Operational Analysis (OA) was tasked by Air Traffic Control (ATC) Group with reviewing aircraft arriving at Melbourne International Airport ('Melbourne') which performed a go-around manoeuvre, as well as determining the go-around rates, and analysing the likelihood of a double go-around during Land and Hold Short Operations (LAHSO). The analysis included data from January 1st 2012 to February 28th 2015.

A double go-around (DGA) event is defined as two go-arounds occurring on intersecting runways where the aircraft cross the runway intersection point within 60 seconds of each other (denoted DGA_{60}). There were two DGA_{60} events recorded in the data and this definition is useful in defining recordable occurrences. Additional analysis is also done for arrivals within a 20-second window (denoted DGA_{20}) as this better reflects a risk-bearing event. No DGA_{20} was recorded in the three years of data.

The likelihood methodology has been improved upon in two key aspects compared with previous work. This has been enabled through high fidelity data provided by ODAS (Operational Data Analysis Suite), and more sophisticated time series analysis methods.

1.1 Main Results

The likelihood of two go-arounds on crossing runways within 20 seconds of each other (DGA_{20}) is of order 1-10 years. Based on a 60 second definition, DGA_{60}, this is of order 4 months – 3 years.

The base go-around rate has increased over a three year period from 2 per 1000 to 4.4 per 1000. Two significant periods exists where the rate was 8 per 1000 arrivals.

A significant factor in the likelihood assessment was that the go-around rate is up to 16 times higher (or potentially higher due to limited data and uncertainty) in the minute after a previous go-around.

The analysis of meteorological conditions showed that restrictions on LAHSO operations for meteorological conditions do effectively decrease the likelihood of a go-around. The analysis showed that during LAHSO restricted meteorological conditions there was no significant change in likelihood with wind speed.

It was also found that the go-around rate during LAHSO was dependent on high arrival rate but not dependent on wind speed, visibility or cloud base. However, there are likely to be other influencing factors (that were not included in the scope of this analysis), including but not limited to airline standard operating procedures, aircraft specific speed, configuration and descent profiles which could be considered in additional or future work.

The analysis identified, within the study period, that there were 2,932 pairs of aircraft (7.6% of LAHSO pairs) that would cross the runway intersection within 20 seconds of each other, if both aircraft did go-arounds.

1.2 Conclusion

The likelihood of a 20 second double go-around (DGA_{20}) is approximately 1 in every 1-10 years which aligns with Airservices likelihood criteria between possible and unlikely (risk between 1-5 years (possible) and 5- 50 years (unlikely) (AA-NOS-RISK-0001). There is evidence that current weather restrictions do help minimise the likelihood of go-arounds.

1.3 Background

An earlier report in 2012 on LAHSO assumed go-around rates were independent. This current 2015 report investigates this assumption.

The key areas of this report included the following analyses:

1. The time between successive arrivals on crossing runways during LAHSO operations.
2. Whether go-around rates increase with meteorological conditions (wind vector, cloud base, visibility).
3. Whether go-around rates increase with arrival rate.
4. Whether the go-around rate is larger if there has already been a recent go-around (correlated events).
5. The likelihood of a double go-around, using the results from points 1-4.

1.4 Additional Results

Both CIRRIS occurrence data and ODAS hi-fidelity track data were used to verify and capture each go-around in the sample period. Over three years of data was analysed with 85,755 LAHSO arrivals, 38,574 LAHSO crossing pairs and 213 go-arounds during LAHSO. The mean go-around rate is 2.5 per 1000 arrivals during LAHSO and 3.2 for all operations. There was an average of 5.7 hours of LAHSO per day.

Go-around rates were tested against a range of possible causal factors including wind, cloud base, visibility and time since an earlier go-around.

*Figure **1*** shows the change in go-around rate with time (as a 31 day moving average). The mean rate over four persistent baseline time periods has increased from 2.0 in 2012-2013 to 2.7 in 2014 and 4.4 in 2015.

A key component of the analysis was the likelihood of a second go-around soon after an earlier go-around. It is shown that this value increases from 2.5 per 1000 arrivals up to 40 [10-90] go-arounds per 1000 arrivals immediately after a go-around. This is likely because some causal factors will persist for a few minutes and affect more than one arrival. *Figure **2*** demonstrates that this effect with go-around rate as a function of time after an earlier go-around. This analysis would include causal factors such as runway occupancy.

*Figure **3*** shows the estimate of the mean time between go-arounds, based on the uncertainty in the data provided within *Figure **2***. This shows the mean time could be within 1 and 10 years. While the peak estimate is approximately 7 years the actual value could be as low as every 1 year, given the uncertainty in several key parameters in the assessment.

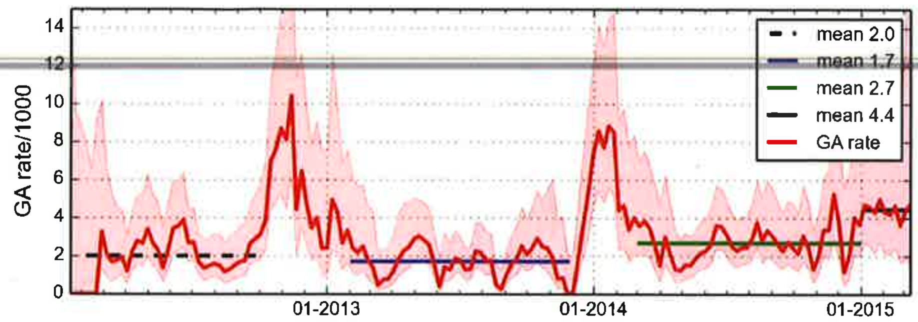

Figure 1: LAHSO go-around rate per 1000 arrivals as a function of time. Mean go-around rate has increased with time from a base of 2 to 4.4 per 1000 arrivals. Two obvious spikes in rates are shown. The red shaded region is the range in estimate of the rate.

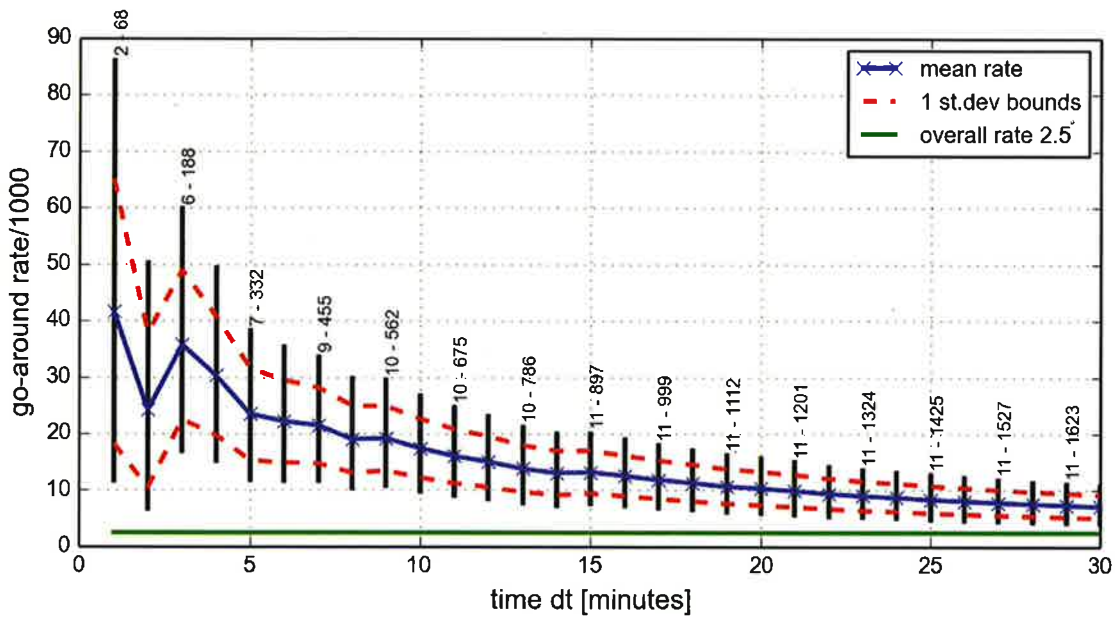

Figure 2: <u>During LAHSO</u> the likelihood (rate) of go-arounds increases in the time period just after an earlier go-around. This value is estimated to be 40 per 1000 arrivals in the minute immediately following a go-around, although this value could be as high as ninety. The black lines indicate uncertainty in this rate due to the small amount of data available. The x-axis is time after the earlier go-around. For example of the 213 go-arounds there were 68 arrivals within 1 minute of a go-around; of these subsequent arrivals 2 also performed a go-around. This is annotated in the figure by 2-68.

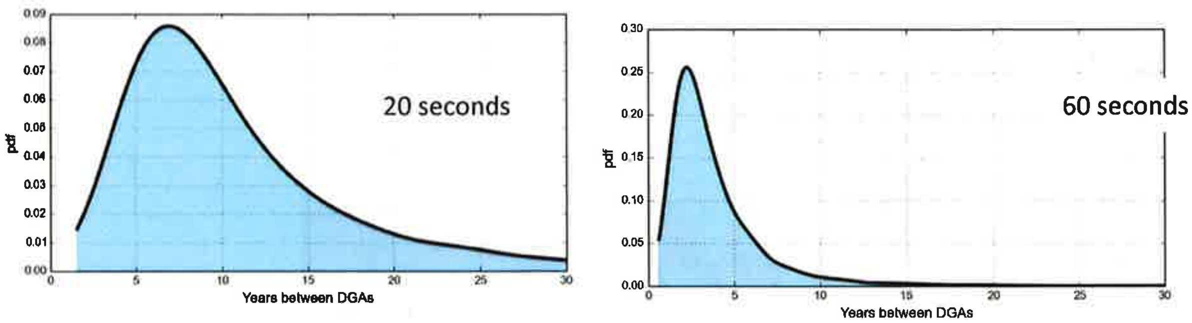

Figure 3: During LAHSO estimation of the mean time between double go-arounds. The left plot uses a 20 second time interval definition (DGA20) while the right plot shows a 60 second time interval definition (DGA60). The peak estimate is ~ 7 years (DGA20) or ~2 years (DGA60) while the actual value could be lower, given the uncertainty in several key parameters in the assessment.

Results show that during LAHSO there is no significant change in rate for winds (since LAHSO operates under restricted wind conditions) but there is a dependence on high arrival rates.

2 Background

In May 2015, Airservices Air Traffic Control (ATC) Group in Melbourne requested an analysis of the current go-around rates at Melbourne International Airport (ICAO code: YMML) with respect to the likelihood of double go-arounds during Land and Hold Short Operations (LAHSO) operations. Future analysis may include other airports where appropriate.

Two definitions are used for a double go-around:

1. DGA20 is two go-arounds within 20 seconds of each other; this is a high risk-bearing occurrence, but one that does not appear in the available data set.
2. DGA60 is two go-arounds within 60 seconds of each other; this occurred three times in the available data and is a good definition for occurrence tracking and alerting purposes.

Figure 4 shows a map of Melbourne International Airport and its runway configurations.

LAHSO are an air traffic control procedure that allow aircraft to landing and 'hold short' (stop) before an intersecting runway or point on the landing runway (see Figure 5 for reference). The LAHSO procedure is an internationally recognised and an Australian Civil Aviation Safety Authority (CASA) approved method to balance airport capacity and air traffic system efficiency with safety considerations.

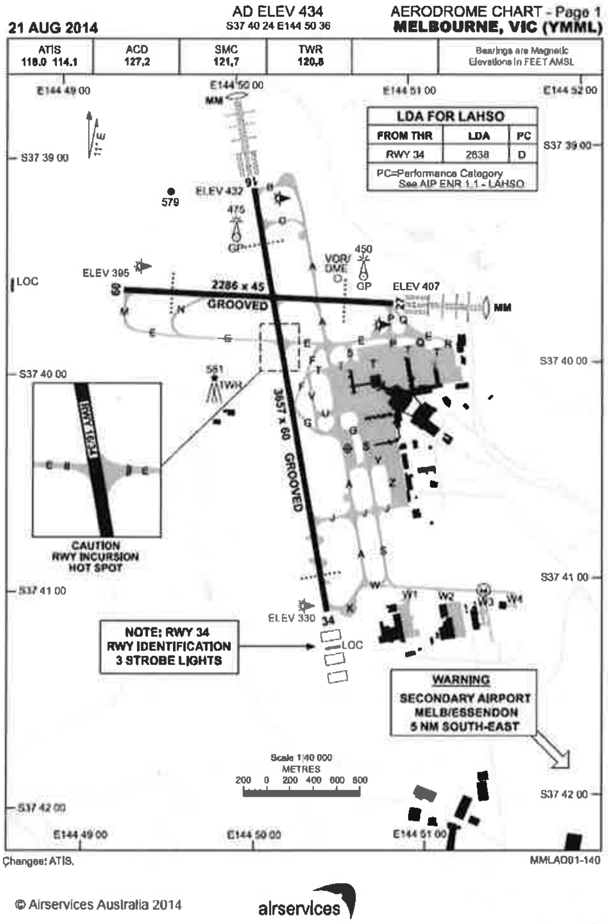

Figure 4: Melbourne International Airport aerodrome chart (source: DAP: Departure and Approach Procedures). The main southerly runway (runway 16) runs from the top of the page down (at a heading of 160 degrees), while the northerly runway (runway 34) runs from the bottom of the page up (at a heading of 340 degrees). Runway 09 runs left to right (west to east) and runway 27 runs right to left (east to west).

12.2.1.3 Crosswind/downwind limitations

Do not nominate a runway for use when:

Runway conditions	Wind
Completely dry	Crosswind exceeds 20 kt including gusts
	Downwind exceeds 5 kt including gusts
Not completely dry	Crosswind exceeds 20 kt including gusts
	There is a downwind component

12.2.1.3.1 Wind in excess of criteria - Refer IMA V32_01

Except during LAHSO, you may nominate a runway when crosswind or downwind exceeds the specifications of Clause 12.2.1.3 if:

a) required by noise abatement legislation;

b) an alternative runway does not exist; or

c) a take-off or landing, as applicable, is not possible on an alternative runway.

See MATS 12.2.1.3 Crosswind/downwind limitations

Figure 5: Example of LAHSO conditions extracted from Manual of Air Traffic Services, MATS 12.2.1.3.

CIRRIS is Airservices occurrence database; the CIRRIS occurrence definition states that: "a go-around has occurred when the final approach to land of an aircraft is terminated and the aircraft conducts a go-around procedure". It also notes that a go-around is not reportable "when an aircraft initiates a published missed approach procedure because visual flight could not be established by the minima".

LAHSO enable Melbourne airport to operate two independent arrival flows during certain meteorological conditions (see MATS 12.2.1.3 - Figure 5). However, if aircraft using both runways simultaneously perform a go-around, there is a risk of collision. Therefore it is essential to establish the likelihood of double go-arounds occurring at Melbourne International Airport, especially during LAHSO.

A CIRRIS safety report recommended the following:
"The targeted review of LAHSO report effective (30 Mar 15) determined the data modelling completed to determine the likelihood of a double go-around did not incorporate the runway 34/09 LAHSO mode or environmental conditions including crosswind and downwind and as a result has, at Action Item 4, the following:

4. Complete a reassessment of the data modelling completed for the Melbourne Go-Around Study (Safety & Assurance Group - June 2013). The assessment should incorporate further analysis, including environmental conditions (crosswind/downwind components) and available data from 2012 to 2014 for all LAHSO runway modes. The assessment is to be incorporated as an addendum to the Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) All Phases Safety Assessment Report (SAF-SAR-12009). In addition, the Melbourne Tower and TCU Operational Risk Assessments (ORA) are to be updated as necessary."

A previous study in 2012 on LAHSO operations followed the same procedure as in this report but made one significantly different assumption. In that analysis go-arounds were considered independent. Additional data fidelity available to the analysis team as part of the Operational Data Analysis Suite (ODAS) initiative has allowed an estimate of the go-around rate being correlated and not independent: that is, we can now test whether a causal factor for one go-around may persist to increase the go-around rate for subsequent arrivals in the next time period. ODAS began development within Airservices in 2012 to allow capture, storage, merging and analysis of high-fidelity aircraft movement data.

3 Aims

The aims of this analysis were to:

- identify Melbourne arriving flights which performed a go-around approach
- estimate the likelihood of a double go around during LAHSO operations by first analysing:
    - arrival rates at each runway
    - LAHSO operating times
    - go-around rates during and outside of LAHSO
    - whether the go-around rate at a given time is independent of whether a go-around recently occurred (That is, are go-around rates independent? Due to data limitations this independence would be tested for on either the same runway or different runways.)
    - whether the go-around rate is dependent on meteorological conditions
    - whether the go-around rate is dependent on arrival rate
    - the time intervals between arrivals at one runway and arrivals at a crossing runway.

4 Scope

The analysis in this report was based on data from January 1st 2012 to February 28th 2015, (1,154 days) including:

- flight track information sourced from Airservices surveillance data (ADS-B, radar and ADS-C) and Flight Data Records (FDR), obtained from Airservices Operational Data Analysis Suite (ODAS)
- Airservices CIRRIS go-around records (875 identified go-arounds)
- Melbourne runway definitions sourced from Aeronautical Data Management System (ADMS) aeronautical data
- Runway usage and LAHSO times sourced from Automatic Terminal Information Service (ATIS) data.

This study did not consider in detail the causal factors for go-arounds, apart from some simple testing of obvious meteorological factors such as visibility and winds. It is beyond the scope of this current analysis to consider other factors such as runway occupancy, aircraft approach speed or angle, pilot actions, aircraft malfunctions or birds.

The table below summarises some of the key data values analysed in this report. There were totally 6,592 hours when LAHSO was in operation from January 1st 2012 to February 28th 2015, or approximately 5.7 hours per day or 173 hours per month.

This report does not consider collision risk but does report on the number of go-arounds on crossing runways within 20 seconds or 1 minute of each other. Further work could be done to estimate a formal collision risk during LAHSO at Melbourne International Airport.

Further work will be done to include data since February 28th 2015 and to include some additional investigations into causal factors.

Table 1: Study data summary with typical values. The results section provides more detail and context to this data.

	Arrivals	Arrivals per day	Go-arounds	Mean Go-around rate, Per 1000 approaches
All	350 622	304	1114	3.2
RWY 16	175 259	152	441	2.5
RWY 27	85 234	74	198	2.3
RWY 34	88 909	77	457	5.1
RWY 09	1 220	1	18	14.8
RWY 27 LAHSO	54 747	47	83	1.5
RWY 34 LAHSO	30 564	26	125	4.1
RWY 09 LAHSO	191	0	3	15.7
Total LAHSO	85 502	74	213	2.5
LAHSO crossing pairs	38 574	34	-	-

Total data sample range	January 1st 2012 to February 28th 2015
Number of days in sample	1 154
Number of hours LAHSO	6 592
Average LAHSO hours per day	5.7
Average LAHSO hours per month	173

The appendix gives a breakdown of CIRRIS go-around data to inform ATC of some of causal factors. Further modelling would be required to assess the likelihood of go-arounds for each of causal factors and incorporate these in the model.

5 Methods

This section describes the methodology used in this analysis and the data and results that support this methodology. Some detail is left to the appendix. *Figure 6* demonstrates the logical flow of the analysis methodology, with the ultimate aim of the analysis to determine the likelihood of a double go-around at Melbourne International Airport during LAHSO.

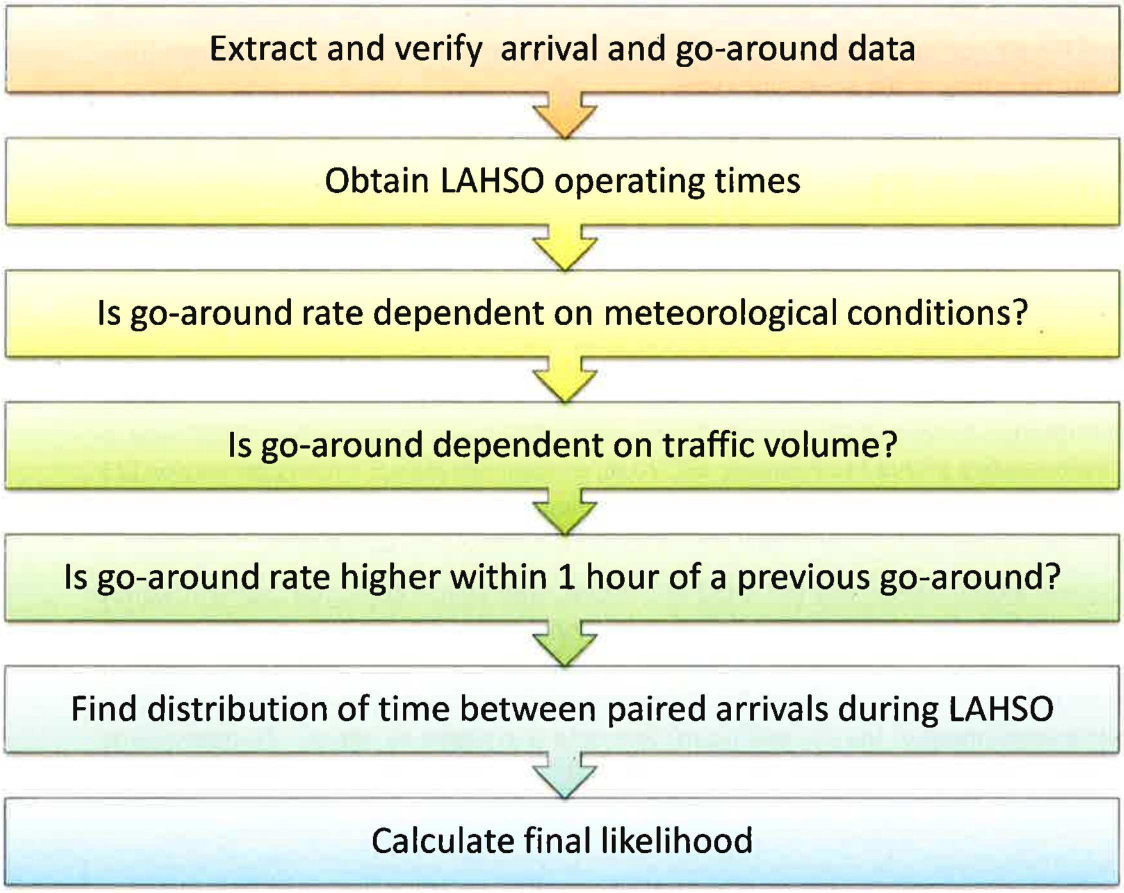

Figure 6: Logical flow of data and analysis used in this report. The final likelihood of a double go-around during LAHSO is dependent on the likelihood of a go-around on the second runway if there is a go-around on the first runway.

5.1 Data validation

This section gives an overview of data validation methods. Details are given in Appendix 9.1.

Go-arounds at Melbourne International Airport were compared between CIRRIS records and ODAS surveillance data.

ODAS identified 1,114 flights as potential go-arounds, where about 239 events were actually classified as missed approaches (rather than go-arounds) and were therefore excluded from this analysis.

During the time period analysed, 875 go-arounds were recorded for YMML with 759 having sufficient information to attempt a match to ODAS data. Of these, 739 flights had confirmed ODAS surveillance go-arounds. Thus approximately 13% could not be accurately matched to an ODAS record due to inaccurate or missing information in CIRRIS to identify the corresponding flight.

It was expected that there would be a discrepancy between the two data sources, with both having their limitations. The 87% correlation between the two data sources was considered to be sufficient to create a data set suitable for this analysis. The appendix gives further details of particular flights and differences between the data sets: CIRRIS data may not have sufficient information to identify a flight; ODAS data requires code to test vast volumes of flight track data to find flights with go-around characteristics and in some cases precise flight data is missing or inaccurate.

Of key importance in some of the calculations used in this analysis was the identification of the exact time of the go-around. In this case, the ODAS data was used, as this provided accurate ADS-B or radar data recording of the go-around time.

The main result of this section was that Airservices has sufficient data with enough statistical integrity to inform this analysis.

5.2 Time when LAHSO in operation

This section briefly explores the times when LAHSO was in operation, although this factor does not directly impact the double go-around likelihood assessment.

The time when LAHSO was in operation at Melbourne Airport was extracted from Automatic Terminal Information Service (ATIS) records. There were 6,592 hours in total when LAHSO was in operation from January 1st 2012 to February 28th 2015, or approximately 5.7 hours per day or 173 hours per month. *Figure 7* illustrates the cumulative hours for a month when LAHSO was in operation for each runway. Runway 09 was almost never used in LAHSO operations.

The results show a clear seasonality to LAHSO operations, with peaks during the southern winter period. *Figure 7* shows that LAHSO was mostly operated on Runway 27 and Runway 34 during the analysis period. Therefore the runways of interest for this LAHSO double go-around analysis at Melbourne Airport were runways 27 and 34. Note that restricting the analysis to these runways is a conservative assessment of the risk and insufficient data is available to inform risk assessments for runway 09.

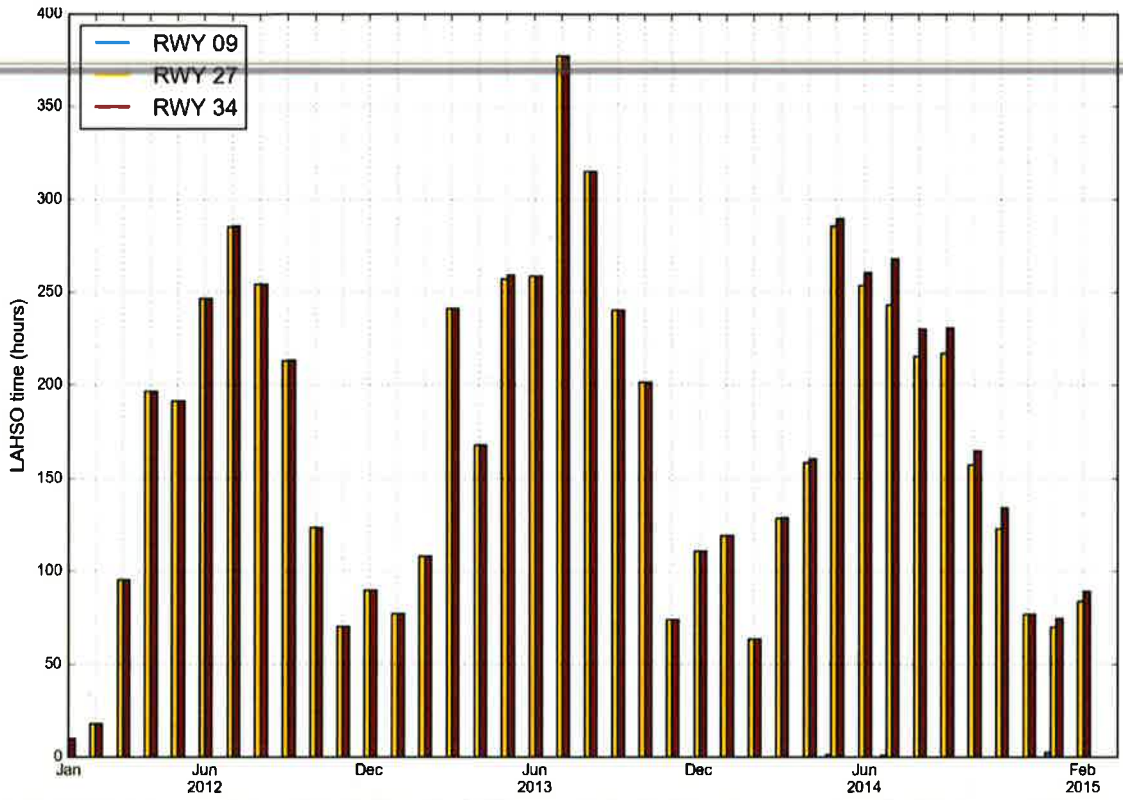

Figure 7. LAHSO operation time recorded in ATIS from 1st January 2012 to 28th February 2015.

The main result from this section was that LAHSO times of operation were highly seasonal, however we have not explored this dependence in this study, which focusses on wind, cloud base, visibility, and high arrival rates as causal factors.

5.3 Is the go-around rate increasing?

This section considers whether any evidence exists for a change in the go-around rate over time.

Figure 8 shows the number of arrivals during LAHSO, the number of go-arounds and the go-around rate as a moving average of 31 days. Data points are calculated every 7 days. The same seasonality for LAHSO arrivals is shown as in the previous figure. The actual go-around has no trend, varying between 0 and 14 for each 31 day period. The go-around rate per 1000 arrivals shows two distinct peaks of abnormal high rates.

The go-around rate was examined for four distinct regions in the data as shown in *Figure **9***. This graph shows the means as being 2.0, 1.7, 2.7 and 4.4 (per 1000) in each region. The first two means of 2.0 and 1.7 are equivalent and not statistically different. The last two regions with means 2.7 and 4.4 are statistically different. The statistical test is explained in Section 9.8.

Thus, if the two obvious spikes in rate are excluded, the go-around rate has increased over time from a base of 2 per 1000 arrivals to one over 4 per 1000 arrivals. The two spikes in rate to 8 go-arounds per 1000 is significant.

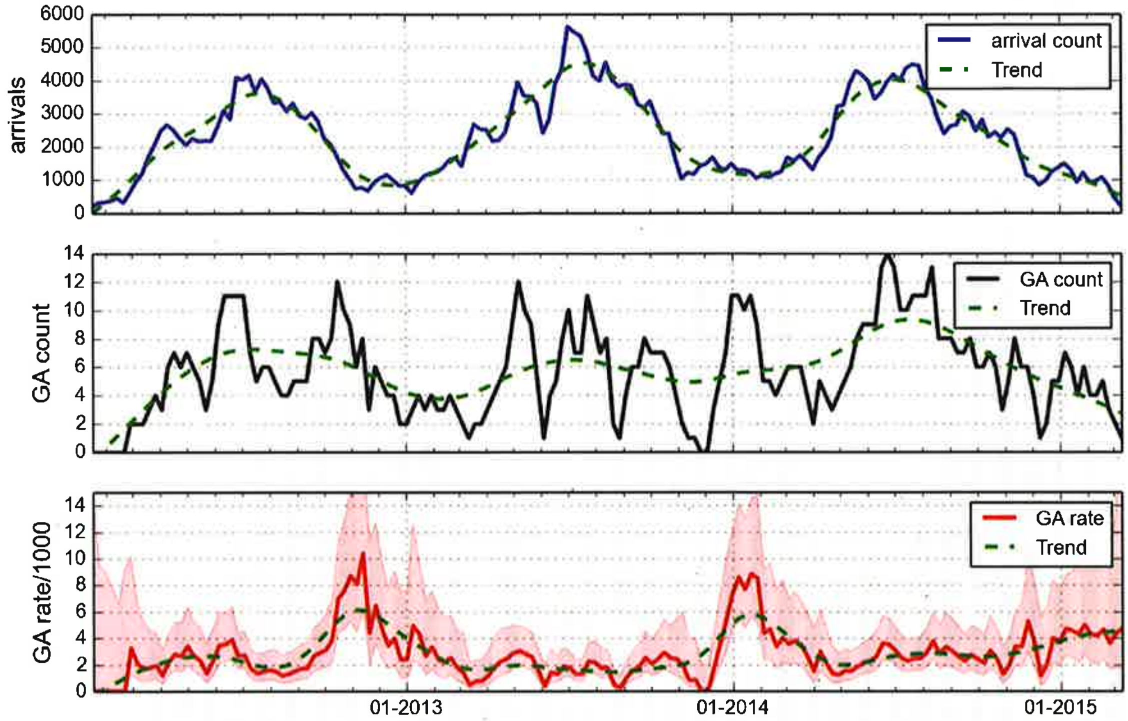

Figure 8: During LAHSO: Arrivals, go-arounds and go-around rate as a function of time. Each plot is calculated using a rolling average of 31 days, with data estimated every 7 days. The top plot is the number of arrivals in each 31 day period. The middle plot shows the number of go-arounds and the bottom plot shows the go-around rate. The shaded region indicates the 95% confidence intervals for the go-around rate. Green trend lines are also shown.

This section shows that the base go-around rate per 1000 arrivals has statistically increased from 2 to2.7 in 2014 and 4.4 in 2015. Two obvious and statistically significant spikes of 8 go-arounds per 1000 arrivals have occurred.

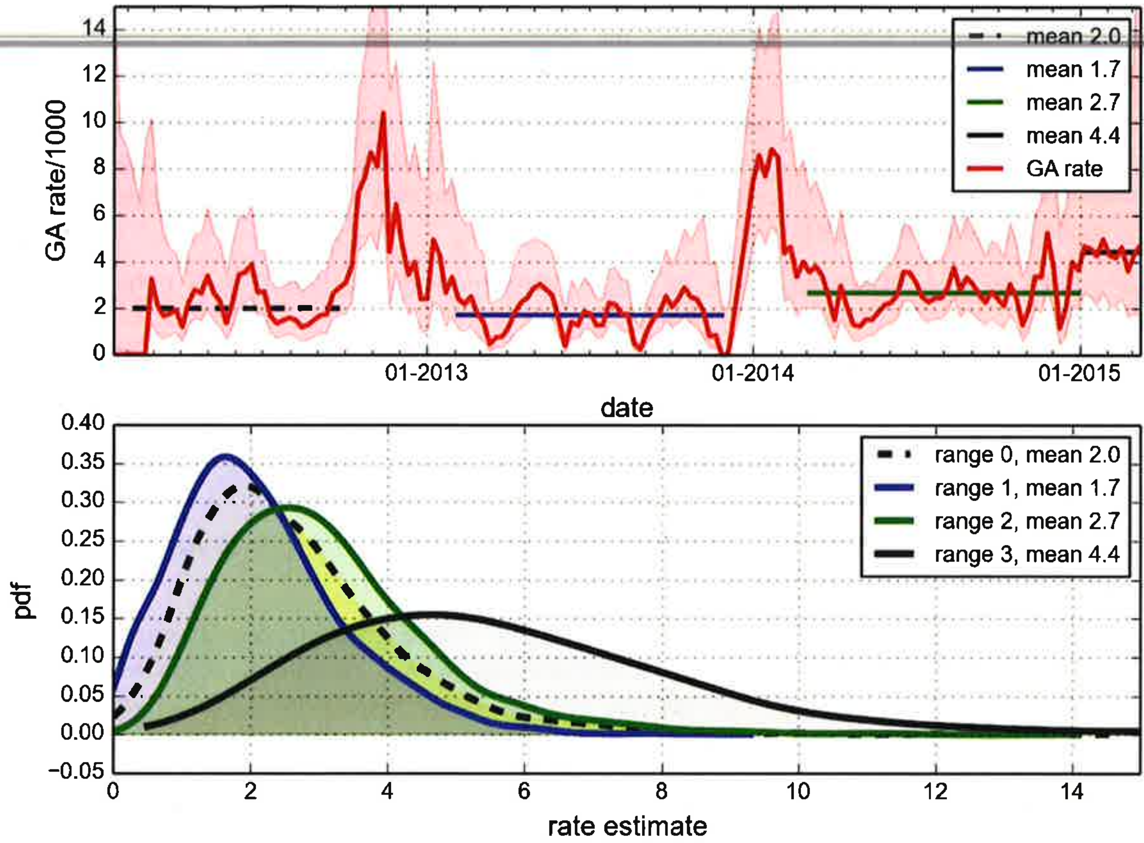

Figure 9: Top graph: Go-around rate versus date with the mean values for the sample period shown. The shaded red region indicates the uncertainty in the rate estimate. The bottom graph indicates the distribution for the rate in each region. The regions with mean 2.0 and 1.7 are statistically the same. The green region with mean 2.7 and black region with mean 4.4 are statistically different.

5.4 Is the go-around rate dependent on wind?

This section explores whether the go-around rate changes with meteorological factors. The study was restricted to LAHSO conditions only, noting that LAHSO is designed to not be implemented in extreme weather. Hence we expect no real dependence of the go-around rate on meteorological factors during LAHSO.

5.4.1 Meteorological information from ATIS

Meteorological information was obtained from Automatic Terminal Information Service (ATIS) records. Cross wind and downwind information were calculated for each runway. In this report, **down-wind was positive when it was in the direction of aircraft flying, negative** when it was in the **opposite** direction (a head wind). **Cross-wind** was **positive** when

- for Runway 27, wind from the north,
- for Runway 34, wind from the east.

ATIS data has limitations regarding the value of wind speeds, with a recorded wind speed not being correctly identified as either maximum or average. This gives an unknown error in the speed values used and this should be considered in the interpretation of results.

In order to review the meteorological conditions on each flight's initial arrival at Melbourne airport, a time was chosen when flights entered the approach detection zones at their first attempted arrivals.

Detailed spreadsheets were created for all flights arriving at Melbourne Airport between January 1st 2012 and February 28th 2015, with information on wind speeds and direction, visual distance and cloud base at their initial arrivals located at the following link (for staff with access privileges and can be made available on request):

\\Filecbr\arm\AAA NEW ARM\Projects\2015 Q1\Active\ODAS request ATC LAHSO\data output\YMMLarrivals

In the appendix, scatter plots were used to display meteorological conditions at a flight's initial arrival approach for go-arounds and non-go-arounds. This helps to build illustrations of the impact of meteorological conditions on go-around occurrences.

Given the available data:

1. for most results, there is no statistically different go-around rate as a function of visibility, cloud base or down-wind conditions.
2. there are some small regions (small ranges of data) where combinations of cross-wind/downwind and cross-wind/visibility conditions align with a statistically significant increase in go-around rate. This may indicate possible causal factors for increased go-around rates suitable for further analysis.

5.4.2 Go-around rate with cross-wind

This section explores whether the go-around rate varies with the level of cross-wind. This is explored for both LAHSO conditions and in general. As LAHSO is not used when high cross winds exist, we expect to find no dependence on go-arounds with wind during LAHSO. However, we do expect to see some dependence of go-around rate on high winds when LAHSO is not used.

The analysis considers winds in the range 10-20 knots since the LAHSO operations has an upper limit of 20 knots. This same lower limit is then used for all operations, for consistency, recognising that during non-LAHSO winds may be much higher than 20 knots.

Figure 10 shows the estimation of the go-around rate during LAHSO in general and when cross-winds larger than 10 knots exist. The rate does increase from 2.5 to 2.9 per 1,000 approaches but is only significant to 75%. That is, the difference between 2.9 and 2.5 is not statistically significant with the usual 95% significance test.

Figure 11 shows the same results as *Figure **10***, but for all operations during the analysis period. Here there is an increase in go-around rate with cross-winds above 10 knots from 3.0 to 4.0 per 1,000 approaches. This is to be expected. Further work can test how this rate changes with different speeds.

These figures also indicate that the current rules for restriction of LAHSO operations due to wind conditions are successful in reducing the risk of go-arounds.

There was insufficient data to examine results per runway.

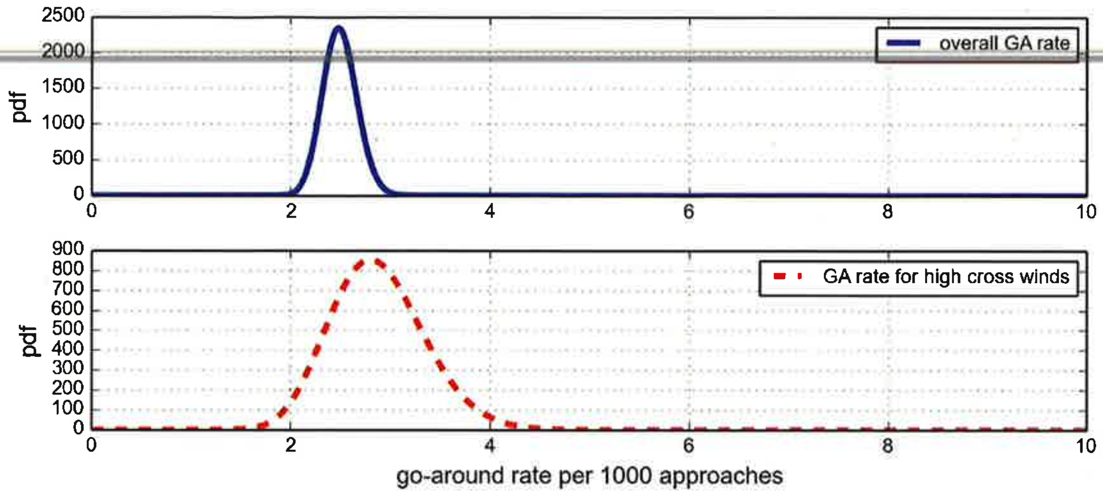

Figure 10: The top plot shows the estimation of the go-around rate during LAHSO operations (2.5 per 1000). The red bottom plot [10-20 knots] shows the estimation of the go-around rate when the cross wind was in the range 10-20 knots. The rate may be marginally higher but was not statistically significant. The y-axis is the probability density function for the parameter estimate. That is, given finite data our estimate of a rate has a level of uncertainty. These plots show the certainty of the rate. For the top data we believe the go-around rate is 2.5 but the spread of the graph indicates how certain we are of this result. For the lower, red, graph we are less certain of the value.

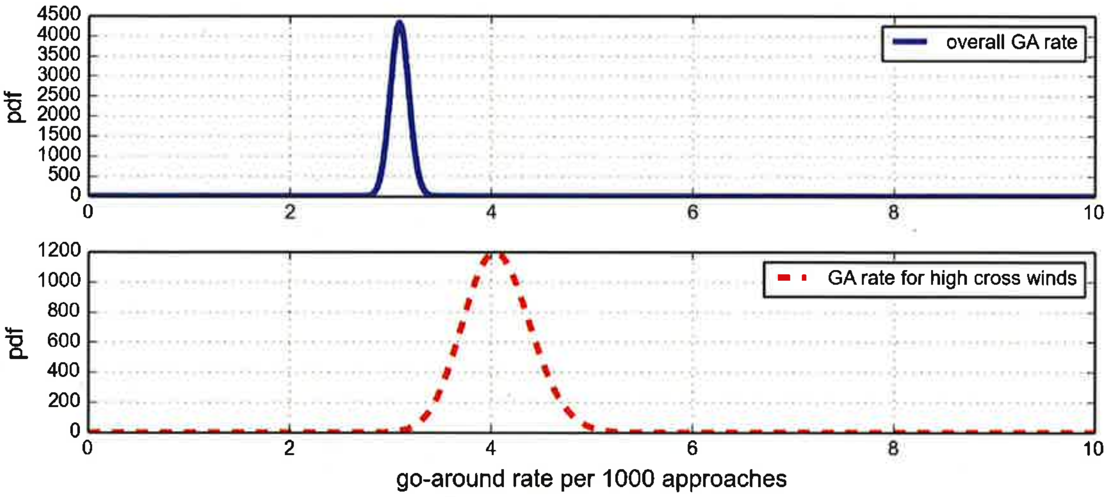

Figure 11: The top plot shows the estimation of the go-around rate NOT just during LAHSO operations (3.2 per 1000). The red bottom plot [>10 knots] shows the estimation of the go-around rate (4.0) when the cross wind was stronger than 10 knots. The rate increase was statistically significant. The y-axis is the probability density function for the parameter estimate. That is, given finite data our estimate of a rate has a level of uncertainty. These plots show the certainty of the rate. For the top data we believe the go-around rate is 3.2 but the spread of the graph indicates how certain we are of this result. For the lower, red, graph we are less certain of the value of 4.0.

This section showed that during LAHSO at Melbourne Airport in the analysis period, there was no significant increase in go-around rate with cross-wind conditions (10 – 20 knots), whereas outside LAHSO, the go-around rate was higher, with higher cross winds (> 10 knots). It can therefore be shown that restrictions on LAHSO operations during high cross-winds do effectively decrease go-around risk.

5.4.3 Go-around rate with down-wind

This section explores whether the go-around rate varied with the level of down-wind. This was explored for both LAHSO conditions and in general. As LAHSO is not used when high down-winds exist, we expect to find no dependence on go-around with down-wind during LAHSO. However, we do expect to see some dependence of go-around rate on high winds when LAHSO is not used.

Figure 12 shows the effect of a large down-wind component (>8 knots within our data sample) on go-around rate during LAHSO operations. There is a marginal increase in go-around rate from 2.5 to 2.8 which is only significant to 83%. Hence during LAHSO down-wind was not a critical factor. Note that, as explained earlier, the data used from ATIS for wind speed may not be representative of the actual speed used by ATC at the time of defining LAHSO operations: hence the value of 8 knots appearing in the data and may in fact represent actual operations of LAHSO near the 5 knot downwind limit.

*Figure **13*** shows go-around rates for all times (not just LAHSO). Here there was a statistically significant increase in go-around rate from 3.2 to 3.5 per 1000 approaches. Further investigation would most likely show an increase in this rate for higher down-winds.

There was insufficient data to examine results per runway.

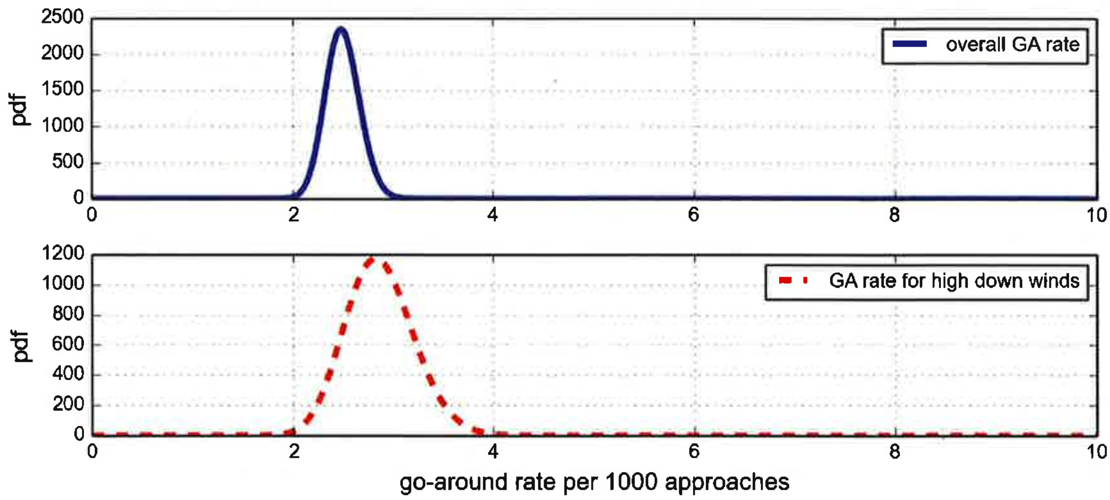

Figure 12: Go around rate during LAHSO overall and with high down-winds (>8 knots). There was no significant difference in the go-around rate. That is, given finite data our estimate of a rate has a level of uncertainty. These plots show the certainty of the rate. For the top data we believe the go-around rate is 2.5 but the spread of the graph indicates how certain we are of this result. For the lower, red, graph we are less certain of the value of 2.8 and indeed the true value may be the same as the top result.

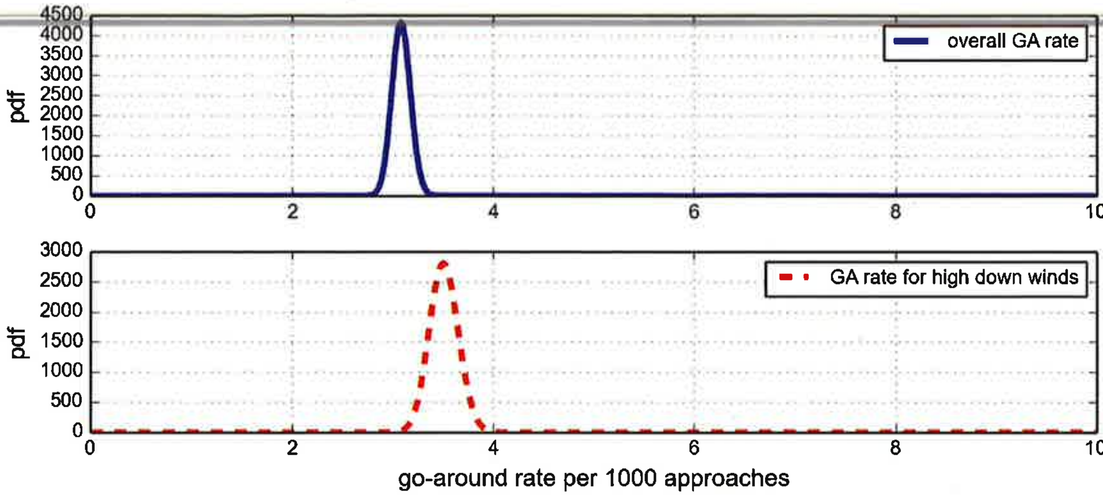

Figure 13: Go-around rate overall and with high down-winds (>8 knots). Results are NOT just during LAHSO operations. Here there is a significant increase in go-around rate from 3.2 to 3.5 per 1000. That is, given finite data our estimate of a rate has a level of uncertainty. These plots show the certainty of the rate. For the top data we believe the go-around rate is 3.2 and the spread of the graph indicates how certain we are of this result. For the lower, red, graph the estimated value of 3.5 is indeed significantly different from 3.2 in the top graph.

This section showed that, during LAHSO at Melbourne Airport during the analysis period, there was no significant increase in go-around rate with **down**-wind, whereas without LAHSO restrictions, the go-around rate was higher with higher **down**-winds.

As noted earlier, the use of 8 knots may represent statistical error in the data and not a breach of LAHSO operation rules – this result simply indicates a need to continually monitor and assess operations with large downwind speeds and correctly affirms the current LAHSO restriction of 5 knots down-wind.

5.4.4 Go-around rate with combinations of wind, visibility and cloud base

This section briefly explores whether there was any dependence of the go-around rate during LAHSO operations at Melbourne Airport during the analysis period, on combinations of wind vector, visibility and cloud base. More results are given in the appendices.

*Figure **14*** shows normal approaches (blue crosses) and go-arounds (red squares) for a combination of cross- and down-wind values during LAHSO. Only one small data region, highlighted in pink, shows any significant increase in go-around rate, however the limited data in this data region may indicate this is a false-positive (that is, the result may not be significant but since we are statistically testing a large number of different data regions we would statistically expect some to give a positive result due to random variation without any underlying cause).

*Figure **15*** shows normal approaches (blue crosses) and go-arounds (red squares) for a combination of cross- and visibility values during LAHSO. Only one small data region, highlighted in pink, shows any significant increase in go-around rate, however as visibility here is good, and not expected to increase go-around rate, this is probably a false-positive.

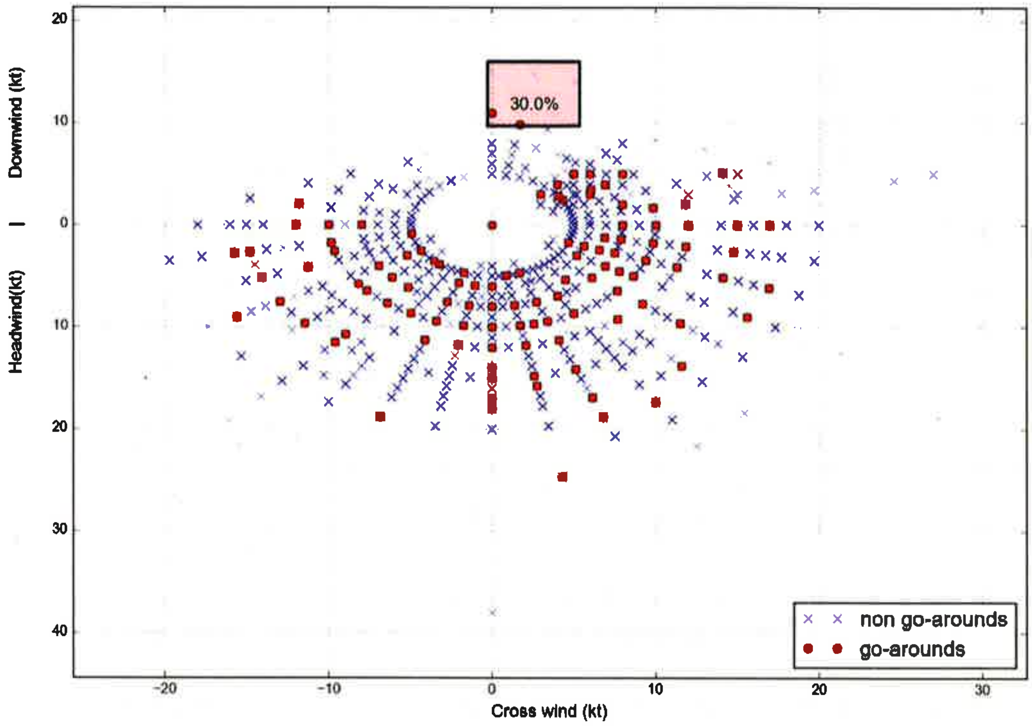

Figure 14: Illustration of LAHSO go-arounds versus downwind and cross-wind data. Each blue cross is a normal; arrival and each red dot a go-around. The red square indicates a data region with a statistically significant increase in the underlying go-around rate (above 0.25%). Note that of the 6 approaches during LAHSO with >8 knot downwind component, 2 were go-arounds (as noted earlier: statistical errors in the wind data imply that this '8 knot' limit may still represent operations within the 5 knot down-wind LAHSO requirements). The figure simply reflects the need to monitor and apply appropriate down-wind restrictions.

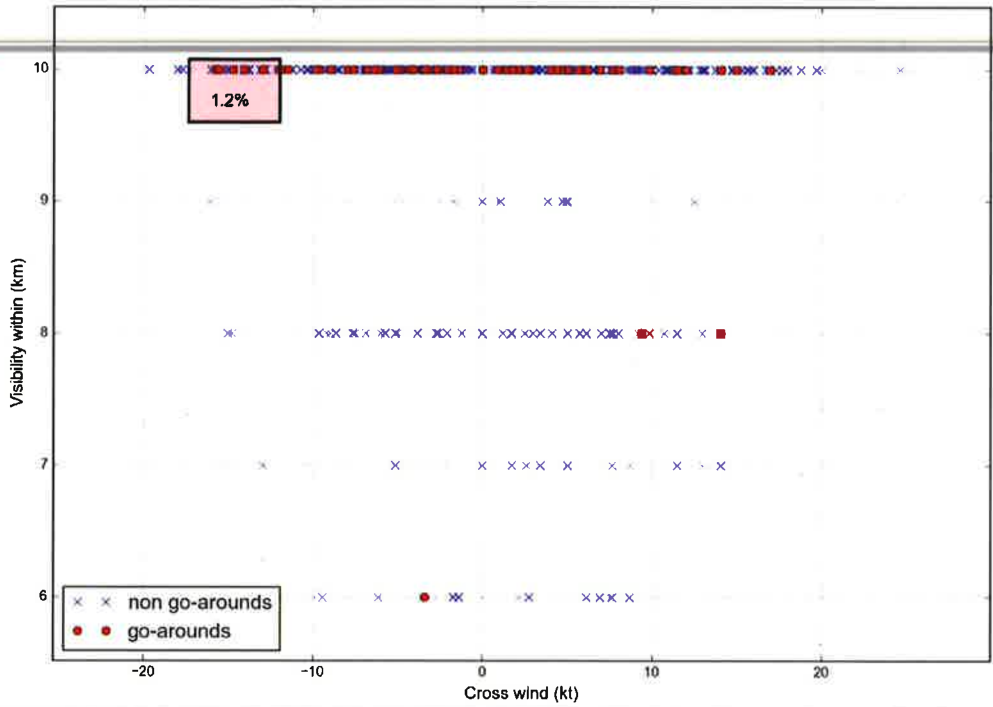

Figure 15: Illustration of go-arounds versus visibility and cross-wind data. Each blue cross is a normal; arrival and each red dot a go-around. The red square indicates a region with statistically significant increase in the underlying go-around rate (above 0.25%).

The main conclusion of this section was that go-around rates are assumed to be independent of meteorological conditions during LAHSO at Melbourne Airport during the analysis period.

5.5 Do go-arounds occur in clusters?

This section explores whether the existence of one go-around implied an increased likelihood of another go-around. It might be expected that a causal factor for go-arounds may persist for some time increasing the likelihood of another go-around in the short term.

Figure ***16*** shows the estimation of the go-around rate during LAHSO operations overall and if a previous go-around had occurred within the last hour. Considering the go-arounds for all LAHSO approaches, the rate was 2.5 go-arounds per 1,000 approaches. However, if a go-around had already occurred, the rate increased to approximately 5.6 go-arounds per 1,000 approaches. In other words, the likelihood of a go-around was twice as high if a go-around had already occurred in the last hour. Note that the value of 5.6 had a large standard deviation of 1.3, however the two means were statistically different to a 98.8% confidence level.

It is expected that go-around rates would increase if a go-around had just occurred. Whatever causal factors contribute to go-arounds, these would be expected to be present for a time period in the order of minutes to an hour. These may be due to weather conditions, traffic levels, occupied runways or other unknown factors beyond the scope of this report.

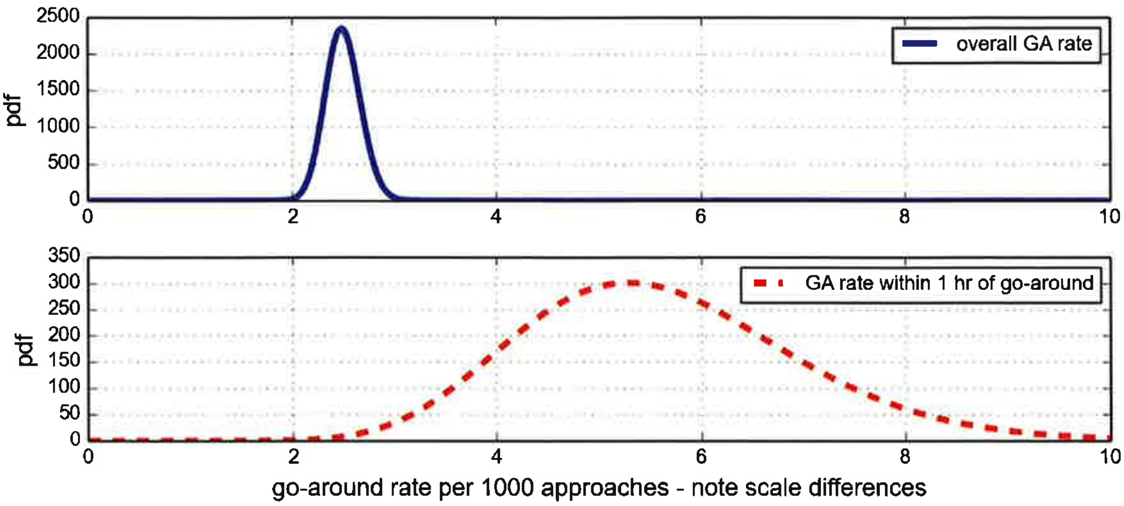

Figure 16: Estimation of the go-around rate (per 1000 approaches) during LAHSO operations. The top plot shows a go-around rate of 2.5 go-arounds per 1000 approaches. The bottom plot estimates the go-around rate within one hour of a previous go-around. Here the mean is 5.6 and is statistically different (to 98% confidence) from the rate of 2.5.

Figure ***17*** shows similar results to *Figure* ***16*** but for a range of times from 1 minute up to 30 minutes. The figure shows that the likelihood of a go-around is much higher in the time immediately following an earlier go-around. This makes sense physically, since the causal factors for some go-arounds will persist for a short time after the first go-around. For example, an occupied runway may persist for 1-2 minutes and cause a second go-around to occur for the subsequent flight. Other causal factor, such as unstable approach, may not be correlated: the cause of the first go-around may have no impact on the second go-around.

In *Figure* ***17*** the vertical axis is the go-around rate per 1000 arrivals for all arrivals within a time dt of an earlier arrival. The horizontal axis is the time period dt in minutes. In *Figure* ***16*** this time period was 1 hour. The blue line is the mean rate (ie 11/897 *1000 for dt=15 minutes). Each vertical line represents the 96% uncertainty in this estimate (approximately +/- two standard deviations but accurately calculated using Beta distributions). The red dashed line is the 66% uncertainty (approximately one standard deviation from the mean). The number (ie 11-897 indicate the number of go-arounds in the number of arrivals for that sample). The overall rate of go-arounds (2.5 per 1000) is indicated by the horizontal line. Thus we can see that despite the uncertainty in our estimate of the rate, it is significantly higher that the base rate of 2.5 per 1000.

The results in *Figure* ***17*** take into account all causal factors and aggregate the proportion that may be correlated or may not be correlated. Figure 12 also takes into account all statistics for double go-arounds: the value of 2 – 88 (2 go-arounds out of 88 arrivals within one minute of an earlier go-around) directly measures this contribution to the risk.

Statistical-significance calculations were done to test whether the different rate (ie 12 per 1000 for dt = 15 minutes) is significantly different from the base rate of 2.5 per 1000, given the large uncertainty range in our estimate. For all cases shown in *Figure* ***17*** the statistical significance was >95% and usually above 98%. That is there less than a 5% probability that this result happened just by chance.

The main conclusion of *Figure* ***17*** is that there is sufficient evidence that the correlated go-around rate is approximately 40 per 1000 arrivals, increased from a base rate of 2.5 per 1000 arrivals. Hence the assumed rate of correlated go-arounds is 16 times higher.

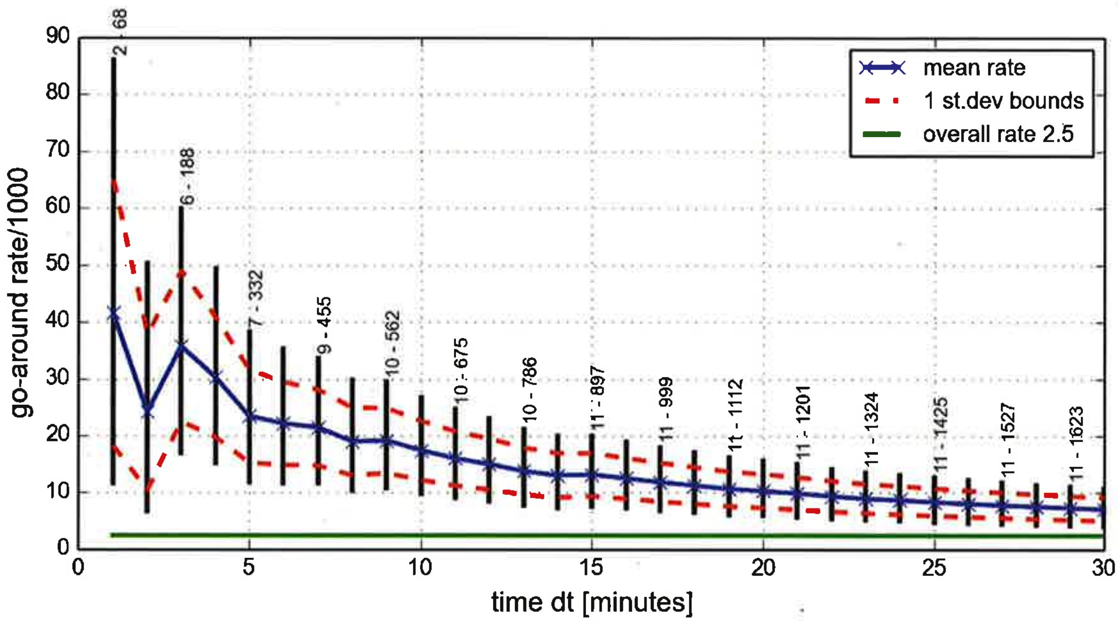

Figure 17: LAHSO go-around rate (per 1000 arrivals) within a time dt of a previous go-around. For example, in the data there were 897 arrivals within 15 minutes of a previous go-around and of these 11 were go-arounds. This gives a mean rate of 14 with a 95% confidence that the true value is within [8,20]. The increase in rate to ~40 go-arounds per 1000 arrivals (for dt = 1) strongly indicates that go-arounds are more likely in the time immediately following an earlier go-round: that is the events are correlated. The red-dashed lines give an idea of uncertainty in the rate estimation (~1 sd) while the black lines give the 5-95% uncertainty levels. Hence the 'drop' in mean value for dt=2 minutes is a statistical artefact within the confidence bounds.

This result has direct implications on the risk of double go-arounds. If a first go-around has occurred, then the likelihood of a second go-around is approximately 16 times as likely to occur immediately afterwards.

There is insufficient data to form relationships between the rates of go-arounds on one runway given a go-around on a second runway. This analysis simply considers the go-arounds on any runway given a previous go-around within the last hour on any runway.

The main result of this section was that after one go-around had occurred; a second go-around **was 16 times as likely to occur within the next minute** if an aircraft arrives in this time.

5.6 Is the LAHSO go-around rate dependent on aircraft arrival rates?

This section explored the hypothesis that the go-around rate was higher during times of high arrival rate. This would impact on the likelihood of go-arounds and imply that the average go-around rate cannot be used. Any increase in go-around rate may be due to aircraft not stabilising on approach due to time and traffic constraints in times of high arrival rates.

*Figure **18*** shows the estimation of the go-around rate for LAHSO operations with low traffic densities (<20 per hour) versus only those LAHSO operations with more than 20 arrivals per hour. There was an increase in the mean from 2.2 per 1000 to 3.0 per 1000. A statistical test shows that the two means satisfy 98% confidence in their difference.

This dependence may also be an artefact of go-around correlation and dependence: that a causal factor for one go-around may persist long enough to influence the next go-around. It is difficult to disentangle this effect from any possible underlying factor associated with large traffic flows.

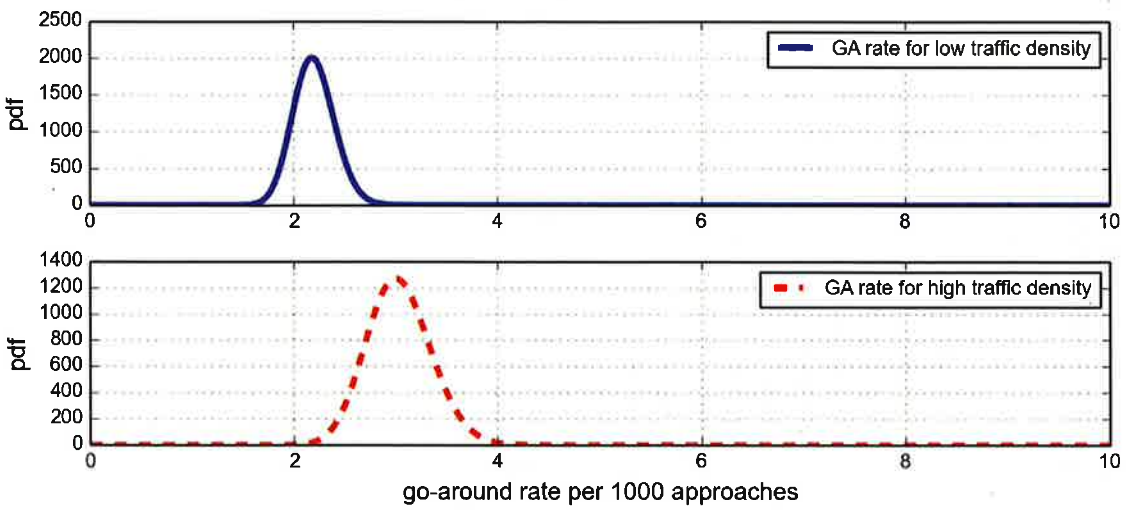

Figure 18: Estimation of the go-around rate (per 1,000 approaches) during LAHSO operations. The top plot is for all LAHSO approaches with low arrival rates (<20 per hour) whereas the bottom plot uses only data during high arrival rates (>20 per hour). The rate increases from 2.2 to 3.0 go-arounds per 1,000 approaches, and is statistically significant to 98% confidence.

The main result from this section was that the LAHSO go-around rate at Melbourne Airport during the analysis period was larger during times of high arrival rates when compared to low arrival rates. This may be an artefact of the previous correlated go-around likelihood and will need further study.

5.7 Distribution of LAHSO arrivals' separation times

This section explores the arrival times at each runway during LAHSO and the difference in times between arrivals on each runway. This informed the likelihood calculations.

The separation time of a consecutive LAHSO arrival pair at the runway intersection is denoted as τ. A $\tau = 0$ value would mean a horizontal overlap of the pair.

There were 19,415 pairs that would cross the runway intersection in order of Runway 27 first then Runway 34, and there were 19,412 pairs with the opposite order.

The figure below shows the histogram of time intervals between pairs arriving on Runway 27 and Runway 34. Approximately 23% of aircraft pairs (arriving on one runway and then on another) were separated by less than 1 minute and 46% by less than 2 minutes. It is clear that below 2 minutes the distribution is uniform which can assist in the analysis.

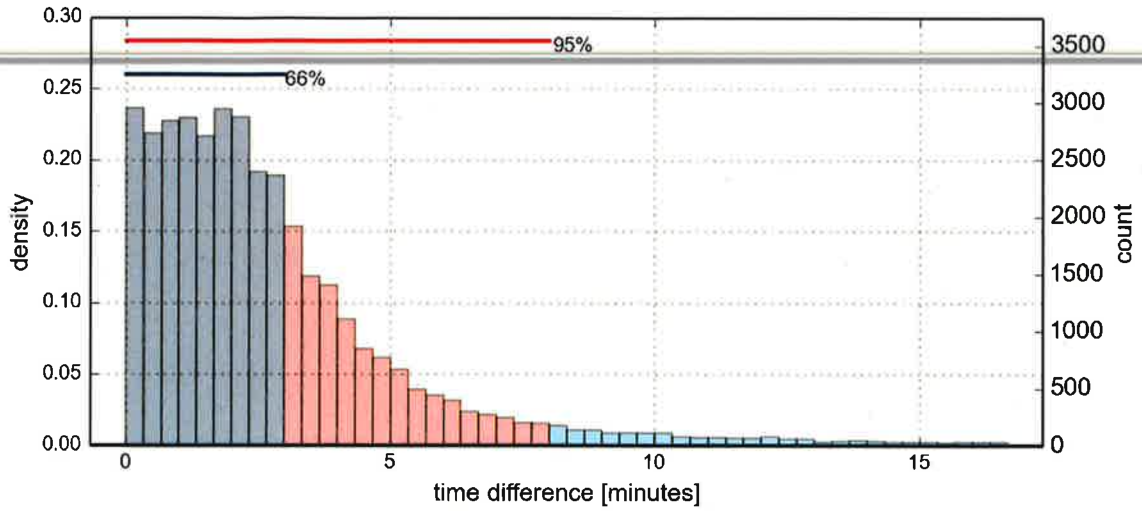

Figure 19: Histogram of arrival time difference between runways 34 and 27. That is during LAHSO operations 66% of aircraft pairs arriving on both 34 and 27 arrived within approximately 3 minutes.

Table 2. Probability of LAHSO arrivals' separation time less than specified threshold τ_c

threshold τ_c	probability that $\tau < \tau_c$ between arrival pairs on different runways
20 seconds	0.076
1 minutes	0.23
2 minutes	0.46

This section showed that the time between arrivals on runway 34 and then runway 27 was uniformly distributed up to 3 minutes with 46% of times less than 2 minutes.

5.8 Likelihood assessment methodology

This section explores some of the mathematical methodology used to calculate the double go-around likelihood. The methodology for assessing double go-around likelihood used in this report was proposed in the "Melbourne Go-around Study" report written by Airservices Operational Analysis team in May 2013. The method proposed below has a slight extension to include the dependent risk of a go-around within one hour of a previous go-around.

A double go-around was defined as an aircraft pair where each aircraft performed a go-around and the time difference at the runway intersection was less than some specified threshold which was denoted as τ_c.

The simple approximation of the risk assuming independence is:

$$P(DGA) = N(\,\gamma_{27}\gamma_{34}\,(F_{27}(\tau_c) + F_{34}(\tau_c))$$

where N is the number of aircraft pairs, γ_{27} is the go-around rate per approach to runway 27, γ_{34} was the go-around rate during LAHSO for Runway 34, and each F is the probability that aircraft arrives on runway B within time (τ_c) of arrival at runway A. The more accurate and general probability of at least one double go-around in a year of LAHSO operations is

$$P(at\ least\ 1\ DGA) = 1 - \left(1 - \ \gamma_{27}\gamma_{34}\,(F_{27}(\tau_c) + F_{34}(\tau_c)\right) + \gamma_{27}^2\gamma_{34}^2 F_{27}(\tau_c)F_{34}(\tau_c)\,)^N$$

where

- γ_{27} was the go-around rate during LAHSO for Runway 27,
- γ_{34} was the go-around rate during LAHSO for Runway 34,
- $F_{27}(\tau_c)$ is the probability there is an arrival on runway 34 within τ_c of an arrival on Runway 27 first,
- $F_{34}(\tau_c)$ is the probability there is an arrival on runway 27 within τ_c of an arrival on Runway 234 first,
- N is the larger of the number of arrival pairs (34 to 27; 27 to 34)

and

- τ was the time difference at the runway intersection of a consecutive arrival pair during LAHSO in operation.

However this assumes that the go-around rates are independent of each other. We would expect that if one go-around has occurred due to meteorological conditions that there will be an increased likelihood on the second runway. Thus the simple equation is now (with the more accurate version suitably modified):

$$P(DGA) = N\left(\gamma_{27}\gamma_{34/27}F_{27}(\tau_c) + \gamma_{34}\gamma_{27/34}F_{34}(\tau_c)\right)$$

Here $\gamma_{34/27}$ is the go-around rate on 34 **given** a go-around recently on 27. As seen before this is 16 times more likely, that is $\gamma_{34/27} = 16\,\gamma_{34}$ and is $\gamma_{27/34} = 16\,\gamma_{27}$ or alternatively is $\gamma_{34/27} = 0.004$ and $\gamma_{27/34} = 0.004$: the results in *Figure **17*** could be interpreted with either of these models.

For example if arrivals on runways A and B occur as AABAABABAA then there are three pairs (AB) and three pairs (BA). The overall risk is approximately F $(3\gamma_A\gamma_{\frac{B}{A}} + 3\gamma_B\gamma_{\frac{A}{B}})$ with F the probability that pairs arrive within tau of each other. Thus, although there are 6 sets of aircraft pairs, the formula given correctly uses N=3 as the maximum of either (AB) or (BA) pairs.

In simple language: this formula expresses the risk that:

- a go-around occurs on one runway, **and**
- a second flight occurs on the second runway within a small time τ_c, **and**
- this second flight performs a go-around.

There is clearly no risk if the flight on the second runway arrives much later than the first arrival.

6 Results: Double go-around likelihood

This section examined the likelihood of a double go-around based on Melbourne Airport historic movements and go around occurrences for the period January 1st 2012 to February 28th 2015.

Here we took:

- $\gamma_{34} = 4.1$ (per 1000)
- $\gamma_{27} = 1.5$ (per 1000)
- $\gamma_{34/27} = 16 \times 4.1$ (per 1000) or 40 (per 1000) depending on the model
- $\gamma_{27/34} == 16 \times 1.5$ (per 1000) or 40 (per 1000) depending on the model
- $F_{27}(\tau_c) = F_{27}(\tau_c) = 0.23 \times \tau_c$ (based on approaches within $\tau_c =$ one-minute of each other).
- $DGA\ L = (1 - (1 - Risk)^N)$ over N arrivals

The values $\gamma_{34/27}$ and is $\gamma_{27/34}$ were based on the available data shown in *Figure **17***.

The following *Table **4*** gives tabulated results for the likelihood for three different models with a DGA defined as two go-arounds within 20 seconds of each other.

- Model 1: $\gamma_{34/27} = 2 \times 4.1 = 8.1$; $\gamma_{27/34} = 2 \times 1.5 = 3$ (per 1000)
- Model 2: $\gamma_{34/27} = 16 \times 4.1 = 65.6$; $\gamma_{27/34} = 16 \times 1.5 = 24$ (per 1000)
- Model 3: $\gamma_{34/27} = 40$; $\gamma_{27/34} = 40$ (per 1000)

The mean time between double go-arounds is given in *Table **3***.

Model	**DGA20 rate per unique pair**	**Mean time to DGA20 [years]**	**DGA60 rate per unique pair**	**Mean time to DGA60 [years]**
	DGA20 20 second definition		**DGA60 60 second definition**	
1	1.9E-6	78 years	5.7E-6	26
2	1.5E-5	9.8 years	4.5E-5	3.2
3	1.7E-5	8.5 years	5.2E-5	2.8

Table 3: The DGA rate per arrival pair on crossing runways and the estimated mean time to a double go around for both DGA20 and DGA60 definitions.

Key Assumptions

- The number of unique pairs to calculate a go-around is 0.226 times the number of arrivals in LAHSO. This is based on 19,415 LAHSO crossing pairs out of 85,755 LAHSO arrivals in sample.

N = # unique pairs	# Appr's	Est, time Yrs	DGA20 Likel'd (M1)	DGA20 Likel'd (M 2)	DGA20 Likel'd (M3)	DGA60 Likel'd (M1)	DGA60 Likel'd (M2)	DGA60 Likel'd (M3)
			DGA20 20 second definition			DGA60 60 second definition		
1	4	-	1.9E-6	1.5E-5	1.7E-5	0.038	0.265	0.295
6 792	30 000	1	0.013	0.097	0.11	0.074	0.459	0.503
13 584	60 000	2	0.025	0.185	0.208	0.109	0.602	0.65
20 376	90 000	3	0.038	0.265	0.295	0.142	0.708	0.753
27 168	120 000	4	0.05	0.336	0.373	0.175	0.785	0.826
33 960	150 000	5	0.062	0.401	0.442	0.206	0.842	0.877
40 752	180 000	6	0.074	0.459	0.503	0.236	0.884	0.914
47 544	210 000	7	0.086	0.512	0.558	0.265	0.915	0.939
54 336	240 000	8	0.097	0.559	0.607	0.292	0.937	0.957
61 128	270 000	9	0.109	0.602	0.65	0.319	0.954	0.97
67 920	300 000	10	0.12	0.641	0.689	0.345	0.966	0.979
74 712	330 000	11	0.131	0.676	0.723	0.369	0.975	0.985
81 504	360 000	12	0.142	0.708	0.753	0.393	0.982	0.989
88 296	390 000	13	0.153	0.736	0.78	0.416	0.986	0.993
95 088	420 000	14	0.164	0.762	0.805	0.438	0.99	0.995
101 880	450 000	15	0.175	0.785	0.826	0.459	0.993	0.996
108 672	480 000	16	0.185	0.806	0.845	0.48	0.995	0.997
115 464	510 000	17	0.196	0.825	0.862	0.499	0.996	0.998
122 256	540 000	18	0.206	0.842	0.877	0.518	0.997	0.999
129 048	570 000	19	0.216	0.857	0.891	0.536	0.998	0.999
135 840	600 000	20	0.226	0.871	0.903	0.038	0.265	0.295

Table 4: Estimated likelihood of double go-arounds (DGA) defined as go-arounds on both runways. Results are only for LAHSO operations. An assumed value of 30,000 approaches during LAHSO per year was assumed. Current traffic levels had 26,645 LAHSO arrivals per year. Coloured squares highlight when the likelihood exceed 25 %(beige) or 50%(yellow).

Figure ***20*** shows similar results to *Table* ***4*** except for a variety of DGA definition times. That is, defining a double go-around as two go-around crossings within 60 seconds would correspond to 60 along the x-axis. The blue solid lines are the basic model and the red-dashed lines are the more conservative model (with four times the go-around rate).

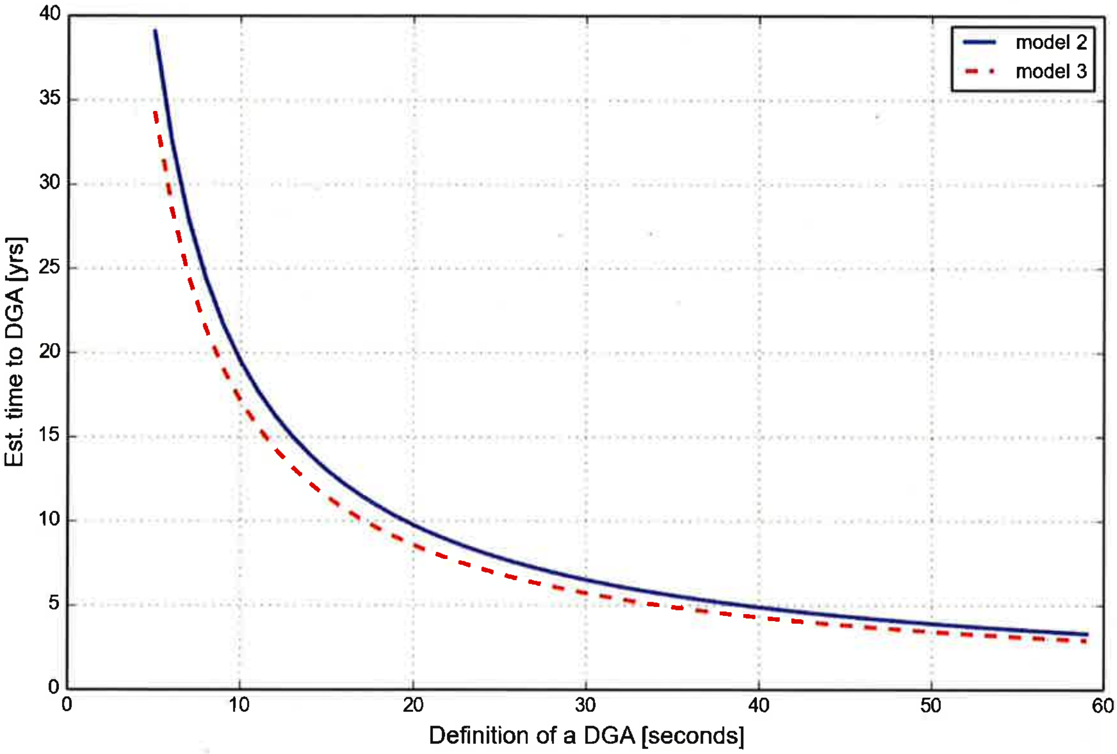

Figure 20: A visual representation of DGA likelihood versus the time definition of a DGA. Values of 20 seconds correspond to results in Table 4. The estimated time to a double go-around is given foe model 2 and 3 as a function of the definition of a go-around. Thus these models indicate a DGA of 1 in every ~7 years using a definition of 20 seconds.

Figure ***21*** shows the model estimate of the mean time between double go-arounds. As the models presented here are based on finite sparse data, each parameter has uncertainty. Thus our estimate of DGAs occurring on average every 8 years is simply an approximation. By using the uncertainty in the values shown in *Figure* ***17*** (that is the correlated rate may be between 10 and 80 or more) we can thus estimate our uncertainty in the estimate of the double go-around rate. Thus our estimate is only accurate to within 1 and 15 years.

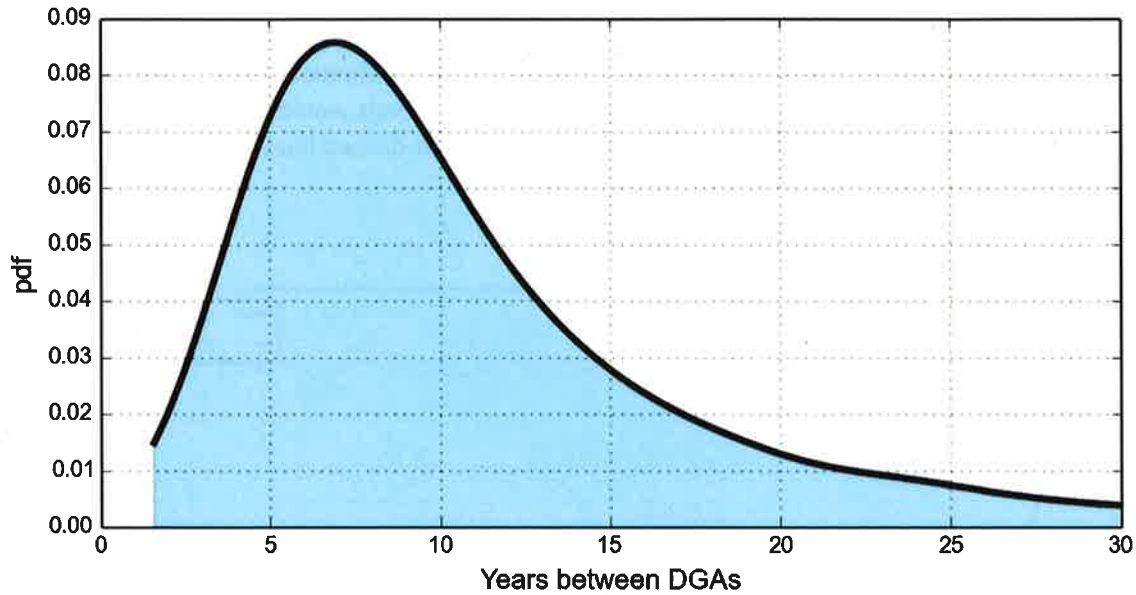

Figure 21: DGA20: Estimate of the time between double go-arounds (20 seconds definition). The y-axis is the probability density function for the estimate. The models can only estimate the time between DGAs and this density illustrates the uncertainty in this estimate.

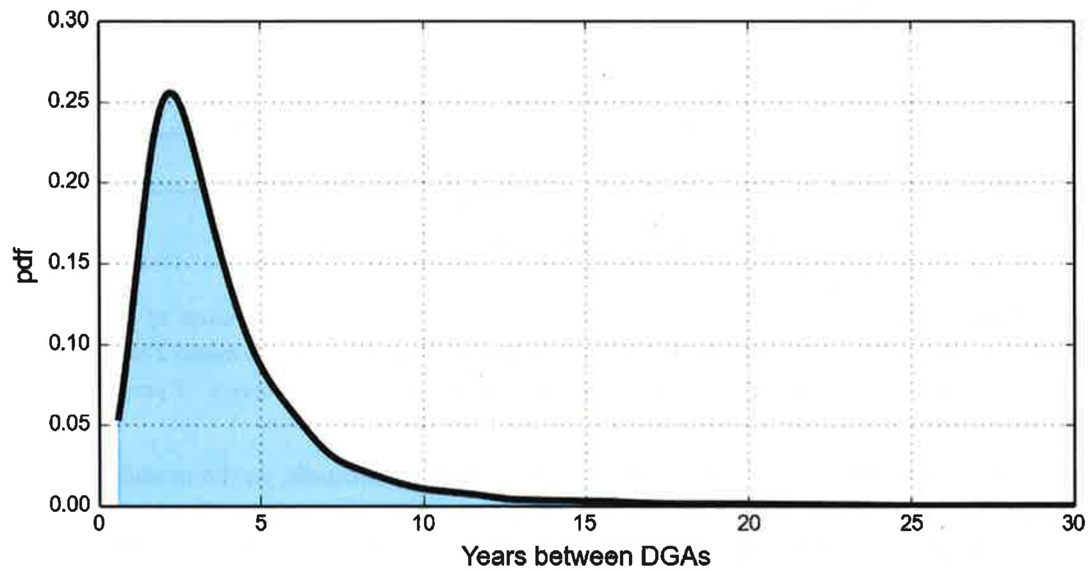

Figure 22: *DGA60: Estimate of the time between double go-arounds (60 seconds definition). The y-axis is the probability density function for the estimate. The models can only estimate the time between DGAs and this density illustrates the uncertainty in this estimate.*

This section shows that the likelihood of two go-arounds DGA20 on crossing runways within 20 seconds of each other is of order 5 - 8 years but could reasonably be as low as 1 year. For DGA60 the likelihood is of order 1 every 0.3-3 years.

7 Discussion and Future Work

This report did not consider the risk of a collision if a double go-around occurred during the analysis period. This calculation would involve estimation of the time of arrival at the joint intersection point along with the height of crossing, by using more accurate data on aircraft size, speeds and path. This type of collision risk analysis is possible, but was outside the scope of this current report.

Standard collision risk target levels of safety (TLS) are in the order of 1.5E-8 per flight hour, 1E-10 per operation or in the order of 1 accident per 100 years. The TLS has long historical roots based on studies going back to the 1950s and is discussed by numerous different groups with no definitive value assumed for all applications. A list of some relevant papers is given in the reference list on page 55.

Further work could consider more causal factors involved in go-around rates outside of LAHSO operations as part of a general safety report. The methodologies used here could be extended using supervised machine learning techniques.

This report does not consider the categorisation of the causal factors for go-arounds nor how this may impact on likelihood. Currently the model assumes that if one go-around occurs there is an increased likelihood of another go-around in the next time period. Data indicates that within the next 1 hour go-around is twice as likely and the go-around rate 16 times higher for go-arounds within one minute of another go-around. Thus we write $\gamma 34/27 = N \gamma 34$ with N assumed either 2 or 16 and vice versa for $\gamma 27|34$. However, there are a class of causal factors which increase the rate to near unity. One such example is an aircraft departing on runway 34 and potentially blocking both runway 34 and 27 as occurred with CIRRIS occurrence ATS0137977. This would modify the risk.

We denote the proportion of these 'high significance' causal factors as 'r'. That is, a 'highly significant' causal factor for a go-around is one in which the likelihood of another go-around on the second runway in the next 1-5 minutes is almost certain if an aircraft did approach. This value can be estimated by having an ATC specialist examine all go-arounds and attribute logical causal factors and counting those to be 'high significance'. This would modify the terms as $\gamma 34/27 = \mathrm{r} + (1\text{-}\mathrm{r})\ 2\ \gamma\ 34$ and equivalently for $\gamma 27|34$.

The values found here do correlate well with previous studies, however, this report found a larger likelihood of double go-arounds due to the increase in go-around rate just after a previous go-around. Recent occurrence data may support the conservative model of a 50% likelihood of a double go-around.

Further work can be done, if required, on a:

- collision risk assessment
- separate analysis of data related to LAHSO with: night-time operations; 34-09 arrival mode; SHEED arrival approach. This may inform decisions regarding possible LAHSO restrictions.
- other causal factors for go-arounds such as: approach speed or angle; runway occupancy; inter-arrival distance separation and wake turbulence categories; approach sector load in and out of LAHSO mode.

8 Conclusion

The main results in this report showed that, for a double go around at Melbourne International Airport during the analysis period:

i. DGA_{20}: the mean time between double go-arounds (20 second definition) is of order 1 to 10 years

ii. DGA_{60}: the mean time between double go-arounds (60 second definition) is of order 0.3 to 3 years

iii. the go-around rate was 16 times higher (or potentially higher due to limited data and uncertainty) if a previous go-around had occurred in the last minute

iv. the go-around rate during LAHSO was dependent on traffic density but not on meteorological conditions

v. strong cross winds or tail-winds do in general increase go-around rates, but LAHSO wind restrictions do successfully decrease the risk by reducing this affect

vi. there is evidence of an increase in base go-around rate with time as well as evidence of significant periods with highly elevated go-around rates.

9 Appendix

This appendix gives further detail to some of the methodology and results.

9.1 Verifying Melbourne go-arounds data

This section explores the definition of a go-around and the verification of go-arounds between different data sources (CIRRIS data and ODAS track data).

The CIRRIS definition of go around incidents is as follows:

"When the final approach to land of an aircraft is terminated and the aircraft conducts a go around procedure.
Note: Not reportable where an aircraft initiates a published missed approach procedure because visual flight could not be established by the minima."

In order to achieve a complete review, it was necessary to

- verify the existing CIRRIS records with another data source such as Surveillance track data
- recover the go-arounds which were not reported by CIRRIS.

Operational Analysis (OA) within Airservices developed an advanced data analysis tool named ODAS (Operational Data Analysis Suite) which contained a verified surveillance data database. Based on this:

- the process to match CIRRIS records with Surveillance track data by incident time, flight callsign, registration and aircraft type was implemented
- a methodology to detect go-arounds from surveillance track data was developed.

CIRRIS go-arounds:

There were totally 875 go-around incidents recorded in CIRRIS for Melbourne arrivals from January 2012 to February 2015. During the matching process:

- some records were with insufficient information and thus failed to match. The following CIRRIS record was an example:

  "21/03/2013 03:55:00 AM, Missed approach due windshear. Primary Occurrence Type: Go Around"

- some CIRRIS go-around incidents could not be identified from surveillance track data, for example (ref to *Figure **25***):

  "19/07/2013 09:23:00 AM, JST971 initiated a missed approach on runway 34 due wx. Primary Occurrence Type: Go Around."

- some records might have inaccurate information, for example:

  "05/07/2013 02:33:00 PM, TGW363 WAS ON SHORT FINAL FOR R34 WHEN THE PILOT ELECTED TO CONDUCT A GO AROUND DUE TO WINDSHEAR. WINDSHEAR HAD BEEN REPORTED BY PRECEEDING ARRIVALS AND THE WARNING WAS ON THE ATIS. Rego: VNG. Primary Occurrence Type: Go Around."

  However, after searching the surveillance data, the flight with callsign TGW363 was with registration VHVNQ rather than VHVNG, departed from YBBN on July 5th 2013 01:16:00 PM and arrived at YMML on the same day 03:18:00 PM, and did not perform a go-around. On the other hand, the flight with registration VHVNG on that day did not perform a go-around either.

In conclusion there were about 13% records in CIRRIS records that were not clear or could not be identified from surveillance track data. Most of the unmatched records were before July 2013 which was migrated from ESIR to CIRRIS.

9.1.1 Go-around occurrences identified by surveillance track data

In this subsection, flight track information (surveillance data) was studied to identify go-around incidents. The goal is to identify a flight's initial approach runway, final landing runway, and go-around incident time (if a go-around occurred).

In order to study the landing and go-around performance, zones were defined for all Melbourne runways (09, 16, 27 and 34). These zones were named "approach detection zones". These approach detection zones were defined to start at the runway thresholds with a dimension of 2 nautical miles (plus runway width) perpendicular to runway heading and 6.5 nautical miles (NM) along the runway heading. The distance 6.5 NM was chosen by considering the Departure and Approach Procedures (DAP) published by Airservices. According to the instrument approach procedures for precision and non-precision approaches at Melbourne airport, earliest final approach started at 6.5 nautical miles from the corresponding runway threshold.

Landing and go-around performance were assessed based on the altitude change within the zones and the change of heading when entering and exiting the zones. A visualization of those approach detection zones was shown in

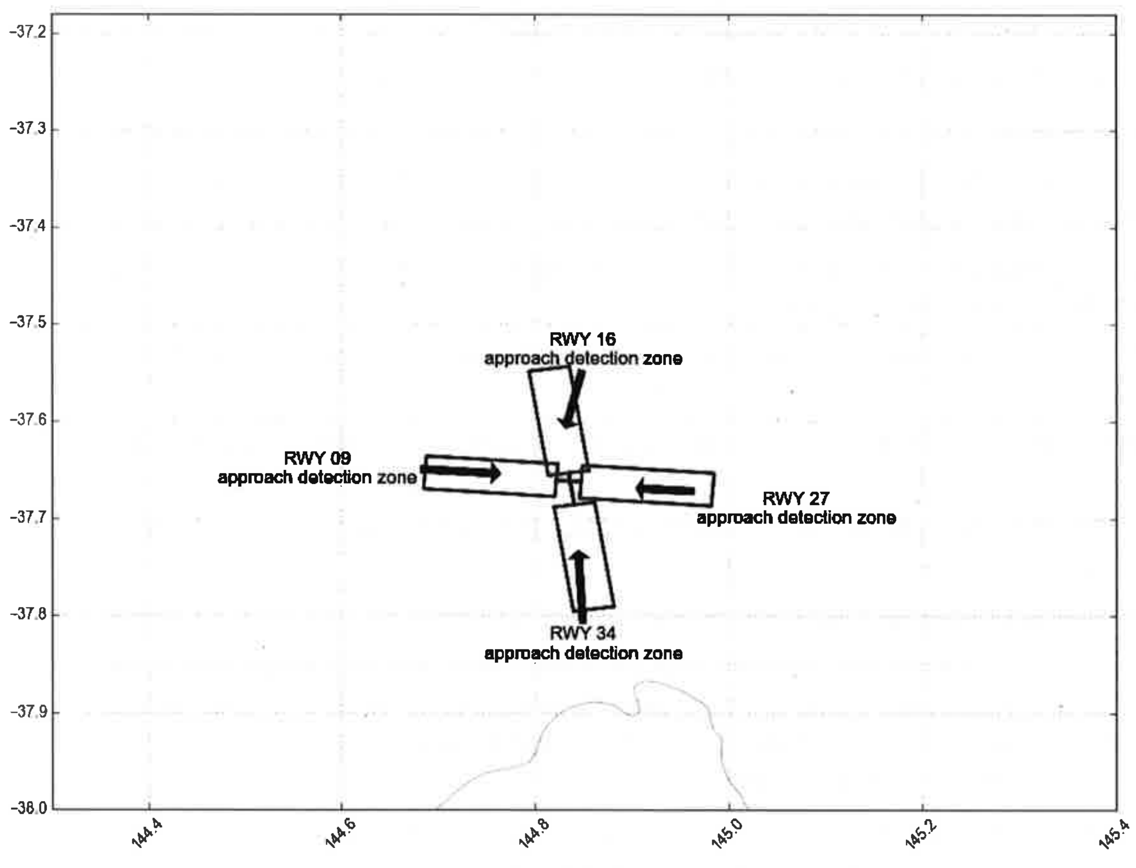

Figure 23: Approach detection zones for RWY 09, 16, 27, 34 at Melbourne International Airport.

Figure ***23*** provided an illustration to explain the methodology of detecting flights that performed a go-around at Melbourne airport. In *Figure* ***24*** a flight approached from North, descended and attempted to land on Runway 16. However, instead of landing it performed a go-around and finally landed on the same runway on its second attempt. The colour of the track indicated the change in altitude. The red point is an estimation of where the go-around commenced.

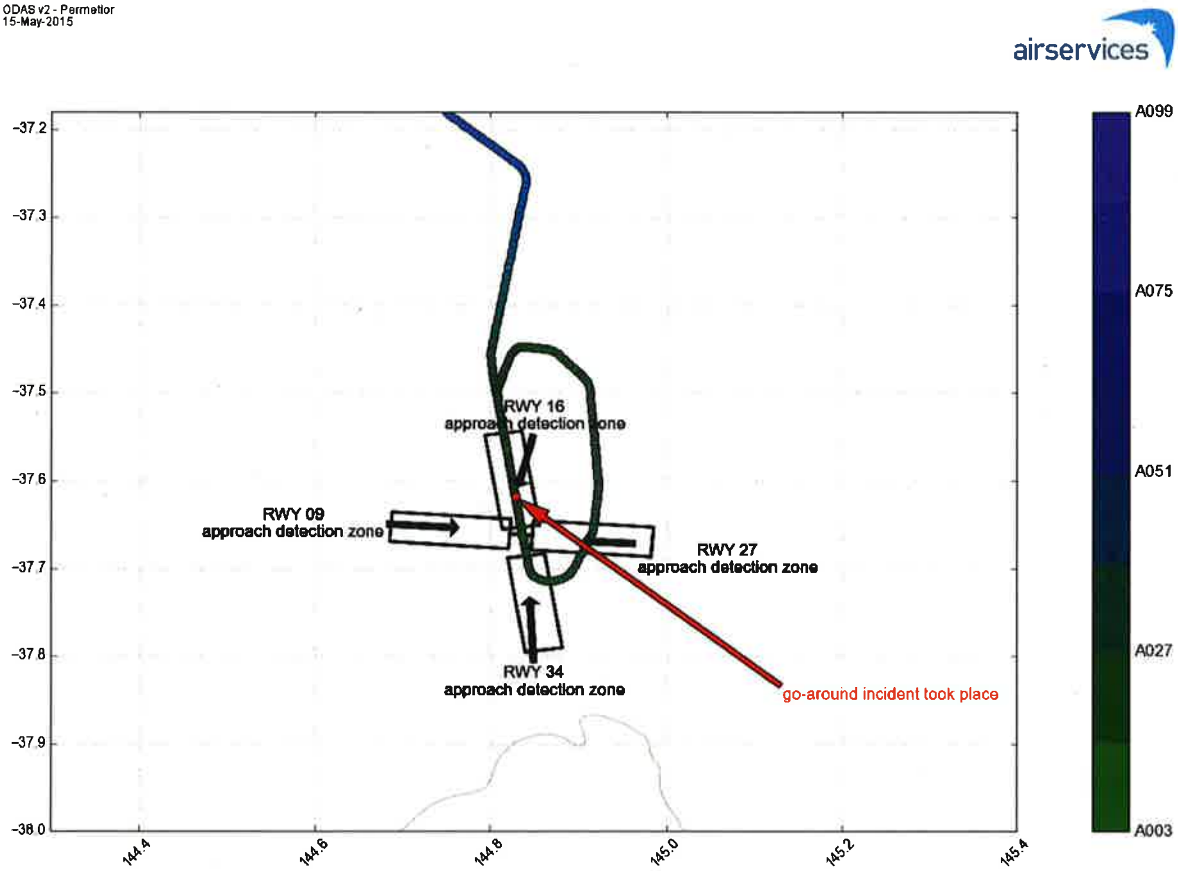

Figure 24: illustration of go-around detection (the flight departed from Adelaide on May 4th 2014 08:44:00 UTC and arrived at Melbourne on May 4th 2014 10:01:00 UTC with callsign QFA694, registration VHVYF and ODAS ID 20140504-0835-QFA694-0).

There were totally 1,117 flights detected as go-arounds within 6.5 nautical miles of the Melbourne aerodrome from January 1st 2012 to February 28th 2015. Among these missed approaches, there were 224 incidents under visual meteorological condition (VMC).

VMC is the atmospheric conditions that permitted pilots to approach, land, or take off by visual reference and to see and avoid other aircraft. In this report, the concept was specifically referred to:

- the cloud ceiling was not less than the highest MVA as specified in local instructions, and
- the visibility was not less than 8KM.

Moreover, other than detecting if a flight performed a go-around, an estimation of the go-around incident time was provided as well. For example, in *Figure* ***24*** the estimation of where the go-around incident took place was marked as the red dot.

9.1.2 CIRRIS records vs go-arounds identified by track data

A comparison between CIRRIS go-around records and the go-around incidents detected from surveillance track data was essential to understand the CIRRIS coverage and also to establish a thorough way of verifying the methodology of go-around detection from flight track data.

After the comparison, it is concluded that:

1. among the 759 identified CIRRIS records 741 flights were able to be confirmed as go-arounds from surveillance track data
2. there were some discrepancies between CIRRIS and surveillance track data as indicated in *Table **5***
3. more flights were detected with go-around performance within 6.5 nautical miles of the Melbourne aerodrome.

*Table **5*** gives examples of some discrepancies between CIRRIS go-around data and available track data from ODAS. The reason for the discrepancies could be either uncorrected CIRRIS record or uncorrected surveillance data record.

Table 5: Some discrepancies between CIRRIS go-around records and flights' behaviour in surveillance data.

ODAS ID	
20130629-0020-TGW485-0	insufficient information contained in CIRRIS
20130705-1230-TGW363-0	Could not find similar aircraft which performed a go-around
20121025-2050-JST771-0	insufficient information contained in ODAS
20131010-1545-QFA7338-0	wrong aircraft registration provided in CIRRIS
20130415-1300-CSN321-0	wrong date recorded in CIRRIS
20140404-2200-VOZ824-0	wrong date recorded in CIRRIS
20130719-0520-JST971-0	Recorded as go-around in CIRRIS yet not observed to have performed a go-around in the ODAS surveillance track data

Take the last flight in *Table **5*** as an example. In CIRRIS a record said

"19/07/2013 09:23:00 AM, JST971 initiated a missed approach on runway 34 due wx. Rego: VGF"

By searching through surveillance data, the flight with ODAS id "20130719-0520-JST971-0" was found to be the most matched flight. This flight departed from Perth on July 19th 2013 05:49:00 UTC and arrived at Melbourne on the same day 09:22:00 UTC with callsign JST971, registration VHVGF. By visualising its track in *Figure **25*** it is clear that it did not perform a go-around as mentioned in CIRRIS.

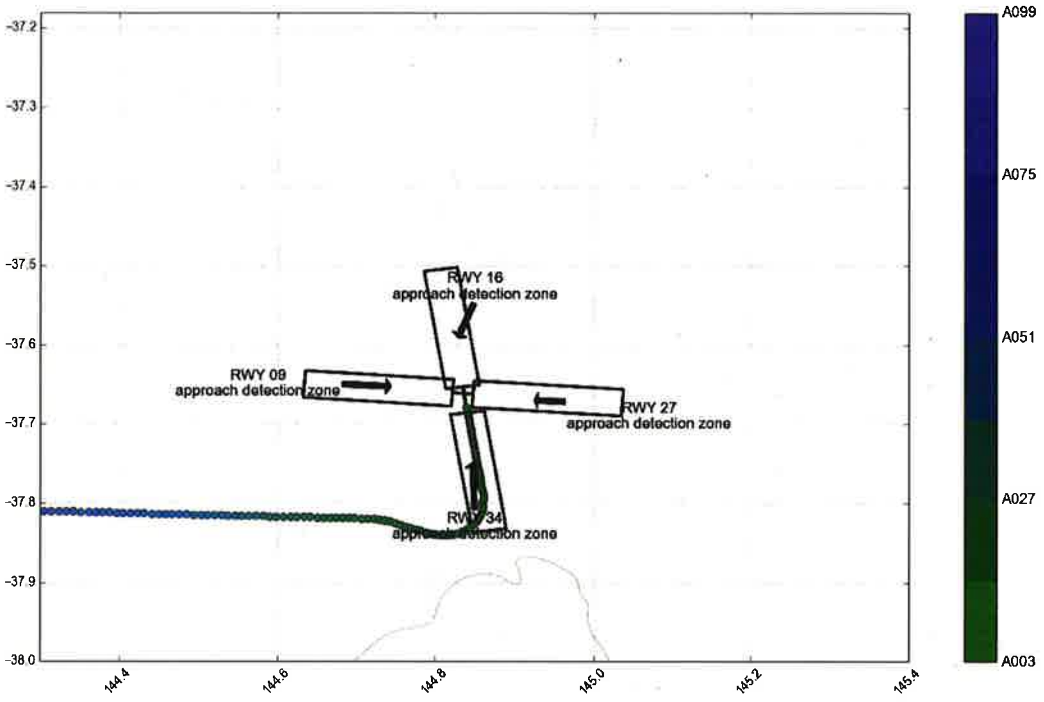

Figure 25: the flight departed from Perth on July 19th 2013 05:49:00 UTC and arrived at Melbourne on July 19th 2013 09:22:00 UTC with callsign JST971, registration VHVGF and ODAS ID 20130719-0520-JST971-0.

Table ***6*** gives a list of flights detected within ODAS data as potential go-arounds but not able to be matched to data within CIRRIS *Figure* ***26*** and *Figure* ***27*** show an example of flights detected by our methodology but not matched in CIRRIS. However, some of these flights may not meet the technical definition of a go-around necessary for inclusion in CIRRIS and are artefacts of the procedure to automatically identify go-arounds from over 100 000 flights: that is, the automated procedure will produce a small selection of false positives. Additionally some of the ODAS-identified go-arounds may be the same as un-matched CIRRIS go-arounds. For example *Figure* ***27*** shows a flight which is most likely the following CIRRIS record which has no identification:

"11/01/2012 12:01:00 AM, Pilot initiated missed approach from late final due windshear. Advertised on CATIS and Sigmet. Primary Occurrence Type: Go Around."

Table 6. samples of flights detected as go-arounds yet not recorded in CIRRIS.

ODAS ID	Go-around incident time	Approach runway	Arrival runway
20120129-0445-PBN184-0	29/01/2012 10:17	34	34
20120420-2030-RXA3752-0	20/04/2012 23:04	16	16
20120420-2215-RXA3153-0	21/04/2012 0:44	16	16
20130213-2100-QFA609-0	13/02/2013 23:12	27	27
20130310-0300-QFA621-0	10/03/2013 5:21	34	34
20130629-0005-QLK79D-0	29/06/2013 0:58	16	16
20130802-0745-JST479-0	2/08/2013 9:35	34	27
20130912-0250-VOZ736-0	12/09/2013 5:43	16	16
20131020-0500-QFA447-0	20/10/2013 7:12	34	27
20131021-0135-VOZ1506-0	21/10/2013 4:17	16	16
20131120-0745-JST166-0	20/11/2013 11:13	16	27
20140731-0330-QFA437-0	31/07/2014 5:01	34	27
20140506-0005-VOZ262-0	6/05/2014 0:53	16	16
20141123-1730-VOZ149-0	23/11/2014 21:53	27	27
20150103-0540-JST706-0	3/01/2015 6:56	34	27
20150103-0535-VOZ232-0	3/01/2015 6:54	34	27
20150103-0300-VOZ101-0	3/01/2015 6:57	34	27
20150221-0500-QFA447-0	21/02/2015 6:40	16	16

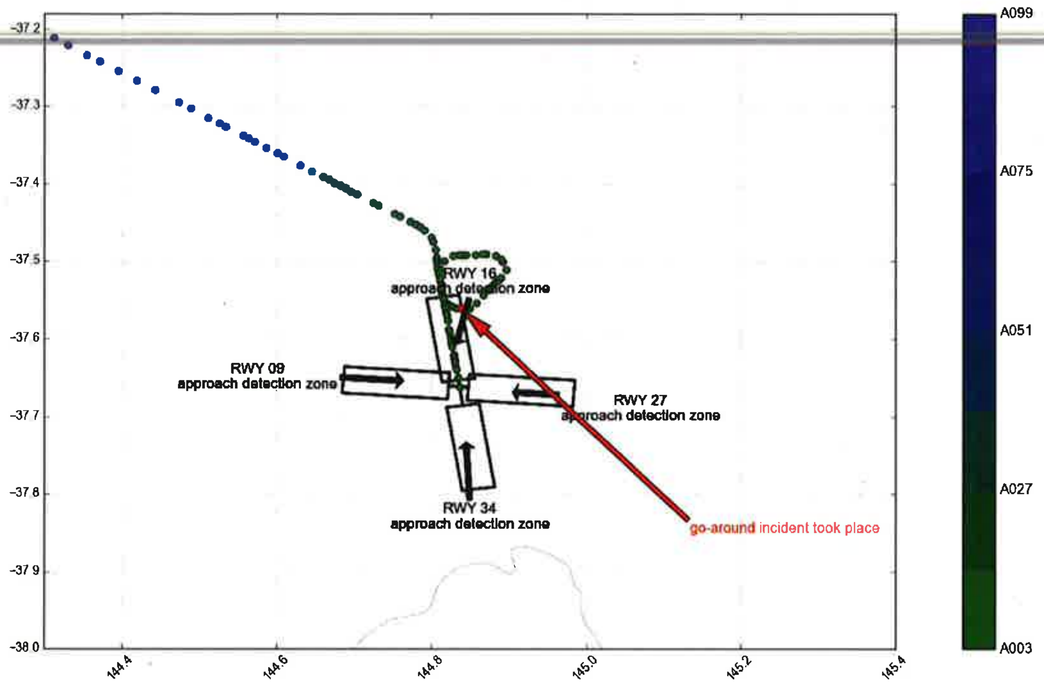

Figure 26: the flight departed from WMKK on January 3rd 2012 02:15:00 UTC and arrived at Melbourne on January 3rd 2012 09:44:00 UTC with callsign MAS129, registration 9MMTD and ODAS ID 20120103-0215-MAS129-0.

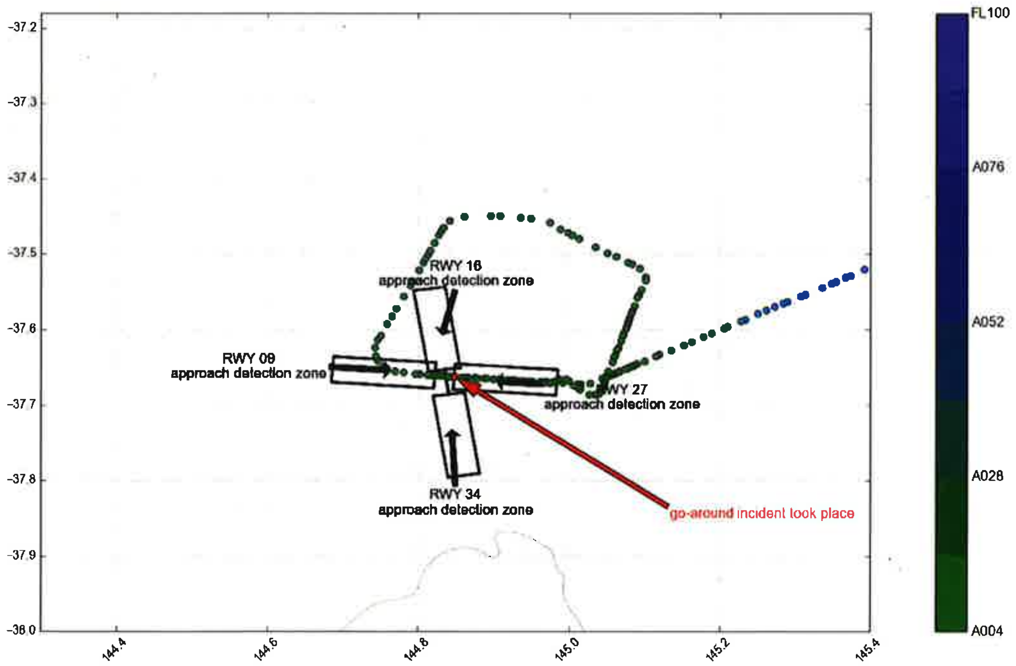

Figure 27: An example of go-around detection (departed from Sydney on January 10th 2012 22:49:00 UTC and arrived at Melbourne on January 11th 2012 00:16:00 UTC with callsign UAL839, registration N180UA and ODAS ID 20120110-2240-UAL839-0).

9.1.3 Estimate the time at runway intersection

For the flights which did fly cross the runway intersection between runway 27 and runway 34, the time was obtained from surveillance track data. For the others, estimations of the time at the runway intersection were calculated by

$$t_{at\ intersection} = t_{enter\ approach\ detection\ zone}\ d/(0.5 * (v_{at\ intersection} + v_{enter\ approach\ detection\ zone}))$$

where

- $t_{at\ intersection}$ was the time at the runway intersection
- $t_{enter\ approach\ detection\ zone}$ was the time flight entering the approach detection zone
- d was the distance between the runway intersection and the point flight entering approach detection zone
- $v_{at\ intersection}$ was the ground speed at the runway intersection
- $v_{enter\ approach\ detection\ zone}$ was the ground speed when flight entered the approach detection zone.

In the above equation, $v_{at\ intersection}$ was not contained in surveillance track data if the flights did not fly cross the runway intersection. According to ATC specialists, the speed of a jet aircraft at the runway intersection would be approximately 170 kts for Runway 34 and 150 kts for Runway 27. The speed at the intersection for a non-jet aircraft would be approximately 146 kts for both runways.

9.2 Time series of go-arounds

This section provides figures of go-around counts and rates for each runway over the time period. Results are presented as values per month. Daily counts are not meaningful due to the limited counts on each day.

The results in this section show a wide range in monthly go-around rates, probably due to prevailing weather conditions during the time period.

Measurements were chosen to provide an overview of go-arounds: monthly go-around occurrences and monthly go-around rates which was defined as

$$\frac{\text{number of go arounds in that month}}{\text{number of total arrivals in that month}} \text{ x 1000 per 1000 approaches.}$$

Figure 28, Figure 29 and Figure 30 show these measurements for each runway in Melbourne except Runway 09. The number of arrivals on Runway 09 was too low each month with a maximum 128 (which was about 4 per day) to be provide a sensible graphic.

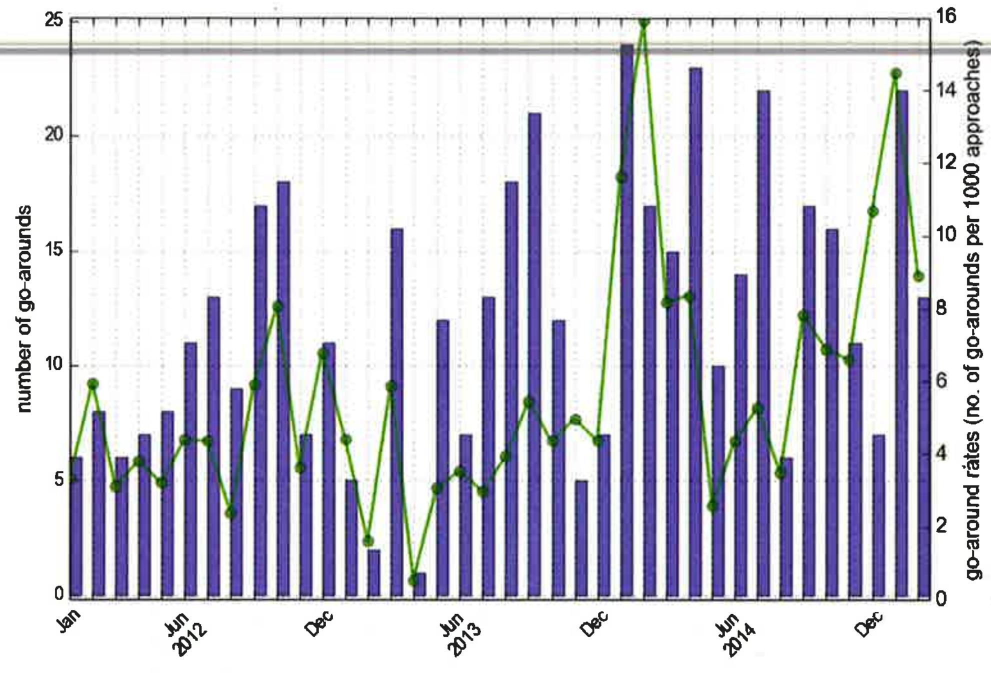

Figure 28: Melbourne go-around review on RWY 34 from January 1st, 2012 to February 28th, 2015.

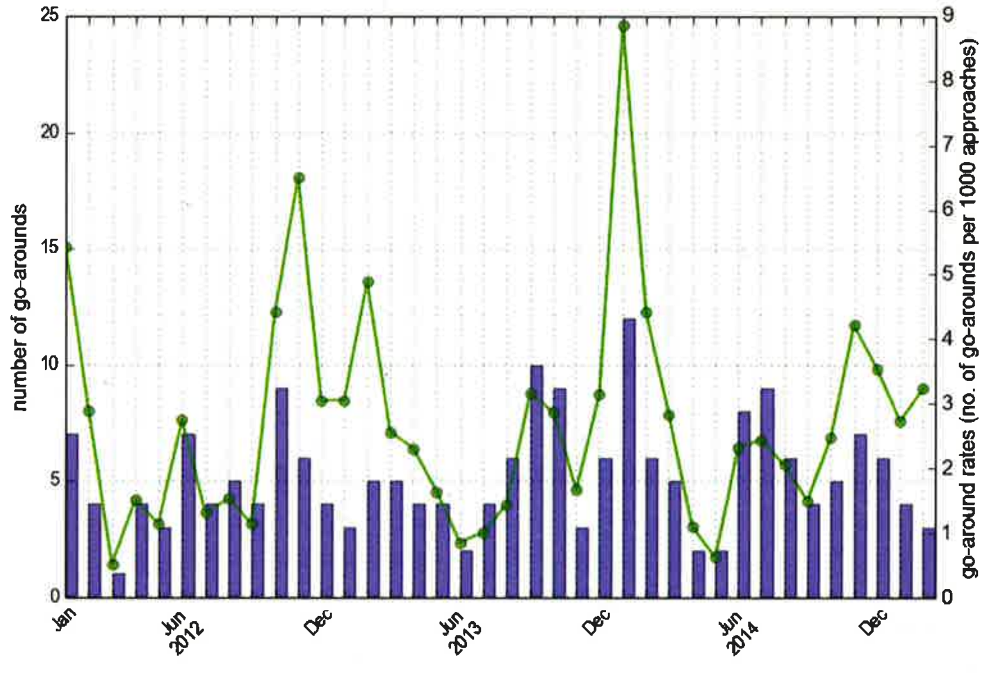

Figure 29: Melbourne go-around review on RWY 27 from January 1st, 2012 to February 28th, 2015.

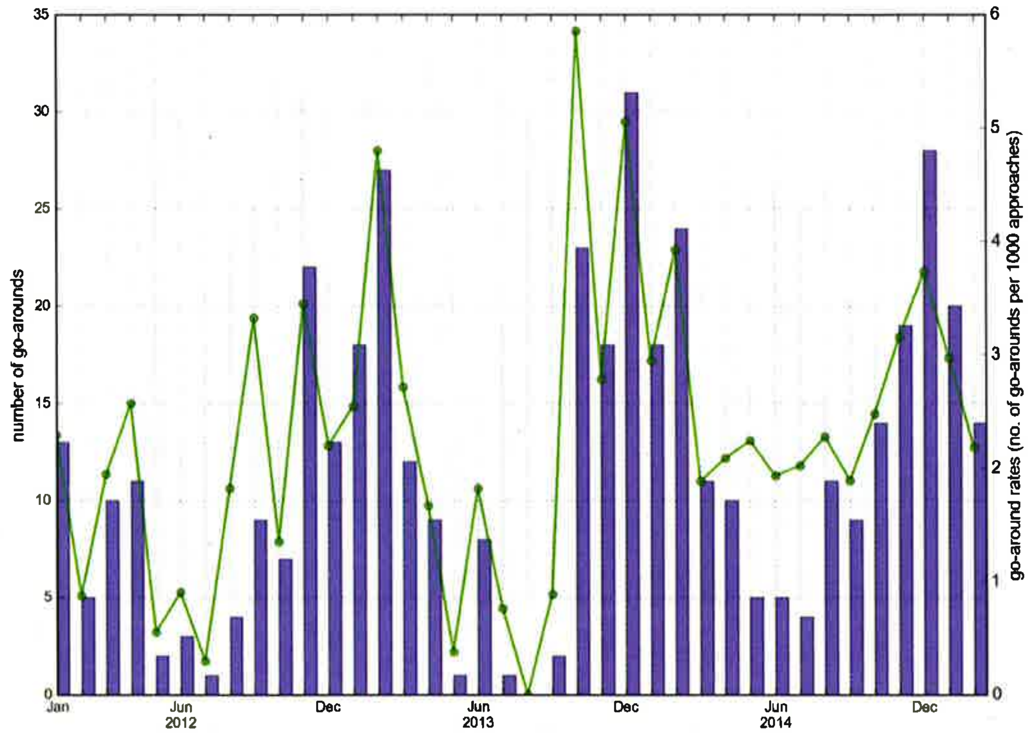

Figure 30: Melbourne go-around review on RWY 16 from January 1st, 2012 to February 28th, 2015.

9.3 Effect of meteorological conditions on go-around rates

This section gives figures and results investigating whether go-around rates are dependent on meteorological conditions, for the available data set.

It was important to assess the changes of LAHSO go-around rates according to the changes of cross wind and downwind and pick up the place where go-around rate was statistically different from the overall average go-around rate. The methodology for this purpose was to:

- divide each of the plots below into small rectangular regions
- calculate the go-around for each sub-region
- test for any statistically significant difference between the overall and sub-region rates.

This process can be repeated using different region positions and sizes. This process may give rise to false positives, since division of a region into 100 subregions will statistically give 5 false positives due to random variation (to a 95% confidence). Hence only a distinct cluster of several such regions would be considered statistically significant.

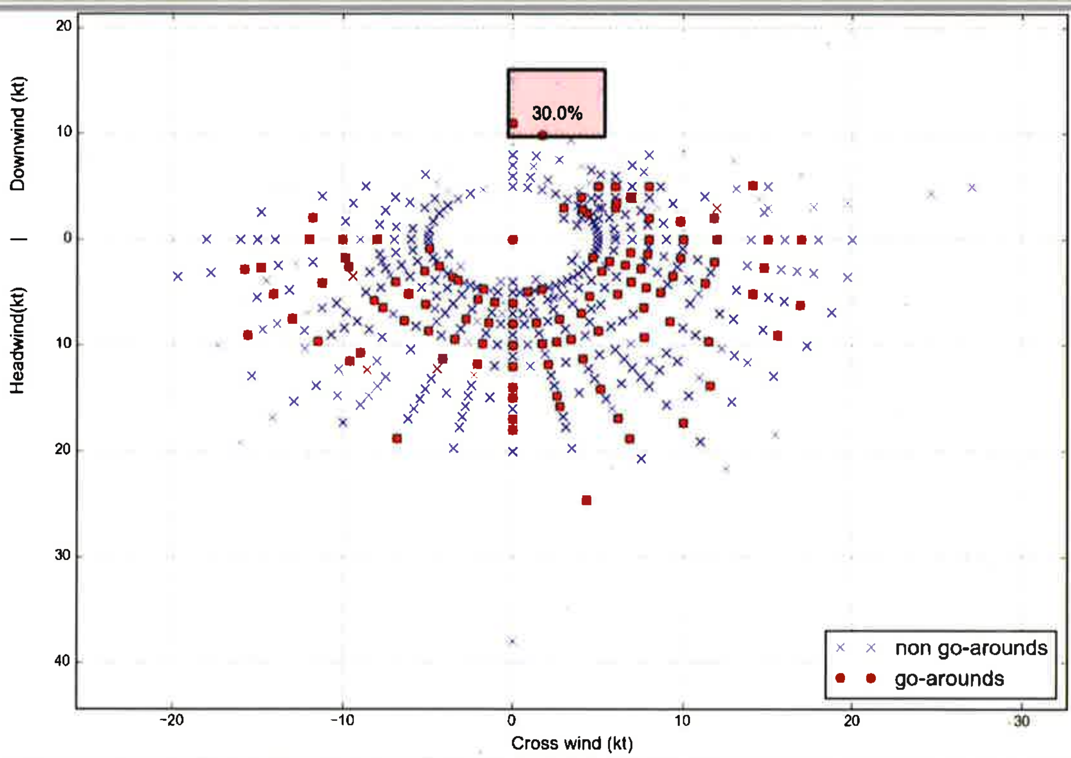

Figure 31: LAHSO go-around rate change detection under factor cross wind and downwind. Test region size was 7 x 6 (cross wind x downwind both in kts). The rectangular regions in red indicated the go-around rate was significant higher than the overall average go-around rate 0.00249 with a confidence interval 99.9%.

From *Figure* ***31*** one could see the regions with potential higher go-around rate were the places where the downwind was 10kts or more. This result was statistically significant despite the small sample size, however as discussed before this may still be a false positive due to the large number of sample regions.

Similarly, cross wind and visual distance *Figure* ***32***, cross wind and cloud base *Figure* ***33***, downwind and visual distance *Figure* ***33***, downwind and cloud base *Figure* ***35*** as well as visual distance and cloud base *Figure* ***36***, were reviewed for impact on LAHSO go-around rates.

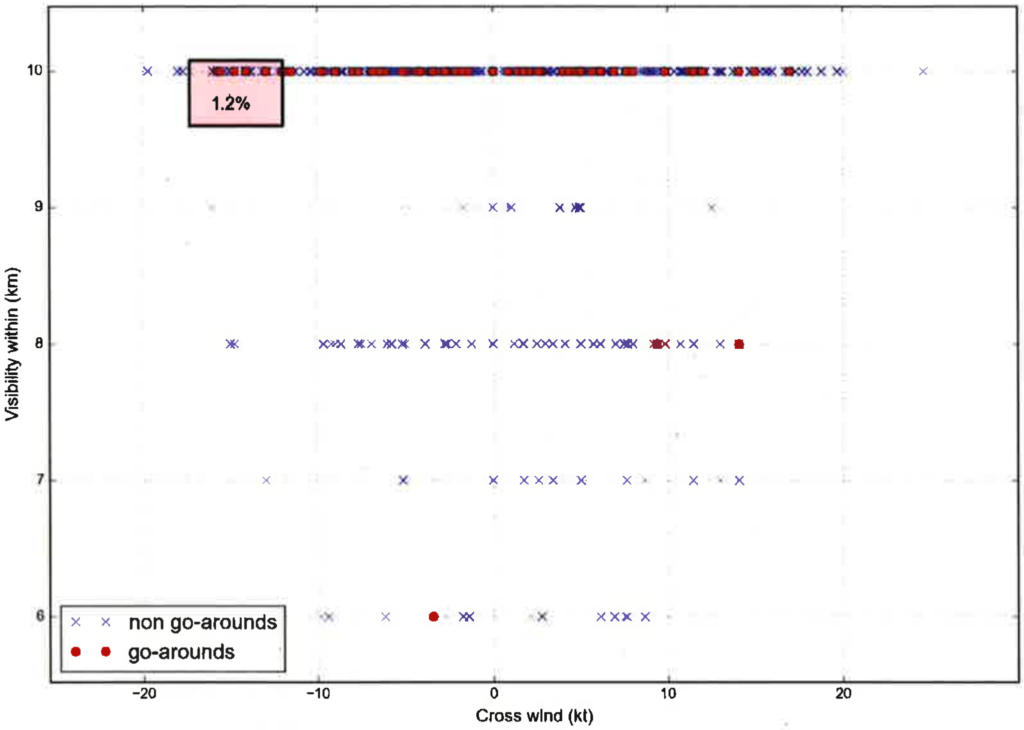

Figure 32: LAHSO go-around rate change detection under factor cross wind and visual distance. Test region size was 7 x 1 (cross wind in kts x visual distance in km). The region in red indicated the go-around rate was significant higher than the overall average go-around rate 2.49 per 1000 with a confidence interval 99.9%. The corresponding go-around rates were marked in the boxes.

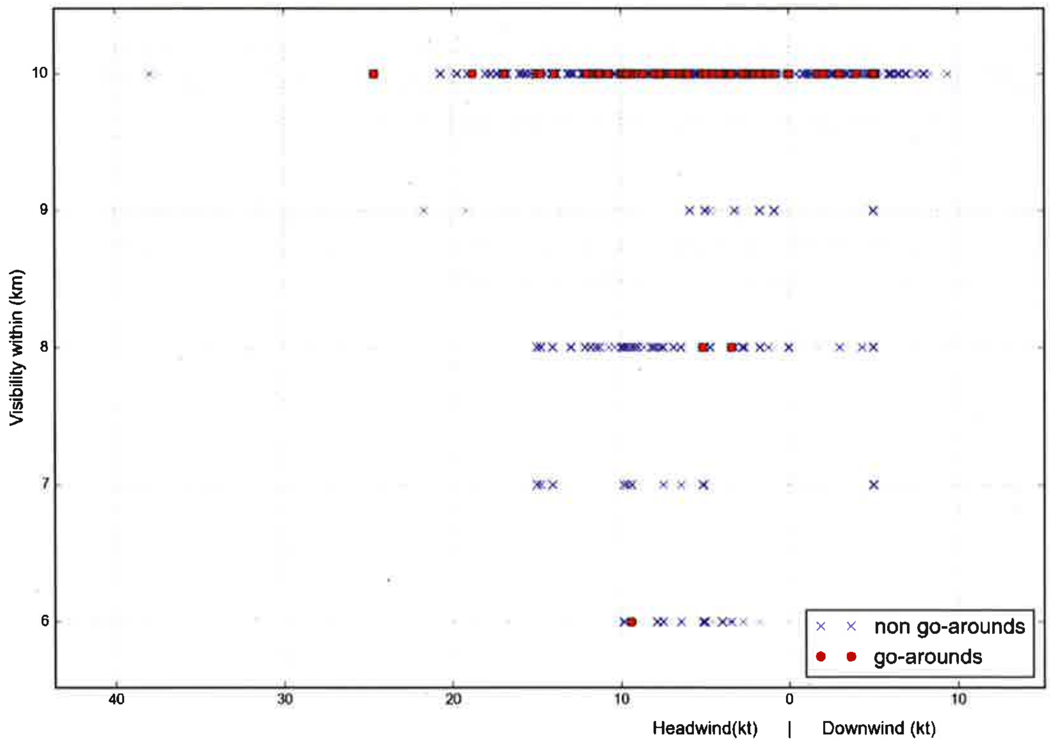

Figure 33: LAHSO go-around rate change detection under factors downwind and visual distance. Test region size was 6 x 1 (downwind in kts x visual distance in km). No significant difference detected.

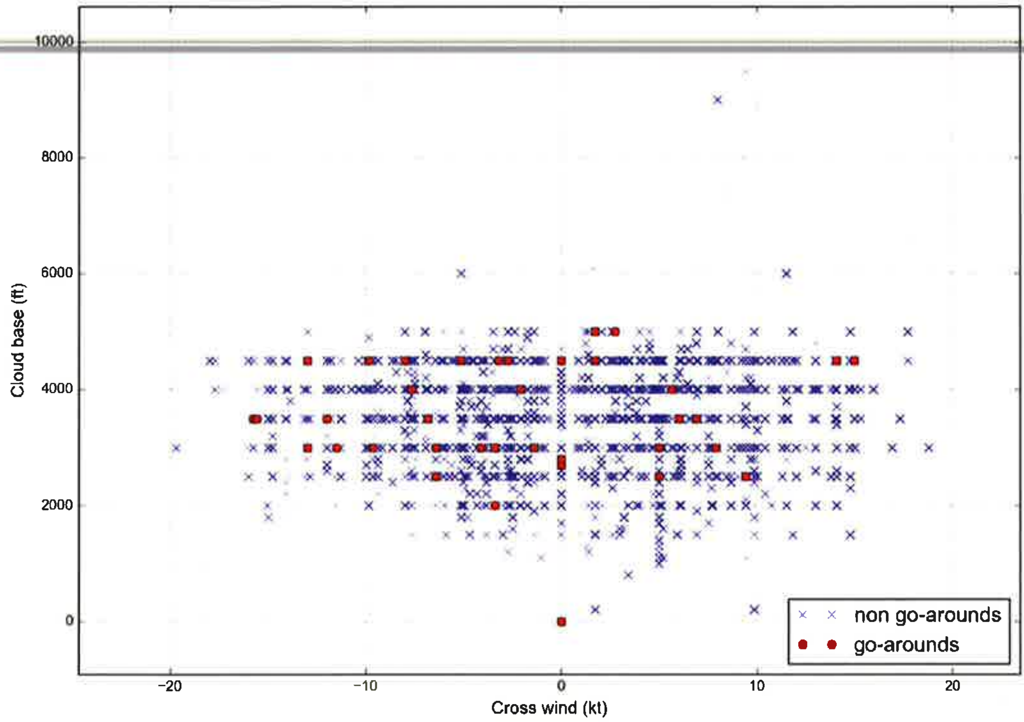

Figure 34: LAHSO go-around rate change detection under factors cross wind and cloud base. Test region size was 5 x 1302 (cross wind in kts x cloud base in ft). No significance detected.

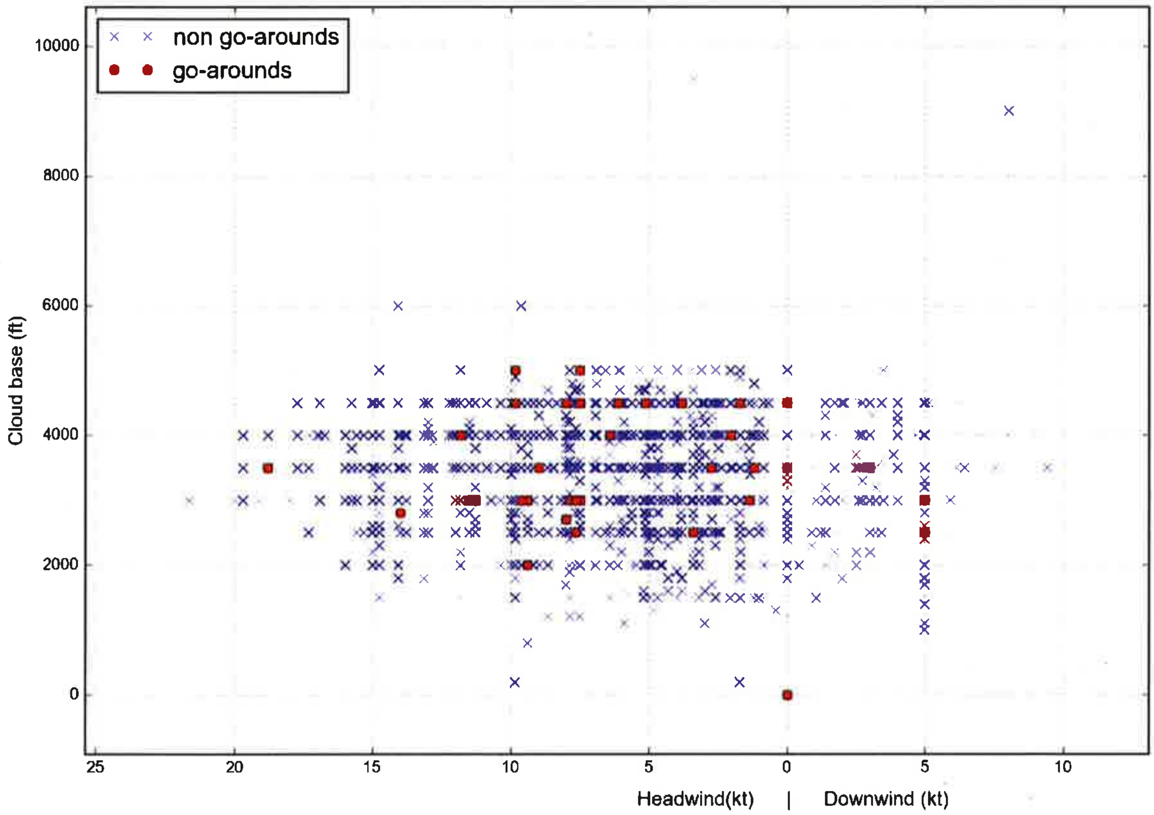

Figure 35: LAHSO go-around rate change detection under factors downwind and cloud base. Test region size was 4 x 1302 (downwind in kts x cloud base in ft). No significant difference detected.

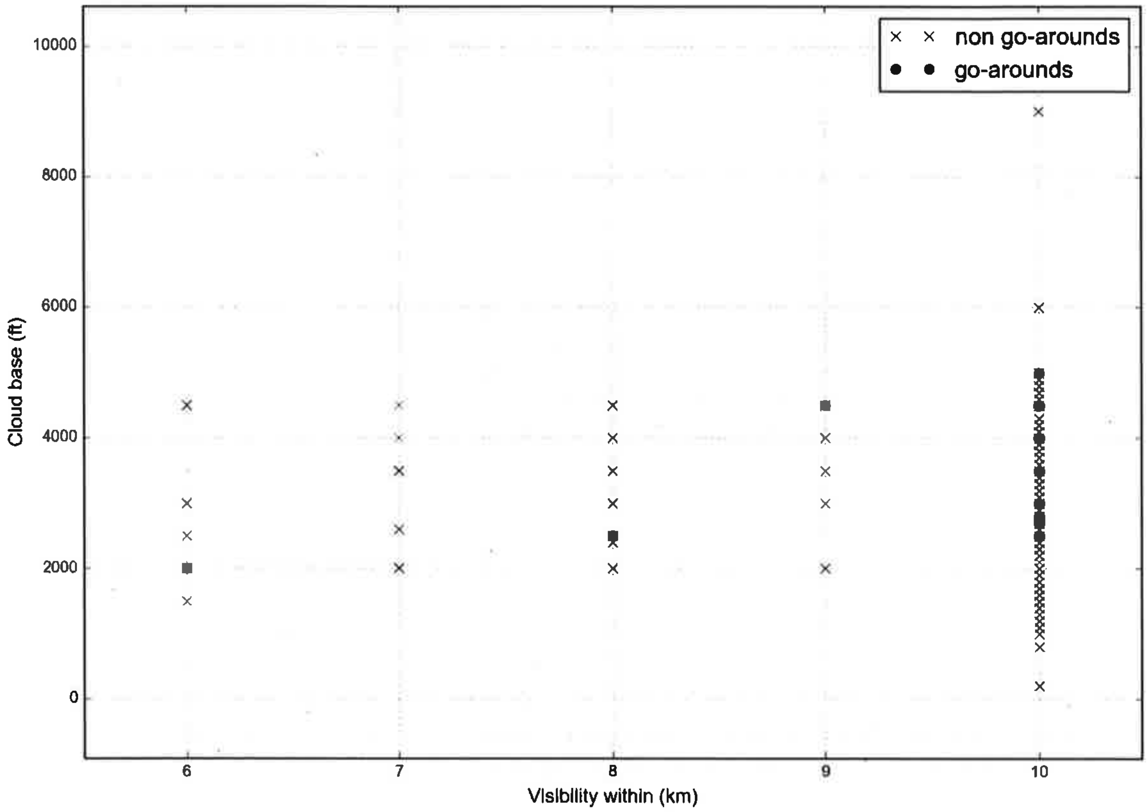

Figure 36: LAHSO go-around rate change detection under factors visual distance and cloud base. Test region size was 1 x 1302 (visual distance in km x cloud base in ft). No significant difference detected.

9.4 Source Directories

For internal Airservices reference the link below is the internal Airservices directory for files and data used in this report:

\\filecbr\arm\AAA_NEW_ARM\Projects\2015_Q1\Active\ODAS_request_ATC_LAHSO\LAHSOreview

9.5 Definitions

Within this document, the following definitions apply.

Term	Definition
ADMS	Aeronautical Data Management System
AIM	Aeronautical Information Management
ATIS	Automatic Terminal Information Service
ATC	Air Traffic Control
Beta distribution	A continuous probability distribution (see Appendix and http://en.wikipedia.org/wiki/Beta_distribution)
Bernoulli trial	In the theory of probability and statistics, a Bernoulli trial (or binomial trial) is a random experiment with exactly two possible outcomes, "success" and "failure", in which the probability of success is the same every time the experiment is conducted. http://en.wikipedia.org/wiki/Bernoulli_trial
CIRRIS	Corporate Integrated Reporting and Risk Information System
CROPS	Converting runway operations
DAH	Designated Airspace Handbook
DGA	Double Go-around
FIB	Flight Information Broker
FIR	Flight Information Region
GA	Go-around
IFR	Instrument Flight Rule
Kts	Knots
LAHSO	Land and hold short operations
MATS	Manual of Air Traffic Systems
OA	Operational Analysis: a unit within SSA
ODAS	Operational Data Analysis Suite: This is python-based numerical suite of tools for analysis of airspace flight data. It was developed within Operational Analysis
ORA	Operational Risk Assessments
pdf	Probability density function. In probability theory, a **probability density function** (**PDF**), or **density** of a continuous random variable, is a function that describes the relative likelihood for this random variable to take on a given value. The probability of the random variable falling within a particular range of values is given by the integral of this variable's density over that range—that is, it is given by the area under the density function but above the horizontal axis and between the lowest and greatest values of the range. The probability density function is nonnegative everywhere, and its integral over

	the entire space is equal to one. https://en.wikipedia.org/wiki/Probability_density_function
Rego	Aircraft Registration
RWY	Runway
RPT	Regular Public Transport
SEA	Safety, Environment and Assurance Group: a major group within Airservices
SIGMET	Significant Metrological Conditions
SSA	Strategy Systems and Analysis: a Branch within SEA
VFR	Visual Flight Rules
WX	Weather

9.6 Statistics of estimating go-around rate

This section explains some of the statistical methodology around how we estimated a go-around rate.
Each aircraft arrival is considered a Bernoulli trial: where the outcome is either success or failure (a go-around, termed here as an event of failure). If there are 3 events out of 1000 trials the estimated rate is 0.003 but there is a significant possibility the true rate is different from this.

Consider the simple case of a Bernoulli trial with **m** failures in **N** trials and our uncertainty in the failure rate **f=m/N** . We then consider the case the this failure rate may be dependent on two other parameters **x** and **y** and our confidence that **f** is different for different **x** and **y**.

The distribution of our estimate for **f** is given by the Beta function with probability density function (pdf) given by:

$$\frac{x^{a-1}(1-x)^{b-1}}{B(a,b)}$$

where *B(a,b)* is the Beta function. The parameters are:

$$a = alpha = 1 + successes,$$

$$b = beta = 1 + N - successes.$$

Figure ***37*** shows an example where the underlying rate is defined as 0.3 and data is generated by a random number generator. In the top plot there were 58 failures in 200 trials. The distribution of our estimate of the failure rate is shown by the distribution centred on 0.29. In the lower plot there was less data with 11 failures in 40 trials giving a much broader estimate of the failure rate.

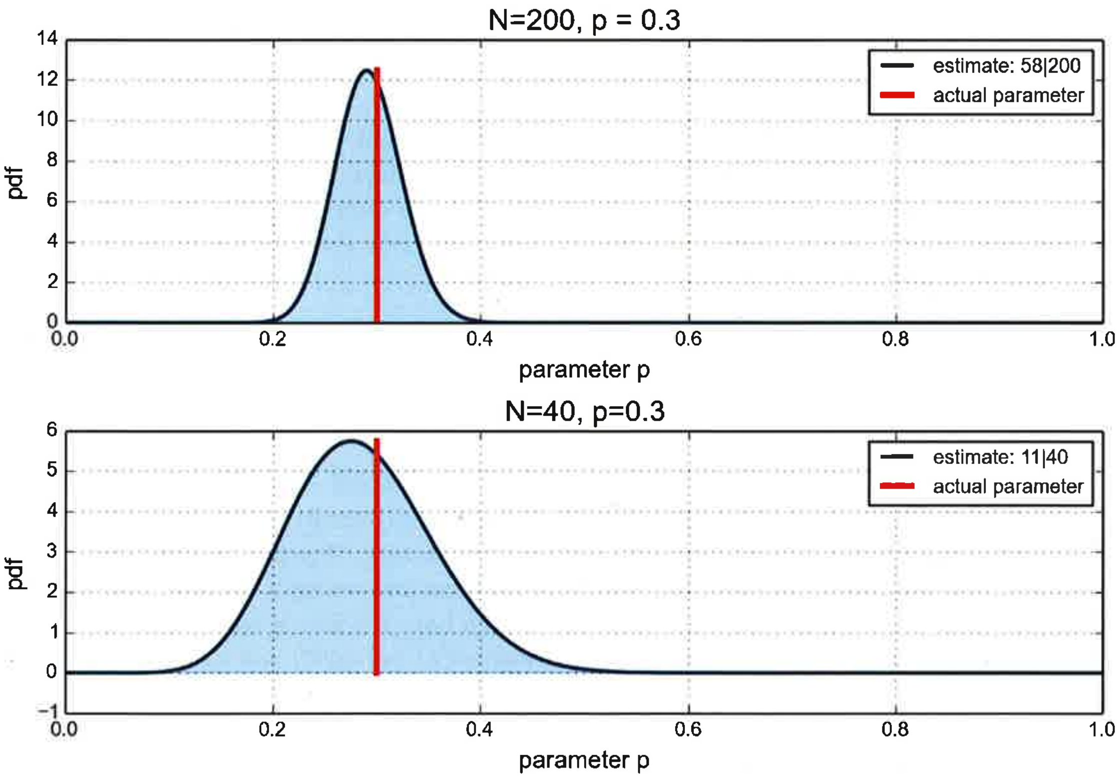

Figure 37: Illustration of estimation of failure rate. The vertical axis is the probability density function for our estimate. Here the actual rate is 0.3 and random number generates are used to simulate the trial. In the top plot there were 58 events out of 200 trials hence our estimate is 0.29 with a standard deviation in this estimate of 0.032. In the lower plot we have only 40 trials and hence with less data our confidence in our estimate is lower.

In probability theory and statistics, the Beta distribution is a family of continuous probability distributions defined on the interval [0, 1] parametrized by two positive shape parameters, denoted by α and β, that appear as exponents of the random variable and control the shape of the distribution http://en.wikipedia.org/wiki/Beta_distribution.

The pdf is

$$\frac{x^{\alpha-1}(1-x)^{\beta-1}}{\mathrm{B}(\alpha,\beta)}$$

The mean of a Beta distribution is

$$\mathrm{E}[X] = \frac{\alpha}{\alpha+\beta}$$

The variance is

$$\mathrm{var}[X] = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$$

9.7 Statistical arguments regarding correlated go-arounds

This section expands on the crucial argument about go-arounds being correlated.

In probability if event A and event B occur with probability P(A) and P(B) then if they are uncorrelated then the risk of both happening is P(A) P(B). For example, the likelihood of getting a 6 by throwing a dice is 1/6. The probability of getting a 6 then a 6 by throwing the dice twice is simply 1/36.

However, sometimes event B is influenced by the same factors as event A. For example, the probability of a rainy day may be 1/10. But the probability of two rainy days in a row is not 1/100 since we know that when one rainy day occurs it is more likely that the same weather is present the next day. Hence here the risk is probability of the first day being rainy and the second being rainy **given** the first day is rainy:

P(A & B) = P(A) P(B/A).

This same argument applies to go-arounds.

Some factors that cause go-arounds will persist for some time. Hence the likelihood of subsequent arrivals doing a go-around will be higher once one has already occurred. They are not independent. Hence it is important to test the data to see if this is true. This can be done by counting the number of arrivals within a few minutes of a go-around and seeing if these arrivals have the same go-around rate. In *Figure* ***16*** we show that within a hour the rate is twice as high, while *Figure* ***17*** shows that within 15 minutes it is 5 times higher (12 per 1000) and within one minute it is 16 times higher (40 per 1000) than the base rate of 2.5 per 1000.

9.8 Comparing two distributions

A two-sample Kolmogorov-Smirnov (KS) test was used to test whether two distributions are the same. The SciPy ks_2samp routine was used.
(http://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.ks_2samp.html)

The KS test considers two sets of numbers and evaluates how certain we are that they came from different distributions. If we have a lot of data we can be more certain. With a small amount of data this certainty is less unless the values are very different.
(https://en.wikipedia.org/wiki/Kolmogorov%E2%80%93Smirnov_test)

In the table below we compare the KS results for all pairs of distributions in *Figure* ***39***. If the p-values is small (<0.05) then there is evidence that the two samples are different. The lower the value for p and the higher the KS statistic, the more sure we are that the values are different.
Here the first two distributions with mean 2.0 and 1.7 are actually statistically the same. Thus in the table we also combine these values as ranges 0-1 with mean 1.8. The ranges correspond to original plot in *Figure* ***9***.

ranges	means	KS statistics	P value	Different?
0 and 1	2.0 and 1.7	0.26	1.3E-1	Same
0 and 2	2.0 and 2.7	0.34	1.4E-2	Different (just)
0 and 3	2.0 and 4.4	0.97	1.7E-7	Different
1 and 2	1.7 and 2.7	0.43	3.9E-4	Different
1 and 3	1.7 and 4.4	0.99	2.8E-8	Different
0-1 and 2	1.8 and 2.7	0.4	1.1E-4	Different
0-1 and 3	1.8 and 4.4	0.98	9.1E-9	Different
2 and 3	2.7 and 4.4	0.87	1.7E-6	Different

Figure 38: KS comparison statistics for the distributions in Figure 39. The ranges are the four distinct regions in the data, each with means 2.0, 1.7, 2.7 and 4.4 respectively. The KS statistics and the p-value give indications as to whether there is sufficient evidence that two means are different. Each mean has a level of uncertainty, with greater data giving more certainty. Hence our estimate of the mean 4.4 for data set in range 3 is quite uncertain.

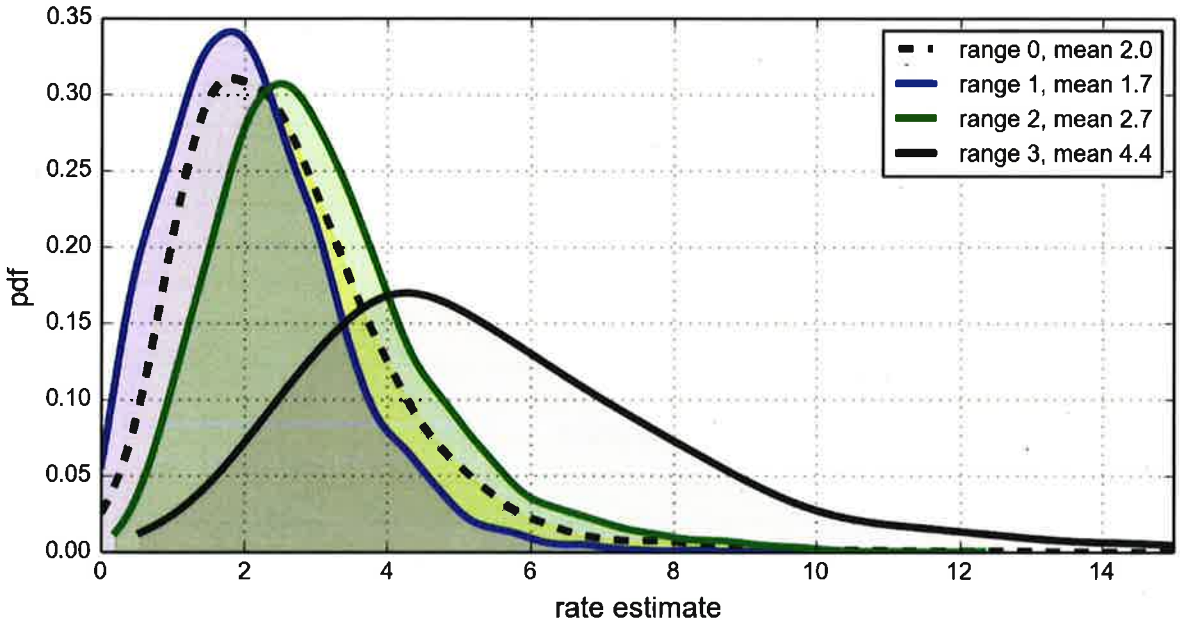

Figure 39: Comparing distributions. The two-sample KS statistic is used to test whether the distributions are statistically different.

9.9 Causal analysis of go-arounds from CIRRIS data

Count of Report Number		
Reason	**Reason & Additional Coding**	**Total**
Departing Aircraft	Rwy occupied - Departing Aircraft	13
	Rwy occupied - Departing Aircraft - Slow to depart	8
	Rwy occupied - Departing Aircraft - Landing Aircraft slow to vacate	6
	Rwy occupied - Departing Aircraft - Held due possible FOD	5
	Rwy occupied - Departing Aircraft - Slow to line up	5

	Rwy occupied - Departing Aircraft - Rejected Takeoff	3
	Rwy occupied - Departing Aircraft - Insufficient spacing with next arrival	2
	Rwy occupied - Departing Aircraft - Aircraft technical issue	2
	Rwy occupied - Departing Aircraft - Landing Aircraft missed RET	2
	Rwy occupied - Departing Aircraft - Maintain Runway Sep standard	2
	Rwy occupied - Departing Aircraft - Aircraft held in lined up position	2
	Rwy occupied - Departing Aircraft - Auto release suspended	2
	Rwy occupied - Departing Aircraft - Crossed holding point	1
	Non-LAHSO departure - crossing runway 27	1
	Rwy occupied - Departing Aircraft - Maintain Wake Turbulence Standard	1
Landing Aircraft	Rwy occupied - Landing Aircraft	2
	Insufficient spacing - Landing Aircraft - Crossing runway 27	2
	Rwy occupied - Landing Aircraft - Insufficient spacing with next arrival	1
	Rwy occupied - Landing Aircraft - Slow to vacate	1
	Rwy occupied - Landing Aircraft - Missed RET	1
Maintenance of wake turbulence separation	(blank)	1
No reason provided by pilot	(blank)	7
Other	(blank)	9
	Too high	1
Taxiing Aircraft	(blank)	1
Technical	(blank)	9
Unstable Approach	(blank)	36
	Too high	13
	Due Turbulence	1
	Windshear	1
Vehicle/Personnel on Runway	(blank)	1
Wake turbulence reported by pilot	Wake turbulence reported by pilot	1
Weather	Windshear	33
	(blank)	31
	Due Turbulence	1
FOD	(blank)	5
Grand Total		**213**

Table 7: Example of identified causal factors for Runway 34 go-arounds from CIRRIS data

Count of Report Number		
Reason	**Reason & Additional Coding**	**Total**
Departing Aircraft	Rwy occupied - Departing Aircraft	13
	Rwy occupied - Departing Aircraft - Slow to depart	8
	Rwy occupied - Departing Aircraft - Landing Aircraft slow to vacate	5
	Rwy occupied - Departing Aircraft - Landing Aircraft missed RET	4
	Rwy occupied - Departing Aircraft - Insufficient spacing with next arrival	4
	Rwy occupied - Unable to depart - Bird Activity	2
	Rwy occupied - Departing Aircraft - Held due possible FOD	1

	Rwy occupied - Aircraft over holding line at taxiway	1
	Rwy occupied - Departing Aircraft - Aircraft held in lined up position	1
	Rwy occupied - Departing Aircraft - Maintain Runway Sep standard	1
	Rwy occupied - Departing Aircraft - Aircraft technical issue	1
	Rwy occupied - Departing Aircraft - Rejected Takeoff	1
	Rwy occupied - Departing Aircraft - Rwy Crossing Aircraft - slow to cross	1
No reason provided by pilot	(blank)	5
Other	(blank)	4
	Non LAHSO arrival	1
	ATC unsure if LAHSO still running due change in weather	1
Rejected Takeoff	(blank)	1
Technical	(blank)	3
Unstable Approach	(blank)	14
	Due Turbulence	1
	Tailwind	1
	Too high	1
	Windshear	1
Vehicle/Personnel on Runway	(blank)	1
Weather	(blank)	30
	Windshear	6
	Excessive downwind	1
FOD	(blank)	2
Grand Total		**116**

Table 8: Example of identified causal factors for Runway 27 go-arounds from CIRRIS data

Count of Report Number		
Reason	**Reason & Additional Coding**	**Total**
Departing Aircraft	Rwy occupied - Departing Aircraft	60
	Rwy occupied - Departing Aircraft - Slow to depart	31
	Rwy occupied - Departing Aircraft - Landing Aircraft slow to vacate	26
	Rwy occupied - Departing Aircraft - Landing Aircraft missed RET	18
	Rwy occupied - Departing Aircraft - Held due possible FOD	13
	Rwy occupied - Departing Aircraft - Slow to line up	13
	Rwy occupied - Departing Aircraft - Insufficient spacing with next arrival	9
	Rwy occupied - Departing Aircraft - Aircraft held in lined up position	8
	Rwy occupied - Departing Aircraft - Rejected Takeoff	6
	Rwy occupied - Departing Aircraft - Aircraft technical issue	5
	Rwy occupied - Departing Aircraft - Maintain Wake Turbulence Standard	4
	Rwy occupied - Unable to depart - Bird Activity	3
	Rwy occupied - Departing Aircraft - Maintain Runway Sep standard	3
	Rwy occupied - Departing Aircraft - Auto release suspended	2
	Rwy occupied - Departing Aircraft - Unable to depart due increasing tailwind	1
	Rwy occupied - Departing Aircraft - Crossed holding point	1

	Rwy occupied - Aircraft over holding line at taxiway	1
	Departing Aircraft	1
	Rwy occupied - Departing Aircraft - Rwy Crossing Aircraft - slow to cross	1
	Non-LAHSO departure - crossing runway 27	1
Landing Aircraft	Rwy occupied - Landing Aircraft - Slow to vacate	15
	Rwy occupied - Landing Aircraft - Missed RET	6
	Rwy occupied - Landing Aircraft	4
	Rwy occupied - Landing Aircraft - Insufficient spacing with next arrival	2
	Insufficient spacing - Landing Aircraft - Crossing runway 27	2
	Landing Aircraft - Insufficient spacing with next arrival	2
	Landing Aircraft - Emergency - possible Rwy closure	1
	Insufficient spacing - Preceding arrival	1
	Landing Aircraft - Maintain Wake Turbulence Standard	1
	Rwy occupied - Landing Aircraft - Stopped on Rwy	1
Maintenance of wake turbulence separation	(blank)	1
No reason provided by pilot	(blank)	25
Other	(blank)	43
	Non LAHSO arrival	1
	Too high	1
	Due excessive groundspeed	1
	ATC unsure if LAHSO still running due change in weather	1
	LAHSO conditions no longer existed due change in weather	1
Rejected Takeoff	(blank)	2
Taxiing Aircraft	(blank)	2
Technical	(blank)	32
Unstable Approach	(blank)	105
	Too high	31
	Due Turbulence	3
	Windshear	2
	Due Track shortening	2
	Due wind change event	2
	Aircraft Technical Issue	1
	Tailwind	1
	Due Mechanical turbulence	1
Vehicle/Personnel on Runway	(blank)	2
Wake turbulence reported by pilot	Wake turbulence reported by pilot	1
	Wake turbulence from preceding arrival	1
Weather	(blank)	121
	Windshear	66
	Excessive downwind	4
	Strong tailwind	2
	Due Turbulence	1
	Variable winds	1
	Turbulence	1
FOD	(blank)	15

Grand Total		**715**

Table 9: Example of identified causal factors for all Runway go-arounds from CIRRIS data

9.10 References

Note:
SASP = ICAO Separation Airspace Safety Panel
RGCSP = Review of the general concept of separation panel (precursor to SASP)

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12. http://docs.scipy.org/doc/scipy-0.15.1/reference/generated/scipy.stats.beta.html
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Attachment 7

18 August 2015	Provision of options paper to CASA which addresses implementation of a stagger, as well as other opportunities to further mitigate LAHSO safety risks.

airservices

Assuring the Safety and Efficiency of the High Capacity Modes of Operation at Melbourne Airport

Table of Contents

	Name	Title	Signature
Prepared By:	[redacted]	Lead ALM, Melbourne and Canberra TCU	[redacted] 5/8/15.
Prepared By:	[redacted]	ALM, Melbourne and Canberra TCU	[redacted] 05/08/15
Prepared By:	[redacted]	ALM, ECSS Business Coordinator	[redacted]
Approved By:	[redacted]	Chief Air Traffic Control Officer	[redacted] 5/8/15
Approved By:	[redacted]	Manager, East Coast Services South	[redacted] 5.8.2015

1. *Executive Summary*

Land And Hold Short Operations (LAHSO) is a high capacity runway mode used at Melbourne airport whereby an aircraft is allowed to land or take off on one while another aircraft is allowed to land and hold short on a crossing runway. The use of LAHSO at Melbourne is known to have a positive effect on the safe operation of the ATC network on the east coast of Australia by reducing capacity 'pressure' in the National Airways System. The ongoing use of LAHSO is supported by our airline partners and Melbourne airport.

There has been an increasing focus on the risks that might be associated with LAHSO. Coincident with more sophisticated and detailed risk analysis, there was a double Go Around occurrence at Melbourne. While the aircraft involved were never in unsafe proximity, the occurrence was considered to be significant enough to warrant an immediate review of the causal factors and identify any action that could reduce the likelihood of a similar occurrence. Initial areas of focus were runway modes where the Go Around rate was highest, off mode departures and training during LAHSO.

To reduce the likelihood of a double Go Around leading to aircraft being placed in unsafe proximity, a variety of options to introduce a "stagger" is being considered. A "stagger" in this case is defined as a procedure where the aircraft are sequenced to achieve a predetermined relative runway threshold crossing time in order to remove or reduce the potential collision risk at the runway intersection in the event of simultaneous Go Around.

Reducing the likelihood of initiating events for a Go Around during LAHSO was also identified as an area that would reduce the likelihood of a double Go Around. During LAHSO, sequencing departures from the active runway (Runway 34 at Melbourne) adds additional complexity to the task of the Aerodrome Controller (ADC). These off mode departures have been identified as a potential trigger for a Go Around.

Another initiating event for a Go Around is an unstable approach. One solution to reduce the likelihood of an unstable approach during LAHSO is to mandate the use of Instrument Approach Procedures (IAP). IAP require the aircraft to be established on the runway heading much further and ensure that the aircraft flies the correct profile.

The use of high capacity arrival modes of operation to facilitate efficient arrivals during low demand creates an expectation that runways modes can and will be changed at anytime. However, frequent short notice mode changes can introduce more risk and increase ATC and pilot workload. If the use of high capacity modes is restricted to those times where delays in the system go beyond an agreed trigger point then there will be fewer opportunities for a double Go Around to occur.

After consultation it has been decided to pursue the following options to reduce the likelihood of a double Go Around occurring.

a. Creation of a stagger by introducing "Runway Dependency within MAESTRO"

b. Introduction of a Pilot/Operator initiated off mode departure request procedure

c. Mandated use of Instrument Approach Procedures during LAHSO

d. Use of high capacity modes only during periods of high demand

2. Purpose

The purpose of this paper is to:

1. explain the immediate action taken to assure the safety and efficiency of the high capacity modes of operation at Melbourne Airport (LAHSO); and,

2. propose other options that could be introduced in the medium to longer term to better systemise the application of the LAHSO procedures.

3. Background

There has been an increasing focus on the risks that might be associated with Land And Hold Short Operations (LAHSO) at Melbourne Airport. Coincident with more sophisticated and detailed risk analysis[1] by the Operational Analysis (OA) unit within Safety, Environment and Assurance, there was a double Go Around occurrence at Melbourne on Sunday 5th July. While the aircraft involved were never in unsafe proximity, the occurrence was considered to be significant enough to warrant an immediate review of the causal factors and identify any action that could reduce the risk of a similar occurrence. The effect of "Off Mode" departures during LAHSO was one causal factor identified and another was the potential impact of the training occurring at the time had on decision making.

A workshop was held in Melbourne on 15th July to review the work of OA and to identify any risks that might be associated with the suspension of LAHSO. In addition, any other potential changes to the procedures that would further reduce the likelihood of aircraft being in unsafe proximity due to a double Go Around event were discussed.

4. High capacity modes

LAHSO is a high capacity runway mode used at Melbourne airport whereby an aircraft is allowed to land or take off on one runway (Runway 27/09 at Melbourne) while another aircraft is allowed to land and hold short on a crossing runway (Runway 34 at Melbourne). Use of this mode permits an arrival rate of 44[2] aircraft per hour compared with a maximum of 27 arrivals using the next best mode. The use of LAHSO is regulated under Civil Aviation Safety Regulation (CASR) Part 172 and the requirements of the Part 172 Manual of Standards (MOS) are translated into rules for Pilots and Air Traffic Controllers in the Aeronautical Information Publication (AIP) and the Manual of Air Traffic Standards (MATS).

LAHSO can be implemented at aerodromes controlled by ATC that have suitable runway configurations, together with taxi markings, signs, runway markings, and lights. It is a "dependant procedure", with the aircraft in the "LAHSO pair" classified as either:

- active – when an aircraft is issued a hold short requirement and is alerted about traffic on a crossing runway; or
- passive – when an aircraft has unrestricted use of the full runway length and is alerted about traffic on a crossing runway.

In the event of aircraft approaching each runway going around during LAHSO, there is the potential for aircraft to be in unsafe proximity at the runway intersect point. This is referred to as a "double Go Around".

[1] Risk analysis of Melbourne LAHSO operation v3.2 Effective 2015-07-17

[2] While LAHSO create a theoretical arrival rate of 44 the demand to date has not exceeded 32

In order to further reduce the likelihood of a double Go Around leading to aircraft being placed in unsafe proximity, a variety of options to introduce a "stagger" are to be considered. A "stagger" in this case is defined as procedure whereby the aircraft are sequenced in such a way that one approaching the passive runway will always arrive at the threshold a time (T) before the other aircraft arrives at the threshold of the active runway and therefore their possible times at the intersection in the event of a double Go Around will be deconflicted.

The use of LAHSO at Melbourne is known to have a positive effect on the safe operation of the ATC network on the east coast of Australia. Any changes to LAHSO may impact on the en route arrivals sectors that feed Melbourne and may also impact on other airports in the network that benefit from the use of this high capacity mode reducing the 'pressure' in the system.

The ongoing use of LAHSO is supported by our airline partners and Melbourne airport.

5. *Initial actions*

The initial investigation into the occurrence on 5th July identified the need for additional controls to manage the risk created by "Off Mode" Runway 34 Departures during 27/34 LAHSO. As the impact of training was not yet quantified, a suspension of training during LAHSO was considered appropriate. Therefore, on 14th July TLI_15_0185 was issued suspending ADC training during LAHSO and restricting off mode departures to those operationally required.

After further consideration and taking into account the information presented at the workshop on 15th July TLI_15_0195 was issued on 24th July introducing the following controls:

- suspending 09/34 LAHSO until further analysis of the risks has been completed. This was because in this mode all departures are from runway 34
- restricting off mode departures from Runway 34 to aircraft that have an operational requirement (with one exception)
- allowing off mode departures generated by a Runway mode change to 27/34 LAHSO. This was done because of the risks generated by the additional complexity for ATC and aircrew caused by aircraft having to change their outbound clearances and taxi to another runway for departure
- suspending training on ADC until any potential for additional risk being introduced in the training environment had been addressed.

The effectiveness of these initial actions is being monitored.

6. *Options to introduce arrivals stagger*[3]

Analysis undertaken by OA of real time Eurocat traffic data shows that of the 38,574 LAHSO pairs identified in the three years to 1st February 2015, 2,932 (7.6%) could have arrived at the runway intersection within 20 seconds of each other had they both gone around. While this scenario has never eventuated the 92% natural stagger does not provide sufficient assurance that in the event of a double Go Around aircraft would not come into unsafe proximity. To do this it would be necessary to ensure that their arrivals at each runway are staggered and a dependency of one arrival on the other is established.

Runway Dependency within MAESTRO

In the Melbourne ATSC the MAESTRO (Means to Aid Expedition and Sequencing of Traffic with Research of Optimisation) tool is used to support the flow of arriving traffic and optimise the delay management process. During LAHSO, MAESTRO is configured to run independent sequences to

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[3] Action 7 (ACT-0006912) from the *Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Safety Assurance* Version 1: 20 March 2015

each runway. It may be possible to configure MAESTRO to provide staggered arrivals to runways 27 and 34 by altering feeder fix times. The stagger would be formulated as follows:

- Aircraft land on RWY 34, 'T' seconds after aircraft lands on RWY 27. T = X% of the landing rate.
- LASHO rates 22 per runway = 165 second spacing, therefore T = 19.8 seconds or 12% of the landing rate
- Theoretically an arrival for RWY 34 would touch down 19.8 seconds behind the RWY 27 arrival
- At 120 knots GS the RWY 34 arrival would be 1.1NM behind the RWY 27 arrival at the respective thresholds giving an increased distance at the runway crossing point greater than 2NM.

The required spacing at the runway could be impacted by:

- Wind
- Pilot/ATC inputs
- Weather deviations

Simulation and other modelling are required to validate the viability and effectiveness of this option.

	Considerations	**Benefits**
Fidelity/Assurance	Dependency at Feeder fix Subject to many variables Simulation required	Reduced risk in the event of DGA
Complexity/Workload	MAESTRO manages workload Additional work for controllers	Low complexity and workload
System support /Resource demand	Operational Analysis support for modelling ATC and SSO Staff required for development and delivery of simulation	
Technology	Data upgrade for MAESTRO	Uses existing technology

MAESTRO Dependency with conflict alert tool

This option proposes use of MAESTRO augmented by a Eurocat system tool to alert the controller if the correct stagger will not be achieved.

During LAHSO a Traffic Director (DIR) would monitor the spacing between the landing pairs. In the event of a conflict the DIR would ensure the spacing by using speed control. If spacing was not assured the DIR would initiate a breakout procedure. These two control options are the only ones considered viable due high cockpit workload and proximity to the landing runway. LAHSO pairs could be designated and an alert generated if the aircraft are within a predefined time of one another at the conflict point [e.g. 20 seconds]. Currently no such tool exists.

	Considerations	Benefits
Fidelity/Assurance	Level of assurance provided	Tool determines time at conflict point Reduced risk in the event of DGA
Complexity/Workload	High complexity to implement and high workload for ATC	Decision support tool to reduce workload
System support/Resource demand	Operational Analysis support for modelling ATC and SSO Staff required for development and delivery of simulation Extra FTE for DIR position Requires investment in system nearing end of life	
Technology	Conflict tool requires significant design, development, testing and validation	

Dependant Runway operations

To provide more certainty of a stagger at the conflict point being achieved the use of a dedicated Traffic Directors (DIR) would be required. This would make the runway operations "Dependent". The potential impact on capacity would need to be determined.

	Considerations	Benefits
Fidelity/Assurance	Level of assurance provided	Guarantee of stagger Removes risk of DGA
Complexity/Workload	High complexity to implement and high workload for ATC TMA airspace redesign required Open STARS and redesign of SID to ensure required segregation of flight paths More ATC intervention (vectoring) Impact on capacity	Up skills controllers prior to 3rd runway
System support /Resource demand	ATC and SSO Staff required for development and delivery of simulation Extra FTE for DIR position Procedure design Environmental concerns re flight path changes Requires investment in system nearing end of life	
Technology	HMI changes and significant system tool design, development, testing and validation	

7. *Managing off mode departures*

During LAHSO sequencing departures from the active runway (Runway 34 at Melbourne) adds additional complexity to the task of the Aerodrome Controller (ADC). The off mode departures require sufficient spacing of approaching aircraft to both the active and passive runways to permit the departure to be clear of both runways before the next landing aircraft reaches the threshold. If the ADC misjudges the "Gap" in the sequence to launch the departure then the aircraft on approach may have to be sent around to assure runway separation is maintained.

Many of the aircraft that operationally require the use of runway 34 during 27/34 LAHSO are long haul international heavy aircraft that have a higher and less predictable Runway Occupancy Time (ROT) than domestic operators.

To allow off mode departures to continue and reduce the likelihood of a Go Around during LAHSO, it may be possible to create regular gaps in the sequence to guarantee the safe departure of aircraft from runway 34. This procedure, associated with the use of cut-off distances by the ADC, i.e. the aircraft can only be lined up for departure with another aircraft within distance Xnm of the threshold, may provide the required assurance.

The more predictable nature of arriving aircraft to runway 34 using Instrument Approach Procedures (IAP) rather than visual approach procedures may also make it easier for the ADC to better judge the gap available for departures.

Procedures put in place for off mode departures during LAHSO may also be applied to other runway modes to reduce the overall rate of Go Around occurrences at Melbourne.

8. *Options to manage off mode departures*

Systemised gap

Configure MAESTRO in such a way as to insert a "gap" every 15-20 minutes to facilitate the off mode departures.

	Considerations	**Benefits**
Fidelity/Assurance	Level of assurance provided	Provides dedicated gap for off mode departure Reduces likelihood of DGA
Complexity/Workload	Additional coordination of pending departure so it is ready at gap time Off mode 34 departure not available to mitigate SMC workload and complexity especially during taxiway works Impact on capacity/network due arrival rate reduction	
System support /Resource demand	Requires operational trial to evaluate effectiveness ATC and SSO Staff required for development and delivery of simulation	
Technology	Uses existing technology	No system changes required

Pilot/Operator initiated off mode request

The pilot or aircraft operator would have a requirement to contact the Traffic Manager (TAC) 30 minutes prior to their intended departure time and inform them that they have an operational requirement for the off mode runway. After coordination with the tower Coordinator (COORD) the TAC would create a dedicated gap in sequence and advise the pilot of the negotiated take off time.

	Considerations	**Benefits**
Fidelity/Assurance	Level of assurance provided	Provides dedicated gap for off mode departure Reduces likelihood of DGA
Complexity/Workload	Gap coordination procedure required Management of non-compliance Off mode 34 departure not available to mitigate SMC workload and complexity especially during taxiway works Increased workload for TAC/COORD Impact on capacity/network due arrival rate reduction	
System support /Resource demand		
Technology	Uses existing technology	No system changes required

Reduce Arrival rate

If the arrival rate of 44 per hour during LAHSO was reduced to a lower number, e.g. 36, this may create natural gaps in an arrival sequence to facilitate the off mode departures. This amendment to the rate linked with cut-off distances may negate the requirement to implement a more complex change.

	Considerations	Benefits
Fidelity/Assurance	Level of assurance provided	Provides gap for off mode departure Reduces likelihood of DGA
Complexity/Workload	Gap coordination Off mode 34 departure not available to mitigate SMC workload and complexity especially during taxiway works Impact on capacity due arrival rate reduction	Change is easy to implement
System support /Resource demand	Changes required to advertised rates in Metron Harmony	No change to procedures or staffing
Technology	Uses existing technology	No system changes required

9. *Other considerations*

Matching the use of high capacity modes to high demand

The use of high capacity arrival modes of operation to facilitate efficient arrivals during low demand creates an expectation that runways modes can and will be changed at anytime. However, frequent short notice mode changes can introduce more risk of errors in the tower, approach and en route sectors affected and increase ATC and pilot workload. Mode changes require careful consideration and close coordination between approach and tower to maximise the operational benefit of mode selected for the management of the near term traffic disposition. By example, if there were a number of aircraft requiring the use of Runway 34 for departure and only a small number of inbound aircraft with minimal delay, the benefit of transitioning to LAHSO for a short period may be negligible. If the use of high capacity modes is restricted to those times where delays in the system go beyond an agreed trigger point, e.g. 10 minutes, then there will be fewer opportunities for a double Go Around to occur.

Go Around Minimisation

The OA draft report contains a comprehensive review of all Go Around occurrences from 1 January 2012 to 28 February 2015. Of note from the report was the Go Around rate on runway 09 was particularly high - 15.7/1000 approaches during LAHSO - compared to the average of 2.5/1000 for all runways. The Go Around rate on runway 34 was also higher at 4.1/1000 approaches during LAHSO.

By better understanding the initiating events leading to a Go Around, it may be possible to reduce the likelihood of a Go Around. To do this, more in depth analysis of the Go Around data will be required.

Stable Approaches: One common cause of a Go Around is an unstable approach. An approach is stabilised when all of the following criteria are met:

- The aircraft is on the correct flight path
- Only small changes in heading/pitch are necessary to maintain the correct flight path
- The airspeed is not more than Landing Reference Speed (VREF) + 20kts indicated speed and not less than VREF
- The aircraft is in the correct landing configuration
- Sink rate is no greater than 1000 feet/minute; if an approach requires a sink rate greater than 1000 feet/minute a special briefing should be conducted
- Power setting is appropriate for the aircraft configuration and is not below the minimum power for the approach as defined by the operating manual
- All briefings and checklists have been conducted

An approach that becomes un-stabilised below 1000 feet above airport elevation in IMC or 500 feet above airport elevation in VMC requires an immediate Go Around.

During LAHSO at Melbourne aircraft are often sequenced to runway 34 via a Standard Arrival Route (STAR) that terminates with a visual approach. This approach is commonly referred to as the "SHEED arrival" after the name of the last waypoint on the STAR. This arrival is designed to avoid Essendon airspace and as such places the aircraft above a normal arrival profile. It is possible that the use of the SHEED arrival contributes to the higher Go Around rate on runway 34 (4.1/1000 during LAHSO).

One solution that may reduce the likelihood of an unstable approach during LAHSO is to mandate the use of Instrument Approach Procedures (IAP). IAP require the aircraft to be established on the runway heading much further out and the pilot is provided with electronic lateral and vertical navigation information that better ensure that the aircraft flies the correct profile. The following procedures are available at Melbourne on runways used for LAHSO:

- RWY 34 - RNP, RNAV
- RWY 09 - RNP, RNAV
- RWY 27 - ILS, RNAV

Ground Based Augmentation System - GBAS

Melbourne airport has one Category III ILS service to Runway 16 and one Category I ILS service to Runway 27. Runways 09 and 34 do not have a precision approaches. The planned installation of GBAS at Melbourne will provide a Category I GBAS Landing System (GLS) service to all four runways. Installation and use of the GBAS system is likely to have a positive impact on the higher Go Around rate for Runway 09 and 34.

Commissioning of the GBAS system is projected to occur late in the first quarter of 2016.

Aerodrome Windshear monitoring

Another common cause of a Go Around is low level wind shear. The rules for LAHSO do not allow for LAHSO to be undertaken if low level windshear of intensity greater than light has been reported by a pilot. As ATC rely on pilot reports, a Go Around has to occur before LAHSO will be cancelled. If it were possible to detect the presence of low level windshear before a Go Around was triggered then the cancellation of LAHSO could be a proactive rather than reactive procedure.

The ability to accurately detect runway specific low level windshear in a timely fashion would assist ATC in proactively minimising windshear Go Around events by changing mode or delaying approaches.

Windshear advice at Melbourne comes from two sources:

- Bureau of Meteorology predictive reports; and
- advice from aircraft either experiencing the phenomena and/or with detection from onboard avionics equipment

In some cases, the windshear is already close enough to the final approach to impact operations. Installation of suitable windshear detection equipment that provides pre-emptive warning of windshear would be of benefit.

There are systems, such as the FAA-Certified Climatronics Low Level Windshear Alert System (LLWAS) in use at 41 airports in the United States, which may be suitable for deployment at Melbourne. The installation of LLWAS at an airport would usually be undertaken by the airport authority and as such any discussion regarding LLWAS should be led by Melbourne Airport.

10. Consultation

After consultation with the Acting EGM ATC, Chief ATC and Regulatory Services Manager, agreement was reached that a stagger is the most powerful mitigator for all the risks associated with LAHSO. It was also agreed that other actions to reduce the likelihood of a Go Around would be pursued. The areas of focus would be:

- Stabilised approaches
- off mode departures from runway 34
- Limiting the time that LAHSO mode is used, ie Matching the use of high capacity modes to high demand

11. Conclusion

LAHSO is a high capacity runway mode used at Melbourne airport whereby an aircraft is allowed to land or take off on one while another aircraft is allowed to land and hold short on a crossing runway. The use of LAHSO at Melbourne is known to have a positive effect on the safe operation of the ATC network on the east coast of Australia by reducing the 'pressure' in the system. The ongoing use of LAHSO is supported by our airline partners and Melbourne airport.

There has been an increasing focus on the safety of LAHSO due to recent occurrences and more sophisticated analysis of the risks. In order to further reduce the likelihood of a double Go Around leading to aircraft being placed in unsafe proximity, a variety of options to introduce staggered arrivals have been considered. In addition, possible measures to reduce the number of Go Around occurrences have been identified.

There are a range of options that vary in their technical complexity and ease of implementation. There are relatively straight forward changes that could be initiated in a short time given appropriate resources are allocated to the change process and other more significant and costly changes that would involve major changes to airspace, procedures and systems.

12. Recommendations

It is recommended that the following identified options are pursued:

a. Creation of a stagger by introducing "Runway Dependency within MAESTRO"

b. Introduction of a Pilot/Operator initiated off mode departure request procedure

c. Mandated use of Instrument Approach Procedures during LAHSO

d. Use of high capacity modes only during periods of high demand

Attachment 8

19 September 2015	Minutes of the August 2015 LAHSO Steering Committee Meeting provided to CASA

Purpose

This is a routine meeting of the Steering Committee oversighting progress on the creation of a stagger by introducing "Runway Dependency within MAESTRO" [1]

Attendees

[redacted]	ECS-S SDLM	[redacted]	ML/CBR TCU ALM
[redacted]	CATC	[redacted]	ECS-S Business Coordinator
[redacted]	ML/CB TCU and TWRs Lead	[redacted]	A/OA Eurocat

Discussion points

- SIM evaluation Monday [[redacted]]
  - Runway dependencies within Maestro not used currently and the use of dependent semi-dependent modes is not well understood.
- Consistency of outcomes relative
- Do controller behaviours impact consistent outcomes?
- MAESTRO data settings – TTG times for each feeder fix
- Can a dummy wind be used to manage the desired stagger?
  - Concerns about reliability and repeatability of this method
- The use of Maestro experience/expertise from Brisbane and Sydney
- Safety: SCARD ready for review. The engagement of a Safety Specialist to be pursued.

Action register

#	Action	Responsible	Due
1	SIM evaluation brief	[redacted]	27 Aug
2	Obtain DROPS update from [redacted]	[redacted]	27 Aug
3	Liaise with [redacted] re availability to assist in non-op capacity	[redacted]	27 Aug
4	Liaise with [redacted] regarding validation safety work/oversight requirements	[redacted]	27 Aug
5	Liaise with [redacted] potential involvement	[redacted]	27 Aug
6	Liaise with [redacted] involvement	[redacted]	27 Aug

Next meeting

Thursday 27 August – Time 1300

[1] Assuring the Safety and Efficiency of the High Capacity Modes of Operation at Melbourne Airport

Attachment 9

8 October 2015	Bi-monthly update on to CASA on improvement LAHSO actions underway (commitment as per letter 7/8/2015)

LAHSO progress report to CASA (Oct 15):

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the definitions and terminology contained in national standards, rule set and procedures to ensure consistency and application intent.	Any implemented changes to rule sets / procedures	The review is completed. All resulting rule set/procedure change actions have been captured in CIRRIS.	Complete
Conduct a review of LAHSO procedures and practices at Melbourne and Adelaide to ensure the application is consistent with the intent of the CASA Manual of Standards (MOS) Part 172, the Aeronautical Information Package (AIP) and the Manual of Air Traffic Services (MATS).	Any implemented changes to rule sets / procedures.	The review is completed. All resulting AIP/MATS change actions have been captured in CIRRIS.	Complete
Reassessment of the data modelling completed for the 2013 Melbourne Go-Around Study. Incorporate data modelling as an addendum to 2012 LAHSO Safety Assessment Report	Risk modelling report	The analysis has been completed.	Complete
Risk assessment of all LAHSO procedures and practices at Melbourne using additional top-down and bottom up techniques as described in AA-GUIDE-SAF-0105C to ensure the identification and assessment of all potential failure modes associated with all operational airspace and runway mode configurations. Incorporate assessment as an addendum to 2012 LAHSO Safety Assessment Report and update ORAs as appropriate	Addendum to the 2012 CROPS/LAHSO SAR report. Updated Melbourne Tower and TCU ORA	The risk assessment of LAHSO procedures (including supporting evidence) has been completed.	Complete
Conduct a review of the training and support for personnel with National Request for Change (NRFC) safety management roles and responsibilities to ensure safety change is managed in accordance with Safety Change Management Requirements.	NRFC Safety Management Roles Training and Support Review (Version 4)	Complete. The following further actions address the findings: – Development of the safety competency framework to include	Complete

Action	Deliverable	Current Status	Planned Completion
		competency requirements for safety specialists and managers approving operational change. Targeted staff training is due to commence in October 2015 (ACT-0007754). – Procedure changes to clarify the relationship between the role of the 'Safety Coordinator' and 'Lead Safety Specialist' (ACT-0007773 and ACT-0007774).	
Implement a scheduled programme of operational surveillance activities of sufficient scope and periodicity to provide assurance that the application of procedures and practices remain consistent with national standards and the rule set.	Program of operational surveillance activities.	The Office of the CATC is conducting an operational surveillance of LAHSO in Melbourne during the month of October 2015. The criteria for determining which units will be a priority for subsequent operational surveillance activity is still under development and Airservices will provide more information in subsequent updates.	Update CASA - Dec 15.
Conduct a study to determine whether alternative means of air traffic segregation (such as dependent runway operations) could be safely applied in Melbourne without material reductions to capacity.	Options study paper.	An options paper examining options to assure the safety and efficiency is LAHSO is complete, and includes the	Complete

Action	Deliverable	Current Status	Planned Completion
		introduction of a stagger via MAESTRO. A team has been established to progress the initiatives.	
Suspension of aerodrome controller training during LAHSO	Local instructions	Implemented	Complete
Only aircraft operationally requiring the use of runway 34 for departures are permitted to use it during LAHSO. Ad hoc requests will not be accommodated.	Local instructions	Implemented	Complete
09/34 LAHSO mode has been suspended (because all departures in this mode are from runway 34)	Local instructions	Implemented	Complete
Airservices safety investigation into 5 July double go around (CIRRIS)	Investigation report	Completed	Completed
Undertake an annual safety review of LAHSO	Annual review report	Ongoing.	Ongoing annual action

Attachment 10

13 October 2015	CASA provided with information sourced from FAA regarding LAHSO, including FAA Order 7110.118, list of LAHSO airports in USA, an example of letter of agreement at Boston-Logan Airport, and LAHSO requirements extracted from the FAA Order 72103.

Land and Hold Short Operations (111 airports)

- **All LAHSO operations are for intercepting runways unless otherwise noted**
  - **All LAHSO airports are listed by Airport/Facility Directory (A/FD)**

Alaska (7)

1. Abbotsford (CYXX)
2. Boundary Bay (CZBB)
3. Comox (CYBB)
4. Portland (HIO)
5. Salem (SLE)
6. Vancouver (CYVR)
7. Victoria (CYYJ)

EC (24)

1. Alton (ALN)
2. Bloomington (BMI)
3. Carbondale (MDH)
4. Champaign (CMI)
5. O'hare (ORD)
6. Aurora (ARR)
7. Chicago Executive (PWK)
8. Rockford (RFD)
9. Decatur (DEC)
10. Marion (MWA)
11. Springfield (SPI)

12. Monroe (BMG)
13. Lafayette (LAF)
14. Muncie (MIE)
15. Terre Haute (HUF)
16. Battle Creek (BTL)
17. Detroit (DET)
18. Flint (FNT)
19. Traverse City (TVC)
20. Akron (CAK)
21. Mansfield Lahm (MFD)
22. Appleton (ATW)
23. Green Bay (GRB)
24. Dane Co (MSN)

NC (13)

1. Cedar Rapids (CID)
2. Des Moines (DSM)
3. Dubuque (DBQ)
4. Sioux City (SUX)
5. Waterloo (ALO)
6. Duluth (DLH)
7. Minneapolis (MSP)
8. Rochester (RST)
9. Alton (ALN)
10. Columbia (COU)

11. Springfield (SGF)
12. Fargo (FAR)
13. Grand Forks (GFK)

NE (26)

1. Bridgeport (BDR)
2. Windsor Locks (BDL)
3. Wilmington (ILG)
4. Portland (PWM)
5. Bedford (BED)
6. Beverly Muni (BVY)
7. Boston (BOS)
8. Hyannis (HYA)
9. Nantucket (ACK)
10. Norwood (OWD)
11. Atlantic City (ACY)
12. Newark (EWR)
13. Teterboro (TEB)
14. Albany (ALB)
15. Farmington (FRG)
16. Long Island (ISP)
17. White Plains (HPN)
18. Erie (ERI)
19. Harrisburg (CXY)
20. Lancaster (LNS)

21. Philadelphia (PNE)
22. Pittsburgh (AGC)
23. Reading (RDG)
24. Burlington (BTV) **runway and taxiway
25. Newport News (PHF)
26. Norfolk (ORF)

SW (9)

1. Prescott (PRC)
2. Burbank (BUR)
3. Long Beach (LGB)
4. Napa (APC)
5. Santa Rosa (STS)
6. Colorado Springs (COS)
7. Pueblo Memorial (PUB)
8. North Las Vegas (VGT)
9. Ogden-Hinckley (OGD)

SE (21)

1. Birmingham- Shuttlesworth (BHM)
2. Daytona Beach (DAB)
3. Fort Lauderdale Executive (FXE)
4. Jacksonville Executive (CRG)
5. Lakeland (LAL)
6. Miami (MIA)

7. Orlando (ORL)
8. Orlando Sanford (SFB)
9. St. Petersburg-Clearwater (PIE)
10. Sarasota (SRQ)
11. Tampa (TPA)
12. Space Coast Regional (TIX)
13. Vero Beach (VRB)
14. Palm Beach (PBI)
15. Atlanta Hartsfield (ATL) - Runway to Taxiway
16. Savannah (SAV)
17. Piedmont-Triad (GSO)
18. Winston-Salem (INT)
19. Charleston (CHS)
20. Memphis (MEM)) - Runway to Taxiway
21. Smyrna (MQY)

SC (4)

1. Baton-Rouge (BTR)
2. Dallas- Ft. Worth (DFW)) - Runway to Taxiway
3. Houston (IAH) - Runway to Taxiway
4. Longview (GGG)

PAC (1)

1. Honolulu (HNL)

NW (6)

1. Twin Falls (TWF)
2. Bozeman (BZN)
3. Portland-Hillsboro (HIO)
4. Salem (SLE)
5. Moses Lake (MWH)
6. Spokane (GEG)

ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

7110.118

7/14/00

SUBJ: LAND AND HOLD SHORT OPERATIONS

1. PURPOSE. This order prescribes the standards for use by Air Traffic (AAT), Flight Standards (AFS), and Airports (AAS) in approving and conducting land and hold short operations (LAHSO). It also establishes the terms of reference, conditions, and limitations for the application of LAHSO. This order provides procedures to be applied when LAHSO clearances are being issued to Federal Aviation Regulations (FAR) Parts 91, 121, 125, 129, and 135 aircraft operators.

2. DISTRIBUTION. This order is distributed to branch level in Washington headquarters and regional Air Traffic, Flight Standards, and Airport Safety and Standards offices, the Office of System Safety, all air traffic field offices and facilities, Flight Standards District Offices, and Airport District Offices.

3. CANCELLATION. This order cancels Notice 7110.199, Land and Hold Short Operations.

4. ACTION. Facility managers shall ensure all air traffic control (ATC) personnel are briefed on the content of this order prior to conducting LAHSO. In order to conduct LAHSO, facility managers shall implement procedures that are in accordance with this order. At airports that are currently conducting LAHSO, facility managers shall ensure that these new procedures are implemented within 180 days. However, during this interim 180-day period, all airports and runway configurations may conduct LAHSO in accordance with the provisions of Notice 7110.199. The exception to this is the runway configurations requiring rejected landing procedures (RLP). Configurations requiring RLP's will be discontinued until such time as the procedures are validated in accordance with paragraph 10 of this order.

5. EFFECTIVE DATE. August 14, 2000.

6. BACKGROUND. LAHSO is an acronym for "land and hold short operations." These operations include landing and holding short of an intersecting runway, an intersecting taxiway, or some other predetermined point on the runway other than on a runway or taxiway. Previously, SOIR, the acronym for "simultaneous operations on intersecting runways," was used exclusively to describe simultaneous operations on two intersecting runways – either two aircraft landing simultaneously or one aircraft landing and another one departing. The term LAHSO incorporates SOIR and is expanded to include holding short of a taxiway and holding short of predetermined points on the runway. The additional operations outlined under this order are for those airports that need additional tools to decrease delays. This order sets the standards for conducting the following LAHSO combinations.

Distribution: A-W(AT/TO/TA/TX/RS/FS/AS/SY)-3, A-X(AT/FS/AS)-3; A-FAT-0 (LTD); A-FFS-7 (LTD), A-FAS-1 (LTD)

Initiated By: ATP-120

a. Landing and holding short of an intersecting runway.

b. Landing and holding short of an intersecting taxiway.

c. Landing and holding short of an approach/departure flight path.

d. Landing and holding short of a predetermined point.

7. EXPLANATION OF CHANGES.

The following changes apply to all LAHSO.

a. Mixed LAHSO operations shall be permitted at such time that adequate pilot training, on these procedures, is accomplished. Notification of completed training will be made by an Air Traffic GENOT.

Note– Adherence to the current policy of sequencing traffic on a first-come-first-served basis shall prevail.

b. Solo student pilots will not conduct LAHSO.

c. When air carrier LAHSO is conducted, vertical guidance is required on the hold short runway.

d. No waivers will be issued to the procedures contained in this order.

8. DEFINITIONS. For the purpose of this order, the following definitions are provided.

a. Available Landing Distance (ALD) - That portion of a runway available for landing and rollout for aircraft cleared for LAHSO. This distance is measured from the landing threshold to the hold short point.

b. Air Carrier Operation - Air carrier and commuter aircraft operating under FAR Parts 121 and 129.

c. Contaminated Runway - For the purpose of this order, a runway is considered contaminated whenever standing water, ice, snow, slush, frost in any form, heavy rubber deposits, or other substances are present. A runway is contaminated with respect to rubber deposits or other friction degrading substances when the average friction value for any 500-foot segment of the runway within the ALD falls below the recommended minimum friction level, and the average friction value in the adjacent 500-foot segment falls below the maintenance planning friction level.

d. Hold Short Point - A point on the runway beyond which a landing aircraft with a LAHSO clearance is not authorized to proceed.

e. Hold Short Position Marking - The painted runway holding position marking located at the hold short point on all LAHSO runways.

f. Hold Short Position Signs - Red and white holding position signs located alongside the hold short point.

g. Land and Hold Short Lights. Six or seven in-pavement, pulsing white lights at the LAHSO hold short point.

h. Vertical Guidance - Visual or electronic glide slope (e.g., precision approach path indicator (PAPI), visual approach slope indicator (VASI)).

Note– The pulsed light approach slope indicator (PLASI) may not be used to provide visual glide slope information during LAHSO.

i. Rejected Landing - For the purpose of LAHSO, a rejected landing is when the pilot in command elects to go around. In the event of a rejected landing on a configuration not requiring a RLP, normal pilot/controller responsibilities remain unchanged.

j. LAHSO - An acronym for "land and hold short operations." These operations include landing and holding short of an intersecting runway, taxiway, predetermined point, or approach/departure flight path.

k. Dry Runway - Defined as no visible moisture.

l. Mixed Operations - LAHSO conducted between an air carrier and any other type of aircraft operation.

m. Rejected Landing Procedure (RLP) - A published, predetermined heading to be used in the event of a rejected landing. Unless alternate instructions are given by ATC, pilots are expected to execute the procedure as published and remain clear of clouds.

9. WAIVERS.

No waivers will be issued.

10. CRITERIA FOR CONDUCTING LAHSO.

General - Local LAHSO development teams shall be established, in accordance with subparagraph 13b1 of this order, to develop procedures utilizing the following criteria.

a. The minimum distance required to conduct LAHSO will be 2,500 feet of the ALD on the hold short runway. This distance will be measured from the landing threshold to the hold short point.

b. For air carrier operations only:

(1) Arrival/arrival. Approved if the distance on the full-length runway from the threshold to the intersection where the hold short clearance is effective is greater than 3,000 feet.

(2) Arrival/departure. Approved if the distance from the departure runway threshold to the intersection where the hold short clearance is effective is less than 2,000 feet.

(3) If the runway distance and configuration do not meet the requirements of subparagraphs 10b1 and 2 of this order and air carrier operations are being conducted, RLP's must be developed and validated through modeling in accordance with Federal Aviation Administration (FAA) requirements using the following guidelines.

(a) The local LAHSO development team (see subparagraph 13b1 of this order) is responsible for developing the procedure collaboratively, considering the following:

1 A heading to fly with instructions to remain clear of clouds.

2 The point from which the rejected landing is initiated (the first one-third of the runway, or 3,000 feet, whichever is less).

3 Potential conflict with terrain or obstacles along the rejected landing flight path.

4 Potential conflicts with other procedural requirements; e.g., is there a possible conflict between an RLP and a one-engine-out procedure for a full-length aircraft?

5 Performance of the LAHSO aircraft and the full-length aircraft.

6 Different full-length traffic scenarios (e.g., arrival, departure, go-around).

7 Any other locally specific issues.

(b) Only one RLP can be developed for each runway configuration. Therefore, this single RLP must then be designed to accommodate all differing types of aircraft that could possibly be required to use it.

(c) Through modeling, RLP's shall demonstrate an acceptable level of safety.

(d) Local facilities must submit the procedure(s) to headquarters for approval. A copy shall be forwarded to the region.

(e) Headquarters is responsible for validating the procedure through modeling before approval to the facility for use.

11. LAHSO PROCEDURES.

a. General. The following conditions shall exist at the airport.

(1) Ceiling and visibility requirements.

(a) Non-air carrier aircraft: ceiling 1,000 feet and visibility 3 miles.

(b) Air carrier aircraft: ceiling 1,500 feet and visibility 5 miles, unless the landing runway is equipped with PAPI or VASI, in which case 1,000 feet ceiling and 3 miles visibility shall be applicable. For configurations requiring a RLP, the ceiling and visibility may differ.

(2) The LAHSO runway ALD must be dry.

(3) The tailwind on the hold short runway shall be calm (less than 3 knots).

(4) LAHSO shall not be utilized if wind shear has been reported.

(5) LAHSO will only be conducted at those airports that maintain a letter of agreement (LOA) signed by all the required parties, as defined in subparagraph 13b1 of this order. A copy of the LOA shall be forwarded to the Program Director for Air Traffic Planning and Procedures, ATP-1; Director, Flight Standards Service, AFS-1; and Director, Airport Safety and Standards, AAS-1.

b. Runway Equipment and Facilities. Markings and signs shall be installed in accordance with Advisory Circular (AC) 150/5340-1, Standards for Airport Markings, and AC 150/5340-18, Standards for Airport Sign Systems.

(1) Runway hold short position markings shall be installed and clearly visible at all hold short points.

(2) There shall be only one designated hold short point per operational direction on a runway.

(3) Runway hold short position signs shall be installed at each hold short point and shall be located on both sides of the runway. If one of the two signs is not functional or is destroyed, LAHSO may continue until the sign is repaired or replaced, if land and hold short lights are installed and operating.

c. Lighting.

(1) Land and Hold Short Lights - Land and hold short lights shall be installed as required below, in accordance with AC 150/5340-29, Installation Details for Land and Hold Short Lighting Systems.

(a) LAHSO may be conducted with the land and hold short lights that pulse at the rate specified in AC 150/5345-54, Specification for L-884 Power and Control Unit for Land and Hold Short Lighting Systems, until December 31, 2000.

(b) Effective January 1, 2001, any LAHSO that requires lights shall be conducted with land and hold short lights that pulse at the rate specified in AC 150/5345-54A.

(c) Land and hold short lights are required for all LAHSO except non-air carrier to non-air carrier runway/runway daytime LAHSO.

Note– Air carrier LAHSO conducted to runway/runway intersections can continue without land and hold short lights until January 1, 2001.

(2) Existing light bars containing five lights are acceptable until December 31, 2000, after which they shall be upgraded to meet the standards in AC 150/5340-29.

(3) When two or more land and hold short lights in a bar are not functional, the entire bar is considered out of service and operations requiring those lights shall be terminated.

(4) If the ATIS broadcast contains a generic LAHSO announcement (e.g., "LAHSO in effect"), then all sets of land and hold short lights shall be on. If the ATIS broadcast contains specific hold short points (e.g., "Expect landing on Runway 22 to hold short of Runway 27"), then only those sets of land and hold short lights shall be on.

d. Vertical Guidance.

(1) Air carrier and/or mixed LAHSO are only authorized on a runway that has electronic or visual glide slope indicator (PAPI or existing VASI is acceptable; PLASI is not acceptable for vertical guidance).

(2) Air carrier and/or mixed nighttime LAHSO may only be conducted with visual glide slope indicator (PAPI or existing VASI).

e. A LAHSO clearance shall only be issued to any aircraft listed in appendix 1 of this order. In addition, a LAHSO clearance shall only be issued to an aircraft and/or operator listed in accordance with subparagraphs 13b3 and 4 of this order. LAHSO operations involving helicopters may be authorized upon operator request. An eligible aircraft stopping distance list for each LAHSO configuration shall be placed at all affected positions.

Note– Controllers should be aware that pilots may not be able to accept a LAHSO clearance below 1,000 feet above ground level.

f. When an arriving pilot identifies their self to the local controller as a solo student pilot, that pilot shall not be issued a LAHSO clearance.

g. When LAHSO operations are expected to be utilized, an announcement shall be made on the ATIS; e.g., "LAHSO in effect" or "Expect landing on Runway 22 to hold short of Runway 27." Local LAHSO development teams will determine whether to broadcast ALD's on the ATIS.

h. When LAHSO is conducted at locations not served by an ATIS, or the ATIS is out of service, pilots shall be advised on initial contact, or as soon as practicable thereafter, to expect a LAHSO clearance.

i. Aircraft conducting closed traffic operations need only be advised once that "LAHSO is in effect." Acknowledgment of the current ATIS meets this requirement.

j. Traffic information shall be exchanged and a readback shall be obtained from the landing aircraft with a LAHSO clearance.

k. Aircraft/vehicles may be allowed to cross the portion of the runway surface beyond the hold short point. All other operations beyond the hold short point are prohibited. An acknowledgment shall be received from the crossing aircraft/vehicle.

l. LAHSO shall be terminated for any situation or weather condition which, in the judgment of the airport traffic control tower supervisor/controller in charge, would adversely affect LAHSO.

12. LETTERS OF AGREEMENT. The conduct of LAHSO, in accordance with the provisions of this order, requires that airport operators agree to undertake specific actions, including the installation and maintenance of required markings, signs, and in-pavement lighting. This not only involves a considerable capital investment, but imposes specific responsibilities and obligations on the airport operator. In order to ensure that LAHSO is conducted safely and in strict accordance with the provisions of this order, and to ensure that airport operators agree and are fully aware of their responsibilities, formal, signed LOA's between the airport operator and the ATC facility manager are required for the approval and implementation of LAHSO. A sample LOA is attached as appendix 2 of this order. LOA's shall address, as a minimum, the following:

a. Procedures for use of LAHSO at their specific localities.

b. Installation and maintenance of required markings, signs, and lighting.

c. Determination of the measured length of the ALD.

d. Coordination procedures for prompt exchange of required information (e.g., periodic friction measurements, inoperative lights, pilot reports, braking action reports, etc.)

13. RESPONSIBILITIES.

a. AAT is responsible for:

(1) Incorporating the applicable standards, procedures, criteria, and requirements contained in this order into appropriate AAT documents.

(2) Publishing appropriate pilot information for LAHSO in the Aeronautical Information Manual (AIM).

(3) Publishing ALD data in both the Airport Facility Directory and appropriate flight information publications.

(4) Annually convening a group to assess the conduct of LAHSO in the National Airspace System.

b. Air traffic managers are responsible for:

(1) Organizing a LAHSO development team consisting of representatives from AFS, AAT, the Airport District Office, airport manager, local National Air Traffic Controllers Association, and airport user representative(s). This team shall operate under the guidelines of this order.

(2) Determining that a valid operational need exists before developing procedures applicable to LAHSO. Such factors as, capacity, efficiency, user input, etc. should be considered in making this determination.

(3) Preparing a list of aircraft types authorized to participate for each configuration utilized at the facility. The list shall be readily available for controller use prior to operational use of LAHSO.

(4) Preparing a list of FAR Parts 121, 125, 129, and 135 operators authorized to participate in LAHSO at the airport. The list shall be readily available for controller use prior to operational use of LAHSO.

(5) Providing a listing of runways authorized for LAHSO, along with the appropriate ALD, for publication in the procedures publications. On a temporary basis, a notice to airmen maybe issued in lieu of the above.

(6) Maintaining a copy of an LOA signed by all parties that participated in the development of the LAHSO procedures.

(7) Coordinating with appropriate AFS field office, airport management, fixed based operators, and representatives of the aviation community while developing a LAHSO program.

(8) Providing a list of appropriate landing distances for all aircraft participating in LAHSO. This list shall be readily available for controller use prior to operational use of LAHSO.

(9) Conducting an annual review of the LAHSO program to validate its continued need and convening a local development team to review all LAHSO events and forward a report through the region to headquarters.

c. AFS is responsible for:

(1) Incorporating applicable standards, procedures, criteria, and requirements into appropriate AFS documents.

(2) Initiating international coordination efforts to update International Civil Aviation Organization (ICAO) Annex 6, Operation of Aircraft, to include LAHSO procedures.

(3) Developing appropriate information on flight procedures for incorporation into the AIM.

(4) Providing guidance materials needed to reach and educate both the pilot community and FAA inspectors concerning proper LAHSO procedures.

(5) Approving all air carrier LAHSO training procedures, including any special or unique go-around procedures resulting from a rejected landing.

(6) Requiring the Aviation Safety Program to develop educational programs and other initiatives to reach the general aviation pilot population concerning proper procedures and safety concerns when conducting LAHSO.

(7) Recommending what LAHSO subject matter should be included in appropriate flight training curriculums under FAR part 141, and in the curriculums for certificated flight instructor revalidation clinics.

(8) Providing ATS information relative to aircraft performance required for conducting LAHSO. AFS will provide support, as outlined in Order 7210.3, Facility Operation and Administration, Paragraph 10-3-7, Land and Hold Short Operations. AFS will support identification of eligible aircraft for operating within assigned ATS groups for use by controllers as a planning tool.

(9) Participating in local LAHSO development teams.

d. AAS is responsible for:

(1) Incorporating applicable standards, procedures, criteria, and requirements contained in this order into the appropriate documents.

(2) Initiating international coordination efforts to update ICAO Annex 14, Visual Aids.

(3) Publishing technical standards, siting specifications, and guidance for the design and installation of all hold short position markings, signs, and in-pavement lighting, as required by this order.

(4) Publishing standards and guidance for maintaining skid-resistant pavements and for publishing standards and guidance for evaluating these pavements with friction measuring equipment.

(5) Developing appropriate information on visual aids for incorporation into the AIM.

(6) Providing instructions to airport certification inspectors for reviewing and inspecting hold short position markings, signs, and lights required for LAHSO at certificated airports.

e. The Office of System Safety is responsible for:

(1) Maintaining/updating development of a risk assessment for LAHSO which considers safety of operations.

(2) Providing analytical support essential to continuing trend analysis of site-specific incidents/accidents involving LAHSO.

(3) Coordinating with AAT the publication of supplemental guidance and criteria to define and systematically collect LAHSO operational error reports.

(4) Coordinating with AFS the publication of supplemental guidance and criteria to define and systematically collect LAHSO pilot deviation reports.

(5) Developing a LAHSO data collection, data analysis, and data protection program.

(6) Participating in LAHSO program testing.

Jeff Griffith
Program Director
for Air Traffic Planning and Procedures

Appendix 1
Aircraft Group/Distance Minima

	Sea Level -999	1,000- 1,999	2000- 2,999	3000- 3,999	4000- 4,999	5000- 5,999	6000- 6,999	7000- 7,000
GROUP 1	2500	2550	2600	2650	2700	2750	2800	2850
GROUP 2 & BELOW	3000	3050	3100	3150	3200	3250	3300	3500
GROUP 3 & BELOW	3500	3550	3600	3650	3700	3750	3800	3850
GROUP 4 & BELOW	4000	4050	4100	4150	4200	4250	4300	4350
GROUP 5 & BELOW	4500	4550	4600	4650	4700	4750	4800	4850
GROUP 6 & BELOW	5000	5100	5200	5300	5400	5500	5600	5700
GROUP 7 & BELOW	6000	6100	6200	6300	6400	6500	6600	6700
GROUP 8 & BELOW	7000	7100	7200	7300	7400	7500	7600	7700
GROUP 9	8000	8100	8200	8300	8400	8500	8600	8700

This table is an air traffic control tool for identifying aircraft, by groups, that are able to land and hold short based on the available landing distance. Air traffic managers shall utilize the above table for identifying aircraft by groups that are able to land and hold short at their facility, according to paragraph 13b3 of this order.

At locations requesting to utilize land and hold short operations (LAHSO) with aircraft requiring greater than 8,000 feet of available landing distance, air traffic managers shall coordinate with the appropriate Flight Standards office and Air Traffic Planning and Procedures to obtain a letter of authorization approving LAHSO.

LAHSO AIRCRAFT LANDING DISTANCES

GROUP 1 - 2500'

AA1	AA1 Trainer, Yankee, TR/TS-2, Cat, Lynx	1
AA5	Cheetah AA-5, Traveller, Tiger	1
AC52	Commander 520	1
AR11	Aeronca Chief/Super Chief, Pushpak	1
AT3P	Model 301	1
B14A	Cruisair, Cruismaster 14-19	1
B18T	Westwind 2/3, Turbo 18, Turboliner	1
BE19	Sport 19, Musketeer Sport	1
BE77	Skipper 77	1
BL17	Super Viking, Turbo Viking	1
BN2P	BN-2A/B Islander, Defender	1
BN2T	BN-2T Turbine Islander, Turbine Defender+C128	1
C120	Cessna 120	1
C150	Cessna 150	1
C152	Cessna 152	1
C172	Skyhawk 172/Cutless/Mescalero	1
C188	AG Wagon/AGTruck/AGHusky 188	1
C72R	Cutless RG, 172RG	1
CH7A	CHAMPION CITABRIA	1
CH7B	CHALLENGER, 7ECA, 7-DC	1
COUR	Courier, Strato-Courier, 250/295/391/392/395/700/800	1
D28D	Do 28D/D - 1/D-2, 128-2 Skyservant	1
D28T	Do-28D-6, 128-6 Turbo Skyservant	1

LAHSO AIRCRAFT LANDING DISTANCES

DHC1	Chipmunk DCH-1	1
DHC3	Otter DHC-3	1
DHC5	Buffalo DHC-5D/E	1
DO27	DO 27	1
G164	Model G-164 Ag-cat, Super Ag-Cat, King Cat	1
G64T	Model G164 Turbo Ag-cat	1
GA7	Cougar GA-7	1
J2	J-2 Cub	1
J3	J-3 Cub	1
J4	J-4 Super Cub	1
J5	J-5 Cub Crusier	1
LARK	Lark 100 Commander	1
M10	Mark 10 Cadet	1
M200	Commander 200	1
M4	M-4 Strata-Rocket, Astro Rocket, Bee-Dee,	1
M4	Jetasen, Super Rocket	1
M5	M-5 180c/200/235C Lunar-Rocket, 210TC	1
M5	Strata-Rocket, Patroller	1
M6	M-6 Super-Rocket	1
M7	M-7-235, MT-7, MX-7-160/180/235,	1
M7	MXT-7-160/180 Super Rocket, Star Rocket	1
M7T	M-7-420, MX-7-420, MXT-7-420 Star Craft	1
ME08	ME 108 Taifun	1
MITE	M-18 Mooney Mite, Wee Scotsman	1
P180	P-180	1

LAHSO AIRCRAFT LANDING DISTANCES

P28A	Cherokee, Archer, Warrior, Cadet,	1
P28A	Cruiser (PA-28-140/150/151/160/161/180/181)	1
PA11	Cub Special	1
PA12	Super Cruiser	1
PA14	Family Crusier	1
PA15	Vagabond Trainer	1
PA16	Clipper	1
PA17	Vagabond	1
PA18	Super Cub	1
PA20	Pacer	1
PA25	Pawnee	1
PA30	Twin Comanche, Turbo Twin Comanche	1
PC7	Turbo Trainer	1
RANG	Rangemaster	1
STLN	H-550/A Stallion	1
T34P	Mentor T34 A/B, E-17	1
TCOU	Twin Courier	1
TCOU	H-580 Twin Courier	1
TF19	F-19 Sportsman	1
VO10	100/150	1

GROUP 2 – 3000'

AC11	Commander 112A/C/114	2
AR15	Aeronca Sedan	2
BE17	Stagger Wing 17 (UC-43 Traveler)	2

LAHSO AIRCRAFT LANDING DISTANCES

BE23	Sundowner 23, Musketeer 23	2
BE36	Bonanza 36	2
BL8	Decathlon, Super Decathlon, Scout 8, MODEL 8	2
BU20	Bushmaster 2000	2
C175	Skylark	2
C177	Cardinal 177	2
C180	Skywagon 180 (U-17C)	2
C182	Skylane	2
C185	Skywagon 185 (U-17A/B)	2
C190	Cessna 190	2
C206	Stationair 6, Turbo Stationair 6	2
C207	Stationair/Turbo Stationair 7/8	2
C210	Centurion 210, Turbo Centurion	2
C303	Crusader 303	2
C336	Skymaster 336	2
C77R	Cardinal RG, 177RG	2
C82R	Skylane RG, Turbo Skylane RG, R182, TR182	2
D228	DO 228- 100/200 Series	2
DH2T	Turbo Beaver DHC-2T	2
DHC2	Beaver DHC-2	2
DHC7	Dash 7 DHC	2
ERCO	Aircoupe A2/F-1	2
G109	G-109 Ranger (Vigilant)	2
GC1	Swift	2
LA25	LA-250/270 Turbo Renegade/ Turbo Seafury, Seawolf	2

LAHSO AIRCRAFT LANDING DISTANCES

LA4	LA-4A,B, 4/200 Buccaneer	2
NAVI	Navion NA 145/154	2
NOMA	N-22-B, N-24-A	2
NORS	Norseman 4/5/6	2
OSCR	P66/64 Charlie, Oscar	2
PA22	Tri-Pacer, Colt, Caribbean	2
PA23	Apache 150/160	2
P28T	Cherokee Arrow 4, Turbo Arrow 4	2
PA31	PA-31P-350	2
PA31	Chieftan, Mohave, Navajo, T-1020	2
PA36	Brave, Pawnee Brave, Super Brave	2
PA44	Seminole, Turbo Seminole	2
PAY2	PA-41 Cheyenne II	2
PUP	B.121 Pup Series	2
S108	Voyager, Station Wagon 108	2
SC7	Shorts SC7 Skyvan, Skyliner	2
T6	Texan, Harvard	2
TAMP	Tampico TB-9	2
TOBA	Tabago TB-10C/200	2
TRIS	BN-2A Mark III Trislander	2

GROUP 3 - 3500'

AC50	Commander 500	3
BE24	Sierra 24, Musketeer Super	3

LAHSO AIRCRAFT LANDING DISTANCES

BE35	Bonanza 35	3
C140	Cessna 140	3
C205	Super Skywagon/Super Skylane	3
C208	Caravan 1-208, (Super Cargomaster,	3
C208	Grand Caravan (U27)	3
C337	Super Skymaster 337	3
C402	Cessna 401, 402, Utiline, Businessliner	3
F26T	SF206TP	3
F50	Fokker 50, Maritime Enforcer	3
L8	Luscombe Silvaire	3
M22	Mark 22, Mustang	3
M404	Martin 404	3
P28B	Dakota, Turbo Dakota, Charger,	3
P28B	Pathfinder (PA-28-201T/235/236)	3
P28R	Cherokee Arrow 2/3, Turbo Arrow 3	3
P32R	Cherokee Lance PA-32R, Saratoga SP,	3
P32R	Turbo Saratoga SP	3
P337	Pressurized Skymaster T337G, P337	3
P66P	P166 Portofino, Albatross	3
P68	P68/B/C/-TC, Victor, Observer/P68R	3
P68T	AP68TP-300 Spartacus	3
PA27	Aztec. Turbo Aztec	3
PA32	Cherokee Six, Lance, (Turbo) Saratoga	3
PA38	Tomahawk	3
RALL	Super Rallye MS 885/886, Commordore MS 150T/150ST/150SV/150SVS/892, Minerva MS 894, Rallye Club MS 100S/100ST880/881	3

LAHSO AIRCRAFT LANDING DISTANCES

TRIN	Trinidad TB 20/21	3
RELI	Reliant (Vultee) V-77	3

GROUP 4 – 4000'

AC56	560-F	4
AC72	Alti-Cruiser	4
AC80	Turbo Commander 680/681 Hawk Commander	4
B209	BO 209 Monsum	4
BE18	Twin Beech 18/Super H18	4
BE33	Bonanza 33, Debonair (E-24)	4
BE50	Twin Bonanza 50	4
BE76	Duchess 76	4
C170	Cessna 170	4
C310	Cessna 310 / Riley 65, Rocket	4
C335	Cessna 335	4
C340	Cessna 340	4
C411	Cessna 411	4
CP10	CAP 10	4
CP20	CAP20	4
DHC6	Twin Otter DHC-6 (all series)	4
DH8A	DHC-8/102/103	4
DH8B	Dash 8, DHC8-100/200	4
DOVE	Dove DH – 104	4
F600	F600, SF-600TP Canguero	4
M20P	M20/A/B/C/D/E/F/G/J/L/R, Mark 21,	4

LAHSO AIRCRAFT LANDING DISTANCES

M20P	Ranger, Maste, Super 21, Chaparral, Executive	4
M20P	Statesman, Ovation, 201, 205, ATS, MSE, PFM	4
M20P	201 / M-20J	4
P136	P136 Gull	4
P32T	Lance 2, Turbo Lance 2	4
P46T	Malibu Meridian	4
PA24	Comanche	4
PA46	Malibu, Malibu Mirage	4
PAY4	Cheyenne 400	4
PC12	PC-12	4
TA20	F-20A Topper, Ranchwagon, Seabird, Zephyr	4
TF21	F-21, T-Kraft	4
U16	Albatross	4

GROUP 5 - 4500'

A748	Bae HS 748 (Andover, C-91)	5
AC68	Super Commander 680S/E/F/FP	5
AEST	Aero Star 600/700	5
ARVA	101 Avara, 102, 201, 202	5
AT43	ATR-42-200/300/320	5
AT44	ATR-42-400	5
AT45	ATR-42-500	5
BE65	Queen Air 65 (U-8F Seminole)	5
BE95	Travelair 95	5
BE99	Airliner 99	5

LAHSO AIRCRAFT LANDING DISTANCES

BE9L	King Air 90, A90 to E90 (T-44, VC6)	5
C119	Flying Box Car	5
C212	C-212 Aviocar	5
C320	Skynight 320	5
C404	Titan 404	5
C425	Corsair/Conquest I-425	5
C551	Citation 2-SP	5
DC3	Skytrain (C-47, C-53, C-117 A/B/C, R4D 1 to 7)	5
DH8C	Dash 8, 300/311	5
DHC4	Caribou DHC-4	5
F27	Friendship F27, Troopship, Maritime, Firefighter	5
G44	Widgeon/Super Widgon	5
JS31	BAe-3100 Jetstream 31	5
JS32	Bae-3200, Jetstream Super 31	5
PAY1	Cheyenne 1	5
S601	Corvette SN 601	5
SF34	SF-340, 340-A	5
SW3	Merlin 3	5
SW4	Metro, Merlin 4	5
TBM7	TBM TB700	5

GROUP 6 - 5000'

AC6L	Grand Commander 685/680FL	6
AC90	Turbo Commander 690,	6

LAHSO AIRCRAFT LANDING DISTANCES

AC95	Commander Jetprop 980/1000	6
AC95	Turbo Commander 695,	6
AT72	ATR-72-101/102/201/202	6
ATP	Jetstream 61, Advance Turboprop	6
BE30	Super King 300/300LW	6
BE55	Baron 55/Chochise	6
BE58	Baron 58, Foxstar	6
C414	Chancellor 414, Rocket Power	6
C421	Golden Egale 421	6
C441	Conquest/Conquest 2 - 441	6
C500	Citation 1	6
C501	Citation 1-SP	6
F406	Caravan 2 - F406	6
G73	Mallard	6
H25A	BAe HS 125 Series 1/2/3/400/600	6
M20T	Turbo Mooney M20K/M20M, Encore, 231, 252	6
M20T	TLS, TSE	6
MU2	Mitsubishi MU-2, Marquise, Solitaire	6
SH33	Shorts 330, Sherpa	6
SH36	SD3-60-100, 300	6
SW2	Merlin 2	6
YS11	YS-11	6

GROUP 7 - 6000'

A306	A300B4 - 600	7

LAHSO AIRCRAFT LANDING DISTANCES

A310	A-310	7
A319	A319	7
A320	A-320	7
ASTR	Astra 1125, 1125-IW	7
B190	1900/C-12J, 1900-D	7
B350	Super King Air 350	7
B721	727-100	7
B722	727-200	7
B731	B737-100	7
B732	B737-200	7
B732	737-200 (Surveiller, CT-43, VC-96)	7
B733	B737-300	7
B735	B737-500	7
B736	B737-600	7
B738	B737-800	7
B73Q	B737 Stage 3	7
B752	B757-200	7
BA11	BAC One-Eleven	7
BA46	Bae 146, RJ, Quiet Trader, Avroliner	7
BE10	King Air 100A/B (U-21F Ute)	7
BE20	Super King Air 200	7
BE9T	Beech F90 King Air	7
C525	Citationjet C525	7
C550	Citation 2/-S2	7

LAHSO AIRCRAFT LANDING DISTANCES

CRJ1	Canadair Regional Jet, RJ-100	7
CRJ2	Canadair Regional Jet, RJ-200	7
CRJ7	Canadair Regional Jet, RJ-700	7
CAT	Canso/Catalina	7
CVLP	Convair 240/340/440, Liner, Samaritan	7
CVLT	Convair 540/580/600/640	7
DC4	Skymaster	7
DC6	DC-6/B Liftmaster	7
D328	Do 328	7
E110	Bandeirante EMB-110/111	7
E120	Brasilia EMB-120	7
E145	Embraer Regional Jet EMB-145	7
F100	FOKKER 100	7
F28	Fellowship F28, MK 4000	7
FA20	Falcon 20, Mystere 20 (T-11)	7
G159	GAC 159-C, Gulfstream 1	7
GLF5	Gulfstream 5	7
H25B	Bae HS 125 Series 700/800	7
H25C	Bae HS 125 Series 1000	7
HF20	HFB 320 Hansa jet	7
JS41	Bae-4100 Jetstream 41	7
L188	Electra 188, 188-C	7
LJ24	Learjet 24	7
LJ28	Learjet 28, 29	7
LJ31	Learjet 31	7
M202	M-202	7

LAHSO AIRCRAFT LANDING DISTANCES

MU30	Mitsubishi Diamond I/MU-300	7
PA34	Seneca 2/3	7
STAR	Starship 2000	7
WW23	1123 Westwind	7
WW24	1124 Westwind	7

GROUP 8 - 7000'

A330	A-330	8
A30B	A-300	8
B72Q	727 Stage 3 (-100 or -200)	8
B734	B737-400	8
B753	B757-300	8
BASS	B.206 Basset Series	8
BE40	Beechjet 400/T-1 Jayhawk	8
BE60	Duke 60	8
C560	Citation 5	8
C650	Citation 3/6/7	8
CL60	CL600/610 Challenger	8
DC3S	Super DC-3 (C-117D, R4D 8)	8
DC7	DC-7/B/C Seven Seas	8
DC9	All Series	8
DC9Q	DC-9 Stage 3	8
F2TH	Falcon 2000	8
F900	Falcon 900, Mystere 900 (T-18)	8
FA10	Falcon 10, Mystere 10	8

LAHSO AIRCRAFT LANDING DISTANCES

FA50	Falcon 50, Mystere 50 (T-16)	8
GLF2	Gulfstream 2	8
GLF3	Gulfstream 3	8
GLF4	Gulfstream 4	8
HERN	Heron DH - 114	8
L18	Lodestar	8
L29A	1329 Jetstar 6/8	8
LJ23	Learjet 23	8
LJ55	Learjet 55	8
MD80	DC-9-MD-87	8
MD80	MD-80 Series	8
MD80	DC-9-MD-80	8
MD90	MD-90	8
PAY3	Cheyenne 3	8
S210	STADE III, X B3, X R, XI R, XII	8
VF14	VFW 614	8
VTOR	AP68TP-600, Viator	8
YK40	YAK-40	8

GROUP 9 - 8000'

A340	A340	9
AP3M	Model 101, Mini Guppy	9
AP52	Model 101, Guppy	9
APIP	Model 201, Pregnant Guppy	9

LAHSO AIRCRAFT LANDING DISTANCES

B07H	707-400	9
B701	707-100, VC-137707, VC-137	9
B703	707-300, E-8 J-Stars,EC-137	9
B720	720	9
B734	B737-400	9
B74S	747SP/SUD	9
B762	767-200	9
B763	767-300	9
B772	B777-200	9
B773	B777-300	9
C750	Citation 10	9
COMT	Comet DH-106, Comet 4-C	9
CONI	MODEL 1649, Starliner (L049, 749, 1049, 1649)	9
DC10	DC-10 (all series)	9
DC85	DC-8-50, Jet Trader	9
DC87	DC-8-70	9
DC8Q	DC-8 Stage 3	9
JCOM	Jet Commander 1121	9
L101	L-1011 Tri-Star (all series)	9
L29B	1329-5 Jetstar 2/731	9
LJ25	Learjet 25	9
LJ35	Learjet 35, 36	9
MD11	MD-11	9
P808	Vespa Jet PD808	9

LAHSO AIRCRAFT LANDING DISTANCES

AIRCRAFT REQUIRING GREATER THAN 8OOO'

B741	747-100
B742	747-200
B743	747-300
B744	747-400
B74R	B747-SR
CONC	CONCORDE
CV99	Convair 990
LJ60	Learject 60
SGUP	Super Turbine Guppy, Super Guppy
VISC	BAC-843

APPENDIX 2. Sample Letter of Agreement

Letter of Agreement (LOA)
Between Federal Aviation Administration (FAA)
and Metropolitan Airport Authority (MAA)

PURPOSE. This agreement delineates the responsibilities of the FAA and MAA that are necessary for initiating and carrying out land and hold short operations (LAHSO) on specified runways at the Metropolitan Airport.

BACKGROUND. LAHSO is an air traffic control procedure which permits the issuance of landing clearances to aircraft to land and hold short of an intersecting runway, taxiway, or other designated point on the runway. It is a procedure designed to increase airport capacity and to more efficiently move aircraft within the terminal airspace and on the airport surface.

APPROVED LAHSO RUNWAYS/LOCATIONS. The following runway hold short locations are approved for conducting LAHSO at Metropolitan Airport:

Runway	Location	Designation
10L	Prior to Runway 15/33 intersection	Day
10R	Prior to Runway 15/33 intersection	Day, night
11R	Prior to Taxiway B1 intersection	Day, night
15R	Prior to Runway 10R/28L intersection	Day
15L	Designated Point "HS-1" depicted on attachment "A"	Day

RESPONSIBILITIES OF MAA. In order to conduct LAHSO at the Metropolitan Airport, the MAA agrees to be responsible for the following actions:

1. Installing LAHSO runway markings and signs at all of the above specified locations in accordance with FAA Advisory Circular (AC) 150/5340-1, Standards for Airport Markings, and AC 150/5340-18, Standards for Airport Sign Systems.

2. Providing FAA with distance measurements from the landing runway threshold to the LAHSO runway position marking at each specified LAHSO location .

3. Installing a LAHSO in-pavement lighting system at all LAHSO locations. The lighting system shall be designed and installed in accordance AC 150/5340-29, Installation Details for Land and Hold Short Lighting Systems.

4. Notifying the FAA airport traffic control tower whenever runway markings, signs, and/or lighting systems are inoperative.

RESPONSIBILITIES OF FAA AIR TRAFFIC CONTROL. In conducting LAHSO at Metropolitan Airport, the FAA shall be responsible for the following:

1. Publishing a list of runways at the Metropolitan Airport that are approved for LAHSO, together with the available landing distance for each hold short location.

2. Terminating LAHSO on any approved runway location whenever MAA reports that signs and markings are not installed or are not in accordance with this order.

3. Terminating LAHSO at any location when, in the judgment of the air traffic manager, conditions are such that an unsafe operation may result.

4. Issuing appropriate notices to airmen relating to LAHSO.

5. Meet annually or as necessary to review events.

____
John M. Doe Manager,
Manager, Metropolitan Airport Tower
Federal Aviation Administration

Date: __________

____
Mary K. Smith
Metropolitan Airport Manager

Date: __________

LETTER OF AGREEMENT

Effective: June 23, 2011

SUBJECT: Land and Hold Short Operations (LAHSO)

1. **PURPOSE**: This agreement delineates the responsibilities of the FAA and the Massachusetts Port Authority (MPA) that are necessary for initiating and carrying out land and hold short operations (LAHSO) on specified runways at Boston-Logan Airport (BOS).

2. **CANCELLATION:** The Boston ATCT/Massachusetts Port Authority, Land and Hold Short Operations (LAHSO), Letter of Agreement dated February 15, 2001, is canceled.

3. **BACKGROUND**: LAHSO is an air traffic control procedure which permits the issuance of landing clearances to aircraft to land and hold short of an intersecting runway, taxiway, or other designated point on the runway. It is a procedure designed to increase airport capacity and to more efficiently move aircraft within the terminal airspace and on the airport surface.

4. **APPROVED LAHSO RUNWAYS/LOCATIONS**: The following runways/locations at Boston-Logan Airport (BOS) are approved for conducting LAHSO:

LANDING RUNWAY	HOLD SHORT POINT	MEASURED DISTANCE *	PUBLISHED AVAILABLE LANDING DISTANCE (ALD)
22L	Prior to Runway 27/9	6,400.2'	6,400'
27	Prior to Runway 22L/4R	5,663.7'	5,650'
4L	Prior to Runway 33R/15L	5,262.6'	5,250'
15R	Prior to Runway 9/27	6,848.5'	6,800'

* Measured from the threshold to the hold-short marking that is painted on the landing runway.

5. **RESPONSIBILITIES OF THE MASSACHUSETTS PORT AUTHORITY**: In order to conduct LAHSO at Boston-Logan Airport (BOS), the Massachusetts Port Authority agrees to be responsible for the following actions:

a. Installing LAHSO runway markings and signs at all of the above specified locations in accordance with FAA Advisory Circular (AC) 150/5340-1, Standards for Airport Markings, and AC 150/5340-18, Standards for Airport Sign Systems.

b. Installing a LAHSO in-pavement lighting systems at the locations noted above. The lighting system shall be designed and installed in accordance with AC 150/5340-29, Installation Details for Land and Hold Short Lighting System.

c. Notifying Boston ATCT whenever runway markings, signs, and/or lighting systems are inoperative/out of service.

Note: An in-pavement lighting system is considered inoperative/out of service when two or more of the light fixtures are not functional.

d. Notifying Boston ATCT when a runway that was wet, has become dry (no visible moisture).

6. **RESPONSIBILITIES OF BOSTON ATCT**: In conducting LAHSO at Boston-Logan Airport (BOS), Boston ATCT is responsible for the following:

a. Publishing a list of runways/locations at BOS that are approved for LAHSO. The list shall include the available landing distance for each location.

b. Allowing LAHSO only on the specific runways/locations noted in this agreement, and only when those runways are dry.

c. Promptly advising the Massachusetts Port Authority when an in-pavement lighting system is out of service (as determined by the Field Lighting System), or reported to be out of service/malfunctioning (by flight crews).

d. Terminating LAHSO at any location when, in the judgment of the Front Line Manager/Controller-in-Charge, conditions are such that an unsafe operation may result.

Deborah L. James

Air Traffic Manager, Boston ATCT

Deputy Director of Aviation Operations,
Massachusetts Port Authority

10−3−7. LAND AND HOLD SHORT OPERATIONS (LAHSO)

a. The air traffic manager must determine a valid operational need exists before conducting simultaneous takeoff and landing or simultaneous landing operations. This need may be considered evident if:

1. Present airport capacity/acceptance rate will be increased; and

2. Arrival/departure delays will be reduced; and

3. A reasonable savings in fuel consumption will result.

b. Before authorizing simultaneous takeoff and landing or simultaneous landing operations as specified in the current LAHSO directive.

1. Coordinate with each of the appropriate Flight Standards field offices having jurisdiction at the airport according to the type of aircraft operations involved and with user groups as required by para 4−2−4, Coordination of ATC Procedures, including the appropriate military authority where units are based at the airport.

NOTE−

Appropriate Flight Standards offices are: the ACDO for air carrier operations or the FSDO or both/either.

5. The LLWAS airport, direct dial, or commissioned AWOS/ASOS automated winds may be used during outages of the sensors that provide threshold winds:

(a) Include in the letter to airmen an explanation that wind information given to arriving aircraft on that runway/s may be derived from the automated AWOS/ASOS wind equipment or wind sensor equipment near the runway threshold rather than from the LLWAS airport wind source. It is not intended that controllers specify the remote source when issuing these winds to arriving aircraft, except when an alert occurs. This must be explained in the letter to airmen.

(b) Use wind information derived from commissioned AWOS/ASOS for ATIS broadcasts and issuing weather reports. Wind information from commissioned AWOS/ASOS or LLWAS centerfield may be used when issuing surface wind to departing aircraft.

REFERENCE–
Para 2–10–1, Wind Instrument Sensors.

b. When it is determined that a component or the whole LLWAS has failed, take the following action: If a component such as a remote sensor fails, notify airway facilities. During periods when wind shear is likely to occur or has been reported; e.g., frontal activity, thunderstorms, or pilot reports, inform users by broadcasting on the ATIS that the component is out of service.

EXAMPLE–
"Low level wind shear west boundary sensor out of service."

c. Technical Operations is responsible for the verification of the accuracy of the LLWAS. The SMO will notify air traffic of any equipment that is out of tolerance.

Attachment 11

13 October 2015	Letter to CASA outlining status of actions taken in the last 12 months
	Addendum to 2012 Safety Assessment Report (SAR)

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Peter Cromarty
Executive Manager
Airspace and Aerodrome Regulation Division
Civil Aviation Safety Authority
GPO Box 2005
Canberra ACT 2601

Dear Peter

RE: Use of Land and Hold Short Operations (LAHSO) at night

Following our recent discussions, we are aware that CASA has concerns with Melbourne LAHSO at night involving simultaneous landings and is considering a directive requiring suspension of the operations.

As previously reported to CASA, Airservices continues to maintain a strong safety focus on LAHSO and has implemented a number of actions to assure that the risk to air traffic service is tolerable and being managed to ALARP. Attachment 1 summarises the actions completed in the last two months. This update was also provided to your team recently.

As part of these actions, Airservices has strengthened the existing ATC risk controls and conducted further risk assessment of all LAHSO procedures and practices at Melbourne. The resulting risk assessment report as an addendum to the 2012 Safety Assessment Report is provided in Attachment 2.

On the basis of implementing these actions, ATC has gained assurance that the current risk controls are comprehensive and remain confident in the continued ATC support of LAHSO during day and night time operations.

I am keen to ensure that CASA has sufficient information to determine the overall aviation safety risk of Melbourne LAHSO at night in order to inform any regulatory decision. Please let me know what information CASA requires to make the regulatory determination.

Yours sincerely

Rob Weaver
Executive Manager
Safety, Environment and Assurance
13 October 2015

LAHSO progress report to CASA (Oct 15):

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the definitions and terminology contained in national standards, rule set and procedures to ensure consistency and application intent.	Any implemented changes to rule sets / procedures	The review is completed. All resulting rule set/procedure change actions have been captured in CIRRIS.	Complete
Conduct a review of LAHSO procedures and practices at Melbourne and Adelaide to ensure the application is consistent with the intent of the CASA Manual of Standards (MOS) Part 172, the Aeronautical Information Package (AIP) and the Manual of Air Traffic Services (MATS).	Any implemented changes to rule sets / procedures.	The review is completed. All resulting AIP/MATS change actions have been captured in CIRRIS.	Complete
Reassessment of the data modelling completed for the 2013 Melbourne Go-Around Study. Incorporate data modelling as an addendum to 2012 LAHSO Safety Assessment Report	Risk modelling report	The analysis has been completed.	Complete
Risk assessment of all LAHSO procedures and practices at Melbourne using additional top-down and bottom up techniques as described in AA-GUIDE-SAF-0105C to ensure the identification and assessment of all potential failure modes associated with all operational airspace and runway mode configurations. Incorporate assessment as an addendum to 2012 LAHSO Safety Assessment Report and update ORAs as appropriate	Addendum to the 2012 CROPS/LAHSO SAR report. Updated Melbourne Tower and TCU ORA	The risk assessment of LAHSO procedures (including supporting evidence) has been completed.	Complete
Conduct a review of the training and support for personnel with National Request for Change (NRFC) safety management roles and responsibilities to ensure safety change is managed in accordance with Safety Change Management Requirements.	NRFC Safety Management Roles Training and Support Review (Version 4)	Complete. The following further actions address the findings: – Development of the safety competency framework to include	Complete

Action	Deliverable	Current Status	Planned Completion
		competency requirements for safety specialists and managers approving operational change. Targeted staff training is due to commence in October 2015 (ACT-0007754). – Procedure changes to clarify the relationship between the role of the 'Safety Coordinator' and 'Lead Safety Specialist' (ACT-0007773 and ACT-0007774).	
Implement a scheduled programme of operational surveillance activities of sufficient scope and periodicity to provide assurance that the application of procedures and practices remain consistent with national standards and the rule set.	Program of operational surveillance activities.	The Office of the CATC is conducting an operational surveillance of LAHSO in Melbourne during the month of October 2015. The criteria for determining which units will be a priority for subsequent operational surveillance activity is still under development and Airservices will provide more information in subsequent updates.	Update CASA - Dec 15.
Conduct a study to determine whether alternative means of air traffic segregation (such as dependent runway operations) could be safely applied in Melbourne without material reductions to capacity.	Options study paper.	An options paper examining options to assure the safety and efficiency is LAHSO is complete, and includes the	Complete

Action	Deliverable	Current Status	Planned Completion
		introduction of a stagger via MAESTRO. A team has been established to progress the initiatives.	
Suspension of aerodrome controller training during LAHSO	Local instructions	Implemented	Complete
Only aircraft operationally requiring the use of runway 34 for departures are permitted to use it during LAHSO. Ad hoc requests will not be accommodated.	Local instructions	Implemented	Complete
09/34 LAHSO mode has been suspended (because all departures in this mode are from runway 34)	Local instructions	Implemented	Complete
Airservices safety investigation into 5 July double go around (CIRRIS)	Investigation report	Completed	Completed
Undertake an annual safety review of LAHSO	Annual review report	Ongoing.	Ongoing annual action

airservices

Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) Safety Assessment Report (SAR) Addendum All Phases

Safety Assessment Report

SAF-SAR-12009-Add

Version 1.0

Effective 31st August 2015

EGM-ATC Received
- 9 SEP 2015
No: KI15090003

Prepared: [redacted]
SE&A Project & Business Support Manager, Brisbane
On behalf of [redacted]
Senior Project Safety Specialist

[redacted] isbane, ou=Project and Business Support, SE&A, email=[redacted]@airservicesaustralia.com, c=AU
Date: 2015.09.08 12:08:57 +10'00'

I declare that this Safety Assessment Report:

- has been prepared in accordance with the requirements of Airservices Safety Management System that are necessary to manage the Operational-Safety aspects of the change
- accurately reflects the Operational Safety Program performed in support of this change

Agreed: Paddy Goodall
Chief Air Traffic Controller (CATC)

Paddy Goodall — Digitally signed by Paddy Goodall

I declare that the Operational Safety Program described within this Safety Assessment Report:

- accurately reflects the safety program performed in support of this change
- includes outstanding activities that are incorporated within the change schedule, resource and budget planning

Endorsed: Rob Weaver
Executive General Manager (EGM)
Safety, Environment and Assurance (SE&A)

9/10/15

I am satisfied, following review of this Safety Assessment Report, that it:

- describes a Safety Program that meets the requirements of the Safety Management System necessary to manage the Operational-Safety aspects of the change
- provides a valid, evidenced safety argument

Accepted: Greg Hood
EGM Air Traffic Control (ATC)

Greg Hood 14/9/15

I am satisfied, following review of this Safety Assessment Report, that it:

- accurately describes the approved and executed Operational Safety Program
- provides a valid, evidenced safety argument that confirms the:
  - validity of the operating concept, for which an accurate and valid set of requirements, including safety requirements, has been articulated
  - solution implements the operating concept
  - operational transition and ongoing operation have been adequately planned and reviewed to ensure the specified requirements are met
  - change, as implemented, ensures all identified Operational Safety risks associated with the operational implementation, transition, and ongoing operation are able to be managed to ALARP

Document Review Record

Those listed below, as well as the signatories, have reviewed this document in the context of their area of expertise and in accordance with their area of accountability. All issues raised from the reviews have been addressed to the satisfaction of all reviewers.

Name	Role / Position
[redacted]	Senior Human Factors Specialist
[redacted]	Brisbane Project and Change Support Manager
[redacted]	Manager, Project and Business Support
[redacted]	Senior ATS Specialist
[redacted]	ATS Integrity Manager
[redacted]	Manager, East Coast Services North
[redacted]	Manager, East Coast Services South
[redacted]	ATC Line Manager (Adelaide Tower)
[redacted]	ATC Line Manager (Adelaide Tower and TCU)
[redacted]	ATC Line Manager (Melbourne Tower)
[redacted]	Business Coordinator
[redacted]	Acting Chief Air Traffic Controller
[redacted]	Melbourne ATC Line Manager - Tower
[redacted]	Melbourne ATC Line Manager - TCU
[redacted]	Melbourne ATC Line Manager - TCU
[redacted]	Change Assurance Manager

Change summary

Version	Date	Change description
0.1	July 2015	Initial Draft
0.2	July 2015	Incorporate comments from DMB
0.3	July 2015	Updated to include prolonged Non LAHSO and additional controls for the double go around.
0.4	July 2015	Addressed the TBA from the Attachment section Updated the Essendon LAHSO hazard with feedback from ATC
0.5	August 2015	Feedback from [redacted] and CATC
0.6	August 2015	Feedback from [redacted]
0.7	August 2015	Feedback from [redacted]
1.0	August 2015	Issued for signature

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1 Executive summary

This Safety Assessment Report (SAR) addendum has been produced to report on the outcomes of activities conducted in response to recommendations from the LAHSO Post Implementation Review (PIR) Report and the Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Report. It excludes CROPS as no new activities were identified in response to the CROPS PIR.

This SAR addendum also provides evidence of additional assurance activities have been performed to support the Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) All Phases Safety Assessment Report (SAR) 2012. These activities have identified additional controls to ensure that the current risks associated with LAHSO are being managed to As Low As Reasonably Practicable (ALARP).

New safety analysis techniques have be used to assist in identifying any additional foreseeable risks to those previously identified with LAHSO, and all LAHSO runway configurations have been captured within the associated safety activities.

Methods that have been used to support this analysis include Human Factors (HF) Analysis and Classification System (HFACS), Detailed Flight Threads and Structured What-If techniques.

As a result of the HFACS analysis, one new Class C hazard was identified in conducting LAHSO. Ways of minimising potential errors or at risk behaviours have been identified through the analysis and the subsequent risk assessment workshops, and these are captured as proposed controls in Hazlog 901. Additional actions have been recorded in the CIRRIS database for ongoing management.

The Operational Analysis Unit within the Strategy, Systems & Analysis (SSA) Branch of SE&A has also produced analysis on all go arounds that have occurred between 1st January 2012 to 28th February 2015, published in Version 3.2 of the Risk Analysis of Melbourne LAHSO operation. This analysis has provided two different likelihoods based on separation at the runway intersection:

- Likelihood of two go arounds on crossing runways within 20 seconds at the intersection can be classified as yearly to 5 yearly
- Likelihood of two go arounds on crossing runways within 60 seconds at the intersection can be classified as daily to yearly

As a result, the likelihood for Hazard 901/10, 2 aircraft perform a go around, has increased in magnitude from that originally reported in the 2012 SAR. Assuming that the 20 second criteria is agreed to meet the description of a 'major' consequence using the Airservices risk matrix, when considering a revised likelihood of yearly to 5 yearly, this will result in a 'B' class risk.

Operational analysis did also confirm that the current crosswind and downwind limitations imposed during LAHSO do decrease the likelihood of a go around, which in turn positively impacts the predicted double go around rates.

Additionally, since the December 2014 LAHSO PIR, two double go around[1] incidents have occurred in LAHSO at Melbourne. One was considered in the Operational Analysis Unit assessment, however as this assessment was already indicating a Class B risk, the second double go around occurrence resulted in the Executive General Managers (EGMs) Safety, Environment & Assurance (SE&A) and Air Traffic Control (ATC) requiring additional safety assurance activities be carried out to:

- revise and update the risk assessment for the double go around risk in light of recent occurrence to confirm it still remained in the tolerable region
- determine if there are any additional controls that could be implemented to ensure the risk remains reduced to As Low As Reasonably Practicable (ALARP)
- assess the operational safety impact of ceasing LAHSO in the short and long term.
- incorporate the outcomes of this additional assessment into this SAR Addendum in order to assist accountable managers in considering the current operational safety risks associated with LAHSO, based on the most recent assessments alongside the risks associated with ceasing LAHSO. This information can then be used by accountable managers to inform a decision regarding the ongoing operation of LAHSO from a cost vs benefit perspective.

The Operational Analysis Unit updated their analysis to include the most recent double go around occurrence in Version 3.3 of the Risk Analysis of Melbourne LAHSO operation report. This resulted in the risk remaining as a Class B risk, although it was considered at the higher frequency end of the range.

In conducting the risk assessment workshop for ceasing LAHSO, two new hazards, one with a 'C' class the other with a 'D' class residual risk, were identified, as well as a number of new controls that are 'yet to be met'.

This workshop also identified a potential 'B' class residual risk for Essendon Tower resulting from its location and the risk associated with managing departures during LAHSO. This risk needs further analysis and treatment to ensure it is managed to ALARP. A full review of the recorded risk was undertaken by East Coast Services South which determined the risk had been previously identified and captured in the Essendon ORA (Aircraft in conflict (EN/ML Proximity) and was reassessed as a Class D risk. Discussion with the Office of the Chief Air Traffic Controller concluded that the threat lines in the ORA required updating to fully capture the risk.

This work also included identification of additional controls that could be implemented to manage the risk associated with a double go around in LAHSO. One of these controls, remove the availability of SHEED, would reduce the number of occurrences where Essendon Tower is required to separate with arrivals on RWY 27 and RWY 34 arrivals overhead Essendon.

It is acknowledged that this Addendum reports only on the operational safety risk associated with continuing or ceasing LAHSO and does not include assessment of

[1] For the purposes of this report and the associated workshop held in July 2015 the definition of a double go around was stated as being two aircraft on approach to the nominated LAHSO runways who, in the event of them both conducting missed approaches, would cross the runways intersection within 60 seconds of each other. (Ref. Attachment 12)

other Major Loss Events (MLEs) in the Airservices Risk Matrix Framework (ARMF), such as reputation, environment or service delivery.

In summary, the most significant risk associated with LAHSO relates to the residual Class B risk associated with double go arounds. While a significant number of controls are already in place, additional controls are in the process of being implemented, and further new controls have been proposed in an effort to ensure the risk remains ALARP and in the tolerable region, it is anticipated that it will continue to remain a Class B risk, subject to any further double go around occurrences. This is as a result of the identified controls being mostly procedural in nature and limited in their effectiveness in controlling the double go around risk, particularly given a go around can be initiated by the pilot as well as ATC and it is not always predictable.

It has been determined that ceasing LAHSO, if done in a managed fashion with some additional controls implemented prior, is feasible from an operational safety perspective. The cost of implementing this risk reduction has not been assessed from a whole of industry perspective.

In accordance with Airservices risk management requirements for a Class B risk, ongoing reviews should include industry to determine if the cost, reduction in capacity and service delivery benefits, of reducing the risk by ceasing LAHSO is grossly disproportionate to the expected risk reduction benefit.

2 Purpose

The purpose of this SAR addendum is to report on the outcomes of safety activities and analysis of the Land and Hold Short Operations (LAHSO) procedures, as recommended by the LAHSO Post Implementation Review (PIR) Report and the Targeted Review of Melbourne LAHSO Report,

This SAR addendum presents updated and revised information on the hazards and controls that have been identified using additional techniques to those identified in the 2012 SAR, and considering all LAHSO runway configurations to ensure that all reasonably foreseeable risks have been identified and these risks are being managed to As Low As Reasonably Practicable (ALARP).

Part of this work included identifying additional controls that can be implemented to further mitigate the likelihood of a double go around which can occur during LAHSO.

This addendum also reports on the risks associated with prolonged non-LAHSO in Melbourne in order to provide the operational safety input into any balanced decision which weighs the operational safety risk against the business benefits of continuing LAHSO.

3 Background

A safety assurance review was conducted in 2012 on Converging Runway Operations (CROPS) and LAHSO performed at Brisbane, Melbourne and Adelaide respectively. The scope of that review was limited to the approved runway configurations in operation at that time.

The objective of the review was to produce evidence to confirm that the overall risks associated with the then current CROPS and LAHSO procedures within the ATM System had been identified, assessed and recorded, and that they had been accepted and were being managed to ALARP.

That review resulted in the identification of a number of additional controls that could be implemented to further reduce the identified risk to ensure it remained ALARP and this was reported in the Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) All Phases Safety Assessment Report (SAR) 2012 (Ref.1), hereinafter referred to as the 2012 SAR.

In December 2014 a PIR for the LAHSO aspect of the 2012 SAR reviewed the implementation of these controls and aimed to validate the assumptions made during the original safety activities (Ref.2).

As a result of the PIR, it was identified that additional safety activities were required to ensure all runway configurations were assessed at Melbourne and Adelaide. Also identified in the PIR was a recommendation to conduct further safety analysis using additional analysis techniques to assist in identifying further potential for errors when applying the LAHSO procedures.

It was agreed that an addendum to the 2012 SAR would be developed to report on these additional safety assurance activities.

Additionally, a PIR for the CROPS aspect of the 2012 SAR was conducted in February 2015 (Ref. 3). This PIR resulted in no major actions or changes for CROPS.

Simultaneous to these PIR workshops, the Risk and Investigations Unit with the Safety, Environment & Assurance (SE&A) group, conducted a targeted review of LAHSO operations at Melbourne. This review recommended that additional techniques should be used to identify and assess the potential failure modes associated with the operational airspace and runway configurations associated with LAHSO (Recommendation 4). The activities conducted to satisfy the LAHSO PIR recommendations also address Recommendation 4 of the Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Report (Ref. 4), hereinafter referred to as the Targeted Review of LAHSO.

Subsequently to the PIRs and Targeted Review of LAHSO, and while the SAR Addendum was being developed, two double go arounds occurred in LAHSO at Melbourne. The associated incident reports are ATS-0134447 and ATS-137997 (Ref. 19 and 20 respectively).

As a result of these incidents, additional safety assurance was requested by the EGM of ATC and SE&A to reconfirm the likelihood of double go around risk that was previously reported in the 2012 SAR, and also to assess if any additional controls could be implemented to ensure risks remain ALARP.

While confirming that the risks associated with LAHSO remained in the tolerable region, consideration was also given to ceasing LAHSO until such time as appropriate assurance was received. This resulted in safety assurance activities which assessed the risks associated with ceasing LAHSO in the short term and longer term and the outcome of these activities is also captured in this SAR addendum.

4 Scope

The scope of the work to be undertaken for this SAR addendum was outlined in a Terms of Reference (ToR) document prior to the safety work commencing (Attachment.1).

The scope of activities subsequently reported on in this SAR addendum include:

- LAHSO PIR Report Action 5 - Generate a detailed flight thread for LAHSO at Melbourne and Adelaide using the flight thread discussed at the PIR workshop. The flight thread will be distributed to Melbourne and Adelaide controllers to review and agree. The Melbourne flight thread will capture runway configurations 34/09 and 34/27 to validate that the current hazards are equally applicable to both runway modes. All the agreed flight threads will provide evidence from the controllers on how the LAHSO procedures and practices are applied. The second part of Action 5 refers to the consistent application of LAHSO over the various documents and has been undertaken by ATS integrity.
- LAHSO PIR Report Action 10 - Analyse the procedures (obtained from action 5) to understand at which point during the LAHSO procedure an error / violation could be introduced and assess the associated risk.
- By completing the above actions, these will address Recommendation 1 and 4 from the Targeted Review of LAHSO (Ref.4).
- Assessment of risks associated with prolonged non-LAHSO
- Identification of additional controls to further reduce the risk of a double go around.

The CROPS PIR did not identify any further safety work to be completed and therefore this SAR addendum will only cover the additional safety activities conducted for LAHSO (Ref.3).

LAHSO is currently performed at three aerodromes in Australia, Melbourne, Adelaide and Darwin. Darwin is not within the scope of PIR activities or this SAR addendum as Darwin Tower and TMA are managed by Defence. However, Darwin did perform a review of the LAHSO operations and Airservices did attend the review (Ref. 5).

Potential Operational Safety Affected Areas	Effect
Service provision(s) under the CASR Provider Certificates and/or non-regulated services	There is no effect on service provision
Business Groups, Service Delivery Lines, Business Branches and Units	The following will be affected: • ATC o Adelaide Tower and TMA o Melbourne Tower and TMA o ATS Integrity • Safety, Environment and Assurance (SE&A) – Project and Business Support (PBS).
Systems (including regulated and non-regulated technical systems, systems of work, and management systems),	There is no effect on systems
Facilities and Equipment (including data and networks) including design, operations and maintenance;	There is no effect on facilities and equipment
People and associated procedures.	The following will be affected: • ATC o ATS Integrity (updates to MATS) o Adelaide Tower and TMA o Melbourne Tower and TMA o Essendon Tower

Table 1 - Potentially Operational Safety Effected Areas and the Associated Effects

5 Assumptions, constraints and dependencies

5.1 Assumptions

- o The safety work conducted assumes that the controllers comply with the instructions as stated in the MOS, MATS, AIP and relevant Local

~~Instructions/agreements. Non-compliance with these documents is covered in the generic ORAs (Ref.11) and (Ref. 12).~~

- This SAR addendum has only sought risk acceptance for new risks that have been identified within this body of work and for any changes the current hazard causes and controls. Hazards for which additional causes and controls have been identified throughout this analysis will be resubmitted to the accountable manager for acceptance. Minor alterations to the description and unchanged hazards will not be resubmitted for acceptance, and the original acceptance is assumed to remain current as previously presented in the 2012 SAR.
- For any changes to documentation associated with LAHSO, it is assumed that these changes will be managed in accordance with the Airservices Safety Management System (SMS).

5.2 Constraints

- The quality of the analysis was dependent on suitably qualified and experienced resources being released to participate in and undertake the safety analysis.
- Due to financial constraints the use of video conferencing was encouraged to minimise expenditure, therefore the workshops were mainly conducted via video conference over three different locations which can impact upon the workshop dynamics.

5.3 Dependencies

- The information analysed in these activities is dependent on the information provided by controllers in the various workshops. Multiple techniques were used to draw as much relevant information from the controllers as possible. However, the analysis is always dependent on the information provided by the controller.

6 Responsibilities

Table 2 shows the key players and their responsibilities

[illegible]	Responsibilities
[redacted] Senior Project Safety Specialist	• Preparation of Safety Documentation • Facilitate Risk Assessment Workshops • Maintaining the Hazard Log (HAZLOG) • Application of the SMS
[redacted] Senior Human Factors (HF) Specialist	• Provide valid input into Safety Documentation • Preparation of HF Documentation • Preparation of HF Documentation to support risk workshops • Attend Risk Assessment Workshops
[redacted]	• Sponsor this body of work

Name and Position	Responsibilities
Sponsor –CATC	• Ensure that the necessary resources and personnel are available as required within ATC • Provide critical business direction and guidance • Monitor and oversight of this body of work • Oversight of project safety management activities • Acceptor of the SAR addendum
[redacted] ATS Integrity Manager	• Identify and facilitate required amendment to regulatory documentation • Participate and manage resources to ensure valid input into safety assurance activities. • Participation in the risk assessment workshops and the development of risk mitigations
[redacted] Senior ATS Specialist	• Identify and facilitate required amendment to regulatory documentation • Provide valid input into safety assurance activities. • Participation in the risk assessment workshops and the development of risk mitigations
[redacted] (ALM) [redacted] (ALM) Melbourne Tower ATC	• Participate and manage resources to ensure valid input into safety assurance activities. • Participation in the identification of hazards and the development of risk mitigations • Provision of expert advice on Melbourne ATC Tower matters
[redacted] Melbourne TMA ATC	• Participate and ensure valid input into safety assurance activities. • Participation in the identification of hazards and the development of risk mitigations • Provision of expert advice on Melbourne ATC TMA matters
[redacted] Melbourne Enroute	• Participate and ensure valid input into safety assurance activities. • Participation in the identification of hazards and the development of risk mitigations • Provision of expert advice on Melbourne ATC Enroute matters
[redacted] Adelaide Tower ATC	• Participate and ensure valid input into safety assurance activities. • Participation in the identification of

Name or Position	Responsibilities
	hazards and the development of risk mitigations • Provision of expert advice on Adelaide ATC Tower matters
[redacted] Adelaide TMA ATC	• Participate and manage resources to ensure valid input into safety assurance activities. • Participation in the identification of hazards and the development of risk mitigations • Provision of expert advice on Adelaide ATC TMA matters
[redacted] Essendon Tower ATC	• Participate and manage resources to ensure valid input into safety assurance activities. • Participation in the identification of hazards and the development of risk mitigations • Provision of expert advice on Essendon ATC Tower matters
[redacted] Operational Analysis, Safety Strategy & Analysis, SE&A	• Analysis of double go around data to inform risk assessment • Production of Analysis report

Table 2 - Roles and Responsibilities

7 Consultation and communication

The Senior Project Safety Specialist was responsible for ensuring all appropriate key stakeholders were involved in the consultation and communication process to support the safety assurance activities.

Table 3 shows the main stakeholders which were consulted and the methods of communication that were used.

Key Stakeholder Group/ Target Audience	Aim	Communication Tools/Methods	Communication Records / Method
Air Traffic Control	• Provided required expertise to participate in the Risk Assessment workshops and flight thread workshops • Safety documentation Review.	• Phone Calls, • Emails, • Workshops, • Safety documentation	• Detailed Flight Threads (Attachment 2) • Melbourne Risk Assessment Workshop (Attachment 3) • Adelaide Risk Assessment Workshop (Attachment 4) • Review of the SAR addendum • Prolonged non LAHSO Risk assessment workshop minutes (Attachment 9)
Office of CATC	• Supported the safety assurance activities • Provided required expertise to participate in the Risk Assessment workshops and flight thread workshops • Safety documentation Review.	• Phone Calls, • Emails, • Workshops, • Safety documentation	• Detailed Flight Threads (Attachment 2) • Melbourne Risk Assessment Workshop (Attachment 3) • Adelaide Risk Assessment Workshop (Attachment 4) • Review of the SAR addendum • Prolonged non LAHSO Risk assessment workshop minutes (Attachment 9)
Project Business Support (PBS)	• HF Specialist to perform HF studies to use as evidence. • HF provided required expertise to participate in the Risk Assessment workshops • Advice on application of SMS. • Safety documentation Review.	• Meetings, • Phone Calls, • Email, • Safety documentation, • HAZLOG • Workshops.	• Detailed Flight Threads (Attachment 2) • Melbourne Risk Assessment Workshop (Attachment 3) • Adelaide Risk Assessment Workshop (Attachment 4) • Review of the SAR addendum • Prolonged non LAHSO Risk assessment workshop minutes (Attachment 9)

Table 3 - Consultation and Communications Table

8 Design process

This section is captured within the LAHSO and CROPS SAR (Ref. 1)

9 Implementation process

9.1 Transition to operations

As LAHSO is currently utilised at Melbourne and Adelaide Aerodromes, no process is required to be followed to transition to operations.

9.2 Implementation procedures and standards

During the safety activities conducted to support this SAR addendum, NRFC 27954 (Ref. 6) was raised by ATS integrity to amend the LAHSO procedures within MATS. The changes to MATS include changes to the passive runway wind criteria, LAHSO transition and no windshear during LAHSO. A Safety Case Assessment and Determination (SCARD) workshop was held to assess the safety reporting requirements to support changes to MATS and it was found to be a 'SCARD only'. (Ref.7) It has been recommended that a PIR be conducted to assess the effectiveness of the implemented changes (Attachment 3). This recommendation will be tracked as an action in CIRRIS and monitored to completion.

9.3 Implementation safety management activities

This section describes the safety techniques used and the safety activities undertaken to provide input into this SAR addendum

9.3.1 Techniques used

Since the 2012 SAR was accepted, there has been a Targeted Review of LAHSO at Melbourne (Ref. 4). This report recommended that additional top-down and bottom-up techniques be used as described in Safety Risk Management Tools and Techniques (Ref.8). The aim of these additional techniques was to ensure the identification and assessment of all potential failure modes associated with the operational airspace in runway mode configurations.

The recommendation to use additional techniques was also highlighted in the LAHSO PIR Report (Ref. 2). However, the PIR report suggested that the failure mode analysis as per Safety Risk Management Tools and Techniques (Ref.8) would not be suitable as this technique is aimed at hardware systems and human errors are not considered in this analysis. The PIR report identified that the HFACS would be more suitable as this examines ways in which human errors and at risk behaviours can be introduced in LAHSO.

Another task analysis technique which was considered was a procedural HAZOP however in considering the benefits and disadvantages of this technique, as outlined in AA-GUIDE-SAF-0104, it was considered inappropriate. HAZOPs depend heavily on data completedness and accuracy of drawings and documentations and LAHSO is not one specific procedure but a number of procedures and rules that can be applied. Additionally it is not considered good for examining operator errors, or common cause or dependent failure and it was felt that there would be minimal additional gain for such a time and resource intensive procedure.

The first part of the HFACS required a detailed flight thread to analyse. During the PIR workshop, a flight thread was discussed in order to try and validate the assumptions made during the previous 2012 SAR safety activities. It was found that these flight threads were high level and more detail was required to perform the HFACS and validate the required assumptions. Action 5 was raised during the PIR (Ref. 2) to generate detailed flight threads for Melbourne and Adelaide.

These detailed flight threads would represent a top-down technique which could be used identify any further errors and at risk behaviours. For more details on how these detailed flight threads were developed and how they were used in the HFACS can be found in the LAHSO Human Factors Analysis and Classification System Report (Attachment 5).

This report explains how these detailed flight threads were then analysed and captured in a HFACS Model and further bottom-up analysis was performed to trace the safety issues back to the organisation as a whole.

The report explains how the technique used is similar to a root cause analysis and the associated challenges in applying such a technique.

In addition to the techniques described in the report, a structured what-if technique was used in the risk assessment workshops. This is another top-down technique used to identify any hazards not already identified. The structured what-if technique explored how controllers would manage the active and passive participants in all runway configurations in a variety of go around scenarios. These go around scenarios tried to reflect the most common reasons for a go around, using data from the LAHSO Literary review (Ref. 9).

9.3.2 ADHOC LAHSO

The scope of the 2012 SAR covered the current modes of operation utilised at Melbourne and Adelaide at the time that the safety activities were carried out. The Targeted Review of Melbourne LAHSO (Ref.4) identified that due to the relocation of Melbourne Tower, LAHSO 34/09 was temporarily suspended at the time that the 2012 SAR was completed. As a result, the original SAR only covered LAHSO for 27/34, and by inference this did not include ADHOC LAHSO.

LAHSO 34/09 has since been reintroduced after the commissioning of the new Melbourne Tower, and this additional mode has now been included in the activities described in section 9.3.3 and 9.3.4. All runway configurations and ADHOC LAHSO have been covered in the detailed flight threads and in the subsequent risk assessment workshops.

During the flight thread workshops, it was stated that the only difference between ADHOC LAHSO and LAHSO, was the nomination of runways on the ATIS (i.e. ADHOC LAHSO does not nominate both runways on the ATIS). Due to the runway configuration at Melbourne, runway 34 is the only runway in which aircraft can hold short, therefore runway 34 by default will always be the active runway during LAHSO at Melbourne. The passive runway could either be 09 or 27, therefore the ATIS as a minimum must nominate the passive runway during LAHSO. However, this has been discussed at length within ATC and it has been agreed that both runways must always be declared on the ATIS when conducting LAHSO, effectively permanently terminating ADHOC LAHSO operations. This has been incorporated into MATS (Ref. 6).

9.3.3 Human Factors Analysis

It was determined through this review that a number of positive controls are in place for LAHSO and that Airservices has been committed to ensuring that safety and efficiency are balanced and satisfied.

A number of HF activities were completed to address the actions identified in the LAHSO PIR and Targeted Review. These were outlined in the ToR (Attachment 1) and included:

- Creation of a Detailed Flight Thread with Melbourne and Adelaide controllers
- Development of a Sequential Event Plot (SEP)
- Development of a HFACS Model for LAHSO
- Analysis and interpretation of findings.

During the HFACS activities, a number of potential errors and at risk behaviours were identified as a result of information provided by controllers and a review of documentation such as MATS. These were categorised within the HFACS model under:

- Unsafe acts
- Preconditions for unsafe acts
- Unsafe supervision
- Organisational influences.

As a result, a number of findings and subsequent recommended actions were identified that have the potential to improve LAHSO and its associated procedures. These are documented in full in the LAHSO Human Factors Analysis and Classification System Report (Attachment 5).

9.3.4 LAHSO Risk Assessment Workshops

There were two LAHSO Risk assessment workshops conducted, one with Melbourne controllers and the other with Adelaide controllers. The workshops followed the same format:

Review of HAZLOG 901
The aim of reviewing HAZLOG 901 was to ensure that the participants were aware of what had been recorded previously to minimise any duplication of work effort.

Findings from the HFACS/Detailed Flight Threads
The LAHSO HFACS Report (Attachment 5) describes how the detailed flight threads were developed and how the information was processed to produce a list of findings. These findings were distributed prior to the workshop to the participants and were discussed in the workshop.

The outcomes of the workshops were recorded in the minutes for each workshop (Attachment 3 and Attachment 4).

Go around Scenarios (SWIFT)
A number of scenarios were presented to the controllers and the controllers were asked the same questions after each scenario. For example the first scenario was:

- During LAHSO with runway configuration (active 34/passive 09) the active participant is 'unstable' (e.g. too high, too fast etc...)
  - Q1 – How would you manage the passive participant
  - Q2 – Would you stop LAHSO
  - Q3 – If you did stop LAHSO, when would you restart it?

The second scenario would refer to the passive participant and Q1 would be amended to refer to the active participant.

Then each scenario after that went through all the runway configurations and how each participant is managed.

The reasons for the go around scenarios were taken from the LAHSO Literary review (Ref. 9) and included aircraft malfunction, turbulence, windshear and runway occupancy.

Runway Configurations
This provided an opportunity to confirm with the controllers that all runway configurations had been identified and assessed.

For more details about the Melbourne or Adelaide workshops, refer to the associated minutes (Attachment 3) and (Attachment 4) respectively. Melbourne and Adelaide specific concerns are discussed within section 9.3.4.2 and 9.3.4.3 respectively.

9.3.4.1 Summary of Key Workshop Outcomes

The following is a summary of key outcomes from the two LAHSO Risk Assessment Workshops which have been captured in the relevant Melbourne and/or Adelaide Workshop Minutes (Attachment 3 and Attachment 4) and Hazlog Register 901 (Attachment 6).

Hold Short Lights: A concern was raised at the Melbourne workshop, which is equally applicable to Adelaide, about the intensity of the hold short lights. The required intensity of the hold short lights will vary throughout the day depending on the available light.

Late Recognition of aircraft unable to participate in LAHSO: The PIR, the Targeted Review and the Detailed Flight Thread all identified an issue with the late recognition of aircraft being unable to participate in LAHSO. The PIR report (Ref.2) and the Targeted Review (Ref.4) contain a number of CIRRIS incidents referring to this issue. During the workshop, it was agreed that an additional control may help to eliminate this issue. This control would require enroute controller to provide a suitable read back when a pilot declares they are unable to participate in LAHSO for an aircraft that defaults to LAHSO approved e.g. "(call sign) NON ACTIVE LAHSO". This will provide an additional prompt for the controller to populate the Flight Data Record (FDR) correctly.

LAHSO FDR annotation: It was found that LAHSO is not recorded consistently in the FDR, causing potential confusion for the TCU and Tower controllers. It was suggested that a standardised directive is required to remind controllers of NAPM notation (Ref. 10).

LAHSO phraseology: It was found that some pilots are using non approved terms such as 'Negative LAHSO' which is creating additional work for controllers to establish if this is negative active or passive LAHSO. It was suggested that ATS provide an AIP supplement to remind industry of the approved terminology.

Transition out of LAHSO: During the discussions about transition to and from LAHSO, it was decided that a hazard was required to cover an 'Unplanned transition out of LAHSO'. There was a discussion with Melbourne controllers about the current update to MATS to cover the transition in and out of LAHSO. It has already been identified that these changes to MATS will require its own PIR to monitor and measure the effectiveness of these changes.

Simulator fidelity: Another area of concern that was raised during the workshops included the limited fidelity of the simulator. The current simulator does not have INTAS, therefore any resulting limitations for LAHSO should be captured in an appropriate manner.

Cloud base: Office of CATC are currently reviewing the possibility of lifting the cloud base during LAHSO to improve visibility to help manoeuvre aircraft. Although, implementation of this control may impact upon the availability of LAHSO and must be carefully considered to ensure that the risk mitigation is balanced against the efficiency gains.

Trigger points for initiating and ceasing LAHSO: ATS Integrity are currently investigating appropriate trigger points to initiate LAHSO to ensure the risk is balanced against efficiency. During the Detailed Flight Thread work, it was discovered that there may need to be two trigger points, one to initiate LAHSO and one to stop LAHSO. During the flight thread discussions with various controllers, it was mentioned on more than one occasion that LAHSO will continue until the weather deteriorates. The action raised during the LAHSO PIR (Ref.2) has been updated to reflect the increase in scope.

9.3.4.2 Melbourne LAHSO Risk Assessment Workshop

During the go around scenario discussions it was established that the only difference between 34/27 and 34/09 LAHSO operations, is that missed approaches from runway 09 must be coordinated with Essendon.

Due to the location of Essendon, it was found that arrivals onto runway 27 and missed approaches from runway 09 must be coordinated with Essendon regardless of which mode (LAHSO, ADHOC LAHSO or single runway) is being utilised.

The workshop participants stated the following were all of the LAHSO runway configurations at Melbourne:

- 27/34
- 09/34
- ADHOC LAHSO 09/34
- ADHOC LAHSO 27/34
- ADHOC LAHSO 09/34 during DEDRAT[2]

[2] DEDRAT – Dedicated Departure Runway Arrangement – Runway 27 for all landings, Runway 34 for all departures to the north east and runway 27 for all departures to the South and West (Ref. 21)

- ADHOC LAHSO 27/34 during DEDRAT

NOTE: NRFC 27954 (Ref. 6) has amended MATS which precludes the use of ADHOC LAHSO.

During the workshop it was explained that for Melbourne Tower there is extra coordination required with 34 arrivals. When changing from LAHSO to DEDRAT, controllers will change the configuration more often. MAESTRO is not yet configured to show that runways 27 and 34 are dependent when in DEDRAT mode. Each time there is a requirement to change from one configuration to the other, it introduces an element of risk due to opportunity for error.

During the flight thread workshops, it was found that Melbourne use 'DEDRAT' mode to expedite departures from Melbourne. Managing ADHOC arrivals during DEDRAT adds complexity for Tower controllers. Currently ADHOC LAHSO is not permitted, however, if ADHOC LAHSO is performed during DEDRAT additional safety work must be carried out to ensure all the risks have been identified. More information about DEDRAT and the associated issues can be found in the HFACS Report (Attachment 5).

During the flight thread discussions with Melbourne, it was stated that if the Echo Taxiway is unavailable, then many of the efficiencies gained from performing LAHSO are lost. This is due to the aircraft having to exit at the nearest exit taxiway which could involve back tracking on the runway. MATS does not provide any clarification with regards to taxiway availability during LAHSO. This requires further analysis and is captured in the Melbourne Risk Assessment Workshop Minutes (Attachment 3) and as an additional cause and control for hazard 901/10 2 aircraft perform a go around and 901/8 By day and VMC an active LAHSO participant performs a go around (Attachment 6)

All of the outcomes from the Melbourne workshop were recorded in the minutes (Attachment 3).

9.3.4.3 Adelaide LAHSO Risk Assessment Workshop

To actively participate in LAHSO, you must be certified in LAHSO from a CAR 217 provider, however, the passive participant does not require any further training. As a result, the question was raised at Adelaide whether General Aviation (GA) impacts upon the go around likelihood. It was confirmed at the Adelaide Workshop that GA do not increase the likelihood of go around at Adelaide. This was not raised as an issue at Melbourne as GA do not land at Melbourne.

During the go around scenario discussions it was established that there were no differences between the various runway configurations and how the LAHSO participants were managed.

The go around scenarios prompted discussion about how controllers would not sequence a LAHSO with an emergency situation. It was confirmed that this is not actually documented anywhere, but it is covered in training. This has been added as an additional control for hazard 901/10 2 aircraft perform a go around and 901/8 By day and VMC an active LAHSO participant performs a go around (Attachment 6).

Also, the go around scenarios initiated discussions regarding what can be done if the active participant has an engine failure, was unable to comply with the hold short and the passive participant has passed the threshold. There was minimal, if at all anything, that could be done from a controller perspective if this occurred. All they can do is hope that the sequence provides the necessary separation at the intersection.

The workshop participants stated that the following were all of the LAHSO runway configurations at Adelaide:

- 12 active / 23 passive
  This is the most common configuration to be utilised due to noise abatement rules.
- 05 active / 12 passive
  This is the second mostly used configuration.
- 12 active /05 passive
  This is the third mostly used configuration.
- 05 active / 30 passive
  (Least rarely used due to predominantly Jet aircraft arriving from the East and general preclusion from using Runway 30 during normal operations due to Noise abatement restrictions)

NOTE: Adelaide does not utilise ADHOC LAHSO.

It was raised at the Adelaide workshop that both the tower and TMA controllers did not feel that traffic was significant enough to use LAHSO mode. There are only a few aircraft that are able to participate actively in LAHSO and they questioned whether the benefits are commensurate with the associated risk. Runway 12 is short, so is very rarely used. Also, operators are becoming more risk adverse and are limiting the conditions (i.e. more stringent than MATS) in which they can participate in LAHSO. During the work in which the trigger points are being formulated (Ref. 2) it will be considered as part of this work package whether LAHSO is appropriate for Adelaide.

All of the outcomes for the Adelaide workshop were recorded in the minutes. (Attachment 4)

9.3.5 Risk Analysis of Melbourne LAHSO Operation Report

During the development of the 2012 SAR, the Operational Analysis Unit within the SSA branch of SE&A were tasked to conduct a quantitative analysis to predict the likelihood of a double go around during LAHSO at Melbourne. The 2013 Melbourne Go Around Study was completed and the likelihood of two go arounds on crossing runways within 20 seconds at the intersection was classified as less frequently than once every 50 years. (Ref.22)

The Targeted Review (Ref. 4) report identified that this analysis precluded data from runway configuration 34/09, which was not in use at the time of the analysis, and recommended that further analysis should be conducted with data for all runway configurations at Melbourne.

The Operational Analysis Unit then produced the Risk Analysis of Melbourne LAHSO Operation Report (Ref.15) which improved upon the previous analysis completed in the 2013 Melbourne Go Around Study in two key aspects:

- o High fidelity data provided by ODAS (Operational Data Analysis Suite),
- o More sophisticated time series analysis methods.

The Risk Analysis of Melbourne LAHSO Operation Report (Ref.15) analysed all go arounds that have occurred between 1st January 2012 to 28th February 2015. This time frame includes a double go around that occurred during LAHSO in Melbourne (Ref.19) In version 3.2 of the Risk Analysis of Melbourne LAHSO operation two different likelihoods were predicted based on separation at the runway intersection:

- Likelihood of two go arounds on crossing runways within 20 seconds at the intersection can be classified as yearly to 5 yearly
- Likelihood of two go arounds on crossing runways within 60 seconds at the intersection can be classified as daily to yearly

As a result, the likelihood for Hazard 901/10, 2 aircraft perform a go around, has increased in magnitude from that originally reported in the 2012 SAR. Assuming that the 20 second criteria is agreed to meet the description of a 'major' consequence using the Airservices risk matrix, when considering a revised likelihood of yearly to 5 yearly, this will result in a 'B' class risk.

Operational analysis did also confirm that the current crosswind and downwind limitations imposed during LAHSO do decrease the likelihood of a go around, which in turn positively impacts the predicted double go around rates.

Subsequent to this analysis, another double go around occurred during LAHSO at Melbourne, (Ref. 20) which resulted in an update to the Risk Analysis of Melbourne LAHSO Operation Report (Ref.15) to Version 3.3 to include the most recent double go around occurrence. This resulted in the risk remaining as a Class B risk, although it was considered at the higher frequency end of the range.

9.3.6 Prolonged Non LAHSO/Additional Double Go around Controls

As a result of the two go arounds in LAHSO at Melbourne additional safety assurance was requested by the EGMs of ATC and SE&A to further revise the predicted rate of double go arounds at ML, and to look at the impact of prolonged non LAHSO operations, in the event that the risk associated with double go arounds was considered unacceptable. This work also identified additional controls that could be implemented to manage the risk associated with a double go around to ensure it stayed within the tolerable region.

9.3.6.1 Prolonged Non LAHSO SCARD

In order to evaluate the impact of suspending LAHSO at Melbourne, a SCARD workshop was conducted. This was initially conducted with managers, however, controller input was sought to validate the results within the workshop. The controller input increased the size of the change from a minor to medium. The additional details provided by the controllers were relevant to the consequences of the change; however the consequence was not as severe for the short term changes. As a result, two SCARDs were produced, one for the short term impacts and another for the long term impacts (Attachments 10 and 11 respectively).

9.3.6.2 Prolonged Non LAHSO Workshop

A Prolonged Non LAHSO Risk assessment workshop was performed, and followed the same format below:

- Lessons learnt from impact of CROPS suspension
- Brief description of current operations and the impact of removing LAHSO

- Application of guidewords
- Application of checklist

More details about the workshop can be found in the associated minutes (Attachment 9).

Lessons learnt from impact of CROPS suspension

In 2010 an incident occurred at Brisbane Airport, a safety case addendum was produced to record the outcomes of the 2010 review. As a result of this review certain modes of operation were suspended in 2010, including night time operation and the availability of the runway19/14 configuration.

The acceptance rate for CROPS was 32 and this was reduced to 23 at night as a result of the introduced restrictions (i.e. return to single runway operations). The impact was felt by the Enroute sectors as airborne holding dramatically increased to manage the levels of traffic coming to Brisbane. This had a subsequent effect on the Gold Coast airport traffic.

The introduction of the Ground Delay Program (GDP) and Metron proved effective controls and reduced the airborne traffic levels back to a reasonable level.

The suspension of CROPS resulted in the enroute sectors being impacted immediately with little or no time for additional mitigations to be put in place to manage the additional risk associated with managing the demand capacity imbalance.

As Melbourne already has an effective GDP, it was determined that a large change to Melbourne arrival rates can be managed, provided there is enough lead time to implement the required controls to manage the change in traffic and stakeholder expectations.

Predicted Impact upon the National Operations Centre (NOC)

Currently with LAHSO, the NOC set the rates through harmony and conduct meetings to set slots and rates for the day. LAHSO acts like a 'pressure relief valve', it does not address scheduling concerns but it can relieve the amount of airborne traffic in a short time frame. The acceptance rate for LAHSO is 44, compared to 24 for single runway operations[3].

If LAHSO is not available, there will be ground delay at Sydney and Brisbane airports. This will require communications and consultation with industry to manage the traffic appropriately.

It is predicted that the workload and task complexity will increase and situation awareness will decrease within the NOC when LAHSO is not available.

Predicted Impact upon the Melbourne Enroute (Grampians/Monaro/Alpines and Bass)

Currently during LAHSO there are minimal delays and minimal communication required. Unusual communications can occur and include interactions with pilots on aircraft who are unable to participate in LAHSO and there is a higher sensitivity to runway changes due to change in LAHSO mode.

[3] The arrival rates are calculated from the arrival spacing which are provided in LOA 3348 – Operational Procedures – Melbourne TCU and Melbourne Tower (Ref. 21)

It is predicted that when LAHSO is unavailable, that the sectors will be split for longer, controllers will have to work harder to tactically manage the holding and the required diversions. Currently LAHSO is only utilised about 30% of the time, therefore non LAHSO operations are experienced 70% of the time. This means that non LAHSO operations are current for the majority of the time. When LAHSO is not available additional staff are required in the Grampians area to manage the traffic. Currently the traffic issues are managed tactically when LAHSO is not available. However, if LAHSO were to be unavailable for the long term, Airservices may have to investigate strategic options to support controllers in managing the traffic.

The impact of not having LAHSO will be minimal in the Alpines and Bass region.

It is predicted that the workload and task complexity will increase and situation awareness will decrease within Melbourne Enroute (Grampians and Monaro) when LAHSO is not available.

Predicted Impact upon the Melbourne TMA

Currently during LAHSO controller workload is high when LAHSO is in operation, but as stated before in the NOC, it acts like a 'pressure relief valve'. In essence, the workload is high when LAHSO is in operation and as soon as the traffic levels decrease, the workload also decreases. When LAHSO is in progress this provides the TMA with additional flexibility as they are more likely to absorb a go around due to the amount of slots that will be available during LAHSO. Also, when LAHSO has addressed the traffic levels, this provides the TMA capability to manage non Regular Public Transport (RPT) such as survey flights and practise instrument approaches.

It is predicted that when LAHSO is unavailable that whilst there will be no peak high workloads, there will be a sustained level of workload which will have no pressure relief. Also, there may be more potential conflicts as a result of wake turbulence. In LAHSO, the acceptance rate is 44 (22 per runway); for single runway operations the acceptance rate is 24 which results in smaller gaps between arriving aircraft.

Whilst the workload and task complexity may be high when LAHSO is in operation, these both reduce to a low level once LAHSO has addressed the traffic demand. Therefore the 'overall' workload and task complexity will increase and situation awareness will remain the same within Melbourne TMA when LAHSO is not available.

Predicted Impact upon the Melbourne Tower

Currently during LAHSO there are issues for the Surface Movement Controller (SMC) managing the demand on the concrete. Due to the amount of arrivals that can be processed during LAHSO, there is often not enough gates available and, as a result, there is holding in the taxiways. Due to the gaps being larger and more regular it is easier to process 'ON MODE' departures during LAHSO (i.e. using runway 27). However, it is more difficult to process the 'OFF MODE' departures (runway 34) as this uses up an arrival slot. For tower the pressure release occurs when coming out of LAHSO, as this is when the departure traffic can be processed. When LAHSO 34/09 is in operation, all traffic departing from runway 09 have to cross runway 34, this is difficult to manage with the arriving traffic on runway 34.

It is predicted that when LAHSO is not available it will still be difficult to insert a departure into the arrivals sequence due to the smaller gaps in arriving traffic on the single runway. As a result there will be more pressure on the Aerodrome Controller (ADC) to fit in departures, which may result in increased go arounds due to runway occupancy. On the other hand, single runway mode improves ground congestion and reduces the amount of holding in the taxiways.

During the discussions, other crossing runway modes were discussed such as Dedicated Departure Runway Arrangement (DEDRAT) and ADHOC Northern Departures (ADNOR). It was recommended that these modes undergo a separate risk assessment to ensure that a current risk baseline is established and to ensure risks are managed to ALARP. This recommendation will be raised as an action on the CATC and tracked in CIRRIS (Attachment 13).

It is predicted that the workload, task complexity and situation awareness will remain high within Melbourne Tower when LAHSO is not available.

Predicted Impact upon the Essendon Tower

Currently during LAHSO on 34/27 configuration, there are complexities associated with managing the 35 departures. Further review indicates that this issue is not specific to LAHSO but could exist when aircraft are independently flowed for arrivals to 34/27 at Melbourne. Refer to Figure 1

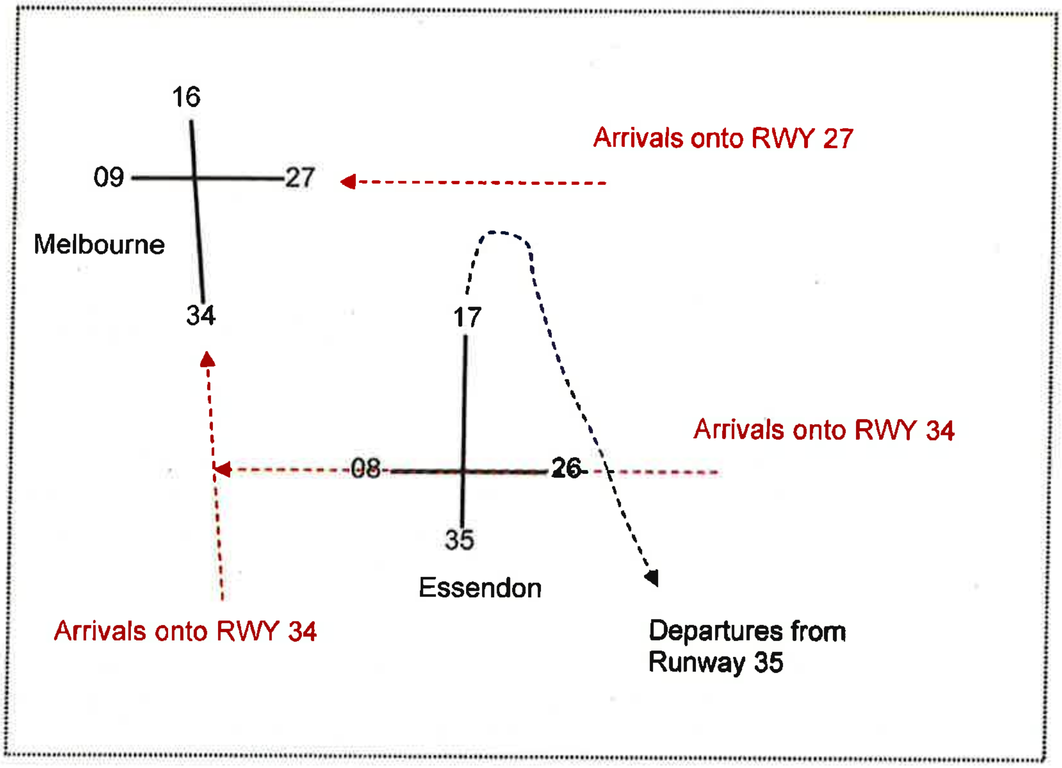

Figure 1 – Diagram of Essendon Runway 35 Departures

The departures from runway 35 have to be vectored out of the way of the arriving traffic onto runway 27. So once the traffic has been turned away from the arriving traffic onto runway 27, they then have to be managed to ensure that there is sufficient vertical separation with the traffic arriving onto runway 34. This has been captured as a new hazard for LAHSO and has been added as hazard 901/16 Increase in LOS risk due to workload and task complexity for Essendon Tower when LAHSO in progress. This is contained within section 9.4. A full review of the recorded risk was undertaken by East Coast Services South which determined that the risk was not LAHSO specific. The risk will remain within the LAHSO hazlog for tracking purposes until the ORA is updated.

It is predicted that it is significantly easier to manage the traffic when there is only one stream of arriving traffic into Melbourne.

It is predicted that the workload and task complexity will significantly decrease within Essendon Tower when LAHSO is not available as the number of aircraft pairs arriving 34/27 is reduced, and situation awareness will remain high.

Application of Checklist

A checklist was used as a prompt as a final check to provide assurance that all hazards had been identified. It was raised that a lot of the risks were managed by the GDP, if the airlines were to stop collaborating that control would not be effective. This control is reliant on industry participation and compliance.

9.3.6.3 Double Go Around Additional Controls

The second part of the workshop aimed to identify additional controls to further mitigate the risk associated with a double go around. The workshop followed the format described below:

- Definition of a double go around
- Go around causes
- Double go around controls and approximate time lines (short, medium, long term)
- Evaluate and assess risk with new controls.

More details about the workshop can be found in the associated minutes (Attachment 9).

Definition of a Double Go Around

For the purpose of the workshop, the double go around was defined by the acting CATC as being two aircraft on approach to the nominated LAHSO runways who, in the event of them both conducting missed approaches, would cross the runways intersection within 60 seconds of each other.

Go around causes

The aim of this session of the workshop was to gain a better understanding of a go around risk and examine potential controls to reduce preventable go arounds. The effectiveness of go-around in managing risk in the operational environment can be compromised by the preparedness and decision making of crew and ATC. World wide data from a study completed in 2012 showed that 4% of all approaches were unstable, yet 97% of those unstable approaches continue to landing.

SE&A and ATC are currently working with industry to better understand go arounds and the impacts they may have on both parties. The go around rate is increasing, particularly as a result of unstable approaches. A significant proportion of go arounds may be preventable when they are attributable to an unstable approach from causes other than weather or windsheer. Whilst go-arounds are initiated to assist crew and ATC avoid hazardous situations, poorly managed go-arounds can lead to an increase in risk or can introduce additional hazards. This is particularly the case at night and in IMC.

The three highest contributing factors to a go around are the weather, departing aircraft and unstable approaches (data extracted from CIRRIS from 1 Jan 2013 to 30 Jun 2015).Work has been undertaken at Brisbane to improve runway occupancy and the impact of a slow departing aircraft. Due to the work undertaken at Brisbane, the runway occupancy time has been reduced by 8 seconds.

There are many contributing factors in which ATC play a role that can lead to an unstable approach, for example:

- Unexpected track shortening
- Being held high
- Requirements for speed changes and unrealistic speed control requests
- Leaving a holding pattern at a nominated time (difficult to do)
- Late runway changes
- Final approach intercepts and late turn-ins onto final
- Early / frequent requests for reporting visual, and getting caught with low cloud
- Lack of awareness of environmental impacts such as tail wind effects, particularly when on base and trying to slow down when turning final
- Human factors aspects of some instructions, multiple instructions

One of the recurring concerns raised by pilots which can contribute to unstable approaches is the requirement for speed changes, with pilots often receiving multiple speed requests. These are often related to either a requirement to meet feeder fix times or slot allocations.

Double go around potential controls and approximate timelines

Double go around potential controls were identified and can be found in Table 4 with their potential approximate timelines in the range of short, medium and long term execution.

Control Title	Control Description	Effect of control on hazard	Work Area Providing Resolution	Comments	Implementation Timeframe
Review the use of runway 34 for off mode departures	Limit the 'off mode' departures	Reduce likelihood of go around	SDL	This has been captured in TLI 185. TLI 185 has created other congestion issues which	Short Term

Control Title	Control Description	Effect of control on hazard	Work Area Providing Resolution	Comments	Implementation Timeframe
				needs to be investigated.	
Limit 09 arrivals to QANTAS group during LAHSO 34/09 and limit the number of pairs	Vary the application of 34/09 MAESTRO	Reduce likelihood of go around	SDL	Currently every 09 arrival loses a departure slot. The QANTAS terminal is situated at the end of runway 09, therefore it will minimise the taxi distance for QANTAS.	Short Term
Suspending 34/09	Remove LAHSO configuration 34/09	Reduce likelihood of go around	SDL		Short Term
Instrument STARs (remove SHEED STAR)	All aircraft must comply with instrument approaches	Reduce likelihood of go around	SDL	Reduces ML TMAs ability to process Essendon traffic. Instrument approaches are more predictable for tower as the aircraft are more stable. ILS approaches would reduce the single go around rate and therefore should reduce double go arounds If no SHEED - would be all instrument	Medium Term

Control Title	Control Description	Effect of control on hazard	Work Area Providing Resolution	Comments	Implementation Timeframe
				approaches and long final. Industry advice would be required.	
Runway allocation from the east	Investigate runway allocation from the north east	Reduce likelihood of go around	SDL	Reduces ML TMAs ability to process Essendon traffic	Medium Term
Review the arrival spacing and rates during LAHSO	Review the arrival spacing and rates during LAHSO	Reduce likelihood of go around	SDL		Medium Term
Stop LAHSO after last light	Stop LAHSO after last light	Enhance recovery from go around	SDL	Currently the tower will instruct an aircraft to turn provided they are visual and remain in the circling area whilst below the MVA (minimum vector altitude)	Medium Term
Airspace Review	Review the SIDs and STARs and provide additional track miles	Reduce likelihood of go around by providing additional miles to aid stability	SDL		Long Term
Implement a stagger	Investigate the implementation of director position to set up a staggered approach. A director will	Reduce likelihood of go around	SDL	This would be a highly effective control.	Long Term

Control Title	Control Description	Effect of control on hazard	Work Area Providing Resolution	Comments	Implementation Timeframe
	have to be appointed to support parallel runways, just implement the director sooner				

Table 4 – Double go around controls and approximate timelines

Subsequent to the workshop other options were identified which could be introduced in the medium to longer term to better systemise the application of the LAHSO procedures. The stagger, including the use of the director was discussed, and the preferred stagger solution to be considered did not include the stagger. (Ref. 23)

Evaluate and assess risk with new controls

The consequence of 'Major' for a double go around has previously been agreed and accepted by the senior Management Team in the 2012 SAR. It was determined through the use of qualitative analysis and quantitative analysis that the initial risk would be between yearly and 5 yearly, however, it could be more towards the 'yearly' end resulting in a 'high' B class risk.

It was agreed that the implementation of the short term controls would reduce the likelihood, but not by order of magnitude, therefore it would still remain as a 'B' class risk.

Due to the unknown effectiveness of the remaining medium and long term controls it was decided that the likelihood would decrease with their implementation however by how much was unknown. It was agreed that the risk would need to be re-evaluated when the controls have been implemented.

9.4 Implementation hazards, controls and safety requirements

The full list of hazards related to LAHSO, as identified in 2012 were reported on in the 2012 SAR (Ref 1). Table 5 displays only those hazards which have been amended and added as part of the safety activities reported on in this SAR addendum.

Table 6 shows the hazards associated with prolonged non LAHSO operations.

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
901/3	ATC unable to provide separation in a double go around when cloud ceiling is below MVA	1	Documented Training Program	Met		• Control No.3 has been added	[redacted] CATC
		2	Raise the Cloud Base Criteria to MVA	Met			
		3 (NEW)	Raise the cloud ceiling to 1000ft +MVA	Yet to be Met			
901/5	Separation standard amended at short notice (late notice of pilot non participation)	None Identified	None Identified	N/A	C	• Update the description, amend the cause and new additional pre existing control as per Melbourne Minutes (Attachment 3) • New cause – a/c incorrectly sequenced for LAHSO (operators have own more restrictive LAHSO criteria – AD only) • Add a new cause – Mechanical turbulence (AD only)	[redacted] CATC
901/6	Pilot unable to hold short due to no glide slope indication	1	Don't do LAHSO without glide slope indication	Met		• Add further detail to the description	Industry (will not be resubmitted refer to
		2	Notify early that the glide slope	Met			

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
			guidance is not working so that the pilot can make a decision				assumptions)
901/8	By day and VMC an active LAHSO participant performs a go around	1 (NEW)	Install windshear detection RADAR	Yet to be Met	[redacted]	• 6 new controls have been added • Add new existing control – MATS – no windshear permitted.	[redacted] CATC
		2 (NEW)	Update AIP to add readback requirement for aircraft unable to participate in LAHSO	Yet to be Met			
		3 (NEW)	Produce a standardised directive to remind controllers about LAHSO notation in the FDR	Yet to be Met			
		4 (NEW)	Use forecasted windshear/turbulence to cease LAHSO	Yet to be Met			

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
		5 (NEW)	Investigate updating the appropriate local instructions for taxiway availability during LAHSO	Yet to be Met	[redacted]		
		6 (NEW)	Update MATS to confirm that aircraft with malfunctions are unable to participate in LAHSO	Yet to be Met	[redacted]		
901/9	Active LAHSO participant does not stop at required point on ground	1	Reassess braking characteristics in wet/damp conditions	Met	[redacted]	• 3 new controls have been added. • Add new cause – ATC error • New existing control – STAR allocation helps prevent enroute controller allocating the wrong runway	[redacted] CATC
		2 (NEW)	Investigate the possibility of updating site specific LI to manage hold short light intensity with weather conditions	Yet to be Met	[redacted]		
		3 (NEW)	Update AIP to add readback requirement for aircraft unable to participate in LAHSO	Yet to be Met	[redacted]		

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
		4 (NEW)	Produce a standardised directive to remind controllers about LAHSO notation in the FDR	Yet to be Met	[redacted]		
901/10	2 aircraft perform a go around	1	Increase cloud ceiling to the MVA – An amendment to MATS (Chapter 10)	Met		14 new controls have been added. Add new existing control – MATS change – no windshear permitted	Greg Hood EGM ATC
		2	Only conduct LAHSO at aerodromes and at times when a reasonable benefit is being realised	Met			
		3	Formalise sequencing intervals or cutoff distance	Met			
		4	Implement procedures to reduce pilot initiated go arounds due to unstable approach for which there is an ATC attribution	Met			
		5 (NEW)	Install windshear detection RADAR	Yet to be Met			
		6 (NEW)	Use forecasted windshear/turbulence to cease LAHSO	Yet to be Met			

Hazard Number	Hazard Title	Control No:	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
		7 (NEW)	Address fidelity limitations of simulator training	Yet to be Met	[redacted]		
		8 (NEW)	Review the use of runway 34 for off mode departures	Met	[redacted]		
		9 (NEW)	Limit 09 arrivals to QANTAS group during LAHSO 34/09 and limit the number of pairs	Met	[redacted]		
		10 (NEW)	Suspending 34/09 LAHSO	Met	[redacted]		
		11 (NEW)	Instrument STARs (remove SHEED STAR)	Yet to be Met	[redacted]		
		12 (NEW)	Runway allocation from the east	Yet to be Met	[redacted]		
		13 (NEW)	Review the arrival spacing and rates during LAHSO	Yet to be Met	[redacted]		
		14 (NEW)	Stop LAHSO after last light	Yet to be Met	[redacted]		
		15 (NEW)	Airspace Review	Yet to be Met	[redacted]		

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
		16 (NEW)	Implement a stagger	Yet to be Met	[redacted]		
		17 (NEW)	Investigate updating the appropriate local instructions for taxiway availabilty during LAHSO	Yet to be Met	[redacted]		
		18 (NEW)	Update MATS to confirm that aircraft with malfunctions are unable to participate in LAHSO	Yet to be Met	[redacted]		
901/13	Foreign Aircraft incorrectly sequenced for LAHSO	1	Maestro installed at Adelaide would cover the arrivals	Not Met	[redacted]	• 1 new control has been added	[redacted] CATC
		2	Adelaide specific ERSA entry for non-eligible passive LAHSO participants	Met	[redacted]		
		3 (NEW)	Update AIP to add readback requirement for aircraft unable to participate in LAHSO	Yet to be met	[redacted]		
901/15 (New Hazard)	Unplanned Transition out of LAHSO	1	Develop suitable trigger points to initiate LAHSO to achieve acceptable risk level	Yet to be met	C	• New Hazard	[redacted] CATC
		2	Build a parallel runway (Melbourne Only)	Yet to be met			

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Hazard Changes	Accepting Authority
901/16 (New Hazard)	Increase in collision risk due to workload and task complexity for Essendon Tower when LAHSO in progress	1	Suspend runway 27/09 operations at Melbourne	Yet to be met	[redacted]	• New Hazard • Reviewed in conjunction with existing ORA, Remove SHEED being pursued under Assuring the Safety and Efficiency of the High Capacity Modes of Operation at Melbourne Airport – Mandated use of instrument Approach Procedures during LAHSO	[redacted] CATC
		2	Remove the availabilty of SHEED	Yet to be met			

Table 5 – Table of Updated Hazards

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Accepting Authority
901/17	Enroute – Demand exceeds capacity (as per ORA)	1	Additional resources in Grampian	Yet to be Met	[redacted]	[redacted]
		2	Review GDP	Yet to be Met		
		3	Review Airspace design	Yet to be Met		
		4	Additional parallel runway	Yet to be Met		
		5	Strategic Slot management plan	Yet to be Met		
901/18	Approach - Demand exceeds capacity	1	Investigate of alternative modes	Yet to be Met	C	[redacted]

Hazard Number	Hazard Title	Control No.	Control Title	Control Status	Residual Risk	Accepting Authority
	(as per ORA)	2	Reduce access to the airspace for lower priority traffic	Yet to be Met		[redacted]
		3	Review the use of visual STARs into Melbourne	Yet to be Met		
		4	Investigate the implementation of director	Yet to be Met		
		5	Review Airspace design	Yet to be Met		
		6	Additional parallel runway	Yet to be Met		
		7	Strategic Slot management plan	Yet to be Met		

Table 6 - Hazards associated with Prolonged non LAHSO

A full extract of Hazlog 901 which contains more information about each hazard can be found in Attachment 6.

9.5 Implementation risk management

Identified hazards, as previously described in Section 9.4 above, were managed in Hazlog Register 901 in accordance with the Safety Risk Management Procedures (Ref.13).

The Project Safety Specialist remains responsible for maintenance of the Hazlog Register until it is archived.

One additional hazard was identified in the prolonged non LAHSO Risk assessment workshop. This hazard is titled 'Increase in collision risk due to workload and task complexity for Essendon Tower when LAHSO in progress' and has been recorded as hazard 901/16. This hazard was assessed and found to have an initial 'B' class residual risk. A full review of the recorded risk was undertaken by East Coast Services South which determined the risk had been previously identified and captured in the Essendon ORA (Aircraft in conflict (EN/ML Proximity)) and was reassessed as a Class D risk. Discussion with the Office of the Chief Air Traffic Controller concluded that the threat lines in the ORA required updating to fully capture the risk.

Overall there are now 16 hazards contained within Hazlog register 901 (Attachment 6). Hazard 901/6 only had a minor update to the description, and therefore has not been reassessed and resubmitted for acceptance. Six hazards have been updated and two new hazards have been created. These have all been risk assessed and this has resulted in one 'B' class, two 'C' class and five 'D' class residual risks. These risks have been presented to the appropriate accepting authority as per the Safety Risk Management Procedures (Ref.13) (Attachment 7).

Two additional hazards related to ceasing LAHSO have been identified (901/17 and 901/18) however these are only applicable if LAHSO is no longer available as a mode in Melbourne. These will not be submitted for acceptance unless there is a decision to suspend LAHSO indefinitely.

Hazard 901/10 – 2 aircraft perform a go around has been reanalysed and the resulting residual risk has been identified as a 'B' class risk. The 'B' class risk has been assessed as a result of quantitative (Refer to section 9.3.5) and qualitative analysis. The consequence was qualitatively analysed in the LAHSO Internal HAZID workshop as Major) (Ref.14) and the likelihood has been derived from quantitative analysis (yearly – 5 yearly if the two go arounds occur within 20 seconds of each other) (Ref.15).

If another double go around were to occur at Melbourne or Adelaide during LAHSO then the barriers and controls will be reviewed for continued effectiveness as part of the investigation process. The Safety and Performance unit of the Office of the Chief Air Traffic Controller will then identify if further analysis or updates to recorded risks is required. The annual review will ensure that this review is completed if no double go around situations occur during the 12 month period.

New and revised risks resulting from the completion of safety activities reported in this SAR Addendum have been presented in a Risk Acceptance Memo to the accountable manager for acceptance. The memo identifies a number of 'yet to be met' controls.

These have been captured as actions in the LAHSO and Adelaide Risk Assessment Minutes (Attachment 3 and Attachment 4 respectively).

The following Operational Risk Assessments (ORAs) have been reviewed and in some cases updated, as a result of the safety work undertaken:

Melbourne Tower (Ver 5) – Aircraft in Conflict (LAHSO)

Melbourne TCU (Ver 5) – Aircraft in Conflict (LAHSO)

Adelaide Tower (Ver 6) – Aircraft in Conflict (LAHSO)

Adelaide TCU (Ver 6) – Aircraft in Conflict (LAHSO)

The following ORA has been identified as requiring an update as a result of the new hazard identified in the prolonged non LAHSO Risk assessment workshop:

Essendon Tower (Ver 5) – Aircraft in Conflict (EN/ML Proximity)

9.6 Pre-implementation risk assessment

Due to the fact that LAHSO is currently utilised at Melbourne and Adelaide Aerodromes, no pre-implementation risk assessment is required.

10 Procedures and engineering support

As a result of the risk assessment workshops and the detailed flight thread workshops, Table 7 a list of proposed document amendments, either as an administrative amendment, or as a new control for an identified hazard:

Document	Required Change
Melbourne Local Instructions[4]	• Additional information regarding LAHSO availability if Taxiway ECHO is unavailable
AIP – Melbourne DAP	• Remove reference to category D performance aircraft.
AIP - Supplement	• Remind industry about acceptable phraseology when declaring unable to participate in LAHSO • Readback required for aircraft unable to participate in LAHSO (Hazard 901/8 Control 2 & Hazard 901/9 Control 3)
Standardised Directive	• Remind controllers about the LAHSO notation in the FDR (Hazard 901/8 Control 3 & Hazard 901/9 Control 4)
MATS[5]	• Update to confirm that aircraft with malfunctions are unable to participate in LAHSO. (Hazard 901/10 Control 18 & Hazard 901/8 Control 6)

[4] Ref. Hazard 901/9, investigate the ability to amend the intensity of the hold short lights to compensate for ambient light. The outcome of this investigation may result in additional text required in the Adelaide and Melbourne LIs.

[5] Depending on the analysis, MATS may be updated to include a revised cloud base and there maybe additional restrictions with regards to turbulence.

Table 7 – Proposed Document Changes

The proposed changes not being tracked as a control in Hazlog will be tracked as an action and monitored in CIRRIS.

Engineering procedures, service level agreements and maintenance agreements will not be affected.

11 Safety performance monitoring

Responsibility for the ongoing monitoring of safety risks and continued management of implemented controls will be transferred to the ORAs Manager. ORAs are managed and reviewed in accordance with the requirements of Airservices SMS. In addition to this, the LAHSO PIR (Ref. 4) raised an action on the office of CATC to perform an annual review of the LAHSO.

CIRRIS will be used to manage any outstanding actions and any 'yet to be met' controls identified in this SAR addendum. Also, CIRRIS will be used to monitor operational safety by recording incidents. Incidents that relate to a double go around during LAHSO must be highlighted to Risk and Investigation for further analysis. (Refer to section 9.5) and confirmation that the risk remains in the tolerable region.

12 Training and education

During the PIR, an action was raised to review the frequency of the tower simulation training, more information about the action can be found in the LAHSO PIR Report (Ref. 4).

During the safety activities to support this SAR addendum, an additional control was identified to ensure that any fidelity limitations of the simulator, such as not having INTAS, is reflected in the classroom training.

No other issues have been identified with the current LAHSO training schedule.

13 Business continuity

As LAHSO procedures have been in use for many years existing business continuity arrangements remain applicable. If any issues are encountered during LAHSO that will affect safety, then LAHSO will be stopped and single runway operations will be enforced. This is current practice when the weather is not conducive to LAHSO.

Additionally, in the event of longer term cessation of LAHSO, additional strategic and tactical controls have been identified to assist in ensuring that risks associated with such a change to operations are managed to ALARP. The office of the CATC will continue to assess and develop these tactical and strategic controls with a view to ensuring that Airservices is able to implement them with minimal delay to mitigate the identified risks should a decision be made to suspend LAHSO.

14 Conclusion

This SAR addendum also provides evidence of additional assurance activities have been performed to support the Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) All Phases Safety Assessment Report (SAR) 2012. These activities have identified additional controls to ensure that the current risks associated with LAHSO are being managed to ALARP.

This SAR addendum fulfils the related recommendations from the LAHSO Post Implementation Review (PIR) Report and the Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Report.

New safety analysis techniques have be used to assist in identifying any additional foreseeable risks to those previously identified with LAHSO, and all LAHSO runway configurations have been captured within the associated safety activities.

As a result of the HFACS analysis, one new Class C hazard was identified in conducting LAHSO. Ways of minimising potential errors or at risk behaviours have been identified through the analysis and the subsequent risk assessment workshops, and these are captured as proposed controls in Hazlog 901. Additional actions have been recorded in the CIRRIS database for ongoing management.

The Operational Analysis Unit within the Strategy, Systems & Analysis (SSA) Branch of SE&A has also produced analysis on all go arounds that have occurred between 1st January 2012 to 28th February 2015, published in Version 3.2 of the Risk Analysis of Melbourne LAHSO operation. This analysis has provided two different likelihoods based on separation at the runway intersection:

- Likelihood of two go arounds on crossing runways within 20 seconds at the intersection can be classified as yearly to 5 yearly
- Likelihood of two go arounds on crossing runways within 60 seconds at the intersection can be classified as daily to yearly

As a result, the likelihood for Hazard 901/10, 2 aircraft perform a go around, has increased in magnitude from that originally reported in the 2012 SAR. Assuming that the 20 second criteria is agreed to meet the description of a 'major' consequence using the Airservices risk matrix, when considering a revised likelihood of yearly to 5 yearly, this will result in a 'B' class risk.

Additionally, since the December 2014 LAHSO PIR, two double go around[6] incidents have occurred in LAHSO at Melbourne. One was considered in the Operational Analysis Unit assessment (V3.2), however as this assessment was already indicating a Class B risk, the second double go around occurrence resulted in the EGMs of SE&A and ATC requiring additional safety assurance activities to be conducted

The Operational Analysis Unit updated their analysis to include the most recent double go around occurrence in Version 3.3 of the Risk Analysis of Melbourne LAHSO operation report. This resulted in the risk remaining as a Class B risk, although it was considered at the higher frequency end of the range.

The additional safety assurance activities included conducting a risk assessment workshop for ceasing LAHSO. In this workshop, two new hazards, one with a 'C' class the other with a 'D' class residual risk, were identified, as well as a number of new controls that are 'yet to be met'.

This workshop also identified an initial 'B' class residual risk for Essendon Tower resulting from its location and the risk associated with managing departures during LAHSO. A full review of the recorded risk was undertaken by East Coast Services South which determined the risk had been previously identified and captured in the

[6] For the purposes of this report and the associated workshop held in July 2015 the definition of a double go around was stated as being two aircraft on approach to the nominated LAHSO runways who, in the event of them both conducting missed approaches, would cross the runways intersection within 60 seconds of each other. (Ref. Attachment 12)

Essendon ORA (Aircraft in conflict (EN/ML Proximity)) and was reassessed as a Class D risk. Discussion with the Office of the Chief Air Traffic Controller concluded that the threat lines in the ORA required updating to fully capture the risk.

This work also included identification of additional controls that could be implemented to manage the risk associated with a double go around in LAHSO. One of these controls, remove the availability of SHEED, would reduce the number of occurrences where Essendon Tower is required to separate with arrivals on RWY 27 and RWY 34 arrivals overhead Essendon.

It is acknowledged that this Addendum reports only on the operational safety risk associated with continuing or ceasing LAHSO and does not include assessment of other Major Loss Events (MLEs) in the Airservices Risk Matrix Framework (ARMF), such as reputation, environment or service delivery.

In summary, the most significant risk associated with LAHSO relates to the residual Class B risk associated with double go arounds. While a significant number of controls are already in place, additional controls are in the process of being implemented, and further new controls have been proposed in an effort to ensure the risk remains ALARP and in the tolerable region, it is anticipated that it will continue to remain a Class B risk, subject to any further double go around occurrences. This is as a result of the identified controls being mostly procedural in nature and limited in their effectiveness in controlling the double go around risk, particularly given a go around can be initiated by the pilot as well as ATC and it is not always predictable.

It has been determined that ceasing LAHSO, if done in a managed fashion with some additional controls implemented prior, is feasible from an operational safety perspective. The cost of implementing this risk reduction has not been assessed from a whole of industry perspective.

In accordance with Airservices risk management requirements for a Class B risk, ongoing reviews should include industry to determine if the cost, reduction in capacity and service delivery benefits, of reducing the risk by ceasing LAHSO is grossly disproportionate to the expected risk reduction benefit.

15 Safety Post Implementation Review

As this is an addendum to the 2012 SAR, there is no requirement for a safety PIR.

An annual review of LAHSO will be conducted by the office of the CATC in order to continue to provide sufficient assurance that LAHSO risks are continuing to be managed in accordance with the SMS.

16 Document review

16.1 Service Delivery Line/Business Branch or Unit

This SAR addendum has been prepared in accordance with the requirements of the All Phases Safety Assessment Report Template (Ref. 16) and is compliant with the requirements of Safety Change Management Requirements (Ref. 17).

Input into the preparation of this SAR has been sought from ATC and a draft copy has been circulated for review and feedback to ensure the accuracy of technical content. Additionally, the document has been reviewed by Project and Business Support to validate compliance with the Airservices SMS and the robustness of the safety argument.

Feedback comments from the Project SMEs, Project Business Support and approving signatories have been considered and where appropriate changes made to the document. All feedback has been stored electronically in the Corporate DMS, under Safety & Assurance, Project Safety Services, Projects, LAHSO CROPS Review file structure.

16.2 Safety, Environment and Assurance

This document has been reviewed by Safety Assurance to ensure compliance with Safety Change Management Requirements (Ref. 17) prior to forwarding to the EGM SE&A for endorsement.

All review feedback and formal response to feedback provided to Safety Assurance have been recorded and stored electronically in the Corporate DMS file location described above.

17 Definitions

If an acronym or initialism contained in this document cannot be found in the Airservices Acronym list (Ref.18), then it will be contained in Table 8.

Term	Definition
Active Participant	The aircraft which is issued a hold short requirement and is alerted about traffic on a crossing runway
ADHOC	Latin phrase meaning "for this"
CATC	Chief Air Traffic Controller
CROPS	Converging Runway Operations
DEDRAT	Dedicated Runway Arrangement
HAZLOG	Hazard Log
HAZOP	Hazard Operability (study)
HF	Human Factors
HFACS	Human Factors Analysis and Classification System
Passive Participant	The aircraft which has unrestricted use of the full runway length and is alerted about traffic on the crossing runway.
PBS	Project Business Support
PIR	Post Implementation Review
SAR	Safety Assessment Report
SE&A	Safety, Environment and Assurance
SEP	Sequential Event Plot
TOR	Terms of Reference

Table 8 - Table of Definitions

18 Attachments

Table 9 lists all the evidence items which are appended to this SAR addendum

No.	Title and version	Number/Link
1.	Terms of Reference for the Human Factors Analysis and Classification Report	HO CB0-2965149
2.	Detailed Flight Thread for LAHSO	HO CB0-3023892
3.	Melbourne Risk Assessment Workshop Minutes	HO CB0-3013158
4.	Adelaide Risk Assessment Workshop Minutes	HO CB0-3013904
5.	LAHSO Human Factors Analysis and Classification System Report	HO CB0-3017719
6.	Updated HAZLOG 901	HO CB0-3028083
7.	Risk Acceptance Memo for Updated LAHSO Hazards	HO CB0-3028082
8.	Brisbane Tower Simulator update	HO CB0-3017796
9.	Prolonged non LAHSO Risk assessment workshop minutes	HO CB0-3023691
10.	Prolonged non LAHSO SCARD (short term suspension)	HO CB0-3024708
11.	Prolonged non LAHSO SCARD (long term suspension)	HO CB0-3024709
12.	For the LAHSO Workshop Wednesday 15 July – Phil Mulhall Email	HO CB0-3021926
13.	New CIRRIS Action for DEDRAT and ADNOR	HO CB0-3024090

Table 9 - Table of Attachments

19 References

The documents in Table 10 have been referenced in this SAR addendum, however they are not included as an Appendix. If required, copies can be provided on request

No	Title and version	Number/Link
1.	Land and Hold Short Operations (LAHSO) and Converging Runway Operations (CROPS) All Phases Safety Assessment Report	SAF-SAR-12009
2.	LAHSO Review Safety Post Implementation Review	SAF-SAR-12009-1
3.	Converging Runway Operations (CROPS) Review Safety Post Implementation Review Report (Brisbane)	SAF-SAR-12009-2
4.	Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Safety Assurance	C-REP0033
5.	Darwin LAHSO HAZID Minutes	HO CB0-3017800
6.	NRFC 27954	NRFC 27954
7.	SCARD for NRFC 27954	HO CB0-3024712
8.	Safety Risk Management Tools and Techniques	AA-GUIDE-SAF-

No	Title and version	Number/Link
		0105C
9.	LAHSO Literary Review	HO_CB0-2101761
10.	National ATS Procedures Manual	ATS-MAN-0014
11.	Generic Class C/D Tower (V6.2) ORA – Conflict in the Air	Generic Class C/D Tower (V6.2) ORA - Conflict in the Air
12.	Generic Enroute and TCU (V6.1) ORA – Conflict in the Air	Generic Enroute and TCU (V6.1) ORA - Conflict in the Air
13.	Safety Risk Management Procedures	AA-PROC-SAF-0105
14.	LAHSO Internal HAZID Minutes	HO_CB0-2112834
15.	Risk Analysis of Melbourne LAHSO Operations	HO_CB0-3027776
16.	All Phases Safety Assessment Report Template	AA-TEMP-SAF-0004
17.	Operational Safety Change Management Requirements	AA-NOS-SAF-0104
18.	Airservices Acronym list	Airservices Acronym List
19.	CIRRIS Incident – ATS-0134447	HO_CB0-3024713
20.	CIRRIS Incident – ATS - 0137997	HO_CB0-3024711
21.	LOA 3348 – Operational Procedures – Melbourne TCU and Melbourne Tower	LOA_3348
22.	Melbourne Go around Study	HO_CB0-3027775
23.	Assuring the Safety and Efficiency of the High Capacity Modes of Operation at Melbourne Airport	HO_CB0-3025769

Table 10 - Table of References

Attachment 12

16 October 2015	Email to CASA advising Aeronautical Information Publication (AIP) update re LAHSO

From: [redacted]
Sent: Friday, 16 October 2015 12:15 PM
To: [redacted]>
Cc: CASA Compliance <CASACompliance@AirservicesAustralia.com>; ATC Surveillance Mailbox <ATCSurveillance@casa.gov.au>; [redacted]
Subject: AIP LAHSO [SEC=UNCLASSIFIED]

[redacted]

Some information on LAHSO which you may have already been aware of:

AIP LAHSO changes:

Commencing October 20th 2015 AIP LAHSO will be updated to reflect ongoing review of the procedure.

The changes are –

- Standardisation of phraseology for advice by crews to ATC for not participating in LAHSO. The phrase becomes standard with the phrases used for advice re RVSM/ADSB etc.

  Aircrew - NEGATIVE (ACTIVE AND/OR PASSIVE) LAHSO
  ATC - (callsign) NEGATIVE (ACTIVE AND OR/PASSIVE) LAHSO

- Runway selection criteria for both Active and Passive LAHSO runways
- Addition of definitions for Active and Passive LAHSO runways
- LAHSO will no longer be in force when wind shear is reported
- Request for crews to pass on advice of the presence of wind shear as soon as possible to allow for timely information to be passed to subsequent aircraft

Kind regards

[redacted]

[redacted]
Safety and Regulatory Compliance Advisor
Safety Assurance

Attachment 13

2 November 2015	Letter advising CASA's intention to issue a Direction to suspend LAHSO at night at Melbourne until certain conditions met

File Ref: EF11/10239

2 November 2015

Mr Greg Hood
Executive General Manager
Air Traffic Control Group
Airservices Australia
GPO Box 367
CANBERRA ACT 2601

cc Jason Harfield
A/g Chief Executive Officer
Airservices Australia

PROPOSAL TO ISSUE A DIRECTION

I am writing to advise that on the basis of the following facts and circumstances I propose to issue the attached direction to an officer of Airservices Australia (**Airservices**) pursuant to regulation 11.245 of the *Civil Aviation Safety Regulations* 1998 (**CASR**).

FACTS AND CIRCUMSTANCES

1. Airservices' Operations Manual - Part 172 (Air Traffic Services) is approved by CASA. Section 16.2 (Provision of Standards, rules and procedures to staff) of the Manual states that the Manual of Air Traffic Services (**MATS**) and some other documents are the principal documents which prescribe Airservices' internal requirements as required to meet the standards in the Manual of Standards Part 172 – Air Traffic Services (**Part 172 MOS**).

LAHSO

2. Land and Hold Short Operations (**LAHSO**) is an air traffic control (**ATC**) procedure for aircraft landing and holding short of an intersecting runway or point on a runway, to balance airport capacity and system efficiency with safety. Paragraph 10.13.5.1 of the Part 172 MOS states:

   > Notwithstanding aerodrome separation standards, operations by an aircraft landing on one runway and another aircraft either taking off or landing simultaneously on a crossing runway may be permitted subject to the provisions of LAHSO.

3. Paragraph 10.13.5.9 states:

   > In the application of LAHSO, controllers must:
   > (a) ensure that the published distance from the landing threshold to the hold short point of the crossing runway is adequate for the performance category of the aircraft as detailed in the Landing Distance Required (LDR) table below;
   > (b) alert aircraft that land and hold short runway operations are in progress by notification on the ATIS;
   > (c) issue directed traffic information to both aircraft participating in the procedure;
   > (d) ensure readback of a hold short requirement;

(e) withhold issuing a take-off clearance to a departing aircraft while another aircraft is landing on a crossing runway having been issued with a duly acknowledged hold short requirement, until such time that in the opinion of the controller, there is no possibility that both aircraft could occupy the intersection at the same time should the landing aircraft subsequently fail to hold short.

4. During LAHSO, paragraph 10.9.5.9.6 of the MATS authorises Air Traffic Controllers to permit simultaneous landings by day and night.

5 July 2015 incident

5. On 5 July 2015, there were simultaneous go-arounds involving two QANTAS Boeing 737 aircraft (registration VH-VXS and VH-VYE) at Melbourne Airport, Victoria. An Emirates Boeing 777 was departing runway 34 at the time. During LAHSO on runways 27 and 34 (crossing runways), these two 737 aircraft conducted simultaneous missed approaches at 6.11pm local time at night. Last light was at 5.42pm local time. During aircraft VH-VYE's missed approach from runway 34, air traffic control manoeuvred the aircraft to maintain wake turbulence separation with the departing Boeing 777. Airservices does not consider the incident to be a loss of separation.

6. This incident was initially reported by Airservices as a go-around and subsequently also reported as a ground proximity occurrence after it was recognised that one of the go-around aircraft (VH-VYE) was issued a vector whilst below the minimum vector altitude.

7. The Australian Transport Safety Bureau (**ATSB**) is investigating this incident.

16 January 2015 incident

8. There was a double go-around incident during daytime LAHSO at Melbourne Airport on 16 January 2015. This incident involved a Tiger Airways Airbus A320 which was on final to runway 27 whilst a QANTAS Airways Airbus A330 was on final to runway 34. They were conducting go around procedures on crossing runways at Melbourne Airport during LAHSO. The Airservices short investigation bulletin report summarised the incident relevantly as follows:

> Two aircraft went round from the converging LAHSO runways due to reported turbulence and overshoot sheer [sic]. The natural stagger which occurred between these aircraft resulted in vertical displacement which meant the conflict was adequately resolved.

9. There have been an additional 5 ATS incident reports (**CIRRIS**) submitted since 2013 that relate to LAHSO operations at Melbourne.

CASA concerns

10. CASA has previously expressed concerns to Airservices in relation to LAHSO at Melbourne Airport, most recently in my letter to Dr Weaver dated 28 July 2015 (CASA Ref: F11/10239).

11. CASA continues to be concerned about the safety of LAHSO at Melbourne Airport, particularly at night. The key concern is the safe management of simultaneous go-arounds from crossing runways, with the night time case having additional constraints on the possibility for ATC to assign responsibility for terrain clearance to pilots and limitations on the effectiveness of visual separation by ATC and between pilots. Associated contributory concerns are:

(a) The requirement for IFR aircraft to remain on the published missed approach procedure until reaching the lowest safe altitude,

(b) The procedural restrictions on ATC not to issue turn instructions applicable whilst the aircraft is below the Minimum Vector Altitude (MVA) during a go-around at night that take the aircraft outside the protections of the published missed approach. This restricts the ability to provide separation services for a time period, albeit short, of significance and introduces an additional discrete hazard in the Safety Management System (SMS) sense,

(c) The LAHSO Operational Risk Assessment (ORA) contains a threat of aircraft conducting missed approaches, however the existing controls have failed to manage this risk,

(d) ATC's inability to assure that a separation standard is applied between aircraft conducting simultaneous go-arounds has been assessed within Airservices (AA)'s SMS as a 'Major' consequence in AA's criteria for operational safety (AA-PROC-SAF-0105). This risk level is only acceptable as a Class B risk to AA as it is forecast to occur less frequently than once per year. AA's SMS assessment methodology assesses the ability to provide/not provide an ATS and precludes any assessment of the mid-air collision risk,

(e) The limitations on the ability of ATC to provide effective separation to aircraft at night based on visual observation,

(f) The limitations on pilots of IFR aircraft to see and manoeuvre to avoid one another at night,

(g) The LAHSO incident rate at Melbourne Airport,

(h) The higher rate of go-arounds at Melbourne Airport in comparison to other aerodromes,

(i) The increasing rate of go-arounds at Melbourne Airport,

(j) The analysis highlighting that the go-around rate at Melbourne Airport is up to 16 times as high for a second go-around in the minute after a previous go-around than for the first go-around,

(k) The increasing air traffic levels at Melbourne Airport,

(l) The lack of demonstrated training competency of air traffic controllers in the handling of night-time compromised separation including double go-arounds, and

(m) The lack of systemic segregation of LAHSO aircraft pairs through the runway intersection (that is, a 'stagger').

Go-arounds in LAHSO

12. In a report of Airservices entitled *Targeted Review of Melbourne Land and Hold Short Operations (LAHSO) Safety Assurance* 20 March 2015, the following was stated:

7.4.1 Operational Risk Assessment (ORA) Management
Prior to the finalisation of the Safety Assessment Report (SAR) in 2012 the Melbourne Tower and Terminal Control Unit (TCU) ORA did not identify LAHSO procedures. Following

a reported double go-around occurrence an unscheduled Safety Services review of the Melbourne Tower ORA was initiated.

The ORA review also considered the hazards and controls identified in the draft SAR hazard register although the register was still in 'development' and identified a number of 'yet to be met' controls. The register status workflow required the register to progress from 'development' to 'operational' where hazard register information is transferred to the respective operational risk assessments and assigned 'complete' following the post implementation review (PIR).

Following this ORA review the threats 'Aircraft conducts a missed approach during LAHSO' and 'Aircraft is unable to hold short during LAHSO' were included in the Melbourne Tower ORA on 7 January 2013.

7.4.4 Hazard review (Double Go-Around)
The SAR identified a hazard of two aircraft performing a go-around. The likelihood was assessed as occurring between 5-50 years and the consequence was classified as 'Major'. It was identified that a double go-around occurred at Melbourne during the preparation of the report however this was not associated with LAHSO operations. The SAR specified a requirement to update the risk should two aircraft go-around when LAHSO was in progress. The action to review the risk associated with double go-around was not explicitly assigned to an accountable manager.

The SAR LAHSO hazard register (Hazard #901/3) was reviewed in October 2012 after a query from Melbourne Tower regarding the assessed likelihood of a double go-around during LAHSO. The Executive General Manager (EGM) Safety, Environment & Assurance (SE&A) requested a quantitative analysis be conducted to revalidate the likelihood of a double go around which had been presented in the SAR. A Melbourne Go-around Study report was provided to SE&A and ATS Integrity in June 2013.

The report analysed LAHSO go-around rates for 2012 on runway 27 and runway 34, and defined a double go-around as two aircraft going around with a time interval less than 20 seconds at the intersection.

The analysis concluded that a double go-around is expected to occur once every 175 years. This analysis validated the likelihood presented in the SAR, however, as runway 34/09 LAHSO mode was suspended during the data capture period the mode was not assessed.

Finding 8 - The Review determined the data modelling completed to determine the likelihood of a double go-around did not incorporate the runway 34/09 LAHSO mode or environmental conditions including crosswind and downwind components.

13. Airservices' response report to the above report, dated May 2015, relevantly stated "*A re-assessment of the data modelling has been completed and a progress report has been developed and circulated for review prior to management endorsement.*"

14. Subsequently, data provided by Airservices in the '*LAHSO and Converging Runway Operations (CROPS) Safety Assessment Report (SAR) Addendum*' dated 31 August 2015, stated the following:

[Airservices] has also produced analysis on all go arounds that have occurred between 1st January 2012 to 28th February 2015. This analysis has provided two different likelihoods based on separation at the runway intersection:

- Likelihood of two go-arounds on crossing runways within 20 seconds at the intersection can be classified as yearly to 5 yearly

- Likelihood of two go-arounds on crossing runways within 60 seconds at the intersection can be classified as daily to yearly

As a result, the likelihood for Hazard 901/10, 2 aircraft perform a go-around, has increased in magnitude from that originally reported in the 2012 SAR. Assuming that the 20 second criteria is agreed to the description of major consequence using the Airservices risk matrix, when considering a revised likelihood of yearly to 5 yearly, this will result in a class 'B' risk.

...

In summary, the most significant risk associated with LAHSO relates to the residual Class B risk associated with double go-arounds. While a significant number of controls are already in place, additional controls are in the process of being implemented, and further new controls have been proposed in an effort to ensure the risk remains As Low As Reasonably Practicable (ALARP) and in the tolerable region, it is anticipated that it will continue to remain a Class B risk, subject to any further double go around occurrences. This is a result of the identified controls being mostly procedural in nature and limited in their effectiveness in controlling the double go around risk, particularly given a go around can be initiated by the pilot as well as ATC and it is not always predictable. (page 7)

...

Whilst go-arounds are initiated to assist crew and ATC avoid hazardous situations, poorly managed go-arounds can lead to an increase in risk or can introduce additional hazards. This is particularly the case at night and in IMC. (page 27)

...

Evaluate and assess risk with new controls

The consequence of 'Major' for a double go around has previously been agreed and accepted by the senior Management Team in the 2012 SAR. It was determined through the use of qualitative analysis and quantitative analysis that the initial risk would be between yearly and 5 yearly, however, it could be more towards the 'yearly' end resulting in a 'high' B class risk.

It was agreed that the implementation of the short term controls would reduce the likelihood, but not by order of magnitude, therefore it would still remain as a 'B' class risk. Due to the unknown effectiveness of the remaining medium and long term controls it was decided that the likelihood would decrease with their implementation however, by how much was unknown. It was agreed that the risk would need to be re-evaluated when the controls have been implemented. (page 30)

...

Hazard 901/10, 2 aircraft perform a go around has been reanalysed and the resulting residual risk has been identified as a 'B' class risk. The 'B' class risk has been assessed as a result of quantitative (Refer to section 9.3.5) and qualitative analysis. The consequence was qualitatively analysed in the LAHSO Internal HAZID workshop as Major)(Ref.14) and the likelihood has been derived from quantitative analysis (yearly- 5 yearly if the two go arounds occur within 20 seconds of each other) (Ref. 15).

If another double go around were to occur at Melbourne or Adelaide during LAHSO then the barriers and controls will be reviewed for continued effectiveness as part of the investigation process. The Safety and Performance unit of the Office of the Chief Air Traffic Controller will then identify if further analysis or updates to recorded risks is required. The annual review will ensure that the review is completed if no double go around situations occur during the 12 month period. (page 39)

...

As a result, the likelihood for Hazard 901/10, 2 aircraft perform a go around, has increased in magnitude from that originally reported in the 2012 SAR. Assuming that the 20 second criteria is agreed to meet the description of a 'major' consequences using the Airservices risk matrix, when considering a revised likelihood of yearly to 5 yearly, this will result in a 'B' class risk.

Additionally, since the December 2014 LAHSO PIR, two double go around[1] incidents have occurred in LAHSO at Melbourne. One was considered in the Operational Analysis Unit

[1] For the purposes of the report and the associated workshop held in July 2015 the definition of a double go around was stated as being two aircraft on approach to the nominated LAHSO runways who, in the event of them both conducting missed approaches, would cross the runways intersection within 60 seconds of each other. (Ref. Attachment 12)

assessment (V3.2), however as this assessment was already indicating a Class B risk, the second double go around occurrence resulted in the EGMs of SE&A and ATC requiring additional safety assurance activities to be conducted.

The Operational Analysis Unit updated their analysis to include the most recent double go around occurrence in Version 3.3 of the Risk Analysis of Melbourne LAHSO operation report. This resulted in the risk remaining as a Class B risk, although it was considered at the higher frequency end of the range.

The additional safety assurance activities included conducting a risk assessment workshop for ceasing LAHSO. In this workshop, two new hazards, one with a 'C' class the other with a 'D' class residual risk, were identified, as well as a number of new controls that are 'yet to be met'. (page 42)

...

In summary, the most significant risk associated with LAHSO relates to the residual Class B risk associated with double go arounds. While a significant number of controls are already in place, **additional controls are in the process of being implemented, and further new controls have been proposed in an effort to ensure the risk remains ALARP and in the tolerable region,** it is anticipated that it will continue to remain a Class B risk, subject to any further double go around occurrences. This is a result of the identified controls being mostly procedural in nature and limited in their effectiveness in controlling the double go around risk, particularly given a go around can be initiated by the pilot as well as ATC and it is not always predictable.

15. As noted, the recent analysis resulted in Airservices confirming the risk as a Class B risk but now at the higher end of the Class B risk range. Airservices states in the report that a double go-around is the most significant risk associated with LAHSO.

16. Further, page 27 of the report highlighted the fact that 'poorly managed go-arounds can lead to an increase in risk or can introduce additional hazards. This is particularly the case at night and in IMC. However, the analysis does not identify a double go-around in LAHSO at night as a discrete hazard.

Vectoring and Obstacle & Terrain Clearance

17. The Part 172 MOS requires ATC to apply the following obstacle clearances when vectoring:

When vectoring, ATC must provide at least 1 000 ft vertical clearance over any obstacle within:
(a) 3 NM of the aircraft when the range scale in not greater than 50 NM; or
(b) 5 NM of the aircraft when the range scale is greater than 50 NM.

These obstacle clearance requirements do not apply:
(a) when vectoring as part of an issued SID; or
(b) when ATC authorises a visual departure; or
(c) in VMC by day only, when ATC assigns responsibility for arranging obstacle clearance specifically to the pilot.

18. The MATS contains a number of provisions in relation to vectoring, obstacles and terrain clearance that relate to Tower operations, relevantly:

- *MATS -Operations below LSALT*

ATC may assign a pilot a level below LSALT provided that:
a) by night, to an IFR pilot that has reported 'VISUAL' or a VFR pilot, you prefix the clearance with 'WHEN ESTABLISHED IN THE CIRCLING AREA, ...'; or

b) by day:
    i. the IFR pilot has reported 'VISUAL'; and
    ii. 'VISUAL' is appended to the level assigned.

- *MATS - Approving pilot terrain clearance*

ATC may permit an aircraft being vectored or given a direct routing in VMC by day to arrange its own terrain clearance, provided that the responsibility is specifically assigned to the pilot.

- *MATS -Terrain clearance and range scales*

ATC must ensure that aircraft are at an altitude which provides a minimum 1000 FT vertical clearance above any obstacle within a radius of:

a) 3 NM of the aircraft when the range scale is not greater than 50 NM; and
b) 5 NM of the aircraft when the range scale is greater than 50 NM.

The obstacle clearance requirements for the above clause do not apply:

a) when vectoring as part of an issued SID;
b) when conducting a visual departure;
c) in VMC by day only, when ATC assigns responsibility for arranging obstacle clearance specifically to the pilot; or
d) when conducting an ATS surveillance system cloud break procedure.

- *MATS - Vectoring - tower controllers*

ATC may permit self-navigation. Whenever possible, permit aircraft to self-navigate and achieve requirements by instruction based on visual and flight path monitoring. VMC by day only. ATC may provide an IFR or VFR aircraft with a vector in VMC by day to ensure separation or assist with traffic management, when necessary.

- *MATS- Considerations prior to vectoring*

Prior to vectoring an aircraft, ensure that the commitment to provide a vectoring service will not be detrimental to other responsibilities and requirements. Consider:

a) disposition of other aerodrome traffic;
b) current and expected traffic levels; and
c) the extent of the vector.

Minimum Vector Altitude (MVA)

19. The Minimum Vector Altitude (MVA) is defined in MATS as the lowest altitude a controller may assign to a pilot in accordance with a radar terrain clearance chart.

20. The term "Visual" is defined in MATS as a term used by ATC to instruct a pilot to see and avoid obstacles while conducting flight below the MVA.

21. If ATC issue a vector to an IFR aircraft conducting a missed approach (and the heading is not part of the published missed approach procedure) then the aircraft is no longer under the obstacle clearance protection provided in the design of the terminal instrument flight procedure. Consequently, in these circumstances, it should be incumbent upon ATC to instruct the pilot to maintain visual terrain clearance while below MVA.

22. CASA notes than many operators of large aircraft that conduct high capacity operations do not normally permit the crew to conduct visual circling approaches or visual manoeuvring below the instrument approach's circling altitude. However, it is not clear on what basis Airservices accepts this risk by instructing large aircraft to perform a visual manoeuvre at night below the MVA or circling altitude.

23. CASA is of the view that the ATM system should not rely, as a primary means of defence, on vectoring or heading changes for IFR category aircraft at night that are below the appropriate minimum altitude.

Visual separation by Tower Controllers

24. Separation of aircraft using visual observation by ATC is authorised in MATS. A number of constraints are imposed on ATC by MATS, relevantly:

(a) Only provide visual separation when the projected flight paths of the aircraft do not conflict,

(b) Allow for the applicable tracking tolerances on the projected flight path,

(c) When applying visual separation, consider: aircraft performance characteristics, particularly in relation to faster following aircraft and closure rates; position of the aircraft relative to each other; projected flight paths of the aircraft; possibility of an ACAS RA due to closer proximity of operation; known weather conditions; and the possibility of visual errors,

(d) In providing visual separation, primarily use azimuth,

(e) Only conduct visual separation by judgement of relative distance or height when there are wide margins, and there is no possibility of the aircraft being in close proximity.

Note: *Visual determination of the relative distance of aircraft in close proximity can be in error or affected by optical illusion;*

25. LAHSO procedures in MATS require, amongst other things, that ATC make allowance for missed approaches, relevantly:

(a) Where conditions exist that increase the likelihood of missed approaches, tower controllers must advise the [Terminal Control Unit] TCU. TCU will advise a heading or range of headings that may be used by tower, without further coordination, and

(b) In the event of a missed approach, or dual missed approaches, the tower is responsible for maintaining visual separation until such time as another separation standard may be applied.

Visual separation by Pilots

26. Separation of aircraft using visual observation by pilots is authorised in MATS. A number of constraints are imposed on ATC in instructing a pilot to maintain visual separation from another aircraft. MATS states the following:

> Before assigning responsibility for visual separation to a pilot, consider the following:
> - aircraft performance characteristics, particularly in relation to faster, following aircraft and closure rates,
> - position of the aircraft relative to each other,
> - projected flight paths of the aircraft,
> - possibility of an ACAS RA due to closer proximity of operation; and
> - known weather conditions.

27. MATS states the following regarding the limitations to a pilot's ability to maintain visual separation:

- the field of vision from the cockpit,
- the contrast of aircraft with the background against which it will appear
- glare of the sun; and
- restrictions on atmospheric visibility which may not be currently apparent to the pilot e.g. loss of forward visibility following descent into a haze layer.

Visual separation in LAHSO

28. The visual separation risk controls applied in LAHSO rely on ensuring the tactical ability of ATC to see affected aircraft and provide tracking instructions to help the pilots see and avoid each other, or on traffic advice to pilots to assist them to see and avoid each other. Such risk controls are in contrast to strategic safety solutions such as the systemic segregation of aircraft pairs at the runway intersection.

29. In recognition of the limitations on visual separation MATS defines a number of considerations, as shown above, in the application of visual separation by Tower controllers and between pilots.

30. During a LAHSO go-around with an avoidance component, as well as the known issues with high cockpit workload, restricted visibility from the flight deck and sudden changes of trajectory close to the ground, the night time case requires the crew to obtain/retain situational awareness and acquire conflicting traffic against a background of cockpit, aerodrome and city lights. Accurate and timely visual acquisition is an essential first step in a see and avoid solution.

31. CASA is of the view that the ATM system should not rely, as a primary means of defence, on visual separation to resolve a double go-around during LAHSO at night.

Visual separation - NTSB recommendation to FAA

32. On 1 July 2013, the National Transportation Safety Bureau of the USA, in a safety recommendation to the FAA (A-13-024), stated in part:

> As shown by the events described in this letter, although a particular set of runways does not intersect on the ground, the assumption cannot be made that potential conflicts will not occur in the vicinity of the airport. When the pilot of a landing aircraft executes a go-around maneuver, as in the examples provided, air traffic controllers may be left with no viable options to ensure that safe separation exists between the go-around aircraft and aircraft operating to or from converging runways. In these events, the ATC tower controllers attempted to use tower visual separation rules to ensure the aircraft did not collide at the point where the flightpaths intersected. ..."
>
> "Because of the nature of the geometry of the encounters and the unexpected nature of the go-arounds, it was not possible for the ATC tower controllers to issue effective control instructions to ensure that the airplanes avoided each other. Therefore, visual separation procedures could not be successfully applied or asserted as an adequate means of resolving the conflicts. The NTSB is concerned that in these events, ATC was not able to ensure the safe separation of aircraft. Instead, separation was established by resorting to impromptu evasive maneuvers by pilots during critical phases of flight. The NTSB concludes that the lack of specific separation standards, similar to those defined in paragraph 3-9-8 of FAA Order 7110.65, "Air Traffic Control," applicable to departing aircraft and aircraft conducting a go-around from non-intersecting runways where flightpaths intersect, facilitates hazardous conflicts and introduces unnecessary collision risk.

> Therefore, the National Transportation Safety Board makes the following recommendation to the Federal Aviation Administration:
>
> Amend Federal Aviation Administration Order 7110.65, "Air Traffic Control," to establish separation standards similar to the provisions of paragraph 3-9-8 between an arriving aircraft that goes around and any combination of arriving or departing aircraft operating on runways where flightpaths may intersect. (A-13-024)

Increases in go-around and traffic rates at Melbourne

33. Additional recent analysis in an Airservices report entitled *'Likelihood of Melbourne LAHSO go-arounds'* dated 4 August 2015 concluded that the base go-around rate has increased over a three year period from 2 per 1,000 arrivals to 4.4 per 1,000 arrivals. This report stated that two significant periods exist where that rate was 8 go-arounds per 1,000 arrivals.

34. According to Airservices statistics, the total annual movement numbers at Melbourne Airport have increased around 8% between 2012 and 2014. This increase in movement numbers coupled with the increased go-around rate means that ATC faces the increased likelihood of simultaneous go-arounds on crossing runways during LAHSO. This is of concern to CASA, and CASA notes that the most recent double go-around event in July 2015 occurred shortly after Airservices published the March 2015 Targeted Review of Melbourne LAHSO referred to in paragraph 12 above.

LAHSO compromised separation techniques at night

35. The Airservices internal Operational Safety Investigation Report (ATS-0137977) into the 5 July 2015 LAHSO double go-around incident highlights (Section 3.6) that the current compromised separation training for Melbourne Tower includes LAHSO exercises designed for Visual Meteorological Conditions (VMC) by day only. The LAHSO exercises do not contain night operations.

36. The Investigation Report goes on to highlight that VMC by day compromised separation training scenarios include recovery from a go-around by vectoring with visual terrain clearance assigned to the pilot. The training does not consider night time scenarios where visual terrain clearance cannot be assigned to the pilot.

37. The Incident Report offers, as one of the contributory factors to the incident, that:

> The trained response by a controller in vectoring aircraft to recover from a loss of separation in LAHSO did not consider the scenario where aircraft are below the MVA at night. It is likely that both the MLA trainee and the [On the Job Training Instructor] OJTI defaulted to this trained response in vectoring QFA819.

38. CASA notes that potentially similar circumstances exist at Adelaide Airport; Airservices Operational Safety Investigation Report ATS-036974 refers.

Managing the LAHSO risk

39. Airservices has provided information to CASA on how it is managing the risk resulting from LAHSO operations, as follows:

(a) Airservices have already introduced a number of changes to LAHSO operations including:

- removing any use of "ad hoc" LAHSO (LAHSO now needs to be on the ATIS and planned for),
- introducing crosswind limits for the passive LAHSO runway,
- cancelling LAHSO on RWY09/34,
- extending the Melbourne Tower Shift manager hours of coverage to cover all LAHSO periods, and
- updating the Melbourne Tower training package.

(b) Airservices are investigating a number of future actions relating to LAHSO including:

- introducing steps to reduce the likelihood that unexpected aircraft performance leads to a missed approach,
- creation of a stagger by introducing "Runway Dependency within MAESTRO" (a current strategic flow management tool in use);
- introducing a new procedure for pilot initiated "off-mode" departure requests;
- mandated use of Instrument Approach Procedures during LAHSO; and
- limiting the use of high capacity modes (such as LAHSO) to periods of high demand only (i.e. lower demand periods managed in non-LAHSO configuration.

40. CASA notes that most of these risk controls are either recently implemented or in the process of being implemented and awaits the validation of their effectiveness based on suitable data collection and analysis over an appropriate period of time. Beyond the updating of the Melbourne Tower training package mentioned above, CASA also notes the absence of specific or intended mitigations to the double go-around during LAHSO at night.

Airport related considerations

41. Airservices relies on LAHSO operations in Melbourne in order to achieve airport efficiencies. The landing rate is around 44 aircraft per hour when using 2 runways with LAHSO and drops to around 24 per hour using a single runway. However, Airservices have not provided the arrival rate for two runways as used in non LAHSO configurations which is expected to be significantly higher than the single runway rate.

42. **Power to issue directions**

43. Regulation 11.245(1) of the CASR relevantly states that CASA may issue a direction about any matter affecting the safe navigation and operation of aircraft. I consider that the recent go-around incidents at Melbourne Airport, affect the safe operation of aircraft.

44. Regulation 11.245(2) of the CASR states CASA may issue a direction:

(a) only if CASA is satisfied that it is necessary to do so in the interests of the safety of air navigation; and

(b) only if the direction is not inconsistent with the Act; and
(c) only for the purposes of CASA's functions.

45. Having regard to the matters set out in this notice, I consider that it is necessary to issue a direction in the interests of the safety of air navigation, namely a direction that would prohibit the Executive General Manager, Air Traffic Control Group permitting simultaneous landings during LAHSO operations at Melbourne Airport at night. CASA notes LAHSO simultaneous landing and departure are restricted to day time only (see MATS 10.9.5.9.7 and paragraph 10.13.5.8 of the MOS).

46. Such a direction would not be inconsistent with the Act and would be for the purpose of CASA's functions, namely the safety regulation of civil air operations in Australian territory, as expressed in section 9(1)(a) of the Act.

47. I am providing you 7 days from the date of this notice to provide reasons in writing as to why CASA should not make such a direction.

48. In the event I make the proposed direction, I would consider revoking it if:

(a) Airservices provides evidence to CASA that all ATCs endorsed for Melbourne Tower Aerodrome Control (ADC) have been assessed as competent in effective night-time compromised separation techniques which include the requirements associated with the Minimum Vectoring Altitude; and

(b) Airservices provides evidence to CASA of the outcomes of an SMS analysis of the discrete hazard "Double go-around during LAHSO at night"; and

(c) Airservices identifies and implements a systemic safety solution that provides appropriate separation or segregation between aircraft conducting simultaneous go-arounds from the crossing runways at Melbourne Airport during LAHSO. In this regard, CASA is aware of Airservices' efforts to design a system that provides alternative means of air traffic segregation between arriving aircraft during LAHSO (a 'stagger' at the runway intersection). It is likely CASA will consider appropriate implementation of such a system as an acceptable systemic safety solution.

49. However, in the event the ATSB makes safety recommendations arising from the 5 July 2015 incident, CASA would also consider requiring Airservices to implement any recommended safety actions raised by the ATSB.

Yours sincerely

Peter Cromarty
Executive Manager
Airways and Aerodromes Division
Delegate of Civil Aviation Safety Authority

INSTRUMENT NUMBER CASA XXX

I, Peter Beilby Cromarty, Executive Manager, Airspace and Aerodrome Regulation Division, a delegate of the Civil Aviation Safety Authority, issue this instrument under subregulation 11.245 (1) of the *Civil Aviation Safety Regulations 1998.*

Peter Cromarty
Executive Manager
Airspace and Aerodrome Regulation Division

XX November 2015

Direction – Prohibiting simultaneous landings during Land and Hold Short Operations (LAHSO) at Melbourne Airport at night.

1 Commencement

This instrument commences on XX November 2015.

2 Application

This Direction applies to the Executive General Manager, Air Traffic Control Group, Airservices Australia.

3 Direction

The Executive General Manager, Air Traffic Control Group, Airservices Australia must ensure that no simultaneous landings during Land and Hold Short Operations are conducted at Melbourne Airport at night.

4 Expiry

Unless varied, suspended, revoked or cancelled this Instrument remains in effect until XX November 2017.

Attachment 14

6 November 2015	Letter from Executive General Manager Air Traffic Control to CASA confirming that Airservices will suspend LAHSO at night at Melbourne and Adelaide. Airservices also advised CASA of additional safety actions being undertaken and that bi-monthly updates would be provided to CASA

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BY EMAIL
peter.cromarty@casa.gov.au

Mr Peter Cromarty
Executive Manager
Airways and Aerodromes Division
Civil Aviation Safety Authority
GPO Box 2005
CANBERRA ACT 2601

Dear Mr Cromarty

Land and Hold Short Operations (LAHSO) at night

Thank you for the meeting on Monday, 2 November 2015 and the subsequent CASA notice of the intention to issue a direction requiring the suspension of simultaneous landings during LAHSO at Melbourne Airport at night.

In consideration of CASA's concerns, Airservices will suspend LAHSO at night at Melbourne and Adelaide Airports. The restriction is being implemented in accordance with our Safety Management System and consultation is underway to clarify and minimise the impact on ATC and industry. A copy of the Temporary Local Instruction will be provided to CASA.

As previously reported, Airservices remains focused on assuring the ongoing safety of LAHSO and more broadly the high-capacity crossing runway operations in Australia. A number of improvement measures are already underway. This includes limiting LAHSO usage to high traffic demand periods by December 2015, developing a system solution to ensure aircraft segregation (e.g. stagger) and enhancing procedures for instrument approaches during LAHSO and off-mode runway utilisation by March 2016. In addition, Airservices continues to conduct workshops and education with ATC and pilots to reduce preventable go-arounds.

Taking into consideration CASA's expectations, Airservices is also progressing the following additional actions:

(a) Rollout of a national program to further enhance the knowledge and skills of Tower controllers. A key focus will be the risks associated with compromised separation scenarios at night, which may require an instruction to pilots to manoeuvre whilst in the circling area and below lowest safe altitude (by February 2016).

(b) Review of the existing evidence of safety risk assessment in relation to double go-around during LAHSO at night (by February 2016).

Airservices will provide detailed information on the progress of all improvement actions, including any resulting deliverables as part of ongoing bi-monthly updates.

Airservices will review the situation in March 2016, including the effectiveness of all implemented actions, and work with CASA to determine whether LAHSO at night can be re-introduced in the interests of balancing safety as our primary consideration, with airport capacity and efficiency.

I am seeking CASA's confirmation that Airservices response to suspend LAHSO at night at Melbourne and Adelaide Airports, and the supporting improvement actions have addressed CASA's concerns and no further regulatory direction would be required at this time.

Yours sincerely

Greg Hood

Greg Hood
Executive General Manager

6 November 2015

Attachment 15

9 November 2015	CASA letter to Airservices requesting clarification on the timeframe to suspend LAHSO at night

Australian Government

Civil Aviation Safety Authority

AIRSPACE AND AERODROME REGULATION

CASA Ref: D15/685659

09 November 2015

Mr Greg Hood
Executive General Manager
Air Traffic Control Group
Airservices Australia
GPO Box 367
CANBERRA ACT 2600

Dear Mr ~~Hood~~ Greg.

Thank you for your letter dated 6 November 2015 in relation to Land and Hold Short Operations (LAHSO), received today.

Whilst your letter conveys the intention that Airservices will suspend LAHSO at night at Melbourne and Adelaide Airports, it is silent in regard to when the suspension of LAHSO will take effect. I understand from a member of your staff that it is your intention to suspend LAHSO at night at Melbourne and Adelaide from tomorrow. As night LAHSO at Melbourne Airport is a direct safety concern to CASA, I would appreciate your urgent formal advice as to when the suspension of LAHSO will be implemented at Melbourne Airport.

My letter was explicit in relation to the methodology for the revocation of the Direction, if issued. To reaffirm:

In the event I make the proposed direction, I would consider revoking it if:

(a) Airservices provides evidence to CASA that all ATCs endorsed for Melbourne Tower Aerodrome Control (ADC) have been assessed as competent in effective night-time compromised separation techniques which include the requirements associated with the Minimum Vectoring Altitude; and

(b) Airservices provides evidence to CASA of the outcomes of an SMS analysis of the discrete hazard "Double go-around during LAHSO at night"; and

(c) Airservices identifies and implements a systemic safety solution that provides appropriate separation or segregation between aircraft conducting simultaneous go-arounds from the crossing runways at Melbourne Airport during LAHSO. In this regard, CASA is aware of Airservices' efforts to design a system that provides alternative means of air traffic segregation between arriving aircraft during LAHSO (a 'stagger' at the runway intersection). It is likely CASA will consider appropriate implementation of such a system as an acceptable systemic safety solution.

However, in the event the ATSB makes safety recommendations arising from the 5 July 2015 incident, CASA would also consider requiring Airservices to implement any recommended safety actions raised by the ATSB.

In relation to point (a) above, whilst I accept that point (a) of your letter is intended to address my concerns about aircraft manoeuvring at night below the MVA, I am unclear as to what is intended by your expression *"...which may require an instruction to pilots to manoeuvre whilst in the circling area and below lowest safe altitude"*. I would be grateful for your clarification in this respect and confirm that CASA will be seeking assurance in terms of the training scenarios adopted and the recording of ATC competency.

My point (b) above records that CASA considers the "double go-around during LAHSO at night" to be a discrete hazard and invites a SMS examination to establish whether this is in fact the case. Although an examination of existing evidence will be an important input to such an SMS examination, I believe the opportunity should be taken to seek and consider additional evidence as necessary. I will ensure priority is given to assessing the SMS analysis as it comes forward.

I accept that point (c) above has been addressed in the third paragraph of your letter and note the intention to develop a stagger to ensure segregation at the runway intersection. Again, I will ensure priority is applied by CASA in assessing these arrangements as they come forward.

I look forward to your prompt reply to the above points.

Yours sincerely

Peter Cromarty
Executive Manager
Airways and Aerodromes Division
Delegate of Civil Aviation Safety Authority

Attachment 16

9 November 2015	Airservices provided CASA with a copy of the local instruction issued to Air Traffic Control implementing the suspension effective 10 November 2015.

airservices

Temporary Local Instruction

TLI_15_0295

Suspension of Land and Hold Short Operations (LAHSO) at Night

Effective from:	**UTC 1511100500**	**Effective to:**	1603011400
Authorised:	[redacted] Liaison and Change Management Manager	**Replaces:**	Nil
NRFC:	30621	ASID:	CIRRIS:

Audience:	Adelaide TCU	Adelaide Tower	Melbourne and Canberra TCU	Melbourne Tower
	Barossa	Monaro	Grampians	Alpine
	Bass	ML ORM	ML SM 2	

Reference documents	MOS Part 172 Ch 10 Manual of Air Traffic Services (MATS) (NOS-SAF-2000) 10.9.5 AIP ENR1.1 section 29

Background

Following analysis of the effectiveness of the risk controls for a simultaneous go-around during LAHSO at night, it has been determined that LAHSO at night will be suspended until the risk controls have been strengthened. This will include enhancements to night time compromised separation training and the introduction of an arrivals stagger to deconflict potential go-arounds at the runway intersection.

It is planned for the suspension to continue to at least March 2016, at which point the effectiveness of controls will be reassessed. It has been identified through the safety change management process that this suspension will have minimal impact during the daylight saving period.

Instruction

Do not conduct LAHSO at night at Melbourne and Adelaide.

Melbourne Flow

Configure Maestro to ensure LAHSO has ceased prior to Last Light.

Adelaide Flow

Create a dummy strip with the following ACIDs:

- First Light: FLxxxx (4 digit time)
- Last Light: LLxxxx (4 digit time).

Place the aircraft in the Adelaide Arrival Traffic Management Window at the corresponding times.

Attachment 17

9 November 2015	Airservices wrote to CASA with formal confirmation of the suspension of LAHSO at night.

airservices

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BY EMAIL
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Mr Peter Cromarty
Executive Manager
Airways and Aerodromes Division
Civil Aviation Safety Authority
GPO Box 2005
CANBERRA ACT 2601

Dear Mr Cromarty

RE: Land and Hold Short Operations (LAHSO) at night

Thank you for your letter today regarding LAHSO.

Airservices confirms that the suspension of LAHSO at night at Melbourne and Adelaide Airports will be implemented from tomorrow, 10 November 2015. A copy of the Temporary Local Instruction (TLI) has been sent to CASA.

Airservices would also like to provide the following clarifications to address the other points noted in your letter.

To clarify our response to point (a), Airservices intends to rollout a national program to further enhance the knowledge and skills of Tower controllers. This will involve enhancements to night time compromised separation training for risk situations including, but not limited to LAHSO at night. We will invite CASA involvement in the development of this program.

In relation to point (b), Airservices will provide evidence of SMS analysis of the discrete hazard "Double go-around during LAHSO at night" following the review of existing safety risk assessments.

Airservices will provide detailed progress of these actions, including any resulting deliverables as part of ongoing bi-monthly updates.

Yours sincerely

Steven Clarke
A/g Manager East Coast Services South

9 November 2015

Attachment 18

10 November 2015	CASA wrote to Airservices advising of a determination not to issue Airservices with proposed Direction.

Australian Government
Civil Aviation Safety Authority

File Ref: EF11/10239

10 November 2015

Greg Hood
Executive General Manager
Air Traffic Control Group
Airservices Australia
GPO Box 367
CANBERRA ACT 2601

cc Jason Harfield
A/g Chief Executive Officer
Airservices Australia

RE: PROPOSAL TO ISSUE A DIRECTION – MELBOURNE AIRPORT

I refer to Peter Cromarty's letter dated 2 November 2015, advising that he was proposing to issue a direction to an officer of Airservices Australia (**Airservices**) pursuant to regulation 11.245 of the *Civil Aviation Safety Regulations* 1998 (**CASR**), on the basis of the facts and circumstances set out in my letter. He invited you to provide reasons in writing as to why CASA should not make the direction. By letter dated 6 November 2015, you replied stating in part:

> Airservices will suspend LAHSO at night at Melbourne and Adelaide Airports. The restriction is being implemented in accordance with our Safety Management System and consultation is underway to clarify and minimise the impact on ATC and industry. A copy of the Temporary Local Instruction will be provided to CASA.

A copy of the relevant Temporary Local Instruction (TLI) suspending night LAHSO at Melbourne and Adelaide Airports with effect from the evening of Tuesday 10 November 2015 has now been received by CASA. Your letter dated 6 November 2015 also states:

> Airservices will review the situation in March 2016, including the effectiveness of all implemented actions, and work with CASA to determine whether LAHSO at night can be re-introduced in the interests of balancing safety as our primary consideration, with airport capacity and efficiency.

Having regard to the supplementary information provided in your letter dated 5 November, the clarification provided in your letter to CASA dated 9 November 2015 and especially the operational effect of the TLI, I have decided not to issue the proposed direction. CASA does not expect Airservices will re-introduce LAHSO at Melbourne Airport unless that is endorsed by CASA.

Yours sincerely

A Tiede

Andrew Tiede
Ag/Executive Manager
Airspace and Aerodromes Regulation Division

Attachment 19

9 December 2015	Bi-monthly update on improvement actions provided to CASA

LAHSO progress report to CASA (Dec 15):

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the definitions and terminology contained in national standards, rule set and procedures to ensure consistency and application intent.	Any implemented changes to rule sets / procedures	The review is completed. All resulting rule set/procedure change actions have been captured in CIRRIS.	Complete
Conduct a review of LAHSO procedures and practices at Melbourne and Adelaide to ensure the application is consistent with the intent of the CASA Manual of Standards (MOS) Part 172, the Aeronautical Information Package (AIP) and the Manual of Air Traffic Services (MATS).	Any implemented changes to rule sets / procedures.	The review is completed. All resulting AIP/MATS change actions have been captured in CIRRIS. AIP changes associated with LAHSO phraseology, runway selection criteria, definitions, and wind shear advice/restrictions have been published in AIP.	Complete
Reassessment of the data modelling completed for the 2013 Melbourne Go-Around Study. Incorporate data modelling as an addendum to 2012 LAHSO Safety Assessment Report.	Risk modelling report	The analysis has been completed.	Complete
Risk assessment of all LAHSO procedures and practices at Melbourne using additional top-down and bottom up techniques as described in AA-GUIDE-SAF-0105C to ensure the identification and assessment of all potential failure modes associated with all operational airspace and runway mode configurations. Incorporate assessment as an addendum to 2012 LAHSO Safety Assessment Report and update ORAs as appropriate.	Addendum to the 2012 CROPS/LAHSO SAR report. Updated Melbourne Tower and TCU ORA	The risk assessment of LAHSO procedures (including supporting evidence) has been completed.	Complete

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the training and support for personnel with National Request for Change (NRFC) safety management roles and responsibilities to ensure safety change is managed in accordance with Safety Change Management Requirements.	NRFC Safety Management Roles Training and Support Review (Version 4)	Complete. The following further actions address the findings: – Development of the safety competency framework to include competency requirements for safety specialists and managers approving operational change. Targeted staff training is due to commence in October 2015 (ACT-0007754). – Procedure changes to clarify the relationship between the role of the 'Safety Coordinator' and 'Lead Safety Specialist' (ACT-0007773 and ACT-0007774).	Complete
Implement a scheduled programme of operational surveillance activities of sufficient scope and periodicity to provide assurance that the application of procedures and practices remain consistent with national standards and the rule set.	Program of operational surveillance activities.	The Office of the CATC has completed an operational surveillance event of LAHSO in Melbourne. The results of the surveillance demonstrated that practices comply with the ruleset (the surveillance report is currently in draft).	Complete

Action	Deliverable	Current Status	Planned Completion
Conduct a study to determine whether alternative means of air traffic segregation (such as dependent runway operations) could be safely applied in Melbourne without material reductions to capacity.	Options study paper	An options paper examining options to assure the safety and efficiency is LAHSO is complete, and includes the introduction of a stagger via MAESTRO. A team has been established to progress the initiatives.	Complete
Suspension of aerodrome controller training during LAHSO.	Local instructions	Implemented	Complete
Only aircraft operationally requiring the use of runway 34 for departures are permitted to use it during LAHSO. Ad hoc requests will not be accommodated.	Local instructions	Implemented	Complete
09/34 LAHSO mode has been suspended (because all departures in this mode are from runway 34).	Local instructions	Implemented	Complete
Airservices safety investigation into 5 July double go around (CIRRIS).	Investigation report	Completed	Completed
Undertake an annual safety review of LAHSO.	Annual review report	Ongoing	Ongoing annual action
Implementation of a national program to further enhance the knowledge and skills of Tower. controllers. This will involve enhancements to night time compromised separation training for risk situations including, but not limited to LAHSO at night.	Training Program	In progress	Feb 16

Action	Deliverable	Current Status	Planned Completion
Review of the existing evidence of safety risk assessment in relation to double go-around during LAHSO at night.	Evidence of SMS analysis of the discrete hazard "Double go-around during LAHSO at night"	In progress	Feb 16
Review the LAHSO arrangements (in March 2016) including the effectiveness of all implemented actions.	Review Report	Scheduled for Mar 16	Mar 16
Implementation of the requirement for traffic on Runway 34 at Melbourne to be processed via an Instrument approach procedure during LAHSO.	Local instructions	Effective 10 Dec 15	10 Dec 15
Implementation of the requirement for LAHSO to be used only during periods of high demand.	Letter of Agreement	Effective 10 Dec 15	10 Dec 15

Attachment 20

5 February 2016	Bi-monthly update on improvement actions provided to CASA via email

LAHSO progress report to CASA (Feb 16):

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the definitions and terminology contained in national standards, rule set and procedures to ensure consistency and application intent.	Any implemented changes to rule sets / procedures	The review is completed. All resulting rule set/procedure change actions have been captured in CIRRIS.	Complete
Conduct a review of LAHSO procedures and practices at Melbourne and Adelaide to ensure the application is consistent with the intent of the CASA Manual of Standards (MOS) Part 172, the Aeronautical Information Package (AIP) and the Manual of Air Traffic Services (MATS).	Any implemented changes to rule sets / procedures.	The review is completed. All resulting AIP/MATS change actions have been captured in CIRRIS. AIP changes associated with LAHSO phraseology, runway selection criteria, definitions, and wind shear advice/restrictions have been published in AIP.	Complete
Reassessment of the data modelling completed for the 2013 Melbourne Go-Around Study. Incorporate data modelling as an addendum to 2012 LAHSO Safety Assessment Report.	Risk modelling report	The analysis has been completed.	Complete
Risk assessment of all LAHSO procedures and practices at Melbourne using additional top-down and bottom up techniques as described in AA-GUIDE-SAF-0105C to ensure the identification and assessment of all potential failure modes associated with all operational airspace and runway mode configurations. Incorporate assessment as an addendum to 2012 LAHSO Safety Assessment Report and update ORAs as appropriate.	Addendum to the 2012 CROPS/LAHSO SAR report. Updated Melbourne Tower and TCU ORA	The risk assessment of LAHSO procedures (including supporting evidence) has been completed.	Complete

Action	Deliverable	Current Status	Planned Completion
Conduct a review of the training and support for personnel with National Request for Change (NRFC) safety management roles and responsibilities to ensure safety change is managed in accordance with Safety Change Management Requirements.	NRFC Safety Management Roles Training and Support Review (Version 4)	Complete. The following further actions address the findings: – Development of the safety competency framework to include competency requirements for safety specialists and managers approving operational change. Targeted staff training is due to commence in October 2015 (ACT-0007754). – Procedure changes to clarify the relationship between the role of the 'Safety Coordinator' and 'Lead Safety Specialist' (ACT-0007773 and ACT-0007774).	Complete
Implement a scheduled programme of operational surveillance activities of sufficient scope and periodicity to provide assurance that the application of procedures and practices remain consistent with national standards and the rule set.	Program of operational surveillance activities	The Office of the CATC has completed an operational surveillance event of LAHSO in Melbourne. The results of the surveillance demonstrated that practices comply with the ruleset. The review report is with the CATC.	Complete
Conduct a study to determine whether alternative means of air traffic segregation (such as dependent	Options study paper	An options paper examining options to assure the safety and	Complete

Action	Deliverable	Current Status	Planned Completion
runway operations) could be safely applied in Melbourne without material reductions to capacity.		efficiency is LAHSO is complete, and includes the introduction of a stagger via MAESTRO. A team has been established to progress the initiatives.	
Suspension of aerodrome controller training during LAHSO.	Local instructions	Implemented Note: Training in the aerodrome control position has resumed (no systemic issues with training during LAHSO were identified)	Complete
Only aircraft operationally requiring the use of runway 34 for departures are permitted to use it during LAHSO. Ad hoc requests will not be accommodated.	Local instructions	Implemented	Complete
09/34 LAHSO mode has been suspended (because all departures in this mode are from runway 34).	Local instructions	Implemented	Complete
Airservices safety investigation into 5 July double go around (CIRRIS).	Investigation report	Completed	Completed
Undertake an annual safety review of LAHSO.	Annual review report	2015 completed, 2016 report due 14 Sep 16 tracked via CIRRIS action ACT-0007465	Ongoing annual action
Implementation of a national program to further enhance the knowledge and skills of Tower controllers. This will involve enhancements to night time compromised separation training for risk situations including, but not limited to LAHSO at night.	Training Program	In progress	Mar 16

Action	Deliverable	Current Status	Planned Completion
Review of the existing evidence of safety risk assessment in relation to double go-around during LAHSO at night.	Evidence of SMS analysis of the discrete hazard "Double go-around during LAHSO at night"	In progress Interim report provided 21 Jan 16. Updated report intended to capture outcomes of changes made in Dec 15 (due end Feb 16)	Mar 16
Review the LAHSO arrangements (in March 2016) including the effectiveness of all implemented actions.	Review Report	PIR completed	Complete
Implementation of the requirement for traffic on Runway 34 at Melbourne to be processed via an Instrument approach procedure during LAHSO.	Local instructions	Effective 10 Dec 15	Complete
Implementation of the requirement for LAHSO to be used only during periods of high demand.	Letter of Agreement	Effective 10 Dec 15	Complete
Concept development for enhanced compromised separation procedures in consultation with CASA.	Safety Case	In progress	Mar 16
Continued development of feasible system solution to ensure aircraft segregation in consultation with CASA (i.e. 'stagger').	SCARD Safety activities and documentation as determined	In progress	Mar 16
Mandating the requirement for a supervisor in the tower during LAHSO.	Temporary Local Instructions TLI 15_0231 (NRFC 29915)	Implemented	Complete Note: Permanent Shift Manager Roster Changes are being made

Action	Deliverable	Current Status	Planned Completion
Development of 'Off Mode' departure procedures	'Off Mode' management procedures	In progress	Mar 16

Attachment 21

12 February 2016	Update provided to CASA on the development and delivery of night time compromised separation training for Melbourne Tower

Land and Hold Short Operations (LAHSO) Compromised Separation Training

Background

On 2nd November 2015 CASA wrote to Airservices regarding ongoing concerns about the safety of LAHSO at Melbourne airport, particularly at night. Their key concern being the safe management of simultaneous go-arounds from crossing runways. CASA stated their intention was to issue a Direction that would *"Prohibit simultaneous landings during Land and Hold Short Operations (LAHSO) at Melbourne Airport at night"*. However, they stated would consider revoking this if Airservices provided evidence that would support its reinstatement and one of those requirements was:

"Airservices provides evidence to CASA that all ATCs endorsed for Melbourne Tower Aerodrome Control (ADC) have been assessed as competent in effective night-time compromised separation techniques which include the requirements associated with the Minimum Vectoring Altitude;..."

Purpose

To provide CASA with an update on the development and delivery of night time compromised separation training for Melbourne Tower.

Compromised Separation Training

1. The compromised separation recovery training developed to manage simultaneous go-arounds requires the controller to assess the trajectories of the aircraft and if necessary, issue a vector.
2. This technique is compliant with the Part 172 MOS in daylight hours because the controller can assign terrain clearance to the pilot by adding the word "visual" to the heading instruction; the pilot accepting terrain clearance by reading it back. However, at night the MOS does not allow a controller to assign terrain clearance in this manner.
3. **The premise**.
    a. There are elements of the Part 172 and 173 MOS which accommodate manoeuvres in the circling area at night below the minimum safe altitude.
    b. Airservices would like to adapt the safety argument that underpins these elements to develop compromised separation training to equip controllers to safely manage aircraft where a threat may exist on the published missed approach path.
4. **Supporting Evidence.** Airservices seeks CASA assistance and guidance to identify and formulate the compromised separation recovery practice. Items identified by Airservices to date include:
    a. The obstacles within the circling area are fixed and known.
    b. Obstacle clearance requirements outside the missed approach path can be routinely met by aircraft climb trajectory. The trajectory of the aircraft and the actions of the crew do not materially change from day to night.
    c. Modelling will identify a limited number of permitted headings left and right of the published missed approach path. The modelling will be completed by Airservices' Instrument Flight Procedures design team.
    d. Airlines that participate in LAHSO (Qantas, Jetstar, Virgin, Qantaslink, Regional Express, Cobham, Express Freighters, Tiger and Air New Zealand) will be consulted and will participate in Airservices led safety management activities regarding the use of the procedure.

e. Airline support for and acceptance of the procedure and their commitment to provide education and training for their crews in the use of this procedure by day and night.

Additional Consideration:

Airservices has identified the need for night time compromised separation training for all towers to manage go-arounds at night.

ATC is not currently equipped under the Part 172 MOS to issue instructions to aircraft other than the published missed approach. Scenarios have been identified here and overseas, which required such a response, such as:

- Single runway operations where a departing aircraft and an aircraft in the missed approach come into conflict upwind;
- Aircraft in the missed approach which requests an immediate turn due to thunderstorms on upwind.

Attachment 22

12 February 2016	CASA provided with presentation summary of Manual of Air Traffic Standards (MATS) and AIP changes relevant to LAHSO

airservices

LAHSO Changes

Robyn Leece
ATS Integrity Manager

Manual of Air Traffic Services

- Consolidated aircraft who are subject to CASA exemption to participate actively and passively for Land and Hold Short Operations (LAHSO) into Manual of Air Traffic Services (MATS) so information was readily available to controllers (NRFC 24024 & 25484)

10.9.5.5 LAHSO exemptions

CASA has issued exemptions to the following operators/aircraft types to actively participate in LAHSO:

a) Boeing 767 300 series aircraft operated by Qantas Airways;

b) Airbus A320 series aircraft operated by Air New Zealand Ltd of Auckland, and also applies to flights conducted under the wet lease agreement between Air New Zealand (Lessor) and Pacific Blue (Lessee);

c) Airbus A321 aircraft operated by Jetstar Airways Pty Ltd; and

d) Boeing 787-8 aircraft operated by Jetstar Airways Pty Ltd.

Manual of Air Traffic Services

- Included companies who have advised they will actively and passively participate in LAHSO into MATS for Adelaide, Darwin and Melbourne airports (NRFC 24024)

10.9.5.6 LAHSO participation

The following operators have notified ability to participate in LAHSO at the following locations:

Location	Active and passive	Passive only
Adelaide	REX, Cobham Regional Services	Alliance, Jetstar, Qantas, QantasLink, Sharp, Tiger Airways and Virgin
Darwin	Cobham Regional Services, Jetstar, Qantas, QantasLink, REX, Tiger Airways and Virgin	Alliance
Melbourne	Cobham Regional Services, Jetstar, Qantas, QantasLink, REX, Tiger Airways and Virgin	Alliance

Manual of Air Traffic Services

- Included agreed landing distances required for companies that have agreed to participate actively in LAHSO (NRFC 24024)

10.9.6.1.2 **Airline LDR**

Use the following minimum LDR for active participation in LAHSO:

Airline	Minimum LDR
Jetstar	2200 m
Qantas	2000 m
Virgin	2200 m
Tiger Airways	2000 m
Cobham Regional Services	1674 m

Manual of Air Traffic Services

- Included MATS clause advising ATC that pilots may elect not to participate if they were concerned about situational awareness (NRFC 27954)

10.9.5.7 Pilot requirements

Pilots who expect and elect to participate actively in LAHSO are required to:

a) obtain the ATIS/CATIS/DATIS broadcast as early as possible;

b) if within 200 NM of destination, and if LAHSO is in progress, immediately confirm ability to participate by advising 'LAHSO APPROVED' to the ATS unit currently providing services; and

c) advise ATS as soon as possible if situational awareness is compromised and they are not able to hold short.

Manual of Air Traffic Services

- Placed restrictions, in excess of the Manual of Standards Part 172, for specific weather criteria that must exist to perform LAHSO (NRFC 27954)

10.9.5.9 Conditions

LAHSO are subject to the following conditions:

a) Runways are equipped with standard LAHSO signs, lights and runway markings as specified in AIP Aerodromes (AD);

b) Cloud ceiling is not less than the highest sector MVA, as specified in local instructions, within 8 KM (5 NM) of the aerodrome and visibility not less than 8 KM;

c) Active and passive participation is restricted to nominated runways as per Clause 12.2.1;

d) For active participants, ground based visual or electronic glide slope guidance is available; and

e) No wind shear is reported.

12.2.1.3.1 Wind in excess of criteria

Except during LAHSO, you may nominate a runway when crosswind or downwind exceeds the specifications of Clause 12.2.1.3 if:

a) required by noise abatement legislation;

b) an alternative runway does not exist; or

c) a take-off or landing, as applicable, is not possible on an alternative runway.

airservices

Manual of Air Traffic Services

- New clause added to provide guidance for the safe transition from LAHSO to normal modes of operation (NRFC 27954)

10.9.5.9.1 Transitioning from LAHSO to non-LAHSO mode

During the period where conditions change from LAHSO mode to a non-LAHSO mode:

a) you may allow aircraft established on final within the IAF to continue to land on the arrival runway provided:

i) you advise the pilot of the revised landing conditions;

ii) the pilot accepts the changed conditions and elects to continue the approach; and

iii) you restate any hold short instruction; and

b) aircraft beyond the IAF, and any departures are processed for the new runway as per runway change processes detailed in local instructions.

Manual of Air Traffic Services

- New clause added to emphasise that the tower controller may terminate LAHSO if they considered conditions would adversely affect LAHSO (NRFC 27954)

10.9.5.9.3 LAHSO termination

Terminate LAHSO for any situation or weather condition which, in the judgement of the tower controller/supervisor, would adversely affect LAHSO.

Manual of Air Traffic Services

- No reported low level windshear (NRFC 27954)

10.9.5.9.8 Low level wind shear

Do not give a 'HOLD SHORT' requirement when low level wind shear is reported.

Manual of Air Traffic Services

- Added the requirement to nominate both active and passive runways on the Automatic Terminal Information Service to aid situational awareness for crews and ATC (NRFC 27954)

10.9.5.10 Responsibilities

When applying LAHSO:

a) ensure that the occulting runway hold short lights are illuminated at all times that LAHSO are in progress;

b) ensure that the published distance from the landing threshold to the hold short point of the crossing runway is adequate for the performance category of the aircraft;

c) nominate LAHSO and both the active and passive runways:

i) on the ATIS/CATIS/DATIS; or

ii) where ATIS/CATIS/DATIS is not serviceable, by directed advice prior to transfer to tower;

d) issue directed traffic information to both aircraft participating in the procedure;

e) ensure readback of a 'HOLD SHORT' requirement; and

f) withhold issuing a take-off clearance to a departing aircraft while another aircraft is landing on a crossing runway having been issued with a duly acknowledged 'HOLD SHORT' requirement, until such time that there is reasonable assurance that both aircraft will not occupy the intersection at the same time, should the landing aircraft subsequently fail to hold short.

AIP

- Reiterated that ATC will consider all domestically registered flight number callsign aircraft that fit performance category A, B, or C* aircraft and those subject to CASA exemption will be sequenced for LAHSO
- Added increased weather criteria, in excess of CASA Manual of Standards Part 172, before LAHSO can be conducted
- Added the requirement for glide path guidance to be available for active participants – except Darwin where a separate hazard workshop identified that the aircraft being instructed to the hold short requirement on runway 36 were of light category below 5700kg Maximum take off weight and regularly used aerodromes without glide slope guidance.

AIP

- Added definitions for active and passive runways via AIP SUPP H92/15
- Changed the phraseology for crews to advise of non-participation in LAHSO to align with other phrases for consistency and ease of understanding
- Added the weather criteria to for runway nomination to aid situational awareness for crews when conducting LAHSO
- New clause added to emphasise that timely wind shear reports to ATC aid in overall operational safety
- New clause added to emphasise that both active and passive runways will be nominated. This ensures that crews are aware which direction the crossing traffic will be coming from.

airservices

Melbourne

- Use of Instrument Approach
- Departures off Runway 34 only if operationally required
- Cancellation of 09/34 LAHSO Mode
- Supervision in both Tower and Approach must be in place to run LAHSO
- Demand driven – delays must be calculated to be greater than 5 minutes for LAHSO to be considered
- Currently suspension of LAHSO at night for both Melbourne and Adelaide

Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 182

Program: n/a
Division/Agency: Airservices Australia
Topic: Adelaide TCU
Proof Hansard Page: Written

Senator Sterle, Glenn asked:

Timeline

1. I understand from your previous submission to this Committee that the Adelaide TCU consolidation into Melbourne is "proposed to commence from 2017". (Airservices Australia, Terminal Control Unit Integration Initiative, Submission to the RRAT Committee, August 2015, pg 4)
2. Is Airservices Australia on schedule to deliver this outcome.
3. If not, why not.

Business Case

4. At Budget Estimates last year, you released a copy of the business case.
5. Do you stand by all financial assumptions which underpin this case, particularly for efficiencies related to staffing, supervision and co-location for technology and hardware. (Airservices Australia, 2015 BE, QoN 107)
6. If not, will you now provide an updated business case – on notice if necessary.

Safety Case

7. I refer to the Air Services Australia Terminal Control Unit Integration submission to this committee which states that "prior to implementation, the CASA will need to approve the safety case which includes documented evidence that safety impacts have been adequately considered and addressed". (Airservices Australia, Terminal Control Unit Integration Initiative, Submission to the RRAT Committee, August 2015, Appendix B)
8. Can you advise the Committee of the current status of the safety case relating to the relocation of air traffic controllers from Adelaide to Melbourne.
9. Has it been finalised.
10. Has it been presented to CASA.
11. Has CASA evaluated and/or approved the proposal.
12. If it has not been finalised, when will it be finalised.
13. Will the Safety Case be made public. If not, why not.

Additional processes

14. How much has been spent on the TCU integration project so far. Is it running on budget or over budget.
15. Is the Airservices Australia Board required to formally approve funding for the project.
16. Has that occurred. If not, when will it occur.
17. Is this project required to go before the Public Works Committee.
18. Has this occurred. If not, when will it occur.

TCU Controllers – Adelaide

19. How many Air Traffic Controllers are in Adelaide - including the TCU and both towers.
20. How many Air Traffic Controllers will remain after the transition.
21. Does this mean there will be job losses of highly skilled jobs in Adelaide following the transition.
22. What consultation have you had with the local member for Hindmarsh, Mr Matt Williams, regarding these job losses.

Career Opportunities

23. I refer to your submission to this Committee which states that "career development opportunities for air traffic controllers will be improved" (Airservices Australia, Terminal Control Unit Integration Initiative, Submission to the RRAT Committee, August 2015, pg 10)
24. I also refer to the statement that "all controllers who wish to remain at their current location will be accommodated – no one will lose their job". (Airservices Australia, Terminal Control Unit Integration Initiative, Submission to the RRAT Committee, August 2015, pg 10)
25. What career opportunities will be available for those air traffic controllers who choose to remain in Adelaide, if the majority of operations are moving to Melbourne.
26. Will they be eligible for further career diversification or promotion if they choose to remain in Adelaide.

Answer:

1-3. Yes.

4-6. Yes.

7-13. Work on the Safety Case (containing documented evidence that the safety impacts have been considered and appropriate management plans are in place) continues to be progressed and will be completed in early 2017 and provided to CASA for endorsement. CASA has been briefed on progress to date.

Airservices will make this available to the Committee once it is endorsed by CASA.

14-18. As of 24 February 2016, the project has spent $1,156,380 and is within budget.

Yes the Airservices Board approved the project proceeding to the planning phase on 10 December 2014. The Board approved the project proceeding to the executing phase on 26 February 2016.

No, Public Works Committee approval is not required.

19-22. There are currently 46 controllers in Adelaide, including the TCU, Adelaide Tower and Parafield Tower.

Based on current preferences of TCU staff, we expect 39 of the current controllers to remain in Adelaide after the transition.

Experienced TCU controllers who wish to remain in Adelaide have the opportunity to transfer to the Adelaide or Parafield towers, and will be provided with the relevant training. Seven staff had indicated they will take a voluntary redundancy at or after transition.

Extensive consultation has occurred between Airservices and a range of stakeholders, including Members of Parliament, on the proposed integration of the Adelaide TCU between September 2014 and December 2015 and is ongoing. The Member for Hindmarsh, whose electorate incorporates Adelaide Airport has been one of the stakeholders consulted.

23-26. The greatest career development opportunities for the existing Adelaide TCU controllers will be at the Melbourne Centre, which was the context of the statement in the submission. As noted in the response to question 21, TCU controllers who wish to remain in Adelaide will be able to do so and have all the same opportunities available to them as current tower controllers.

Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 183

Program: n/a
Division/Agency: Airservices Australia
Topic: Perth and Jandakot – WebTrak
Proof Hansard Page: Written

Senator Sterle, Glenn asked:

1. Is there any other reason that aircraft movements around the relevant airports would not be fully captured by Webtrak?
2. Are there particular types of aircraft not captured on Webtrak?
3. *If so,* how do you think the lack of a comprehensive display reconciles with the original intention of Webtrak as put in place in 2008?
4. Is there a technical fault with Webtrak that impacts Jandakot?
5. Are you aware of community concerns that Webtrak does not currently accurately capture movements around Perth and Jandakot airports?

Answer:

1-3. Depending on the category of operation, some general aviation aircraft may not be required to lodge flight plans and in this case WebTrak would display the track without an aircraft's identification. Similarly, the Civil Aviation Safety Authority does not mandate the carriage of radar transponders for all general aviation aircraft, particularly when operating in the circuit area of an airport or outside controlled airspace. In these cases, flights would not be visible on WebTrak.

Some state aircraft involved in official operations such as law enforcement or transport of dignitaries are also not displayed.

4. There were some technical issues with noise monitors associated with Perth Airport during the periods of 25-28 January 2016 and 3-5 February 2016 which have now been resolved.

5. Some concerns have been raised with Airservices Noise Complaints and Information Service about the display of information on WebTrak relating to operations at Jandakot Airport (and other similar secondary airports) where circuit training occurs. As noted above, if an aircraft is not equipped with a radar transponder, information would not be available for display through WebTrak.

A short-term noise monitoring program is in place at Jandakot between February and July 2016 as part of Airservices national monitoring program. Not all aircraft will be visible on Web Trak, however all noise events are being recorded by four noise monitors and information will be published at the conclusion of the study.

Rural & Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Additional Estimates 2015 - 2016

Infrastructure and Regional Development

Question no.: 184

Program: n/a
Division/Agency: Airservices Australia
Topic: Tullamarine Airport runways and aircraft routing
Proof Hansard Page: Written

Senator Rice, Janet asked:

1. On days with northerly winds, I understand most flights inbound to Tullamarine Airport from the north east fly west over Essendon before turning north to Runway 34. Why then do international flights from the north east appear to regularly route over densely populated areas of inner Melbourne?
   a) On days with little or no northerly winds, why are flights not directed to land on Runway 16 or 27, and not Runway 34?

2. Is it anticipated that potential GLS changes to routing over densely populated areas of inner Melbourne will take place? If so, what number of aircraft and type will cease to fly over inner Melbourne, or conversely what increased air traffic will occur?

Answer:

1. Melbourne Airport operates with a number of runway modes to accommodate traffic demand and wind conditions. The approach over Essendon is a visual approach procedure which requires a crew to navigate by visual reference to the airport and local landmarks. Under the Civil Aviation Safety Regulations, heavy non-Australasian international aircraft cannot be assigned visual approach procedures, and therefore must fly the alternative instrument approach procedure which takes the aircraft further south.
   a) Generally when the wind is light, the preferred runway mode to effectively manage traffic is arrivals onto runway 16 or 27 unless the airport is operating in high capacity mode which requires use of runway 34.

2. The design of the GLS procedure to runway 34 has yet to be completed but will, as far as practicable, follow existing flight paths. Any proposed changes to flight paths would be assessed and consulted on with community and industry stakeholders in accordance with Airservices commitment to aircraft noise management.

Question no.: 185

Program: n/a
Division/Agency: Airservices Australia
Topic: Draft EIS WSA
Proof Hansard Page: 135 (8 February 2016)

Senator Cameron, Doug asked:

Senator CAMERON: Are you surprised then that your indicative flight paths have produced a situation in an area of the lower Blue Mountains where we have these negative impacts that are going to be almost certain, with major consequences and a significance rating of very high? Have you had a look at this since you designed those flight paths?
Mr Harfield: I personally have not looked at the environmental impact statement since that time.
Senator CAMERON: Has someone in your department? I am not asking you personally. When I say 'you', it is your organisation.
Mr Harfield: I would have to check on that. However, the whole idea of doing a draft environmental impact statement and putting it out for consultation is based on the inputs that were placed in there and putting it out for consultation, which is occurring, and that feedback would then be taken into account before the environmental impact statement is finalised.

Answer:

Airservices is continuing to assist the Department of Infrastructure and Regional Development with the planning for Western Sydney Airport including the development of the draft environmental impact statement.

As part of the future design process, environmental assessments will be carried out on proposed flight path options. This will inform opportunities to optimise flight paths on the basis of safety, efficiency, noise minimisation and other environmental considerations.