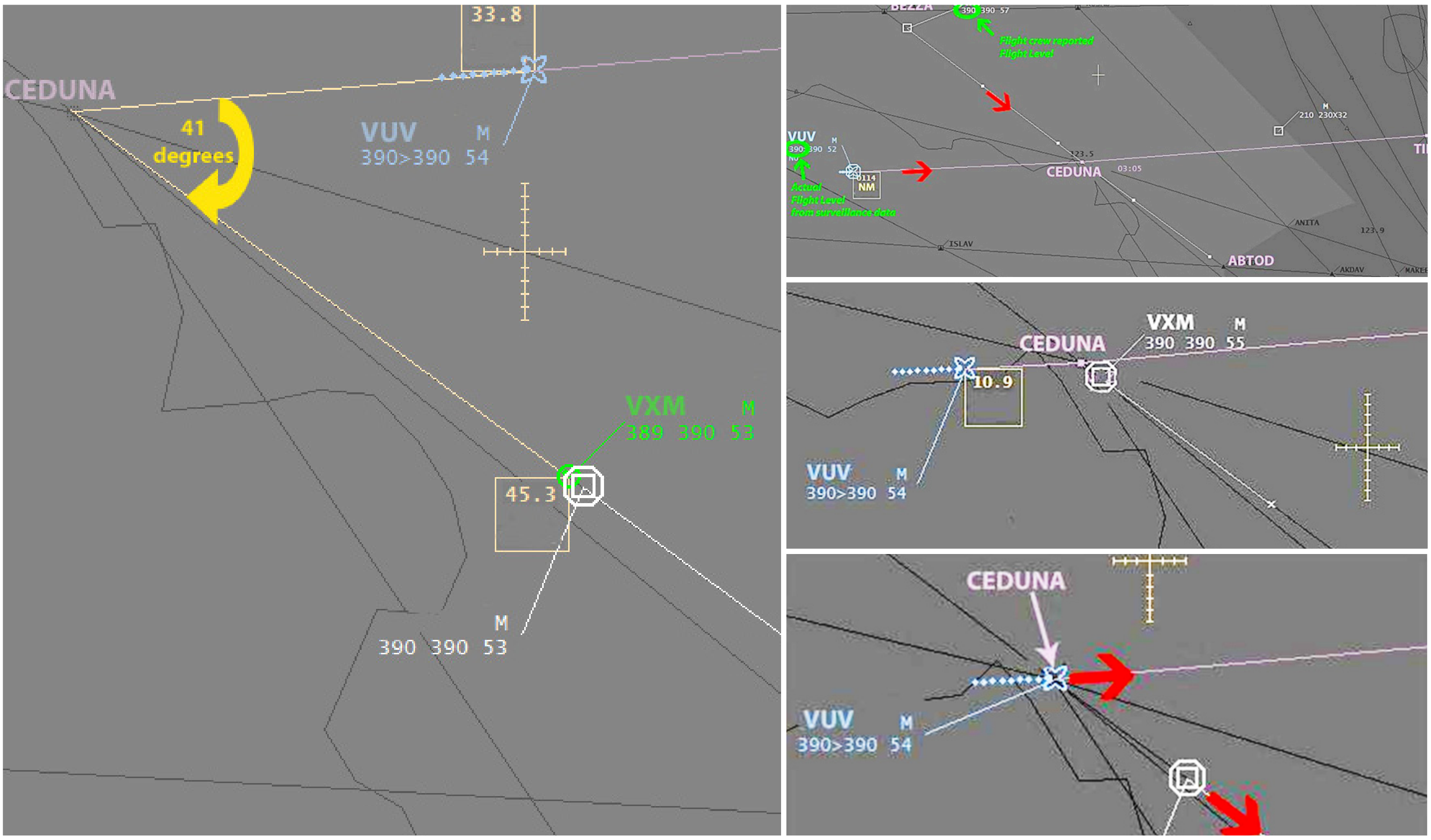
Australian Government
Australian Transport Safety Bureau

Loss of separation involving Boeing 737, VH-VUV and Boeing 737, VH-VXM

near Ceduna, South Australia | 8 November 2011



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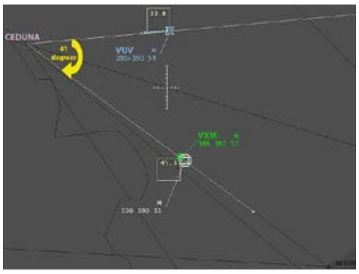
Safety summary

What happened

Aircraft positions at 1409:20



Source: ATSB modified image sourced from Airservices Australia data

On 8 November 2011, a loss of separation occurred between a Boeing Company 737-8FE, registered VH-VUV, and a Boeing Company 737-838, registered VH-VXM, near Ceduna, South Australia. The aircraft were conducting scheduled passenger flights and were under the air traffic control of Airservices Australia (Airservices). The aircraft were operating on converging tracks at 39,000 ft. The procedural longitudinal separation standard of 20 NM (37 km) was infringed. It is likely that there was between 6 NM (11.1 km) and 12 NM (22.2 km) longitudinal separation between the aircraft.

What the ATSB found

The ATSB found that the two controllers involved were experiencing a high workload due to a range of factors, including the number of tasks and their limited experience. Airservices' processes for monitoring and managing controller workloads did not ensure that newly-endorsed controllers had sufficient skills and techniques to manage the high workload situations to which they were exposed. In addition, Airservices's fatigue risk management system (FRMS) did not effectively manage the fatigue risk associated with allocating additional duty periods. The ATSB is also concerned that there had been increasing traffic levels and complexity in some sectors in recent years, combined with a decrease in the experience levels of controllers and without a concomitant increase in controller resources. In addition, although Airservices has been in the process of developing and trialling a flight plan conflict function for procedurally-controlled aircraft for several years, the fact that it is still not operational is a safety issue.

What's been done as a result

Airservices reported that the airspace sectors involved in the occurrence had been re-sectorised into three sectors in November 2012 to manage workload and that a working group had been established to determine a suitable workload model to monitor and forecast controller workload on a sector by sector basis. The first stage of a flight plan conflict function had also been deployed in Brisbane Upper Airspace, with further roll out planned in Melbourne Centre in 2014.

In addition, Airservices reported that an updated FRMS had been implemented in July 2012 and that it had addressed the systems limitations outlined in the report.

Safety message

High workload can have significant effects on a controller's performance. It needs to be monitored and managed using a systemic approach, particularly for less experienced controllers but also those who have recently received a new endorsement. Other recent loss of separation occurrences involving high workloads and newly-endorsed controllers indicate that this problem is not restricted to the sectors involved in this occurrence. Ideally the best way of managing workload is to reduce the level of work demands and distractions. If the work demands cannot be reduced, then another option is to ensure the controllers have the experience, skills techniques and support to effectively manage their task demands.

Contents

The occurrence

At 1404:19 Eastern Daylight-saving Time[1] on 8 November 2012, a loss of separation[2] occurred near Ceduna, South Australia between:

- a Boeing Company B737-8FE registered VH-VUV (VUV), operating on a scheduled passenger service from Perth, Western Australia to Brisbane, Queensland, and
- a Boeing Company B737-838 registered VH-VXM (VXM), operating on a scheduled passenger service from Port Hedland, Western Australia to Melbourne, Victoria.

The two aircraft were on different routes, but both were planned to track overhead Ceduna (Figure 1). Both aircraft were also operating at flight level (FL)[3] 390. As the magnetic tracks for both aircraft were within the arc from 000° to 179º, the use of the same FL was consistent with relevant requirements.

Figure 1: Routes of VH-VUV and VH-VXM

Source: Underlying map from Jeppesen Sanderson Inc. Modified by the ATSB.

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1 Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours. This time zone is used in this report as it was the local time of the relevant controllers.

2 An occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists, or may exist, in airspace where the aircraft is subject to an air traffic separation standard.

3 At altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 390 equates to 39,000 ft.

There was no radar coverage in the airspace to the west of Ceduna. VUV was fitted with Automatic Dependant Surveillance-Broadcast (ADS-B) equipment, which meant that its position was displayed on the controller's air situation display (ASD) in real time. VXM was not ADS-B equipped and therefore was under procedural control. Its crew were required to provide regular position reports and estimates for subsequent positions to air traffic control (ATC). VXM's position was also presented on the controller's ASD, based on the position reports and estimates that the controller entered into the aircraft's flight data record in The Australian Advanced Air Traffic System (TAAATS) (see also *Aircraft surveillance* below).

In the period leading up to the occurrence, both aircraft were operating in the Nullarbor (NUL) airspace sector. VUV's flight crew first contacted the NUL controller at 1245 and VXM's flight crew first made contact at 1254.

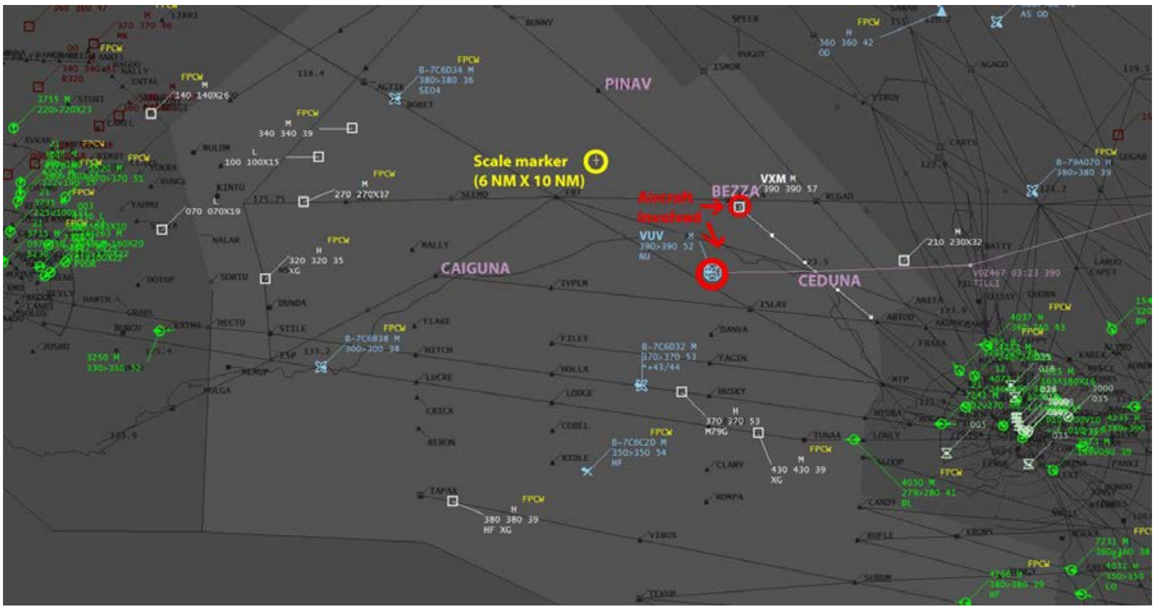
At 1300, the NUL controller (controller 1) handed over the sector to another controller (controller 2) to obtain a 30-minute break away from the console. During the handover, controller 1 mentioned VXM was operating at FL 390 and that VUV was operating at FL 390 but did not refer to their relationship to each other. At that stage a potential traffic confliction existed but both aircraft were over 1 hour away from Ceduna.

At 1330, controller 2 started handing back to controller 1. During the handover, at 1332:28, the crew of VXM reported being at position PINAV at 1331 and estimating BEZZA at 1351, maintaining FL 390. Controller 2 also indicated to controller 1 that one of the tasks that needed to be done was to request the crew of VUV to change frequencies. Controller 2 did not notice the potential conflict between VXM and VUV, and did not indicate any potential conflict to controller 1 during the handover.

At 1333, controller 1 took over the NUL sector. At 1333:57 the controller instructed the crew of VUV to change frequency, and the crew complied and reported that they were maintaining FL 390.

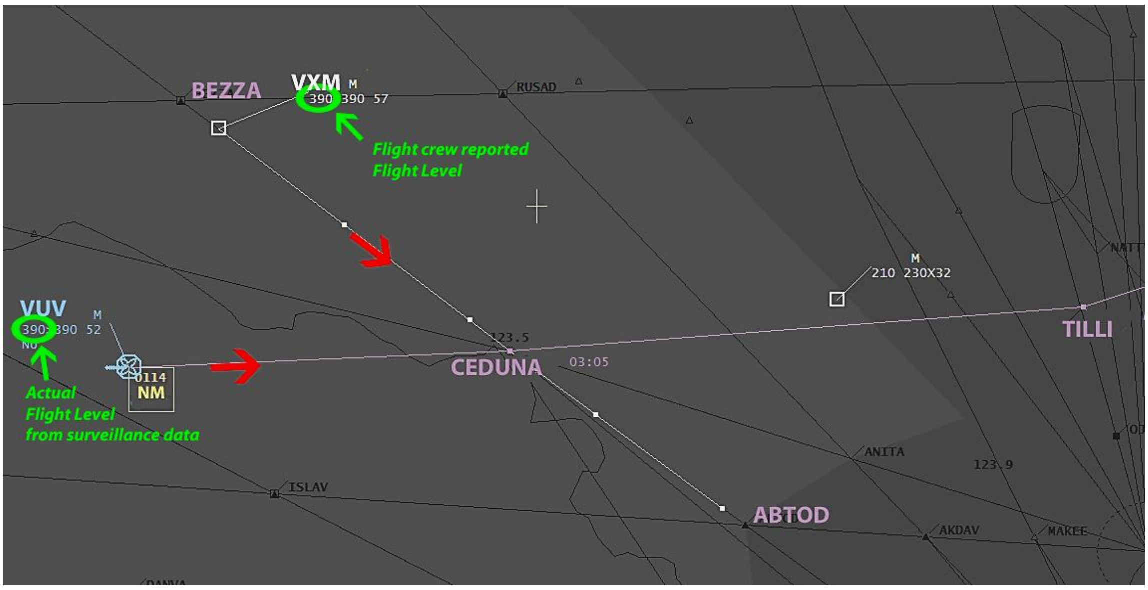
At 1352:35, the crew of VXM reported reaching BEZZA and estimated being overhead Ceduna at 1404, maintaining FL 390. At that time, VUV was 114 NM (211 km) from Ceduna (Figure 2 and Figure 3) and, based on air traffic system data, was estimating to be overhead Ceduna at about 1405.

Figure 2: Nullarbor/Nullarbor Low sectors air situation display (default range) at 1352:35



Source: Underlying image from Airservices Australia. Modified by the ATSB.
Note: ADS-B, radar and procedurally-controlled aircraft were presented as different symbols on the controller's air situation display.

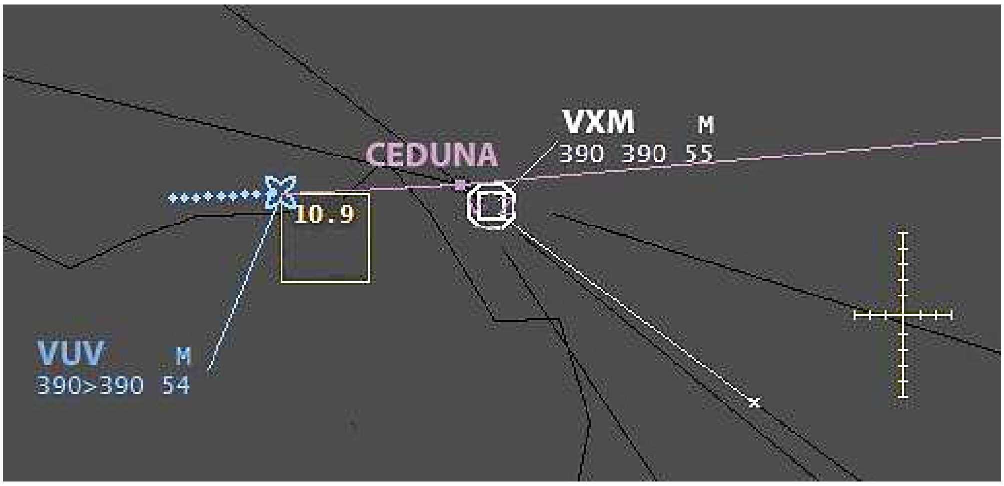
Figure 3: Displayed positions of the aircraft at 1352:35



Source: Underlying image from Airservices Australia. Modified by the ATSB.
Note: This image has been enlarged. The default display range viewed by the controller is depicted in Figure 2.

At 1404:19, over an hour after the aircraft had entered the NUL sector, the loss of separation occurred when VUV was 10.9 NM (20.2 km) from Ceduna and VXM was also within 11 NM of Ceduna (Figure 4). The estimated arrival times for the two aircraft overhead Ceduna indicated that there would be 2 minutes between the aircraft, which was less than the required 10-minute procedural time separation standard.[4] The separation was also less than the longitudinal separation standard of 20 NM (37 km), or the lateral separation standard of 11 NM (20.4 km), which were also both procedural standards. In the event that longitudinal or lateral separation did not exist, the vertical separation standard required was 1,000 ft.

Figure 4: Displayed positions of the aircraft at 1404:19



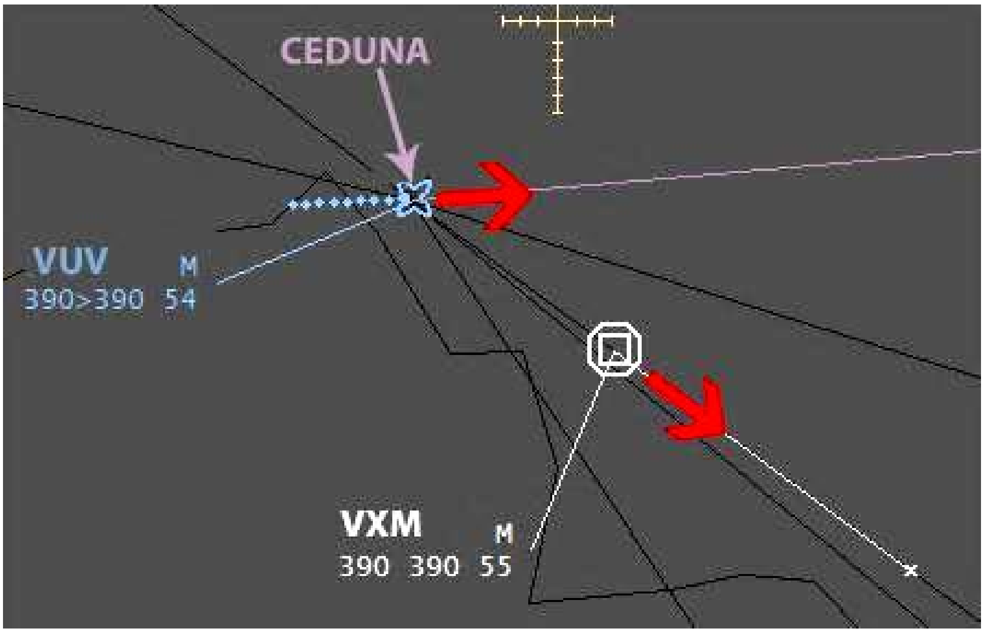
Source: Underlying image from Airservices Australia. Modified by the ATSB.
Note: This image has been enlarged. The default display range viewed by the controller is depicted in Figure 2.

At 1405:33, ADS-B data indicated that VUV was overhead Ceduna (Figure 5). The crew of VXM subsequently reported (at 1407:22) that they had been overhead Ceduna at 1404. As the times

4 There was 41° between the aircrafts' flight tracks. As the angle was less than 45°, the aircraft could be treated as being on the same track for separation purposes. If the aircraft were on crossing tracks, the separation standard would be 15 minutes.

reported to ATC were to be rounded within a 30-second period, VXM would have been overhead Ceduna sometime between 1403:31 and 1404:29. As VUV was observed on ADS-B to be overhead Ceduna at 1405:33, the time between the two aircraft would have been between 63 seconds and 122 seconds. Based on a groundspeed of about 6 NM per minute for the Boeing 737 aircraft, it was estimated that there was 6 to 12 NM longitudinal separation between the two aircraft when VUV was overhead Ceduna.

Figure 5: Displayed positions of the aircraft at 1405:33



Source: Underlying image from Airservices Australia. Modified by the ATSB.
Note: This image has been enlarged. The default display range viewed by the controller is depicted in Figure 2.

At 1406:49, ADS-B data indicated that VUV was maintaining FL 390 and 11.5 NM (21.3 km) to the east of Ceduna, which was outside of the 11 NM lateral separation point for the tracks of the two aircraft. Lateral separation between VXM and VUV was re-established at that time.

At 1407:17, the controller contacted the crew of VXM to ask if they had passed overhead Ceduna. The crew replied that they had passed overhead at 1404 and were estimating the next position (ABTOD) at 1414.

The controller later reported that they detected the loss of separation soon after the aircraft had passed Ceduna. Initially, the controller was ‘stunned’ and thought that they must be mistaken, before realising that there had been a loss of separation. The controller then reported the occurrence to the Shift Manager. As VXM was a procedural track, there was some uncertainty regarding its exact position. No alerts or instructions were provided to either flight crew.

There were no reports from the flight crews involved that the aircraft came within close proximity or that their traffic collision avoidance system (TCAS)[5] had generated any alerts.

[5] Traffic collision avoidance system (TCAS) is an aircraft collision avoidance system. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder and gives warning of possible collision risks.

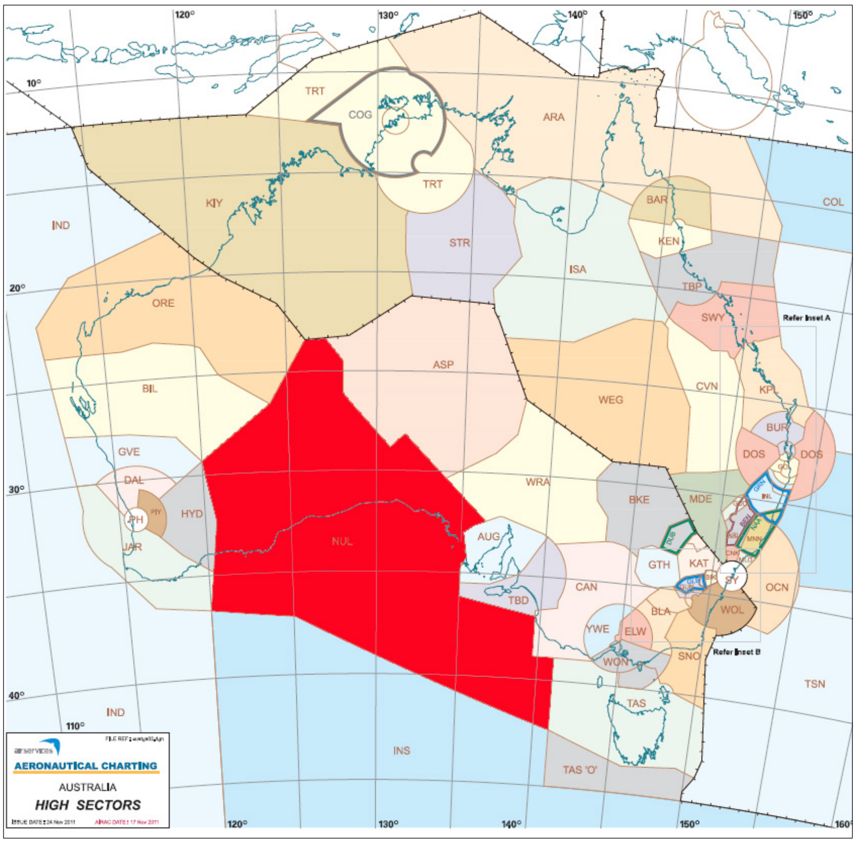
Context

Airspace information

The two airspace sectors under the relevant controllers' jurisdiction were Nullarbor (NUL) and Nullarbor Low (NLO), which were part of the ATC Bight Group. Airservices Australia (Airservices) was the air traffic services (ATS) provider responsible for the Bight Group, which was located in the Melbourne Flight Information Region.

The vertical limits of NUL were from FL 285 to FL 600 and NLO were from the surface to FL 285. The two sectors encompassed an area of about 800 NM (about 1,500 km) across from east to west and about 850 NM (about 1,600 km) from north to south, including the Great Australian Bight region (Figure 6). The controller's ASD was normally set to the default range of 1,270 NM (2,350 km) (see also Figure 2). Due to the physical size of the airspace, nine ATC frequencies were required to ensure that communications with aircraft were maintained.

Figure 6: Location of the NUL/NLO sectors (in red)

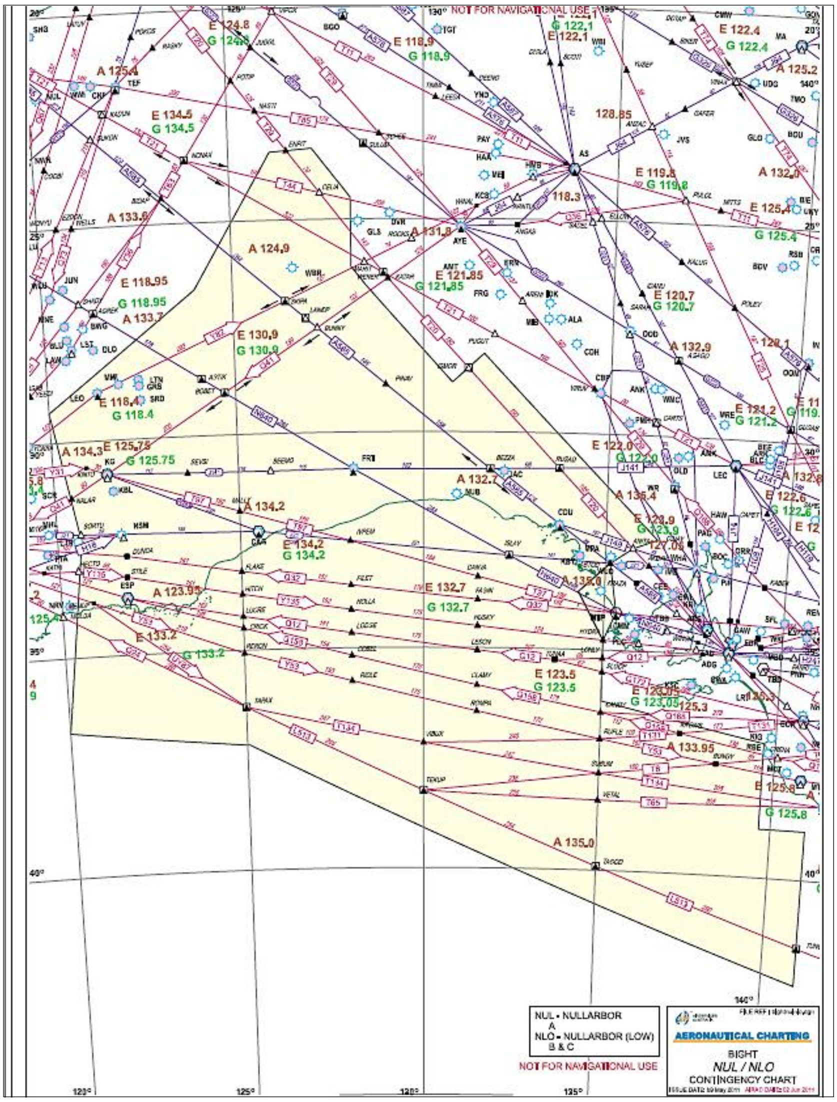


Source: Underlying image from Airservices Australia. Modified by the ATSB.

There were a number of promulgated air routes in NUL/NLO in addition to flexible routes that were published on a daily basis (Figure 7). There were not many crossing tracks.

The mix of aircraft utilising the airspace included jet, turboprop and piston-engine aircraft. The type of operations included regular public transport, both domestic and international, charter, emergency services and general aviation. The NUL and NLO sectors encompassed three different airspace classifications and a number of different separation standards were required, depending on the airspace classification, type of control service and type of aircraft involved. Due to the variety of operations and applicable control processes, TAAATS required a controller to make numerous inputs to maintain system validity.

Figure 7: NUL/NLO airspace



Source: Underlying image from Airservices Australia. Modified by the ATSB. Shaded area indicates NUL and NLO sectors.

NUL and NLO were entry-level sectors within the Bight Group where controllers who had been through their initial training within Airservices (‘ab initio controllers’) often undertook their final field training to obtain an en route rating. The two sectors were permanently combined to be managed at one console, and were not able to be de-combined to reduce workload as there was no spare console available. Controllers were endorsed for both sectors concurrently. The main skills that controllers developed on the NUL/NLO sectors were to interact with aircraft, scan and complete frequency transfers on time, distribute weather information, and apply some basic procedural separation standards. From about mid-2010, other sectors within the Bight Group had been considered too difficult for ab initio controllers to achieve an initial rating.

Aircraft surveillance

There was limited radar coverage to the west of Ceduna, and neither of the aircraft involved in the loss of separation were operating within radar surveillance in the period prior to and during the occurrence.

From FL 300 and above, there was full ADS-B coverage for aircraft appropriately equipped and approved for ADS-B operations. ADS-B is a satellite-based technology, with ground-based stations that enable aircraft to be tracked in real time by ATC. Flight crews are not required to provide regular position reports to controllers. However, controllers were required to inform flight crews when they needed to switch frequencies. Approximately 60 per cent of the aircraft in the NUL sector at the time of the occurrence were ADS-B equipped. All aircraft in Australia operating above FL 290 are required to have ADS-B equipment installed by December 2013.

For aircraft that were not subject to ADS-B or radar surveillance, separation and traffic management was achieved through procedural control processes and standards. Flight crews were required to provide regular position reports and estimates to the controller. If frequency transfers were required, controllers usually instructed flight crews to change frequency when the crews provided position reports.

If a frequency change was not completed on time, then an aircraft could fly out of communication range on that frequency. The controller would then need the assistance of other aircraft to re-establish two-way communications, and this process of using other aircraft increased workload. The frequency overlap allowed a 10-minute window to conduct a frequency transfer.

TAAATS had a Short Term Conflict Alert (STCA) function for detecting when two aircraft were approaching a compromised separation situation requiring immediate controller intervention. However, the STCA was only available in situations involving two conflicting aircraft under either radar or ADS-B surveillance. The STCA was not available for a situation involving a procedurally-controlled aircraft such as VXM.

Personnel information

Controller 1

Controller 1 undertook ATC en route training at Airservices' Learning Academy before undertaking final field training for their initial endorsement on NUL/NLO. They had been endorsed on the NUL/NLO sectors for 4 months at the time of the occurrence. The controller had completed compromised separation recovery training during their initial training and also during their final field training.

Because they had not completed 6-months work as a controller, they had not been subject to a formal performance check since their endorsement. It was normal practice for experienced controllers to informally monitor newly-rated controllers, particularly during periods of high workload. The controller noted it would have been beneficial to have an experienced controller monitor their performance for an extended period at various stages after their initial endorsement and provide feedback and mentoring, but that this was not normal practice.

In the period leading up to the occurrence, the controller had worked a normal roster cycle, consisting of the four shifts:

- 4 November 1400–2230
- 5 November 1000–1900
- 6 November 0800–1400[6]
- 7 November 0000–0630.

The controller was rostered for an additional duty on 8 November from 1200–2000. The controller reported feeling fit for duty at the start of the shift, but 'exhausted' after the incident had occurred.

The controller reported normally having about 30–60 minutes light sleep prior to commencing a 0000–0630 shift. On 7 November, they also had 1 hour sleep at work soon after starting their 0000–0630 shift[7], and 5 hours sleep starting at 1000. They then had difficulty sleeping that night, obtaining about 3–4 hours sleep, which they described as 'rough' and much less than normal for

6 The controller's normal shift cycle started the third shift at 0700 rather than 0800.
7 This was an accepted practice and within the organisation's Fatigue Risk Management System guidelines.

them at that stage of a shift cycle. The controller lived about 50–60 minutes driving time away from the ATC centre.

Controller 2

Controller 2 undertook ATC en route training at Airservices' Learning Academy before undertaking final field training for their initial endorsement on NUL/NLO. They had been endorsed on the NUL/NLO sectors for 7 months. The shift was the first in a new cycle, and the controller had the two previous days off duty.

Air traffic control activities

Between 1230 and 1730 there was a consistent traffic period for the NUL/NLO sectors, with between 20 and 28 aircraft on frequency. It was reported that this was not an uncommon amount of traffic for the sector during afternoons, and that traffic levels had been increasing in recent years.

Airservices reviewed the proportion of time that the NUL/NLO controllers were engaged on ATC frequency or intercom communications during the period leading up to the occurrence. The percentages were:

- 1230 to 1300 (controller 1) – 60 per cent
- 1300 to 1330 (controller 2) – 75 per cent
- 1330 to 1400 (controller 1) – 80 per cent.

Both the controllers recalled that they felt very busy but not overloaded during these periods, and they had not considered asking for assistance. Controller 1 reported that their workload was about nine on a scale out of ten, but they felt they were managing the situation satisfactorily.

Both the controllers reported that frequency transfers were one of the most time critical tasks on the NUL/NLO sectors. Scanning for frequency transfers for ADS-B aircraft was an ongoing activity, and the transfers occurred at a greater rate than potential conflicts.

Following the handover from controller 2 at 1330, controller 1 had four or five different outstanding tasks that required immediate action, including the frequency transfer for VUV and an uncertainty phase (INCERFA) on an aircraft near the north-western airspace boundary due to the pilot not being in radio contact. This required controller 1 to make several radio calls and also liaise with the Shift Manager, who was standing nearby, to work through the phase requirements. Subsequent workload included separation issues to address in the north of the airspace, an aircraft conducting airwork at Ceduna, level change requests, weather deviations, pilots either taking longer than expected to respond or needing a second or third radio call to get a response, and frequency congestion.

Controller 1 reported that their normal process when taking over a sector was to scan and review all of the traffic independently to ensure separation had been established and maintained. However, due to the outstanding tasks from the handover, this initial scan did not occur on this occasion.

Both controllers also advised that they normally rechecked their scan on receipt of position reports and when making frequency changes, but that this process was possibly abbreviated when they were very busy. In this case, controller 1 reported that every time they received a position report or initiated a frequency change another aircraft or controller contacted them and interrupted their normal scanning process.

In terms of general scanning, controller 1 recalled checking for conflicting traffic for VXM in the opposite direction on multiple occasions because the aircraft was on a two-way route. They expected that if there was going to be conflicting traffic it would be from the opposite direction. However, at no stage was the conflict with VUV identified.

Working environment

As NUL/NLO were entry-level sectors, there were often multiple trainee controllers completing their on the job training and consolidating their skills. The experienced controllers providing the training were endorsed on other sectors and were often unable to complete a full training shift with a trainee due to their other duties. As a result, trainee controllers often spent time observing less experienced controllers handling the NUL/NLO sectors.

During the period when controller 1 and controller 2 were handling the NUL/NLO sectors, there was a trainee controller also plugged into the console. The trainee sat behind the rated controller and monitored console communications and activities. Controller 1 recalled that the trainee asked a couple of questions and pointed out some tasks that they suspected controller 1 had overlooked, including a handover to an adjacent sector that the controller had missed due to their attention being focused on another part of the airspace. Both controller 1 and controller 2 reported that the presence of the trainee was a distraction to their train of thought at times.

The trainee controller had unsuccessfully undergone the second day of a rating check earlier that morning. They had subsequently wanted to observe traffic handling on the NUL/NLO console when the sectors were busy. The trainee recalled pointing out aircraft to the other two controllers that required frequency changes that appeared to have been missed. The trainee indicated that they did not have comprehensive situation awareness of all activity on the sector. As with the two endorsed controllers, the trainee did not identify the traffic confliction between VUV and VXM.

Supervision

The Shift Manager role was an endorsed position that was responsible for the overall provision of ATC services. The documented requirements of the position were to provide general supervision of operational staff to ensure a safe and efficient air traffic service and to exercise Operational Command Authority.[8] There was no operational requirement for a Shift Manager to maintain ATC endorsements unless a business need was identified.

Shift Managers provided supervision by minimising distractions, organising combined sectors to be de-combined if controllers were becoming overloaded and assisting with organising rest breaks for the controllers. There was no published procedure for Shift Managers to adhere to with regard to controllers or visitors observing or monitoring consoles, and the managers generally used their discretion when considering circumstances such as traffic levels and controller experience. In this case the trainee recalled monitoring NUL/NLO without advising or obtaining permission from the Shift Manager, although the manager was aware that the trainee was there. The rated controllers advised that on this occasion there was a reluctance to prohibit the trainee from observing as the trainee was in the final stages of their training.

Controllers reported that there was very little ‘over the shoulder’ supervision and that their interaction with the Shift Manager was usually limited to when a controller had to advise them of something or ask for assistance. The manager could then either monitor the traffic over the controller’s shoulder or call another controller to return from their break to plug into the same console and provide assistance. On this occasion, the controllers did not see a need to call for assistance.

Related occurrences

29 July 2011, BLAKA, ATSB investigation AO-2011-090

On 29 July 2011, a loss of separation occurred between two B737 aircraft in the holding pattern at BLAKA, a reporting point south-west of Brisbane, Queensland. The aircraft were inbound to Brisbane on the same air route, with a requirement to hold at BLAKA for sequencing.

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8 The overall responsibility for the provision of an operational service.

The air traffic controller did not identify that the sequence in which the two aircraft entered the holding pattern had changed, and twice assigned one aircraft descent through the flight level of the other aircraft. One of the flight crews identified the confliction and queried the controller, who then took action to recover the compromised separation situation.

The controller had only been endorsed on the Gold Coast (GOL) sector for about 2 weeks, after experience in the tower environment and another en route sector. There were limitations with the controller's training on the GOL sector. Overall, the controller probably had not consolidated effective control techniques for the sector, particularly for high workload situations.

18 January 2012, TANEM, ATSB investigation A0-2012-012

On 18 January 2012, 2125 Eastern Daylight-saving Time, there was a loss of separation (LOS) between an Airbus A320, registered 9V-TAZ, and an Airbus A340, registered A6-EHH, 907 km NW of Karratha, Western Australia. The A320 was southbound at FL 350 and the A340 was heading west and cleared to operate in a block level, between FL 340 and FL 360. Both aircraft were estimated to cross waypoint TANEM within 2 minutes of each other. The relevant separation standards were 1,000 ft vertical separation or 15 minutes lateral separation at the same position. Controller 1, who approved the block level clearance, did not detect the traffic confliction prior to handing over to controller 2. After a short break, controller 2 handed back to controller 1, and the confliction was detected by controller 2 during the handover. Compromised separation recovery techniques were applied to re-establish vertical separation.

The two controllers were experiencing a high workload due to a range of factors, including traffic levels, weather diversions and the airspace configuration. Controller 1 rated the workload that day, and the previous day, as the highest they had ever encountered. Controller 1 had achieved their initial en route endorsement on NUL/NLO in June 2011. They then commenced training on the Indian/Ore/Billabong sectors in the West Procedural Group in October 2011, and achieved an endorsement on those sectors in December 2011. Overall, they had about 7 months operational ATC experience at the time of the occurrence.

Safety analysis

The two 737s were about 6-12 NM (11-22 km) apart at the time they passed overhead Ceduna on different routes at the same flight level. This was less than the minimum required separation of 20 NM (37 km). The two aircraft did not come close enough to trigger an alert on either aircraft's traffic collision avoidance system (TCAS). However, the loss of separation was not detected by air traffic control (ATC) until after the aircraft had passed each other. Overall, the investigation highlighted several issues associated with factors that can lead to such traffic conflictions not being detected or effectively managed.

Controller workload

Workload refers to the interaction between a specific individual and the demands associated with the tasks that they are performing. It varies as a function of the number and complexity of task demands and the capacity of the individual to meet those demands. For the same situation, different individuals will experience different levels of workload depending on their experience, skills and techniques, as well as factors such as fatigue.

High workload can result in an individual's performance on some tasks degrading, tasks being performed with simpler or less comprehensive strategies, or tasks being shed completely. In some cases tasks can be shed efficiently by eliminating lower priority tasks or they can be shed inefficiently by abandoning tasks that should be performed (Wickens and Hollands 2000).

A range of factors can influence an individual's visual scanning performance. These include the salience of the items being searched for, the expectancy of finding relevant items, the value of identifying the items, and the amount of effort involved (Wickens and McCarley 2008). Workload and time pressure lead to a reduction in the number of information sources an individual will access, and the frequency or amount of time these sources are checked (Staal 2004).

In this occurrence, both controller 1 and controller 2 were experiencing high workloads as indicated by the significant proportion of their time they were engaged in communication activity with flight crews or other controllers. Factors contributing to the workload included a large number of aircraft in the airspace, aircraft of different types, varied ATC separation standards, the large airspace size, the number of ATC frequencies, the various ATC system human-machine interface requirements, and the distraction associated with the presence of the trainee controller.

The evidence indicates that the controllers either shed or reduced the depth of their scanning activities due to the high workload. In addition, it appears that given the nature of the large airspace with many ATC frequencies, the task of searching for and initiating frequency transfers for aircraft subject to Automatic Dependant Surveillance-Broadcast (ADS-B) or radar surveillance was perceived as a high priority. The relatively low level of expectancy of traffic conflictions on crossing tracks meant that scanning for such conflicts received less attention when under high workload.

Workload management

As high workload was ultimately the key reason why the two controllers did not detect the traffic confliction involving VXM and VUV, the investigation examined the ways that workload was being monitored and managed.

On a tactical basis, workload was monitored by the controllers themselves and the Shift Manager. In this case the controllers thought they were managing the situation. Workload effects can be subtle, and it is likely that inexperienced controllers may not realise the extent to which their scanning processes are being adversely influenced. It would also be difficult for a Shift Manager to detect a developing problem unless the controller asked for assistance or the adverse effects were quite salient. Shift Managers oversee a significant number of consoles and do not have detailed knowledge of each of the sectors, and do not have the time to monitor specific controllers for a significant period of time.

On a strategic basis, there had been no formal assessment of workload for the Nullarbor (NUL) and Nullarbor Low (NLO) sectors in recent years. There had been traffic modelling studies which looked at the number of aircraft in the sector, but such modelling did not consider all of the factors than can influence workload.

In addition, the nature of the work on the NUL/NLO had been changing with the introduction of ADS-B. ADS-B reduced the need for pilot position reports and therefore reduced some controller workload associated with voice communications. It also reduced some of the controller workload involved in entering updated details for each aircraft into the ATC system. However, these changes also reduced the extent to which controllers were actively processing information about each aircraft on a regular basis, and increased the potential to have less situation awareness. On an en route sector outside of radar coverage, the introduction of ADS-B also led to the need for controllers to more actively search for and initiate frequency transfers. On a sector with a large number of frequencies such as NUL, this resulted in an increased workload.

There were also potential problems associated with having a mixture of procedurally-controlled and ADS-B aircraft, given the associated differences in the way the aircraft are processed and the different separation standards that are applicable. Overseas research has shown that a relatively even mix of the two types of aircraft can lead to an increase in workload and decrease in situation awareness (Forest and Hansman 2006). The hazards associated with a mixed-equipment environment were not identified in the ATC provider's safety case for the introduction of ADS-B. In addition, the provider reported that it had not conducted a formal workload assessment on the effects of introducing ADS-B into an en route, non-radar environment. In addition, the Bight Group had not developed specific techniques and training for managing the difficulties associated with a mixed-equipment environment.

Ideally the best way of managing workload is to reduce the level of work demands and distractions. On a day-by-day basis there were limited options available to reduce workload as the NUL and NLO sectors were not able to be de-combined. The distraction associated with a trainee could be managed, but concerns in this case were not reported to the Shift Manager.

If the work demands cannot be reduced, then another option is to ensure the controllers have the experience, skills and techniques to effectively manage their task demands. In this case, both the controllers were relatively inexperienced and they were still consolidating their skills. Line managers reported that they paid more attention to newly-endorsed controllers to ensure they develop the skills to perform at the required level. However, there appeared to be no formal process of monitoring newly-endorsed controllers and routinely assessing their abilities to manage high workload situations, other than their 6-monthly performance checks. Following the occurrence, both controllers received additional training, which they reported as significantly enhancing their scanning techniques under workload.[9]

Overall, high workload can have significant effects on a controller's performance, and it needs to be monitored and managed using a systemic approach, particularly for less experienced controllers but also controllers who have recently received a new endorsement. For the newly-rated controllers on the NUL/NLO sector, it did not appear that an effective, systemic approach to monitoring and managing workload was being undertaken. The occurrence of other recent loss of separation occurrences involving high workloads and newly-endorsed controllers on other sector indicates that this problem was not restricted to the NUL/NLO sectors.

[9] Controller 1's training was on NUL/NLO, whereas controller 2's training was part of the training for an endorsement on another more complex sector.

Fatigue

The International Civil Aviation Organization (ICAO 2011) defined fatigue as:

> A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety related duties.

Fatigue can have a range of adverse influences on human performance, such as slowed reaction time, decreased work efficiency, reduced motivational drive, increased variability in work performance, and more lapses or errors of omission (Battelle Memorial Institute 1998). In addition, most people generally underestimate their level of fatigue.

It is generally agreed that most people need at least 7–8 hours of sleep each day to achieve maximum levels of alertness and performance. A review of relevant research (Dawson and McCulloch 2005) concluded:

> …we can make broad assumptions from existing literature that obtaining less than 5 h [hours] sleep in the prior 24 h, and 12 h sleep in the prior 48 h would be inconsistent with a safe system of work. Furthermore, wakefulness should not exceed the total amount of sleep obtained in the prior 48 h.

Recent research looking at errors performed by flight crews (Thomas and Ferguson 2010) and road vehicle drivers' involvement in accidents (summarised by Williamson et al. 2011) has provided support for these prior-sleep proposals, or indicated even more sleep would be appropriate.

In the 8 November 2011 incident, controller 1 had obtained 6–7 hours sleep in the previous 24 hours prior to the start of the shift. However, they had only obtained 10–11 hours sleep in the previous 48 hours prior to the start of the shift, and they would have been awake for significantly longer than this period by the end of the shift. In addition, not much of their recent sleep was obtained during the window of circadian low, and some of it was of limited quality. Accordingly, the controller was experiencing an elevated level of fatigue due to the amount and quality of their recent hours of sleep.

The controller was probably also experiencing some cumulative fatigue. The controller's normal roster was to have a cycle of four shifts (as indicated in *Personnel information*) ending at 0630 on the fourth day and then commencing again 3 days later at 1400. However, for seven of the last eight cycles, the controller had completed an additional duty shift during each break. Three of the additional shifts were from 0000–0630 and one was from 0230–0630. On another occasion, the night shift was commenced at 2300 rather than 0000, resulting in 9 hours break between it and the previous shift. The normal shift cycle worked by the controller was challenging, particularly the transition from the morning shift to the night shift with only 10 hours break in between. The frequent adding of additional duties, many of them night shifts, would reduce the ability of a controller to ensure they had sufficient rest and could manage non-work responsibilities.

Overall, it is likely that controller 1 was experiencing fatigue at a level known to have at least a mild to moderate effect on performance. However, there was insufficient evidence to conclude that fatigue contributed to the loss of separation. As already indicated, not detecting the traffic conflict can be explained by high workload, although it is possible that fatigue reduced the controller's ability to manage the workload. In that context, controller 2 did not appear to be experiencing fatigue and also did not detect the confliction.

Fatigue risk management

Assessment of normal rosters

Air traffic control is a 24-hour activity, and consequently there will always be some level of fatigue associated with controllers conducting shift work. Airservices had a fatigue risk management system (FRMS) to ensure that the levels of fatigue were managed to an acceptable level. The FRMS documentation stated that managers were responsible for fatigue management awareness training, rosters that provided sufficient recuperative sleep opportunity between shifts, and work and shift management strategies that moderated fatigue accumulation. Controllers were responsible for managing their lifestyle and recuperative sleep opportunities to enable them to attend scheduled shifts fit for duty, and to disclose when they were impaired due to fatigue.

In terms of roster design, the FRMS included recommended strategies such as rostering only one night shift in any shift cycle, keeping night shifts as short as possible, having a minimum of 2 days off between shift cycles, and having a minimum period of 10 hours between shifts. The strategies also stated that 'use of quick change shifts that do not include an overnight sleep period is not recommended and individual exposure should be minimised'.

The FRMS required that all shift cycles be assessed with a bio-mathematical model known as FAID (Fatigue Audit Interdyne). The model used hours of work as the input and produced a work-related fatigue score based on predicted sleep opportunity (Roach et al. 2004). FAID documentation stated that scores of 40 to 80 were broadly consistent with a safe system of work. The Airservices FRMS documentation stated that peak scores for rosters should not exceed 80, and would preferably be much lower. Controller 1's normal roster, without consideration of additional duties, had a peak FAID score of 70. The style of roster was not atypical for en route controllers.

There have been a number of documented limitations with bio-mathematical models such as FAID that reduce the extent to which they should be relied on as a basis for evaluating rosters (CASA 2010). With regard to FAID in particular, the Independent Transport Safety Regulator (ITSR) of New South Wales (2010) noted that FAID assumes every hour of rest or time away from work has the same recuperative value, regardless of the time of day. Consequently, the model can potentially overestimate the recuperative effects of rest periods during the day for shifts involving night work. ITSR stated that 'a FAID score of less than 80 does not mean that a work schedule is acceptable or that a person is not impaired at a level that could affect safety'. The United States Federal Railroad Administration (FRA) compared FAID with a bio-mathematical model that the FRA had validated, and concluded that FAID scores between 70 and 80 can be associated with 'extreme fatigue' and that a score of 60 provided an appropriate threshold for determining unacceptable accident risk.

Assessment of additional duties

Airservices' FRMS procedures stated that additional duties had to be allocated in a manner that was equitable and avoided unnecessarily high FAID scores. The standards and practices stated that the FAID score needed to be checked in certain situations, such as if the additional duty was a night shift and the adjoining shift cycle also contained a night shift. If the FAID score for an additional duty exceeded 80, then a fatigue risk assessment was required using a fatigue risk assessment calculator (FRAC). The FRAC required obtaining the amount of sleep in the 24 hours prior to the additional duty, 48 hours prior to the duty and hours awake and calculating a fatigue likelihood score. Task risk and availability of fatigue risk controls were then considered before determining the fatigue risk level. The higher the risk level, the higher the management level required to approve the additional duty.

The FRMS standards and practices for allocating additional duty also stated that certain situations should be avoided if possible, including less than 10 hours between shifts, and a night shift without a full recuperative sleep opportunity on the previous night. It also stated that best practice fatigue management included strategies such as not having more than one night shift in any cycle.

A review of the controller's worked shifts over the previous 7 weeks noted at least two occasions when the additional duty resulted in a FAID score above 80, and both were associated with an additional night shift duty at the end of the standard shift cycle, resulting in two night shifts in a row. However, no FRAC was conducted for any of the controller's seven additional duties. In addition, the recommended practices listed above for additional duties were often not followed. In the course of other recent investigations, the ATSB has been made aware of several other cases of controllers conducting a significant number of additional duties, one example being ATSB investigation AO-2012-012.

Line managers reported that they considered factors such as a controller's previous shifts and the number of recent additional duties when assigning a new additional duty. They also noted that there was a relatively high amount of additional duties occurring at around the time of this occurrence due to increasing traffic levels and limitations in the number of appropriately endorsed controllers in some groups.

In summary, controller 1 received a significant number of additional duties on top of a roster cycle that involved elevated risk. The additional duties were not always consistent with Airservices' recommendations and processes. In addition, the defined FRMS process for assessing additional rosters did not fully consider the cumulative effect of multiple additional duties. The defined process also required a relatively high level of fatigue risk before considering important factors such as prior sleep and time awake history. Overall, Airservices' processes for assigning additional duties did not effectively manage the fatigue risk associated with these additional duties.

Detection of and recovery from the traffic confliction

Detection of conflict

In this occurrence, the traffic confliction was not detected by either of the controllers on duty in the period leading up to the loss of separation, or a trainee controller who was observing the NUL/NLO sectors. In addition, the Short Term Conflict Alert (STCA) that is available when both aircraft are subject to radar or ADS-B surveillance was not available as one of the aircraft was procedurally controlled. Overall, the only automated detection system that was functioning effectively was the TCAS in the two aircraft.

Safety management principles recognise that individuals can make errors and may not detect and correct those errors without assistance. High reliability systems such as for air traffic control rely on having multiple risk controls in place to reduce the likelihood of individual errors, and to detect and recover from such errors.

The STCA has been in place within TAAATS for aircraft subject to radar and ADS-B surveillance for many years. As all aircraft in Australia operating above FL 290, excluding those categorised as State aircraft[10], are required to have ADS-B equipment installed by December 2013, there will be a significant increase in the amount of traffic that will have an ATS-based automatic conflict detection system available.

However, there will still be areas where aircraft will be procedurally controlled outside of the range of radar and ADS-B surveillance, and for some aircraft operating below FL 290. The ATSB is also concerned that there have been increasing traffic levels and complexity in some sectors in recent years without a concomitant increase in controller resources, combined with a decrease in the experience levels of controllers. Although Airservices has also been in the process of developing and trialling a flight plan conflict function for procedurally-controlled aircraft for several years, the fact that it is still not operational is a safety issue. [11]

Compromised separation recovery

Controller 1 did detect the loss of separation shortly after it had occurred, and probably shortly after the aircraft had passed each other. However, at that stage there was some uncertainty regarding the position of VXM as it was under procedural control. That is, its position was not as accurate as that displayed for VUV based on ADS-B data. Accordingly, it would still have been

[10] An aircraft or any part of the Defence Force (including any aircraft that is commanded by a member of that force in the course of his/her duties as such a member), other than any aircraft that by virtue of registration under the regulations is an Australian aircraft; and aircraft used in the military, Customs, or police services of a country other than Australia.

[11] Airservices previously advised the ATSB that a flight plan conflict function was scheduled to be operational in late 2006 (see ATSB investigation report 200404707).

appropriate for the controller to initiate compromised separation[12] recovery actions, but such actions did not occur.

At the time of the occurrence, MATS required controllers to issue safety alerts to pilots of aircraft as a priority when they became aware that aircraft were in a situation considered to be in unsafe proximity to other aircraft. The following phraseology was an example of the words to be used:

> (Callsign) TRAFFIC ALERT (position of traffic if time permits) TURN LEFT/RIGHT (specific heading, if appropriate), and/or CLIMB/DESCEND (specific altitude if appropriate) IMMEDIATELY.

The controller had completed compromised separation recovery training, with limited exercises during their initial and final field training periods. They reported that those training sessions did not contain the element of surprise that occurred with a real compromised separation event, as during the training they had been prepared to deal with a staged or simulated confliction.

In this instance, it is likely that the controller did not use any compromised separation recovery techniques due to a combination of their surprise associated with identifying the unexpected loss of separation, their limited operational experience, the undetermined actual proximity of the aircraft and the absence of reports from the flight crews that the aircraft were within proximity. In addition, procedural separation standards, which are more conservative than standards applied in a surveillance environment, were applicable and this may have reduced the controller's level of concern. In consideration that the controller was not aware of the actual proximity of the aircraft at the time that they identified the confliction, it would still have been appropriate for them to have issued a traffic alert to the flight crews, relative to the procedural separation standard having been infringed, and an immediate climb or descent instruction for one of the aircraft to establish vertical separation.

12 Separation is considered to be compromised when there is a loss of separation, or where separation assurance is lacking to the extent that a loss of separation is imminent.

Findings

From the evidence available, the following findings are made with respect to the loss of separation between a Boeing Company 737-8FE, registered VH-VUV, and a Boeing Company 737-838, registered VH-VXM, on 8 November 2011 near Ceduna, South Australia. They should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The traffic confliction between the two aircraft existed for over 60 minutes but was not identified by either of the controllers on duty on the relevant sector during this period.
- Both controllers were experiencing a high workload due to a range of factors, including the number of tasks and their limited experience.
- **The air traffic services provider's processes for monitoring and managing controller workloads did not ensure that newly-endorsed controllers had sufficient skills and techniques to manage the high workload situations to which they were exposed. *[Safety issue]***

Other factors that increased risk

- The controller on duty at the time of the loss of separation was probably experiencing fatigue at a level likely to have at least a mild to moderate effect on performance.
- **The air traffic services provider's fatigue risk management system (FRMS) did not effectively manage the fatigue risk associated with allocating additional duty periods. *[Safety issue]***
- The controller on duty at the time of the loss of separation did not manage the compromised separation recovery situation effectively.
- **Although the air traffic services provider has been working on the issue for several years, there was still no automated air traffic conflict detection system available for conflictions involving aircraft that were not subject to radar or ADS-B surveillance services. *[Safety issue]***

Other findings

- Based on a groundspeed of about 6 NM (11 km) per minute for the Boeing 737 aircraft, it is likely that there was between 6 NM and 12 NM (22 km) longitudinal separation between the aircraft when VH-VUV passed overhead Ceduna.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

Controller workload monitoring and management

Number:	**AO-2011-144-SI-01**
Issue owner:	Airservices Australia
Type of operation:	Air Traffic Services
Who it affects:	All relatively inexperienced controllers

Safety issue description:

The air traffic controller provider's processes for monitoring and managing controller workloads did not ensure that newly-endorsed controllers had sufficient skills and techniques to manage the high workload situations to which they were exposed.

Response to safety issue and proactive safety action taken by Airservices Australia

The ATSB was advised that:

> *Airservices does not support the finding indicating that our processes do not ensure that newly endorsed controllers had sufficient skills and techniques to manage the high workload situations. Airservices training and checking processes, which are also subject to ongoing regulatory oversight, ensure that controllers are appropriately trained and assessed to be competent to perform roles in their licensed environment with varying traffic volume, complexity and workload levels.*
>
> *To further enable equitable workload management, the Nullarbor (NUL) and Nullarbor Low (NLO) Sectors were re-sectorised into three (3) Sectors (WBRIFRT/ESP) in November 2012. In addition, Airservices has also established an ATC Workload and Complexity Reference Group to determine a suitable workload model to be used by ATC Shift Managers to monitor and forecast ATC workload on a sector by sector basis. This is aimed at further managing and mitigating workload-related risks.*

In response to this safety issue also being identified in ATSB investigation report AO-2012-012, Airservices reported additional safety action related to the airspace sectors involved in that occurrence.

Current status of the safety issue:

Issue status: Adequately addressed

Justification: Although Airservices disagreed with the identified safety issue, the ATSB is satisfied that the actions taken by Airservices since the incident have satisfactorily addresses the concerns that gave rise to the identification of this safety issue.

Allocation of additional duty periods

Number:	**AO-2011-144-SI-02**
Issue owner:	Airservices Australia
Type of operation:	Air Traffic Services
Who it affects:	All controllers

Safety issue description:

The air traffic services provider's fatigue risk management system (FRMS) did not effectively manage the fatigue risk associated with allocating additional duty periods.

Response to safety issue and proactive safety action taken by Airservices Australia

Airservices advised that:

> *the details in the report regarding fatigue risk management were in relation to the previous Fatigue Risk Management System (FRMS) which has been superseded by an updated system (referred to as FRMS 2) implemented from 30 July 2012. Airservices previously briefed ATSB on the key features of FRMS 2 and further information is included in Attachment 2.*
>
> *The FRMS 2 has addressed the system limitations mentioned in the report, such as replacement of fatigue risk assessment calculator (FRAC) with an enhanced Fatigue Assessment and Control (FACT) tool and providing roster design criteria in addition to the Fatigue Audit Interdyne (FAID). The implementation of FRMS 2 has resulted in improved work scheduling capabilities through a new rostering tool to limit cumulative fatigue and further mitigate fatigue-related risk.*

In addition:

> *The FACT decision support tool embedded within the rostering tool assists managers and supervisors with effectively managing changes to work schedules to:*
>
> • *identify the most suitable individual for an Additional Duty/Extended Duty (AD/ED) or*
>
> *Change of Shift (COS)*
>
> • *assess situational factors that may affect potential fatigue-related risk, such as traffic complexity, weather, traffic volume*
>
> • *identify risk controls to be implemented to mitigate any potential fatigue related risk*
>
> • *record information about proposed changes to the published roster.*
>
> *The FRMS 2 is closely aligned with relevant International Civil Aviation Organisation (ICAO) FRMS Standards and Recommended Practices (SARPs) and embraces three system risk controls of work scheduling, education and assurance.*

Current status of the safety issue:

Issue status: Adequately addressed

Justification: The ATSB is satisfied that adherence to the policies and procedures detailed in FRMS 2 should reduce the likelihood of controllers being allocated excessive additional duty periods.

Procedural air traffic control conflict detection system

Number:	**AO-2011-144-SI-03**
Issue owner:	Airservices Australia
Type of operation:	Air Traffic Services
Who it affects:	All en route flights under procedural control

Safety issue description:

Although the air traffic services provider has been working on the issue for several years, there was still no automated air traffic conflict detection system available for conflictions involving aircraft that were not subject to radar or ADS-B surveillance services.

Response to safety issue proactive safety action taken by Airservices Australia

Airservices Australia (Airservices) advised that the first stage of a flight plan conflict function, called Flight Plan Safety Net Alert (FPSNA) had been deployed in Brisbane Upper Airspace, with further rollout planned in Melbourne for 2014. The FPSNA was an advisory safety net alerting tool for aircraft not subject to radar of Automatic Dependant Surveillance-Broadcast (ADS-B) surveillance services. Airservices advised that 'however controllers are still responsible for performing the tasks in relation to conflict detection and resolution and assuring aircraft separation without FPSNA'. In addition, it was advised that:

> *Current procedural ATC operations are not considered limited or deficient. The rollout of the tool will support the controller in the conduct of their duties, but it is not required for the safety of air traffic operations.*

Current status of the safety issue:

Issue status: Adequately addressed

Justification: The ATSB is satisfied that this safety action will, when fully implemented, satisfactorily address the safety issue.

General details

Occurrence details

Date and time:	8 November 2011 – 2245 EST
Occurrence category:	Serious incident
Primary occurrence type:	Aircraft separation
Type of operation:	Air traffic services
Location:	Near Ceduna Airport, South Australia

Aircraft 1 details

Manufacturer and model:	Boeing 737-8FE
Registration:	VH-VUV
Serial number:	37821
Type of operation:	Air transport high capacity
Damage:	None

Aircraft 2 details

Manufacturer and model:	Boeing 737-838
Registration:	VH-VXM
Serial number:	33483
Type of operation:	Air transport high capacity
Damage:	None

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Air traffic controllers
- the operators of VH-VUV and VH-VXM
- Airservices Australia (Airservices)
- the Civil Aviation Safety Authority (CASA)
- the Manual of Air Traffic Services
- the Australian Aeronautical Information Publication
- an independent fatigue specialist.

References

Battelle Memorial Institute 1998, *An Overview of the scientific literature concerning fatigue, sleep, and the circadian cycle*, Report prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors, US Federal Aviation Administration.

Civil Aviation Safety Authority 2010, *Biomathematical modelling in civil aviation fatigue risk management: Application guidance*. Available from www.casa.gov.au.

Dawson, D & McCulloch, K 2005, 'Managing fatigue: It's about sleep', *Sleep Medicine Reviews*, vol. 9, pp. 365-380.

Federal Railroad Administration 2010, *Procedures for Validation and Calibration of Human Fatigue Models: The Fatigue Audit InterDyne Tool*, DOT/FRA/ORD-10/14.

Forest, L & Hansman, RJ 2006, 'The future oceanic ATC environment: Analysis of mixed communication, navigation and surveillance equipage', *Air Traffic Control Quarterly*, vol. 14, pp. 117-138.

International Civil Aviation Organization 2011, *Fatigue risk management systems (FRMS): Implementation guide for operators*, 1st edition.

Independent Transport Safety Regulator 2010, *Transport Safety Alert 34 - Use of bio-mathematical models in managing risks of human fatigue in the workplace*. Available from www.transportregulator.nsw.gov.au.

Thomas, MJW & Ferguson, SA 2010, 'Prior sleep, prior wake, and crew performance during normal flight operations', *Aviation, Space, and Environmental Medicine*, vol. 81, pp. 665-670.

Staal, M. A. 2004, *Stress, cognition, and human performance: A literature review and conceptual framework,* NASA/TM – 2004-212824.

Wickens, CD & Hollands, JG 2000, *Engineering psychology and human performance*, 3rd edition, Prentice-Hall International, Upper Saddle River, NJ.

Wickens, CD & McCarley, JS 2008, *Applied attention theory*, CRC Press, Boca Raton, FL.

Williamson, A, Lombardi, DA Folkard, S Stutts, J Courtney, TK & Connor, JL 2011, 'The link between fatigue and safety', *Accident Analysis and Prevention*, vol. 43, pp. 498-515.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the air traffic controllers, aircraft operators, Airservices and CASA.

Submissions were received from Airservices and CASA. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation

Loss of separation involving Boeing 737, VH-VUV and Boeing 737, VH-VXM near Ceduna, South Australia
8 November 2011

AO-2011-144
Final – 18 October 2013