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Australian Transport Safety Bureau

RESEARCH REPORT

National Airspace System Stage 2b: Analysis of Available Data

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National Airspace System Stage 2b: Analysis of Available Data

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Abstract
This report examines what, if any, trends may be emerging as a result of the introduction of NAS stage 2b from 27 November 2003. Four indicators – airprox, breakdown of separation (BOS), resolution advisories (RA) and violation of controlled airspace (VCA) – were analysed to assess any net effects resulting from NAS 2b changes.

There was no significant change in the rate of airproxes per aircraft movement in the 180-day period after NAS 2b was introduced relative to the 180-day period immediately before. There was also no significant change in airproxes involving RPT aircraft. There was a reduction in the rate of BOS incidents per aircraft movement in the post-NAS 2b period compared with the period immediately before, but this was not statistically significant. Analysis of RA incidents indicated no statistically significant change in the rate per movement reported after NAS 2b was introduced compared with the period immediately before. A statistically significant increase in VCA reports recorded since the implementation of NAS 2b may be due to an increase in sensitivity of air traffic control (ATC) to VCAs and a failure of pilots to fully understand their responsibilities under the new system.

Overall, the report concludes that data currently available do not enable reliable conclusions to be drawn about NAS 2b safety trends. Therefore, the results in this report cannot be used to confidently assert that safety has either improved or deteriorated as a result of NAS 2b changes.

Keywords
National Airspace System, NAS, ATSB, aviation, data, safety

Notes
(1) ATSB reports are disseminated in the interest of information exchange.

(2) The views expressed are those of the ATSB and do not necessarily represent those of the Australian Government.

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EXECUTIVE SUMMARY

On 21 April 2004 the Australian Transport Safety Bureau (ATSB) released a preliminary report that was intended to examine what, if any, trends may be emerging as a result of the introduction of NAS stage 2b from 27 November 2003. The analysis was complicated by the change in mandatory occurrence reporting requirements to the ATSB from 1 July 2003 as a result of the new *Transport Safety Investigation Regulations 2003*.

Further, due to the NAS 2b changes, there was no longer an Instrument Flight Rules (IFR) separation standard with Visual Flight Rules (VFR) aircraft in new Class E (previously Class C) airspace. This meant that no equivalent to former 'breakdown of separation' occurrences were recorded in that airspace unless there was an 'airprox'. This report incorporates a number of comments received by the ATSB on the preliminary report and additional data analysis.

In the 180-day period to 25 May 2004, the ATSB had classified 38 incidents as NAS 2b-related out of a (fairly typical) total of 2,458 aviation occurrences. The overwhelming majority of these incidents (34 out of 38) were of relatively minor safety significance.

Four indicators – airprox, breakdown of separation, resolution advisories and violation of controlled airspace – were analysed to assess any net effect Australia-wide resulting from the NAS 2b changes. These indicators provide a measure of the risk of mid-air collisions. Data were examined for the 180 days after the introduction of NAS 2b compared with the same period a year earlier. Data were also compared with the 180-day period immediately before NAS 2b implementation (30 May 2003 to 26 November 2003). A summary of these comparisons are presented in Table 1.

Table 1
Airprox, breakdown of separation, resolution advisory and violation of controlled airspace occurrences

	27 Nov. 2003 to 25 May 2004	*30 May 2003 to 26 Nov. 2003*	*27 Nov. 2002 to 26 May 2003*
Aircraft movements	1,332,492	1,396,578	1,444,484
Airprox			
Occurrences	40	39	13
Rate per 100,000 movements	3.0	2.8	0.9
Breakdown of separation			
Occurrences	30	43	31
Rate per 100,000 movements	2.3	3.1	2.1
Resolution advisory			
Occurrences	45	57	48
Rate per 100,000 movements	3.4	4.1	3.3
Violation of controlled airspace			
Occurrences	626	477	447
Rate per 100,000 movements	47.0	34.2	30.9

There were 40 airprox incidents in the 180 days after NAS 2b compared with 39 in the 180 days before its introduction and 13 during the same period a year before.

There were 30 breakdown of separation (BOS) incidents in the 180 days after NAS 2b compared with 43 in the 180 days before its introduction and 31 during the same period a year before.

While the analysis revealed a significant increase in the rate of airprox incidents per aircraft movement compared with the same period a year before, caution should be used in drawing conclusions from these numbers. The post-NAS 2b data are likely to have been affected by the introduction of the new investigation regulations from 1 July 2003, which specifically required the reporting of airprox incidents, and to a lesser extent, the increased use of transponders by general aviation aircraft. Only four of the airprox occurrences which occurred in the post-NAS 2b period were identified by the ATSB as being NAS 2b-related. There was no significant change in the rate of airprox incidents in the period after NAS 2b was introduced compared with the period immediately before. There was a reduction in the rate of BOS incidents per aircraft movement in the post-NAS 2b period compared with the period immediately before its implementation, but this was not statistically significant.

There has been no change in the requirements to report TCAS resolution advisory (RA) incidents to the ATSB, so the data for these events are consistent across time. There were 45 RA incidents in the period after NAS 2b compared with 57 RA incidents in the 180-day period before the introduction of NAS 2b and 48 RA incidents in the 180-day period a year earlier. Preliminary analysis of the detail of the reports to the ATSB showed that only one of the RAs in the pre-NAS 2b period (a breakdown of separation in Class C airspace) was a significant safety concern. In the post-NAS 2b period there was one serious airprox incident involving a RA – an airprox occurrence at Launceston on 24 December 2003. Analysis of RA incidents indicated no statistically significant change in the rate per movement reported after NAS 2b compared with the period immediately before.

There were 34 RA activations that involved jet aircraft in the 180-day period after the introduction of NAS 2b, two of which involved a BOS or an airprox incident. This compares with 38 in the 180 days before the introduction of NAS 2b (one involving a BOS or an airprox event) and 33 RA activations involving jet aircraft (one involving a BOS or an airprox event) in the comparable period one year before the introduction of NAS 2b. Again, the analysis indicated no statistically significant change in the rate of reported RA incidents for jet aircraft per aircraft movement between the pre- and post-NAS 2b comparison periods.

Data from Airservices Australia showed that there has been a statistically significant increase in the rate of violation of controlled airspace (VCA) incidents per aircraft movement since the implementation of NAS 2b. There were 626 reported VCAs in the 180-days after the implementation of NAS 2b, compared with 477 in the 180-days before the introduction of NAS 2b, and 447 in the corresponding period a year before the introduction of NAS 2b. Airservices Australia suggested that the increase may be due to an increase in sensitivity of air traffic control (ATC) to VCAs and a failure of pilots to fully understand their responsibilities under the new system. However, not enough detailed information is available to quantify how much of this increase is due to a reporting issue and how much is due to an actual increase in VCAs.

Neither the ATSB's nor Airservices' data analysed in this report provide a reliable comparison of risk between pre- and post-NAS 2b airspace due to the relatively small number of occurrences and their volatility. This was further complicated by the changes in

reporting regulations and possible changes in reporting rates. The available data do not provide consistent results or reliable conclusions about NAS 2b safety trends. Therefore, the results in this report cannot be used to confidently assert that safety has either improved or deteriorated as a result of NAS 2b changes.

1 INTRODUCTION

The Australian Transport Safety Bureau (ATSB) is an operationally independent body within the Australian Government Department of Transport and Regional Services. In civil aviation, the ATSB collects accident and incident data and investigates and undertakes data analysis in accordance with International Civil Aviation Organization (ICAO) standards and recommended practices through the *Transport Safety Investigation Act 2003*, under which the ATSB's independence is ensured[1]. This report reviews ATSB investigation and database data on occurrences, as well as additional event data from Airservices Australia.

A preliminary version of this report was released on the ATSB's web site on 21 April 2004 and contained an analysis of resolution advisories for the 140 days after the implementation of the National Airspace System (NAS) stage 2b. This report incorporates a number of comments received and extends the analysis by including data on incidents involving TCAS resolution advisories, breakdown of separation occurrences, airprox occurrences and a discussion of data provided by Airservices Australia on violation of controlled airspace events. The report compares occurrences for the 180 days after the implementation of NAS 2b with the 180-day period before its introduction and with the same period in the previous year.

The ATSB has a mandate to investigate accidents and incidents and analyse data, in order to learn safety lessons and help prevent future accidents. Around 5,000 aviation accidents and incidents are reported and entered into the ATSB's OASIS database. The ATSB was resourced to investigate 60 new occurrences in 2003-04 based on guidelines published on the ATSB website (see Appendix) which emphasise ICAO requirements, the seriousness of the occurrence and its likely future safety significance. Additional Federal Budget funding will enable the ATSB to conduct up to 100 new aviation safety investigations per year from 1 July 2004.

Australia has an excellent aviation safety record[2] that is comparable with the record of other developed countries in North America and Europe. Perceptions of Australia's aviation safety are also very positive[3].

[1] See in particular, Section 15 of the *Transport Safety Investigation Act 2003*.

[2] See the ATSB's report Aviation Safety Indicators 2002: A report on safety indicators relating to Australian aviation, Canberra: ATSB, November 2003. The report indicates that the high capacity RPT sector fatality rate remains the lowest in the world (no fatal accidents since 1968); the low capacity RPT sector fatality rate is comparable with the lowest international rates and has exhibited no trend in the past decade; the general aviation sector fatality rate is also comparable with the world's lowest and has been decreasing in the past decade.

[3] In addition to the 'Rain Man' effect relating to no hull losses or fatalities involving commercial jet aircraft in Australia, a survey by CASA conducted in May 2002 indicated that *"the majority of people are confident about the safety of air travel in Australia and over 80 per cent think it is as safe or safer than flying in countries such as the United States or Canada."* (CASA Annual Report 2002-03, p 16).

1.1 NAS 2b airspace changes

The introduction of NAS stage 2b on 27 November 2003 involved a number of changes to Australian airspace. These changes included:

- some frequencies and all frequency boundaries being removed from aviation charts;
- the expansion of Class A airspace to replace some Class C airspace;
- the establishment of Class E airspace to replace significant portions of Class C airspace;
- the establishment of Class E airspace to replace significant portions of Class G airspace; and
- the introduction of requirements for mandatory general aviation transponder carriage and use.

Some changes involved improved safety defences (e.g. carriage of transponders, extension of Class A airspace), while others (e.g. extension of Class E in lieu of Class C airspace) involved a reduction in the available defences. There has been debate about the net effect associated with stage 2b of NAS implementation.

During the implementation of significant airspace change, it could be expected that there may be more occurrences than normal, as pilots and air traffic controllers become familiar with the new system. In particular, the lack of separation standards for instrument flight rules (IFR) aircraft (e.g. high flying passenger aircraft but also including some other aircraft) from visual flight rules (VFR) aircraft (e.g. some lower flying general aviation aircraft) during climb and descent in new Class E airspace that was previously Class C airspace could potentially lead to an increase in resolution advisory incidents and airprox events.

2 METHOD

Air accidents are relatively rare events. Their frequency is determined by an interaction between risk and exposure. For this reason, changes in risk within the aviation system should be analysed using measures other than the rate of accidents. This analysis attempts to measure risk by assessing whether there has been any change in incidents where the last level of defence before an accident was reached. Four indicators – airprox incidents, breakdown of separation incidents, resolution advisory incidents, and violation of controlled airspace incidents – were examined for comparable time periods before and after the introduction of NAS 2b. These indicators provide a measure of the risk of mid-air collisions.

2.1 Data sources and data classification

Data from the ATSB's Occurrences Analysis and Safety Investigation System (OASIS) database and from Airservices Australia were examined for the 180 days after the introduction of NAS 2b. These data were compared with data for the 180-day period immediately before NAS 2b implementation (30 May 2003 to 26 November 2003) and with data for the corresponding period a year earlier.

The ATSB has worked with Airservices Australia to seek agreement where possible on disputed classification, particularly in regard to airprox events and breakdown of separation occurrences. It should be noted that the OASIS database contains details on incidents occurring outside controlled airspace that are not available to Airservices Australia. In addition, some events reported to the ATSB by Airservices Australia are not categorised by the ATSB as occurrences. Hence figures reported in this paper may not be consistent with figures reported by Airservices Australia.

Aircraft movement data were obtained from Airservices Australia and used as a measure of traffic during the three periods analysed. Movements were defined as all landings and circuits (excluding military aircraft) multiplied by two. The movement data are collected for airports where Airservices Australia conducts air traffic services during hours of tower operation. Underlying the analysis was the assumption that the movement data are representative of all aircraft traffic and that there were no significant changes to the composition of traffic represented by the movement data.

2.2 Data collection issues

The introduction of the *Transport Safety Investigation Act 2003* and associated regulations changed the definitions of reportable occurrences from 1 July 2003. The new Act changed the requirement to report accidents, serious incidents and incidents to 'immediately reportable matters' and 'routinely reportable matters', the definitions of which are different for air transport operations (regular public transport (RPT) and charter) and other non fare-paying (general aviation) passenger aircraft operations. An aim of the new regulations was to avoid an excessive reporting burden on the general aviation sector with regard to minor occurrences, while requiring detailed reporting in relation to fare-paying passenger transport aircraft. The net impact of these changes was a small decrease in the total number of occurrences recorded (but some categories may have increased).

Additional measures of exposure such as flying hours were not used in this report because it is not possible to obtain these data for the time periods analysed. Data on flying hours are

not collected on a daily basis and as such could not be compiled for time periods that split individual calendar months.

The year 2004 is a leap year. As a result, the time period reported for the post-NAS 2b period ends on 25 May 2004, compared with the time period one year earlier that ended on 26 May 2003.

2.3 NAS 2b-related occurrences

The ATSB routinely collates the details of occurrences determined by the ATSB as being related to the implementation of NAS 2b. An occurrence is considered as a 'NAS 2b-related occurrence' when the probability of the occurrence was measurably affected by the implementation of NAS 2b.

2.4 Airprox and breakdown of separations

An airprox is defined as: '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 are not subject to an air traffic separation standard, or where separation is a pilot responsibility.' Given that the provision of air traffic control separation is dependent on airspace classification and category of flight (VFR or IFR), it is possible for an airprox to occur in all classes of airspace used in Australia except Class A airspace where VFR flight is not permitted. Specifically, in the airspace classifications used in Australia, an airprox could occur as follows:

- In Class C airspace:
  - between two VFR flights

- In Class D and E airspace:
  - between two VFR flights, or
  - between an IFR and VFR flight

- In Class G airspace:
  - between all flights

Where airspace classification and aircraft flight category requires the provision of an air traffic control separation service, any failure of the air traffic control system to apply and maintain defined separation criteria or 'standards' is termed a 'breakdown of separation' (BOS). Essentially, a BOS will involve events between IFR aircraft in Class A, C, D and E airspace and between IFR and VFR aircraft in Class C airspace.

The ATSB's definition of a BOS, as found in regulation 2.3 of the *Transport Safety Investigation Regulations 2003*, is 'a failure to maintain a recognised separation standard (vertical, lateral or longitudinal) between aircraft that are being provided with an air traffic separation service.'

Airprox and BOS data are also presented by category of risk. The ATSB assigns a category of risk of collision to each airprox and BOS occurrence. Where a pilot was required to take evasive action to avoid a collision, the category of risk is classified as 'critical'. Where a BOS or airprox has occurred, but there was no collision risk, it is classified as 'potential'. A third category, 'none', can also be assigned to some occurrence types.

Caution needs to be exercised in drawing conclusions regarding levels of risk based on rates of airprox and BOS events. Consideration of such rates without considering the circumstances under which they occur, does not give a consistent or reliable indication of the absolute level of risk of a midair collision. However, it will give a useful indication of the rate at which an effective defence fails, which in itself is a useful indication of the level of risk.

All BOS and airprox incidents that occurred in the 180 days after the implementation of NAS stage 2b on 27 November 2003 were compared with data for the corresponding period a year before and the 180-day period immediately prior to the implementation of NAS 2b. Rates of airprox and BOS were calculated using aircraft movement data and compared across the three periods. The airprox and BOS data were further broken down to highlight those occurrences involving regular public transport (RPT) aircraft.

2.5 Resolution advisories

Larger aircraft that operate in civilian airspace carry equipment called a Traffic Alert and Collision Avoidance System (TCAS). This equipment provides a visual display and two levels of alert to flight crews regarding the risk of a mid-air collision.

The lower level of alert is an information warning, called a traffic advisory (TA). A TCAS TA is an indication provided to the pilot showing the approximate relative positions of transponding aircraft which may become a threat. It is not mandatory to report TAs for any operation type. A review of the ATSB database revealed limited data on TA events. A detailed analysis of those data would be of no significant value because the TA reporting was normally incidental to some other more significant reason for submitting the report. Moreover, the result of such an analysis would be of limited value given the limited and incomplete dataset available. For this reason, an analysis of TAs has not been included in this report.

The higher level of alert, called a resolution advisory (RA), is a maneuvering instruction to reduce the risk of a midair collision (e.g. descend or climb away from target aircraft). The ATSB considers that a RA is an indication of a potential safety deficiency, and the *Transport Safety Investigation Regulations 2003* (and predecessor legislation) require the reporting of all resolution advisories to the ATSB. A high proportion of RAs are not serious or indicative of a major safety problem – for example, in the vicinity of an aerodrome, aircraft may sometimes come within RA parameter alert range while being appropriately separated by air traffic control. Similarly, high rates of closure between aircraft which nonetheless are complying with a separation standard can result in a RA alert. Such events are described in this report as routine operational alerts. False alarms are also identified. These indicate where a RA was activated with no other traffic in the near vicinity.

The algorithms that control a TCAS response are designed to quantify risk, and to provide an appropriate response to mitigate that risk irrespective of airspace separation rules. The designed purpose of a TCAS RA is to be a 'last defence' if all the other defences to prevent

a collision have failed. Because of the sensitivity and nature of the algorithms that govern the initiation of a TCAS resolution advisory, a RA may activate while other defences are still working adequately.

It is most appropriate to consider TCAS RAs as an indication of the risk of a midair collision where the RA has actually been a 'last defence', when other defences have either failed, or could be considered unreliable. In this analysis, those instances where the RA was the 'last defence' in uncontrolled airspace and where aircraft were at risk of a potential collision were it not for the RA were classified as an 'airprox' or BOS occurrence.

All TCAS RAs during the 180 days after the implementation of NAS stage 2b reported to the ATSB were compared with similar data for the 180-day period immediately prior to the implementation date, and with the corresponding period a year before. A further analysis of TCAS RA data was performed for jet aircraft and propeller aircraft to ascertain whether there had been any change in occurrences among these specific aircraft groups. Rates of TCAS RAs were calculated using aircraft movement data and compared across the three periods.

2.6 Violation of controlled airspace

Violation of controlled airspace (VCA) incidents are defined as the: 'unauthorised entry of an aircraft into airspace for which clearance is required, or to which entry is prohibited.' Any VCA in controlled airspace has the potential to result in an airprox or BOS event. Consequently, any increase in VCAs has the potential to increase the number of airprox and BOS events and, in turn, create an increase in risk to the aviation system.

Airservices Australia provided the ATSB with data, analysis and commentary relating to VCAs occurring in controlled airspace in the 180 days after the implementation of NAS 2b compared with the corresponding periods before its implementation and one year earlier. Rates of VCAs were calculated using aircraft movement data and compared across the three periods.

3 RESULTS

3.1 NAS 2b-related occurrences

Table 2 below summarises the NAS 2b related occurrences for the period 27 November 2003 to 25 May 2004 as classified by the ATSB. There were 38 NAS 2b related occurrences reported to, and classified by, the ATSB out of a total of 2,458 aviation occurrences in this period (1.5 per cent of occurrences). Almost all of them (34 out of 38) were assessed as being of minor safety significance.

Table 2
ATSB assessed NAS 2b-related occurrences between 27 November 2003 and 25 May 2004

Date	*Callsigns*	*Description*
27 Nov	VH-REI	VFR aircraft overflew Tamworth in Class E airspace without transponder mode C operating and on an inappropriate frequency. (Category 5)
28 Nov	VH-OKK	VFR aircraft operated in Class E airspace about 37 NM from Tamworth without a transponder due to unserviceable mode C. (Category 5)
28 Nov	VH-LBE	VFR aircraft operated in Class E airspace without turning on transponder after departing from Tamworth. (Category 5)
29 Nov	VH-ZMD	Aircraft conducted parachuting ops in Class E airspace without broadcasting on the appropriate frequency at Toogoolawa. (Category 5)
29 Nov	VH-TSP	VFR aircraft operating at an IFR level in Class E airspace near Tamworth. (Category 5)
1 Dec	Unknown	VFR powered glider operated in Class E airspace without transponder near Tamworth. (Category 5)
2 Dec	VH-ASN	Violation of controlled airspace – aircraft was climbed into Class E airspace without clearance (pilot using old charts) overhead Kununurra. (Category 5)
3 Dec	VH-AAI/VOP	TCAS RA non-serious airprox event near CANTY involving 737. (Category 4)
8 Dec	VH-DIL	Violation of controlled airspace – IFR aircraft departing Gove climbed into Class E airspace without a clearance. (Category 5)
8 Dec	VH-FIC	VFR aircraft operated in Class E airspace between Tamworth and Armidale without serviceable transponder mode C. (Category 5)
9 Dec	VH-BWE	VFR aircraft operating in Class E airspace at an IFR level 60 NM southwest of Cairns. (Category 5)
14 Dec	VH-EHG	Carrying out parachuting operations, pilot did not give required ‘2 minutes to drop’ call to ATC, resulting in ATC being unable to provide traffic information prior to the drop near Ayr aerodrome. (Category 5)

14 Dec	Unknown	VFR operated in Class E airspace without a serviceable mode C transponder while conducting parachute operations near Rockhampton. (Category 5)
21 Dec	VH-LMD	The aircraft at 9,500 ft transited Class E airspace without a serviceable transponder north of Brisbane. (Category 5)
22 Dec	VH-VOJ/KZH	An IFR RPT aircraft was diverted around a VFR aircraft that showed on the radar as penetrating Class C airspace near the edge of Class E airspace at FL145. The VFR aircraft was later identified abeam Walgett and when asked to squawk ident the Mode C transponder level readout instantly changed from FL145 to 7500 feet. This was verified with the pilot and the pilot advised ATC that the highest level he had flown during the flight was 7500 feet after the 737 had initiated an evasive manoeuvre. (Category 5)
24 Dec	VH-VBV/TBA	Serious incident airprox 19 km north of Launceston – a 737 crew received TCAS RA on a VFR aircraft at 7,500 ft in Class E airspace. TCAS indicated the VFR aircraft passed slightly to the left of and 200 ft below the 737. (Category 3)
4 Jan	VH-TFU	Violation of controlled airspace – IFR aircraft departed Bamaga and climbed into Class E airspace about 100 NM south-east of Bamaga without a clearance. (Category 5)
10 Jan	VH-CHY	Aircraft conducted parachuting operations in Class E airspace without broadcasting on the appropriate frequency near Maroochydore. (Category 5)
13 Jan	VH-OYE	Violation of controlled airspace – IFR aircraft departed Maningrida for Darwin and climbed into Class E airspace without a clearance. (Category 5)
15 Jan	VH-IMD/CKZ	Failure of TCAS to detect known VFR traffic in Class E airspace near Launceston, indicating a transponder problem with the VFR traffic, despite normal equipment indications to the VFR pilot. (Category 5)
18 Jan	VH-TJB	Violation of controlled airspace – IFR aircraft departing Broome climbed into Class E airspace without a clearance. (Category 5)
22 Jan	VH-UPV/NJJ	Incorrect operation of transponder and unserviceable transponder. VFR pilot in Alice Springs Class E and Class D airspace selected the incorrect transponder code for the type of operation. In addition the aircraft did not appear on the TCAS of an arriving jet, including after reselection of the correct code, suggesting a technical problem with the transponder. (Category 5)
30 Jan	VH-VBO/ Unknown	Non-serious airprox and violation of controlled airspace – an unknown VFR aircraft was observed on radar to descend from Class E into Class D airspace near Maroochydore. A B737 departing Maroochydore was provided with traffic information by ATC and the crew received a TCAS traffic advisory on the VFR aircraft. (Category 5)
30 Jan	VH-RXJ	VFR aircraft operated in Class E airspace inbound to Rockhampton without a serviceable mode C transponder. (Category 5)

10 Feb	VH-TNU/ Powered Parachute	Just prior to turning onto the 12 DME arc at Tamworth, the pilot of a VFR Dash 8 conducting flying training reported sighting a powered parachute, in Class E airspace, straight ahead at approximately 5000 ft – Violation of controlled airspace. (Category 5)
13 Feb	VH-LMZ	VFR aircraft operated in Class E airspace north of Maroochydore without an operating mode C transponder. (Category 5)
15 Feb	VH-SQV/LMZ	SQV initiated an amended track without prior notification to ATC, to self-separate with LMZ in Class E airspace near Maroochydore. (Category 5)
19 Feb	VH-VQA/ Unknown	VFR aircraft operated in Class E airspace north of Hobart without an operating mode C transponder. (Category 5)
19 Feb	VH-DQO	Aircraft conducted parachuting ops in Class E airspace near Euroa (Vic) without making mandatory radio broadcasts. (Category 5)
21 Feb	VH-KGG	Violation of Class C airspace by VFR aircraft near Adelaide – the pilot thought that he was still in Class E airspace when he requested a clearance. Apparent that the pilot did not understand new airspace structure. (Category 5)
8 Mar	VH-ZEP	VFR flight operated in Class E airspace northwest of Melbourne without an operating mode C transponder. The aircraft was subsequently observed on radar to violate controlled airspace when it entered Class C airspace without a clearance. (Category 5)
9 Mar	VH-LWL	IFR aircraft in Class E airspace without clearance. The pilot of the IFR aircraft flying from Dubbo to Echuca requested climb from F180 to F200 into Class E airspace, commenced climbing prior to the clearance being issued and did not read back the clearance. During transmissions requesting a full read back the aircraft reached F200 but then commenced descent leaving Class E airspace without clearance to do so. (Category 5)
31 Mar 2004	VH-MUS	VFR aircraft at 5,500 feet was observed by ATC to be operating in Class E airspace, without any transponder mode C function and was not in accordance with requirements of the national airspace system. (Category 5)
7 Apr 2004	VH-LDJ/VBT	The crew of a Boeing 737-7BX aircraft advised ATS that they were responding to a TCAS RA due to the proximity of a VFR Lancair IV-P aircraft. The Lancair was on climb to FL165 tracking YBMC direct to St George. Both aircraft were communicating with air traffic control and the B737 took avoidance action prior to the RA. (Category 4, still under investigation)
12 Apr	VH-BPW	VFR aircraft operated in Class E airspace near Coffs Harbour without an operating mode C transponder. (Category 5)
30 Apr	VH-DVM	VFR aircraft operated in Class E airspace southeast of Rockhampton without an operating mode C transponder. (Category 5)
13 May	SSQ300	Sunstate Dash 8 aircraft descending into Rockhampton received a TCAS RA to climb due to a VFR aircraft in Class E airspace overflying Rockhampton. (Category 5)
13 May	VH-TQG	Non-serious airprox. VFR aircraft operating in Class E airspace south of Coffs Harbour without an operating transponder was sighted by the crew of a Dash 8 while descending into Coffs Harbour. (Category 5)

3.2 Airprox and breakdown of separation

There were 40 airprox incidents in the 180 days after NAS 2b compared with 39 in the 180 days before its introduction and 13 during the corresponding period a year before. There were 30 breakdown of separation (BOS) incidents in the 180 days after NAS 2b compared with 43 in the 180 days before its introduction and 31 during the corresponding period a year before.

Figure 1
Airprox and breakdown of separation occurrences

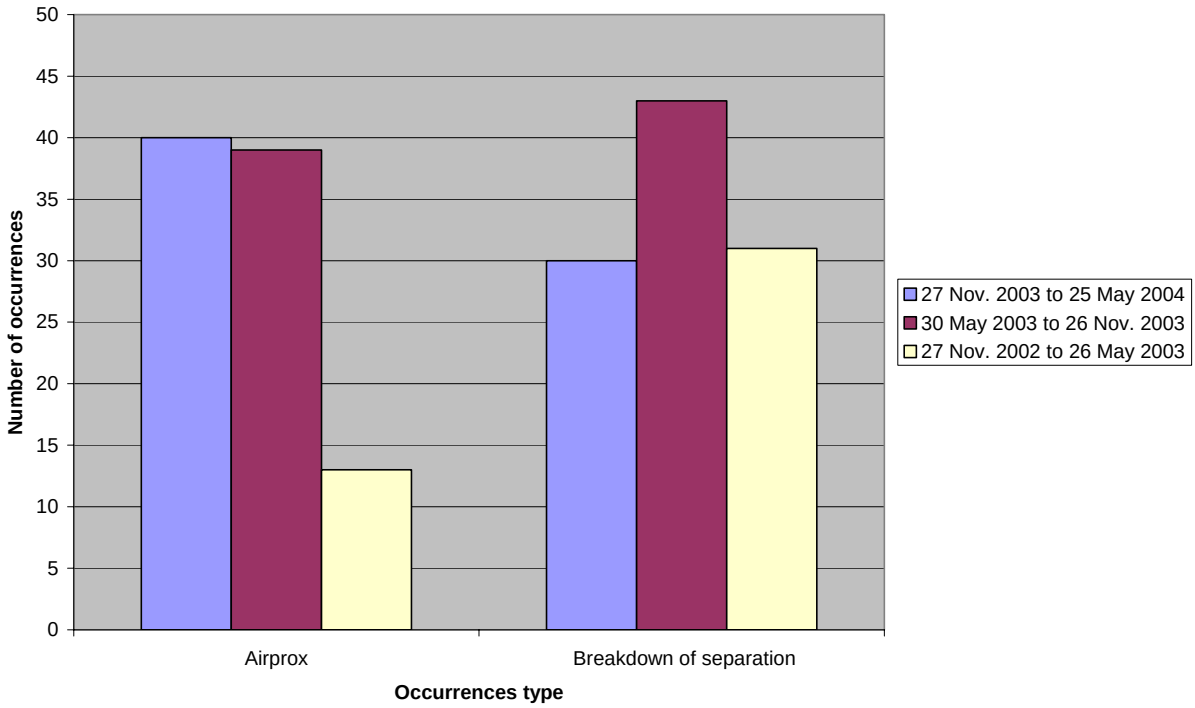


Table 3 shows that the majority of airprox incidents after the implementation of NAS 2b occurred in Class G (63 per cent) and GAAP airspace (23 per cent). A similar pattern is evident in the comparison periods. Tables 4 and 5 show that the majority of airprox incidents occurring in the 180-day period before the implementation of NAS 2b (Class G, 51 per cent; GAAP, 44 per cent) and in the same period one year before occurred in Class G and GAAP airspace (Class G, 54 per cent; GAAP, 31 per cent).

Table 3
Breakdown of separation and airprox occurrences by airspace class and occurrence type for the period 27 November 2003 to 25 May 2004

Airspace class	*Airspace type*	*Occurrence type*		
		Airprox	*Breakdown of separation*	*Total*
A	CTA	0	3	3
C	CTA	0	13	13
	CTR	0	11	11
D	CTA	0	1	1
	CTR	3	0	3
E-Radar	CTA	2	1	3
E - Non-radar	CTA	1	0	1
G	CTAF	5	0	5
	MBZ	13	0	13
	Other	7	0	7
GAAP	CTR	9	1	10
Total		40	30	70

Table 4
Breakdown of separation and airprox occurrences by airspace class and occurrence type for the period 30 May 2003 to 26 November 2003

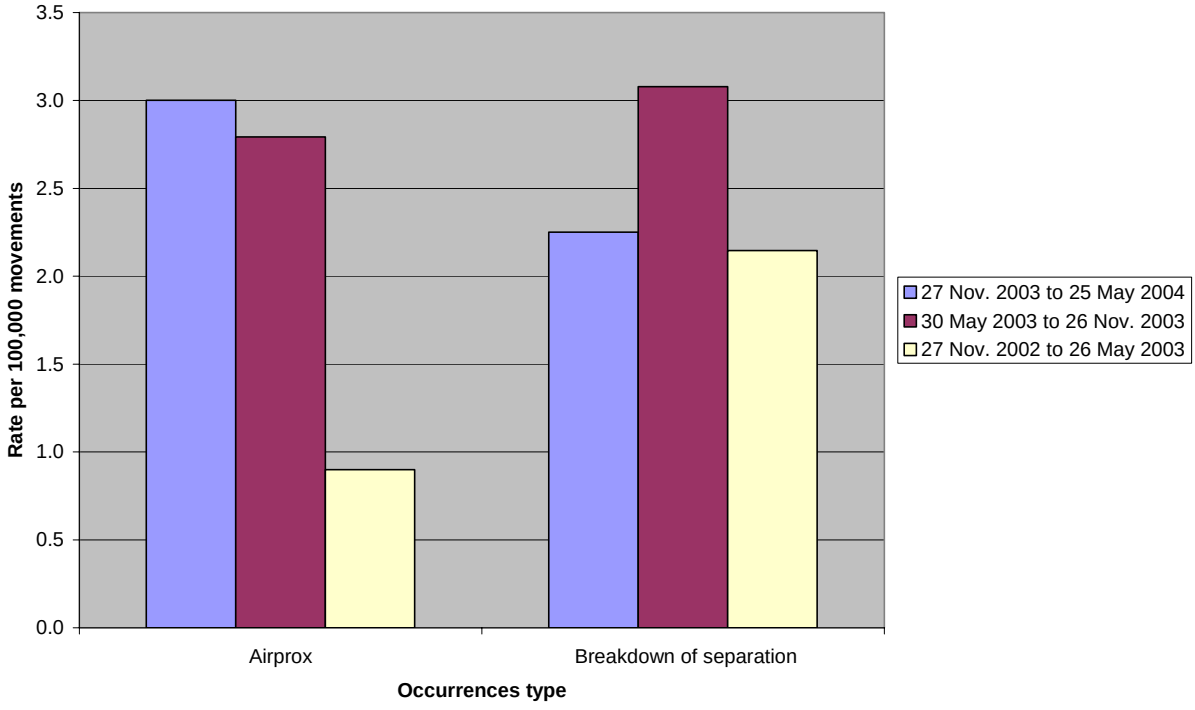
Airspace class	Airspace type	Occurrence type		
		Airprox	Breakdown of separation	Total
A	CTA	0	5	5
C	CTA	0	27	27
	CTR	0	9	9
D	CTR	0	2	2
E - Radar	CTA	1	0	1
G	CTAF	1	0	1
	MBZ	11	0	11
	Other	8	0	8
GAAP	CTR	17	0	17
Restricted		1	0	1
Total		39	43	82

Table 5
Breakdown of separation and airprox occurrences by airspace class and occurrence type for the period 27 November 2002 to 26 May 2003

Airspace class	Airspace type	Occurrence type		
		Airprox	Breakdown of separation	Total
A	CTA	0	2	2
C	CTA	0	22	22
	CTR	0	4	4
D	CTA	0	1	1
	CTR	1	2	3
G	CTAF	1	0	1
	MBZ	4	0	4
	Other	2	0	2
GAAP	CTR	4	0	4
Restricted		1	0	1
Total		13	31	44

There were 3.1 airprox occurrences per 100,000 aircraft movements in the post-NAS 2b period (see Figure 2). There were 2.8 airprox occurrences per 100,000 aircraft movements in the 180 days before the introduction of NAS 2b and 0.9 in the 180-day period one year earlier.

Figure 2
Airprox and breakdown of separation occurrences per 100,000 aircraft movements



A statistically significant difference was found between the rate of airprox incidents per aircraft movement during the post-NAS 2b period and the same period a year before. There were 3.2 more airprox incidents per aircraft movement in the post-NAS 2b period than in the same period the previous year[4]. However, there was no difference between the number of airprox incidents per aircraft movement in the post-NAS 2b period and the period immediately before NAS 2b implementation. This suggests that the increase was principally the result of the change in reporting requirements from 1 July 2003.

There were 2.3 BOS occurrences per 100,000 aircraft movements in the post-NAS 2b period. There were 3.1 BOS occurrences per 100,000 aircraft movements in the 180 days before the introduction of NAS 2b and 2.1 in the 180-day period one year earlier. Statistical analysis revealed no significant change in the rate of BOS occurrences per aircraft movement when the post-NAS 2b rate was compared with the 180-day period before the implementation of NAS 2b[5] or with the 180-day period one year earlier.[6]

There are no separation standards applicable between Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) aircraft in class E airspace. As no separation standards were applicable, it was not possible to categorise any close proximity event between an IFR aircraft and a VFR aircraft in E airspace as a BOS. However, the circumstances, if serious enough, could constitute an airprox.

There were seven critical airprox occurrences during the post-NAS 2b period. This compares with eight in the 180 days before the introduction of NAS 2b and two in the corresponding 180-day period one year earlier. The reduction after NAS 2b compared with immediately before NAS 2b is not statistically significant.

There were no critical BOS occurrences during the post-NAS 2b period. This compares with two in the 180 days leading up to the introduction of NAS 2b and one in the same 180-day period one year earlier.

Table 6
Breakdown of separation and airprox occurrences by risk category of occurrence for the period 27 November 2003 to 25 May 2004

	Occurrence type		
	Airprox	*Breakdown of separation*	*Total*
Critical[7]	7	0	7
Potential	33	30	63
Total	40	30	70

[4] Poisson regression was used. Chi Square = 13.18, df = 1, $p < 0.001$.

[5] Poisson regression was used. Chi Square = 2.04, df = 1, $p = 0.15$.

[6] Poisson regression was used. Chi Square = 0.00, df = 1, $p = 0.99$.

[7] 'Critical' refers to where a pilot was required to take evasive action to avoid a collision. This is defined in the 'Method' section of this report.

Table 7
Breakdown of separation and airprox occurrences by risk category of occurrence for the period 30 May 2003 to 26 November 2003

	Occurrence type		
	Airprox	*Breakdown of separation*	*Total*
Critical	8	2	10
Potential	31	41	72
Total	39	43	82

Table 8
Breakdown of separation and airprox occurrences by risk category of occurrence for the period 27 November 2002 to 26 May 2003

	Occurrence type		
	Airprox	*Breakdown of separation*	*Total*
Critical	2	1	3
Potential	11	30	41
Total	13	31	44

Airprox and BOS occurrences were further broken down by involvement of RPT aircraft in order to gauge any increased risk for fare paying passengers and higher capacity aircraft. There were 19 airprox occurrences involving RPT aircraft in the 180 days post-NAS 2b (Table 9 through 11) compared with 13 in the 180 days prior to NAS-2b and three in the 180 days one year earlier.

The rate of airprox incidents involving RPT aircraft per 100,000 aircraft movements was 1.93 in the 180 days after NAS 2b compared with 1.35 in the 180 days before NAS 2b and 0.32 in the 180-period one year earlier. The increase in the rate of RPT airprox events for the 180-day period after NAS 2b implementation compared with the period before was not statistically significant. As noted previously, the increase in reported airprox events occurred before NAS 2b was implemented and strongly suggests that it is related to the change in reporting requirements from 1 July 2003 rather than to NAS 2b[8].

[8] The *Transport Safety Investigation Regulations* came into force on 1 July 2003 and had a specific category for mandating airprox reporting.

Table 9
Breakdown of separation and airprox occurrences involving regular public transport aircraft by airspace class for the period 27 November 2003 to 25 May 2004

	Occurrence type		
Airspace class	*Airprox*	*Breakdown of separation*	*Total*
A	0	2	2
C	0	17	17
D	2	1	3
E - Non-radar	1	0	1
E-Radar	2	1	3
G	13	0	13
GAAP	1	0	1
Total	19	21	40

Table 10
Breakdown of separation and airprox occurrences involving regular public transport aircraft by airspace class for the period 30 May 2003 to 26 November 2003

	Occurrence type		
Airspace class	*Airprox*	*Breakdown of separation*	*Total*
A	0	5	5
C	0	22	22
D	0	2	2
E – Radar	1	0	1
G	12	0	12
GAAP	0	0	0
Total	13	29	42

Table 11
Breakdown of separation and airprox occurrences involving regular public transport aircraft by airspace class for the period 27 November 2002 to 26 May 2003

	Occurrence type		
Airspace class	*Airprox*	*Breakdown of separation*	*Total*
A	0	2	2
C	0	12	12
D	0	1	1
G	3	0	3
GAAP	0	0	0
Total	3	15	18

There were 21 BOS occurrences involving RPT aircraft in the 180 days after NAS 2b compared with 29 in the 180 days before NAS 2b and 15 in the 180 days one year earlier.

The rate of BOS occurrences involving RPT aircraft per 100,000 aircraft movements was 2.13 in the 180 days after NAS 2b compared with 3.01 in the 180 days before NAS 2b and 1.61 in the 180 days one year earlier. There was no significant change in the number of BOS occurrences involving RPT aircraft per movement pre- and post-NAS 2b[9].

It is important to consider BOS and airprox occurrences within the context of NAS 2b. While there were 40 airprox occurrences during the 180 days after the implementation of NAS 2b, only four of these were determined by the ATSB to have been related to the implementation of NAS 2b. Of the four NAS 2b-related occurrences, two were investigated by the ATSB and only one of those (near Launceston on 24 December 2003) was assessed as a serious incident. That incident occurred in non-radar Class E airspace that was Class C airspace prior to the introduction of NAS 2b. The ATSB made recommendations to CASA, Airservices and the National Airspace System Implementation Group (NASIG) as a result of this incident. The recommendations related to communications requirements, particularly in non-radar Class E airspace, including education, training and charting.

The other occurrence investigated by the ATSB involved a B737 aircraft and a light aircraft approximately 60 NM north of Melbourne on 3 December 2003. In that occurrence, the controller applied a 500-foot vertical buffer between the B737 and the VFR aircraft and the B737 crew had the VFR aircraft in sight. A further occurrence on 7 April 2004 was still under investigation at the time of finalisation of this report.

Of the two occurrences which were not investigated by the ATSB, one was in radar Class E airspace near Coffs Harbour on 13 May 2004 and the other occurred in Class D airspace at Maroochydore on 30 January 2004.

In the case of the Coffs Harbour incident, Air Traffic Services (ATS) did not know of the VFR aircraft, and the crew of the IFR aircraft did not identify the VFR aircraft on their TCAS because there was no mode C transponder information. The pilot of the VFR aircraft did not appear to be monitoring relevant frequencies.

The pilot of the VFR aircraft involved in the Maroochydore incident did not announce his presence prior to entering Class D airspace and did not respond to radio broadcasts.

The unknown nature of the VFR aircraft involved in each of these two occurrences made investigation unlikely to yield significant additional information to the reports submitted by the IFR crews involved and ATS.

None of the incidents in Class E airspace would be likely to have occurred before NAS 2b, as all aircraft involved would have been subject to ATC clearance and separation in Class C airspace. The incident in Class D airspace would also have been unlikely to have occurred in the pre-NAS 2b system, as the VFR aircraft would have been required to have a clearance to fly in the Class C airspace which previously overlaid the Maroochydore Class D airspace.

[9] Poisson regression was used. Chi Square = 0.85, df = 1, p = 0.36 and Chi Square = 1.35, df = 1, p = 0.25.

3.3 Resolution advisories

There were 45 TCAS RA incidents reported to the ATSB in the 180 days after the implementation of NAS 2b. This was 12 fewer than the number of TCAS RAs reported in the 180 days before the implementation of NAS 2b (Figure 3) and three less than in the 180 days a year before the implementation of NAS 2b. This information is presented in Tables 12 through 14 below and in Figure 3.

Table 12
TCAS resolution advisory occurrences by airspace class and seriousness for the period 27 November 2003 to 25 May 2004

	Airspace class							
TCAS type	*A*	*C*	*D*	*E - Non-*	*E-Radar*	*G*	*GAAP*	*Total*
Airprox or breakdown of	0	0	0	1	1	0	0	2
Routine operational alert	1	31	2	2	3	3	0	42
False alarm	0	1	0	0	0	0	0	1
Total	1	32	2	3	4	3	0	45

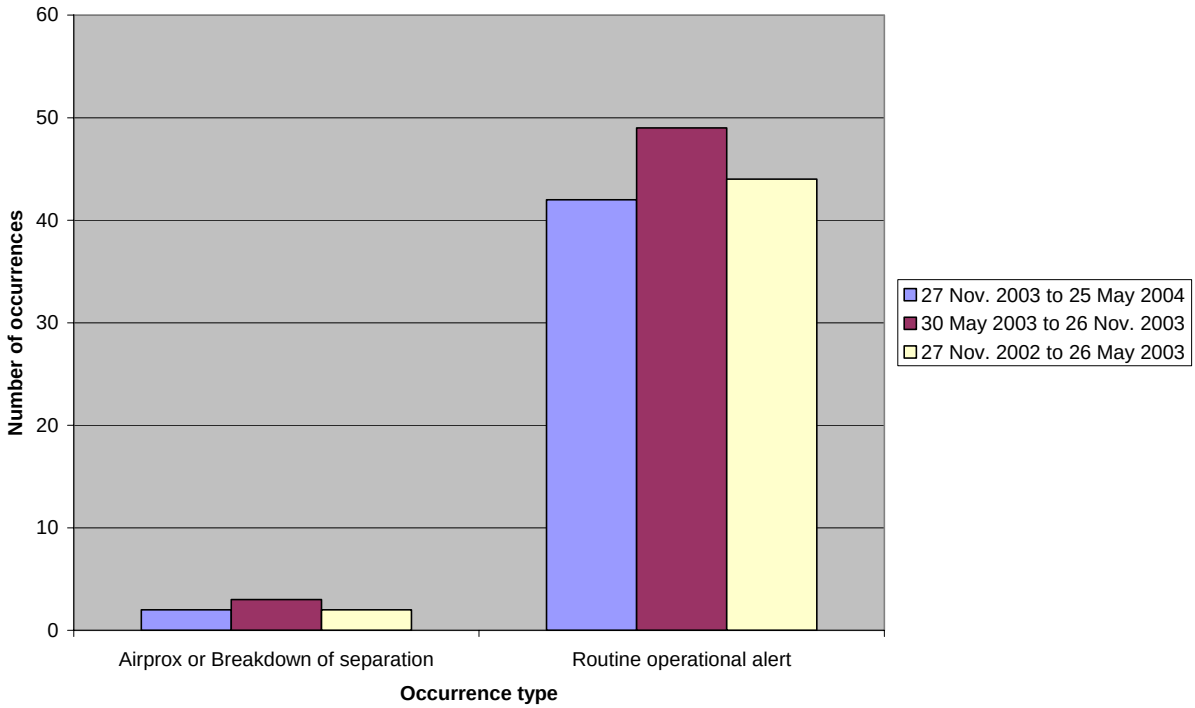
Table 13
TCAS resolution advisory occurrences by airspace class and seriousness for the period 30 May 2003 to 26 November 2003

	Airspace class							
TCAS type	*A*	*C*	*D*	*E - Non-*	*E-Radar*	*G*	*GAAP*	*Total*
Airprox or breakdown of	0	0	1	0	1	1	0	3
Routine operational alert	2	37	5	0	0	5	0	49
False alarm	0	5	0	0	0	0	0	5
Total	2	42	6	0	1	6	0	57

Table 14
TCAS resolution advisory occurrences by airspace class and seriousness for the period 27 November 2002 to 26 May 2003

	Airspace class							
TCAS type	*A*	*C*	*D*	*E - Non-*	*E-*	*G*	*GAAP*	*Total*
Airprox or breakdown of	0	1	0	0	0	1	0	2
Routine operational alert	0	36	2	0	0	5	1	44
False alarm	0	2	0	0	0	0	0	2
Total	0	39	2	0	0	6	1	48

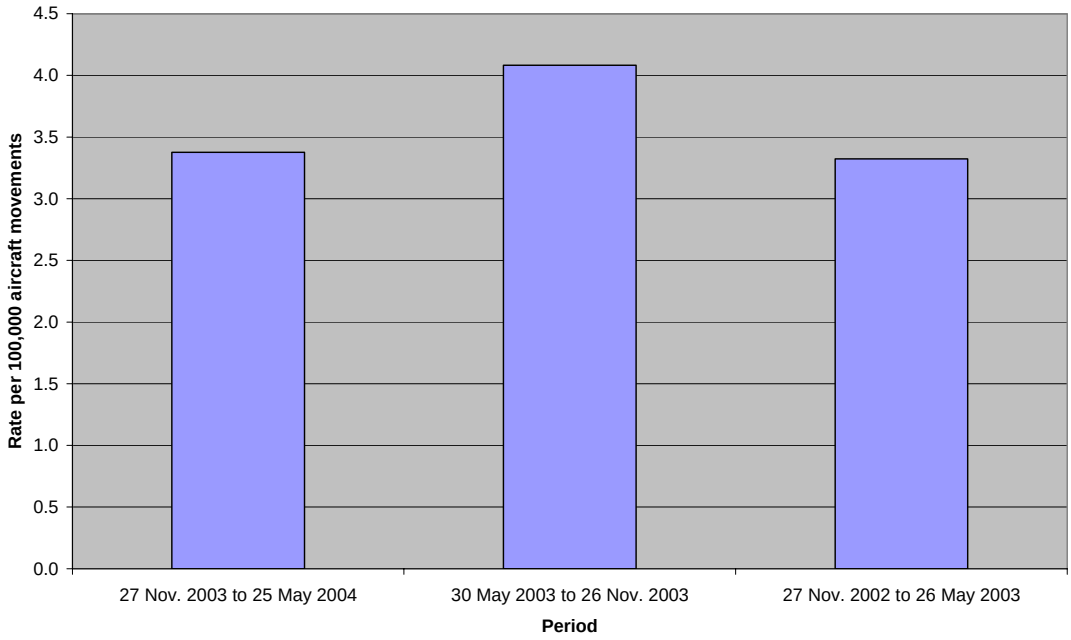
Figure 3
TCAS RA occurrences



There were 3.4 TCAS RA occurrences per 100,000 aircraft movements in the post-NAS 2b period (see Figure 4) compared with 4.1 in the 180 days before the introduction of NAS 2b and 3.3 in the 180-day period one year before NAS 2b. The rate of TCAS RAs increased slightly after the introduction of NAS 2b compared with the same period a year earlier. However, statistical analysis revealed no statistically significant difference between the rates of resolution advisories per aircraft movement among any of the three periods[10].

[10] Poisson regression was used. Chi Square = 0.14, df = 1, p = 0.71 and Chi Square = 0.72, df = 1, p = 0.39.

Figure 4
TCAS resolution advisory occurrences per 100,000 aircraft movements



In the 180 days from 27 November 2002, there was one breakdown of separation event in Class C airspace between a B737 and a BAe146 aircraft near Gunnedah in which a RA was triggered. The airspace where this occurred did not change classification with the introduction of NAS 2b. The ATSB reviewed the incident in detail and established that avoiding action had been initiated before the RA and that even if it had not been, minimum horizontal separation would have remained about 1.5 to 2 NM. The two aircraft actually passed with 1,200 feet vertical and 2.5 NM lateral separation. The ATSB did not release an investigation report into this incident. Airservices Australia conducted a detailed internal investigation of the reasons why the 5 NM horizontal separation standard was breached, leading to a short term conflict alert indication to the controller[11].

The proportion of jet aircraft versus propeller driven aircraft that reported RA activations was also analysed. The results are presented in Tables 15 through 17 and in Figures 5 and 6.

Table 15
TCAS resolution advisory occurrences by aircraft type for the period 27 November 2003 to 25 May 2004

TCAS Type	*Jet*	*Prop*	*Unknown*	*Total*
Airprox or breakdown of separation	2	0	0	2
Routine operational alert	31	10	1	42
False alarm	1	0	0	1
Total	34	10	1	45

[11] Airservices included this occurrence as part of its 'Systemic Review of Breakdown of Separation Occurrences' (January 2000 to April 2003), a review that led to 31 recommendations for improvement, all of which were implemented by 27 July 2004.

Table 16
TCAS resolution advisory occurrences by aircraft type for the period 30 May 2003 to 26 November 2003

TCAS Type	*Jet*	*Prop*	*Unknown*	*Total*
Airprox or breakdown of separation	1	2	0	3
Routine operational alert	32	17	0	49
False alarm	5	0	0	5
Total	38	19	0	57

Table 17
TCAS resolution advisory occurrences by aircraft type for the period 27 November 2002 to 26 May 2003

TCAS Type	*Jet*	*Prop*	*Unknown*	*Total*
Airprox or breakdown of separation	1	1	0	2
Routine operational alert	30	14	0	44
False alarm	2	0	0	2
Total	33	15	0	48

There were 34 RA activations that involved a jet aircraft (two were classified as BOS/airprox) in the post-NAS 2b period compared with 38 jet RA activations in the period immediately before NAS 2b. In the 180-day period one year before NAS 2b implementation, there were 33 RA activations that involved a jet aircraft (of which one was a BOS/airprox). Consistent with the other RA findings, the majority of RAs activated in jet aircraft were routine operational alerts or false alarms. There was no significant change in the small number of RA activations where the RA was the last line of defence for jet aircraft among the three periods.

There were 10.3 RA activations in jet aircraft per 100,000 aircraft movements in the post-NAS 2b period compared with 12.2 in the period immediately before NAS 2b and 10.8 in the corresponding period one year earlier. No significant difference was found in the rate of RA activations in jet aircraft per aircraft movement across the three time periods[12].

[12] Poisson regression was used. Chi Square = 0.32, df = 1, p = 0.57 and Chi Square = 0.05, df = 1, p = 0.83.

Figure 5
TCAS resolution advisory occurrences, jet aircraft

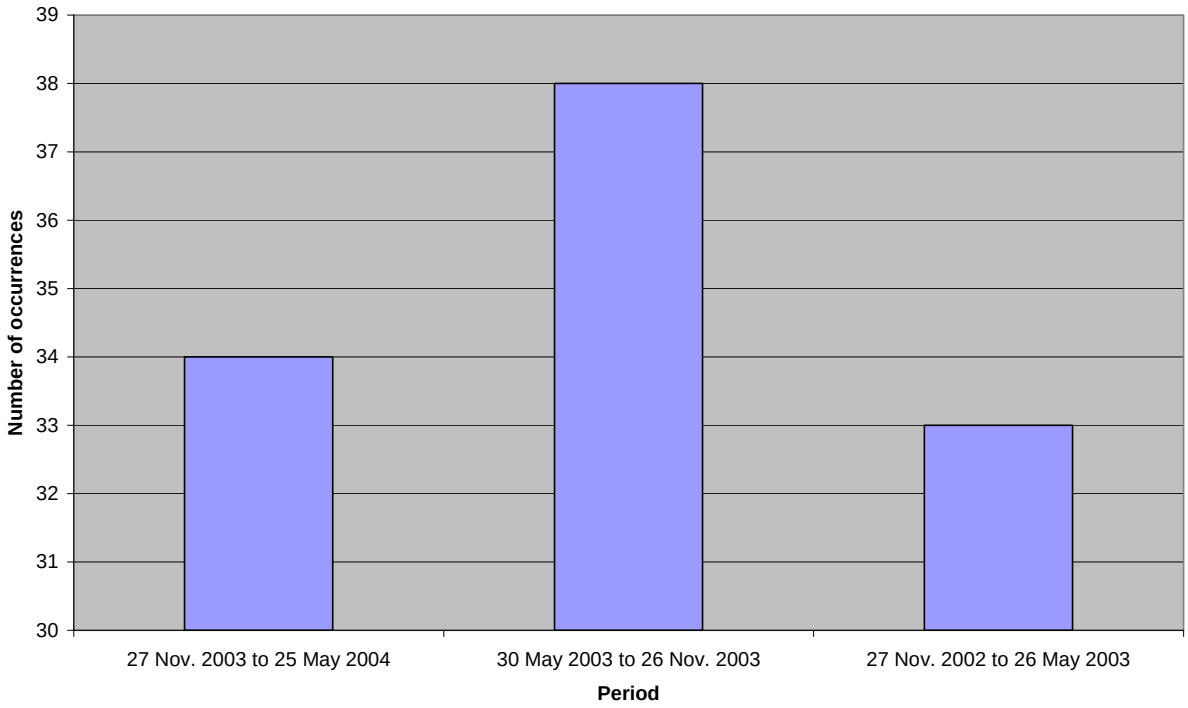
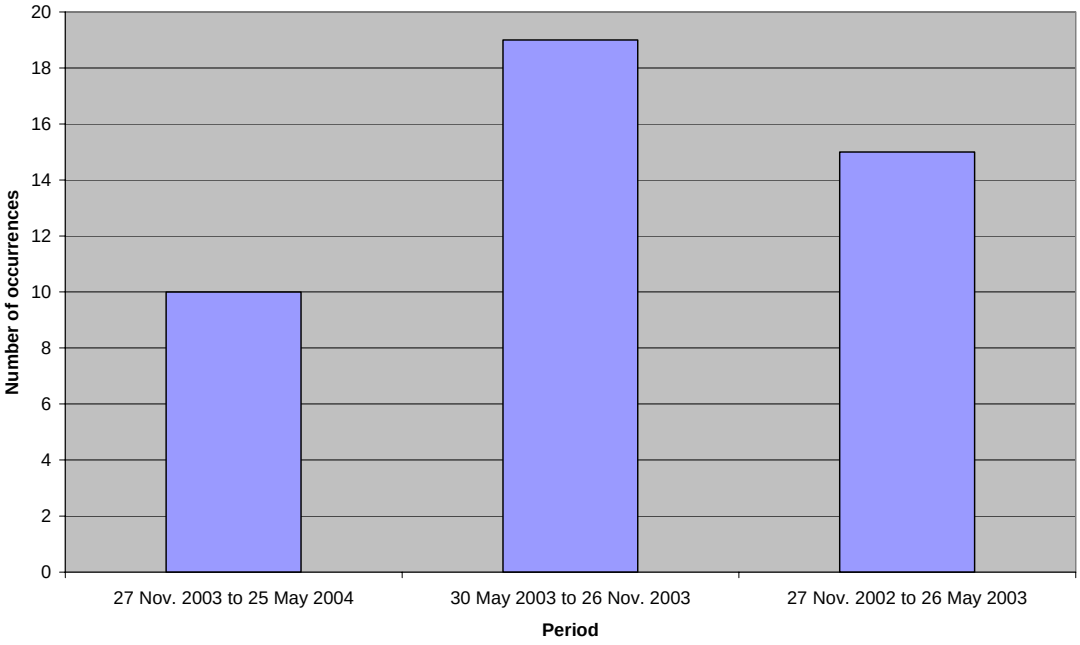


Figure 6
TCAS resolution advisory occurrences, propeller aircraft



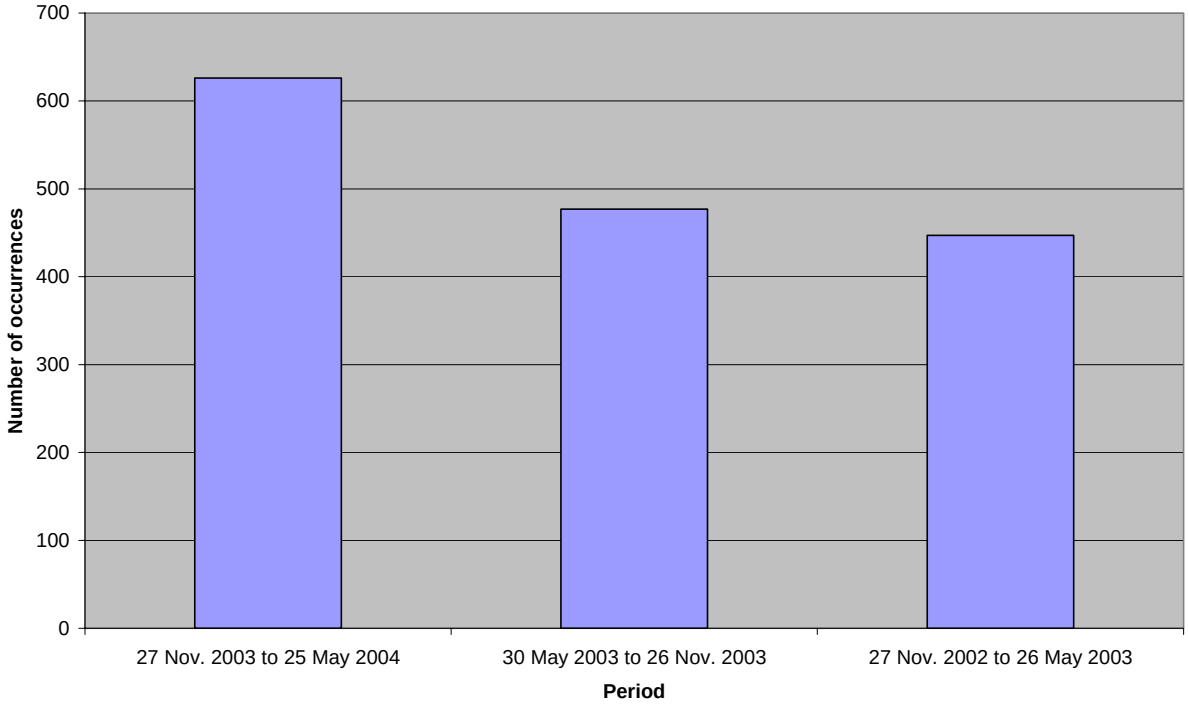
3.4

Violation of controlled airspace

There were 626 reported VCAs in the 180 days after the implementation of NAS 2b, compared with 477 in the 180 days before the introduction of NAS 2b and 447 in the corresponding period a year before (Figure 7).

Figure 7

Violation of controlled airspace occurrences

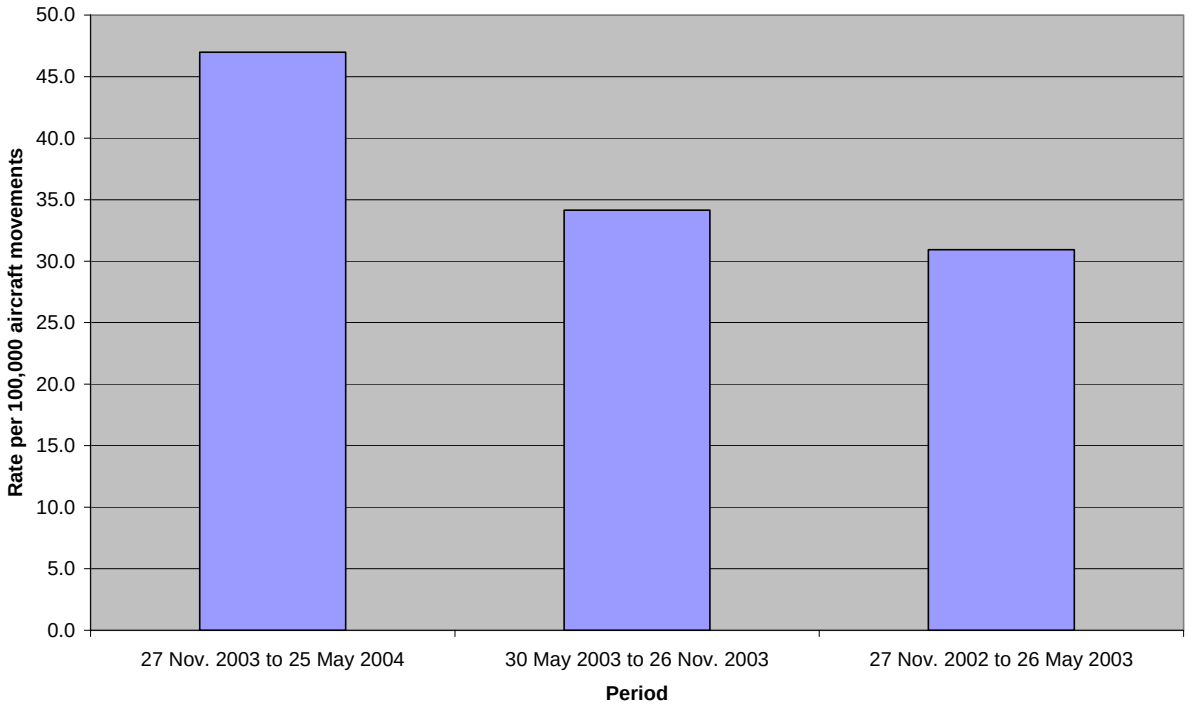


There has been a significant increase in the rate of VCA per aircraft movement following the implementation of NAS 2b. There were 47.0 VCA occurrences per 100,000 aircraft movements in the post-NAS 2b period compared with 34.2 in the 180 days before the introduction of NAS 2b and 30.9 in the 180-day period one year earlier (see Figure 8). More precisely, there have been 1.4 times more VCAs post-NAS 2b than in the same period a year earlier[13] and 1.3 times more VCAs compared with the 180 days immediately before NAS 2b[14].

[13] Poisson regression was used. Chi Square = 36.1, df = 1, p = 0.0001.

[14] Poisson regression was used. Chi Square = 23.12, df = 1, p = 0001.

Figure 8
Violation of controlled airspace occurrences per 100,000 movements



The largest increase in VCAs was around the Terminal Manoeuvring Areas (TMA), with an increase of 37 per cent during the 180 days following the implementation of NAS 2b, compared with the other two periods considered in the report (Figure 9).

Figure 9
Violation of controlled airspace by airspace category

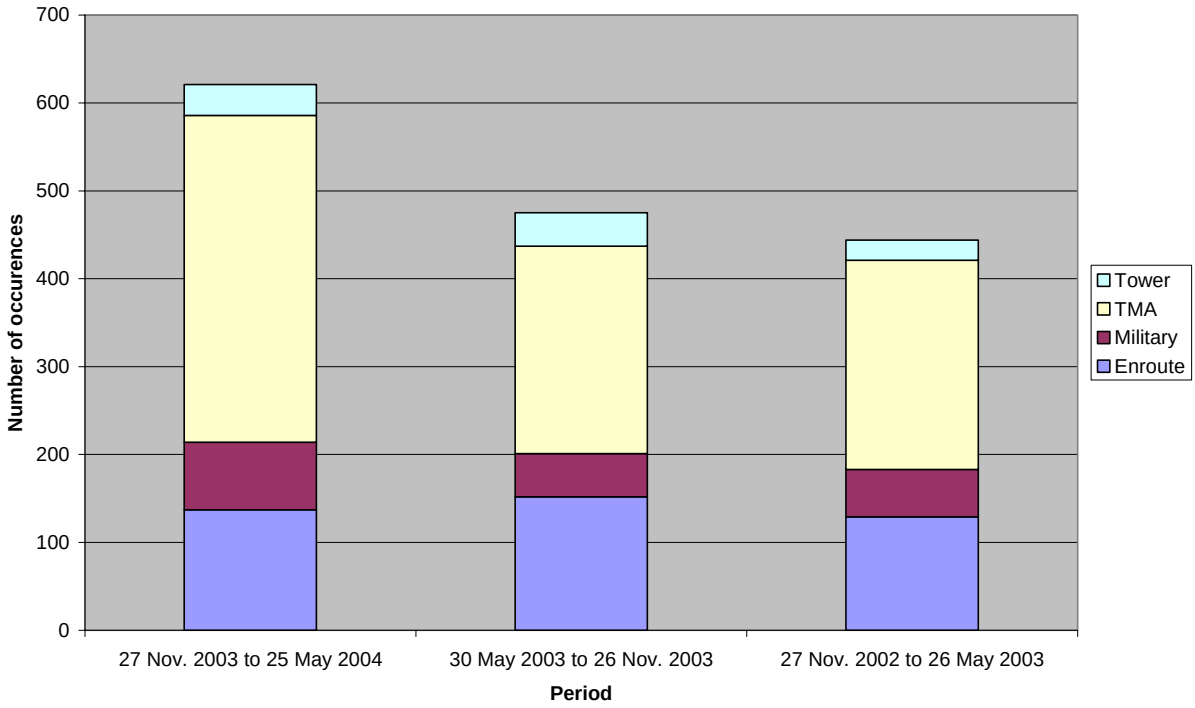
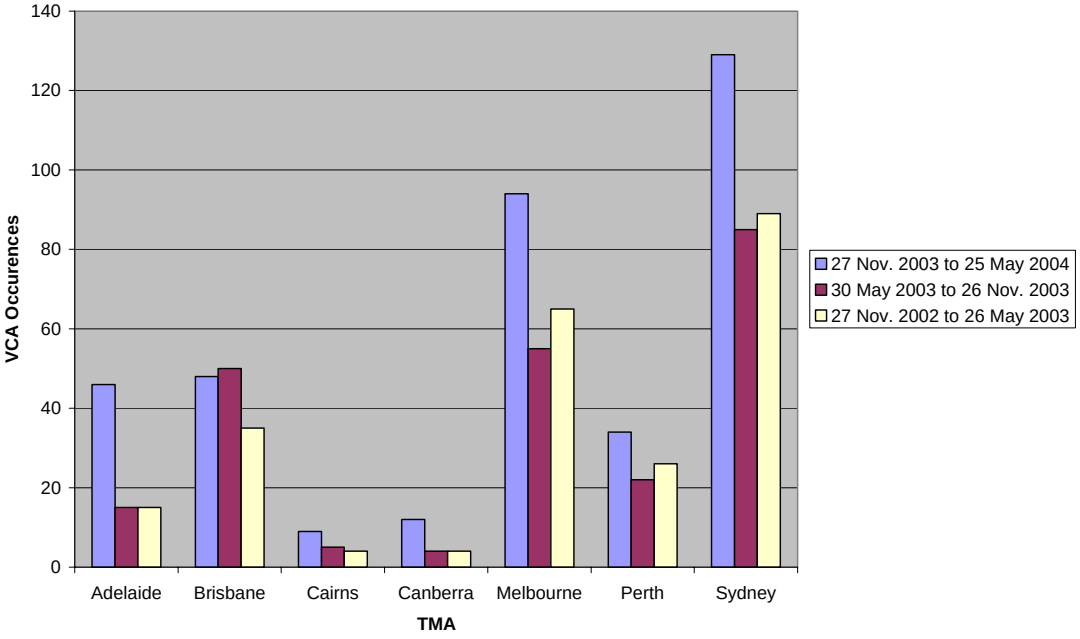


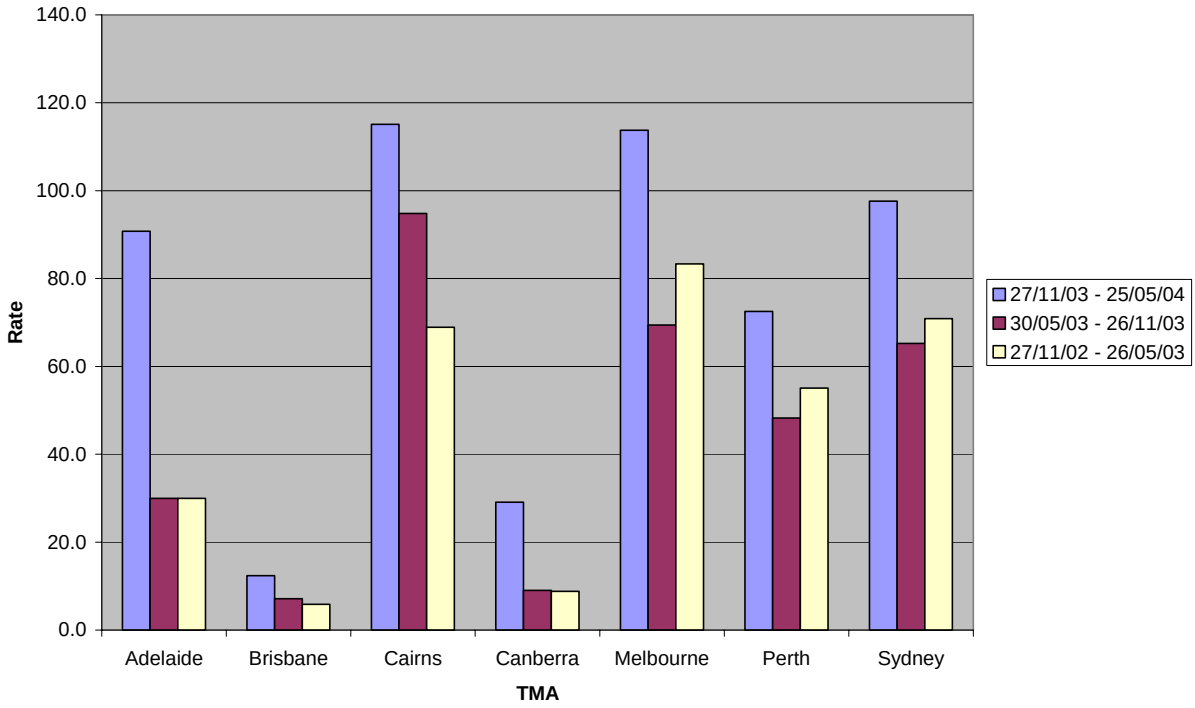
Figure 10 shows there has been an increase in VCAs within a number of TMAs, particularly Adelaide, Melbourne and Sydney.

Figure 10
Violation of controlled airspace occurrences at terminal manoeuvring areas



The rate of VCAs per 100,000 movements increased post-NAS 2b at all TMAs compared with both the 180 days prior to the implementation of NAS 2b and the 180 days one year earlier (Figure 11). This was particularly evident in Adelaide, Sydney and Melbourne TMAs.

Figure 11
Violation of controlled airspace occurrences at terminal manoeuvring areas per 100,000 movements at the associated aerodrome



While there is not enough detailed information to come to any definitive conclusions, Airservices Australia has proposed a number of theories as to the reasons for the increase in VCAs. There may have been an increase in sensitivity of ATC staff to VCAs following NAS 2b training. The subsequent implementation of procedures and modified airspace design around the major terminal areas may also have resulted in greater reporting rates. It may also be that NAS 2b training did not satisfactorily provide pilots with sufficient skills in understanding their responsibilities while operating under the visual flight rules (VFR) in the new system. In particular, pilots may not have fully comprehended the differences between Class C and Class E airspace and thus entered Class C airspace without clearance.

4 DISCUSSION

Analysis of the occurrence data provides no definitive evidence that there has been any change in actual risk associated with the implementation of NAS 2b.

It is not possible to draw any firm conclusions from the airprox and BOS occurrence data due to the relatively small number of occurrences and the volatility of the numbers. While a significant increase was found in the rate of airprox occurrences between the post-NAS 2b period and the same period one year earlier, there was no difference found between the post-NAS 2b period and the 180 days before the introduction of NAS 2b. The change in rates between the period after NAS 2b and the period one year before is therefore likely to be the result of changed airprox reporting requirements from 1 July 2003 rather than any real change in risk.

The reduction in the rate of reported BOS occurrences involving RPT aircraft in the 180-day period after NAS 2b compared with the corresponding period before was not statistically significant. The increase in airprox rates involving RPT traffic occurred before the implementation of NAS 2b, which suggests that factors other than NAS 2b contributed to the increase. The data are likely to have been affected by the introduction of the new *Transport Safety Investigation Regulations* (on 1 July 2003) which specifically required the reporting of airprox incidents, and to a lesser extent, the increased use of transponders by general aviation aircraft. Further, the NAS 2b changes themselves meant that there was no longer an Instrument Flight Rules (IFR) separation standard with Visual Flight Rules (VFR) aircraft in new Class E (previously Class C) airspace and therefore no equivalent to former BOS occurrences was recorded unless there was an airprox incident.

It is important to look at the context of the airprox and BOS occurrences and the potential risks they posed. The majority of these airprox and BOS events occurred in Class G and GAAP airspace, which were not directly affected by the implementation of NAS 2b. Three airprox and one BOS incident occurred in Class E airspace during this period. Four of the airprox incidents in the post-NAS 2b period were determined by the ATSB to have been related to the implementation of NAS 2b.

The analysis indicates that, in the overwhelming majority of TCAS resolution advisory activations, other separation defences were in place and working effectively in parallel with the RA activation. Therefore, the majority of RAs do not have significant safety implications because they were either routine operational alerts or false alarms. There were two TCAS resolution advisory activations where the TCAS resolution advisory was the prime defence that prevented a potential traffic conflict in the 180 days after the implementation of NAS 2b. The TCAS RA statistics indicated no significant change in the number of activations pre- and post-NAS 2b and it is difficult to draw conclusions regarding the level of safety (and therefore the level of risk) due to the limited number of occurrences where TCAS acted as a ‘last defence’ in each of the periods.

The Airservices Australia data indicate a significant increase in VCA occurrences after the implementation of NAS 2b, particularly at TMAs. While the data were not detailed enough to provide any clear indication of why this occurred, some theories have been proposed by Airservices Australia as to the reason for this increase. An increase in sensitivity of ATC to VCAs following NAS 2b training and implementation may have led to an increase in reporting. Another possibility is that the NAS 2b training did not satisfactorily provide pilots with sufficient skills in understanding their responsibilities while under the visual flight rules (VFR) in the new system, leading to an increase in VCA occurrences.

The only established serious incident in 180 days after the implementation of NAS 2b was the 24 December 2003 airprox near Launceston. As the ATSB investigation report on this airprox concluded: *"while a single occurrence does not provide the basis for a major change to the US-based NAS, which is yet to be fully implemented, the circumstances of this serious incident are indicative of a need for further review and analysis by the responsible authorities in consultation with industry."*

Both the Civil Aviation Safety Authority (CASA) and Airservices Australia have advised that they have initiated significant review action in response to the ATSB's recommendations and the subsequent direction from the Minister.

5 APPENDIX

5.1 Categorising aviation safety occurrences

In categorising aviation transport safety matters and selecting which of those the ATSB should investigate, the decision-makers must consider:

- The potential safety value that may be gained by conducting an investigation;
- On board fatalities and/or serious passenger injuries;
- The public profile of the occurrence;
- The extent of resources available and projected to be available; and, in the event of conflicting priorities, any risks associated with not investigating; and
- The requirement under s21 (2) of the TSI Act for the Executive Director to publish reasons (justification) for discontinuing an investigation where an investigation has already commenced.

The following broad hierarchy should also be taken into account when making the decision to initiate and categorise an investigation:

- Passenger operations;
- Freight and other commercial operations; and
- Non-commercial operations.

The decision to investigate will also have regard as to whether, in the absence of an ATSB investigation, a credible safety investigation is likely.

Following the initial assessment of an occurrence a decision will be made whether or not to conduct a field investigation. Unless otherwise agreed by the Executive Director, all occurrences (being investigated) will initially be categorised at level 4. Subsequently an investigation may be upgraded or downgraded. The decision to upgrade (and commit extra resources) or to downgrade must be made at Deputy Director level or above after discussion with the Director and/or Executive Director. Any decision to discontinue an investigation must be endorsed by the Executive Director.

The following guidance on the categorisation of aviation transport safety matters is intended to serve as a suggested starting point based on initial information. This guidance is not intended to cover all possible scenarios but illustrates a broad range of typical events. It is expected that judgment will be required in order to categorise some events which do not neatly fit these categories or where the circumstances, potential safety value and available resources suggest that they should be assigned a different category.

Category 1

- An *accident* involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft *with fatalities*.
- An *accident* involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft *without fatalities*
    - *where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport accidents and funding is available for an investigation under this category*.
- A *serious incident* (as defined by ICAO see Appendix 5.2 and 5.3) involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft
    - *where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport (scheduled and non-scheduled) accidents and funding is available for an investigation under this category*.

Category 2

- An *accident* involving one or more High Capacity Air Transport cargo aircraft *with fatalities and serious injuries*.
- An *accident* involving one or more High Capacity Air Transport cargo aircraft *without fatalities and serious injuries*
    - *where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport cargo aircraft accidents and funding is available for an investigation under this category*.
- An *accident* involving one or more Low Capacity Air Transport (scheduled) passenger aircraft *with a significant number of fatalities* (for example, it may involve more than five fatalities) and serious injuries.
- An *accident* involving one or more Low Capacity Air Transport (scheduled) passenger aircraft *without fatalities or with a relatively low level of fatalities* (eg less than five) and serious injuries
    - *where there was a significant risk of more fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents and funding is available for an investigation under this category*.
- A *serious incident* (as defined by ICAO see Appendix 5.2 and 5.3) involving one or more Low Capacity Air Transport (scheduled) passenger aircraft
    - *where there was a significant risk of multiple fatalities (eg more than five) and serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents and funding is available for an investigation under this category*.
- An *accident* involving one or more Low Capacity charter (non-scheduled) aircraft with fare-paying passengers and *multiple fatalities* and serious injuries (for example it may involve more than five fatalities)
    - *where a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) and charter (non-scheduled) accidents and funding is available for an investigation under this category*.

Category 3

- An *accident* involving one or more Low Capacity Air Transport passenger (scheduled) or charter (non-scheduled) aircraft with fare-paying passengers with *fatalities* and/or serious injuries not classified as a category 2 investigation.
- An *accident* involving Air Transport cargo operations with *fatalities*.
- An *accident* involving one or more training aircraft with *fatalities* and where investigation is likely to significantly mitigate future accidents and funding is available for an investigation under this category.
- An *accident* (as defined by ICAO, see Appendix 5.2) *without fatalities* involving one or more High or Low Capacity Air Transport aircraft not classified as a category 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents and funding is available for an investigation under this category.
- An *accident* involving one or more general aviation aircraft (other than sport aviation) with *fatalities* where investigation is likely to significantly mitigate future accidents and funding is available for an investigation under this category.
- An *accident* involving one or more charter or other general aviation aircraft
    - *where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources would significantly mitigate accidents and funding is available for an investigation in this category*.
- A *serious incident* (as defined by ICAO see Appendix 5.2 and 5.3) involving one or more High or Low Capacity Air Transport aircraft not classified as a category 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents and funding is available for an investigation under this category.
- A *serious incident* (as defined by ICAO see Appendix 5.2 and 5.3) involving one or more Air Transport cargo, charter or training aircraft where investigation is likely to significantly mitigate future accidents and funding is available for an investigation under this category.

Category 4

- An *accident* involving a foreign aircraft covered by *Article 26* of the Chicago Convention that is not being investigated as category 1, 2, or 3.
- An *accident* involving aircraft (other than sport aviation) with *fatalities* where available resources and future safety considerations do not allow for a more detailed investigation.
- An *accident* or *serious incident* (as defined by ICAO, see Appendix 5.2 and 5.3involving Australian designed and manufactured aircraft types on the Australian Register with international safety implications not being investigated as category 1, 2, or 3.
- An *accident* or *serious incident* (as defined by ICAO, see Appendix 5.2 and 5.3) involving one or more High or Low Capacity Air Transport aircraft not being investigated as category 1, 2, or 3 and funding is available for an investigation.
- An *accident* (as defined by ICAO, see Appendix 5.2) involving one or more charter or general aviation aircraft *without fatalities*

    - *where a limited commitment of investigative resources could significantly mitigate future aviation accidents and funding is available for an investigation.*
- A *serious incident* (as defined by ICAO, see Appendix 5.2 and 5.3) involving one or more non Air Transport aircraft
    - *where a limited commitment of investigative resources could significantly mitigate future accidents and funding is available for an investigation.*

Category 5

- An *accident* (including with *fatalities*) or *serious incident* involving a sport aviation aircraft unless foreign and required to be investigated under *Article 26* of the Chicago Convention.
- An *accident* involving aircraft *without fatalities*
    - *where the potential safety lessons do not, after initial review, justify the commitment of investigative resources within available funds. Basic incident data will be filed for statistical purposes.*
- A *serious incident* or *incident* involving aircraft
    - *where the potential safety lessons do not, after initial review, justify the commitment of investigative resources within available funds. Basic incident data will be filed for statistical purposes.*

5.2 ICAO definitions for aircraft accidents and serious incidents

Accident. An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

a) a person is fatally or seriously injured as a result of:

– being in the aircraft, or
– direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
– direct exposure to jet blast,
except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

b) the aircraft sustains damage or structural failure which:

– adversely affects the structural strength, performance or flight characteristics of the aircraft, and
– would normally require major repair or replacement of the affected component,

except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories; or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin; or

c) the aircraft is missing or is completely inaccessible.

Note 1. *For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified as a fatal injury by ICAO.* ***Note 2.*** *An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located.*

Serious incident. An incident involving circumstances indicating that an accident nearly occurred.

Note 1. *The difference between an accident and a serious incident lies only in the result.*

Note 2. *ICAO examples of serious incidents can be found in Appendix 5.2.*

5.3 List of examples of serious incidents

The incidents listed are typical examples of incidents that are likely to be serious incidents. The list is not exhaustive and only serves as guidance to the definition of serious incident.

- Near collisions requiring an avoidance manoeuvre to avoid a collision or an unsafe situation or when an avoidance action would have been appropriate.
- Controlled flight into terrain only marginally avoided.
- Aborted take-offs on a closed or engaged runway.
- Take-offs from a closed or engaged runway with marginal separation from obstacle(s).
- Landings or attempted landings on a closed or engaged runway.

- Gross failures to achieve predicted performance during take-off or initial climb.
- Fires and smoke in the passenger compartment, in cargo compartments or engine fires, even though such fires were extinguished by the use of extinguishing agents.
- Events requiring the emergency use of oxygen by the flight crew.
- Aircraft structural failures or engine disintegrations not classified as an accident.
- Multiple malfunctions of one or more aircraft systems seriously affecting the operation of the aircraft.
- Flight crew incapacitation in flight.
- Fuel quantity requiring the declaration of an emergency by the pilot.
- Take-off or landing incidents. Incidents such as undershooting, overrunning or running off the side of runways (RPT and Charter).
- System failures, weather phenomena, operations outside the approved flight envelope or other occurrences which could have caused difficulties controlling the aircraft.