Aviation inquiry 10-005
Cessna A152, ZK-NPL and Robinson R22 Beta, ZK-HIE near-collision
New Plymouth Aerodrome
10 May 2010

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Final Report

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Approved for publication: October 2011

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

Commissioners

Chief Commissioner	John Marshall, QC
Deputy Chief Commissioner	Helen Cull, QC
Commissioner	Captain Bryan Wyness
Assessor	Pat Scotter

Key Commission personnel

Chief Executive	Lois Hutchinson
Chief Investigator of Accidents	Captain Tim Burfoot
Investigator in Charge	Peter R Williams
General Counsel	Rama Rewi

Email	inquiries@taic.org.nz
Web	www.taic.org.nz
Telephone	+ 64 4 473 3112 (24 hrs) or 0800 188 926
Fax	+ 64 4 499 1510
Address	Level 16, AXA Centre, 80 The Terrace, PO Box 10 323, Wellington 6143, New Zealand

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Nature of this report

This report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 prohibits the report from being admitted as evidence in any proceeding except for a Coroner's inquest.

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Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in the report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in the report are provided by, and owned by, the Commission.

Cessna A152, ZK-NPL
(photograph courtesy of New Plymouth Aero Club)

Robinson R22 Beta, ZK-HIE

Source: mapsof.net

Location of the incident

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Abbreviations

Airways	Airways Corporation of New Zealand Limited
ATC	air traffic control
CAA	Civil Aviation Authority
Commission	The Transport Accident Investigation Commission
Director	The Director of Civil Aviation
ft	feet
ICAO	International Civil Aviation Organization
IFR	instrument flight rules, or a flight conducted in accordance with those rules
UTC	coordinated universal time
VFR	visual flight rules, or a flight conducted in accordance with those rules

Glossary

aerodrome control service	an air traffic control (ATC) service provided for the control of aerodrome traffic
aerodrome traffic circuit	the pattern flown by aircraft operating in the vicinity of an aerodrome
ATC clearance	authorisation for an aircraft to proceed under conditions specified by an ATC unit
ATC instruction	a directive issued by ATC for the purpose of requiring a pilot to take a specific action
autorotation	the condition of flight during which a helicopter's main rotor is driven only by aerodynamic forces, with no power from the enginecontrol zone controlled airspace extending upwards from the surface of the earth to a specified limit
controlled aerodrome	an aerodrome at which an ATC service is provided to aerodrome traffic
instrument flight rules	prescribed operating procedures for flight that may be conducted solely by reference to aircraft instruments
movement	a take-off or landing
separation	the prescribed spacing of aircraft to achieve their safe movement in flight and while taking off and landing
tower	the ATC unit at an aerodrome
traffic information	information issued by an air traffic service unit to alert a pilot to other known or observed air traffic, which may be in proximity to the position, or intended route of flight, and to help the pilot to avoid a collision
visual flight rules	prescribed operating procedures for flight in meteorological conditions that are expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima

Data summary

Aircraft registration:	ZK-NPL	ZK-HIE
Type and serial number:	Cessna A152 Aerobat, 0921	Robinson R22 Beta, 3724
Number and type of engines:	one reciprocating Textron Lycoming O-235 L2C	one reciprocating Textron Lycoming O-360-J2A
Year of manufacture:	1979	2004
Operator:	New Plymouth Aero Club	Ice Aviation Limited
Type of flight:	VFR - training	VFR - training
Persons on board:	2	2
Pilot's licence:	commercial pilot licence (aeroplane)	airline transport pilot licence (helicopter)
Pilot's age:	49	47
Pilot's total flying experience:	1348 hours (1250 hours on type)	6235 hours (146 hours on type)
Date and time:	10 May 2010, 1001[1]	
Location:	New Plymouth Aerodrome latitude: 39° 00.5´ south	longitude: 174° 10.7´ east
Injuries:	nil	
Damage:	nil	

[1] Times in this report are New Zealand Standard Time (UTC + 12 hours) and expressed in the 24-hour format.

1. Executive summary

1.1. On 10 May 2010, a light helicopter and a light aeroplane, both of which were being used for dual pilot training, had a near-collision overhead New Plymouth Aerodrome.

1.2. The pilots of both aircraft were operating under VFR and in accordance with their respective ATC clearances. The aeroplane was descending from overhead using the standard circuit joining procedure for a left-hand circuit for runway 14, the runway in use, whereas the helicopter was operating above the normal circuit altitude in a right-hand circuit for the same runway. The aeroplane descended through the downwind leg of the helicopter's circuit.

1.3. The Transport Accident Investigation Commission (the Commission) made the following **findings:**

- the air traffic controller's (the controller's) instructions were valid for Class D airspace, but he did not manage the increased risk of collision presented by the aeroplane descending to circuit altitude in the opposite direction
- the aviation community, including the regulator, Airways Corporation of New Zealand Limited (Airways), aerodrome operators and aircraft operators, does not have a consistent approach to reducing the collision risks associated with simultaneous opposed circuits at aerodromes
- Civil Aviation Rule 91.223 can be interpreted ambiguously in non-standard traffic situations, which could contribute to the collision risk at aerodromes
- the descriptions of and requirements for the standard overhead circuit joining procedure that are published in Civil Aviation Rules, the Aeronautical Information Publication New Zealand (Aeronautical Information Publication) and the Flight Instructor's Guide can be misinterpreted or misapplied in non-standard traffic situations. This could contribute to the collision risk at aerodromes
- the controller recognised the potential for a conflict, but he provided traffic information to the pilots of the aeroplane only, and not to the pilots of the helicopter
- the incident would not have occurred had either of the aeroplane pilots stopped the descent when he lost sight of the helicopter
- the incident would have been less likely to occur had the aeroplane pilots immediately broadcast that they had lost sight of the helicopter
- local aerodrome user groups benefit their participants by providing information about their respective activities. Aerodrome operators, in order to manage their operational risks, should require their relevant tenants and users to participate fully in such groups
- the see-and-avoid principle continues to have relevance, provided pilots and controllers counter its well-known limitations by the appropriate sharing of traffic information
- some VFR pilots continue to misconstrue ATC traffic information and instructions in Class C and D airspace as the provision of traffic separation.

1.4. The Commission made the following **recommendation:**

That the Director of Civil Aviation takes action to address the following safety issues:

- the aviation community, including the regulator, Airways, aerodrome operators and aircraft operators, does not have a consistent approach to reducing the collision risks associated with simultaneous opposed circuits at aerodromes. Simultaneous opposed circuits can exist as a result of locally agreed procedures at uncontrolled aerodromes, and also at controlled aerodromes under some conditions

- ATC, having cleared an aircraft to make a non-standard circuit, is not prevented from concurrently clearing a following aircraft to join the circuit by the standard overhead joining procedure, even though that could lead to a head-on traffic conflict

- the descriptions of and requirements for the standard overhead circuit joining procedure that are published in the Civil Aviation Rules, the Aeronautical Information Publication and the Flight Instructor's Guide can be misinterpreted or misapplied, particularly if a preceding aircraft is operating in a non-standard circuit, which could contribute to the collision risk at aerodromes

- in controlled airspace where separation is not provided between aircraft operating under VFR, a VFR aircraft that is instructed to follow another aircraft is not explicitly required to advise ATC promptly if visual contact is lost with the relevant traffic

- the present voluntary and informal nature of aerodrome user groups restricts their potential for improving operational safety at aerodromes.

1.5. The **key lessons** from the inquiry into this occurrence were:

- the aviation community must take concerted and consistent action to reduce the collision risk associated with simultaneous opposed circuits at aerodromes

- controllers must be alert to situations that warrant the issuing of mutual traffic information

- to minimise the risk of collision, pilots must combine an effective look-out with an attentive radio listen-out, especially in the vicinity of aerodromes

- pilots should advise, by broadcast if appropriate, when relevant traffic is no longer in sight and take any necessary action to ensure the safety of their flights

- the see-and-avoid principle continues to have relevance, provided pilots and controllers counter its well-known limitations by the appropriate sharing of traffic information

- Civil Aviation Rules and Aeronautical Information Publications must be written carefully and explained clearly to students to avoid ambiguity

- pilots must understand that, under most circumstances, ATC does not provide separation between VFR traffic in Class C and Class D airspace, even when clearances are issued

- aerodrome operators have a responsibility to manage their operational risks. A useful tool for risk management is an effective user group that includes all tenants and regular aircraft operators at the aerodrome.

2. Conduct of the inquiry

2.1. On 10 May 2010 Airways, the national air traffic services provider, notified the Civil Aviation Authority (CAA) of this serious incident. The CAA notified the Commission promptly and the Commission opened an inquiry the next day.

2.2. On 17 May 2010 the involved pilots and the controller were interviewed at New Plymouth Aerodrome. Enquiries were also made of the New Plymouth Aero Club, the aerodrome operator, other aircraft operators, and specialist staff of the CAA and Airways.

2.3. On 25 August 2011 the Director of Civil Aviation (Director) and 2 senior managers met the Commission to discuss pertinent aspects of the inquiry, including the CAA's responsibilities and action it had taken or intended to take in regard to aerodrome safety.

2.4. On 13 September 2011 the Commission approved a draft final report for circulation to interested persons. Submissions were received from the Director; Airways, on behalf of the Corporation and the controller; and the New Plymouth Aero Club on behalf of the club and the aeroplane instructor. These submissions were considered when preparing the final report.

2.5. On 26 October 2011 the Commission approved the publication of the final report.

3. Factual information

3.1. Histories of the flights

3.1.1. On 10 May 2010 at 0916, a Cessna 152 registered ZK-NPL (the aeroplane) departed from runway 05[2] at New Plymouth Aerodrome with an instructor and student on board for a training area east of the aerodrome (see Figure 1). The purpose of the flight, which was conducted under VFR, was consolidation before a flight test for the issue of a private pilot licence.

3.1.2. At 0927, a Robinson R22 Beta helicopter, registered ZK-HIE (the helicopter) and also operating under VFR, entered the control zone from New Plymouth city with an instructor and student pilot on board to conduct pre-solo training at the aerodrome. The controller later cleared the helicopter to operate in the runway 14 circuit, a published left-hand circuit (see Figure 2).

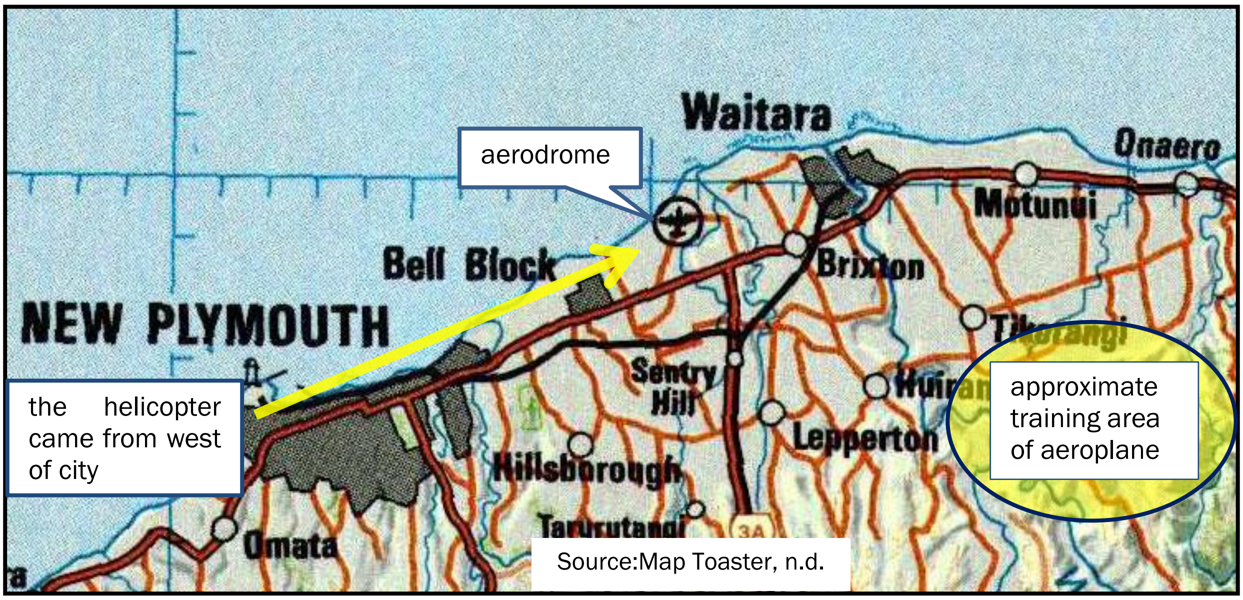


Figure 1
Location of New Plymouth Aerodrome

3.1.3. At 0952, the helicopter instructor was cleared to fly circuits at 1500 feet (ft), rather than the normal 1100 ft, to facilitate training in forced landings without engine power (autorotations). Two minutes later, to assist in sequencing a passenger aeroplane approaching from the north to land on runway 23, the controller instructed the helicopter to operate in a right-hand circuit for runway 14. He later asked the helicopter to 'keep the circuit tight and continue in a right hand circuit'.

3.1.4. At 0955, the pilots of the aeroplane requested to return to the aerodrome for a 'standard overhead re-join'. Neither the pilots nor the controller mentioned the runway in use. The controller cleared the aeroplane to fly to the aerodrome via the town of Brixton at 2000 ft and to report at Brixton and again when overhead the aerodrome. This clearance was correctly read back.

3.1.5. At about 1000, when just north of the threshold of runway 14, the aeroplane reported overhead the aerodrome at 2000 ft. The controller asked the aeroplane to 'report sighting a Robinson R22 just climbing out runway 14 to enter a right-hand circuit at 1500 feet'. The student pilot, sitting in the left seat of the aeroplane, reported "Traffic in sight'. The controller then cleared the aeroplane for a 'standard overhead re-join runway 14', which was read back correctly. The pilots of the aeroplane had the anti-collision beacon selected on, but could not recall whether the forward-facing landing light was on.

[2] The runway designation is the magnetic heading in the take-off direction, rounded to the nearest 10 degrees.

3.1.6. The aeroplane instructor said that while they were turning left before descending the helicopter was well clear, but then it 'just seemed to disappear against that background' and he did not see it again until the near-miss. While turning, the aeroplane's high wing obscured the pilots' view in the direction where the helicopter had last been seen.

3.1.7. About 30 seconds after being cleared for the joining procedure, the aeroplane reported 'descending non-traffic side to join left-hand downwind 14'. A left-hand circuit was opposite to the circuit direction being flown by the helicopter. The controller then instructed the aeroplane to report when downwind. The controller could not see either aircraft at this stage, because his view was obscured by the control tower roof.

3.1.8. The pilots of the helicopter and of the aeroplane were aware of each other's radio transmissions. No position report was made by the helicopter pilots on the downwind leg of that circuit. The controller later said that the pilots of the helicopter had been making the required downwind calls, but they tended to be made at a late stage.

3.1.9. The aeroplane instructor said that he knew they would descend through the helicopter's circuit, but he was not concerned when he could no longer see the helicopter, because it had been well clear when last seen. He told his student to aim for the upwind threshold of runway 14, thinking that would keep the aeroplane closer to the runway and inside the helicopter's circuit pattern. Neither aeroplane pilot told the other that he had lost sight of the helicopter, nor asked the controller for its position.

3.1.10. After the aeroplane had been cleared for a 'standard overhead rejoin runway 14', the helicopter instructor realised the aeroplane would descend through the helicopter's circuit. As the student (who was sitting in the right seat) began the right turn for the crosswind leg, the instructor told him to look for the aeroplane. The helicopter anti-collision beacon was on, but the instructor said he thought that the landing light, which was angled downwards for optimum use at night, was probably not on.

3.1.11. The helicopter was passing about 1400 ft on the climbing turn to the downwind leg when the instructor saw the aeroplane close above, heading towards him, so he took control and descended the helicopter straight ahead (see Figure 3). The helicopter student could not recall all of the earlier transmissions from the aeroplane and he did not see the aeroplane until the instructor took control. The instructor asked the controller whether the aeroplane had had the helicopter in sight, to which one of the aeroplane pilots replied 'affirm[ative]'.

3.1.12. Both instructors said the incident was serious. The aeroplane instructor and student met the controller after they had landed. The helicopter instructor did not discuss the incident further with the controller, but met the aero club chief instructor and the aeroplane instructor and student later. They agreed that aero club staff and students were unfamiliar with how tight the circuits of light helicopters could be. Following the incident, the helicopter instructor gave some aero club instructors familiarisation flights in the Robinson R22.

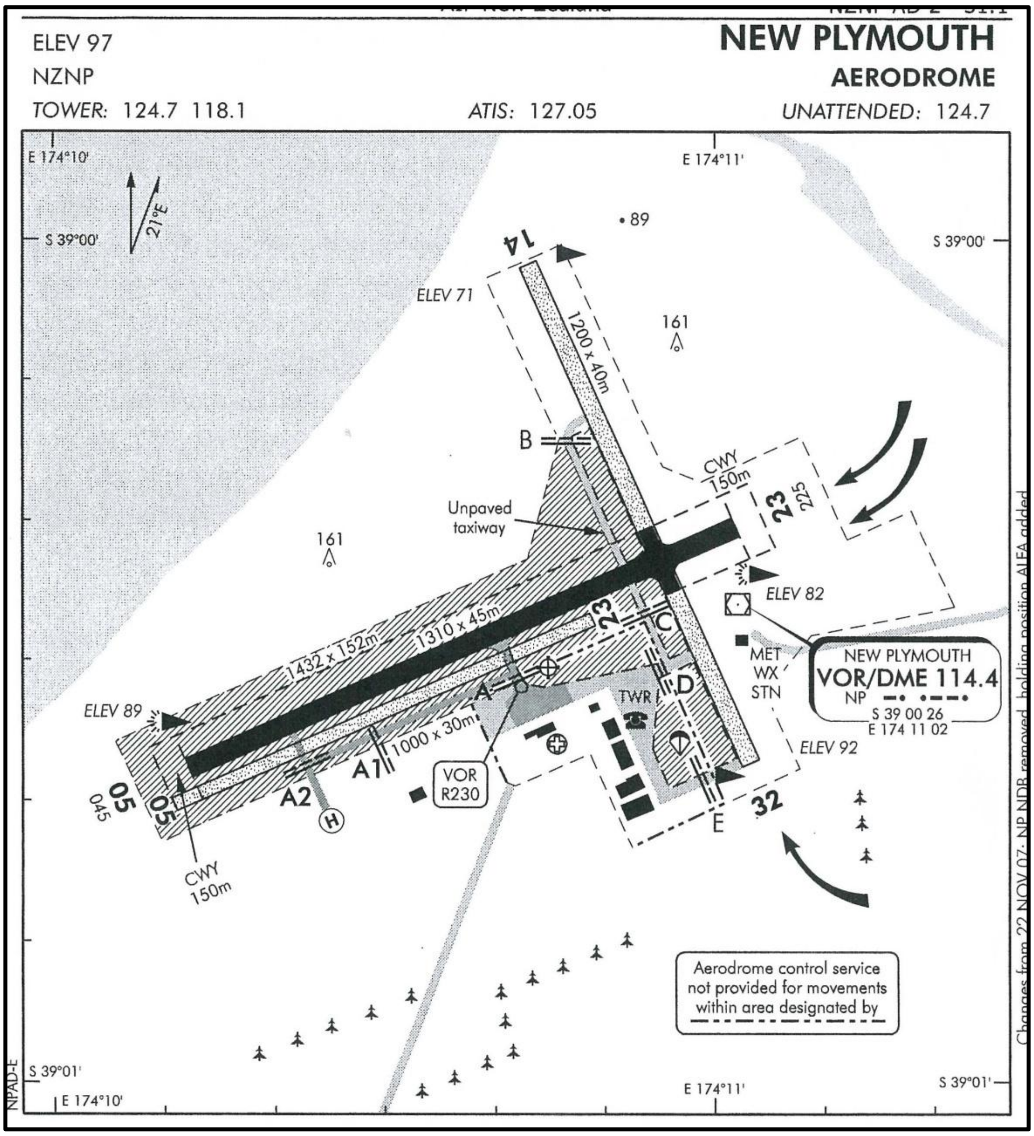


Figure 2
New Plymouth Aerodrome

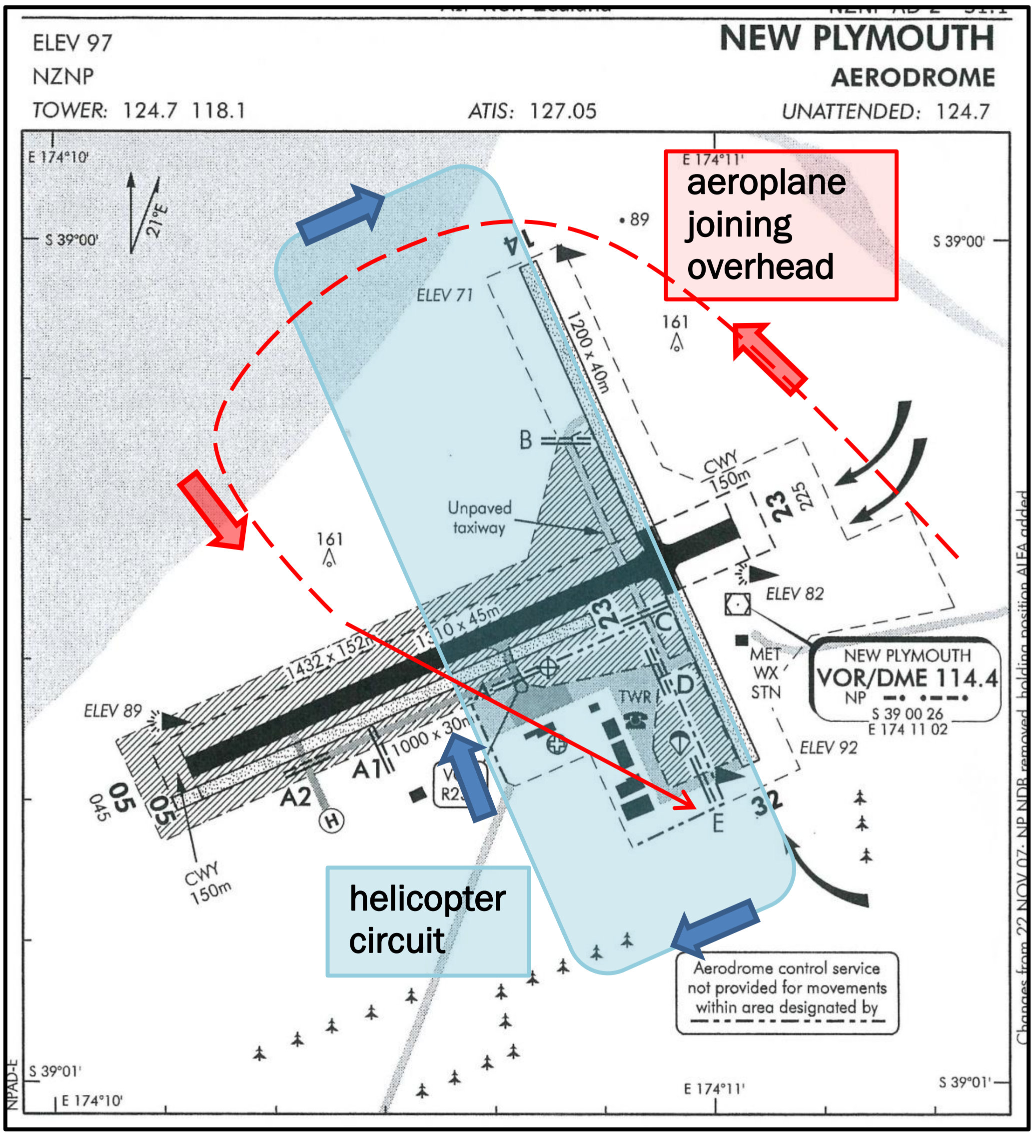


Figure 3
Conflicting flight paths

3.2. Personnel information

3.2.1. The aeroplane instructor had obtained a commercial pilot licence (aeroplane) in October 1999 and a C-category instructor rating in December 2007. He had been a part-time employee of the aero club since July 2008, and on 6 October 2009 obtained a B-category instructor rating and completed his biennial flight review. His total flight time was 1350 hours, about 1200 hours of which were on C152 aeroplanes operating from New Plymouth Aerodrome. He had no helicopter experience.

3.2.2. The aeroplane student had commenced flight training in 2009 and by 10 May 2010 he had accrued 54 hours' flight experience, of which about 18 hours had been solo flying. During the previous week he had had 2 dual flights and 2 solo cross-country flights. He passed the flight test for the issue of a private pilot licence 2 days after this incident.

3.2.3. The helicopter instructor was normally employed in Australia as a helicopter instructor. Since December 2009 he had owned, and operated, between duty periods with his employer, a flight training business using the helicopter. He held an airline transport pilot licence (helicopter) issued in 2003 and an A-category helicopter instructor rating. He also held a commercial pilot licence (aeroplane) issued in 1986 and a C-category aeroplane instructor rating. His most recent flight crew competency check had been conducted by his employer on 26 April 2010 and his previous biennial flight review had been conducted in New Zealand on 12 August 2009.

3.2.4. The helicopter student had received 19 hours of dual training only since commencing training in February 2010. He had last flown, before the incident flight, on 23 April 2010.

3.2.5. All of the pilots considered they had been fit to fly on 10 May 2010.

3.2.6. The controller had been an air traffic controller since 1981. His most recent proficiency assessment had been conducted on 10 August 2009. On 10 May 2010 the controller operated the morning shift, commencing at 0630 and ending at 1310. The controller considered he had been fit for duty. Around the time of the incident he was controlling 4 aircraft.

3.3. Aircraft information

3.3.1. The Cessna 152 is a high-wing light aeroplane that seats 2 persons and is commonly used in basic flight training. ZK-NPL was painted white with red trim.

3.3.2. The Robinson R22 is a light helicopter that seats 2 persons and is popular for basic flight training. ZK-HIE was painted dark grey.

3.3.3. Both aircraft were using the New Plymouth tower radio frequency during these flights. Neither was fitted with an airborne collision avoidance system, nor were they required to be so fitted.

3.4. Aerodrome information

3.4.1. New Plymouth Aerodrome has a main runway, 05/23, and a secondary runway 14/32. Although runway 23 was in use initially on 10 May 2010, both directions of the main runway, as well as grass runway 14, were used at different times during the hour preceding the incident. The standard circuit elevation is 1100 ft.

3.4.2. Apart from scheduled airline flights and those of a helicopter operator that flew medium helicopters in support of the off-shore petroleum industry, movements at the aerodrome were primarily those of a pilot training organisation affiliated to the local aero club. Basic helicopter pilot training had commenced, on an occasional basis, at the aerodrome in December 2009. The off-shore helicopter operator's flight procedures were similar to those for aeroplanes in regard to arrivals and departures, so most of the pilot training school and aero club pilots were unfamiliar with the tight circuits typically flown by light helicopters.

3.4.3. Aerodrome user groups were encouraged by the CAA, but at the time of the incident they had a voluntary and informal status. A user group did exist at New Plymouth, but even a year after the incident the helicopter instructor did not know that. Prior to the incident, the integration of helicopter and aeroplane training patterns had not been considered an issue.

3.4.4. The CAA advised that it had begun the process of amending Civil Aviation Rule Part 139, *Aerodrome – certification, operation and use* to require aerodrome operators to pro-actively assess and manage risks within their areas of responsibility and to give the CAA the necessary tools to monitor aerodrome performance. To assist aerodrome operators to manage their operational risks, in February 2011 the CAA issued Advisory Circular 139-15, *Aeronautical studies for aerodrome operators* (CAA, 2011b).

3.4.5. The advisory circular described an aeronautical study as a tool that should be a part of an aerodrome operator's safety management system and that could be used to review the appropriateness and adequacy of aerodrome and local airspace processes and procedures. Risk management was a key goal. As decisions made to mitigate one risk could affect other facets of aerodrome operations, the best results were likely if key stakeholders (often represented by a user group) had broadly agreed with the outcomes of such a study.

3.5. Air traffic control

General

3.5.1. The International Civil Aviation Organisation (ICAO) states that the prime objective of ATC is to prevent collisions between aircraft. A secondary purpose is to expedite and maintain a safe and efficient flow of air traffic (ICAO, 2001, section 2.2).

3.5.2. Airspace is classified according to the services and separation between aircraft that ATC provides, as well as certain operating requirements. New Plymouth Aerodrome lies within the New Plymouth control zone, which is Class D airspace. In Class D airspace ATC does not provide separation between VFR flights, but does give traffic information to enable pilots to look for possible conflicting traffic.[3] ATC separates runway movements for all aircraft at controlled aerodromes and provides wake turbulence separation in most circumstances.

3.5.3. The direction of runway circuits is left-hand unless promulgated otherwise for a particular runway, or the pilot is otherwise authorised or instructed by ATC.[4] The Manual of Air Traffic Services authorises a controller to instruct an aircraft to fly a non-standard circuit if the manoeuvre is not specifically precluded and adequate traffic control can be maintained. Such a clearance is specific to the aircraft so cleared. A controller can also vary the circuit altitude to fit weather, traffic separation or specific operational requirements (Airways, Manual of Air Traffic Services, p.RAC 4-1, effective 20 November 2008).

3.5.4. The Manual of Air Traffic Services requires a clearance to 'contain all the elements needed for separation, provision of traffic information and traffic management as appropriate'. In Class D airspace, a clearance has to 'provide for the safe and orderly management of traffic, and the prevention of collisions by the provision of effective traffic information' (Airways, Manual of Air Traffic Services, p.RAC 3-13, effective 8 April 2010).

Aerodrome joining procedures

3.5.5. The procedures for operations at unattended and attended (controlled) aerodromes are given in the Aeronautical Information Publication. A key requirement is that pilots 'entering or flying within the circuit [are to make all turns] in the direction appropriate to the runway-in-use' (Airways, Aeronautical Information Publication, p.AD1.5-2, 2 September 2004). The Aeronautical Information Publication gives guidance on simultaneous circuits at unattended aerodromes, and parallel (same direction) runway operations at controlled aerodromes. Generally, the first aircraft to form a traffic circuit has priority.

3.5.6. The pilots of the aeroplane requested a 'standard overhead re-join', examples of which are shown in Figure 4. The standard procedure should be followed at unattended aerodromes or at any aerodrome when a pilot is unfamiliar with the aerodrome layout or uncertain of the circuit traffic. The procedure requires, in part, for the joining pilot to 'pass overhead the aerodrome in order to observe wind, circuit traffic…'. Once the circuit in use or most suitable to use has been determined, the standard procedure is to 'make all subsequent turns in the direction of the traffic circuit' (Airways, Aeronautical Information Publication, p.AD1.5-4, 14 February 2008).

3.5.7. The Aeronautical Information Publication describes the overhead circuit joining procedure as a way of complying with Civil Aviation Rule 91.223, *Operating on and in the vicinity of an aerodrome*, which states in part[5]:

> (a) Except as provided in paragraph (b), a pilot of an aeroplane operating on or in the vicinity of an aerodrome must—
>
> > (1) observe other aerodrome traffic for the purpose of avoiding a collision; and

---

[3] Separation is provided by ATC in some cases of aircraft operating as special VFR flights (in poor meteorological conditions) and in all cases between special VFR flights and flights operating under IFR.

[4] Civil Aviation Rule Part 93 prescribes the processes for the approval and disestablishment of right-hand circuits.

[5] Sub-section (b) dealt with operations at an aviation event.

> (2) unless otherwise authorised or instructed by ATC, conform with or avoid the aerodrome traffic circuit formed by other aircraft; and
>
> (3) perform a left-hand aerodrome traffic circuit when approaching for a landing at and after take-off from an aerodrome that is published in the [Aeronautical Information Publication] NZ unless—
>
> (i) the pilot is otherwise authorised or instructed by ATC; or ...

3.5.8. Civil Aviation Rule 91.223 corresponds to an ICAO standard for the avoidance of collisions, which states, in part (ICAO, 2005, section 3.2.5):

> An aircraft operated on or in the vicinity of an aerodrome shall, whether or not within an aerodrome traffic zone:
>
> a) observe other aerodrome traffic for the purpose of avoiding collision;
>
> b) conform with or avoid the pattern of traffic formed by other aircraft in operation;
>
> c) make all turns to the left, when approaching for a landing and after taking off, unless otherwise instructed.

3.5.9. The CAA Flight Instructor's Guide states, 'The standard overhead join procedure is the **standard** [emphasis in original] method for joining the traffic circuit at an aerodrome' (CAA, 2003, p.193). The guide further states, 'When joining at a controlled aerodrome, the pilot-in-command always has the option of requesting a standard overhead join' (*ibid*, p.199), or ATC could instruct a pilot to follow the procedure.

3.5.10. The CAA Flight Instructor's Guide confirms the priority of established traffic in setting the circuit direction, stating (CAA, 2003, p.195):

> Determine the runway in use by reference to the windsocks, or other traffic established in the circuit. All subsequent turns are made in the circuit direction
>
> and
>
> Aircraft already in the circuit have right of way. This means if aircraft in the circuit are using a runway considered unsuitable for your operation, the responsibility of avoiding conflict is on the joining aircraft.

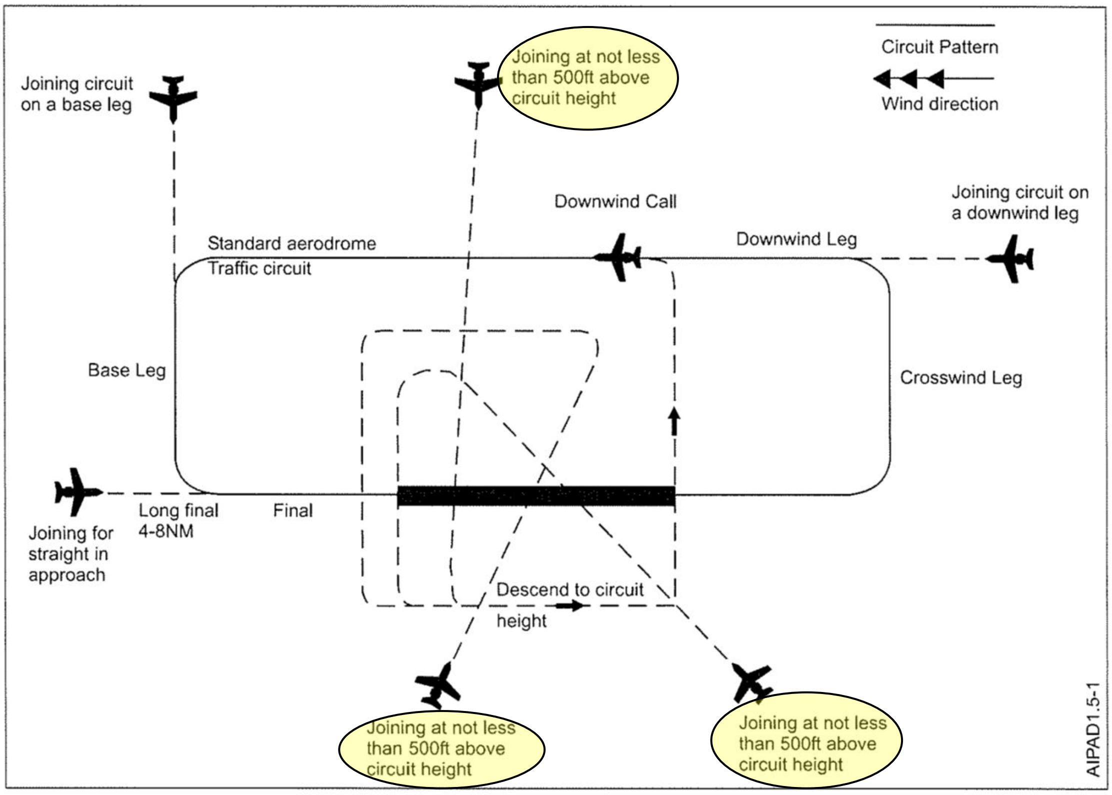
3.5.11. The controller said that he expected the aeroplane to join for a left-hand circuit from the overhead position. The pilot's next radio call that they were 'descending non-traffic side to join left-hand downwind 14' was consistent with the controller's expectation. However, the aeroplane instructor later said he would not have flown a circuit contrary to that of the preceding traffic when at an uncontrolled aerodrome.

3.5.12. In an issue of Vector magazine published after the New Plymouth incident, the CAA cautioned that a 'standard' overhead rejoin might not be the safest option under all circumstances (CAA, 2010b, p.15). The article primarily concerned joining the circuit at an unattended aerodrome and gave examples of when a standard join might not be prudent, for example when an opposed circuit was in use or helicopters were conducting autorotation training. The article, in stressing the importance of pilots communicating their positions and intentions, stated:

> ... only continue with an overhead join if there is no potential for a traffic conflict while descending to circuit height. If you see or hear any traffic on the "non-traffic" side of the runway you have chosen to use – do not descend in accordance with the standard overhead join plan.

3.5.13. In a later, short article in Vector, the CAA stressed the importance of complying with the published circuit direction when conducting an overhead joining procedure (CAA, 2011a, p.3).

3.5.14. The importance of joining a circuit correctly was illustrated by the CAA flight test standards stating that a pilot who joined contrary to preceding traffic and who failed to maintain sight of the traffic would be declared 'not yet competent' in that criterion.[6]



Source: Aeronautical Information Publication

Figure 4
Aerodrome traffic circuit
(Examples of the standard overhead circuit joining procedure are highlighted)

Traffic information

3.5.15. ATC does not provide separation between VFR aircraft in Class D airspace, but at times it would be appropriate to provide the aircraft with traffic information, the purpose of which is to:

> alert a pilot to other known… traffic, which may be in proximity to the position or intended route of the flight, thereby helping the pilot avoid a collision. The provision of traffic information is not intended to relieve the pilot of the responsibility of continued vigilance to see and avoid other aircraft; it is intended to assist visual surveillance by drawing attention to possible conflicting traffic (Airways, Manual of Air Traffic Services advisory circular Nr 12, 2 June 2011).

3.5.16. That ATC advisory circular lists 'integration into a traffic pattern' and 'positioning for the purpose of sequencing' as aerodrome control 'situations where traffic information may be provided for the purpose of situational awareness or the prevention of collision'. The circular also states:

> When separation within controlled airspace is not applicable, prevention of collision is collaborative between ATC and **each affected pilot**… It is achieved by the provision of an ATC clearance… supported by traffic information that will enable **each pilot**, as far as practicable, to comprehend the relative position of other aircraft, and if necessary to sight and avoid each other [emphasis added].

[6] CAA Flight Test Standards Guide, Recreational and Private Pilot Licence Issue and Biennial Flight Review (BFR). Aeroplane, Revision 7, September 2010, pp.78, 94.

3.5.17. The ATC advisory circular further states that 'the provision of traffic information is an essential component of the provision of an [air traffic service], therefore where a threat of collision exists, it must be passed'.

3.5.18. 'Traffic avoidance advice' is described as an enhancement of traffic information that 'pre-supposes an awareness, either by a pilot or a controller, of a higher risk of collision'. Traffic avoidance advice could include vectoring, rerouting, holding or an altitude change.

3.5.19. Although VFR aircraft are not separated in Class D (or Class C) airspace, some provisions of the Manual of Air Traffic Services in regard to separation could be usefully observed by VFR pilots when instructed to report sighting or to follow an aircraft (Airways, Manual of Air Traffic Services, p.RAC 5-7, 15 February 2007). For example:

> The acceptance of a clearance to… "follow" another aircraft is an acknowledgement that the pilot will keep the other aircraft continuously in sight and maintain adequate separation from that aircraft.
>
> and
>
> When instructed to… "follow" another aircraft, a pilot is required to promptly advise ATC… if visual contact is lost.

ATC services to VFR aircraft

3.5.20. The helicopter instructor said that in his experience ATC instructions to VFR aircraft in Class D airspace often amounted to 'fairly positive separation', especially between VFR aircraft and those aircraft operating under IFR. However, he believed the onus for collision avoidance was on pilots who acknowledged traffic information.

3.5.21. The aeroplane instructor understood that he was responsible for his own separation from other traffic in Class D airspace. However, he recalled occasions when ATC had delayed approval for a manoeuvre or required him to orbit to fit into a VFR traffic sequence, which instructions he took to be, in effect, the provision of separation.

3.5.22. The CAA sought to dispel that sort of misconception with an article in the Vector magazine that emphasised VFR aircraft were not, apart from specific exceptions, separated from other VFR aircraft (CAA, 2010c, p.13). The article, written before this incident but published afterwards, commented that 'it can be surprising for a VFR pilot to realise that even though they have been given a clearance by a control tower… they are not being separated from other VFR traffic". This situation also applied to VFR traffic in Class C airspace.

3.5.23. The Vector article stressed that traffic avoidance for pilots of VFR aircraft depended on their having a good lookout, making proper position reports, having correct situational awareness and adhering to the general flight rules published in the Civil Aviation Rules.

3.5.24. On 4 May 2010, the CAA issued Advisory Circular 172-2, *Air traffic services at controlled aerodromes* to provide guidance to controllers and pilots because the rules, which generally met ICAO standards and recommended practices, were often imprecise. A second aim was to ensure that Airways provided a 'consistent and predictable' service at similar air traffic service units. Audits of air traffic service units had shown that local adaptations had in some cases deviated from the intended procedures. The advisory circular stated, in part:

> 1.3.3 The level of air traffic service that is to be provided at an aerodrome depends on the classification of the airspace designated for the control zone. … An inconsistent level of aerodrome control service may lead a pilot to misinterpreting the ATC separations being applied in a particular classification of airspace and, in the worst case, expect separation when none is provided.

3.6. See-and-avoid principle

3.6.1. See-and-avoid is an established operating principle for reducing the risk of a collision, particularly in uncontrolled airspace, but the method is applicable at all times when flying in visual meteorological conditions. Civil Aviation Rule 91.229, *Right-of-way rules,* is typical of national civil aviation rules in requiring that:

> A pilot of an aircraft… must, when weather conditions permit, regardless of whether the flight is performed under IFR or under VFR, maintain a visual lookout so as to see and avoid other aircraft…

3.6.2. As well as conducting an active visual scan for other aircraft, pilots are alerted where to look by the content of radio transmissions. Therefore, it is essential that pilots pay attention to others' radio transmissions. The importance of an active look-out and listen-out must be explained to student pilots on their first day of training and emphasised continually thereafter.

3.6.3. However, many studies, including one by the Australian Bureau of Air Safety Investigation in 1991, have confirmed that the see-and-avoid concept has many limitations. Examples of these are given in Appendix 1. These limitations should be well known to licensed pilots and have been re-stated by the CAA[7] and in previous accident reports of the Commission.[8]

3.6.4. When a pilot has doubt about the location of a threat aircraft, a simple solution is to radio ATC or to broadcast, 'Where is the traffic?'. Similarly, if ATC has advised a pilot of another aircraft that is a collision risk (which implies it should be kept in sight), the pilot should advise ATC when the traffic is no longer seen.

3.6.5. Technological solutions to minimise the collision risk include airborne collision avoidance systems of varying complexity and cost. These systems are most effective if the conflicting aircraft are fitted with ATC transponders with an altitude-reporting function, which are now mandatory in all controlled airspace in New Zealand.

3.7. Other occurrences

3.7.1. In 2009, the Commission published its report of an inquiry into a fatal collision that had occurred on 17 February 2008 between a light aeroplane and a light helicopter in the vicinity of Paraparaumu Aerodrome, an uncontrolled aerodrome. The helicopter was established in one circuit when the aeroplane joined overhead for a parallel runway with an opposite-direction circuit pattern. Two pertinent findings in the Commission's report were (the Commission, 2009, p.33):

> The design of the aerodrome circuit pattern, with counter-rotating circuit directions around parallel runways, together with the standard overhead joining procedure, was flawed in that it created the potential for 2 aircraft in different circuits to be at the same height at the same place.
>
> The relative speeds involved, difficulty in visually detecting other aircraft under certain conditions, and the natural limitations of human performance meant that the concept of "see and avoid" cannot be relied on as the only defence for preventing mid-air collisions. As well as radio communications, aerodrome circuit design and other technologies should be considered by regulators and aerodrome operators to lessen the risk.

3.7.2. As a result of the Paraparaumu accident, that aerodrome operator amended the published aerodrome information to discourage the use of the standard overhead circuit joining procedure. The amended information also noted that 'helicopters will be much closer to the aerodrome during autorotation practice than during a normal circuit' (Airways, Aeronautical Information Publication, p.NZPP AD 2-35-1). The CAA published an article in its Vector magazine to remind pilots of the correct procedures at unattended aerodromes (CAA, 2010b, p.15).

3.7.3. The Commission in its report on the Paraparaumu accident made 3 recommendations to the Director aimed at reducing the risk of collision, particularly at non-certificated aerodromes as Paraparaumu was at the time, and which are uncontrolled. One of those recommendations was that the Director 'review the operations at other aerodromes around New Zealand that have opposing circuits, to assess and minimise the potential for mid-air collisions'.

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[7] CAA, 2009, p.4.

[8] For example, Report 08-001, mid-air collision, Paraparaumu, 17 February 2008.

3.7.4. On 11 September 2009, in reply, the Director noted that 'the Aeronautical Information Publication Volume 1 AD 1.5 clearly provides advice on the issue of Standard Overhead Circuit Joining procedures'. He did not accept the recommendation as written, but he undertook (the Commission, 2009, p.36):

> ... to make aerodrome operators aware of the TAIC recommendation, and their responsibilities with respect to the formation of aerodrome user groups/safety committees.
>
> and
>
> ... to make aerodrome operators aware of the risks associated with a 'mix' of operational activities, and their need to develop appropriate local procedures to minimise the risk of mid-air collisions.

3.7.5. The CAA advised at that time that it had reviewed the procedures published for all New Zealand aerodromes and had not identified any safety issues associated with opposed circuit directions as long as pilots complied with the Civil Aviation Rules and the aerodrome operational conditions.

3.7.6. On 1 November 2010 the CAA was notified of an incident that had occurred on 22 October 2010 at Palmerston North Aerodrome in which a large freight aeroplane joined downwind left-hand while light training aeroplanes were operating in the published right-hand circuit. The pilot of the freight aeroplane reported taking avoiding action after one of the light aeroplane pilots, who was confused and unfamiliar with the situation, carried out an orbit late on the downwind leg. The incident occurred at night outside the ATC hours of service.

3.7.7. The procedures that were in place at Palmerston North had been agreed in November 2008 by the aerodrome user group, which comprised representatives of the aerodrome operator, Airways, the Royal New Zealand Air Force, scheduled airlines, and operators based at Palmerston North Aerodrome. The procedures were intended to satisfy recommendations made by the Director after a March 2008 CAA study of the Palmerston North airspace, but the CAA was not a party to the agreement and had not known that the procedures had a provision for simultaneous opposed circuits.

3.7.8. On 23 February 2011, as noted above, the CAA published Advisory Circular 139-15, *Aeronautical studies for aerodrome operators*, as a guide for the management of operational risks, such as a mix of different activities.

4. Analysis

4.1. This serious incident occurred when the pilots of the aeroplane, who were conducting an overhead circuit joining procedure, descended through the downwind leg of the circuit of the helicopter, which was established in a non-standard circuit for the same runway. The pilots of both aircraft had been cleared by ATC for their respective procedures, and they and the controller had recognised that the aeroplane's descent could conflict with the helicopter's circuit.

4.2. The controller issued the clearance to the aeroplane after its pilots said they had the helicopter in sight. Within Class D airspace such as the New Plymouth control zone, separation was not applied by ATC between VFR aircraft, therefore each pilot-in-command was responsible for seeing and avoiding the other aircraft. The situation increased the risk of a collision, but there was an expectation that the risk would be mitigated by the aeroplane pilots performing the joining procedure safely and all of the pilots exercising an effective lookout.

4.3. However, both of the aeroplane pilots lost sight of the helicopter before beginning the descent and continued with the procedure without advising each other or ATC. The helicopter pilots were unable to look for the aeroplane until they were on the crosswind leg of their circuit, and the controller had not specifically advised them that the aeroplane was relevant traffic.

4.4. This incident occurred at a controlled aerodrome, and although no collision resulted, some of the circumstances were similar to those of the collision at the uncontrolled Paraparaumu Aerodrome in 2008. After that accident, the Commission made recommendations that were intended to prevent a recurrence. However, the present investigation found that the aviation community, from regulator to operators, had not acted in concert or consistently to reduce the mid-air collision risk at aerodromes.

4.5. The following safety issues were identified and are discussed more fully below:

- the simultaneous use of opposed circuits
- the correct interpretation of the overhead circuit joining procedure.

4.6. The following factors are also discussed:

- the limitations of the see-and-avoid principle for collision avoidance
- pilots' understanding of the ATC services provided to VFR aircraft.

4.7. Environmental and aircraft factors were relevant only to the extent that they affected the conspicuity of the helicopter and hence the effectiveness of the see-and-avoid principle.

Simultaneous opposed circuits

4.8. Apart from the passenger aeroplane that had landed, the helicopter and the training aeroplane were the only 2 aircraft in the vicinity of the aerodrome. The controller expected that the aeroplane would fly a left-hand pattern to runway 14, which he recognised could lead to a conflict with the helicopter. The controller mitigated this risk to some extent by informing the aeroplane pilots that the helicopter was in a right-hand circuit and asking the pilots if they had it in sight before he cleared them for the joining procedure. Although not specifically stated, the traffic information was intended to caution the pilots of the aeroplane that a descent on the 'non-traffic' side of the left-hand circuit would pass through the altitude and downwind leg of the helicopter's circuit.

4.9. After passing the traffic information to the aeroplane pilots, the controller could have avoided the identified potential conflict had he instructed them to 'pass behind the helicopter', or instructed them to join for a right-hand circuit, a variation with which a student pilot about to sit their flight test should have easily coped.

4.10. However, after the aeroplane pilots reported that the helicopter was in sight, the weight of responsibility for collision avoidance shifted from the controller to them. If the helicopter pilots had sighted the aeroplane early enough, the collision risk should have reduced further, but they did not see it until a collision nearly occurred.

4.11. The instructor in the aeroplane said he would not have flown a circuit opposed to that of the preceding traffic if he had been at an uncontrolled aerodrome. However, compliance with Civil Aviation Rule 91.223 was required at uncontrolled and controlled aerodromes. Therefore, it appeared that the instructor's instinct to reduce the collision risk was overridden by his understanding of how to comply with the clearance for the standard joining procedure.

4.12. The incident drew attention to what should be an obvious threat: a situation of simultaneous opposed circuits means there is no 'non-traffic side' for a joining aircraft to descend to circuit altitude, which increases the risk of collision. While controllers need to have the flexibility to direct a specific aircraft to operate contrary to a published circuit, they should not do so if that creates an unmanageable risk of collision, and all affected pilots should be aware of such an abnormal situation. Unless a controller is providing separation, the situations when an aircraft can be safely cleared to perform an opposed circuit will be limited.

Finding

The controller's instructions were valid for Class D airspace, but he did not manage the increased risk of collision presented by the aeroplane descending to circuit altitude in the opposite direction.

4.13. That such a situation could be 'set up' at a controlled aerodrome suggested that the lessons of the Paraparaumu accident in 2008 had not been understood by all pilots and controllers. After the Paraparaumu accident, the Director indicated that he would encourage the formation of aerodrome user groups and expect them to develop local procedures to minimise the risk of collisions. Ironically, it was a user group that developed a local procedure incorporating opposed circuits that were a factor in the incident at Palmerston North in October 2010.

4.14. The Commission's recommendations after the Paraparaumu accident might have been interpreted by some industry participants as applying to uncontrolled aerodromes only. However, the role of ATC in the New Plymouth incident and the industry cross-section that was involved in formulating the Palmerston North user group procedures suggested that the aviation community had not fully understood or taken effective action at all aerodromes to remove, or at least reduce, the collision risk associated with opposed circuits.

4.15. In September 2009, the CAA advised the Commission that it had not identified any safety issues associated with opposed circuits as long as pilots complied with the Civil Aviation Rules and the aerodrome operational conditions. In a submission made to the Commission during the present inquiry, the CAA stated its preference for aerodrome operators to take more responsibility for assessing and mitigating the operational risks at their aerodromes, rather than have the CAA intervene. The use of opposed circuits to segregate a mix of aircraft types or activities was one such risk to be managed. This preference of the CAA was in line with the proposed amendment to Civil Aviation Rules Part 139. In the interim, the CAA has worked with some aerodrome operators and Airways to mitigate identified risks (see section 6.2).

Finding

The aviation community, including the regulator, Airways, aerodrome operators and aircraft operators, does not have a consistent approach to reducing the collision risks associated with simultaneous opposed circuits at aerodromes.

4.16. The requirements of sub-sections (a)(2) and (a)(3) of Civil Aviation Rule 91.223 could be read as conflicting, when applied to the circumstances of the New Plymouth incident. The rule stated, in part:

(a) Except as provided in paragraph (b), a pilot of an aeroplane operating on or in the vicinity of an aerodrome must—

(1) observe other aerodrome traffic for the purpose of avoiding a collision; and

(2) unless otherwise authorised or instructed by ATC, conform with or avoid the aerodrome traffic circuit formed by other aircraft; and

(3) perform a left-hand aerodrome traffic circuit when approaching for a landing at and after take-off from an aerodrome that is published in the [Aeronautical Information Publication] NZ unless—

(i) the pilot is otherwise authorised or instructed by ATC; or...

4.17. As the controller had not instructed the aeroplane to fly a different circuit from that of the helicopter, its pilots would seem to have been required by (a)(2) to fly the same right-hand circuit as the helicopter (or remain clear), but (a)(3) also appeared to require them to fly the published left-hand circuit for runway 14.

4.18. Specialist ATC staff of the CAA and Airways advised that a non-standard circuit required a specific clearance, so in their view the pilots of the aeroplane were correct in joining for the published left-hand circuit, in accordance with sub-section (a)(3). As a left-hand circuit did not conform with that of the helicopter, the pilots of the aeroplane were therefore obliged by sub-section (a)(2) to avoid the helicopter's circuit. In practice, they might have achieved that by judging carefully the timing and flight path of their descent from 2000 ft to the circuit altitude.

4.19. Although Civil Aviation Rule 91.223(a)(2) reflected the corresponding ICAO standard and the involved persons in the New Plymouth incident had the same expectation of which way the aeroplane would turn, the correct application of the rule to a situation like that, in which the aircraft ahead was flying a non-standard circuit, was unclear. The ATC specialists disagreed, noting that the controller had not given specific alternative instructions to the aeroplane. However, if an ATC presence was required to understand the rule, the rule was less likely to be applied correctly at an uncontrolled aerodrome. An unclear rule for right-of-way procedures and collision avoidance was a safety issue that needed addressing.

Finding

Civil Aviation Rule 91.223 can be interpreted ambiguously in non-standard traffic situations, which could contribute to the collision risk at aerodromes.

The overhead circuit joining procedure

4.20. Although ATC could instruct an aircraft to join a circuit via the overhead procedure in order to establish or maintain a traffic sequence, the procedure was carried out more often at uncontrolled aerodromes. The pilots of the aeroplane requested the procedure to practise what the student would likely be required to demonstrate on his flight test. New Plymouth Aerodrome was controlled at the time of the incident and the pilots had been listening to the tower frequency, so they knew the conditions and traffic before reaching the overhead. The benefits of the practice were primarily in the student sighting the traffic and flying the correct pattern.

4.21. The Aeronautical Information Publication's description of the standard overhead joining procedure required a pilot, having determined the runway in use, to 'make all subsequent turns in **the direction of the traffic circuit**' (Aeronautical Information Publication, p.AD1.5-4) [emphasis added]. There was potential for the direction of the joining procedure to be mistaken because of the subtle distinction between **the direction of the traffic circuit**, which implied preceding traffic, and the general circuit procedure of making all turns 'in the **direction appropriate to the runway in use**' [emphasis added]. When there was preceding traffic, Civil Aviation Rule 91.223 required the joining aircraft to conform with or avoid the established circuit, but the rule did not address the possibility of the preceding aircraft being in a non-standard circuit.

4.22. The different interpretations of required turn direction are shown by the controller and the involved pilots expecting the aeroplane to join for the left-hand circuit, appropriate to the runway in use, while the direction of the traffic circuit flown by the helicopter was right-hand. Specialist ATC staff of the CAA insisted that the correct interpretation of the joining procedure was that the runway in use was determined by the pilot of the first aircraft to arrive, or by ATC, and the circuit direction was then that published for the chosen runway. At a controlled aerodrome, specific clearance was required for an aircraft to fly a non-standard circuit. Therefore, the specialists advised, as the helicopter was operating in the runway 14 circuit, the correct circuit direction for the aeroplane was left-hand, unless cleared otherwise by ATC.

4.23. The pilot of an aircraft joining from overhead needs to identify the non-traffic side of the circuit so that the descent to circuit altitude can be accomplished safely. As an aircraft joins a circuit before operating in the circuit, it could be argued that if the traffic conditions cause a conflict, the joining requirement to 'make all subsequent turns in the direction of the traffic circuit' should have precedence over the general circuit procedure of making all turns in the direction appropriate to the runway in use. At New Plymouth, had the pilots of the aeroplane advised that they would follow the helicopter and join for a right-hand circuit, or had they requested or been instructed to do so, the potential conflict that they all recognised likely would have been eliminated.

4.24. Discussions with some very experienced flight instructors confirmed different opinions regarding the correct way to join in circumstances like those of this incident. The lack of agreement could be due to the Aeronautical Information Publication and Civil Aviation Rule interpretations noted earlier, but the CAA Flight Instructor's Guide was clear in stating that the circuit direction for a joining aircraft was the same as that being flown by an aircraft already in a circuit, and that the aircraft ahead had priority. The CAA had discussed the overhead joining procedure in a Vector article (CAA, 2010b, p.15), but as there were continuing misunderstandings in regard to a common flight manoeuvre, which has been implicated in collisions, the relevant Civil Aviation Rule and references in the Aeronautical Information Publication and Flight Instructor's Guide should be clarified.

> **Finding**
>
> The descriptions of and requirements for the standard overhead circuit joining procedure that are published in Civil Aviation Rules, the Aeronautical Information Publication and the Flight Instructor's Guide can be misinterpreted or misapplied in non-standard traffic situations. This could contribute to the collision risk at aerodromes.

The see-and-avoid principle

4.25. The controller and instructors of both aircraft realised that the aeroplane, in joining overhead for a left-hand circuit, might conflict with the helicopter operating in a right-hand circuit for the same runway. Reducing that risk depended on the pilots of both aircraft applying the see-and-avoid principle and, in particular, the pilots of the aeroplane keeping the helicopter in sight.

4.26. Pilots should be taught from their earliest instructional flights how to combine a thorough look-out with an attentive radio listen-out in order to form an accurate understanding of the traffic situation. Pilots learnt how to project the flight paths of other aircraft and to alternate looking out for the traffic with the performing of essential activities within the cockpit, such as completing checks. If there was a heightened risk of collision, continuous sighting of the traffic was required.

4.27. Pilots are assisted in looking for traffic by receipt of traffic information from ATC, when an air traffic service is provided, combined with their own continuous radio listening watch. However, in practice pilots tend to vary the attention given to others' transmissions, particularly if a transmission does not contain the pilot's call-sign or if they are engaged in flight instruction or dealing with an emergency.

4.28. The Manual of Air Traffic Services described collision avoidance in Class D airspace as a 'collaborative exercise' between ATC and pilots, but it also required controllers to avoid conflict situations and to pass traffic information to all affected aircraft. The controller at New Plymouth expected the pilots of the helicopter to have overheard him when he advised their position to the aeroplane. However, the situation was one of recognised potential conflict, and mutual traffic information should have been passed. Although the helicopter pilots started looking for the aeroplane as soon as they could, it was unlikely, even with specific advice, that they would have seen it any earlier.

> **Finding**
>
> The controller recognised the potential for a conflict, but he provided traffic information to the pilots of the aeroplane only, and not to the pilots of the helicopter.

4.29. The controller had provided a height buffer between the joining aeroplane and the helicopter circuit, and the aeroplane pilots should have maintained that buffer until they were assured that their descent would remain clear of the helicopter. They did not have to descend as soon as ATC had cleared them for the procedure.

4.30. The pilots of the aeroplane reported seeing the helicopter when advised by ATC and when the helicopter was on the crosswind leg of its circuit. However, as the aeroplane continued its left turn before starting the descent, the helicopter 'just disappeared'. It was possible that as the 2 aircraft turned towards each other, there was a period of no apparent relative motion. Movement is one of the strongest cues for detecting another aircraft. Each aeroplane pilot should have realised as soon as he lost sight of the helicopter that unless the other pilot still had the helicopter in sight, it would not be safe to descend. However, they both lost sight of it and did not tell each other, and commenced the descent.

4.31. The lowered wing of the aeroplane would have obscured the helicopter, which was flying a circuit pattern much closer to the runway than aeroplanes flew. In addition, the controller had asked the helicopter pilots to keep their circuit 'tight', so the aeroplane pilots, being unfamiliar with helicopter circuits anyway, misjudged where to look to re-sight the helicopter.

> **Finding**
>
> The incident would not have occurred had either of the aeroplane pilots stopped the descent when he lost sight of the helicopter.

4.32. If a pilot was asked by ATC to report sighting certain traffic before being cleared for a procedure, it was implied that the cleared pilot had to keep the traffic in sight. That was an explicit requirement under IFR, and if visual contact was lost with the aircraft ahead, ATC had to be advised. However, a VFR pilot is not explicitly required to do so. The instructor in the aeroplane did not ensure that he or his student kept the helicopter in sight during the joining manoeuvre, even though he recognised the increased risk of collision initially; and when he did lose sight of the helicopter, he mistook the spacing of the helicopter's downwind leg. The correct action would have been to advise ATC that the helicopter was no longer in sight and to have discontinued the descent.

> **Finding**
>
> The incident would have been less likely to occur had the aeroplane pilots immediately broadcast that they had lost sight of the helicopter.

4.33. The aeroplane instructor's unfamiliarity with the light helicopter circuit was likely due to the low frequency of helicopter training at the aerodrome. The aerodrome users might have been more aware of helicopter characteristics had the helicopter instructor joined the user group when he started business and informed the group of his planned activity.

4.34. The planned establishment of a new flight training business at an aerodrome was an example of a potential change in risk profile that the CAA believed an aerodrome operator should identify and assess. The involvement of aerodrome user groups in aeronautical studies should ensure greater awareness of planned changes and improved safety. The proposed amendment to Civil Aviation Rule Part 139 was intended to assist the CAA and operators towards that goal.

> **Finding**
>
> Local aerodrome user groups benefit their participants by providing information about their respective activities. Aerodrome operators, in order to manage their operational risks, should require their relevant tenants and users to participate fully in such groups.

4.35. Once the aeroplane and the helicopter entered the cone of invisibility above the tower, the controller would have been restricted in his ability to offer traffic avoidance advice, even if the aeroplane pilots had advised losing sight of the helicopter. The potential for the controller to lose sight of the traffic would appear to be another reason to provide mutual traffic information.

4.36. The see-and-avoid principle, in spite of its well documented limitations, was effective in preventing a collision in this case. The principle remains an essential tool for collision avoidance, particularly where there is low relative speed, but its application requires pilots and controllers to seek, share and use the best available information regarding other traffic.

4.37. Even for aircraft fitted with airborne collision avoidance systems, the first action by the pilots on receipt of a‘traffic advisory’ is to try to sight the other traffic. Furthermore, airborne collision avoidance systems do not generate traffic advisories under some conditions, especially at low heights, therefore pilots still have to look for and sight potentially conflicting traffic.

> **Finding**
>
> The see-and-avoid principle continues to have relevance, provided pilots and controllers counter its well-known limitations by the appropriate sharing of traffic information.

Air traffic control of VFR aircraft

4.38. At controlled aerodromes in New Zealand, which were designated Class C or Class D airspace, ATC procedures for sequencing VFR traffic were formalised and applied with little variation. So it was not surprising that procedures that were intended to achieve safe operations and expeditious traffic flow often had the same outcome as formal separation standards.

4.39. For example, by requiring the aeroplane to join overhead at 2000 ft, rather than the usual 1600 ft (which was 500 ft above the circuit altitude), the controller created a 500 ft buffer between the aeroplane and helicopter circuit altitudes. The pilots of the aeroplane were required to comply with the instruction, which separated them from the helicopter, until they had sighted the helicopter and were cleared for the joining procedure. The controller called this 'segregation' rather than separation.

4.40. ATC does not separate VFR aircraft[9], apart from runway and wake turbulence separation. However, the involved instructors were not alone in observing that ATC instructions often gave an impression of being *de facto* separation. The CAA acknowledged this in a recent Vector article (CAA, 2010c, p.13) and in Advisory Circular 172-2.

4.41. The aeroplane instructor's comment that his application of Civil Aviation Rule 91.223 depended on whether ATC was in attendance was a correct interpretation of the rule, to a point. However, the comment, and his not advising ATC that visual contact with the helicopter had been lost, might have reflected a misplaced reliance on ATC and a misunderstanding that an ATC instruction to a VFR aircraft meant separation was being applied.

4.42. The CAA has attempted, with an article in Vector, to clarify pilots' understanding of the services provided to VFR traffic in different classes of airspace, and has taken action in conjunction with Airways as described in section 6.2(b).

Finding

Some VFR pilots continue to misconstrue ATC traffic information and instructions in Class C and D airspace as the provision of traffic separation.

[9] With the exception of Special VFR aircraft in control zones under specified meteorological conditions.

5. Findings

5.1. The controller's instructions were valid for Class D airspace, but he did not manage the increased risk of collision presented by the aeroplane descending to circuit altitude in the opposite direction.

5.2. The aviation community, including the regulator, Airways, aerodrome operators and aircraft operators, does not have a consistent approach to reducing the collision risks associated with simultaneous opposed circuits at aerodromes.

5.3. Civil Aviation Rule 91.223 can be interpreted ambiguously in non-standard traffic situations, which could contribute to the collision risk at aerodromes.

5.4. The descriptions of and requirements for the standard overhead circuit joining procedure that are published in Civil Aviation Rules, the Aeronautical Information Publication and the Flight Instructor's Guide can be misinterpreted or misapplied in non-standard traffic situations. This could contribute to the collision risk at aerodromes.

5.5. The controller recognised the potential for a conflict, but he provided traffic information to the pilots of the aeroplane only, and not to the pilots of the helicopter.

5.6. The incident would not have occurred had either of the aeroplane pilots stopped the descent when he lost sight of the helicopter.

5.7. The incident would have been less likely to occur had the aeroplane pilots immediately broadcast that they had lost sight of the helicopter.

5.8. Local aerodrome user groups benefit their participants by providing information about their respective activities. Aerodrome operators, in order to manage their operational risks, should require their relevant tenants and users to participate fully in such groups.

5.9. The see-and-avoid principle continues to have relevance, provided pilots and controllers counter its well-known limitations by the appropriate sharing of traffic information.

5.10. Some VFR pilots continue to misconstrue ATC traffic information and instructions in Class C and D airspace as the provision of traffic separation.

6. Safety actions

General

6.1. The Commission classifies safety actions by 2 types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry, and which would otherwise have resulted in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally have resulted in the Commission issuing a recommendation.

6.2. Safety actions addressing safety issues identified during this inquiry:

(a) on 15 July 2011, the CAA advised that its Aeronautical Services Unit, in conjunction with the CAA Aviation Safety Advisers, was working with a number of aerodrome operators to address specific issues identified with local procedures. In particular, the Memorandum of Understanding of the Palmerston North aerodrome user group was being reviewed to address the identified deficiencies. The CAA was to review any amendments for acceptability

(b) on 15 July 2011, the CAA advised that the Director had requested Airways to undertake a safety and risk review of all its regional tower operations, to be completed before October 2011. (The CAA later advised that the target date had been extended to November 2011.) The review followed CAA audits conducted in 2008 that identified inconsistencies in the level of air traffic management procedures at regional towers. The relatively high rates of reported airspace and aerodrome incidents at some regional aerodromes were considered by the CAA to give concern for the level of safety at those aerodromes.

6.3 Safety actions addressing other safety issues:

Nil.

7. Recommendations

General

7.1. The Commission may issue, or give notice of, recommendations to the persons or organisations that it considers most appropriate to address the identified safety issues.

7.2. In the interests of transport safety, it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents.

Recommendations

On 26 October 2011, the Commission recommended to the Director of Civil Aviation that he take action to address the following safety issues:

7.3. The aviation community, including the regulator, Airways, aerodrome operators and aircraft operators, does not have a consistent approach to reducing the risk of simultaneous opposed circuits at aerodromes. Simultaneous opposed circuits can exist as a result of locally agreed procedures at uncontrolled aerodromes, and also at controlled aerodromes under some conditions. (020/11)

7.4. ATC, having cleared an aircraft to make a non-standard circuit, is not prevented from concurrently clearing a following aircraft to join the circuit by the standard overhead joining procedure, even though that could lead to a head-on traffic conflict. (021/11)

7.5. The descriptions and requirements for the standard overhead circuit joining procedure that are published in the Civil Aviation Rules, the Aeronautical Information Publication and the Flight Instructor's Guide can be misinterpreted or misapplied, particularly if a preceding aircraft is operating in a non-standard circuit, which could contribute to the collision risk at aerodromes. (022/11)

7.6. In controlled airspace where separation is not provided between aircraft operating under VFR, a VFR aircraft that is instructed to follow another aircraft is not explicitly required to advise ATC promptly if visual contact is lost with the relevant traffic. (023/11)

7.7. The present voluntary and informal nature of aerodrome user groups restricts their potential for improving operational safety at aerodromes. (024/11)

8. Key lessons

8.1 The investigation findings provided reminders of the following practices that contribute to aviation safety:

- the aviation community must take concerted and consistent action to reduce the collision risk associated with simultaneous opposed circuits at aerodromes
- controllers must be alert to situations that warrant the issuing of mutual traffic information
- to minimise the risk of collision, pilots must combine an effective lookout with an attentive radio listen-out, especially in the vicinity of aerodromes
- pilots should advise, by broadcast if appropriate, when relevant traffic is no longer in sight and take any necessary action to ensure the safety of their flights
- the see-and-avoid principle continues to have relevance, provided pilots and controllers counter its well-known limitations by the appropriate sharing of traffic information
- Civil Aviation Rules and Aeronautical Information Publications must be written carefully and explained clearly to students to avoid ambiguity
- pilots must understand that, under most circumstances, ATC does not provide separation between VFR traffic in Class C and Class D airspace, even when clearances are issued
- aerodrome operators have a responsibility to manage their operational risks. A useful tool for risk management is an effective user group that includes all tenants and regular aircraft operators at the aerodrome.

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Appendix 1: Limitations of the see-and-avoid concept

The effectiveness of see-and-avoid can be limited by many factors that include, but are not limited to:

1. Factors affecting looking for the traffic

   workload

   crew numbers

   behaviour in glass cockpits, whether heads-down

   diffusion of responsibility, and

   whether alerted by radio or not.

2. Factors affecting the visual search itself

   physiology of the eye: foveal and peripheral vision, blind-spot, age, empty-field myopia

   glare

   whether day or night, and

   search method used.

3. Factors that obstruct the field of view

   cockpit visibility and

   other on-board obstructions.

4. Target characteristics (conspicuity)

   colour scheme

   lighting

   contrast with background

   lack of relative motion, where the aircraft are on lines of constant (relative) bearing, and

   subtended visual angle.

Adapted from Bureau of Air Safety Investigation. (1991). *Limitations of the See-and-Avoid Principle.*

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08-001	Cessna 152 ZK-ETY and Robinson R22 ZK-HGV, mid-air collision, Paraparaumu, 17 February 2008

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